VOITH

MAGAZINE FOR HYDROPOWER TECHNOLOGY

HyPower

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INVESTING IN SUSTAINABILITY

EMBRACING THE FUTURE

FULL-LINE SUPPLIER

TURKEY'S HYDROPOWER POTENTIAL

GREEN ENERGY MIX

TOWARD ENVIRONMENTAL ACCOUNTABILITY

IMPRINT

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All figures on installed hydropower capacity include pumped storage. Figures on hydropower potential refer to technically feasible hydropower potential.

RESOURCE-EFFICIENT POWERING

How can we preserve our environment? This is a question that has become increasingly relevant in recent years as we become more aware of the fragile nature of our planet and the importance of doing everything we can to secure its future. While for some sustainability may simply be a buzzword, “greenwashing” to portray a company and its product as environmentally friendly, for hydropower, sustainability is part of the genetic fingerprint.

Being the most established and cost-efficient form of renewable energy generation, hydropower plays a key role in the daily supply of clean energy to the world, fostering economic and social development in many parts of it.

As one of the world’s leading suppliers in the hydropower industry, we are proud to be at the forefront of sustainable development. Our expert teams are constantly striving to improve our portfolio of products and enhance sustainability, both in terms of energy efficiency and the effects our products have on different environments.

To be truly sustainable, however, we need to look beyond our products. We are also casting a close eye over our internal processes and tools across the globe, carefully monitoring the resources we use and identifying new ways to operate more efficiently. Reducing the use of freshwater in our foundry cooling towers or advancing the lighting system in our manufacturing workshops are just two of many examples that will be covered within this issue of HyPower. During the course of the magazine, you will discover more about our individual efforts in these areas and beyond, as well as about how we plan to extend them in the future.

For us, sustainability is not a goal that can be achieved – it is an ongoing process for our continued business success. Enjoy the read!

Yours sincerely,

Ute Böhringer-Mai
Head of Communications

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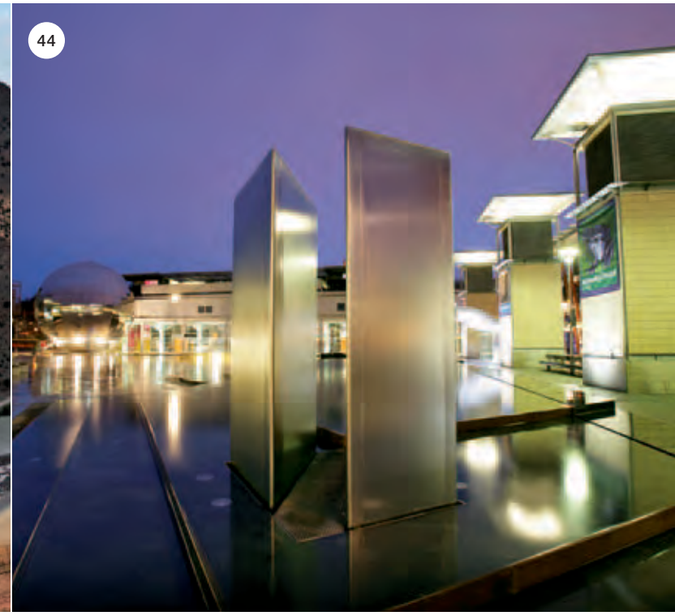


Discover more about Voith in its other insightful publications.

REGULARS

GREEN ENERGY MIX

AGENDA SETTING

SUCCESSFUL PARTNERSHIPS

FULL-LINE SUPPLIER

GLOBAL EXPERTISE

PROJECT DIRECTORY

A NEW NAME, A PROVEN PARTNER

SWEDEN Voith Hydro has started operating under its proven brand name also in Sweden: The Swedish operating unit, formerly active as VG Power AB, will now be trading under the name of Voith Hydro AB. With the name change, the company strengthens its presence in the Swedish market and underscores the successful development of the Swedish branch. Having held a majority stake in VG Power since 2006, Voith Hydro acquired all remaining shares at the beginning of 2013. "We are convinced that, based on our local strength and our generator expertise as well as Voith Hydro's excellent global reputation, we will realize many further successful hydropower projects together with our customers," says Stefan Borsos, CEO of Voith Hydro AB in Västerås. //

AWARD-WINNING IN BRAZIL

BRAZIL Voith Hydro has been elected the best company in the capital goods sector in Brazil for the second time in a row. The prize was awarded as part of the 40th Special Edition of "Best and Largest" ("Melhores e Maiores") of the leading Brazilian trade magazine *Exame*. The ranking rates 3,500 companies from 19 different business sectors, with the assessed indicators reflecting the companies' success in business. The indicators include growth, profitability, financial stabillity, investments and productivity per employee. "This important award is an acknowledgment of our permanent commitment to Brazil," commented Osvaldo San Martin, President and CEO of Voith Hydro in Brazil. "We are suppliers of complete solutions for the largest hydropower generation projects in the country and in Latin America – which are deemed strategic to ensure the supply of electrical energy and hence the region's economic development and growth." //

IMPORTANT MILESTONE

CHINA The most powerful generator-turbine unit ever built by Voith has entered service in the Chinese hydropower plant Xiluodu on the Jinsha River. After a successful 72-hour test run, Voith handed over the first of a total of three such machines to the customer China Three Gorges Corporation. With 784 MW the output of the generator-turbine unit in Xiluodu is higher than that of the world's largest hydropower plants. This achievement is a milestone for the company and an important step toward the first one-gigawatt unit. The installation of the first unit in Xiluodu started about a year and a half ago in close cooperation between Voith Hydro in Shanghai and the global research and development laboratory for water turbines and generators. //

THE SUSTAINABILITY REPORT 2012 PROVIDES INSIGHT INTO SUSTAINABLE THINKING AND ACTING AT VOITH. FOR MORE INFORMATION, FOLLOW THE QR CODE OR VISIT: WWW.VOITH.COM

FULFILLING TURKISH POTENTIAL

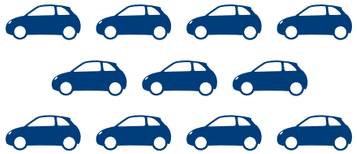
AUSTRIA Voith Hydro has received a major order for equipping the new hydropower plant Upper Kaleköy in Turkey, realized by a consortium. Voith Hydro in St. Pölten, which is responsible for the Turkish market, will be delivering three Francis turbines, each rated at 202 MW, as well as the associated equipment. Voith has been active in the Turkish hydropower market for more than 75 years and has so far put more than 100 projects into practice. For more information on hydropower in Turkey, see pp. 34-35. //

10 FACTS ABOUT HYDROPOWER

up to 115%

Between 98% and 115% of **Norway's annual electricity demand** is covered by hydropower (depending on rainfall).

38 million



Using hydropower avoids nearly 200 million metric tons of carbon pollution in the United States each year – equal to the output of over 38 million passenger cars.

1870

The **first hydraulic turbine** from Voith was manufactured in 1870.

More than 80% of the world's renewable energy is generated from hydropower.

85%

Over 85% of all dams in the world remain unused for hydropower generation.

35 COUNTRIES

By 2009, more than 35 countries obtained more than half of their total electricity from hydropower.

99%

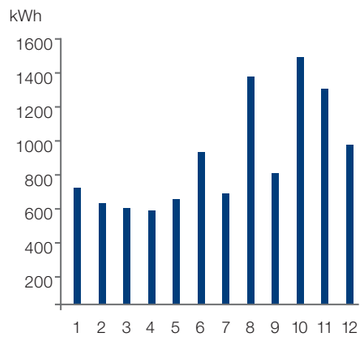
Pumped storage represents 99% of energy storage capacities worldwide.

1 KILOGRAM

Each kWh produced with hydropower reduces CO_2 emissions by 1 kg.

As the world's largest affordable renewable energy source, hydropower currently accounts for over **16% of the total world electricity supply.**

Hydroelectric power generation per person p.a.



1 Central Africa
2 Southeastern Africa
3 Northern Africa
4 Southern Asia
5 Asia Pacific
6 Middle East
7 Eastern Asia
8 South America
9 Eastern Europe
10 North America
11 Western Europe
12 Japan

LOOKING TO THE FUTURE

The concept of sustainability embodies the tradition and business style of Voith, says Barbara Fischer-Aupperle, Head of Sustainability at Voith Hydro. Family-owned, the company feels an obligation to conduct environmentally compatible, clean and fair business. Of course, hydropower has its inherent properties of sustainability: it provides green, clean and renewable energy to millions of homes and businesses worldwide, with considerable potential still untapped. Ensuring the further development of sustainable practices within defined action fields remains a key aspect of Voith's strategy.

"We are a company that delivers more than pure technology," states Fischer-Aupperle. "Sustainability is a key part of our mentality, with innovation, reliability, safety and technological excellence included, and we aim to give equal importance to economic, ecological and social aspects in our management, products and processes." This means, for example, that the company pays close attention to internal resource management at its locations around the world. "We are continuously increasing the number of ways in which we can operate more efficiently and reduce energy and resource consumption as well as waste generation without affecting quality," she explains.

Naturally, there is also a strong focus on the products the company produces. "Take our HyEco product portfolio: it offers forward-looking solutions to improve energy efficiency, water consumption and environmental compatibility. It covers the full spectrum of a hydropower plant's needs, from oil-free turbine components to energy-saving automation systems." ▷

▷ Broadening the scope, sustainability is something the whole supply chain must take into consideration, as more and more companies embrace it as a measure of business success. An increasing number of Voith's customers measure and report on sustainability, highlighting the importance of global practices and standards. As a key player in the industry, Voith Hydro has long been working closely with the International Hydropower Association in the development of the Hydropower Sustainability Assessment Protocol, which allows all partners involved to measure a hydropower project's sustainability. Still, this is an area that will continue to evolve in the coming years.

Overall, increased awareness of the importance of sustainability will leave its mark on the future, as the industry changes. "Whether for Voith Hydro as equipment manufacturers, for electricity providers, their clients, investors or other partners, sustainability is raising the bar for what is considered good economically, environmentally and for our society." //

RESOURCE-CONSCIOUS

How Voith employees are helping to **reduce resource consumption** wherever possible.

Keeping an eye on the meter

In order to encourage a more energy-conscious method of working, meter displays have been introduced at Voith Hydro in St. Pölten, Austria. These show employees how much energy is being used, with comparison figures to previous months to encourage saving, from water to electricity or gas.

Energy-saving days

To investigate how employee energy consumption can be decreased, Voith Hydro introduced energy-saving days at its location in St. Georgen, Austria. During these days, extra focus was put on energy consumption and usage of everyday devices like computers, printers, coffee machines and fans. The initiative was then followed up by an analysis, which showed that electrical baseload can be decreased significantly if energy is consumed more wisely and, for example, devices are switched off. As a result, the company is considering expanding the energy-saving days to all operating units once a year.

Under pressure

At Voith Hydro in York, compressed-air production accounts for almost one quarter of the electrical consumption. A number of technical measures have been carried out in order to maximize savings – including power meters for improved monitoring, shutoff valves and new cooling methods in the fabrication department.

Saving fresh water

Every year, 25,000 m^3 of fresh water is used in foundry cooling towers at Voith in São Paulo. Recent analysis of treated water, however, indicates that it is of high enough quality to be used for cooling tower purposes. Abandoning the use of fresh water and replacing it with treated water can thus save 25,000m^3 of fresh water every year – the same as 10 Olympic-sized swimming pools.

Bright ideas

An energy analysis of Voith Hydro's workshop in Heidenheim revealed that lighting was one of the biggest electricity consumers. As a result, Voith invested in energy-saving LED lighting. The new lights will offer longer durability and a significantly lower energy consumption level thanks to a better light management system. The effect was remarkable: About 33 tons of carbon-dioxide emissions can be avoided, equal to what five soccer pitches of forest could compensate for.

