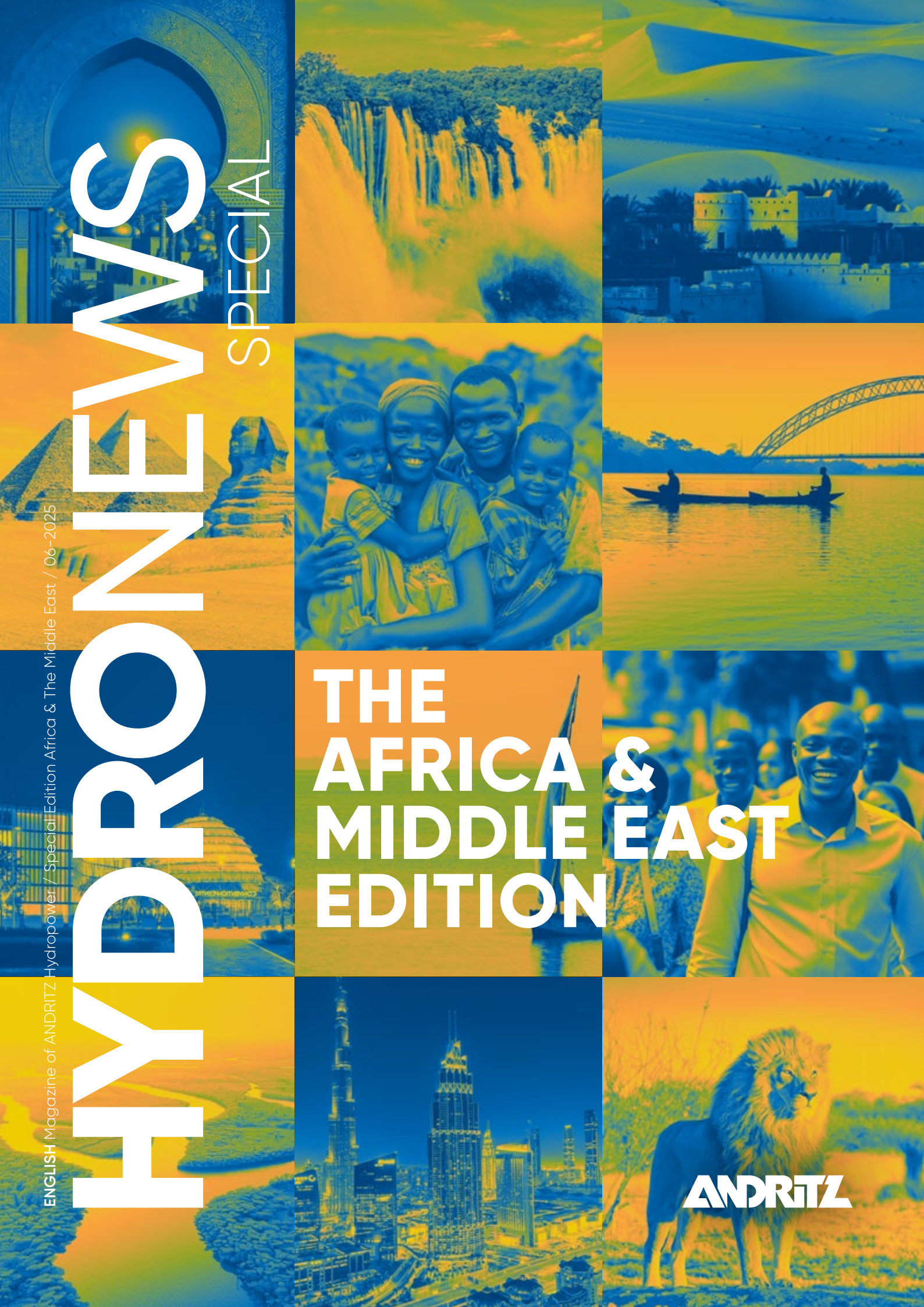


HYDRO NEWS SPECIAL

THE AFRICA & MIDDLE EAST EDITION

ENGLISH Magazine of ANDRITZ Hydropower / Special Edition Africa & The Middle East / 06-2025

ANDRITZ

AFRICA

54 COUNTRIES

4 CLIMATE ZONES

"THE CRADLE OF HUMANKIND" – WORLD'S OLDEST FINDINGS OF HUMAN REMAINS

Total area:
30,370,000 km²

20% of world's landmass

2nd largest continent

Total population
1,479 million

Second populous continent,
only about **40%** live in urban areas

Oldest continent – youngest population:
50% under **19 years old**

Megacities **> 10 million** people:
KINSHASA/ DR CONGO
LAGOS/NIGERIA
CAIRO/EGYPT

THE MIDDLE EAST

14 COUNTRIES

MAINLY ARID CLIMATE

"CRADLE OF CIVILIZATION" - ORIGIN OF THE EARLIEST CULTURES AND SOCIETIES."

Total area:
5,501,765 km²

Crossroads of
3 continents

Saudi Arabia is the largest country by area:
2,149,690 km²

Total population
279 million

About **60%** of the population is **aged below 25**

Megacities **> 10 million** people:
TEHRAN/IRAN
BAGHDAD/IRAQ
RIYADH/SAUDI ARABIA

Sources: TheWordlBank.org, worldatlas.com, Statista.com, Wikipedia.com, Britannica.com, isu.edu

Hydropower in
Africa and the Middle East:

UNLOCKING THE POTENTIAL FOR SUSTAINABLE ENERGY

Dear valued customers,

As Africa and the Middle East experience rapid population growth and economic development, the demand for reliable, affordable, and sustainable energy is more pressing than ever. Hydropower plays a vital role in the transition to an equitable, accessible and clean energy future. Despite challenges such as water scarcity, the changing climate and infrastructure gaps, innovative projects and strategic collaborations are helping to shape a greener energy system with hydropower acting as a vitally important element.

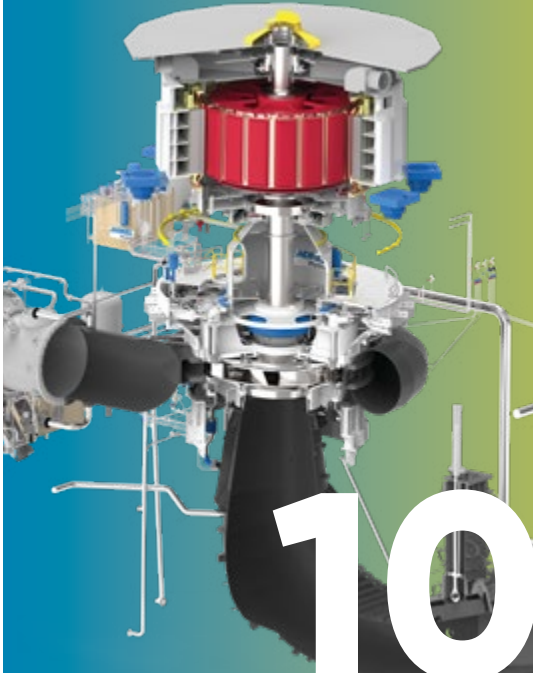
Africa has a vast untapped hydropower potential and presents huge opportunities for new projects and the modernization of existing plants, both large and small. Increasingly, solar and wind energy is being combined with hydropower, paving the way for a resilient energy mix. Even arid areas like North Africa and the Middle East are exploring pumped storage solutions to complement vulnerable energy sources and stabilize grid systems. Green hydrogen is proving to be a transformative opportunity, offering a path to more widespread decarbonization and a net zero emissions future. Green hydrogen production, derived from renewable sources, is in need of constant and reliable electricity supply, provided by hybrid solutions with pumped storage plants as a core.

