MAGAZINE OF ANDRITZ HYDRO | 06-2017 ENGLISH

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HYDRONEWS AFRICA

ANDRITZ Hydro

Dear Business Friends,

Africa is a fascinating and diverse continent experiencing rapid population growth. By 2050 the population of Africa is widely expected to double and individual countries will have more inhabitants than the USA today. At the same time, social and industrial growth is irrevocably bound to the supply of affordable energy.

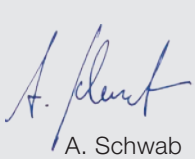
The desire to use fossil-based energy resources is in decline, but energy demand continues to rise. A compromise thus has to be found between the need to support social and industrial growth for an expanding population and an ongoing responsibility to future generations.

Hydropower is the most proven and best-developed form of renewable electricity generation. The technically feasible potential for hydropower in Africa is enormous and could cover much more than the entire future power requirements of the continent. The construction of new hydropower plants and the refurbishment of existing ones is therefore an important part of Africa's energy future.

ANDRITZ HYDRO has been active in this region for more than 100 years and has supplied more than 40% of all the installed turbines across the continent. More powerful new plants like HPP Laúca in Angola and HPP Rusumo Falls in Rwanda are under construction in order to satisfy significant and continuing growth in electricity demand. For instance, the hydropower complex Inga in DR Congo is currently using only a small portion of its enormous potential for power generation. Rural electrification and decentralized off-grid solutions based on small hydroelectric plants will also contribute to improvements in the distribution of power in Africa, where many millions do not have access to electricity supply. Modernization and upgrades to existing power plants will also make a major contribution to satisfying the energy hunger of many nations. Examples of ANDRITZ HYDRO's present-day rehabilitation successes include HPP Ruacana in Namibia, HPP Inga 2 and Djoué in DR Congo, HPP Kpong in Ghana as well as HPP Mount Coffee in Liberia.

The technology offered by ANDRITZ HYDRO provides state-of-the-art know-how combined with the latest designs to help sustain the natural environment.

At ANDRITZ HYDRO we are fully committed to support this continent on its way to better social and economic welfare based on its wealth of renewable hydropower resources.



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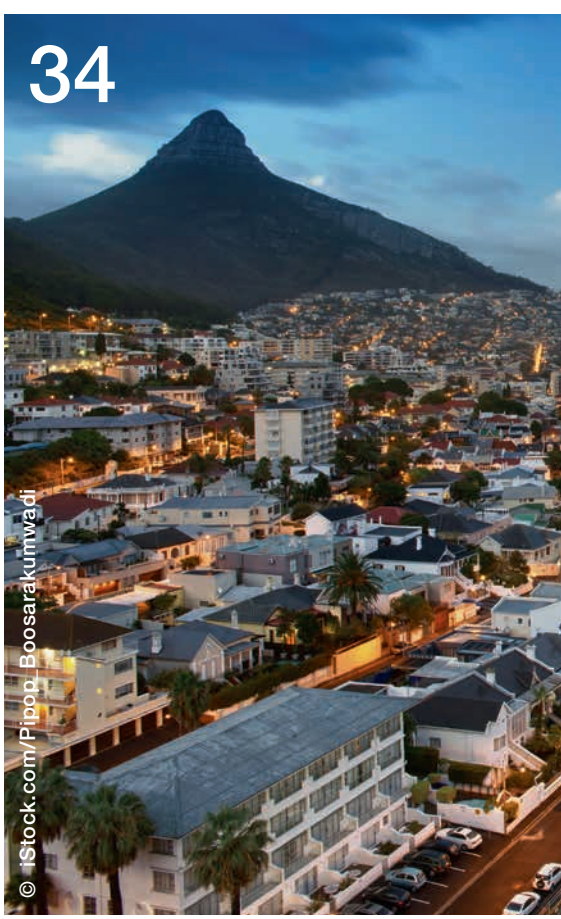

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iPad App

Android App

Online magazine

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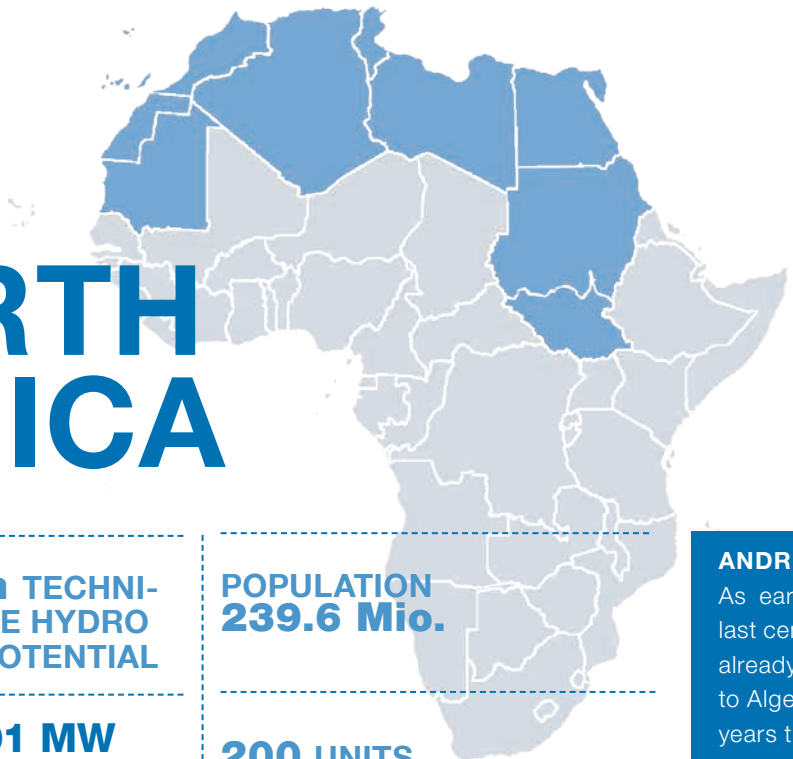
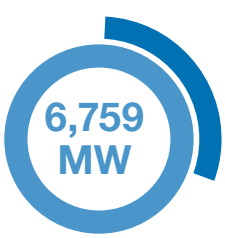


NORTH AFRICA

91,252 GWh TECHNICALLY FEASIBLE HYDRO GENERATION POTENTIAL

2,001 MW INSTALLED BY ANDRITZ HYDRO



TOTAL INSTALLED HYDRO CAPACITY

POPULATION **239.6 Mio.**

200 UNITS INSTALLED BY ANDRITZ HYDRO

22,722 GWh HYDRO GENERATION

358 MW HYDRO CAPACITY UNDER CONSTRUCTION

ANDRITZ HYDRO

As early as the beginning of the last century ANDRITZ HYDRO had already made equipment deliveries to Algeria. Through the intervening years the company supplied about 200 hydropower units across the region, with a total capacity of about 2,000 MW. Major projects such as HPP Roseires or Jebel Aulia in Sudan are on ANDRITZ HYDRO's reference list, as well as HPP Matmata, Afourer and Al Massira in Morocco, and HPP New Naga Hammadi, New Esna, and the recent order for HPP Assiut in Egypt.

The Sahara Desert covers about 75% of the North African region, which encompasses Algeria, Egypt, Libya, Mauretania, Morocco, Sudan, South Sudan, and Tunisia.

Along with the Sahara, other dominant geographical structures are the Atlas Mountains in the west, the Nile River and its delta in the east and the Mediterranean coastline to the north. Countries in this part of Africa, such as Tunisia, Algeria, Morocco and Egypt, are relatively economically advanced. One major source of income is oil – Algeria has the largest oil reserves in Africa and Libya is in second place. Furthermore, most of the region's economies are export-oriented and show solid growth rates.

In contrast with some Sub-Saharan countries, hydropower does not play such an important role as an energy source. For instance Libya has no potential identified; Mauretania has only 132 GWh, and Tunisia just 250 GWh of technically feasible hydropower potential. However, Egypt and Sudan both have significant hydropower potential – 50,000 GWh and 31,000 GWh, respectively. There are also a number of large hydropower schemes installed. In Morocco some pumped storage hydropower plants as well as some small hydro developments are of interest. Furthermore, the newly-formed country of South Sudan could secure an economic boost by introducing some hydropower schemes, which would also serve to improve the living standards of the population and increase access to electricity.

A number of North African countries plan to increase their use of renewable energy resources. In the wide uninhabited desert regions the possibilities for wind and solar installations are varied. Some solar power stations have already been built and some wind power stations are in planning. Algeria and Tunisia have government programs designed to increase their renewable share to at least a quarter of the national energy mix by 2030, while Sudan has also implemented similar plans.

MOROCCO

SAFE AND STABLE

MOROCCO FACTS	
34.38 Mio.	Population
99%	Access to electricity
1,306 MW	Installed hydro capacity
170 MW	Hydro capacity under construction
1%	Share of generation from hydropower
400 GWh	Hydro generation
5,203 GWh	Technically feasible hydro generation potential
ANDRITZ HYDRO	
787 MW	Installed capacity
30	Installed units
60.30%	Fleet share

The World Bank, IEA, World Energy Outlook, Hydropower & Dams World Atlas 2016

by Diego Vilanova
diego.vilanova@andritz.com

Morocco has the fifth largest economy of Africa and is regarded as liberal and stable. Since the 1990s the progress of privatization has been ongoing, attracting investment and making Morocco a major player in African economic affairs. Government-backed reforms have induced steady growth over the last decade. In 2015, Morocco was named by a French consulting firm as the second safest country in Africa.

There are more than 140 large dams in operation in the country, most of them for water supply, irrigation and flood control. More than half of the facilities are privately owned. Currently, there are 1,306 MW of hydropower installed, including pumped storage. About 33% of the nation's total electricity production is covered by renewable energy resources such as hydropower, wind or solar. More than 5,000 GWh/year of technically feasible hydropower potential has encouraged the Moroccan government to expand its renewable energy capacity. A goal of making the renewable energy contribution more than 50% of installed electricity generation capacity by 2030 has been established. A number of facilities are currently under construction and many projects, pumped storage, large as well as small hydro, are in planning. About 60 large dams are planned by 2030.

ANDRITZ HYDRO

ANDRITZ HYDRO has had numerous equipment deliveries to Morocco through the years. The history of the company reaches back to the early 1920s. Since then ANDRITZ HYDRO has delivered or rehabilitated about 30 units with a total capacity of almost 800 MW, representing 60% of the nation's total hydro generation capacity. Projects such as HPP Afourer, HPP Al Massira, HPP Hansali (Dchar el Oued), HPP El Khamir, HPP El Borg, HPP Tanafnit, and HPP Matmata are on ANDRITZ HYDRO's reference list.

HPP Lau Talambot

New Naga Hammadi Dam

EGYPT

GIFT OF THE NILE

by Diego Vilanova
diego.vilanova@andritz.com

Egypt is the most populous country in North Africa and the Arab world. The majority of its people live along the fertile banks of the Nile River. About half of the population lives in urban areas and about 98% of Egyptians live on just 3% of the territory. The government has struggled to meet the demands of Egypt's rapidly growing population through economic reform and massive investments.

