ANDRITZ Hydro

From water to wire

With global megatrends shaping our present, answers to the questions of the future are needed today.

Upon examination of changes in demographics, economics, and energy policy, it quickly becomes clear that we are heading toward a challenging future.

Demographic, technological, and economic megatrends – such as urbanization and increasing demand for electricity – will bring social and political upheavals in the next few decades. In this context, people are discussing a “Scenario 2050”.

According to current predictions, the global population will have increased to approximately 10 billion people in 2050. At the same time, energy demands will have doubled compared with today. This situation represents a challenge for politics, the economy, and research. It’s a challenge that requires consideration today.

Urbanization

In 2050 half of the world’s population will live in major urban centers. Currently cities cover just 0.5% of the earth's surface. However, they consume 75% of global resources. By 2025, there will likely be 40 cities with more than 10 million inhabitants. Megacities such as New York, São Paulo, Cairo, and Beijing will have to make billions of dollars of infrastructure investment within the next 10 years. Urban technologies are racing ahead. An example is the emergence of "smart cities”, where inhabitants can interact intelligently and efficiently with their urban environment. But despite increasing energy efficiency, the energy demands of such megacities will be enormously high.

Climate change and resource scarcity
Population increase, urbanization, and increasing energy demands will ensure that conventional energy sources will reach their limits in the near future. With respect to current consumption data, it appears that in just a few decades it will no longer make economic sense to produce fossil fuels. Regardless of this, existing reserves are still being used extensively causing without appropriate filter systems an additional increase in emissions, and thus resulting in global warming. The climate target determined at the climate summit in Paris at the end of 2015 to limit global warming to less than 2°C will only be accomplishable with extreme efforts. Integrated solutions that optimally combine renewable energies are already in demand today and will be even more so in the future.

Demographic developments
Overall, the world's population increases by approximately 150 people every minute. And yet the regional differences in demographic development could not be more drastic. Especially in the industrialized nations, the majority of the population will be over 65 years old in the future. On the other hand, the population of Africa will probably have doubled by 2050, while the population of Europe will shrink. By this time, individual countries in Africa could have more inhabitants than the USA has today.

For ANDRITZ HYDRO, the discussion of the “Scenario 2050” is a motivating vision of the future – to find tomorrow’s solutions today. The immense potential of hydropower has by no means been fully exploited; it can make a significant contribution to the redesign of energy supply on the road to sustainability.

Nant de Drance, Switzerland

Hydropower.
Sustainable, renewable, and flexible.

Many benefits – great potential
Approximately 70% of the earth is covered with water, which means that there are 14.3 billion cubic meters of a re-newable, clean energy source. Electricity from hydropower is cost-effective and not subject to price volatility – unlike fossil fuels. It offers socio-economic benefits since the construction of hydropower plants also creates local jobs, supports the regional economy, water supply and flood protection are guaranteed, and it can also be used for irrigation and shipping navigation.

In a time when harnessing fossil resources is becoming less economical and energy demands continue to climb, we must find a compromise between the needs of the present and the responsibility to future generations.

Technology with vision
Hydropower is the most proven and best-developed form of renewable electricity generation. An increasing awareness of global climate change and sustainable electricity generation, social responsibility on the part of politics, as well as an increasingly critical attitude toward CO_2 emissions from fossil fuels, will cause demand for hydropower to increase in the coming years.

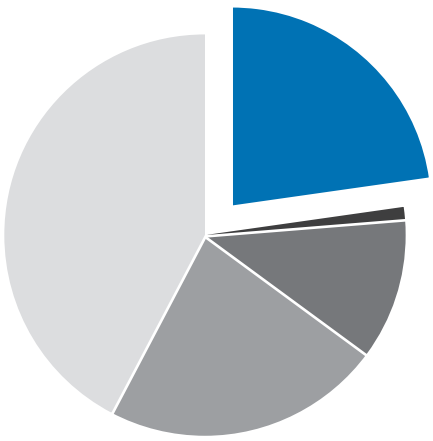
Proven in many applications
Currently, approximately 16% of the world's electrical energy comes from hydropower. In the future, the assumption is that the enormous, increasing demand for electricity will be fulfilled by those energy concepts that best combine the various resources available. Hydropower is trendsetting here, for it does not end with power generation. Instead, it offers a wide spectrum of applications, including energy storage for grid stability and peak load coverage.

The global hydropower market. Possibilities and opportunities.

Only up to 25% of potential exploited
Approximately 22% of the world's demand for electricity is currently satisfied through renewable resources. At 74%, hydropower represents the largest share by far, followed by wind energy with approximately 12%. The shares of biomass, solar energy, and geothermal energy are in the single-digit range.