ANDRITZ has been a driving force behind energy sector advances across these regions for many decades. With a strong commitment to efficiency and sustainability, the company supports new greenfield installations, pumped storage solutions, and modernization of existing plants at all scales, ensuring access to clean and stable energy for millions of people. Cutting-edge technologies such as synchronous condensers, advanced automation, and innovations in green hydrogen further reinforce the company's role in shaping a cleaner energy landscape for Africa and the Middle East.

Looking ahead, regional cooperation, hybrid energy integration, and supportive financing models will be key to further unlocking the region's full hydropower potential. By embracing these opportunities, Africa and the Middle East can lead the charge toward energy security built on a solidly sustainable footing. ANDRITZ remains ready to partner with customers and stakeholders to deliver world-class technology and expertise to power the next generation of clean energy solutions.

Thank you for your continued trust,

Alexander Schwab
Senior Vice President
ANDRITZ HYDRO GmbH



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HYDRONEWS online magazine, newsletter and contact information:
www.andritz.com/hn-africa

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Print product with financial climate contribution

IMPRINT:
Publisher: ANDRITZ HYDRO GmbH,
A-1120 Vienna, Eibesbrunnergasse 20, Austria
Phone: +43 50805 0
E-Mail: hydronews@andritz.com
Responsible for the content:
Alexander Schwab, Jens Paeutz
Art Director and Editorship: Marie-Antoinette Sailer

Online magazine: www.andritz.com/hydronews
Published in: English, French, Portuguese
Layout & Design: INTOUCH Werbeagentur, Austria
Contributing Photographers & Providers:
Adobe Stock, FreeVectorMaps.com
Printed at WGA Print-Producing, Austria;
Printed on FSC paper;

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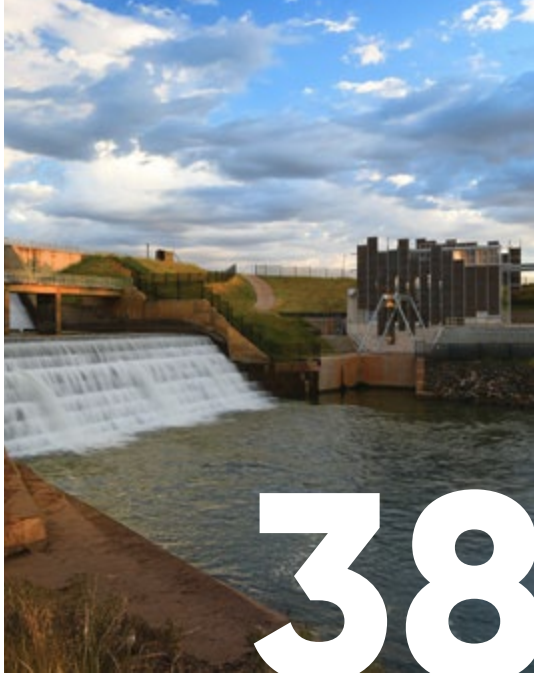

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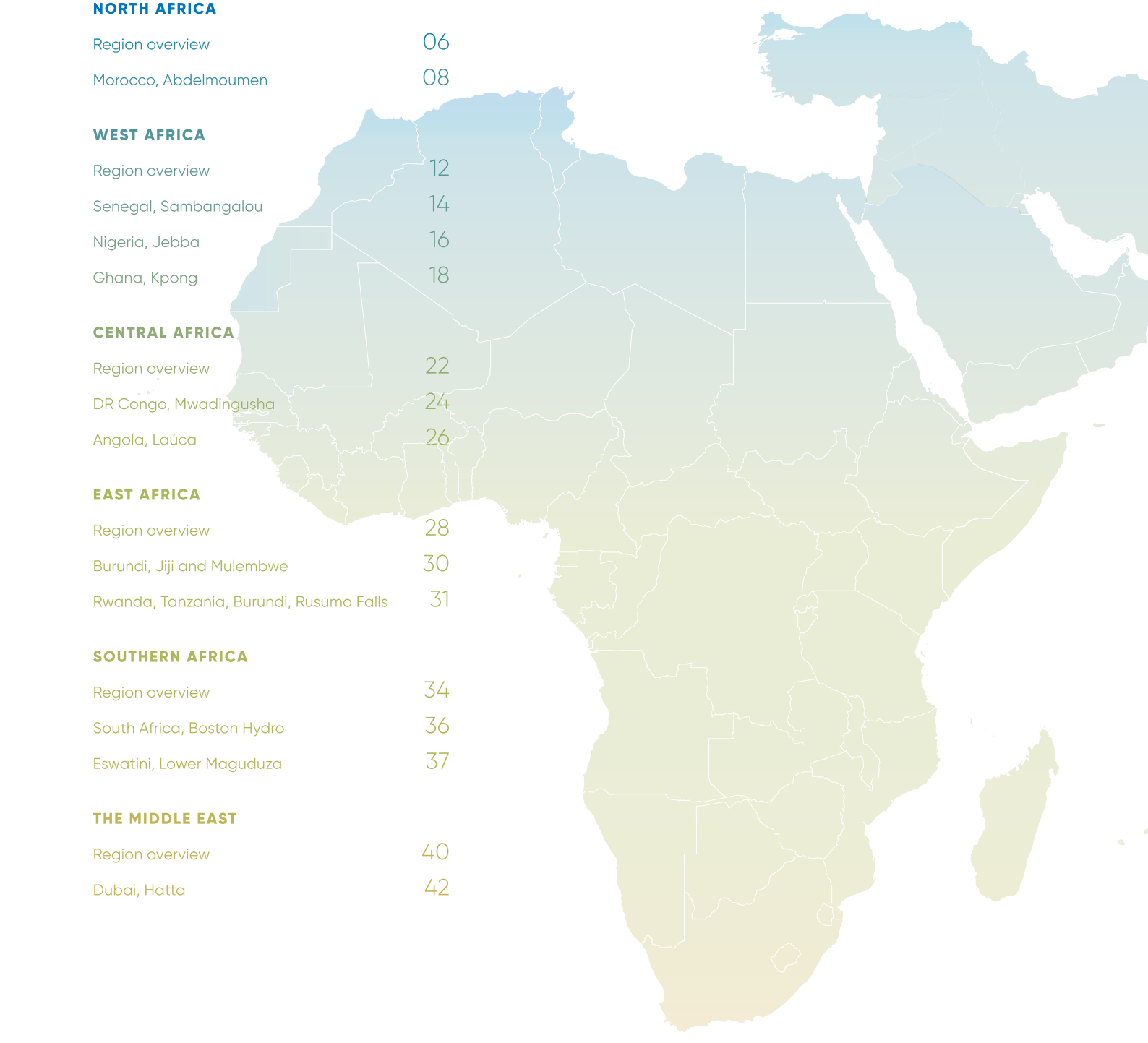