Reducing waste

During the last three years, the Voith Hydro foundry in São Paulo has been replacing new sand with regenerated and recycled sand wherever possible, as well as updating certain components to reduce sand wastage. During this period, the amount of new sand used at the foundry has gone down by 30%. ▷

INVESTING IN FUTURE GENERATIONS
STIMULATING TECHNICAL AND CULTURAL KNOWLEDGE

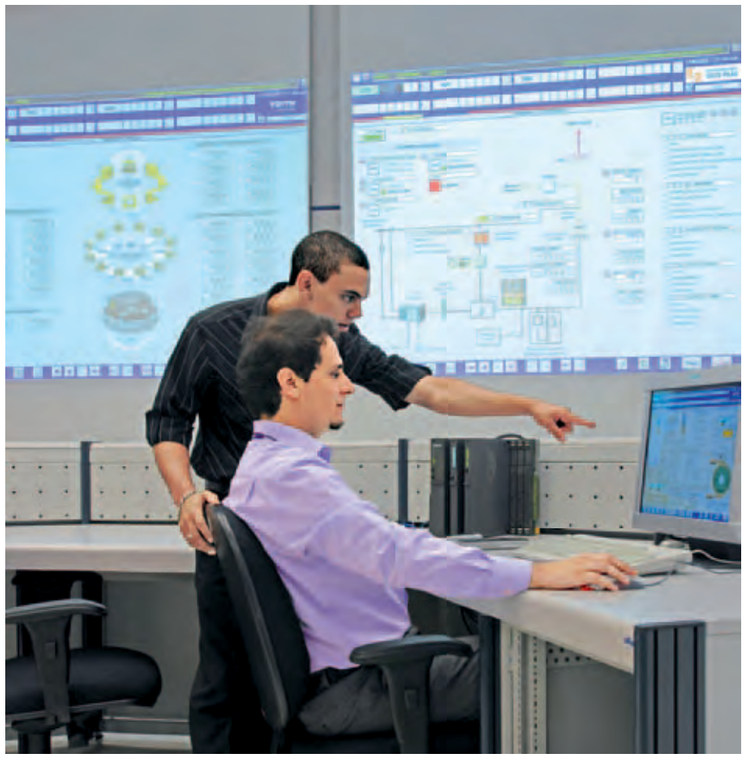
▷ **Scouting for improvements**
The long pipes of the compressed air system that run through Voith Hydro's workshop in Heidenheim can be difficult to monitor and maintain. Remedying the situation is a select group of six trainees who have been carrying out a series of tests for leakages in the system throughout the production facilities. To date, these "energy scouts" have found and fixed 65 leaks. In combination with new standards for detection and repair, this can help reduce CO_2 emissions by up to 10 tons a year. The "scouting missions" will take place at regular intervals in the future.

Providing education in Brazil
The Voith Foundation helps support a number of educational and cultural projects for children in Brazil aimed at providing better cultural and environmental awareness. Since its creation in 2004, the Foundation has invested over $2 million to the benefit of thousands of youngsters in the São Paulo region. The highlight is the 'Formare' program, a 10-month project that helps prepare 20 young people for the world of work. In São Paulo, around 80 Voith employees help out as volunteer teachers, passing on their technical and commercial knowledge in different courses. In Manaus, the Voith Foundation Brazil and the 3M Institute have recently established an innovative partnership: the Voith Foundation Brazil & 3M Institute Formare Project. The aim of the initiative is to provide training for disadvantaged young people from communities close to the Manaus industrial district, and to support their integration into the labor market. //

SUSTAINABLE TECHNOLOGY

Endless, ecological and efficient: Voith Hydro's HyEco solutions represent next-generation technology for utilizing hydropower in a sustainable way.

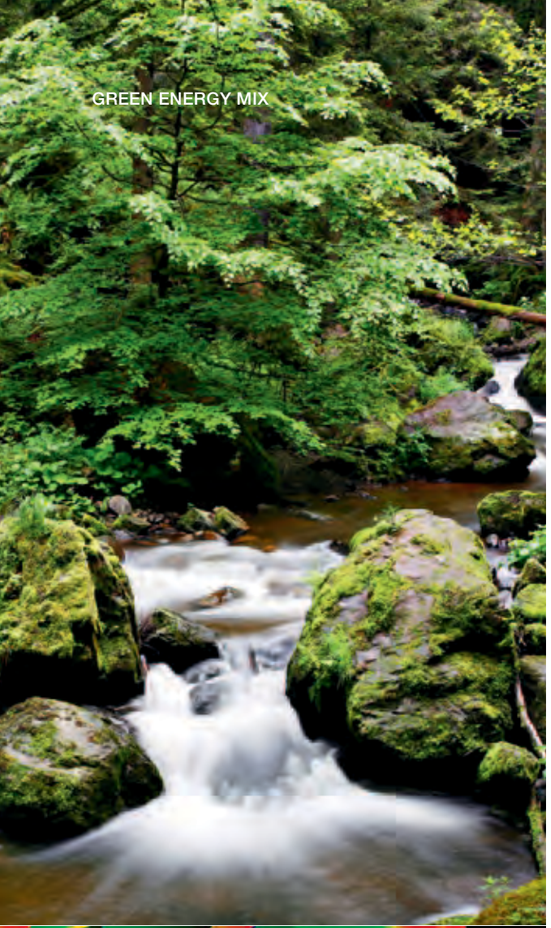
The key to achieving greater sustainability is to constantly search for improvement. Hydropower is already the most efficient way to generate green electricity. It is low in emissions and independent from primary energies, as well as being endless and commercially viable. The question at Voith Hydro is: How can we improve on this even further? Through constant innovation and research, the company is creating a range of solutions under the name HyEco that aim at further minimizing the impact of hydropower on the environment. "It is necessary to concentrate not only on the efficiency of the power unit, like the turbine and generator," says Oliver Hesse, Product Manager for Voith Hydro, "but also to examine all other plant systems for their ecological impact." HyEco solutions can improve energy usage, water consumption and eco-compatibility. They range from cooling-on-demand systems, which reduce water consumption by selectively cooling only specific generator elements, to oil-free solutions that eliminate the risk of water pollution. Here, we take a closer look at three HyEco solutions.

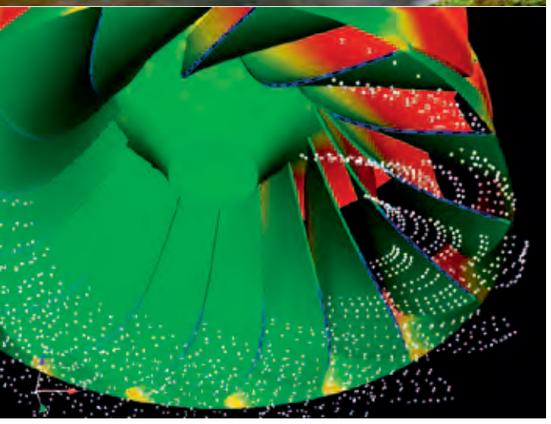


The HyCon system can reduce water consumption and increase energy efficiency.

ENERGY

HyCon Plant Optimization Increased efficiency is also a result of intelligent operations management: Here, automation has a vital role to play, providing precise regulation and control across a hydropower plant. In many multi-unit facilities manual regulation or classic joint control systems are used to distribute the discharge of water across the available machines – not taking into account small differences in turbine efficiency or channel flow areas. As a result, the overall plant operation is theoretically efficient – but can be improved by intelligent systems and technologies. Here, Voith's HyCon Plant Optimization comes into play: Using a detailed plant model, the system aims to achieve optimum efficiency for the entire facility, increasing the plant's overall output. HyCon looks at optimizing the distribution of water as well as dividing the required output between the turbines in an ideal combination. As a result, every drop of water is used in the most efficient way. ▷





Oil-free solutions help to protect the local environment (top); water life also benefits from the oxygenated water provided by auto-venting turbines.

WATER

Auto-Venting Turbines Many hydroelectric facilities are built together with a dam to create a reservoir, from which water is used to drive turbines and generate electricity. Looking at it from an ecological point of view, the water that comes from the reservoir is lower in dissolved oxygen than normal river water; oxygen that is vital for plant and animal life in the river. The solution is to re-oxygenate the water, using auto-venting turbines. These create a low-pressure region below the runner that draws atmospheric air into the turbine during operation. "Auto-venting turbines improve the levels of dissolved oxygen in waterways to enhance the quality of the water for creatures in this habitat with a minimum impact on energy generation," says Hesse, and Voith Hydro creates made-to-measure solutions for each plant, taking into account its location as well as the desired outcome.

ENVIRONMENT

Oil-Free Turbines It is an axiom of engineering that moving parts must be lubricated, to reduce friction and cut down on wear and tear. Traditionally, oil was the lubricant of choice, but while it has many benefits as a lubricant, there is a risk of water pollution if it spills or leaks into the river. The solution sounds simple, but takes a lot of work to get right: oil-free turbines. For axial power units like Kaplan or bulb turbines, the hub is a complex system of gears and bearings to control the angle of the blades, which is typically filled with oil. Voith Hydro has been installing oil-free turbine hubs since 1985, and in addition to preventing spills, the latest turbines are easier to maintain, produce less friction and have good bearing performance without needing to increase servo size. At a hydropower plant in Galicia, Spain, for example, five of six oil-free turbines have already been installed, and when the plant goes fully online next year, HyEco technology will begin to play its part in ensuring local water quality. //

Discover more about Voith's HyEco products at www.voith.com

SEIZING THE INITIATIVE

After successfully proving the company's life cycle assessment model, **Voith is leading the hydropower equipment industry in environmental accountability.**

When we started on this over four years ago we saw that other sectors – the auto industry, for example – had already gone down this road," says Voith environmental expert Dr. Jürgen Schuol. "They had tracked down in great detail the data required to provide a good understanding of greenhouse gas emissions involved in the making of every single component, right down to last screw, as well as emissions from the vehicle's engine. We recognized that this level of environmental accountability is going to be expected of every industrial sector in years to come, even including ones that have traditionally been seen as part of the solution rather than part of the problem, such as hydropower."

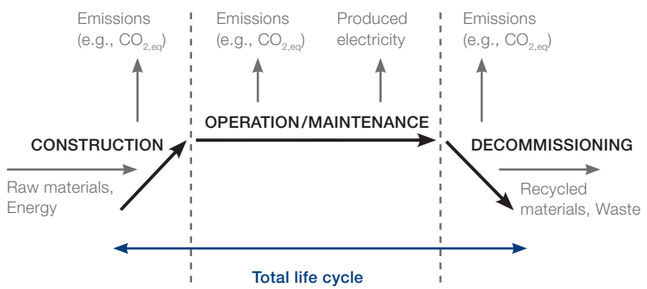
Instead of waiting for the issue to arrive at the door of the hydro industry, though, Voith has taken the initiative. Schuol and his team have developed the company's own comprehensive life cycle assessment (LCA) model to determine the output of greenhouse gases from the construction and operation of hydropower stations. More than just an exercise in quantifying output and associated costs, Schuol says, Voith also wanted to find out how its hydro components could be manufactured in an even more ecologically friendly manner in the future.

Obtaining data and making certain assumptions for a product with a relatively short lifespan, such as a car, can be difficult. However, the initial study, undertaken on Waldeck I, a pumped-storage plant in Germany with an estimated lifespan of up to 100 years, turned out to be an enormous task. While there was sufficient information available about the masses and materials connected with production of Voith components, collecting these data as well as obtaining similar data about parts or manufacturing processes from other companies proved to be exceptionally difficult.

One of the lessons learned, Schuol explains, is that "Whoever wants to set up such an LCA for an entire hydropower station should ideally work with partners collecting data right from the beginning."

Despite these challenges, Schuol and his team initially developed a sophisticated computer model using market-leading software to prepare a conclusive pilot case study. "Our timing turned out to be good," he notes. "Two-and-a-half years ago we received our first customer approach on the question of carbon ▷

LCA: Comprehensible assessment of environmental impact



Life Cycle Assessment (LCA, ISO 14040) is a method developed to evaluate the mass balance of inputs and outputs of systems and to organize and convert those inputs and outputs into environmental themes or categories relative to resource use, human health and ecological areas.

Measuring the impact of hydropower on the surrounding environment is becoming increasingly important for all industry partners.

▷ footprints. They were keen to certificate their electricity generation and to do it in a way that would help them create an Environmental Product Declaration [EPD]."