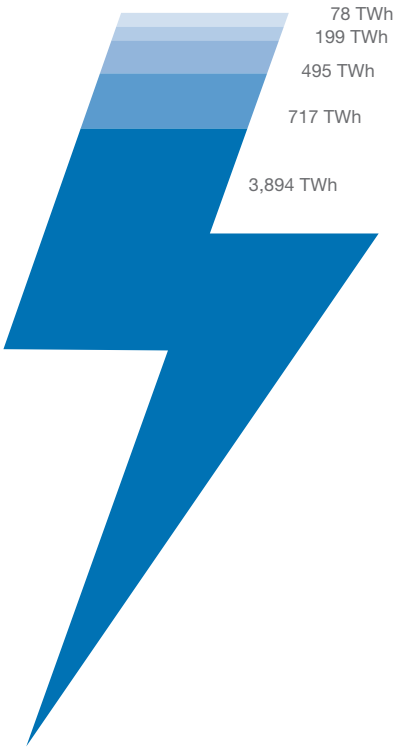
Although the technically feasible potential of hydropower is an unbelievable 16,000 TWh per year, at the moment not even 25% of this potential has been exploited. Annual generation from hydropower is currently less than 4,000 TWh.

Strong growth around the world
People around the world are working to exploit this potential by building new hydropower plants, as well as modernizing and improving existing ones. In particular in regions where energy demands will increase dramatically in the next few years – such as in Asia, South America, and Africa – in addition to new large plants, a multitude of small hydropower projects will be implemented. Current predictions indicate that the construction of new hydropower plants will grow by 2–3% per year. There is also a big potential in Europe and North America, since half of the facilities here are older than 30 years and can make a more significant contribution toward power supply in the future through modernization.



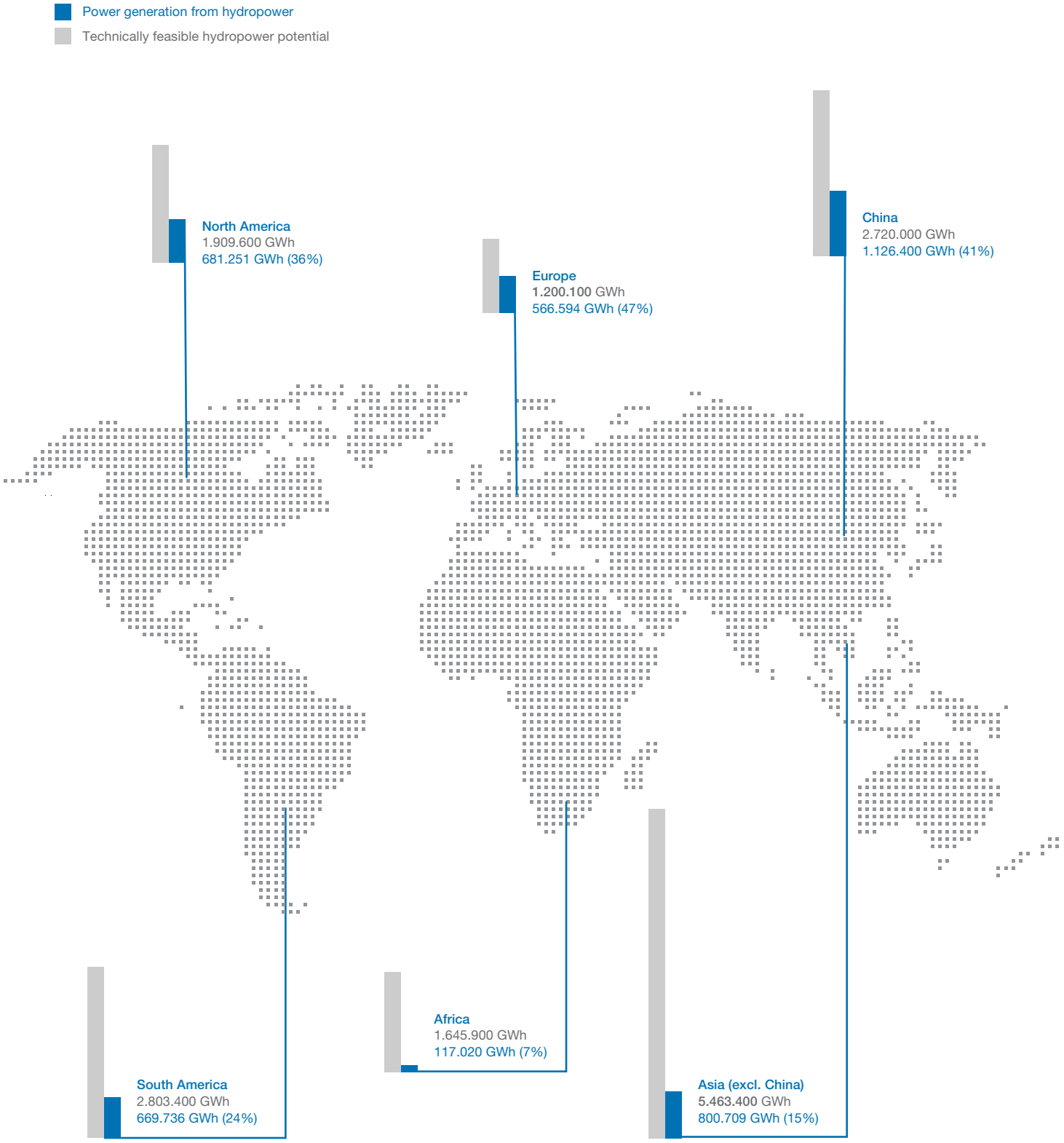
- Coal **41%**
- Gas **22%**
- Nuclear **11%**
- Oil **4%**
- Renewable Energy Sources **22%**