Egypt has a technically feasible hydropower potential of about 50,000 GWh/year strongly depending on the Nile River, the flow, upstream requirements and irrigation needs.

Currently, only about 9% of the nation's electricity is supplied by hydropower but the government has plans to increase the development of renewable energy sources like hydro, wind and solar. According to the government, there are a lot of hydropower facilities to be upgraded. There are also studies and negotiations ongoing for a pumped storage plant (PSP Ataqa 2,100 MW). The official target is to achieve a generation of about 20% from renewables by 2020.

EGYPT FACTS

91.51 Mio.	Population
99%	Access to electricity
2,800 MW	Installed hydro capacity
32 MW	Hydro capacity under construction
9%	Share of generation from hydropower
13,352 GWh	Hydro generation
50,000 GWh	Technically feasible hydro generation potential

ANDRITZ HYDRO

678 MW	Installed capacity
45	Installed units
24.22%	Fleet share

The World Bank, IEA, World Energy Outlook, Hydropower & Dams World Atlas 2016

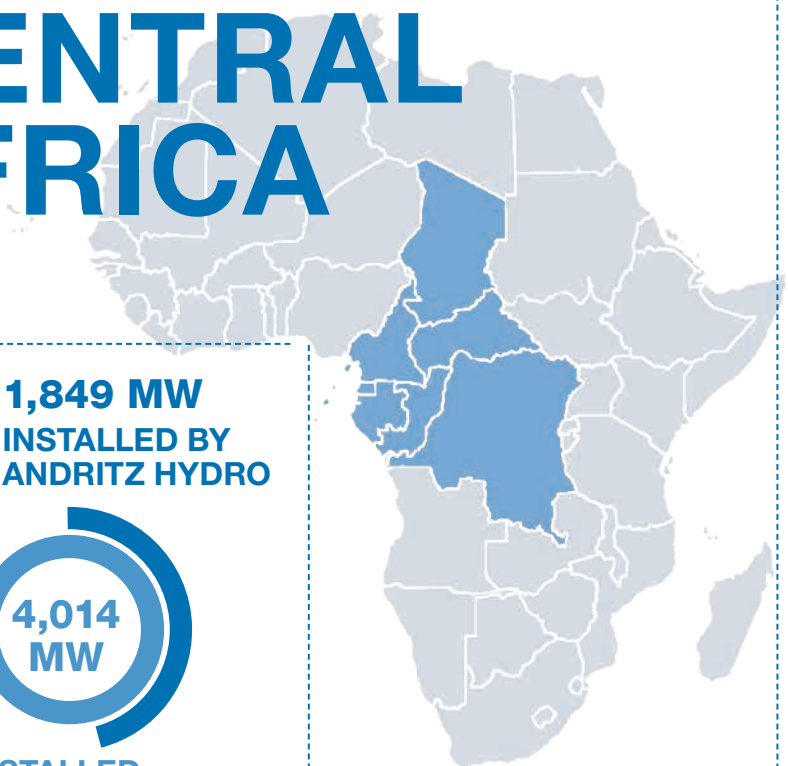
ANDRITZ HYDRO

ANDRITZ HYDRO has a long history in Egypt. First equipment deliveries took place in the early 1920s. Since then ANDRITZ HYDRO has delivered or rehabilitated about 45 units with a combined capacity of almost 700 MW, being involved in all major hydropower projects in the country. The order for HPP Assiut, currently under execution, is the fourth in a row after rehabilitation contracts for HPP Aswan I, HPP Esna and HPP New Naga Hammadi, underlining the strong presence of ANDRITZ HYDRO in Egypt.

HPP Assiut

In 2011 ANDRITZ HYDRO received a contract for the supply of electromechanical equipment for the hydroelectric power plant Assiut Barrage on the Nile River from the Hydro Power Plant Executive Authority (HPPEA). The order comprised supply and installation of four 8 MW Bulb turbines, generators, electro- and hydro-mechanical equipment, including sluiceways. The dam was originally commissioned 1903 and is the oldest dam on the Egyptian section of the Nile. Completion of the installation, scheduled for summer 2017, will significantly improve conditions for irrigation and navigation.

CENTRAL AFRICA



1,849 MW
INSTALLED BY ANDRITZ HYDRO

TOTAL INSTALLED HYDRO CAPACITY

Including Cameroon, Central African Republic, Chad, DR Congo, Equatorial Guinea, Gabon, and Republic of Congo – Central Africa is a dramatically diverse region.

Countries like the Central African Republic or Chad are facing some economic difficulties, whereas Cameroon enjoys relatively stable conditions and is building on its emerging economic status. Most of the countries in the region are dependent on their rich oil reserves. Equatorial Guinea is the third largest oil producer in Sub-Saharan Africa and Chad holds the biggest oil reserves in the whole region. However, with falling oil prices, growth rates in the Central African states have decreased in recent years. All of the region's countries struggle to reduce poverty and to increase living standards for the population by improvement in clean water supply and better access to electricity, which is very low in most countries in Central Africa.

Regionally, the potential for development of hydropower could not be more diversified. DR Congo with 100,000 MW has the largest technically feasible hydropower potential in Africa; in contrast Chad has only about 30 MW. The Central African Republic has revealed plans to expand its use of renewable energy resources such as hydropower and solar. About 30 sites for hydropower development with capacities between 0.5–180 MW were identified to exploit the 3,000 MW potential of the country. Equatorial Guinea, as one of Africa's smallest countries, has only one 120 MW hydropower scheme installed, representing 20% of the nation's electricity production. Gabon has about 8,000 MW of hydropower potential, of which only 2% (330 MW) have been harnessed so far. The government plans to increase the nation's installed capacity to 1,200 MW by 2020, strengthening the economy of one of the most prosperous nations in Sub-Saharan Africa.

ANDRITZ HYDRO

ANDRITZ HYDRO has a long history of equipment deliveries to the Central African region. In Cameroon ANDRITZ HYDRO has supplied or rehabilitated more than 85% of the nation's installed capacity and also has a strong presence in DR Congo. New office establishments in DR Congo and Republic of Congo are strengthening the company's position in this promising African region.

HPP Kinguélé, Gabon

In May 2016, ANDRITZ HYDRO received an order from CGE Gabon for a new double Francis runner, new runner shaft, new turbine covers, and fixed and mobile labyrinths for HPP Kinguélé in Gabon. Installation supervision completes the scope of supply, which is scheduled for completion in September 2017.

POPULATION
128.74 Mio.

492,758 GWh TECHNICALLY FEASIBLE HYDRO GENERATION POTENTIAL

698 MW HYDRO CAPACITY UNDER CONSTRUCTION

14,995 GWh
HYDRO GENERATION

80 UNITS INSTALLED BY ANDRITZ HYDRO

MOVING FORWARD WITH HYDRO-POWER

REPUBLIC OF CONGO

Young man catches fish at the Congo River, suburb of Brazzaville

by Manuel Tricard
manuel.tricard@andritz.com

The Republic of Congo is the fourth largest oil producer in the Gulf of Guinea. The economy is a mixture of village farming, hunting and handicrafts, whereas the industry is based largely on petroleum. Also a large untapped mineral wealth is to be found.

International organizations, notably the World Bank and the International Monetary Fund, support economic reforms. Privatization and renewing cooperation with international financial institutions are slowly progressing.

The privatization of the national utilities for water and electricity plays an important role in the process of establishing regulatory agencies within these sectors. Objectives are a transparent regulatory framework, effective competition and private participation, favorably aiming towards international investors for new projects.

So far there are only three hydropower plants existing – HPP Imboulou with 120 MW, HPP Moukoukoulou with 74 MW and HPP Djoué with 19 MW but not in operation since 2007. The Republic of Congo has a technically feasible hydropower potential equivalent to 3,942 MW, of which only about 4% has been developed. A big part of it could be developed in the north of the country in the Plateaux region, the Sangha region and Cuvettes and Cuvettes-Ouest. The south of the country also offers opportunities – almost 1,400 MW. The hydropower plant Chollet with about 600 MW is in planning together with the government of Cameroon. A feasibility study for HPP Sounda (with different scenarios from 600 MW to 1200 MW) is underway. Studies for new greenfield projects HPP Murala (150 MW), Kouembali (150 MW) and Loufoulakari (50 MW) will also start in 2017.

View on Congo River from the surge tank of HPP Djoué

HPP Djoué

Machine hall of HPP Djoué

Congo River close to HPP Djoué

ANDRITZ HYDRO in Congo

With the prospect of the opening of the country to private investors and opportunities to develop numerous hydropower plants, ANDRITZ HYDRO has decided to establish a permanent office in the capital Brazzaville. This office allows better contact with local government and institutions and is a stepping stone to this interesting hydropower market, together with wider regional perspectives from countries within the Economic Community of Central African States (CEMAC and CEAC).

HPP Djoué

In March 2013, the Délégation Générale aux Grands Travaux (DGGT) – a national construction commission created to oversee development of Congo's energy infrastructure – awarded ANDRITZ HYDRO a contract for the rehabilitation and modernization of HPP Djoué.

Located less than 10 km from the capital, HPP Djoué supplies Brazzaville with electricity and is strategically important for electricity generation in the Republic of Congo. The complex is built on the Djoué River, a tributary of the majestic Congo. The water intake is built inside a gravity dam to retain water for Brazzaville's electricity demand.

Since its construction in the 1950s, there have been many incidents. The most significant one occurred in April 2007, when the power plant was flooded. It has been out of operation since then.

The scope of supply for ANDRITZ HYDRO included new turbine generator units and hydro- as well as electro-mechanical equipment, a new control room and a completely rehabilitated switchyard. The main objectives were to secure the safety of the facility and to increase the plant's power output by over 25%. Both units will contribute to the production of clean sustainable electrical energy for the Congolese population and industry.

REPUBLIC OF CONGO FACTS

6.62 Mio.	Population
42%	Access to electricity
213 MW	Installed hydro capacity
19 MW	Hydro capacity under construction
90%	Share of generation from hydropower
1,500 GWh	Hydro generation
10,000 GWh	Technically feasible hydro generation potential

ANDRITZ HYDRO

32 MW	Installed capacity
2	Installed units
15.02%	Fleet share

The World Bank, IEA, World Energy Outlook, Hydropower & Dams World Atlas 2016

TO BETTER LIFE

SOCIAL ENGAGEMENT OF ANDRITZ HYDRO

by Roland Cuénod
roland.cuenod@andritz.com

It is often forgotten how lucky people in industrialized countries are to be able to just open a tap to have access to clean drinking water at all times and without restrictions. Unfortunately, over 2.5 billion people around the world don't have this. High infant mortality rate and major diseases could be drastically reduced with access to safe and clean water. Since 2013 ANDRITZ HYDRO has supported a number of special social projects in Africa.