An EPD is an internationally recognized and standardized way of quantifying the environmental impact of a product or system. It includes information on the environmental impact of raw material acquisition, energy use and efficiency, content of materials and chemical substances, emissions to air, soil and water, and waste generation, as well as other product and company information.

"If you can put an EPD stamp on something, that's a message you can show in public and use for promotion purposes. In Germany, for example, as a consumer you can select whether you want to buy electricity produced by renewable sources, such as hydro," comments Schuol. "These days, many people want to know where their electricity is coming from."

LCAs provide a valuable basis for this approach and, while its main focus is on the carbon footprint, it is actually concerned with far more than that. "Other considerations include, for example, acidification and energy used for manufacturing and production of a plant versus its lifetime output. The energy payback ratio is an important one."

Today, Schuol says, Voith's customers are seeking greater levels of information related to their environmental impact in order to establish their credentials with their customers. For a conventional coal plant the main source of emissions results from combustion of fuel used in the production of electricity. It is a similar story for producers of concrete or steel, traditionally regarded as 'dirty' industries from an environmental perspective.

However, hydroelectricity producers are also coming under closer scrutiny today, even though the sector has traditionally been regarded as a clean source of power, observes Schuol. In reality, greenhouse gas emissions associated with hydropower are extremely low and primarily attributable to the inputs of key building materials – concrete and steel. Nevertheless, like every industrial sector, hydropower also has its critics and LCAs provide a scientifically objective approach to demonstrating that its associated emissions are indeed low while the energy payback ratio is high.

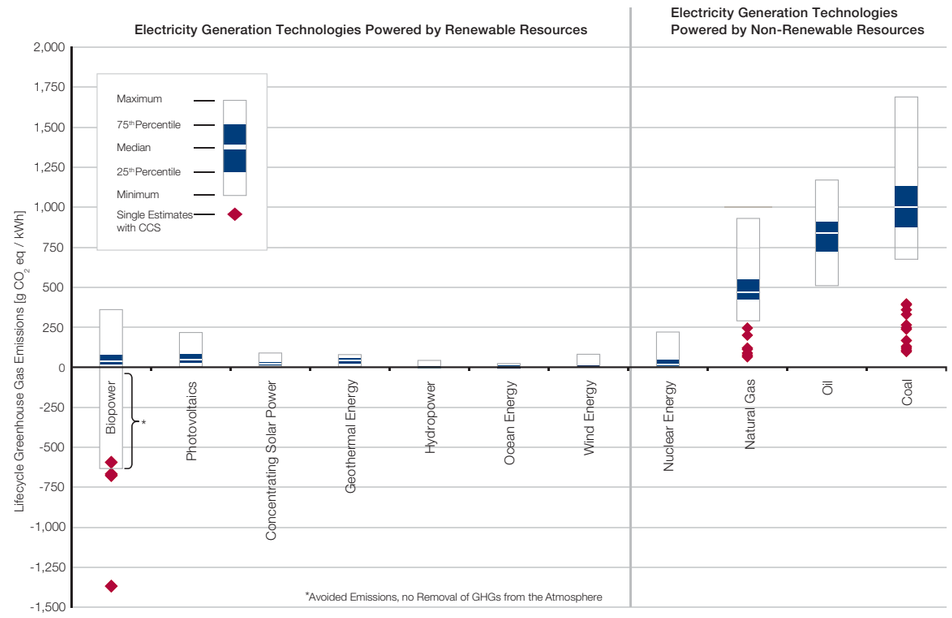
Until recently, LCAs have been open to variations in approach, yielding a spread of detail. The task for the Voith team was to identify where the focus should be in its own model, ensuring the main elements are assessed accurately and in a standardized way. This is essential for compliance with EPD requirements, which are concerned with producing comparable results between plants.

"Having started on our own, so that we could learn exactly how to do it, we are now in a position to implement it on request from customers. Currently, the main interest comes from Europe," says Schuol. To carry out an LCA correctly is a very complex task, he emphasizes. "In the past, there were on-off approaches, but these can be very misleading. Net greenhouse gas emissions from reservoirs during the operation phase should be included as an input to LCAs but there is still an ongoing discussion on the proper determination of these emissions. No account might be taken, for example, of emissions prior to reservoir impoundment or to emissions due to anthropogenic sources (e.g. sewage). Due to the importance of this issue as well as the knowledge and expertise required, Voith – as a member of the Hydro Equipment Association – supports and sponsors research in this area through the International Hydropower Association [see pp.18-19]."

Opponents of hydropower projects may be concerned for various reasons, from the potential effects on fish migration to general environmental impact or social effects on communities. It is crucial, therefore, that project promoters are in a position to use clear science and clear data to demonstrate the reality about any given proposal.

"At Voith, we seek to participate in projects that are truly sustainable and to this end, along with customers, sources of finance such as banks, and governments, we promote and support the Hydropower Sustainability Assessment Protocol as a tool to achieve this. The hydropower sector these days in most countries is working hard to deliver sustainable projects with the least environmental and social impacts. In taking this initiative in relation to LCAs our aim is to help the sector, and Voith in particular, graduate from good practice to best practice." //

Greenhouse gas emissions among different forms of energy generation



	Biopower	Photovoltaics	Concentrating Solar Power	Geothermal Energy	Hydropower	Ocean Energy	Wind Energy	Nuclear Energy	Natural Gas	Oil	Coal
Count of Estimates	222 (+4)	124	42	8	28	10	126	125	83 (+7)	24	169 (+12)
Count of References	52 (+0)	26	13	6	11	5	49	32	36 (+4)	10	50 (+10)

Source: Intergovernmental Panel on Climate Change (full source listing on page 2).

Hydropower, like other renewables, has a relatively low greenhouse gas emission rate. Knowledge on emissions during the entire process is required to evaluate the whole life cycle.

MEASURING SUSTAINABILITY

Richard Taylor, Executive Director at the International Hydropower Association, outlines the process behind introducing the Hydropower Sustainability Assessment Protocol and the progress made since its launch in 2011.

There's little doubt that hydropower has a major part to play in delivering cleaner energy and freshwater management to the world. It has a uniquely multipurpose role in the provision of energy, water and climate services. However, for hydropower to realize its optimum potential, all involved will need to become increasingly accountable to sustainability values.

In the past, there was no agreed way of measuring sustainability. The sector was stuck for many years, with open-ended and inconsistent decision-making. This was true at both the policy and project levels. Consequently, many proponents and investors were dissuaded from involvement.

It was clear a new approach had to be found with a better definition of good practice and a way of measuring performance. For several years, we have been working toward a framework to help guide hydropower planning, implementation and operation from a sustainability point of view. We listened to concerns about the kinds of impacts that were being experienced and reported, especially those affecting environmental and social aspects. We also looked at good practice around the world, to avoid or minimize negative impacts, but also to make the most of positive impacts and the sharing of benefits. Importantly, we also looked at the types of evidence needed to demonstrate good practice. In 2006, the International Hydropower Association (IHA) developed a prototype tool for measuring sustainability performance and began testing it with the collaboration of various members.

The IHA is a non-profit organization, working with a network of members and partners to advance sustainable hydropower.

From 2008 to 2010, IHA entered into the multi-stakeholder Hydropower Sustainability Assessment Forum with key partners from government, finance and NGOs. The forum reviewed and tested the original tool, covering all types of hydropower and the perspectives of both the developed and developing world. The process was supported by various reference groups and interested parties. It was a major and protracted effort to distill many aspects and concerns, involving 1,933 individuals in 28 countries and 20 field trials in 16 countries. The outcome of this work was the Hydropower Sustainability Assessment Protocol, launched in 2011.

The protocol's aim is not to define a project as good or bad; we don't aggregate results into a pass or fail. Each of the 20 or so sustainability topics are assessed on a calibrated scale, where the lowest represents significant gaps against basic good practice, and the highest represents best performance. A spider diagram plots the performance for each of the assessment topics, mapping project sustainability by highlighting project strengths as well as opportunities for improvement, thus allowing for more informed decision-making.

Quality control is a cornerstone of the protocol, and only licensed accredited assessors will be authorized to provide commercial protocol services, including official assessments. To date, six assessors have been accredited, with another tranche expected to complete the process by the end of 2013. Official assessments have already been carried out on projects in Australia, Brazil, Germany, Iceland and Norway – with several others nearing completion. We have found that those being assessed greatly value the protocol's feature of targeting the areas in need of further work, and the process of stakeholder dialog during the assessment process.

Richard Taylor, Executive Director, IHA

Progress since the launch has been good. External stakeholders are now recognizing the protocol, including the OECD and the World Bank. Assessments are being conducted in several countries in Europe, Asia, and North and South America. The protocol is available in six languages, and in Europe the EU-funded Hydro4Life project promotes the protocol's use in the region's member states.

In Africa and Asia, the Norwegian Development Agency, Norad, is supporting the use of the protocol in several of the least developed countries. The IHA has entered into sustainability partnerships with 15 organizations (including private developers, utilities, government and lending agencies, contractors and suppliers) providing training and assistance leading toward incorporation of the protocol. I'm pleased to say that Voith Hydro, as a member of the Hydro Equipment Association, was one of the first organizations to become involved as a Sustainability Partner.

Among other things, an official protocol result can be used by many parties, whether that's giving permission to proceed, funding decisions or entry into premium markets. It could also assist in CSR reporting, informing stakeholders, and demonstrating the performance of an asset to investors and shareholders. It recognizes that no project is perfect and highlights areas that may need attention. It will certainly go a long way toward making the dialog about projects more constructive and less polarized. //

SUSTAINABLE PARTNERS

As a member of the Hydro Equipment Association (HEA), Voith Hydro is an important Sustainability Partner for the IHA and a supporter of the protocol. In 2013, the company hosted workshops in Sweden and Heidenheim in conjunction with the IHA, with a focus on implementing the protocol. In addition to participants from Voith, a number of external participants took part, including WWF representatives and employees from numerous finance institutes that support sustainable hydropower projects. "The workshops are an excellent opportunity to bring together the various stakeholders in hydropower, planning and finance and to discuss the protocol as a practical tool for assessing the sustainbility of hydropower," says Barbara Fischer-Aupperle, Voith Hydro Head of Sustainability. //

"WE ARE ASKED MORE AND MORE, 'WHAT ARE YOU DOING?'"

The IHA's Hydropower Sustainability Assessment Protocol gives modern hydro-energy providers a common tool for understanding the importance of sustainability, says Professor Dr. Dominik Godde, director of E.ON Kraftwerke GmbH.

When E.ON Kraftwerke set out to use the Walchensee hydropower plant to test the IHA's new Hydropower Sustainability Assessment Protocol ("the Protocol"), director Prof. Dr. Dominik Godde knew that he was facing a large and potentially enlightening task. Documents had to be dug out of the archives of the decades-old hydropower plant, and resources had to be freed for project management and training of staff. All to assess the notoriously intangible concept of "sustainability."

"We chose the Walchensee plant, because it is one of the oldest plants in our portfolio. After so many decades of operation, we wanted to know if we were still up to the task of pursuing the best practices," says Prof. Godde when asked about the reasons for implementing the Protocol at Walchensee. "It is the first plant in Europe to assess sustainability using the Protocol. It's a big effort, but it will pay off."

Built in 1924, the Walchensee plant in southern Bavaria boasts a capacity of 124 MW and lies at the heart of E.ON's European hydropower operation. The company runs plants in various countries in Europe, and according to Prof. Godde, sustainability has long earned its status as a priority across the E.ON portfolio. Using the Protocol to pilot an assessment run at the historically significant Walchensee was therefore a straightforward decision. The plant not only provides the ideal setting for the testing the Protocol, but also allows E.ON to pursue increasingly sustainable practices, Prof. Godde explains.

"It is a necessity to recognize sustainability. The license to operate our power plants is given to us by society. There are ethical reasons involved. But we also feel that to provide a certain level of service, we need to adhere to sustainable principles. It makes a difference to financial markets, investors and competitors, too. We are asked, 'What are you doing?' more and more," he says.