1) Percentage distribution of worldwide power generation (Source: IEA World Energy Outlook 2016)



- Hydropower **72,3%**
- Wind power **13,3%**
- Biomass **9,2%**
- Solar energy **3,7%**
- Geothermal energy and other energy sources **1,5%**

2) Percentage distribution of power generation from renewables (Source: IEA World Energy Outlook 2016)



3) Global hydropower generation
(Source: Hydropower & Dams World Atlas 2016)

From water-to-wire 2050.
Power generation from hydropower in the future.

Application Examples

1 Annual storage reservoir

2 Short-term storage reservoir

3 Conventional river power plant

4 Small hydropower plant

5 Mini hydropower plant

6 Urban river power plant

7 Hydropower plant with low head

8 Tidal power plant

9 Pumped storage power plant (fresh water); energy storage for solar power plant

10 Pumped storage power plant (salt water); energy storage for wind park

11 Energy island; off-shore pumped storage power plant for wind/solar/tidal range

12 Tidal stream power array

ANDRITZ HYDRO.
Market leadership thanks to tradition and innovation.

The ANDRITZ GROUP is a globally leading supplier of plants, equipment, and services for hydropower stations, the pulp and paper industry, the metal-working and steel industries, and solid/liquid separation in the municipal and industrial sectors. ANDRITZ is always close to its customers, with more than 250 production locations and service and sales companies around the world.

ANDRITZ HYDRO is part of the ANDRITZ GROUP. It is a global supplier of electro-mechanical equipment and services “from water-to-wire” for hydropower plants. As one of the world's largest suppliers on the market for hydropower generation, ANDRITZ HYDRO – with more than 175 years’ experience in turbine technology and 120 years’ experience in electrical engineering – offers a comprehensive portfolio.

The cornerstone was laid by the turbine and generator pioneers in Europe and North America in the 19th century. Over time, growth, mergers, and cooperation agreements have created a state-of-the-art technology company with more than 7,500 employees.


Finnshyttan
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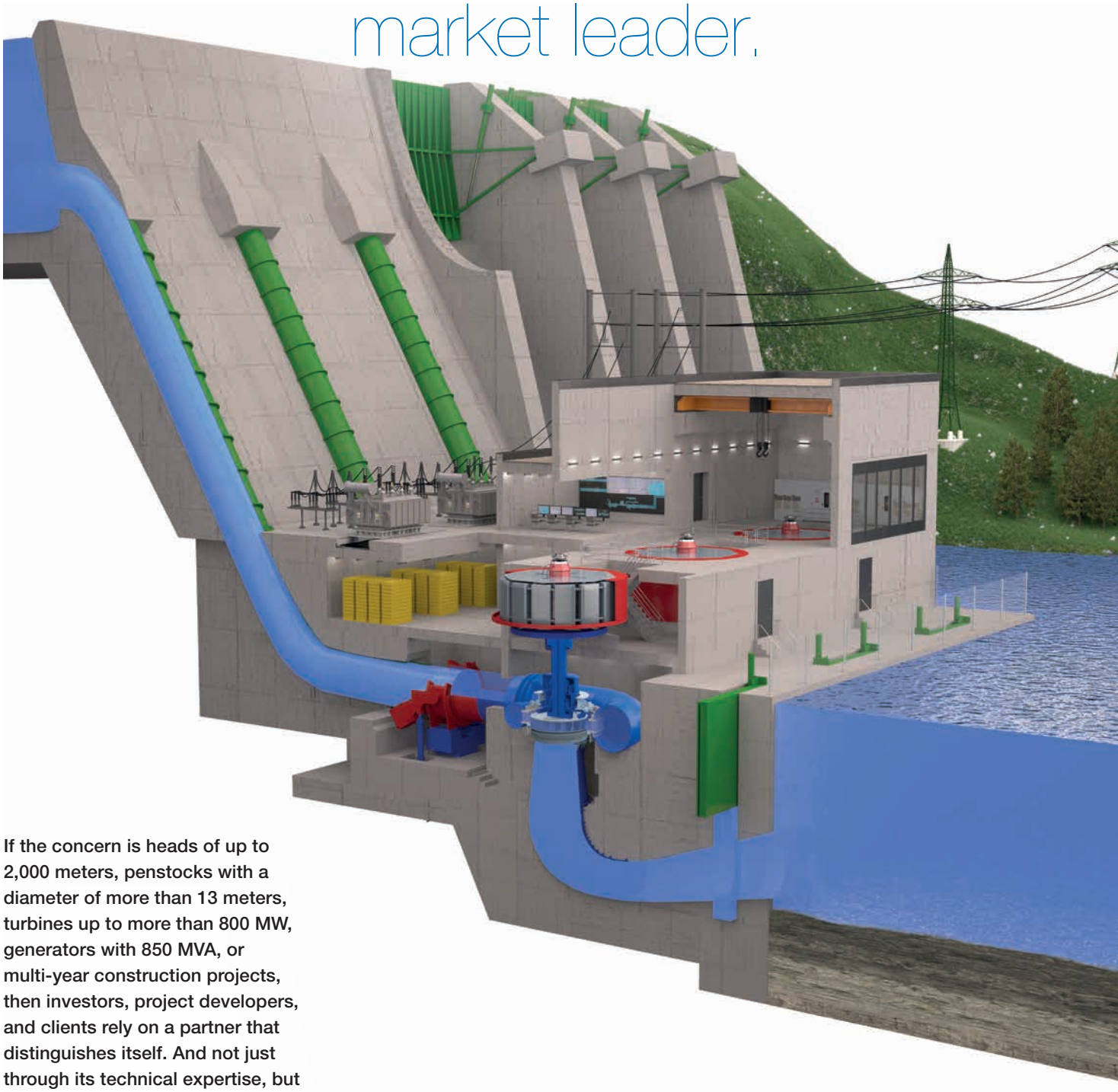
KMW
NOHAB
English Electric
Escher Wyss
General Electric
I.P. Morris
Dominion Engineering
Pichlerwerke
Sulzer Hydro
Ateliers de Constructions Mécaniques de Vevey (ACMV)
Hydro Vevey
Pelton Water Wheel
Bell
Boving
Baldwin-Lima-Hamilton
Ateliers des Charmilles
C.E.G.B.
SAT
ELIN
Bouvier
Waplans
Tampella
Møller
Andritz
Hammerfest Strøm
VOEST
KVAERNER
VA TECH HYDRO
Andritz VA TECH HYDRO
GE HYDRO
Precision Machines
GE HYDRO inepar
VOEST MCE
AFI
Hemi Controls
ANDRITZ
Hydro