North Africa

HYDROPOWER MARKET

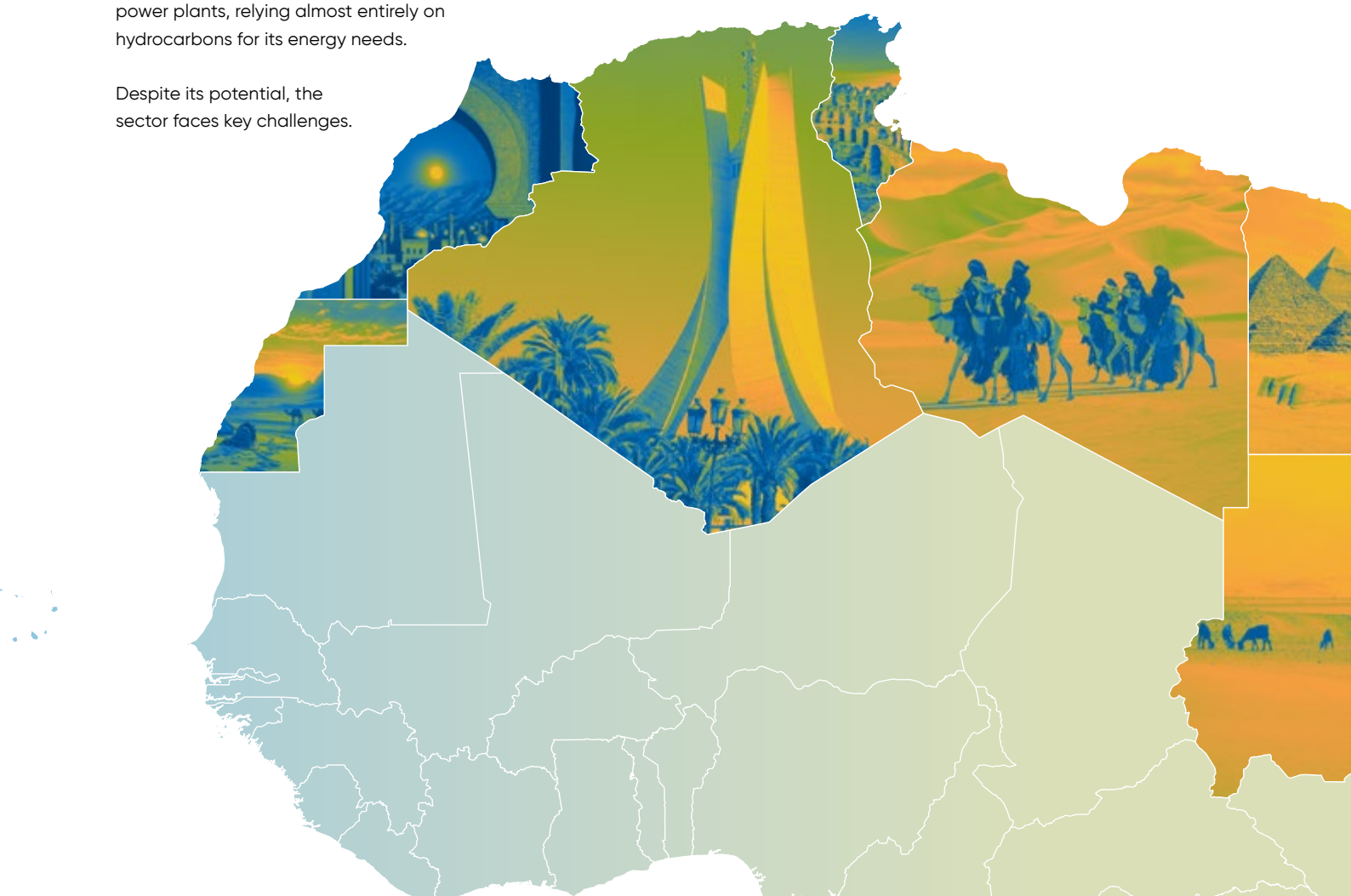
North Africa's hydropower sector presents a landscape of both established infrastructure and untapped potential. Nonetheless, the region varies significantly in its hydropower development and ambitions.

Egypt leads the sector with an installed capacity of 2,832 MW, primarily driven by the Aswan High Dam, contributing 7.2% of the total national electricity generation. Morocco follows with 1,306 MW, integrating hydropower, especially pumped storage, within its broader renewable energy strategy. Algeria and Tunisia, while possessing limited capacity, are expanding efforts with new high dams and small hydro projects. In contrast, Libya lacks any operational hydropower plants, relying almost entirely on hydrocarbons for its energy needs.

Despite its potential, the sector faces key challenges.

Climate change threatens water availability, affecting generation capacity. Political instability and economic constraints further impact project development, particularly in Libya and Sudan. However, North African governments are prioritizing renewable energy, with Algeria and Tunisia targeting at least 25% renewables in their energy mix by 2030. Morocco is aiming for over 50% renewables by the same year, including a substantial hydropower contribution.

With strategic policies and investments, hydropower can play a crucial role in the region's energy transition, offering sustainable solutions to meet growing demand while contributing to global climate goals.



COUNTRIES: 6

ALGERIA, EGYPT, LIBYA, MOROCCO, SUDAN, AND TUNISIA

POPULATION: 268 MIO

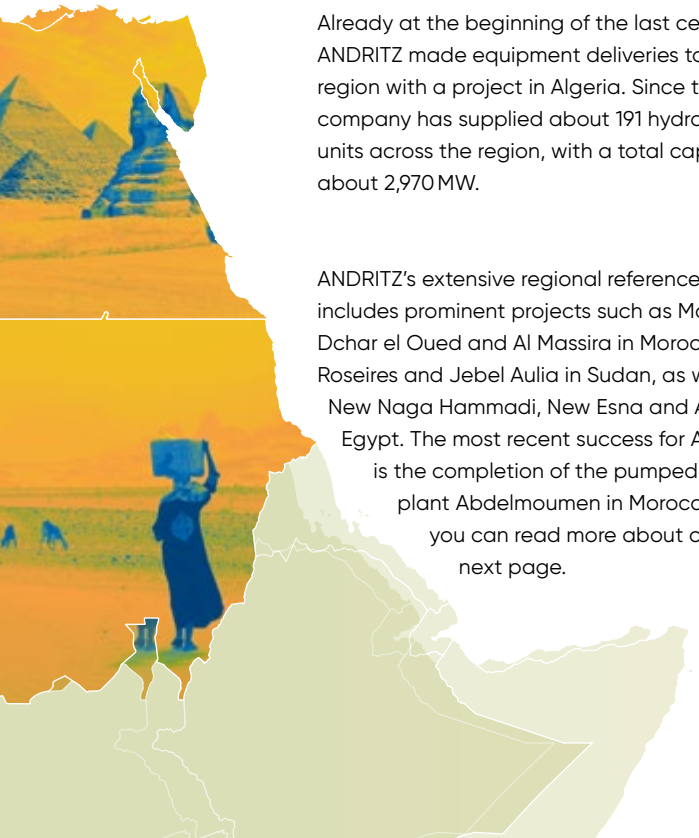
HYDROPOWER INSTALLED CAPACITY: 7,254 MW

HYDRO GENERATION: 23,776 GWh

PUMPED STORAGE CAPACITY INSTALLED: 815 MW

(INCLUDES ABDELMOUMEN)

TECHNICALLY FEASIBLE HYDRO GENERATION POTENTIAL: 91,120 GWh



ANDRITZ HYDROPOWER

Already at the beginning of the last century, ANDRITZ made equipment deliveries to the region with a project in Algeria. Since then, the company has supplied about 191 hydropower units across the region, with a total capacity of about 2,970 MW.

ANDRITZ's extensive regional reference list includes prominent projects such as Matmata, Dchar el Oued and Al Massira in Morocco, Roseires and Jebel Aulia in Sudan, as well as New Naga Hammadi, New Esna and Assiut in Egypt. The most recent success for ANDRITZ is the completion of the pumped storage plant Abdelmoumen in Morocco, which you can read more about on the next page.

UNITS INSTALLED BY ANDRITZ: 191

WITH A CAPACITY OF: 2,970 MW

All figures concern 2023;
Sources: IHA 2024 World Hydropower Outlook; International Hydropower & Dams WorldAtlas 2024

FUTURE ENERGY STORAGE

ABDELMOUMEN STRENGTHENS MOROCCO'S POWER GRID

Morocco – By the end of 2023, over a third (approximately 39%) of Morocco's energy mix came from renewable sources. This achievement positions Morocco as a leader in the energy transition within the Middle East and North Africa (MENA) region. Through its ambitious National Energy Efficiency Action Plan (NEEAP) launched in 2009, Morocco aims to decarbonize the energy sector, lower dependence on costly fuel imports, and reduce electricity costs. The strategy has stimulated significant renewable energy investments, including hydropower.