"If you look at safety and health, there is a longer tradition. But the energy industry is confronted with quite some challenges today. Worldwide energy demand is growing, and we are faced with debates on climate protection and finite fossil resources. All this brings us to think about sustainability. We, as an energy company, have to play an active role in finding a solution. We are keen to be involved in sustainability topics and also to be recognized as sustainable energy providers."

Using the International Hydropower Association's Hydropower Sustainability Assessment Protocol to assess and evaluate practices at Walchensee is an important step in this direction, Prof. Godde explains. The Protocol was developed by the association following intense reviews of sustainability practices between 2008 and 2010, before being launched in May 2011 at the IHA world congress in Iguaçu, Brazil. It covers more than 20 sustainability topics and offers an assessment tool based on objective evidence and standardized results. The standard is not thought of as a ranking system or a stamp of approval, but rather as an engine for operating with "sustainability" as a stringently defined term across the sector.

"The partners who have been contributing to this assessment, they also now understand how to talk jointly about the topic. Before the Protocol was available they had difficulties discussing the notion of sustainability. The Protocol teaches us to use a common language," Godde says. "And that is important." For companies like E.ON, however, there are also other clear advantages attached, in terms of capacities, expertise and money.

Prof. Dr. Dominik Godde is Director Hydro Fleet Germany at E.ON Kraftwerke GmbH and a member of the IHA board. He also teaches energy economics and hydroelectric installations as a professor at the Technical University of Munich.

"The idea was to train our own people in the use of the Protocol in order to understand it and use it for future projects, too. You can call it 'capacity building.' We can use it in the future, inside and outside Europe. It gave us insights into and understanding of performance gaps, too. If we could identify performance gaps at the Walchensee plant, as a mature power plant, then we were likely to have similar gaps at other power plants. Of course I was also interested in our scores. Maybe we are performing extraordinarily well in some areas, while others might need improvement. All these questions have been answered and can tell us something about where we stand with respect to this plant, and what we can use our experiences for at other plants. And I am happy to report that the Walchensee power plant assessment showed excellent results, with respect to public health, labor, and working conditions or infrastructure safety."

"We now also have a further tool for evaluation of projects that can help us decide whether it is worth investing money into a project or not. Besides a general ecological and social view on the projects until now, we had two major categories of questions we would ask when discussing a project: does it fit our strategy? And how is the economic viability of this project? Now we have a third group of clear and measurable criteria, which are: how is the sustainability performance of this project? The Protocol gives us an opportunity to discuss and foster internal and external acceptance of a project – we can discuss a project with stakeholders before its implementation. In this way we can arrive at the best project. This is where we believe the Protocol can help us the best – to allocate and optimize resources with respect to sustainability performance. In terms of cold cash, it reduces business risks, giving us an economical advantage, too."

Following the success of the Walchensee plant, Prof. Godde is not afraid to share his optimism for the future of both the Protocol and its influence on the industry. Prioritizing and investing in sustainability, he says, is not only at the very heart of E.ON's business, but also an obligation for any energy provider who aims to be a part of tomorrow's energy landscape.

"We have so many interfaces with society – particularly when it comes to hydropower. I think there is no way around it. It's at the heart of our business and our ethical behavior as a corporation," he says. "E.ON's strategy is coined by the slogan to provide 'cleaner and better energy.' Wherever we go we aim to contribute to a better energy situation by working toward implementing a level of sustainability that lives up to our own expectations."

Ultimately, and despite great effort, dusty documents and hundreds of man-hours, Walchensee was a big success, Prof. Godde sums up. "Having applied the Protocol, I can certainly say that we understood how it can help us a lot. We will do it again as soon as we have a case where that makes sense."

Such a case may already be on the drawing board, Prof. Godde reveals, although "it is too early to speak about specific plans just yet." //

PRESERVING HISTORY

The commercial archives of Baden-Württemberg in Germany offer a fascinating insight into the **history of Voith and hydropower technology itself**.

The archive is situated within the attractive grounds of the University of Hohenheim, in an 18th-century castle.

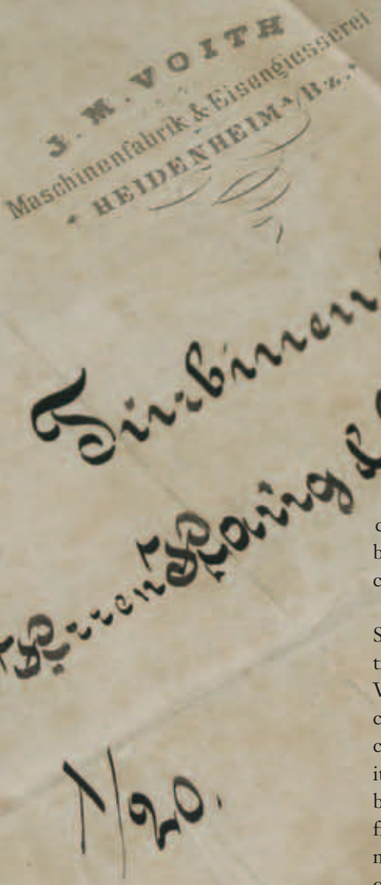
Tradition and history are important, they're not just dusty old papers," explains Jutta Hanitsch as she removes a 19th-century drawing of a turbine from a file in the archives. "A long tradition is a real marketing asset for a company like Voith," she points out. "And Voith is a company that makes wonderful use of its history." Hanitsch is Deputy Director of the Wirtschaftsarchiv (commercial archives) Baden-Württemberg, which collects, preserves, archives and studies historical documents and materials from companies located in the southwestern German state.

And there are plenty of companies in the region sharing a rich tradition that features a justified reputation for being especially hardworking and highly inventive. The historical documents of some 600 companies from the southwest of Germany are the responsibility of the 12 employees of the commercial archives. There are 11 kilometers of shelves holding archived materials in the basement of Hohenheim Palace on the outskirts of Stuttgart and in a nearby storage facility just outside the city. "No other archive looks after materials from the past of private companies," says Hanitsch. "It is our job to locate, collect and preserve these invaluable historical sources."

Tradition as a marketing asset: historical turbine brochure, most probably from 1905.

The Voith materials bear witness to a long history. There are close to 10,000 indexed items, dating back over 300 years to 1707 and stored on 200 meters of shelving. Many of these old documents relate to hydropower, the oldest of the renewable energies, and they succeed in making us aware of the unbelievably long history of this technology. There are sketches, design drawings and contracts for the first Voith turbines, delivered in 1870. That was when the company first developed its reputation as a hydropower expert, one it still proudly holds.

The archive contains brochures and other promotional materials that provide a vivid reflection of their times and serve as evidence of the longevity of the company and hydropower technology: pen-and-ink design drawings, carefully colored blue and red, as well as neatly listed columns of numbers for calculating raw material requirements and sales brochures featuring Art Nouveau stylistic elements.



Witness to a long history: a turbine construction drawing from 1881 for a customer in Bavaria.

These pieces of Voith history have been in the archives in Stuttgart since the mid-1980s, which was created as a foundation only a few years earlier. There had been no systematic Voith archives until then. Much of what is now properly archived and indexed had been haphazardly stored in cellars and cabinets in offices and boxes on the company's premises. Some items were maintained as archives by employees on a casual basis, including the most important documents and papers from the company's history. "We often obtained important materials by accident," notes Hanitsch, as the result of moves or cellar clean-up campaigns, or because attentive employees recognized the value of the materials they came across.

The oldest document involving hydropower actually predates Voith: an 1856 design drawing for a turbine including an estimate of its power requirement. Even the casual observer cannot fail to be impressed by the significance and age of the materials. "Voith has an incomparable tradition," comments Hanitsch on the company's archival holdings. The innumerable documents make the company's tradition and its remarkable ability to develop and innovate both visible and telling. And they show what has determined the character of one of the oldest family companies in Europe. "The company always came first," she notes, glancing at the papers and correspondence with customers, partners and family members.

For a company like Voith that is proudly aware of its tradition, the archive is a real treasure chest. On special occasions such as anniversary celebrations, the archives can be used as a rich source to hunt for milestones, historic projects or important events in the company's history.

Amusing stories and telling anecdotes can also be found in the archive. These include information about Friedrich Voith's friendship with another genial Swabian inventor of his day, automobile pioneer Gottlieb Daimler, with whom he often went on quick spins in his motor carriage. Or diary entries by a young Voith engineer who traveled to America in 1909 for negotiations on the delivery of turbines for the power plant on Niagara Falls and who – besides making business notes – commented on the quality of the meals he was served, including steaks that he found much too rare for his taste.

Numerous examples in the archives show that Voith has long been an extremely active global company. There are Japanese registered designs, along with applications submitted to the Imperial Patent Office for impulse turbine and Francis turbines from the early 20th century, for example. The patents issued by the United States Patent Office at the end of the 19th century likewise reflect the inventiveness and technical expertise of the company. Indeed, the purchase agreement for the Brunnenmühle, now stored in the archives, represents the foundation of the Voith Hydro research and development center that is still making the company's technical knowledge available to its engineers from around the world.

Certain qualities have characterized the company from the very first day of its existence: long-term, sustainable thinking and constant innovative genius. As Jutta Hanitsch says, "Voith is a company that has always been modern." In 1870, Voith recognized the hunger for energy inherent in industrialization and began to develop and produce water turbines. Today, hydropower is an important contributor to supplying environmentally friendly and reliable energy to modern industrial companies and newly developing countries. Many of the ideas of the past remain the basis of sustainable energy production using hydropower. //

TRADITIONALLY INNOVATIVE

After joining Voith Hydro in 2012, **Chief Business Development Officer Kirsten Lange** reflects on a year in hydropower and plans for expanding aftermarket business.

After a little over a year of working in the hydropower industry, what fascinates you the most?
What I find intriguing is the fundamental importance of hydropower. It constitutes such a large share of renewable energy, making a very decisive contribution toward the attainment of climate objectives. I am also impressed by just how efficient it is, especially in comparison with thermal power stations. A third aspect: the positive side effects, such as flood protection and navigability. When I lived in China in the 1990s I experienced myself how important these factors are.

What else has impressed you so far?
Hydropower is a unique combination of tradition and innovation. It is a sector that has been around for a long time – some plants have been operating for over 100 years. At the same time, there is a great potential for innovation, in areas ranging from small hydro plants to the use of ocean energy. I find this combination extremely interesting.

“Service is more than just replacing parts; we want to be a comprehensive problem-solver for our customers.”

What attracted you to join Voith?
Voith is a hidden champion with an excellent reputation, a company that successfully combines a long tradition and set of values with a modern approach. This can be seen in both the strategy and the day-to-day interactions with the customer. This special corporate culture really distinguishes Voith.

Do you think these values are practiced actively at Voith around the world?
Yes, definitely. They are a very unifying element. We are represented locally in markets all over the world, and yet there are the same strong values and a common understanding of what is important for the customer and what “engineered reliability” means.

So, for you, Voith Hydro is both a global and a local company?
We are active all over the world; there are very few companies globally that have such a high share of sales – and value-added – outside of their home country. And in all of these markets we are truly local companies with local employees.

Where could Voith Hydro improve?
I would like to move from an “either-or” mentality to more of an “and” approach. In other words, instead of focusing on either technology *or* costs, we need to think more about technology *and* costs. We won't put restrictions on technological development just to save money. We want to be both quick *and* thorough simultaneously. From the point of view of an outsider, however, I can also say this: in its 140-year history, a great many things have been done well at this company. We can be proud of our capabilities.

And what could be improved in the hydropower industry in general?
I am troubled by the occasionally negative image that hydropower still has for some of the public. The entire industry needs to act more decisively and emphasize the advantages very clearly and distinctly: a safe, stable energy supply is the prerequisite for social development opportunities and economic growth. It can lead to greater educational opportunities, increased prosperity, more jobs and improved living conditions in developing and emerging economies. As the biggest contributor in the area of renewable energy, hydropower has a vital role here.

You are in charge of aftermarket business, among other things. What innovations and developments are there in this area?
The service business is a global growth market and a very important one. We want to be a comprehensive problem-solver for our customers. Service is more than replacing parts, it is about comprehensive asset management. There are many possibilities for us to contribute our technical expertise and help our customers.