Comprehensive expertise.

The outstanding characteristic of a market leader.



If the concern is heads of up to 2,000 meters, penstocks with a diameter of more than 13 meters, turbines up to more than 800 MW, generators with 850 MVA, or multi-year construction projects, then investors, project developers, and clients rely on a partner that distinguishes itself. And not just through its technical expertise, but also its social competence, financial strength, and solid, long-term project management experience.

ANDRITZ HYDRO's service portfolio supports the entire life-cycle of a hydropower plant, from design and engineering to manufacturing, installation, on through to commissioning and training. Whether the project at hand concerns hydraulic and electro-mechanical equipment for new hydropower plants or the modernization and automation of existing facilities, ANDRITZ HYDRO provides custom-tailored solutions "from water-to-wire" – everything from a single source.

The committed employees in research and development are working constantly to improve and enhance technologies and products. They make an essential contribution to ANDRITZ HYDRO's market leadership. Production locations and test benches around the world guarantee the high quality of ANDRITZ HYDRO's products and services.

Large new installations
As a comprehensive supplier, ANDRITZ HYDRO provides turn-key hydro- and electro-mechanical equipment for large new installations and implements expansion projects; as well as modifies existing plants, hence they meet changing customer and market requirements.

Small hydropower
ANDRITZ HYDRO is the world's leading provider on the small and mini hydropower plant market and provides a full spectrum of electro-mechanical equipment based on pre-defined modular components.

Modernization and renovation
For maximum customer benefit, ANDRITZ HYDRO develops solution-oriented service and rehabilitation concepts, ones that offer a short return on investment. Innovative modernization measures and state-of-the-art technologies increase profitability and extend system life span, taking into account basic economic, ecological, and legal conditions.

Hydraulic steel structures
In the market for hydraulic steel structures, ANDRITZ HYDRO has positioned itself as a world leader, one that sets records. The product and service offerings for hydropower plants, water supply, treatment and irrigation facilities include manifolds, bifurcations, pipe bridges, and penstocks, as well as gates.

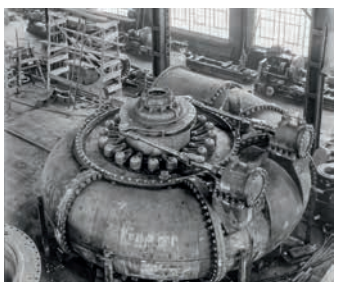
Electrical power systems
ANDRITZ HYDRO's employees' many years' experience in the electrical power systems sector provides an optimal basis for implementing project-specific customer requirements for fully-functional hydropower plants.

Automation
For the design of new installations and modernization projects, automation solutions based on optimized hardware architecture and step-by-step function integration are a significant factor. ANDRITZ HYDRO's concepts enable fully automated operation, low investment costs, simple commissioning, and rapid system replacement.

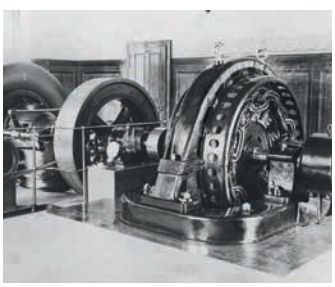
Pumps
ANDRITZ HYDRO provides pumps that meet the demand for ever-larger, higher-performance units, whether for low flow rates or wear-resistant applications. Depending on the application case, ANDRITZ HYDRO develops, produces, tests, and supplies both standard pumps and custom-tailored large pumps.