PUMPED STORAGE: KEY TO THE ENERGY TRANSITION

Morocco's energy strategy includes the construction of two pumped storage plants by 2030 with a total capacity of 725 MW: Abdelmoumen (350 MW) and El-Menzel (300-400 MW). As wind and solar energy capacities expand, so does the need for efficient, large-scale energy storage solutions. Pumped storage plants are a proven and effective technology to balance natural fluctuations in solar and wind energy generation by moving water between two reservoirs at different elevations to store and release energy.

ABDELMOUMEN PUMPED STORAGE PLANT IN THE ATLAS MOUNTAINS

Located near the Issen River in Tarroudant province, approximately 70 km northeast of Agadir, the Abdelmoumen pumped storage plant stands above the existing Abdelmoumen reservoir. In 2017, ANDRITZ, as part of a consortium with VINCI Construction, which handled the major construction work, was awarded the contract to supply the electromechanical equipment for the new plant by the Office Nationale de l'Électricité et de l'Eau Potable (ONEE). ANDRITZ was responsible for the design, manufacture, supply, installation, supervision, and commissioning of the reversible pump turbines, motor-generators, and electrical energy systems. Together with VINCI Construction, ANDRITZ successfully completed the technically challenging waterway, which includes a freestanding penstock with diameters of 4.8 m, 4.25 m, and 3.6 m, and a length of approximately 1.6 km. This project also features 800 m of tunnels, a 60 m-high vertical shaft, and both low head and high head bifurcators.

With a peak load capacity of 350 MW, Abdelmoumen is a key asset to respond flexibly to daily grid demands.

INNOVATIVE COMMISSIONING CONCEPT

In mid-2024, the project reached a significant milestone with its successful commissioning.

Traditionally, hydropower plants start commissioning with the water flowing in the turbine or power generating mode. Spinning at low speed with no loads to allow verification of the mechanical behavior of the unit prior to full-load operation. For Abdelmoumen, ANDRITZ engineers changed the commissioning process and adopted a rare if not unique approach by starting commissioning in pumping mode first. Using the frequency converter, the engineers were able to spin the unit at

TECHNICAL DATA

Abdelmoumen:

Total output: 350 MW

Scope: 2 × 175 MW

Head: 555 m

Speed: 600 rpm

Runner diameter: 3,200 mm

zero load but nominal speed which allowed for verification of the mechanical behavior but spinning in the opposite direction to conventional commissioning. Having successfully passed this verification step in early 2024, the first of the two Abdelmoumen units began operating in pump mode at 165 MW. Within two hours, this first unit had delivered enough water to the upper reservoir to begin commissioning the second unit in turbine mode.

Now, with its peak load capacity of 350 MW, the Abdelmoumen plant is a key asset for ONEE to respond flexibly to daily grid demands.

ANDRITZ is proud to have delivered this time-saving procedure, showcasing both engineering excellence and an innovative approach. The success of Abdelmoumen underscores the growing importance of pumped storage plants for the future of renewable energy in Morocco and across the African continent.

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Overview of Abdelmoumen with view of the reservoir and the penstock

Commissioning of the switchyard in 2024

Pumped storage:
ENABLING G ENERGY TRA

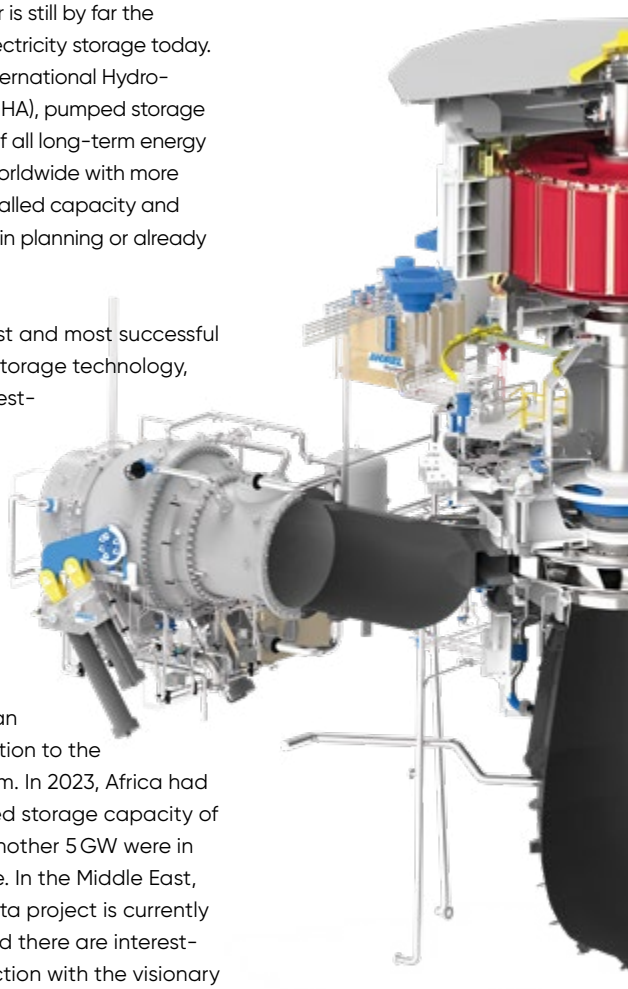
Premium pumped storage technology delivering renewable energy promise

Bulk energy storage is crucial as the world moves to a more sustainable and clean energy system. Seamlessly integrating intermittent renewables like wind and solar, storage enables the optimal use of the available primary energy and its responsiveness makes it an ideal partner. Pumped storage also supports grid stability, addresses grid bottlenecks and provides critical black start capability.

ANDRITZ plays a pivotal role in developing pumped storage plants like the 250 MW Hatta plant in the United Arab Emirates and the 350 MW Abdelmoumen project in Morocco.

In a pumped storage hydropower system, two vertically separated reservoirs are hydraulically connected. When there is excess renewable electricity, it is used to pump water into the upper reservoir. When demand exceeds supply, this water is released via turbines to generate power. There are two main types of pumped hydro, with open-loop systems relying on a water source such as a river, while closed-loop systems shuttle water between two reservoirs without a significant natural inflow.

Pumped hydro is not only a very efficient method of balancing the grids, but its large capacity also makes it ideal for mid- to long-term energy storage. While chemical batteries have made terrific advances in the domain of short-time storage, pumped storage hydropower is still by far the largest source of electricity storage today. According to the International Hydropower Association (IHA), pumped storage provides over 90% of all long-term energy storage capacity worldwide with more than 240 GW of installed capacity and over 200 GW either in planning or already under construction.



As the world's oldest and most successful form of electricity storage technology, it remains the longest-lived, best-proven and lowest-risk option.