Will these changes take place in conjunction with customers?
It only works in close collaboration with our customers, when combining the specific issues of our customers with our experience and expertise to create win-win solutions. We are continuing to invest and we will further build our local presence. To this end, we already took over Vortex Hydro earlier this year to strengthen our business in North America.

Tell us about the developments in the automation sector.
Automation is also a core component for us. We have our own products in the market and want to continue to grow. We have not only an integrated product offering for large plants, but also competitive solutions in individual components. In modernization projects in particular a lot can be achieved with up-to-date control systems. Our specialists are available worldwide, such as in our automation laboratory in Brazil, where the advantages and efficiency of modern automation systems can be simulated in real time. This is a solution that has been very well received by many of our customers.

What would you like to see in the upcoming year?
I would like to see satisfied customers, who notice time and again that we are a reliable partner, not just for turbines and generators, but also in automation and in the service business – in other words, that our traditional strengths are also effective in newer business areas. //

POWERING AFRICA SUSTAINABLY

After successful rehabilitation of Cambambe I in Angola, Voith will soon start a second project: the company's biggest in Africa to date and **a further step towards realizing the continent's huge hydropower potential.**

Voith has completed a major upgrade of the Cambambe plant on the Kwanza River. Now, a second plant is planned for the region.

The numbers tell the story. Although Africa has an estimated 400 GW of technically feasible hydropower, its installed capacity is only around 25 GW. This means that Africa has a higher percentage of untapped hydropower potential than any other continent. Africa is a new frontier for hydropower companies, and major projects are coming on stream – none too soon for the continent's population.

Only one in four people living in Africa has access to electricity, and supplies are often disrupted by blackouts. The situation is especially dire in Sub-Saharan Africa, which has around 900 million residents but generates about the same amount of power as Spain, population 47 million. All this is changing rapidly, however. New hydropower developments are bringing sustainable energy to people and businesses all over Africa, and many more projects are in the works. Angola – with an estimated 18 GW of hydropower potential, only 4% of which has been harnessed so far – is one of Africa's most promising hydropower markets, and Voith Hydro is rapidly expanding its presence there.

Ethiopia, South Africa, Angola and the DRC – some examples of Voith's presence in Africa.

Voith Hydro supplied complete turbine technology along with related equipment and services for the modernization of the 1960s-era Cambambe plant on the Kwanza River, a four-year project completed in December 2012 that upped the plant's output by 40%.

Now, Voith has been commissioned to supply and install four generators and turbines as well as controls and associated systems for a new plant in the same area: Cambambe II, with an order volume of over €100 million for Voith, is one of the company's biggest projects in Africa to date. It will add 700 MW of power to Angola's energy grid, almost doubling the country's installed hydropower capacity. "The national energy company, ENE, was very satisfied with the work we did on the Cambambe I project. Not only did we deliver on time, but the plant's power output is even better than expected. ENE had never tackled a project like that before and we have earned their trust," says Patric Kiehlmann, Voith Hydro Project Manager for both projects.

> "The national energy company, ENE, was very satisfied with the work we did on the first Cambambe project. Not only did we deliver on time, but the plant's power output is even better than expected."
>
> **Patric Kiehlmann,** Project Manager, Voith Hydro

Angola offers the right conditions for hydropower development, explains Jörg-Peter Albrecht, Head of Sales and Marketing at Voith Hydro in Heidenheim. "Not only is the country making major long-term investments in hydropower, but also commissioning Western companies for its hydropower projects, even though these companies might cost more. Because of its oil revenues, Angola has the means to go for higher quality, and is choosing to do so."

Angola's needs are great: over 70% of the country's infrastructure was destroyed in a long civil war and since the fighting stopped in 2002, the Angolan government has been engaged in a massive development drive. Fueled by oil and gas exports, international financing and public-sector spending, the Angolan economy achieved average annual GDP growth of 11.1% up to 2010.

The country continues to invest heavily in infrastructure projects. Only 30% of the population has access to electricity (only 10% in rural areas), and the government plans to boost generation capacity from around 900 MW to over 6,000 MW by 2017, with a focus on hydropower and other renewables.

In spite of Angola's great progress, getting projects off the ground is not easy. Investors must cope with a hot climate, limited transport infrastructure, a lack of skilled labor, bureaucratic tangles, and problems left over from the war. For Cambambe I, for example, it took six months to clear away landmines before a new spillway could be built, and throughout the project workers had ▷

Cambambe I is just one of a number of infrastructural investments made by the country in recent years as it strives to recover from a long civil war.

▷ to stay within de-mined areas. Cultural differences also come into play, Kiehlmann says. “The time factor was a challenge. Angolans say to us Europeans: ‘You have watches; we have time.’ Things we thought would be done one day would not get done until the next day, or later. In addition, almost all materials for projects like this must be imported and each shipment takes three months. You have to plan ahead.”

Since local workers on Cambambe I lacked the skills needed to build, operate and maintain a modern hydropower plant, Voith Hydro played a significant role in human resources training. Kiehlmann explains: “We provided support beyond what our contract required and we’ll continue to do this for Cambambe II. We have made a long-term commitment to Angola and to ensuring these projects are sustainable.”

Hydropower in Angola

Installed capacity:	**1 GW**
Potential not yet installed:	**41 GW**

Cambambe II is one of Voith’s biggest projects in Africa to date.

The Cambambe projects signal Voith Hydro’s increasing focus on Africa, where the company has had a presence as a supplier for decades. Voith was involved in Ethiopia’s Gigel Gibe II, which doubled the country’s installed hydropower capacity and raised the percentage of the rural population with access to electricity from 15% to 50%. In South Africa, the company is providing all the electromechanical equipment for the Ingula Pumped Storage Scheme.

A further recent agreement will see Voith Hydro lead a consortium to modernize the Inga I plant on the Congo River in the Democratic Republic of Congo (DR Congo). This €58-million project for local energy supplier SNEL will involve a comprehensive rehabilitation of two 55-MW generator-turbine units in the 1970s-era plant.

Other projects in Africa are also under analysis, including in Angola and in the DR Congo. Albrecht also cites Mozambique, Zambia, Cameroon and Ethiopia as other potential markets. “Virtually any African country with hydropower resources is on our radar,” he says.

In addition to hydro potential, other factors must be considered, such as stability and access to adequate financing. “Large hydropower projects involve high initial costs and international monetary bodies have often avoided them,” says Albrecht. In recent years, however, organizations like the World Bank and the African Development Bank have increased their investments. Voith, too, has a role to play: for Cambambe II, the financing is backed by cover from Euler Hermes and was structured and arranged by Voith Financial Services. “International funding is recognizing that hydropower has the best chance at reducing the carbon footprint and providing the most sustainable energy while driving the economic development.” //

INVESTING IN AFRICA

Why the **World Bank Group** is backing Voith technology at Cambambe II.

The World Bank has stepped up its support for hydropower projects in developing countries as part of its commitment to promoting sustainable, clean energy generation where it is needed most. The Bank’s defining vision for energy projects is the United Nations’ “Sustainable Energy for All” initiative. In line with this strategy, the World Bank group’s Multilateral Investment Guarantee Agency (MIGA) is providing essential support for Cambambe II by underwriting around €470 million for the project’s international lenders. Antonio Barbalho is MIGA’s Sector Manager, Energy and Extractive Industries, and leads the team that is handling MIGA’s involvement in the Cambambe project. “The critical message is that the World Bank Group is definitely supporting hydropower development in poor countries worldwide, whether the project is considered large or small in the country involved,” he says. “Of course, Africa gets a lot of our attention because of the continent’s energy poverty, and our support for Angola in particular is part of our commitment to assist post-conflict countries.”

Antonio Barbalho is Sector Manager, Energy & Extractive Industries at MIGA. Prior to this, he held several senior positions at Deutsche Bank in the energy, utilities and financial sectors.

In choosing its projects, MIGA focuses on sustainability. “What matters most is that whoever develops a project, it must be sustainable at every level, from costs to compliance with MIGA’s rigorous performance standards, including environmental and social criteria,” Barbalho explains. “We take a very holistic approach and we monitor projects at every stage. One aspect of sustainability is clarity in the legal framework, and in Angola we paid close attention to the government’s plan for the power sector.”

According to Barbalho, MIGA is very satisfied with the project so far. “Our partnership with the Angolan government has been extremely good. Their willingness to cooperate and find the right solutions is definitely on the table. Cambambe is our first energy project in Angola, but we hope it will not be the last.” //

The Budarhals power station is located on the Tungnaá river, around 150 kilometers east of the capital, Reykjavik.

MASTERING THE ELEMENTS

At the cold edge of Europe, Voith Hydro engineers are working hard to bring the Budarhals Hydroelectric Power Station online.

Access to the site is not easy. About a one-hour drive from the nearest small town, along a road and across a new bridge, almost hidden from view, Voith engineers are installing electro-mechanical equipment, excitation systems, turbine governors, and mechanical and electrical auxiliary systems. The company is also providing powerhouse cranes and the control system, as well as handling both installation and commissioning. When Iceland's Budarhals plant goes online for testing at the end of the year, it will run with a harnessed discharge of 240 m3/s, an installed capacity of 95 MW and an energy generating capacity of an estimated 585 GWh annually.

The project is not without its challenges. "The weather was a bit of a problem," says Lothar Ritter, Project Manager for Voith Hydro. "Especially when compared to some of our other projects, in India for example." On some days, freezing blizzards made it virtually impossible for the engineers to get from their accommodation to the site, only 500 meters away. Water seeped into the machine area and froze in a sheet 30 centimeters thick. "We used heaters," says Ritter matter-of-factly, "and we kept going."

A further issue is the wind, which whips up sand and grit from the ground. "With little-to-no vegetation to offer shelter, the wind in Iceland can be harsh, and it's hard to work with a face full of sand."

In spite of the challenges of nature the Voith Hydro team is set to finish on schedule when the plant is handed over in January 2014. Indeed, the national power company in Iceland, Landsvirkjun, is also doing its best to respect the surrounding nature during construction. "We have a commitment to reduce waste and environmental impact at every stage of the project and have been working together with Voith to achieve this," comments Kristján Kristinsson from Landsvirkjun, responsible for safety and environment on the project. "Waste from the building site is separated and recycled whenever possible. Accurate data is collected on how much waste is produced, and fuel consumption is carefully monitored to maximize efficiency."

The Budarhals project also represents a welcome return to the Icelandic market for Voith Hydro, which last carried out a full turbine installation more than 100 years ago, in 1912. The power plant at Fjardarsel was the first of its kind in the country, the first to generate alternating current. As well as housing a museum and visitor center, the plant is still running today – it is the oldest operational power station in Iceland.

When the Budarhals plant goes into full operational service early next year, this will be an important contribution to sustainable energy generation in Iceland, and Voith Hydro will once again have played its part in writing a new chapter in the history of green energy in the country. //

"The wind in Iceland can be harsh, and it's hard to work with a face full of sand."

Lothar Ritter, Project Manager, Voith Hydro Heidenheim

Hydropower in Iceland

Installed capacity: **2 GW**

Potential not yet installed: **15 GW**

Before Budarhals, Voith's last full turbine installation in Iceland was in 1912.

When completed in 2014, the Budarhals power plant will have an installed capacity of 95 MW.

THE POWER OF AUTOMATION

Voith modernizes one of Canada's largest hydropower plants.

The height of a 15-story building and the length of three football fields, the subterranean Churchill Falls Generating Station, with its 11 Francis turbines, has a capacity of 5,428.5 MW, produces 34 billion kWh of energy a year – roughly 1% of the world's hydroelectric power. Located in the Canadian province of Newfoundland and Labrador, the plant opened in 1971. It was the largest civil engineering project ever undertaken in North America at the time. It's the second-largest underground hydroelectric plant in Canada, and ninth-largest in the world.

With the units having given 40 years of service, the Churchill Falls Labrador Corporation Limited (CF(L)Co) decided to replace unit controls, exciters, protection, communication and governor controls for the 11 generators. Components will be replaced at a rate of one to two units per year, commencing in 2014. "Manufacturers do not support the original technology anymore," says Sidney Martz, Offer Project Manager at Voith Hydro in Montréal. "As this system is the brain of the whole plant, if you have a breakage, you can have a serious problem. It's vital that the customer can get spare parts." The new generation of automation is all electronic. "You're able to have much more control and input, to conduct metering, prevention and maintenance," Martz says.