Turbo generators
The heart of a gas-fired combined- and open-cycle power plant is a high-performance turbo generator. ANDRITZ HYDRO is one of the leading suppliers of air-cooled turbo generators, which correspond to the highest technical specifications and requirements.

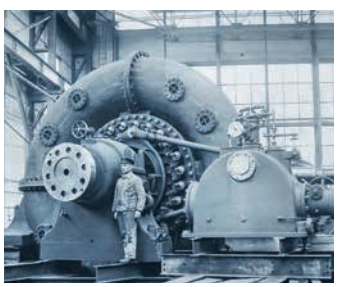
The World of ANDRITZ HYDRO



Niagara Falls, USA
Francis turbine for the world's first commercial hydropower plant
1903



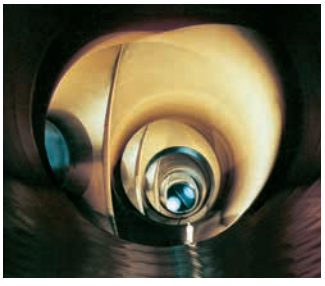
Stubenbergklamm, Austria
Generator for one of the first hydropower plants in Styria
1905



Niederwartha, Germany
Electro-mechanical equipment for the world's first pumped storage power plant
1929

Mica Dam, British Columbia, Canada (2009)
More than 1,000 MW of additional capacity due to the supply and commissioning of two further units. Each of the two 520 MW Francis runners weighs more than 137 tons and increases the total power of the hydropower plant to more than 2,800 MW.

Ruacana, Namibia
Turbines for Namibia's largest hydropower plant
1974



Tarbela Dam, Pakistan
World's largest bifurcation (diameter 13.2 m; height 16 m); Guinness Book of World Records
1993

Goldisthal, Germany
First asynchronous, variable speed pumped storage units outside of Japan
1997

Three Gorges (Sanxia), China
Turbines and generators for the world's largest hydropower plant
1997

Keselstraße, Kempten, Germany (2006)
Electro-mechanical equipment for a modern, urban small hydropower plant including two 1.34 MW units in an historic location.

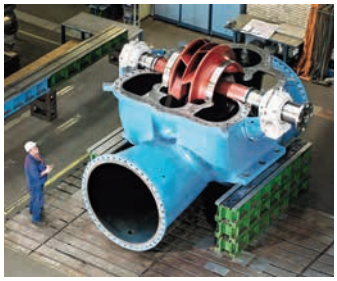
Tsankov Kamak, Bulgaria
Electro-mechanical equipment for Austria's first joint implementation project according to the Kyoto Protocol for reduction of CO_2 emissions
2004

Simón Bolivar (Guri II), Venezuela
World's largest Francis turbines (5 × 770 MW) for the largest hydropower plant in Venezuela
2006

Sihwa, Korea
Electro-mechanical equipment including 10 bulb turbines (26 MW each) for the world's largest tidal power plant
2006

Theun Hinboun, Lao PDR (2008)
Delivery and commissioning of an additional 220 MW unit for the Theun Hinboun hydropower plant on the Nam Gnouang River.

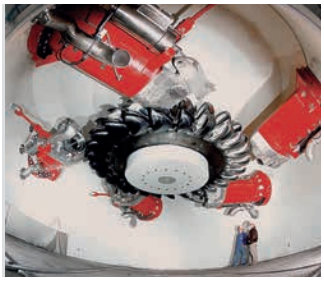
Santo Antônio, Brazil (2008)
This hydropower plant is among the world's largest low head hydropower plants and has an installed capacity of 3,568 MW. With an output of 71.6 MW each, the bulb turbines installed are the largest of their kind worldwide and distinguish themselves through their enormous diameter of 7,500 mm.



Peking, China
Large pumps for water supply with a total flow rate of 60 m^3/s across a distance of 60 km
2006

Ilısu, Turkey
Electro-mechanical equipment for the largest hydropower plant in Southeastern Anatolia
2008

Ashta, Albania
90 modules for the world's largest HYDROMATRIX® power plant (Ashta I with 24 MW, Ashta II with 45 MW)
2008



Cleuson-Dixence, Switzerland
Two world records for the most powerful Pelton turbines (3 × 423 MW) and highest head (1,883 m)
2009

Láuca, Angola (2014)
Electro-mechanical equipment for two power houses, six 340 MW Francis units, as well as an eco-flow unit for the first and most important hydropower plant on the Kwanza River.