The first project in this regard was "Water is Life" in Cameroon. ANDRITZ HYDRO's contribution to Cameroon's water and sanitary infrastructure complements and enhances its strong presence in rehabilitation projects in the hydropower sector of the country, such as HPP Song Loulou and HPP Edéa. "Water is Life" was initiated in 1989 by a Swiss Benedictine priest who had been living in Cameroon for several years and founded the St. Martin Foundation. Since its beginning, this charity organization has installed over 1,400 wells all around the southern part of Cameroon, providing drinking water to more than 500,000 people.

In 2013, ANDRITZ HYDRO financed the installation of a new well in the village of Lipombe. Except for the pump, which came from Europe, the remaining components were built and assembled locally in the small town of Otélé, just about 60 km from the capital Yaoundé.

The village of NtuiEssong, located about 40 km from Yaoundé, celebrated the inauguration of its first drinking well in late 2014. The new well, also sponsored by ANDRITZ HYDRO, provides sufficient fresh, clean and healthy drinking water for more than 600 people, dramatically increasing the living standards of the whole village. The old well had to be replaced due to the bad quality of the water, which caused infectious diseases. Furthermore, the water was not available in sufficient quantity, especially for agriculture in the village – the economic backbone of NtuiEssong. Previously, the villagers had to cover a distance of 2 km to fetch water, now it is in the center of the village.

In 2014, ANDRITZ HYDRO also supported a charity named "Water for Water" a non-governmental organization founded in 2012 and based in Lusaka, the capital of Zambia. It actively finances projects related to the development and installation of "water kiosks" in Lusaka's largest slum, Kanyama. These small kiosks are connected to the state-run piped water distribution system, allowing access to safe and clean drinking water for up to 1,200 local residents per unit, just for a very small financial contribution. "Water for Water" also provides a plumbing educational programme which trains the population and imparts basic skills for installing and repairing water pipes. It also teaches the residents the importance of using clean water for hygienic and health aspects.

ANDRITZ HYDRO decided in 2015 to support the Cameroonian Interprogress Foundation, providing local tribes in the arid northern part of the country with clean water and irrigation systems. The region only receives rain for two months a year. Depending on their needs, three Small and Medium Scale Enterprises (SMEs) received various materials such as pumps, irrigation systems, water pipes, wheel barrels, and shovels. The natives also received the appropriate training to maintain and repair this equipment. Through this support, ANDRITZ HYDRO hopes to strengthen the development of autonomy and to support the increase of economic growth in this region, especially regarding the production of vegetables for personal consumption or cattle breeding.

Of course, these single actions are like small drops of water in an ocean. However, ANDRITZ HYDRO strongly believes that raising the attention of employees, customers, and partners to the global need for clean water is important and may lead to further contributions to other charity projects throughout the continent.

Sanaga River near HPP Song Loulou

CAMEROON

POWER FOR A STRONG NATION

by Manuel Tricard
manuel.tricard@andritz.com

Cameroon enjoys fairly high political and social stability. This has resulted in the development of agriculture, roads, railways, and large petroleum and timber industries. Cameroon has had a decade of strong economic performance, its GDP growing at an average of 4% per year; one of the 10 highest in sub-Saharan Africa. The government has introduced a development plan for the electricity sector to be able to meet an energy target by 2035.

Cameroon has an immense hydropower potential of about 115,000 GWh/year, of which only about 4% has been developed so far. The total electricity consumption in 2015 was about 6,500 GWh, increasing by estimated 6.5% per year. The development of hydropower plants is crucial to meet this growing energy demand.

A lot of planning and feasibility study activities are ongoing throughout the country. More than 6,000 MW have been identified on the rich rivers and waterfalls, with the main focus is on the big rivers in the south of the country. There are plans to further develop the potential of the Sanaga River to increase the capacity of the two big plants already existing, another two-plant cascade with more than 400 MW on the Nyong River, and almost 300 MW on the Ntem River. The northeast of the country also offers opportunities for hydropower development. The impressive feasible hydropower potential of Cameroon offers a lot of opportunities for investments in the future, which will be facilitated by the Law Environment Act introduced in 2005.

Site visit at HPP Song Louou

Machine hall of HPP Edéa

ANDRITZ HYDRO

The activities of ANDRITZ HYDRO in Cameroon reach back to the 1950s. The company was involved in the two major hydropower projects in the country – HPP Edéa with 264 MW and HPP Song Loulou with 396 MW. A series of contracts for both hydropower plants were received, totaling in a delivered rehabilitated capacity of about 648 MW, representing almost 90% of the country's total.

Edéa hydropower scheme

The hydropower plant Edèa comprises three plants and is one of the three big hydropower schemes in Cameroon. It is located on the Sanaga River, the country's largest, around 60 kilometers from the city of Douala.

In 1953 the first two units with 11 MW each were commissioned. At the end of 1950s and again in the mid-1970s the capacity was extended to 14 units with 264 MW in total. ANDRITZ HYDRO was involved in the original installation of all three stages.

In 2008 the owner, AES Sonel, awarded ANDRITZ HYDRO an order for the rehabilitation of the three units at HPP Edéa I, comprising the replacement of the three Kaplan turbine generator sets, including electro- and hydro-mechanical equipment. The works could be successfully carried out within a 40-month schedule while output of the units #1 and #2 could be improved by 44%, and of unit #3 by 33%, increasing the total capacity by up to 16.4 MW.

HPP Song Loulou

The Song LouLou hydroelectric power plant, located on the Sanaga River upstream of HPP Edéa, comprises eight Francis turbine units with a total installed capacity of 396 MW. It was originally commissioned in two phases from 1981 to 1988. ANDRITZ HYDRO was essentially involved with the supply of the turbines, the governor systems and intake gates. Between 1999 and 2005, ANDRITZ HYDRO executed the complete rehabilitation of seven of these units, with an outage of just five months for the last unit.

In 2008, ANDRITZ HYDRO was awarded the contract for rehabilitation of penstocks #1 to #4, which were facing significant leakage. Replacement of the expansion joints was also executed on site, together with the pre-assembly of the steel structure and the installation of specific hoisting gear. The rehabilitation was performed in 22 months, two months ahead of the original contracted schedule.

ANDRITZ is also continuously supplying spare parts and services for maintenance (including frame contract agreements and replacement of speed governors) for both HPPs Edèa and Song Loulou.

CAMEROON FACTS

23.34 Mio.	Population
62%	Access to electricity
732 MW	Installed hydro capacity
256 MW	Hydro capacity under construction
59%	Share of generation from hydropower
3,900 GWh	Hydro generation
115,000 GWh	Technically feasible hydro generation potential

ANDRITZ HYDRO

648 MW	Installed capacity
20	Installed units
89.5%	Fleet share

The World Bank, IEA, World Energy Outlook, Hydropower & Dams World Atlas 2016

CORNU-COPIA OF AFRICA

DEMOCRATIC REPUBLIC OF CONGO

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“LARGEST hydro-power potential in Africa”

by Manuel Tricard
manuel.tricard@andritz.com

Extremely rich in natural resources, the Democratic Republic of Congo is the second largest country in Africa by area and the largest in Sub-Saharan Africa. After the peace accords in 2003, the government is implementing reforms and opening the country to international investors and companies and the country’s economy is slowly recovering.

The Congo River system dominates the region; its river basin occupies nearly the entire equatorial country collecting water from an area of nearly 3,700,000 km² (1,400,000 sq mi), an area larger than the whole of India. The Congo has the second-largest flow and the second-largest watershed of any river in the world, trailing the Amazon in both respects.

Since the end of World War II, some 100 medium-sized hydropower plants from 10 MW to 80 MW have been built throughout the country. There are only 16 dams in operation as of today, 12 owned by SNEL, the national utility. Only four are privately owned. The new framework for liberalization of the electricity sector could contribute to government plans to increase electricity access rate of the population in the coming years.

The DR Congo has the largest hydropower potential in Africa and one of the largest worldwide, with a technically feasible potential of some 100,000 MW. Only about 2.5% of this potential has been developed so far. More than 5,000 MW are in planning, including hydropower plants such as HPP Inga 3 (4,230 MW), HPP Luapula (900 MW), HPP Ruzizi 3 (147 MW) or HPP Nzilo 2 (120 MW) and HPP Busanga (240 MW).

Currently though, the main focus is on the Grand Inga scheme, for which studies and evaluations are ongoing. With a potential 40,000 MW, the scheme will play a crucial role in the electric power supply for the whole continent, enabling the DR Congo to export power to Egypt, as well as South Africa via long distance transmission lines.

ANDRITZ HYDRO

Since the first project, HPP Kalule in 1923, ANDRITZ HYDRO has been supplying equipment to the country for close to a century. Over this time it has delivered or rehabilitated more than 40 units with a total capacity of about 1,000 MW. This represents almost half of the DR Congo's hydro fleet. One of the projects recently awarded to ANDRITZ HYDRO is the refurbishment of HPP Mwadingusha in the Katanga Province (four Francis units with 11.8 MW each) financed by the Sino-Canadian mining company Ivanhoe. ANDRITZ is also heavily involved in offers for the electro-mechanical package of HPP Inga 3, with a capacity of 4,800 MW.

ANDRITZ HYDRO's focus is not only on the evaluation of this huge hydro market, but also on the development of public as well as private project partnerships. So, in 2013, the company decided to establish a permanent office in the capital Kinshasa to be able to better support the country in the development of this most promising potential for both, large and small hydropower schemes.

HPP Inga 2

HPP Inga 2, with 1,424 MW one of the largest hydropower plants in Africa, is situated close to the mouth of the Congo River about 300 km downstream of the capital Kinshasa. Built in the 1970s, with its eight 178 MW turbine units HPP Inga 2 will be a significant part of the further planned extensions of the Grand Inga scheme.

Congo River area surrounding HPP Inga 1 and HPP Inga 2

DR CONGO FACTS

77.27 Mio.	Population
18%	Access to electricity
2,600 MW	Installed hydro capacity
223 MW	Hydro capacity under construction
99%	Share of generation from hydropower
8,185 GWh	Hydro generation
100,000 MW	Technically feasible hydro generation potential

ANDRITZ HYDRO

1,130 MW	Installed capacity
56	Installed units
43.45%	Fleet share

The World Bank, IEA, World Energy Outlook, Hydropower & Dams World Atlas 2016

Project team HPP Koni

In 2012, ANDRITZ HYDRO was awarded a contract by the government to rehabilitate two units (unit#21 and #22) under World Bank financing. Contractual scope included repair and overhaul of the penstocks, hydraulic steelworks and the Francis turbines. Operations are expected to resume in 2017.