Ronald Rochon, Business Development Manager at Voith Hydro for Eastern Canada, says the upgrade will help future-proof the plant by standardizing on a modern system. "This does not only apply to this plant, but also to others that customers are going to be looking at modernizing." Thanks to modern systems, power output is set to become more reliable, which is probably the No. 1 factor for the customer. "The new systems will provide better control and diagnostic, and the reaction time is much faster, giving more stability to the whole system."

Voith must work against the clock to install the new system during scheduled outages, says Martz. "It's a big job and it must be done in a very short time, because the customer still needs to guarantee some operation."

To date, Churchill Falls is the largest Controls and Automation project undertaken by Voith in Canada, notes Pierre Seguin, Head of Business Development for Voith Hydro in Canada. "Strategically, this project was identified as a target to propel our Voith automation products and systems in Canada." Cooperation with Voith Hydro in York was vital in helping to guarantee the project's success, he adds, with assistance in the development strategy as well as through continual technology transfer. "This, in turn, will add to our consistent growth in the automation market in Canada." //

Hydropower in Canada

Installed capacity: **74 GW**

Potential not yet installed: **162 GW**

Churchill Falls is the second-largest hydropower station in Canada.

After about 40 years of service, CF(L)Co decided to replace control systems at Churchill Falls. Electronic automation will enable optimized operation thanks to more available information.

The largest of their kind in Europe: the Kaplan pit turbines at Litoměřice

MAXIMIZING RESOURCES

In the Czech Republic, Voith Hydro is proving that supplying green energy can be achieved by adapting existing infrastructure.

To generate energy from water, it is not always necessary to build brand new hydroelectric stations. With many of the weirs and dams found in Europe's rivers and waterways not being utilized for power generation, considerable untapped hydropower potential exists.

Take Litoměřice. This small Czech town is located south of the Bohemian Forest and 60 kilometers north of Prague, where the Elbe meets the Eger. Protecting the landscape and preserving natural resources have always been local priorities. That also applies to the power supply. Litoměřice covers almost its entire electricity demand with renewable energy, with hydropower contributing since the end of 2012. To do so, an existing weir was converted and upgraded, meaning the station now supplies around 12,000 households with green electricity.

"Prior to converting the weir into a hydropower station, the Elbe's water simply ran over it unused," explains Herbert Boden, project manager for Voith Hydro in St. Pölten, Austria. "But now, this untapped potential is being put to use."

Driven by the Elbe's current, the power station has two 3.5 MW Kaplan pit turbines, each measuring 5.1 meters in diameter – the biggest of their kind in Europe. This record-setting size is a result of the low fall height of slightly over 2.5 meters at the dam wall. "The subsequent electrification of dams is especially sustainable because we are upgrading existing parts of the weirs and putting them into use. As a result, any impact on nature and the environment is kept to a minimum," explains Boden.

This is a key factor for residents in the Litoměřice region because most of them earn a living from their vineyards, fruit orchards and grain farming. "During construction, the river's water could simply continue to flow over the existing construction, avoiding any flooding of the surrounding area." The project was recognized by the European Union for its minimal impact on the Elbe's landscape, qualifying for financial support from the European Regional Development Fund. The extra money ensured that nature conservancy requirements could be better addressed.

Since the conversion, life has become much easier for the local fish. The previous weir had no measures in place to protect migrating fish species swimming upstream; they had no way of getting past the obstacle in their path. However, the conversion equipped the structure with a fish ladder – "a clear sign of progress," says Boden. Thanks to the fishway, fish traveling upstream can now reach their spawning grounds. This successful solution in Litoměřice has spurred on further work 20 kilometers upstream, where the project is currently being replicated at Štětí. Voith Hydro is in the process of installing two identical pit turbines for the Štětí hydropower station. The conditions there are comparable, with a weir also being retrofitted.

Remaining flexible while working with what nature has provided has been the key to the success at Litoměřice and Štětí. "In both projects, we intensively discussed the on-site factors and made adjustments accordingly," says Boden. "As a result, we were able to come up with an optimal solution to utilize existing weirs on the Elbe despite the challenge of dealing with a low fall height." //

Hydropower in the Czech Republic

Installed capacity: **2 GW**

Potential not yet installed: **<1 GW**

The Litoměřice station provides around 12,000 households with green energy.

Beyhan I is the first of four hydropower plants in this area of the Murat river. Voith Hydro is fitting the plant with three generators.

FAR-REACHING POTENTIAL

Away from the beaches of the tourist resorts and the cultural highlights of Istanbul, **Turkey is home to a vast natural resource** crucial to its continued development.

Hydropower in Turkey

Installed capacity:	**21 GW**
Potential not yet installed:	**39 GW**

Voith Hydro has been active in Turkey for 75 years and has worked on more than 100 projects.

According to calculations, Turkey holds 16% of Europe's hydropower potential. On a global scale, it makes up 1% of the world's entire hydropower potential. A total of 25 river basins and a varied topography combine to provide the drops necessary for hydroelectric generation.

"Without doubt, the potential for hydropower plants here is enormous," says Dr. Artur Pfeiffer, General Manager for Voith Hydro in Ankara. "It is estimated at up to 60,000 MW of technically feasible projects, of which 45,000 MW are considered economically viable under current conditions. There are currently 20,400 MW of hydropower plants in operation, accounting for 34% of total installed capacity. 6,000 MW of hydropower plants are currently under construction."

One of these new projects is the Beyhan I plant in eastern Anatolia, on the Murat river. It is the first of a planned cascade of four hydroelectric plants on this stretch of river, and Voith Hydro is providing Beyhan I with three generators, each with an output of 235 MVA, as well as excitation and monitoring systems. This is the largest order Voith Hydro has ever filled for a private client in the Turkish market, and the continuation of a long tradition. Voith Hydro has been market leader in the country for 75 years, supplying equipment and expertise for over 100 projects, from the largest facilities to small systems under 30 MW. "We have been able to establish ourselves as a strong partner for our customers in Turkey," says Dr. Leopold Heninger, CEO of Voith Hydro in St. Pölten, Austria. "With this large-scale project, we are further strengthening our position as a leading hydropower supplier in this country."

In the north of Turkey at Kargi, close to the Black Sea coast, another plant is under construction. The Norwegian energy company Statkraft has awarded to a consortium led by Voith Hydro the construction of a new facility on the longest river in the country, the Kizilirmak.

Voith Hydro is supplying the entire electromechanical systems for the 102-MW facility in a turnkey delivery, a common solution in the Turkish market. "In Turkey, turbine, generator, automation and electrical balance of plants are usually tendered as one package," says Pfeiffer. "For large projects the equipment is designed and manufactured by Voith Hydro in Austria as the market responsible for Turkey, while local manufacturing and installation is done by Voith Hydro in Turkey."

And Turkey needs power. At the moment, energy use is still low, with the average per-capita consumption one third of that in the EU, but that is all set to change as the economy grows. Within a decade, Turkey is expected to overtake Britain as the third-largest consumer of electricity in Europe.

There are challenges in expanding the Turkish energy market. Much of the grid infrastructure is old and overloaded, leading to power outages in certain areas. And while the country produces most of its own electricity, as of 2012, only 26% of the total primary energy consumption was based on local resources, leaving Turkey reliant on foreign suppliers with the worry of currency fluctuation and dependence that this entails.

Thus, utilizing local resources is key. In order to redress the imbalance and provide the energy that Turkey will need to progress, the country has been undergoing a process of deregulation, opening up the energy market for foreign investors. This has led to a construction boom and a very competitive market. The goal is not just energy independence for future growth, however. Turkey wants to establish itself as a modern energy-trading hub, using its location to connect the EU with energy markets to the east. To this end, an energy exchange will be launched in October, with electricity futures trading.

The future is bright as far as new construction projects is concerned, but other opportunities await. As older facilities are privatized, the new commercial owners will look to modern technology solutions to increase efficiency and maximize their output. "This should open up great potential for the rehabilitation business in the future," concludes Pfeiffer. //

BIG PLANS FOR SMALL HYDRO

Hydropower may be long established in Switzerland, but scope for further development remains. **New and refurbished small hydro plants** hold the key to the government's ambitious renewable energy goals.

SWITZERLAND

Hydropower

Installed capacity:	**14 GW**
Potential not yet installed:	**<1 GW**

There are over 1,000 small hydro plants of up to 10 MW in operation in Switzerland.

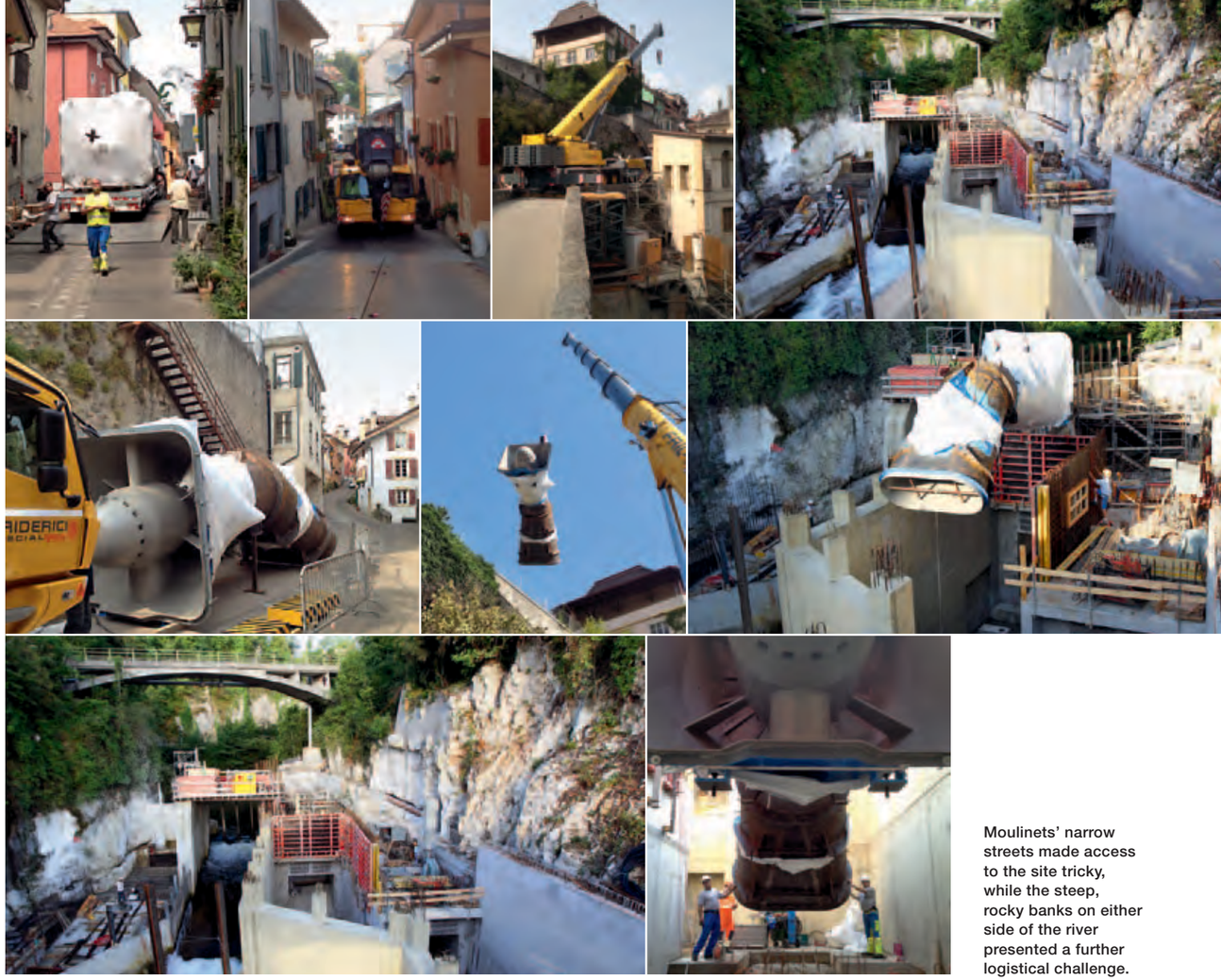
The Tambobach plant produces 7.2 million kWh a year – enough for 1,400 households.