El Hierro (Gonora del Viento), Spain
Turbine runners for a small pumped storage hydropower plant combined with a 10 MW wind park
2010

Belo Monte Complex, Brazil
Hydro- and electro-mechanical equipment for the second largest hydropower plant in Brazil and the largest spillway in the world
2011

Ybbs-Persenbeug, Austria
Modernization of the hydro- and electro-mechanical equipment of the oldest hydropower plant on the Danube in Austria
2012

Turbogenerator, USA
Transport of a 90-ton turbo generator with one of the world's largest airplanes – an Antonov 124
2013

Langenprozelten, Germany (2015)
Modernization of the world's most powerful hydropower single-phase motor generators (2 × 94 MVA) in the most important peak load plant for the Deutsche Bahn. Shaft raw weight (150,000 kg), mechanical pole loads (≙34,000 kg), as well as centrifugal forces on the poles (≙27,000 tons at 756 rpm) are unique worldwide.

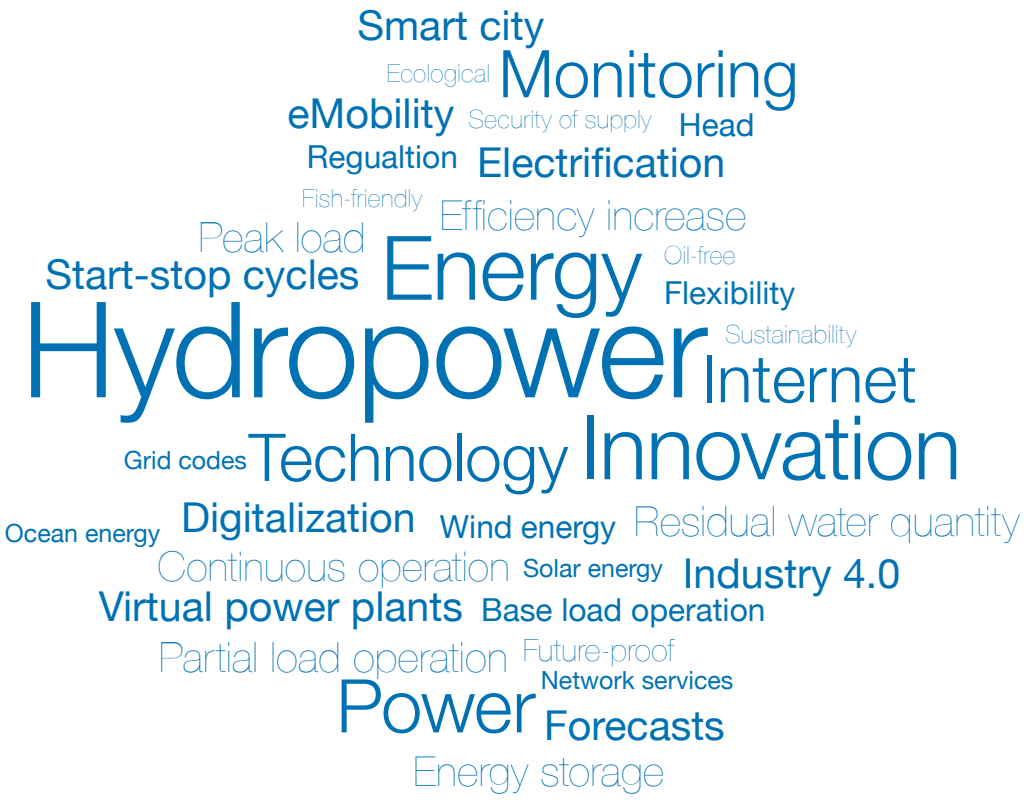
EMEC, UK
European Marine Energy Centre
World's first commercially-operated tidal current turbine (1 MW)
2013

Xayaburi, Lao PDR
Electro-mechanical equipment for the largest hydropower plant on the Mekong River in Lao PDR
2013

HIPASE
Worldwide first integrated product platform for excitation, protection, turbine governor, and synchronization
2015

Kalwakurthy Stage 2, India
Large pumps (5 × 30 MW, 5 × 23 m³/s) for agricultural irrigation in Andra Pradesh
2016


Nam Lik 1, Vietnam



ANDRITZ HYDRO.
The future begins now.

The electricity market is subject to constant change. The dynamic load of power grids is also increasing due to the growing share of wind and solar energy, not to mention power trading. This requires new technical specifications for all facilities. Existing hydropower plants must be adapted to these new requirements. At the same time, ecological restraints are increasing for new projects and existing hydropower plants.

ANDRITZ HYDRO has always been focused on providing equipment that is optimally adapted to the special requirements and customers' needs – durable, environmentally-friendly, and efficient solutions for hydraulic power generation. The experienced employees of ANDRITZ HYDRO work constantly on adapting proven technologies to changing market conditions so that facilities will fulfill more demanding requirements in the future.

Today, consideration of ecological issues is increasing. ANDRITZ HYDRO invests extensively in the research and development of solutions for these requirements, such as in the advancement of fish-friendly turbine technology or oil-free applications for bulb turbine runners.

In addition, topics like energy storage, ocean energy, and solutions for low head sites also present interesting possibilities for the future.

Energy from low heads

New market requirements for hydropower development in middle and lower river sections have necessitated the revision of some basic design principles of hydropower technology. At the same time, more emphasis is being placed on ecologically and economically sustainable solutions. ANDRITZ HYDRO's low head and bulb turbines are especially well-suited for fulfilling these requirements. They can be applied very flexibly, whether large or small, run-of-river or tidal power plant or HYDROMATRIX*, fixed or variable speed – with a bulb turbine, everything is possible for heads from 0.5 up to 30 meters.