ANDRITZ HYDRO followed this in 2013, when it was awarded another contract to rehabilitate a further two units (unit#27 and #28). The project was financed by the Kamoto Copper Company (KCC), the local mining affiliate of Glencore. Scope of supply covers the complete replacement of the intake trash racks, speed governors, a rehabilitation of hydro-mechanical equipment and repair of the two penstocks. The project is scheduled to be completed by the end of 2019.

HPP Koni

HPP Koni

The Koni hydropower station, owned by SNEL (Société Nationale d'Électricité) is located in Kantanga Province. It has a total installed capacity of 42 MW and is equipped with three vertical Francis turbines. This project is supported by the private mining and funding partner ENRC PLC.

After being in operation for almost 60 years, the existing turbines, originally supplied by ANDRITZ HYDRO, reached the end of their lifetime and units #1 and #3 had to be put out of operation in 2010. ANDRITZ HYDRO received a contract for the replacement of the defective butterfly inlet valves in 2012. Unit #1 was successfully reconnected to the grid in 2015. On dismantling unit #3 it was discovered that more extensive repair work was necessary. ANDRITZ HYDRO is currently in charge of the rehabilitation of unit #3. Commissioning is planned for summer 2017.

Penstock HPP Inga 2

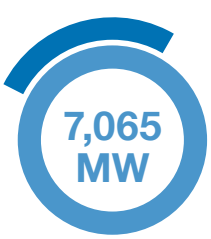
EAST AFRICA

POPULATION
301.9 Mio.

43% OF POPULATION HAVE ACCESS TO ELECTRICITY

549,218 GWh TECHNICALLY FEASIBLE HYDRO GENERATION POTENTIAL

1,811 MW
INSTALLED BY ANDRITZ HYDRO



TOTAL INSTALLED HYDRO CAPACITY

The region of East Africa encompasses following countries: Burundi, Djibouti, Eritrea, Ethiopia, Kenya, Mauritius, Réunion, Rwanda, Seychelles, Somalia, Tanzania, and Uganda.

The region is dominated by the Great Lakes, the Great Rift Valley and the Nile Basin. It includes also islands like Mauritius, Réunion and the Seychelles in the Indian Ocean. Ethiopia is a fast growing economy and Kenya has the largest economy in East Africa; Tanzania or Uganda are rebounding after economic crisis.

Ethiopia shows the largest hydropower potential of 260,000; followed by Kenya with 40,000 GWh. Several countries in the region jointly share the electricity generated by some hydropower stations. The power generation of HPP Ruzizi I and II are shared between Rwanda, Burundi and DR Congo. The planned HPP Rusumo Falls will benefit Rwanda, Burundi as well as Tanzania.

A reformed energy policy and increase of investments result in development of new hydropower schemes or the rehabilitation of existing ones expanding people's access rate to electricity which is not very high in most countries. This furthermore means a boost to large, medium and small economies and better farming thus higher economic growth rates.

ANDRITZ HYDRO

Since almost 100 years ANDRITZ HYDRO is present in East Africa. More than 80 units with a total capacity of about 1,800 MW proof the strong presence in this diverse region. ANDRITZ HYDRO was involved in important projects such as HPP Mtera in Tanzania, HPP Owen Falls in Uganda, HPP Ruzizi II in Rwanda, HPP Beles and HPP Gigel Gibe in Ethiopia, and HPP Kindaruma in Kenya. Recent projects in Kenya were HPPs Lower Nyamindi, South Mara, and North Mathioya.

HPP Nkusi, Uganda

End 2016, ANDRITZ HYDRO received a contract for a "from water-to-wire" package for the new 9.6 MW Nkusi hydropower plant in Uganda.

The project site is along Lake Albert in western Uganda, approximately 230 km west of Kampala. The scope of supply comprises supply, installation supervision, and commissioning of two horizontal Francis turbines including the upstream manifold, generators and additional equipment and installation up to the 33 kV switchgear. The HPP Nkusi project is scheduled to be completed by mid-2018.

20,935 GWh
HYDRO GENERATION

7,411 MW
HYDRO CAPACITY UNDER CONSTRUCTION

84 UNITS INSTALLED BY ANDRITZ HYDRO

TANZANIA
OF LAKES AND ANIMALS

by Martin Koubek
martin.koubek@andritz.com

Tanzania is a mountainous and densely forested country. Majestic Mount Kilimanjaro is located in the northeast. Three of Africa's Great Lakes are partly within Tanzania - Lake Victoria, Africa's largest lake, Lake Tanganyika, the continent's deepest lake, and Lake Nyasa. The Kalambo waterfalls are the second highest uninterrupted falls in Africa and are also to be found in the country.

Tanzania is a middle-power country, the economy has expanded over the last decade thanks to strong tourism, investments in telecommunications, and a growing banking sector. About 30% of Tanzanians have access to electricity. With 717 MW of hydropower capacity installed, some 15% of the country's total economically feasible hydropower potential - equivalent to 4,700 MW - has been developed to date.

The government has announced an Electricity Sector Reform Strategy and Roadmap to introduce a legal and regulatory framework for the development of power generating projects. A shortfall in generating capacity, the need to boost the economy, especially the mining sector, and to expand rural electrification has led to increased investment.

ANDRITZ HYDRO

ANDRITZ HYDRO has installed almost half of the total installed hydro capacity in Tanzania. As far back as 1930, ANDRITZ HYDRO supplied electro-mechanical equipment to Tanzania. The company was involved in some of the major projects in the country, such as HPP Kishani (180 MW), HPP Mtera (80 MW), and HPP Pangani Falls (68 MW).

HPP Rusumo Falls

At the end of 2016, ANDRITZ HYDRO signed a contract with Rusumo Power Company Ltd for the design, supply, installation, and commissioning of electro-mechanical equipment for the Rusumo Falls Hydroelectric Project. Located on Kagera River, about 2 km downstream of the confluence of the rivers Ruvubu and Kagera at the border with Rwanda, the project is a joint development together with Burundi and Rwanda.

ANDRITZ HYDRO's scope of supply comprises the delivery of three 27.5 MW vertical Kaplan turbines and auxiliaries, generators, Electrical Power System (EPS), powerhouse cranes, draft tube gates and stop logs, as well as the control and protection system of the whole power plant. Completion of the project is planned for the end of 2019.

TANZANIA FACTS

53.47 Mio.	Population
30%	Access to electricity
717 MW	Installed hydro capacity
0 MW	Hydro capacity under construction
52%	Share of generation from hydropower
1.800 GWh	Hydro generation
20,000 GWh	Technically feasible hydro generation potential

ANDRITZ HYDRO

328 MW	Installed capacity
10	Installed units
45.75%	Fleet share

The World Bank, IEA, World Energy Outlook, Hydropower & Dams World Atlas 2016

KENYA
BOOSTING THE ECONOMY

KENYA FACTS

46.05 Mio.	Population
20%	Access to electricity
820 MW	Installed hydro capacity
0 MW	Hydro capacity under construction
43%	Share of generation from hydropower
3,308 GWh	Hydro generation
40,000 GWh	Technically feasible hydro generation potential

ANDRITZ HYDRO

113 MW	Installed capacity
8	Installed units
13.88%	Fleet share

The World Bank, IEA, World Energy Outlook, Hydropower & Dams World Atlas 2016

by Martin Koubek
martin.koubek@andritz.com

ANDRITZ HYDRO

ANDRITZ HYDRO's activities in Kenya reach back to the 1960s, when the company was involved in the initial installation of HPP Kindaruma (72 MW). In 2010, ANDRITZ HYDRO received the order for the rehabilitation of this hydropower plant, which was successfully re-commissioned in 2013. Other projects, such as HPP Masinga and the most recent order for HPP North Mathoyia, further strengthen the position of ANDRITZ HYDRO in Kenya.

HPP Lower Nyamindi and HPP South Mara

The general EPC contractor JIANGXI Water and Hydropower Construction Kenya Ltd. awarded ANDRITZ HYDRO with another two contracts to supply the complete electro-mechanical equipment, including two 930 kW Compact Francis turbines for HPP Lower Nyamindi and one 2,200 kW six-jet vertical Compact Pelton turbine for HPP South Mara.

The two small hydropower plants were developed as pilot projects to generate power for the Kenya Tea Development Agency (KTDA). Commissioning of both hydropower projects, which further secure independent electrical energy supply from two more installations under the management of KTDA Power Company, took place in August 2016.

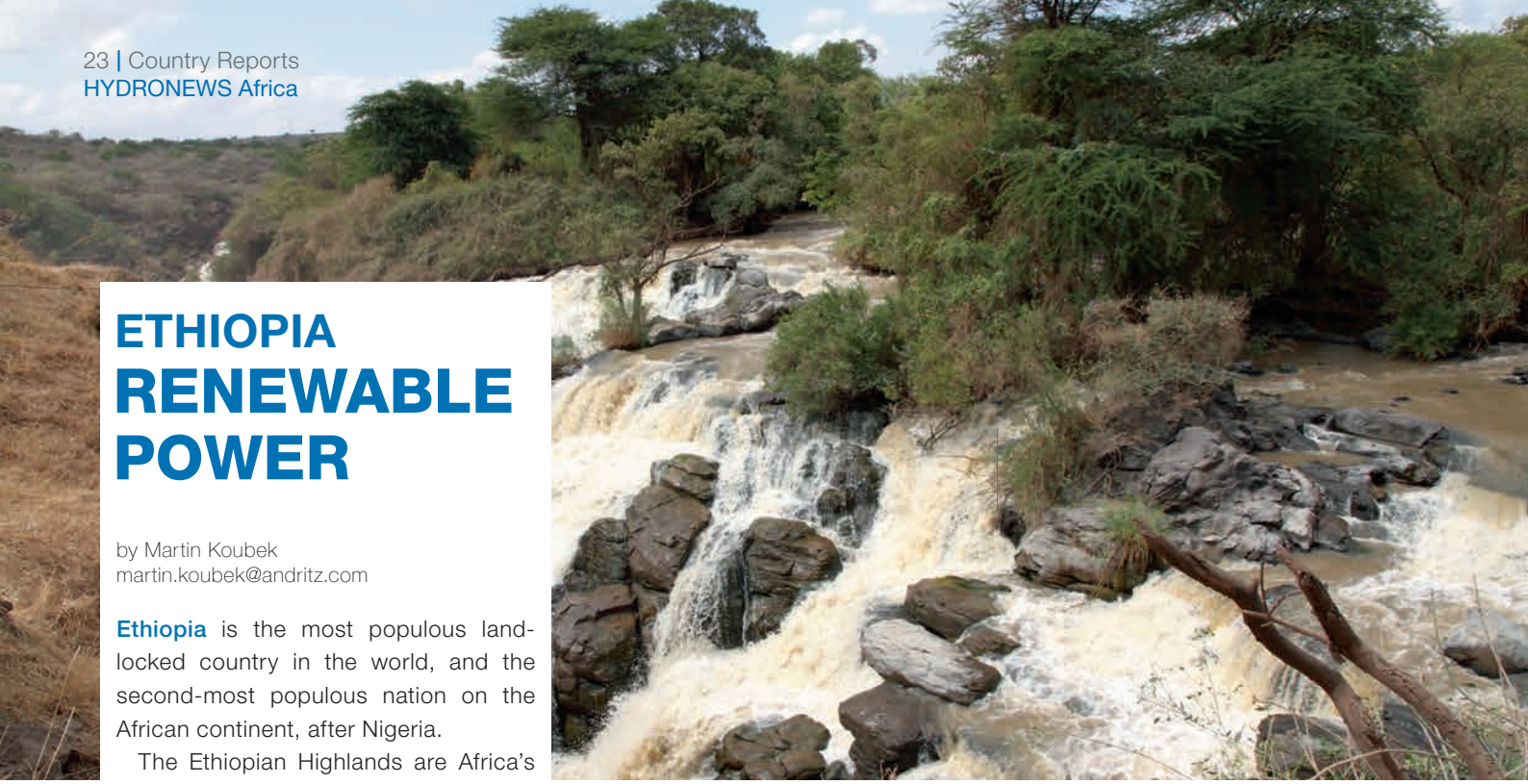
Kenya is part of the African Great Lakes region and well-known for its safaris, diverse climate and geography, as well as expansive wildlife reserves. The economy of Kenya is the largest in East and Central Africa and has grown over the last seven years.