THE STANDOUT STORAGE SOLUTION

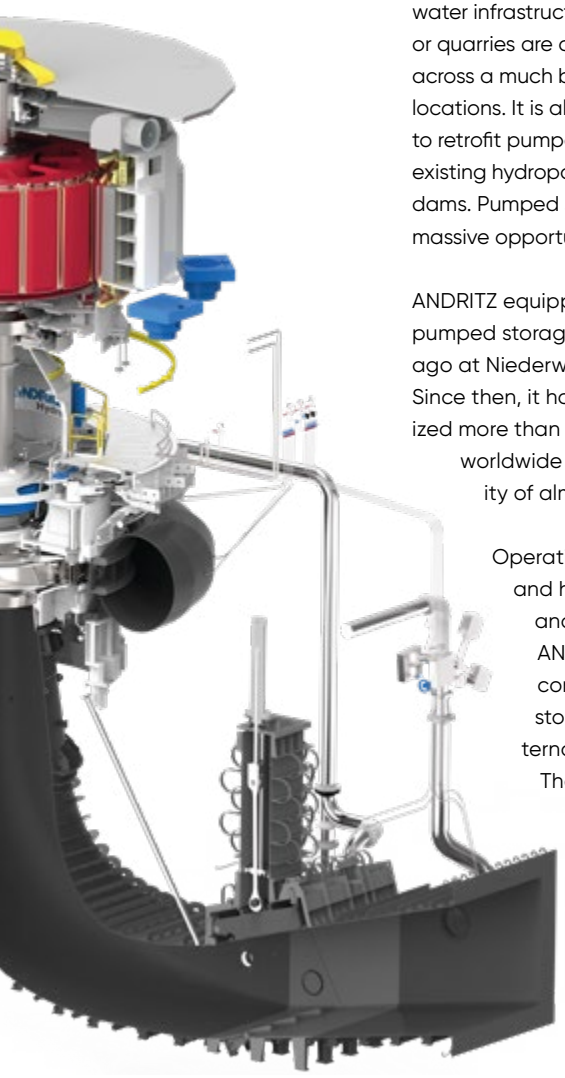
Pumped storage is already making an important contribution to the clean energy system. In 2023, Africa had an installed pumped storage capacity of about 3 GW and another 5 GW were in the project pipeline. In the Middle East, the prestigious Hatta project is currently being executed and there are interesting plans in connection with the visionary visionary project The Line.

The scope for pumped storage is also expanding. Traditionally restricted to

REEN NSITION

READ MORE ABOUT ANDRITZ PUMPED STORAGE PROJECTS IN THIS ISSUE

Abdelmoumen, Morocco, page 08
Hatta, Dubai, page 42



areas with appropriate geographical features, using existing pipelines and water infrastructure, abandoned mines or quarries are allowing its deployment across a much broader spectrum of locations. It is also sometimes possible to retrofit pumped storage facilities at existing hydropower plants and irrigation dams. Pumped storage thus represents a massive opportunity for Africa.

ANDRITZ equipped its first commercial pumped storage facility nearly a century ago at Niederwartha in Germany in 1929. Since then, it has supplied or modernized more than 460 pumped storage units worldwide with a combined capacity of almost 40,000 MW.

Operating across low-, medium- and high-head applications and at different scales, ANDRITZ offers three broad configurations for pumped storage systems: binary, ternary, and quaternary sets. The most commonly used are binary sets or reversible pump turbines, ternary sets use multiple machines on a common shaft, while quaternary sets separate pumps and turbines into distinct units. Each configuration is designed to meet specific storage and grid-balancing needs, from gigawatt scale down to small decentralized pumped storage plants under 100 MW. For smaller units, combined-pump turbines without adjustable guide vanes offer a simple-to-operate, cost-effective, and low-maintenance solution.

ANDRITZ has already played a decisive role in the development of pumped storage in Africa and the Middle East, with landmark projects such as Drakensberg, Steenbras and Vanderkloof in South Africa, the 350 MW Abdelmoumen project in Morocco, and the 250 MW Hatta power plant in the United Arab Emirates. More information about the last two projects can be found in this edition. However, the company is continuously investing in advanced research and development to further improve the technology. For example, the installation of the world's most powerful test rig for high-pressure pump turbines in Linz, Austria has set new standards in development.

An extensive local presence means ANDRITZ is ready to support both existing and new pumped storage projects to help Africa meet its storage needs. Without it, the green energy transition could stall.

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West Africa

HYDROPOWER MARKET

West Africa, a diverse region spanning 19 countries, holds substantial hydropower potential, but faces challenges in its development. While Nigeria leads with an estimated 32,450 GWh/year, other countries like Benin, Togo, and Guinea also possess considerable resources. Several countries, including Ghana and Ivory Coast, have made considerable progress with developed capacities of 48% and 19% of their potential, respectively.

However, financing remains a major hurdle. Political instability, unequal water distribution, and climate change are further challenging the expansion of hydropower. Despite these obstacles, regional initiatives such as the West African Power Pool (WAPP) and support from institutions such as the World Bank and the African Development Bank are driving progress.

A substantial element of future development lies in hybrid solutions that combine hydropower with solar and wind energy, as explored in Ghana and Guinea. Huge investments are ongoing in Nigeria driven by Mainstream Energy Solutions, a new player in the power sector. With strategic investments, increased regional collaboration, and innovative approaches, West Africa's hydropower sector has the potential to play a pivotal role in the regional sustainable energy transition.

ANDRITZ HYDROPOWER

ANDRITZ first supplied equipment to West African countries in the early 1950s. Since then, more than 84 units with a total output of about 4,091 MW have been delivered to the region.

The company was involved in West Africa's most important hydropower projects, such as Akosombo and Kpong in Ghana, Kainji, Jebba, Kashimbila and Shiroro in Nigeria, Taabo, Ayamé and San Pedro in Ivory Coast, Bagré in Burkina Faso, Garafiri and the ongoing rehabilitation of Grandes Chutes and Baneah in Guinea.

COUNTRIES: 19+

BENIN, BURKINA FASO, CAPE VERDE, IVORY COAST, THE GAMBIA, GHANA, GUINEA, GUINEA-BISSAU, LIBERIA, MALI, MAURITANIA, NIGER, NIGERIA, SENEGAL, SIERRA LEONE, AND TOGO AS WELL AS SAINT HELENA, ASCENSION AND TRISTAN DA CUNHA (UNITED KINGDOM OVERSEAS TERRITORY)

HYDROPOWER INSTALLED CAPACITY:

7,248 MW

HYDRO GENERATION:

24,639 GWh

POPULATION:

446 MIO

TECHNICALLY FEASIBLE HYDRO GENERATION POTENTIAL:

112,364 GWh

HYDRO CAPACITY UNDER CONSTRUCTION:

1,126 MW

For Mount Coffee in Liberia, ANDRITZ rehabilitated the hydraulic steelworks. In countries such as Nigeria, Ghana, and Mali, the company has provided more than 60% of the total installed hydropower capacity, and in Senegal and Togo, almost 100% of the hydro-power fleet. A recent success in Senegal is the award of the Sambangalou project, a cooperation project of four countries – Senegal, The Gambia, Guinea, and Guinea-Bissau, whereas the rehabilitation of the Jebba hydropower plant in Nigeria is currently in progress. Please read more about ANDRITZ's work on the Sambangalou, Jebba, and Kpong projects on the following pages.

UNITS INSTALLED BY ANDRITZ:

84

WITH A CAPACITY OF:

4,091 MW

All figures concern 2023;
Sources: IHA 2024 World Hydropower Outlook; International Hydropower & Dams WorldAtlas 2024