Tierfehd-Nestil, Switzerland

Energy storage

Pumped storage power plants are currently the most economical way of storing large amounts of energy with great efficiency. They also play a significant role as a stabilizer for power grids. For example, in case of sudden shortages such as those due to power failures, large amounts of power can be quickly provided. The first pumped storage power plants were built at the beginning of the 20th century. ANDRITZ HYDRO was and is one of the pioneers of this technology.

Energy from the ocean

Three-quarters of the earth's surface are covered by water, 97% thereof are salt water. The possibilities for generating electrical energy from this are many and varied, whether through waves, streams or tidal lift. ANDRITZ HYDRO is aware of the role that ocean energy can play in the future, and contributes to the development of trendsetting concepts.

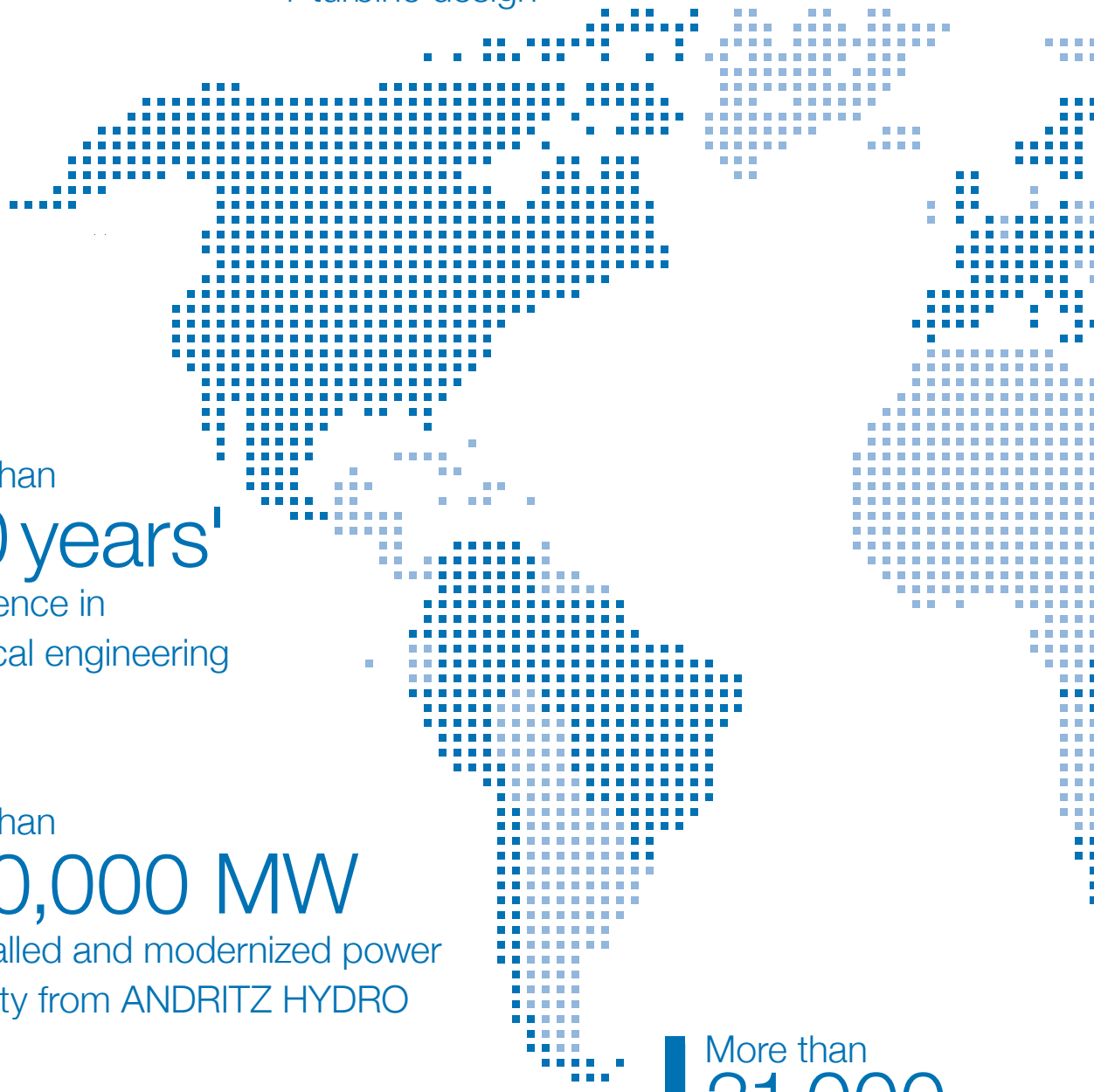
For each geographic location, optimized solutions are designed. These include marine water bulb turbines that exploit the tidal lift in bays or estuaries, tidal stream turbines on the sea floor near the coast that make use of the underwater tidal streams, and offshore applications such as "tidal lagoons".