Only about 20% of the population has access to electricity. The country's technically feasible hydropower potential is about 3,500 MW, though not even a quarter of that has been developed.

There are no hydropower schemes currently under construction, but several in planning, such as The High Land Falls scheme with 700 MW or HPP Karura, both on the Tana River. An additional 120 MW could be achieved by modernization and upgrading of existing facilities. There is also the potential for several small-scale hydropower plants.

The government has a national energy strategy to boost the economy with the development of more hydropower.

On-site HPP Kindaruma



ETHIOPIA RENEWABLE POWER

by Martin Koubek
martin.koubek@andritz.com

Area surrounding HPP Beles

Ethiopia is the most populous landlocked country in the world, and the second-most populous nation on the African continent, after Nigeria.

The Ethiopian Highlands are Africa's largest continuous mountain range. Ethiopia is often referred to as the "water tower" of Africa because of its abundant water resources, the greatest in the whole of Africa. More than 30 rivers originate in the Great Plateau, 14 major rivers pour off the high tableland. It also has the greatest water reserves in Africa. Among the numerous lakes, Lake Tana in the north is the source of the Blue Nile.

According to the International Monetary Fund (IMF), at one time Ethiopia had one of the fastest growing economies in the world, but despite this it contends with poorness. The economy faces a number of serious problems, which are addressed with a focused investment in public infrastructure and industrial parks. The economy's progress is highly dependent on the development of the nations' hydro resources. Only 25% of the population has access to electricity today and the government plans to increase this up to 75% within the next five years.

Ethiopia has the second largest hydropower potential in Africa, with only 10% developed to date but nonetheless covering 90% of the nation's electricity demand. Currently, installed capacity is about 4,330 MW of hydro, but more than 6,600 MW are under construction. By 2020, about 14,000 MW could be in operation. Besides hydro, also geothermal energy and wind are going to be intensively developped.

Already supplying power to the neighboring countries of Djibouti and Sudan, Ethiopia has further ambitious plans to connect East Africa with Southern Africa via a powerful transmission line. The first step is a 500 kV transmission line to Kenya and further agreements with Somali have been signed and negotiations with Tanzania completed.

ANDRITZ HYDRO

ANDRITZ HYDRO's activities in Ethiopia reach back into the 1960s, when the company was involved in generator deliveries for HPP Awash I and II. Over the years ANDRITZ HYDRO has delivered equipment for several major hydropower plants, delivering a quarter of the country's hydro capacity. Projects like Gigel Gibe or Beles are important references.

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ETHIOPIA FACTS

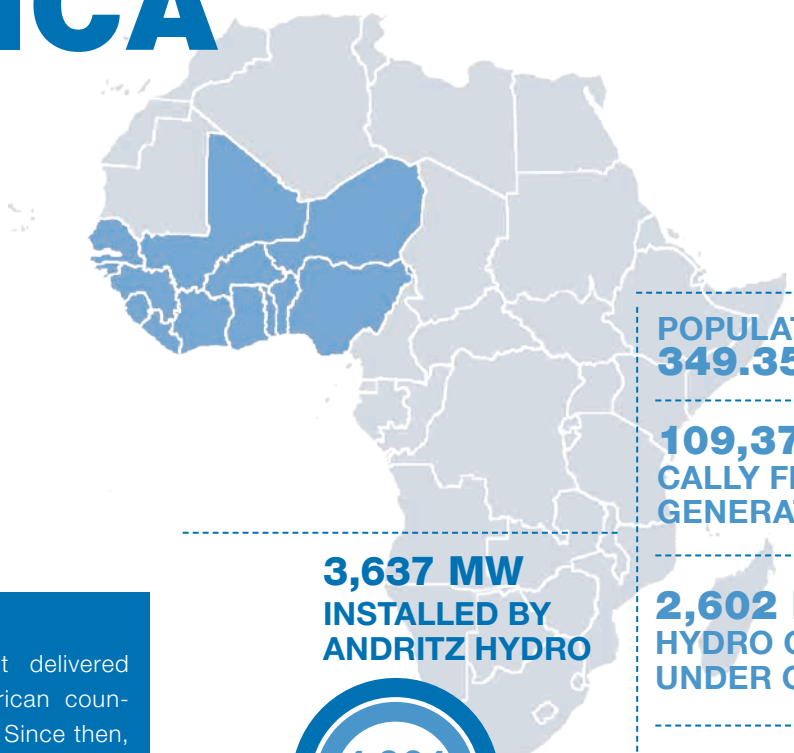
99.39 Mio.	Population
25%	Access to electricity
4,330 MW	Installed hydro capacity
6,600 MW	Hydro capacity under construction
90%	Share of generation from hydropower
11,000 GWh	Hydro generation
260,000 GWh	Technically feasible hydro generation potential

ANDRITZ HYDRO

1,004 MW	Installed capacity
18	Installed units
23.19%	Fleet share

The World Bank, IEA, World Energy Outlook, Hydropower & Dams World Atlas 2016

WEST AFRICA



POPULATION
349.35 Mio.

109,371 GWh TECHNICALLY FEASIBLE HYDRO GENERATION POTENTIAL

3,637 MW
INSTALLED BY ANDRITZ HYDRO

2,602 MW
HYDRO CAPACITY UNDER CONSTRUCTION

4,964 MW
TOTAL INSTALLED HYDRO CAPACITY

939 GWh
HYDRO GENERATION

74 UNITS INSTALLED BY ANDRITZ HYDRO

ANDRITZ HYDRO
ANDRITZ HYDRO first delivered equipment to West African countries in the early 1950s. Since then, more than 70 units with a total output of about 3,600 MW have been delivered to the region. The company was involved in West Africa's most important hydropower projects, such as HPP Akosombo and Kpong in Ghana, HPP Kainji and Shiroro in Nigeria, HPP Taabo, Ayamé and San Pedro in Côte d'Ivoire, HPP Bagré in Burkina Faso, HPP Garafiri and Banea in Guinea Conakry, and HPP Contador – the only hydropower plant in São Tomé & Principe. One recent project was HPP Mount Coffee in Liberia, for which ANDRITZ HYDRO rehabilitated the hydraulic steelworks. In Senegal and Togo ANDRITZ HYDRO has supplied almost 100% of the hydropower fleet. In countries like Nigeria, Ghana and Mali, the company has supplied more than 60% of the total installed hydropower capacity.

Reaching from the dry Sahara in Mali and Niger to the sub-tropical rainforest on the Atlantic coast, the region of West Africa encompasses 16 countries. They are: Benin, Burkina Faso, Cape Verde, Cote d'Ivoire, Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Niger, Nigeria, São Tomé & Principe, Senegal, Sierra Leone, and Togo.

In 2015, the region was struck by the Ebola crisis, causing a halt in economic progress. The economic outlook is nonetheless promising. West Africa has managed to maintain an impressive growth rate in recent years, in particular driven by the largest economy in Africa, Nigeria, and Ghana, one of the strongest economies in the whole of Africa.

Given the wide climate variation across the West African countries, hydropower also exhibits a wide range of national potentials. Guinea-Bissau has a hydropower potential of only about 500 GWh/year, for example, while coun tries such as Benin or Togo have around 1,700 GWh/year, and Nigeria has an identified potential of an impressive 32,450 GWh/year.

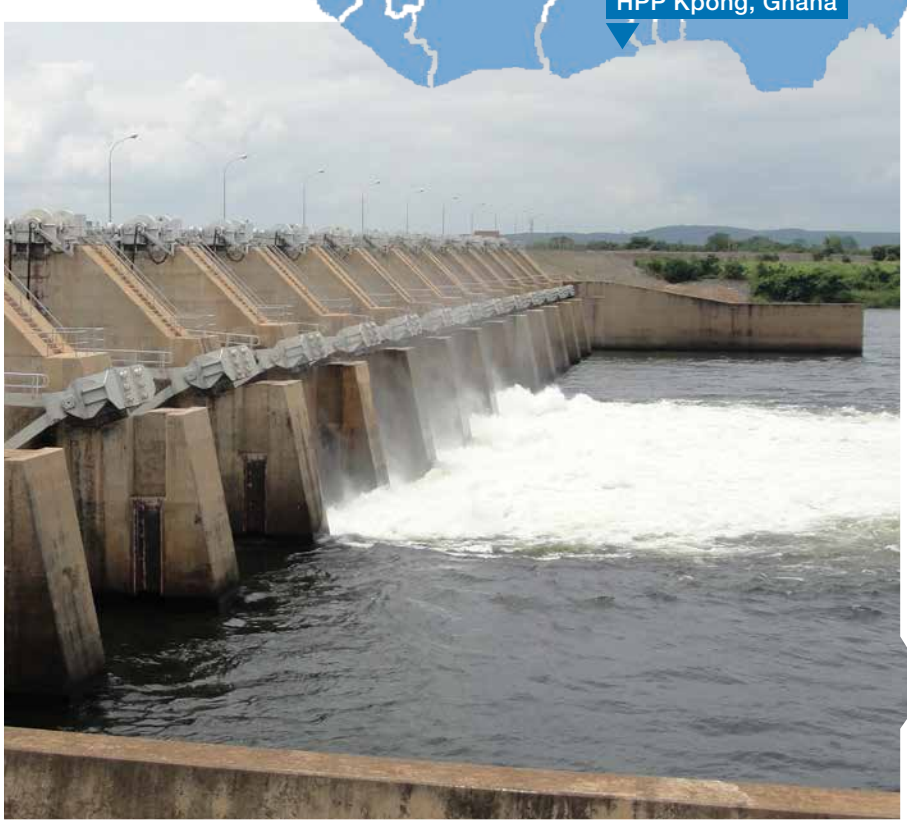
The region offers interesting possibilities for large hydropower projects as well as small hydro developments.