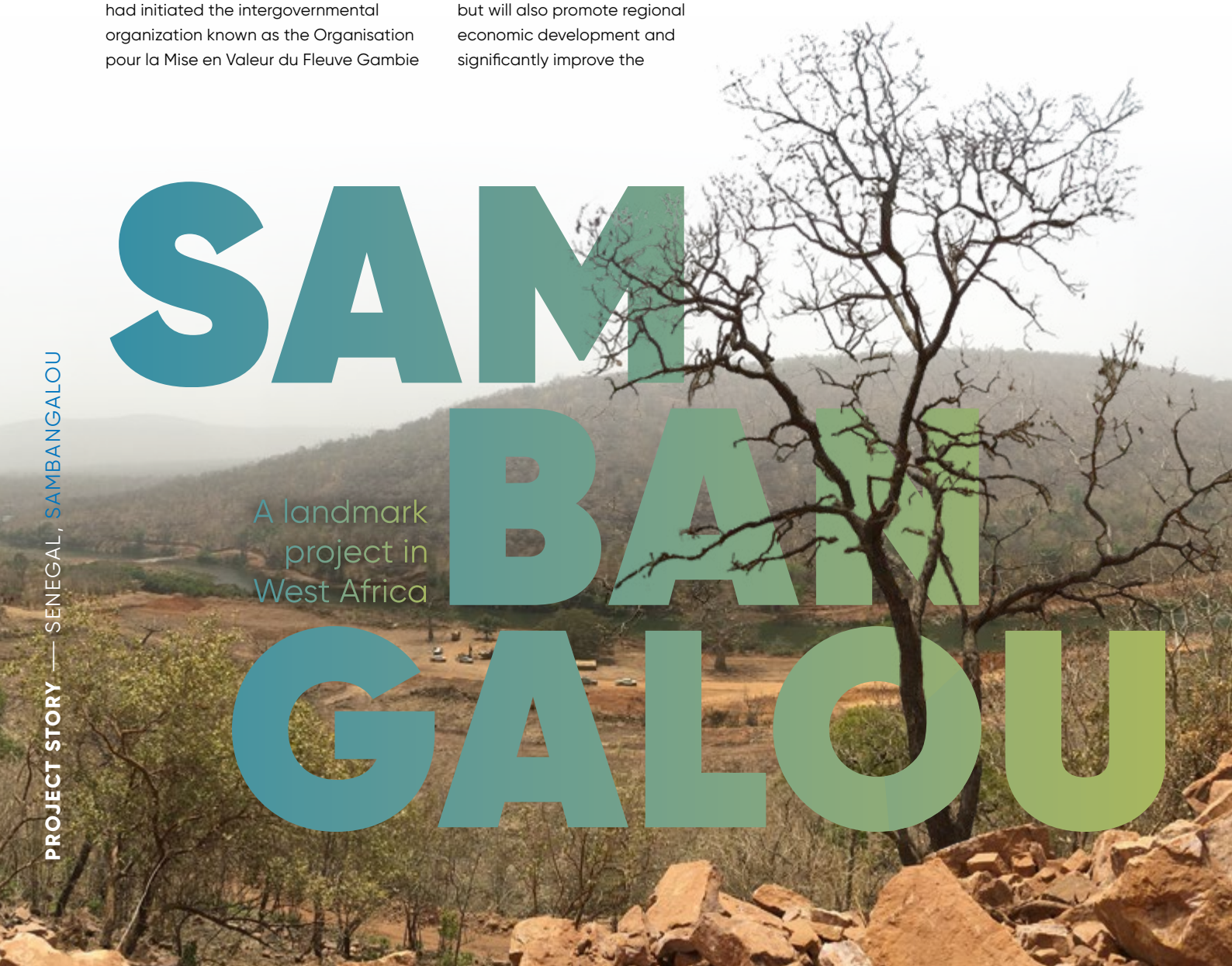
Senegal – The West African countries of Senegal, The Gambia, Guinea, and Guinea-Bissau have an enormous potential for renewable energy with a wealth of solar, wind, and hydropower resources. To enable investments in sustainable energy generation, numerous policy and market reforms have been initiated in recent years. The goal of these reforms is to continuously increase the share of renewable energy in electricity production while simultaneously reducing the imports of fossil fuels.

The Gambia River plays a central role in the regional utilization of hydropower. With a length of more than 1,120 km, the river originates in the Fouta Djallon Plateau in northern Guinea, flows through southeastern Senegal, and on further west through The Gambia, before emptying into the Atlantic Ocean. As early as 1978, Senegal and The Gambia had initiated the intergovernmental organization known as the Organisation pour la Mise en Valeur du Fleuve Gambie (OMVG) to promote the joint economic use and development of the river. Later, Guinea and Guinea-Bissau also joined the initiative.

The Energy Development Program developed by the OMVG includes, among other projects, the joint construction of the Sambangalou hydropower plant. Located about 800 km from Dakar in the Kédougou region in southeastern Senegal with a capacity of 128 MW, the planned power plant will provide not only sustainable and clean energy but also deliver significant improvements to regional agriculture and water supply. Once complete, electricity generated by the project will be distributed among all participating countries via a network of 1,677 km of high-voltage transmission lines together with 15 substations. This development will not only grant many people access to electricity for the first time, but will also promote regional economic development and significantly improve the quality of life of many people. Electrification rates in rural areas of this region currently remain significantly below 50%.

INNOVATIVE TECHNOLOGY FOR SUSTAINABLE ENERGY

In December 2020, the international technology group ANDRITZ – as part of a consortium together with VINCI Construction – was awarded the contract to supply electromechanical equipment for the new Sambangalou hydropower dam. As part of its scope of supply, ANDRITZ will design, manufacture, deliver and install three high-efficiency Francis turbines and their associated generators. To minimize transportation distances and involve local workers, an on-site production facility has been established to manufacture additional critical components, such as penstocks and bottom outlet.



SAMBANGALOU

A landmark project in West Africa

PROJECT STORY — SENEGAL, SAMBANGALOU

A DRIVER FOR REGIONAL DEVELOPMENT

The 108-meter-high dam will impound a reservoir with a capacity of 4 billion m^3. In addition to electricity generation, the infrastructure will help to stabilize the Gambia River's flow, reducing downstream flooding during the rainy season for example. It will also support the irrigation of agricultural lands in both The Gambia and Senegal. Preparatory works for the project were launched in late September 2022 with the start of construction beginning shortly afterwards.

Sambangalou will not only provide sustainable and clean energy, but also significantly improve regional agriculture and water supply.

By delivering these diverse functions, Sambangalou will become a cornerstone of regional development. It strengthens energy supply, reduces dependence on fossil fuels, and actively contributes to regional economic development.

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Overview of the construction site including camps

Pre-fabrication at Sambangalou site

ENERGIZING NIGERIA'S FUTURE

ANDRITZ's commitment to hydropower development

TECHNICAL DATA

Jebba:

Total output: 578.4 MW

Scope: 6 × 96.4 MW / 103 MVA

Head: 27.6 m

Speed: 93.75 rpm

Runner diameter: 7,100 mm

PROJECT STORY — NIGERIA, JEBBA

Nigeria – The most populous country in Africa, Nigeria is embarking on an ambitious journey to secure the future of its hydropower generation through a comprehensive privatization program. With a significant potential for renewable energy, particularly hydropower, Nigeria is ready to make substantial strides in electricity supply and economic development. Hydropower remains a cornerstone of the country's energy landscape, and the government's target of achieving a 90% electrification rate by 2030 underscores the country's commitment to a sustainable energy future.

The privatization of Nigeria's hydropower sector has been a decisive move, attracting investments from key players such as Mainstream Energy Solution Limited (MESL). In line with its expansion strategy, MESL has partnered with ANDRITZ to provide technical services and acquire additional power generation assets within Nigeria and beyond. This collaboration is a prime example of how privatization can overcome the challenges posed by the existing hydro stations and infrastructure, paving the way for a brighter energy future.

ANDRITZ, a global leader in hydropower technology, has been a pivotal partner in this journey. With a legacy of over 50 years in Nigeria, ANDRITZ has played a vital role in the development, modernization, and expansion of the country's most significant hydropower projects. From Kainji and Jebba to Shiroro and Kashimbila, ANDRITZ's expertise and cutting-edge technology continue to drive Nigeria's transition to clean and sustainable renewable energy.

REVITALIZING THE JEBBA HYDROPOWER PLANT: A SUCCESS STORY

One of the key projects reinforcing ANDRITZ's commitment to Nigeria is the rehabilitation and modernization of the Jebba hydropower plant. In mid-2019, the senior management team of MESL visited ANDRITZ's locations in Austria to gain insights into the company's extensive R&D, manufacturing, and engineering facilities. During this visit, a Memorandum of Understanding was signed to explore the rehabilitation of unit 2G6 at Jebba, as well as the overhaul of units 2G5, 2G3, 2G2, and 2G1, including their associated equipment.