An early pioneer in hydropower, Switzerland maintains a leading position in the sector today, generating around 60% of its electricity by hydropower. While it already generates 85% of its technically feasible potential of 41,000 GWh per year, it is ambitious about developing further.

The Swiss government features hydropower substantially in its plans to source half of the country's total energy needs from renewable supplies. Several new schemes, many of them for pumped storage, are under way or planned, but there are also extensive opportunities for the refurbishment of aging existing installations large and small.

In particular there is scope for new small hydro schemes and an even larger opportunity for refurbishments of the approximately 1,000 existing small hydro plants of up to 10 MW. The total combined capacity of these plants is 780 MW. "Small hydro has significant potential in Switzerland," confirms Georg Neuber, sales and project engineering manager at Kössler, a Voith Hydro subsidiary in Austria specializing in small hydro. "Many old plants have been closed or are due to be refurbished. A number of them are 70, 80, even 100 years old and must be rebuilt with new turbines and generators."

Two recent installations handled by Kössler are good examples of the potential as well as the challenges facing modern small hydro schemes. The 1.8-MW capacity Tambobach plant has been generating electricity since the autumn of 2012, using water from the catchment area of the River Tambo. Projects like these must meet strict environmental safeguards on noise levels and vibration, especially when they are located close to or in villages or towns, as they often are. Kössler also had responsibility for both the design and installation of the Moulinets plant. Installing the unit presented a range of practical challenges, says Gerald Hochleitner, Head of Design Engineering at Kössler. "This was a unique project that demanded a somewhat different approach with special materials. It was a challenge due to the limited space during construction, making it difficult to move the machines into position. There were also challenges with the positioning of the turbine relative to the generator." Fortunately, the installation went as planned, says Hochleitner. "It was a perfect execution. The team operating the mobile crane did a lot of preparation on the road."



Moulinets' narrow streets made access to the site tricky, while the steep, rocky banks on either side of the river presented a further logistical challenge.

Kössler has had to innovate to meet strict new environmental and noise requirements for schemes such as these, says Hochleitner. "We are finding solutions – for example, the use of water-cooled generators – as well as modifying the construction process. In Tambobach we modified the turbine housing to reduce noise levels by encasing part of the housing in concrete. From the outside it looks small and flat and there are no openings for aeration because the generators are water-cooled. Everything is maintenance-free, with oil-free designs eliminating the risk of waterway pollution."

And there is further scope for innovation that will make future installations cleaner, more reliable and more efficient, says Hochleitner. "Direct-drive generators with no gearbox, for example, can run at low speeds to avoid vibration and noise. A gearbox solution may be cheaper initially but in the long term it's better in relation to maintenance and reliability to avoid a gearbox."

Despite these positive developments, the sector has faced economic challenges in recent years, with the crisis in Europe affecting investment, says Neuber.

Volatile energy prices are also a factor, with low prices due to solar and wind power. "It makes funding these schemes more difficult. I think the market will remain this way for the next year or two, but there is certainly a future for it. We will see new projects happening." //

UNITY IN DIVERSITY

At Voith Hydro Mississauga, **employees from around the world,** both young and old, are cooperating to help boost customer satisfaction.

Engineers of different backgrounds and experience levels work together to provide top service.

Imagine arriving at Voith Hydro Mississauga (VHMS) to start your new job as a trainee mechanical designer – you overhear a colleague chatting in Persian (Farsi). Mehrzad Shahouei, an engineer from Iran, then welcomes you in English. Seconds later, head of engineering Inna Kremza, from Ukraine, enters the office. A customer is coming to review manufacturing of multi-turn coils for five units in Quebec, she says. They have to be modernized to increase generator power to earn more revenue. Then, Nenad Vujcic, a young engineer from the Serbian capital, Belgrade, arrives with a progress report on another project. This polyglot of languages and diversity of cultures is reality in the engineering section at VHMS in Greater Toronto. There, people from countries as far-flung as China and Burkina Faso – 15 nationalities in all – strive to achieve top-notch performances from turbines and generators for a variety of demanding customers.

Inna Kremza, who heads a team of 20, explains: “Voith in Mississauga is a center of excellence and a worldwide supplier of multi-turn stator coils. We have more than 35 years of experience in modernizing and refurbishing hydro generators through a full-service, 24/7 package. An example is our client, FORTIS. They called to say the generator’s main leads had burned out and damaged the stator winding. Within 24 hours, we had sent an engineer to assess the unit and proposed a solution.” Such quick response times require in-depth knowledge of equipment from all major manufacturers, she adds.

Key skills in the team include knowledge of reverse-engineering processes and hydropower. But most young graduates have yet to learn the ropes – at this point, theory and practice simply must merge. Mentoring at group and individual levels proves crucial, ensuring that an enriched transfer of knowledge ensues, bridging generations and honing expertise on every echelon.

Nenad Vujcic joined Voith Hydro in 2012 in a supportive role as a mechanical designer. After quickly impressing both his colleagues and his clients, he has already moved up the ladder to become the lead engineer on a seven-person team. Everyone’s input is considered, regardless of hierarchy, emphasizes Vujcic. Coupled with diversity of culture and experience, such factors are key to the team’s success. “The most important aspect is that no individual is above another. We achieve our goals as a team comprising unique personalities and diverse backgrounds. Working together is where we really shine.” In this context, technical training in what are known as “Lunch and Learn” sessions, where senior employees hold lectures on a certain component or system, are proving to be an inspiration. Anyone can attend, and young professionals can turn to a senior colleague for guidance.

This was the case for Mehrzad Shahouei. Originally from Iran, he has been working as a senior turbine engineer at VHMS since 2008. His unique 20-year experience in hydroelectric turbines, unlike that of his colleagues, who are more skilled with generators, has sparked renewed customer interest in turbine rehabilitation.

Neal Cumming, a young Canadian trainee and mechanical design engineer, has worked in the department since 2012. Neal is benefiting from Shahouei’s expertise. “Rehabilitation projects require quick solutions to issues that cannot be foreseen in an initial assessment,” Cumming explains, before adding, “Mehrzad is very open and lets me figure out problems.” For Shahouei, it is important that all designs are approved based on a common decision made by the turbine team, including young engineers. “The diverse input makes our work more dynamic.”

“Clients are often impressed by our professionalism and creative approach to problem solving,” says Kremza.

Her background also comes in handy when communicating with new customer Saratov Hydro Generation, for whom VHMS is supplying stator winding coils; she speaks fluent Russian as well. //

INNA KREMZA

Head of Engineering

Nationality: Ukrainian

Languages spoken: Ukrainian, English, Russian

NENAD VUJCIC

Mechanical Designer – Generators

Nationality: Serbian

Languages spoken: Serbian, English

NEAL CUMMING

Mechanical Designer – Turbine

Nationality: Canadian

Languages spoken: English

MEHRZAD SHAHOUEI

Lead Engineer – Turbine

Nationality: Iranian

Languages spoken: English, Farsi, Kurdish

READY FOR ANYTHING

With hydropower plants located in some of the world's more remote, unusual and sometimes dangerous locations, **the company's security and logistics teams must be prepared for every eventuality.**

"If you ask me to tell you anecdotes about what I've experienced around the world, that could take some time – because there are a lot," says Winfried Rosenbach, Head of Corporate Security at Voith. Guards at a site in Angola carrying weapons but no ammunition, having no radios and just one shoe – that's one example. An aircraft at full speed swerving round a pothole in a runway in Congo is another. Or, more intimidating, the nervous atmosphere in Kashmir, created by the bubbling political conflict in the contested region where Voith Hydro works on the Baglihar hydropower plant.

It can be a challenging and nerve-racking task to develop first-rate security for sites and employees as well as logistic processes for complex hydropower projects across the globe. While not all the issues are as dramatic as those in Kashmir, geopolitical challenges, sometimes fraught with danger, have an impact on sites, particularly in isolated locations. In such cases, Voith's security expertise, detailed planning, flexibility and overall project management come into their own.

Due to the special locations of the sites, around 75% of security issues for the Voith Group involve the hydropower business, says Rosenbach. The company is one of a few globally active firms ideally placed to deal with many of the most trying security issues. Voith is part of the Global Player Initiative, set up by Germany's Federal Criminal Police Office, and in cooperation with other firms, offers security advice and support wherever and whenever it is needed. Indeed, such is the excellent reputation of Voith in the field, various partners rely on the company for much of their own on-site security. The issues in question are wide-ranging, from the dangers of kidnapping or local crime to the more sedate considerations of hospital facilities and perimeter fences.

The key to successful on-site security is detailed risk assessment. "Once risks are identified," explains Rosenbach, "the necessary measures can be taken to deal with them." With years of experience in the field, he has come across just about everything. These experiences range from troubled areas in the Congo and Angola to Columbia and Kashmir, and cover a variety of security issues, from areas suffused with ethnic tension to sites in danger of attacks by rebel groups. But the odd incidents, as well as the dangerous ones, are at the forefront of Rosenbach's mind, such as receiving fingerprint "signatures" from ministry workers in Afghanistan; finding the telephone in an Iranian hospital in the disinfection ward; or discovering a site with snakepits instead of a fence.

Not quite as dramatic, but certainly as important in ensuring successful project completion, is the work of Gebhard Salcher, Head of Voith Hydro Field Services. Similar to Rosenbach, working in remote locations is central to Salcher's remit. The field services team oversees the installation and commissioning of partly prefabricated components, and as with security, good planning and flexibility underpin everything. "If a problem arises," says Salcher, "we can't just claim it's not in the plan. It doesn't matter what the problem is – with us, on the civil side or a subcontractor – we have to come together to deal with it. The focus must always be on the whole project." As an example, Salcher cites the installation of a powerhouse in the United States, where the crane intended for the job could not lift the huge parts being embedded. He came up with a flexible solution that by-passed the approved plan, changed the sequence of installations and ended up successfully fitting the unit.

Salcher and his team also ensure that skilled workers and the right equipment are in position for each project – something that's complicated in remote areas of Tibet, Iran and China. Cultural differences naturally play a role, too. It is only by using those decades of experience and garnering the help of local experts that projects get completed. He fondly recalls working with four female engineers in Tibet, jointly coming up with solutions by communicating in "an unconventional mix of Chinese, Tibetan and English."

Largely unheralded, security and logistics clearly play key roles in maintaining Voith's exceptional standing in the hydropower industry. With every project prone to throwing up unexpected challenges, expert planning can take a project only so far. The realms of security and logistics, however, perfectly highlight that with the right expertise and a high degree of flexibility, even seemingly intractable problems in the most challenging locations can be overcome. //

1 **Difficult access: works inside a cavern.**
2 **Challenging transport of heavy components.**
3 **Lifting of a pump spiral.**
4 **Security assessments include housing conditions.**

WORKING ACROSS BOUNDARIES

The Dasque Creek project demonstrates the value of a fully integrated offering.

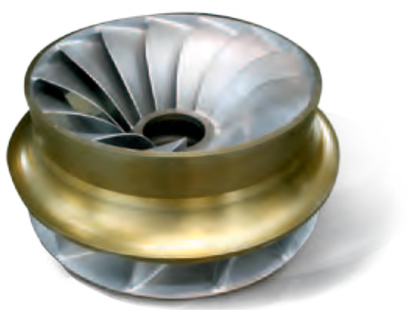
The wheel is now turning full circle in all types of manufacturing industries. For years many producers have tried to improve their cost competitiveness by subcontracting. Today, however, customers are increasingly recognizing the real value to be added from doing business with large, fully integrated suppliers with genuine global reach. Voith fits squarely into that camp, as demonstrated by one relatively small but significant recent hydropower project on Dasque Creek in British Columbia, Canada. After receiving a request for proposal from Veresen Inc., Voith opted to submit two workable, but quite different, solutions. Eventually, the client decided for the installation of two units with different capacities: a 4.8 MW and a 10.3 MW Francis turbine. The entire arrangement enables the hydropower plant to achieve a considered balance between energy production and flow ramping over 12 hours, taking into account the owner's technical requirements and the need for compliance with the licenses and permits for the project.