HPP Manantali, Mali

In 2014, ANDRITZ HYDRO signed a contract with La Société de Gestion de l'Energie de Manantali (SOGEM) to perform the overhaul and update of five 41 MW generating units at the Manantali hydropower plant in the Republic of Mali.

All five Kaplan turbines were commissioned in 2002. Since 2013 units #2, #3 and #4 experienced successive failures of their blades internal control mechanism, so SOGEM called for an international tender for the repair and general ten year overhaul of all five units.

ANDRITZ HYDRO as the original turbine manufacturer (OEM) offered the technologically and economically best offer. Finalization of the project is scheduled for late 2017 and will benefit the populations of Senegal, Mauritania and Mali for years to come.



HPP Kpong, Ghana

In 2013 ANDRITZ HYDRO signed a contract with Volta River Authority for the four 40 MW Kpong retrofit project on the Volta River, the second largest hydroelectric dam in Ghana, covering about 12% of the country's electricity production.

ANDRITZ HYDRO will supply design, manufacturing, delivery, erection, and testing as well the commissioning of electrical and mechanical equipment including generators and excitation equipment, turbine and auxiliary equipment, governors, generator transformer, powerhouse station service facilities as well as hydro-mechanical equipment.

The first unit was successfully handed over to the customer in August 2016. The second unit is in the refurbishment and installation phase; commissioning is scheduled for mid-2017. The two further units will follow subsequently.

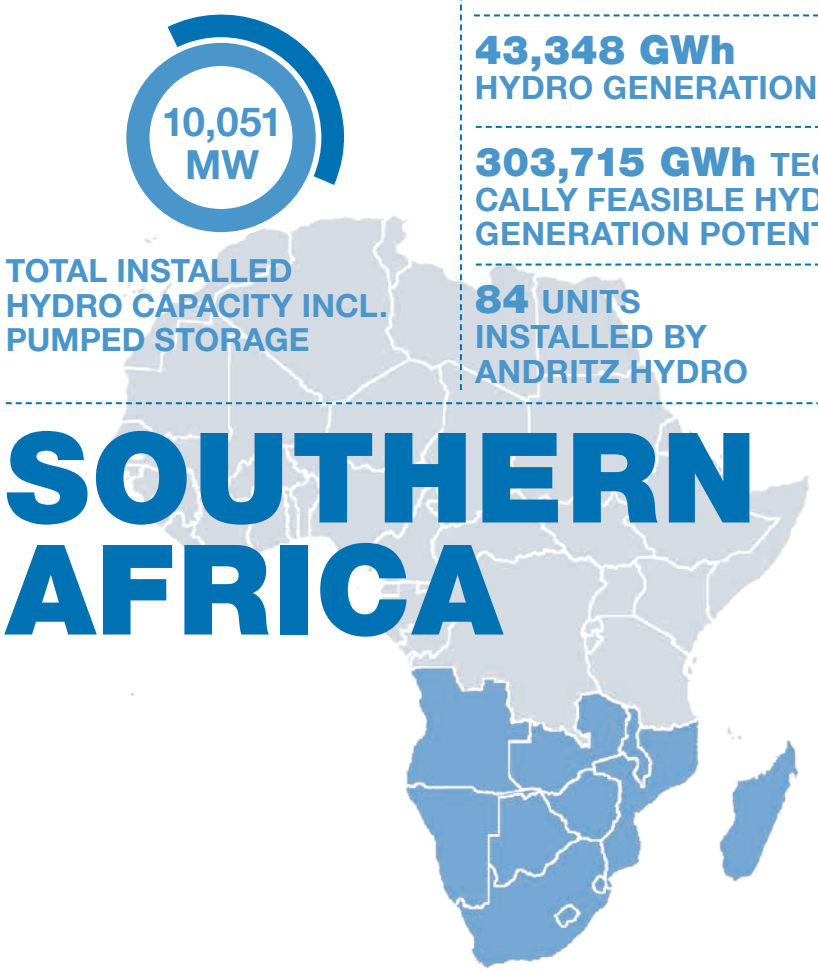
POPULATION
165.13 Mio.

3,860 MW
INSTALLED BY ANDRITZ HYDRO

3,921 MW
HYDRO CAPACITY UNDER CONSTRUCTION

43,348 GWh
HYDRO GENERATION

303,715 GWh TECHNICALLY FEASIBLE HYDRO GENERATION POTENTIAL



TOTAL INSTALLED HYDRO CAPACITY INCL. PUMPED STORAGE

84 UNITS INSTALLED BY ANDRITZ HYDRO

SOUTHERN AFRICA

The region of Southern Africa encompasses the following countries: Angola, Lesotho, Madagascar, Malawi, Mozambique, Namibia, South Africa, Swaziland, Zambia, and Zimbabwe.

Countries in this region are mostly stable and middle-income. Vast abundancies of minerals like gold, platinum, uranium, copper, and diamonds identify the economies, besides agriculture and subsistence farming. As the most industrialized country, South Africa is economically dominant in the region, but countries such as Zambia and Botswana have fast growing economies and add to regional stability. The drought over recent years has caused a decline in the economy, but the prospects are nonetheless promising.

Angola, with a technically feasible hydropower potential of about 150,000 GWh, has a leading role in the development of hydropower in Southern Africa. Madagascar shows promising 180,000 GWh. Zambia with its numerous rivers has a potential of about 68,000 GWh. Mozambique further represents encouraging 37,647 GWh. In Zambia, about 775 MW of capacity are under construction and there is a strong focus on rehabilitation of existing facilities. In Zimbabwe, which has a potential of more than 17,000 GWh, some major projects are planned in cooperation with Zambia. Also, more than 100 MW of small hydro schemes have been identified. In Lesotho a feasibility study on a pumped storage plant is underway.

ANDRITZ HYDRO

ANDRITZ HYDRO can look back on more than 100 years of business in the Southern African region. The company has had a local company operating in South Africa since 1979 and was involved in major projects throughout the region, including; HPP Muela in Lesotho, PSPP Steenbras and PSPP Drakensberg in South Africa, HPP Kafue Gorge and HPP Kariba in Zambia, HPP Ruacana in Namibia, HPP Laùca and HPP Cambambe in Angola, as well as all the significant hydropower plants in Malawi.

HPP Ruacana, Namibia

HPP Ruacana is situated on the Kunene River and was originally commissioned in 1978. ANDRITZ HYDRO was the original equipment manufacturer (OEM). The underground power plant consists of four Francis turbines with a total installed capacity of 330 MW. In 2009, the fourth unit was delivered and installed; rehabilitation of units #1–#3 was completed during 2015 and the power plant successfully recommissioned.

MOZAMBIQUE
POWER-UP GROWTH

ANDRITZ HYDRO
ANDRITZ HYDRO has almost 70 years of experience in the Mozambican hydropower market. First equipment deliveries were executed in the late 1940s at HPP Mawusi. Since then, ANDRITZ HYDRO has equipped a number of small hydropower plants. The latest developments pose interesting possibilities to improve the presence of ANDRITZ HYDRO in Mozambique and to support the country in the development of its promising hydropower potential.

by Wilhelm Karanitsch
wilhelm.karanitsch@andritz.com

and Martin Koubek
martin.koubek@andritz.com

Mozambique is a success story in Sub-Saharan Africa. The country's economy is based mainly on agriculture but a growing industrial sector has seen manufacturing operations, light engineering, food industries, textiles, and a number of other industries established. Over the last decade national GDP has increased by a factor of eight, one of Africa's strongest performances, although the country is still among the poorest of the world. To attract further large investment projects in natural resources and to keep high growth rates, reforms to stabilize the economy were introduced by the government.

Mozambique has a technically feasible hydropower potential of about 37,647 GWh/year, equivalent to around 6,600 MW of installed capacity. Some 92% of the country's current electricity demand is covered by hydropower. Access to electricity has tripled over the last decade, with up to 40% of the population having mains supply, and electricity demand is expected to increase by 8–10% within the next decade.

With a capacity of about 2,185 MW, only a third of the hydro potential has been developed so far but more than 4,000 MW are in the feasibility study phase. There are plans to build more than 3,400 MW of new hydropower facilities, most of them in the Zambezi River valley. HPP Mphanda Nkuwa with 1,500 MW and the 1,245 MW extension of the Cahora Bassa hydropower station are among these projects.

Small hydro is also an interesting solution for the supply of the mostly small-scale farming economy in Mozambique with affordable and reliable power. About 3,000 MW of additional small hydropower plants could be developed throughout the country.