In February 2020, ANDRITZ received its first major contract for the rehabilitation and modernization of 2G6. This included the entire electro- and hydromechanical equipment, including a 96.4 MW turbine, a 103 MVA generator, as well as accessory equipment and the intake gate. In September 2021, a second order for 2G5 comprised an identical scope of supply and services. By 2023, the MESL team, ANDRITZ, and AFRY had developed a concept to uprate Jebba and increase its output by approximately 40 MW.

Generator installation work

Generator shaft installation work

ANDRITZ'S LEGACY IN NIGERIA: A TRUSTED PARTNER IN HYDROPOWER

The ANDRITZ's footprint in Nigeria extends far beyond Jebba. The company has long been instrumental in equipping and modernizing major hydro facilities across the country:

- **Kainji Dam** (760 MW): A landmark project in which ANDRITZ supplied core technology and continues to provide technical support for maintenance and upgrades.
- **Shiroro Dam** (600 MW): Another critical installation benefiting from ANDRITZ's state-of-the-art solutions.
- **Zungeru Dam** (700 MW): One of Nigeria's newest hydropower projects. ANDRITZ provides technical support for Operation & Maintenance.
- **Kashimbila Dam** (40 MW): Designed for flood protection and electricity generation, this project highlights ANDRITZ's strengths in integrated water resource management.

A COMMITMENT TO NIGERIA'S RENEWABLE ENERGY FUTURE

The long-standing presence of ANDRITZ and its active involvement in Nigeria's hydropower projects demonstrate the company's dedication to supporting the country's renewable energy goals. As Nigeria continues to develop its hydropower market, ANDRITZ remains committed to providing innovative solutions and expertise to ensure a sustainable and prosperous energy future for the nation. Together with partners such as MESL, ANDRITZ is helping Nigeria achieve its ambitious electrification goals and build a better society for all.

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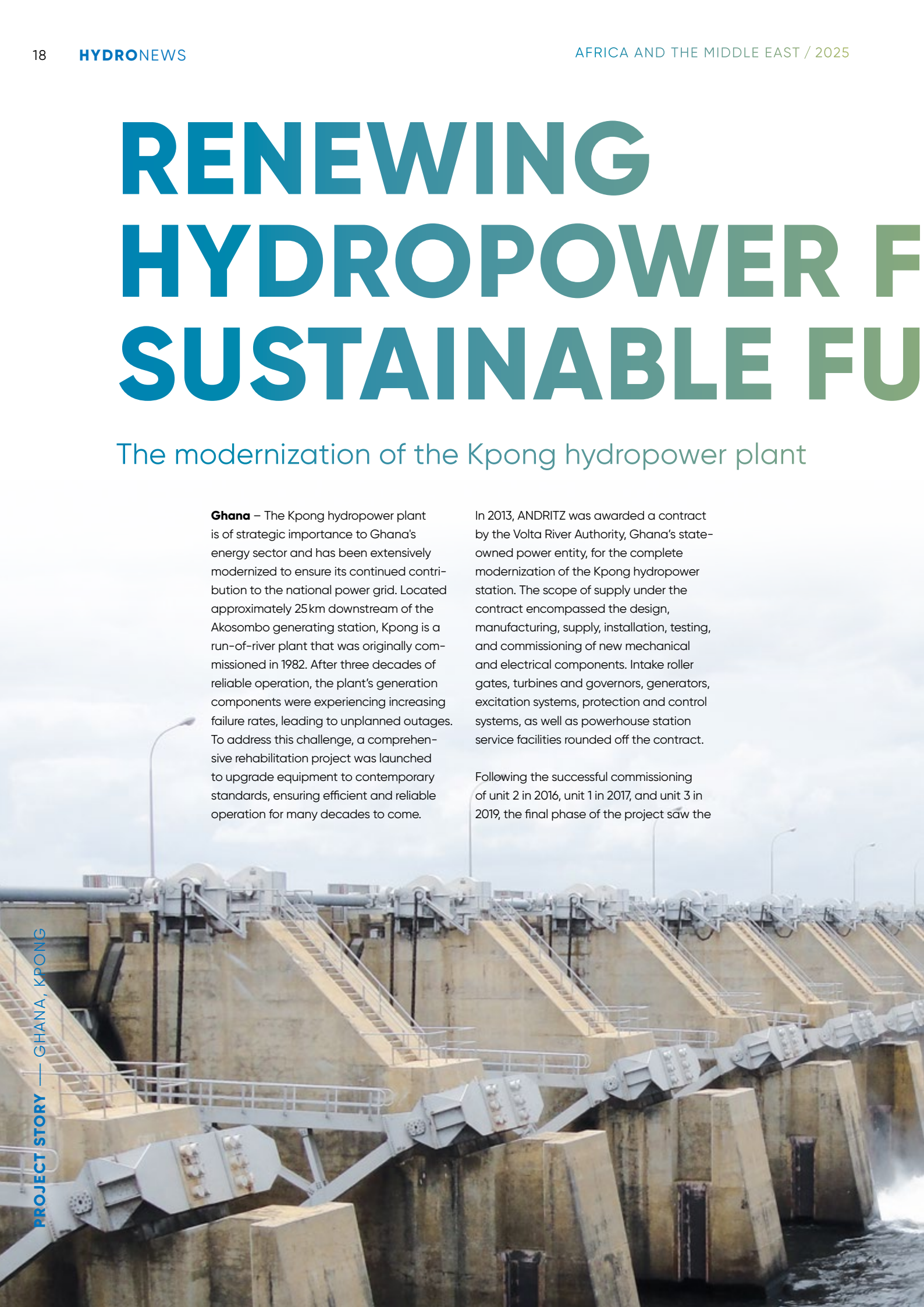
RENEWING HYDROPOWER F SUSTAINABLE FU

The modernization of the Kpong hydropower plant

Ghana – The Kpong hydropower plant is of strategic importance to Ghana's energy sector and has been extensively modernized to ensure its continued contribution to the national power grid. Located approximately 25 km downstream of the Akosombo generating station, Kpong is a run-of-river plant that was originally commissioned in 1982. After three decades of reliable operation, the plant's generation components were experiencing increasing failure rates, leading to unplanned outages. To address this challenge, a comprehensive rehabilitation project was launched to upgrade equipment to contemporary standards, ensuring efficient and reliable operation for many decades to come.

In 2013, ANDRITZ was awarded a contract by the Volta River Authority, Ghana's state-owned power entity, for the complete modernization of the Kpong hydropower station. The scope of supply under the contract encompassed the design, manufacturing, supply, installation, testing, and commissioning of new mechanical and electrical components. Intake roller gates, turbines and governors, generators, excitation systems, protection and control systems, as well as powerhouse station service facilities rounded off the contract.

Following the successful commissioning of unit 2 in 2016, unit 1 in 2017, and unit 3 in 2019, the final phase of the project saw the



PROJECT STORY — GHANA, KPONG

OR A TURE

Unit hall of Kpong hydropower plant

installation and commissioning of unit 4. The refurbishment was completed on schedule at the beginning of 2020, with final commissioning successfully executed shortly afterwards. With this milestone, all four generating units at Kpong were brought back to fully operational status, marking the successful completion of the retrofit initiative.

The modernization of the Kpong hydropower Station plays a crucial role in strengthening Ghana's electricity supply. The plant now contributes 160 MW of sustainable and clean electricity to the national grid, supporting energy demand both domestically and for neighboring countries. Beyond electricity generation, the Kpong dam also provides essential services such as irrigation for farmland in the districts of Fodjoku, Amedeka, and Akuse, as well as flood control and opportunities for local fishing.

Furthermore, the refurbished Kpong hydropower plant significantly contributes to environmental sustainability. By generating approximately 1,000 GWh of renewable energy annually, the plant prevents the emission of around 400,000 tons of carbon dioxide each year, reinforcing Ghana's commitment to climate change mitigation. This long-term investment in clean energy infrastructure thus supports the country's sustainable development goals and secures a resilient energy future.