MeyGen, UK

ANDRITZ HYDRO worldwide

15
ANDRITZ HYDRO test benches

More than
175 years'
experience in turbine design



More than
120 years'
experience in electrical engineering

More than
430,000 MW
of installed and modernized power capacity from ANDRITZ HYDRO

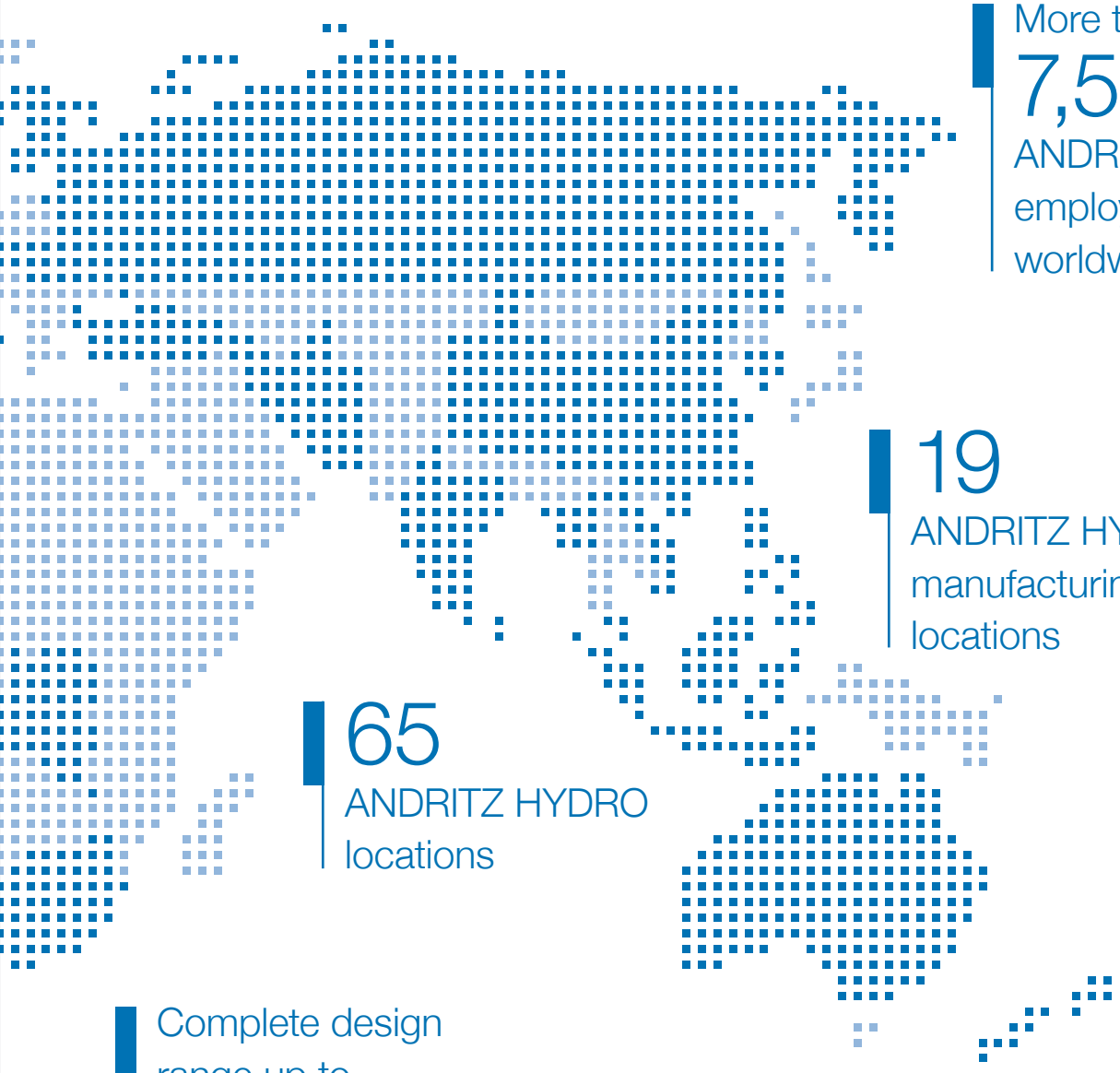
More than
31,000
turbine units delivered

Countries with ANDRITZ HYDRO locations
Countries with ANDRITZ HYDRO presence

3.789 TWh/year
worldwide annual
hydropower generation

More than
120 Compact Hydro
units per year

More than
7,500
ANDRITZ HYDRO
employees
worldwide



19
ANDRITZ HYDRO
manufacturing
locations

65
ANDRITZ HYDRO
locations

Complete design
range up to
800 MW

15,700 TWh/year
global hydropower potential

LINKS TO HYDRO NEWS CUSTOMER MAGAZINE

Online Magazine

iPad App

Android App

VIDEO LINKS

Visit the ANDRITZ HYDRO Youtube Channel

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Mica, Canada

Watch the video of:
Santo Antônio, Brazil

Watch the video of:
Langenprozelten, Germany

Watch the video of:
Lauca, Angola

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