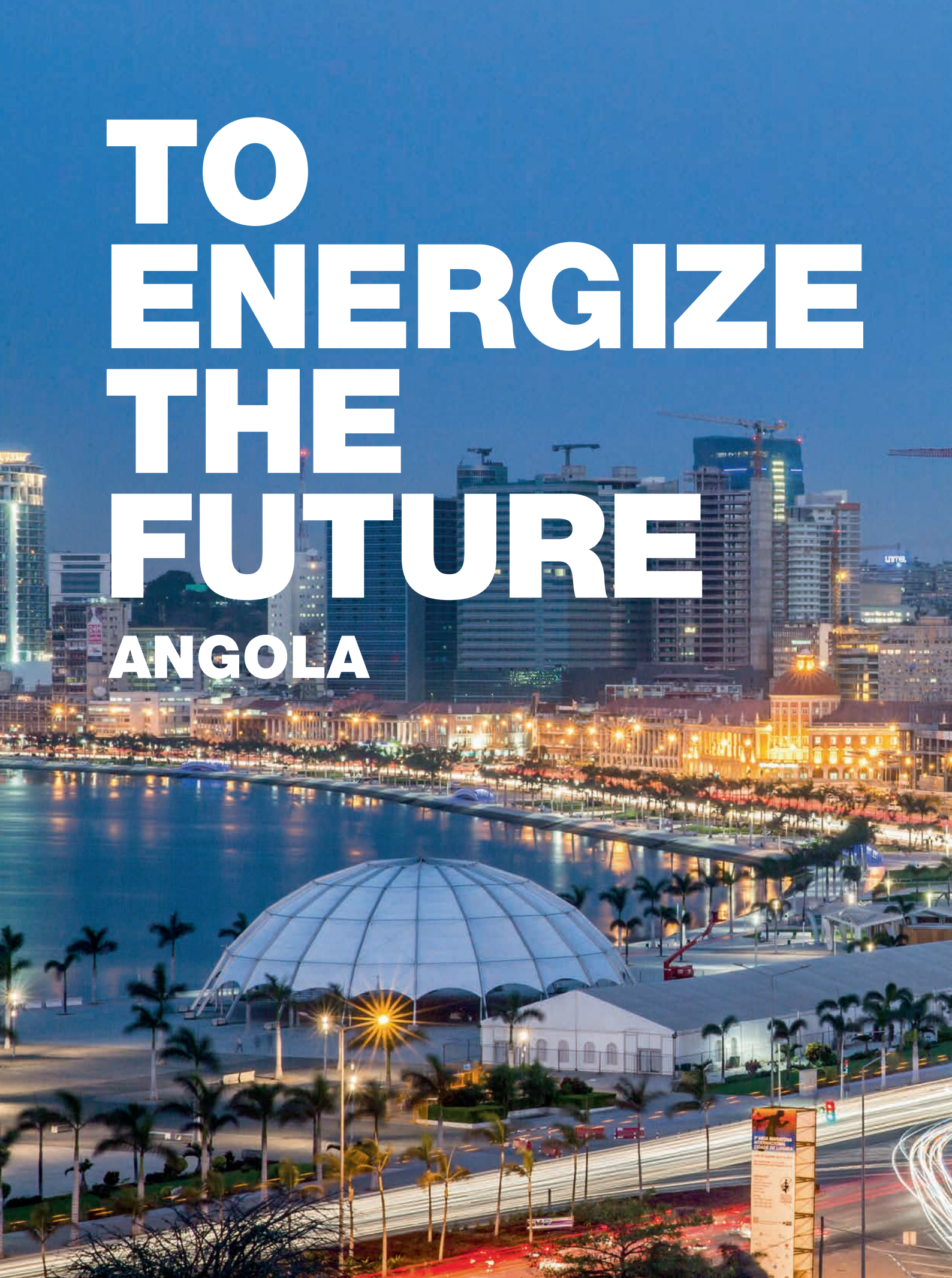
MOZAMBIQUE FACTS

27.98 Mio.	Population
40%	Access to electricity
2,185 MW	Installed hydro capacity
35 MW	Hydro capacity under construction
92%	Share of generation from hydropower
15,398 GWh	Hydro generation
37,647 GWh	Technically feasible hydro generation potential

ANDRITZ HYDRO

11.3 MW	Installed capacity
7	Installed units
0.54%	Fleet share

The World Bank, IEA, World Energy Outlook, Hydropower & Dams World Atlas 2016



TO ENERGIZE THE FUTURE

ANGOLA

Site works machine hall HPP Laúca

by Wilhelm Karanitsch
wilhelm.karanitsch@andritz.com

Depending mainly on oil and diamonds, Angola has one of the fastest growing economies in the world. In the last 15 years the country has significantly improved its financial status, infrastructure and living standards. There is a huge demand for electricity due to rapid urbanization and population growth, especially in the capital city of Luanda. Currently only about 33% of the population has access to electricity.

Angola's government plans to increase the electrification rate up to 60% by 2025, investing billions in the energy sector to construct new power stations, transmission and distribution networks and to rehabilitate existing facilities. Angola not only wants to improve its energy supply, but also to become an electricity exporting country in the Southern African Development Community (SADAC).

A special focus is on energy production from hydropower – there is an estimated potential of about 150,000 GWh/year corresponding to an impressive installed capacity of about 18,000 MW. Only some 4% of this hydropower potential has been tapped so far.

Angola has already defined potential hydropower projects in the three main river basins – the Cuanza River in the north, Catumbela River in central Angola and Cunene River in the south. In the coming years it is expected that the power production capacity will be increased from the existing 1,528 MW up to about 5,000 MW. Angola is also planning to open up the energy market for private investors in the near future, especially with regard to smaller hydropower projects.

ANDRITZ HYDRO

ANDRITZ HYDRO has been active in Angola since the 1950s, supplying equipment for HPP Cambambe (272 MW), HPP Matala (42.63 MW), HPP Neuville (38.6 MW), and numerous small hydropower plants. ANDRITZ HYDRO is ready and looking forward to support Angola in its extensive plan to develop its promising hydropower potential.

Lowering rotor unit #1 HPPLaúca

Areal view of HPP Laúca site

Francis turbine for HPP Laúca

HPP Laúca

In 2014, ANDRITZ HYDRO received a contract to supply the electro-mechanical equipment for HPP Laúca, a new hydropower plant located in the middle part of the Kwanza River. The project consists of a main power house with six units and an eco-power house with one unit. Total capacity of HPP Laúca will be 2,070 MW with a head of about 200 m. It will supply renewable energy to meet the rapidly growing demand of the capital Luanda.

The scope of supply for ANDRITZ HYDRO includes design, supply, installation supervision, and commissioning of the Francis turbines, generators, main transformers, isolated bus ducts, control and protection system, as well as the security, access control and telecommunication systems for the above mentioned main and eco-power houses. The project is in the main installation phase. The rotor of the first unit was lifted into position in December 2016; the commissioning period has started in the meantime.

At HPP Laúca several social activities are taking place, e.g. a permanent training center was established directly on site, where currently 85 people are being trained. ANDRITZ HYDRO has supplied the equipment for three labs of this training center. The objective is to prepare technicians for operation and maintenance of HPP Laúca and for future projects of power generation and transmission in Angola.

HPP Luachimo

In March 2017, ANDRITZ HYDRO was awarded the contract to supply the complete turbine equipment for the new Luachimo hydropower plant, located on the Luachimo River, near Dundo village, Lunda-North Province. The general scope comprises the construction of a complete new 36 MW powerhouse next to the old power station. ANDRITZ HYDRO will supply four horizontal Compact Axial Turbines (CAT), four hydraulic power units, the sealing and lubricating water supply systems, and the turbine governors. Transportation up to site, installation and the commissioning are completing the contractual scope. The commercial operation of the new hydropower plant will start in June 2019.

ANGOLA FACTS

25.02 Mio.	Population
33%	Access to electricity
1,578 MW	Installed hydro capacity
2,784 MW	Hydro capacity under construction
70%	Share of generation from hydropower
4,000 GWh	Hydro generation
150,000 GWh	Technically feasible hydro generation potential

ANDRITZ HYDRO

368 MW	Installed capacity
18	Installed units
23.35%	Fleet share

The World Bank, IEA, World Energy Outlook, Hydropower & Dams World Atlas 2016

MALAWI
ROAD TO ELECTRI-FICATION

HPP Nkula A

MALAWI FACTS

17.22 Mio.	Population
12%	Access to electricity
352 MW	Installed hydro capacity
22 MW	Hydro capacity under construction
99.9%	Share of generation from hydropower
1,905 GWh	Hydro generation
6,000 GWh	Technically feasible hydro generation potential

ANDRITZ HYDRO

110 MW	Installed capacity
9	Installed units
31.25%	Fleet share

The World Bank, IEA, World Energy Outlook, Hydropower & Dams World Atlas 2016

by Wilhelm Karanitsch
wilhelm.karanitsch@andritz.com

Landlocked Malawi is one of the most densely populated countries in the world. The economy is mostly agricultural with about 80% of the population living in rural areas. The Malawian government has introduced several programs to boost the economy.

Only about 12% of the population has access to electricity today. It is planned to increase this to 17% by 2020. A process to deregulate the energy sector to allow independent power producers is ongoing. The objective is to attract private investors to increase electricity production from 1,900 GWh to 3,580 GWh within the next decade. Some 6,000 GWh/year of technically feasible hydropower potential has been identified. Impressively, almost 100% of Malawi's power generation comes from hydropower.

ANDRITZ HDRO in Malawi

First contracts in Malawi date back to the early 1970s. ANDRITZ HYDRO delivered the complete electro-mechanical equipment for the Tedzani I, II and III hydropower plants on the Shire River, as well as for HPP Wovwe. For the Nukla B and Kapichira hydropower plants, also on the Shire River, ANDRITZ HYDRO delivered some hydro-mechanical equipment.

HPP Tedzani III

In 2016, the Electricity Supply Corporation of Malawi Limited (ESCOM) and ANDRITZ HYDRO signed a contract for rehabilitation, modernization and upgrading of the 51 MW Tedzani III hydropower station. ANDRITZ HYDRO is responsible for a new control and SCADA system, new excitation, protection and synchronisation systems, as well as repair and replacement works on turbines and generators.

HPP Nkula A

A contract to rehabilitate and upgrade the 24 MW Nkula A hydropower station to 35.1 MW was awarded to ANDRITZ HYDRO, as leader of a consortium, by the Millennium Challenge Account – Malawi (MCAM). The scope of supply for ANDRITZ HYDRO includes modernization of intake and draft tube gates, penstocks, installation of new turbine runners, new generators, mechanical and electrical auxiliary systems, as well as a new high voltage hybrid switch gear, and SCADA system. HPP Nkula A is expected to resume operations in mid-2018.

Recently, a further contract for a Generation Control & Monitoring System was awarded to ANDRITZ HYDRO.

MADAGASCAR
A BRIGHT FUTURE FOR THE ISLAND

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MALAWI FACTS

24.24 Mio.	Population
13%	Access to electricity
162 MW	Installed hydro capacity
0 MW	Hydro capacity under construction
61%	Share of generation from hydropower
884 GWh	Hydro generation
180,000 GWh	Technically feasible hydro generation potential

ANDRITZ HYDRO

105 MW	Installed capacity
20	Installed units
65.37%	Fleet share

The World Bank, IEA, World Energy Outlook, Hydropower & Dams World Atlas 2016

by Wilhelm Karanitsch
wilhelm.karanitsch@andritz.com

Madagascar is an island country in the Indian Ocean off the coast of Southeast Africa. The main island is the world's fourth-largest. Madagascar suffers from a slow economy. Tourism and agriculture, together with big investments in education, health, and private enterprise are essential to the government's development strategy. In recent years, these investments have produced some substantial economic growth.

Madagascar has a technically feasible hydropower potential of about 180,000 GWh. Less than 1% has been developed so far, with 162 MW of installed hydro capacity producing 61% of the nations' electricity.

In 2016, the government introduced the "New Programme for Energy" to increase generation capacity and therefore boost hydropower development. Under this premise three major sites for hydropower schemes have been identified with a total capacity of more than 500 MW. One project – HPP Sahofiaka on the Onive River – could already be contracted. For HPP Volobe Upstream on the Irondro River and HPP Antetezambato on the Mania River the bidding processes are ongoing. A further 13 small hydropower sites have been identified, seven at less than 15 MW.

ANDRITZ HYDRO

Since beginning of the 20th century ANDRITZ HYDRO has delivered or rehabilitated 20 units for Madagascar, representing 65% of the nation's total installed capacity. Hydropower plants such as HPP Mandraka, HPP Antelomita, and HPP Volobe are part of ANDRITZ HYDRO's reference list.

In 2016, BETC Nanala, a Malagasy-owned developer, awarded three contracts to ANDRITZ HYDRO for the supply design, manufacturing, delivery, installation supervision, and commissioning supervision for HPP Maheriara (one 750 kW Francis unit), HPP Androkabe (two 800 kW Francis units), and HPP Ambatomanoina (two 50 kW Banki units).