Securing the contract against stiff competition reflected Voith's underlying strength as a fully integrated hydropower company that shares technical knowledge between designers, engineers and factories worldwide, explains Eric Leblanc, Head of Small Hydro at Voith Hydro in Canada.

The project was thus a joint effort of Voith Hydro in Canada, the two Voith Hydro locations in India, and Voith Hydro in Sweden, as well as a partnering company in Bangalore. The specialized units each contributed with their engineering and manufacturing expertise to the project, with one location being responsible for the complete system engineering, another supplying the generator units, while a third location provided two fully assembled and tested turbines, along with all related equipment. This division of work has advantages also for the client: As a result of the specialization in manufacturing certain components, the particular expertise and quality assurance contributes to developing a deep understanding of the client's needs and sustaining a strong customer relationship.

Voith's ability to work across boundaries, specifying solutions and sourcing components from its in-house suppliers, is the only way it believes it can ensure consistent delivery of value and quality to customers. "Voith simply does not compromise on quality," Eric Leblanc points out. "We are able to ensure consistent quality standards, no matter which factory a machine is produced in." During the initial phase at Dasque Creek, for example, careful analysis was undertaken to look at the balance between transport costs and local manufacture. The importance of the customer's reliance on Voith's engineering integrity cannot be overstated, he adds. "Because we have strong systems for sharing information and we fabricate in our own factories, it means the client can be reassured about our commitment to them. That reassurance on quality can be hard to quantify, but we know it is significant to the customer." //

> "Voith simply does not compromise on quality."
>
> **Eric Leblanc,** Head of Small Hydro at Voith Hydro in Canada



Quality: Voith's global reach ensures quality products that fit every client's needs.

VOITH LAUNCHES NEW BLUELINE PRODUCT PORTFOLIO FOR PAPER PRODUCTION

NEW PRODUCT LINE – Voith Paper has launched its new BlueLine product portfolio for waste paper treatment. BlueLine features new or improved components that all have one thing in common: They save energy, water and fibers with very low levels of maintenance. The first BlueLine machines have already been installed at various paper mills. In particular, the new disc filter, which is used for stock preparation, has demonstrated very good results. By adding a new disc filter with a corrugated surface, capacity is increased and there is no need for a filter bag, making maintenance a minor concern. The installation and startup proved to be easy and problem-free. Holger Hampel, director of the Schönfelder paper mill in Annaberg, Germany, emphasizes: "We were impressed with how quickly and flawlessly Voith commissioned and implemented the disc filter." The BlueLine project is still ongoing: Other resource-saving Voith components for waste paper treatment are already in development. //

DIW BUILDS CHINA'S BIGGEST LED INSTALLATION

EFFICIENT LIGHT CONTROL – 480 lamps fitted with 1,920 LED tubes, spread across 15,000 m². These are the numbers behind the new Voith Paper production hall in Kunshan, China. Here, DIW has developed and realized a new energy-efficient lighting concept in just six months. All lighting in the production hall is now computer-controlled. This allows the lamps to respond to the daylight conditions through a DALI system, which ensures that they are only switched on when natural lighting drops below a certain value. With this energy-efficient lighting management, DIW has implemented a sustainable approach and therefore meets the criteria for a LEED certificate. Voith continues its work to obtain a LEED Gold Certificate, which would allow the company to rank among the top 10 manufacturing companies in China. //

ADVANCED TURBINE CONTROL

LINEAR DRIVES – Voith Turbo has unveiled a new turbine control system, which offers high performance combined with cost-effectiveness and reliability. The new electrohydraulic linear drive regulates control valves on turbines precisely and dynamically. The drive is self-contained and operates completely without a hydraulic power pack. An integrated spring assembly allows the drive to close its control valve in less than 200 milliseconds in the event of a malfunction. The linear drive works as a Plug & Play solution, suitable for both new systems and existing equipment. The design of the turbine control system allows it to reduce energy costs by up to 50% and ensures lower CO_2 emissions to contribute to climate protection. The modular design also enables very flexible integration options in turbine control systems. Installation into new systems or during a retrofit is therefore kept simple, quick and cost-effective. //

THE FASCINATION OF WATER

Displayed around the world, **English artist William Pye's** works highlight his lifelong attraction to the beauty and power of water.

"The sound of a waterfall or a babbling brook can be beautiful," explains an enthusiastic William Pye. For a leading sculptor who has become renowned for integrating water in such an elegant way into his art, expounding on the beauty of his principle inspiration is no surprise.

Pye's fascination with water, however, is much more profound than his sculptures alone: "The physicality of water is also a major part of the attraction." He talks with passion about visiting Kielder Water, a large reservoir and hydro-electric plant surrounded by a forest park in the north of England, and watching in awe as the 2.5-meter inlets were opened and "columns of water many metres in diameter belted out." He describes it simply as "thrilling."

Citing other "hydro-electric schemes," Pye has a fascination with what he calls "the power of water," though his own particular use is clearly somewhat more refined, if equally alluring. His water sculptures grace numerous corners of the globe, with his work on permanent public display in countries such as Brazil, Canada, Hong Kong, Norway, Spain, and across the length and breadth of England.

William Pye

1938:	Born in London
1958-1961:	Studies at the Wimbledon School of Art
1961-1965:	Studies at the Sculpture School of the Royal College of Art
1960s:	Makes name as expert in creating reflective stainless-steel sculptures
1969/70:	Makes transition to combining stainless steel with water for their complementary form, movement and reflective qualities
1970s – present day:	Wins numerous commissions, with highlights such as *Downpour* (British Embassy, Muscat, Oman); *Water Wall* (Seville, Spain); *Cedra* (Sussex, UK); *Vannpaviljong* (Drammen, Norway); and *Caribdis* (Campinas, Brazil)

With a father who was a noted engineer, and later became the president of the prestigious UK Institute of Mechanical Engineers, and an influential aunt who was a sculptor, perhaps there should be little surprise that Pye took from both disciplines when he made his way as an artist. After attending the Royal College of Art, he worked predominantly with stainless-steel cables in order to reflect "very fine shafts of light." He soon discovered, however, that pairing water with stainless steel had an even greater impact, and water has featured in most of his works since.

Though born in London, and still retaining a house in the British capital, Pye's family spent a great deal of time at a property 40 miles southwest of the city, on common land now designated as an area of outstanding natural beauty. On this ground, which he now owns, "I built a waterfall across the stream that runs through the garden when I was 17 years old. The magic of the place, with water all around, gave me a deeply routed fascination with water. It was natural, therefore, that at some stage this enchantment would be reflected in my work as a sculptor."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1 The Aquarena sculpture in Bristol, UK, combines running water with a stainless-steel planetarium sphere.
2 Pye's personal favorite, the Salisbury Cathedral Font in Wiltshire, UK.
3 Only by taking a cable car can viewers discover the secret atop Attica.

"As you climb the mountain, you see this wonderful abstract shape with water flowing down a mirror-polished surface."

William Pye, water artist

With many vaunted works under his belt, Pye is actually best known for *Aquabar*, an installation at London Gatwick Airport's North Terminal, which is made up of three transparent vessels of different diameters. As the vessels are filled with water, passengers stand transfixed as air-core vortexes surge upwards, subsiding only when the water reaches the rims.

An arguably more fascinating piece, however, is *Attica*, commissioned by a wealthy Greek businessman who owns a site north of Athens. Ingeniously, visitors only discern the secret atop this towering, shiny metallic sculpture when rising up the adjacent cable car. "As you climb the mountain," explains Pye, "you see this wonderful abstract shape with water flowing down a mirror-polished surface. And if you are observant, you will notice that it appears to be an Attic helmet."

Now in his mid-70s, Pye is as busy and enthusiastic as ever. He travels the world for his art and is currently working on a piece in Baku, the capital of Azerbaijan. Pye's own favorite, though, is his cruciform-shaped font in England's Salisbury Cathedral, a fine example of the artist's deep appreciation of placing contemporary works in historically significant settings. "The basic principle is that there is water constantly flowing from spouts at four corners," he says, "with the life-giving properties of water expressed in this font."

William Pye's fascination with water – whether it is delighting in the sounds of a "babbling brook" or gasping at the might of hydro-electric power – has informed his art for decades. His work is refined and mesmerizing, never iconoclastic, and best seen when he engages with areas rich in history. Few better than in the contrasting locations of Athens and Salisbury Cathedral, two centuries-old sites graced with creative works from an innovative sculptor. //

COFFEE BREAK

Voith Hydro **CEO Dr. Roland Münch** on the ecological as well as social sustainability of hydropower.

Dr. Münch, coffee consumption has risen considerably in recent years, particularly in developing countries. Do you recognize parallels with the hydropower industry?
There are certainly some similarities: developing nations, particularly those in South America and Asia, are among the most dynamic markets for hydropower. This is where we are seeing the strongest growth in demand for environmentally friendly energy supplies.

The demand for sustainably produced coffee is rising around the world. This is beneficial for residents of developing countries…
… which is something that you could also apply to hydropower. As the largest provider of renewable energy, it plays an important role in sustainable energy supply, particularly in developing countries. The local populations of these countries can certainly all benefit from this.

In what way?
Hydropower provides a secure and affordable source of energy. It contributes to economic and social development, and so to an improvement in living conditions: people receive access to education, while jobs and infrastructure are created.

Nevertheless, there is still criticism from some areas of the environmental impact of hydropower. How does it all fit together?
All large infrastructure projects have an impact on the environment and result in changes for local people. I'm convinced, though, that the advantages of hydropower far outweigh any disadvantages. Of course relocation is a burden, but ultimately it leads to improvements. The Three Gorges Dam in China, for example, has made a considerable contribution to the country's economic and social development. It also provides people with much improved flood protection – in an area where, in the first half of last century, millions lost their lives due to a complete lack of flood control.

Social aspects in particular are often the focus of criticism.
I've personally visited a number of large hydropower sites. I've been there before a project has started and seen poverty, inadequate living conditions and a lack of infrastructure. I am convinced that locally produced energy from hydropower contains many long-term benefits. Local development brings schools and hospitals, giving access to education and medical care. The key is that local inhabitants have a choice, that they have new perspectives and opportunities for education, prosperity and a better future.

Do you also provide institutional support for sustainability?
For years, we have been campaigning for high standards in hydropower projects by working together with organizations such as the International Hydropower Association. We were involved in the creation of the Hydropower Sustainability Protocol. As a supplier, we can't have the decisive vote in how projects are run, but we are contributing as strongly as possible. //

All plants mentioned in this issue and

Voith's scope of supply

1 Churchill Falls, Canada: Replacement of automation/control systems in the 5,428.5 MW underground hydropower plant.
2 Dasque Creek, Canada: Supply of two new 10.3 MW and 4.8 MW Francis turbines and generators.
3 Budarhals, Iceland: Complete electro-mechanical equipment, turbine governors and auxiliary systems for the 95 MW plant.
4 Litoměřice, Czech Republic: Dam upgrade with two new 3.5 MW Kaplan pit turbines, associated controls systems and synchronous generators.
5 Moulinets, Switzerland: Supply of two 0.6 MW Kaplan pit turbines plus generators.
6 Tambobach, Switzerland: Supply of complete generating unit with 1.8 MW vertical Pelton turbine.
7 Beyhan-I, Turkey: Supply of three 235 MVA generators, excitation and monitoring systems.
8 Kargi, Turkey: Complete electro-mechanical equipment including two 51 MW Francis turbines and generators.
9 Xiluodu, China: Supply of three sets of 784 MW Francis turbines and generators.
10 Cambambe-I, Angola: Rehabilitation of four 67 MW Francis turbines.
11 Cambambe-II, Angola: Supply of four new 179 MW Francis turbines and 195 MVA generators, plus control and associated systems.
12 Inga-I, DR Congo: Rehabilitation and supply of two 55 MW turbine-generator units.

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