ANDRITZ HYDRO is also involved in several operational projects for rural electrification.

ENLIGHT THE RAINBOW NATION

SOUTH AFRICA

by Wilhelm Karanitsch
wilhelm.karanitsch@andritz.com

South Africa is the most industrialized nation in Africa with an abundant supply of natural resources. The country has well-developed financial, legal, communications, energy, and transport sectors and a stock exchange that is Africa's largest and one of the top 20 in the world. Economic growth has decelerated in recent years, but South Africa still has the second largest economy in Africa, after Nigeria.

Drakensberg

The technically feasible hydropower potential of South Africa is about 14,000 GWh/year, of which about 90% has already been developed. 3,586 MW of hydropower including 2,832 MW of pumped storage capacity produce some 4,750 GWh of electrical energy per year, about 2% of national supply. Feasibility studies for new pumped storage power are now ready and some 100 MW of small hydropower could also be developed.

Furthermore, there is the potential to harness marine energy along the coast; for wave power in the south and southwest, and for current tidal turbines in the east.

HPP Palmiet

ANDRITZ HYDRO

ANDRITZ HYDRO has a long history in South Africa, with a local company operating from Johannesburg since 1979. More than 750 MW have been delivered to the country to date and the company was involved in major hydropower projects, such as PSPP Drakensberg, PSPP Steenbras and HPP Vanderkloof.

ANDRITZ HYDRO has a partnering contract with national utility Eskom for replacement of the control systems in their hydropower plants. Under the frame of this contract ANDRITZ HYDRO is currently executing the order for the 400 MW Palmiet pumped storage power plant.

Power Recovery Turbines in Mines

About 18% of the electricity demand in South Africa comes from the mining industry. Exploitation of minerals such as gold and platinum from deep mines require large volumes of cooling water as temperatures in the working areas can exceed 40°C. To reduce the temperature, cooling water from a central refrigeration plant at the surface is brought down to depths of about 3,000 m. The warmed water is then pumped up to the refrigeration plant for re-cooling, a process which requires about 14% of the overall electricity demand of the mine. Energy costs and friction losses can be partly compensated for by the installation of power recovery turbines. ANDRITZ HYDRO has already installed more than 50 underground energy recovery turbines with a total capacity of over 80 MW in various mines in South Africa.

HPP Stortemelk

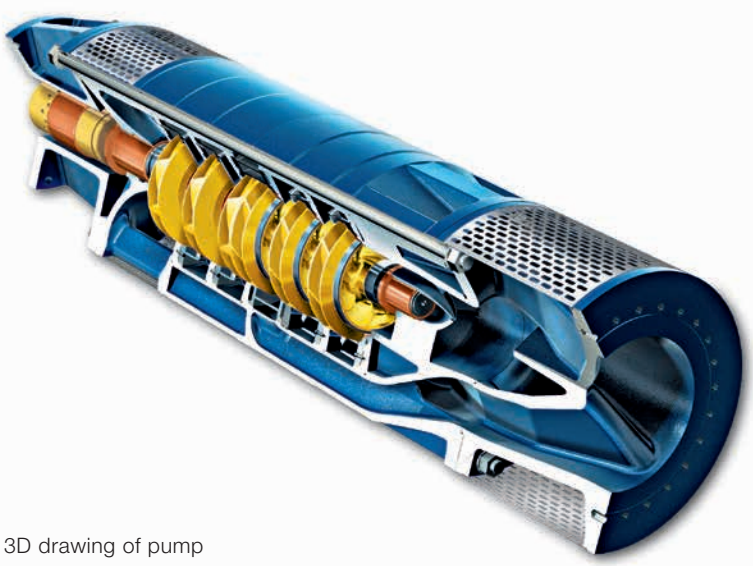
Autumn 2016 saw the Preliminary Acceptance Certificate (PAC) signed for the new hydropower plant Stortemelk. Developed for the customer Stortemelk Hydro (RF) (Pty) Ltd. by Renewable Energy Holdings (REH), Stortemelk is located near the town of Clarens in the Free State Province. Aurecon,

HPP Stortemelk

Automation equipment at HPP Stortemelk

South Africa provided the engineering, procurement, and construction management services for the implementation of the project.

The scope of supply for ANDRITZ HYDRO comprised the complete electro-mechanical equipment, including one 4.4 MW vertical shaft compact axial turbine (CAT) with a runner diameter of 2,350 mm, the synchronous generator (with consortium partner), the complete control and SCADA-system, and the MV switchgear. During the commissioning phase, the strict South African grid code describing the required behavior of a connected generator during system disturbances was also successfully implemented. The new power station will produce about 25 GWh of renewable energy per year.



3D drawing of pump

Johannesburg – Submersible Pumps

Beneath Johannesburg numerous abandoned shafts from former gold mines have created a problem for city planners. Water has been entering these shafts and a lake of heavily contaminated water has formed under the city. In the spring of 2014, two double-suction submersible motor pumps from ANDRITZ with an average daily flow of about 60 million liters were installed to bring the water level down again.

ANDRITZ offers a pump series specially conceived for the difficult mining conditions. The design is based on ANDRITZ' proven HDM (Heavy Duty Mining) technology, which uses the concept of a double-suction pump with a service life of 10 to 15 years. The engineers at ANDRITZ developed an innovative design based on encapsulation of the submersible motors to fend off the aggressive acid. This encapsulation prevents water from penetrating and attacking the components inside. Two pumps were delivered and after successful operation more deliveries are in progress.

SOUTH AFRICA FACTS

54.96 Mio.	Population
86%	Access to electricity
2,336 MW	Installed hydro capacity
0 MW	Hydro capacity under construction
2%	Share of generation from hydropower
4,750 GWh	Hydro generation
14,000 GWh	Technically feasible hydro generation potential

ANDRITZ HYDRO

750 MW	Installed capacity
12	Installed units
32%	Fleet share

The World Bank, IEA, World Energy Outlook, Hydropower & Dams World Atlas 2016

MOUNT KILIMANJARO
HIGHEST MOUNTAIN in Africa; only glacier in Africa, predicted to be gone by 2030 due to global warming

FOCUS ON:

AFRICA

SECOND LARGEST continent; 20% of world's landmass

4 HEMISPHERES

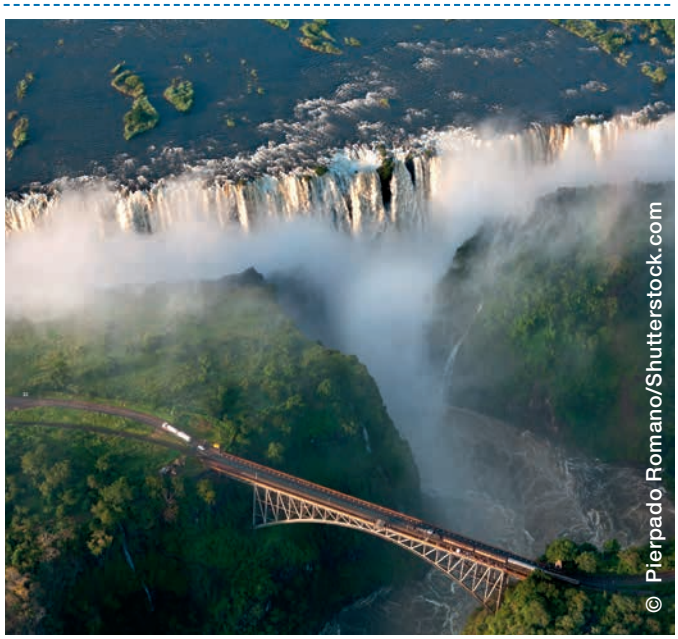
54 COUNTRIES

NILE SECOND LONGEST river in the WORLD – water resources shared by 11 countries

CONGO RIVER SECOND LARGEST by discharge in the WORLD; 13% of entire African land-

SAHARA DESERT largest hot desert and 3RD LARGEST DESERT in the WORLD; one third of Africa's landmass, same size as USA

OLDEST CONTINENT – **YOUNGEST** POPULATION (19.7 average age)



VICTORIA FALLS WIDEST uninterrupted WATERFALLS worldwide

LAKE VICTORIA LARGEST lake IN AFRICA; 3rd largest lake of the world

SECOND MOST POPULOUS CONTINENT

2 **MEGACITIES** (≥10 mio.)

39% of population **LIVES IN URBAN AREAS**

1.1 **BILLION PEOPLE TODAY** (15% world total)

EST. 2.5 BILLION PEOPLE IN 2050 (26% world total)

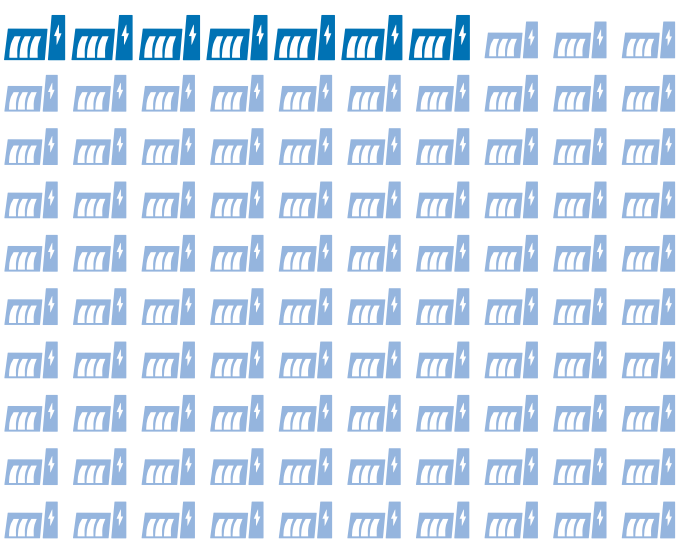
UNITS INSTALLED BY ANDRITZ HYDRO **516**

ANDRITZ HYDRO in Africa

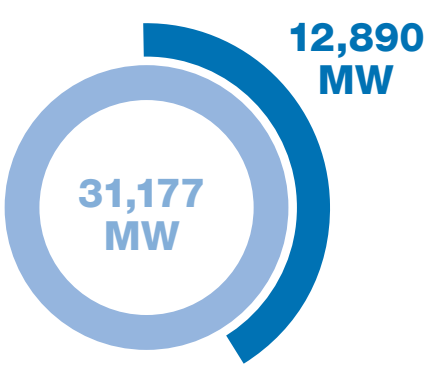
HYDROPOWER POTENTIAL

117,020 GWh actual annual hydro-power generation

1,645,900 GWh total technically feasible hydropower potential



41.3% (12,890 MW) of total installed capacity, **INSTALLED BY ANDRITZ HYDRO**



ANDRITZ
Hydro

HP.HNAfrica.3,200.en.06.17

www.andritz.com/hydro
hydronews@andritz.com
contact-hydro@andritz.com