The successful completion of the Kpong rehabilitation project exemplifies the benefits of proactive infrastructure modernization. With improved efficiency and reliability, the plant is well-positioned to deliver clean and sustainable energy for decades to come, thereby reaffirming its role as a cornerstone of Ghana's energy landscape.

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TECHNICAL DATA

Kpong Hydropower Station:

Total Output: 182.8 MW
Scope: 4 × 45.7 MW
Voltage: 13.8 kV
Head: 11.75 m
Speed: 62.5 rpm
Runner Diameter: 8,238 mm
Average Annual Production: 1,000 GWh

AFRICA'S
ENERGY

SERVICE AND R

ANDRITZ has been a leading supplier of electromechanical equipment across Africa for over 100 years and has built up an OEM fleet with a capacity of over 18 GW, which includes rehabilitations. In the mid-20th century, ANDRITZ's predecessor companies ventured into Africa, driven by the wave of independence across many nations. This brought renewed ambition to leaders aiming to industrialize their countries by leveraging the continent's abundant natural resources, particularly its mighty rivers.

Modernizing existing hydropower plants improves efficiency, reduces costs and ensures access to energy for the people.

Numerous hydropower plants were equipped or rehabilitated by ANDRITZ, including Edea (Cameroon), Ayame and Taabo (Ivory Coast), Ntaruka (Rwanda) Roseires (Sudan), Drakensberg (South Africa), Jebba, Shiroro, and Kainji (Nigeria), Ruacana (Namibia), Nalubaale (Uganda), Kariba North (Zambia), and Inga (DR Congo). In addition, more than 200 Compact Hydro units were installed and ANDRITZ has modernized, upgraded and uprated more than 18 GW of hydropower capacity.

Currently, Africa's total energy generation capacity is about 284 GW, with 42 GW of hydropower contributing around 18% of generation. Hydropower also accounts for 75% of Africa's renewable electricity. Although electricity consumption in Africa is projected to grow by 61% and reach 1,180 TWh by 2030, as of 2023, approximately 43% of the population still lacks access. In rural areas some 80% of residents remain without power.

A recent study by the African Development Bank (AfDB) and the International Hydropower Association (IHA) evaluated 87 power stations rated over 50 MW. Of these, 21 plants with a combined capacity of 4.6 GW require urgent modernization. Another 31 plants totaling 10.1 GW will require significant investment within the next decade.

Modernizing these plants is crucial for reliable, efficient, safe, and clean electricity generation. The IHA estimates that US$2.1 billion is needed for immediate upgrades, with an additional US$4.7 billion for more comprehensive improvements over time.

Many of Africa's older, medium-sized power plants rely on outdated technology, operate below capacity, or have non-functional units as a result of aging electromechanical components, limited access to spare parts, and deteriorating civil structures. Revitalizing these plants would yield significant social and economic benefits. Rehabilitation work costing just a few million dollars can restore or significantly

Mwadingusha hydropower plant in DR Congo **before** rehabilitation

DORMANT
Y GIANT
REHABILITATION

Mwadingusha hydropower plant in DR Congo **after** rehabilitation

enhance these plants, improving both efficiency and reliability and offering highly favorable returns on investment. Unlike greenfield projects, these plants are already licensed, mitigating the time for necessary approvals. Since transmission lines and civil structures are already in place, major rehabilitation costs can also be reduced.

The global ANDRITZ Small Service Business Team (SSB) combines service and maintenance expertise to add value for customers. We provide fast, flexible solutions for unplanned emergencies and planned interventions, ensuring smooth power plant operations. Quality and customer satisfaction are our primary goals.

Service and refurbishment are core competencies of ANDRITZ. With services ranging from operation, maintenance and repairs, digitalization, control and automation, to full refurbishment of complete electromechanical systems, ANDRITZ has the optimal solution for even the oldest hydropower plants.

Unlocking this potential will require a collaborative effort among international financial institutions, consultants, customers, and all stakeholders. Success hinges on collective commitment, supported by flexible, responsive, and coordinated teams. It will take dedication, perseverance, and an entrepreneurial spirit across all involved parties to fully harness Africa's vast dormant energy potential within this decade.

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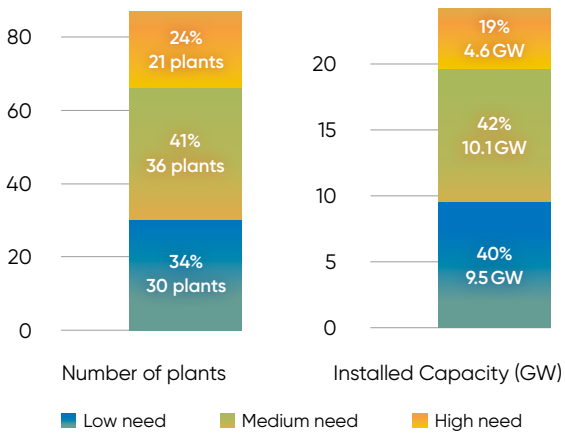
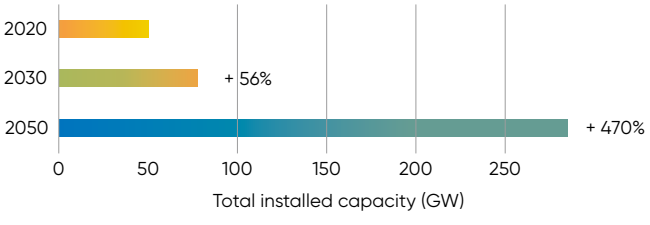
MODERNIZATION NEEDS BY NUMBER OF STATIONS AND INSTALLED CAPACITY



AFRICA AND THE MIDDLE EAST – HYDROPOWER INSTALLED CAPACITY AND EXPECTED CAPACITY IN 2030 AND 2050 (1.5°C PATHWAY, IRENA)



Source: IHA, Continent-wide Mapping of Hydropower Modernisation Needs in Africa

Central Africa

HYDROPOWER MARKET

Central Africa, a region rich in natural resources, holds significant hydropower potential, yet much remains untapped. Countries such as Cameroon, the Central African Republic (CAR), Chad, DR Congo, Equatorial Guinea, Gabon, and the Republic of Congo are at various stages of developing their hydropower resources and face both opportunities and challenges.

Cameroon, with a potential of 115,000 GWh/year, has developed only 4% of this resource, focusing on projects along the Sanaga, Nyong, and Nem rivers. CAR has identified 30 hydropower sites to utilize its 3,000 MW potential, while Chad has developed only a modest 30 MW of capacity. DR Congo possesses Africa's largest hydropower potential at 100,000 MW, with the vast Grand Inga project (40,000 MW) set to impact regional power supply. Equatorial Guinea, Gabon, and the Republic of Congo also seek to expand their hydropower infrastructure, with key projects like Chollet (600 MW) and Sounda (600–1,200 MW). The potential rehabilitation of existing power plants could also lead to significant increases in power generation for the Central African region.

Challenges such as economic instability, infrastructure deficits, underdeveloped grid networks and environmental concerns hinder progress. However, continued investment and regional cooperation could unlock vast clean energy resources, improving electricity access and driving economic growth. With strategic development, Central Africa's hydropower sector can be a pillar of sustainable economic development.

COUNTRIES: 9

ANGOLA, CAMEROON, CENTRAL AFRICAN REPUBLIC, CHAD, DR CONGO, EQUATORIAL GUINEA, GABON, SÃO TOMÉ & PRÍNCIPE, AND REPUBLIC OF CONGO

HYDROPOWER INSTALLED CAPACITY:

8,498 MW

HYDRO GENERATION:

37,912 GWh

POPULATION:

206 MIO

TECHNICALLY FEASIBLE HYDRO GENERATION POTENTIAL:

824,539 GWh

HYDRO CAPACITY UNDER CONSTRUCTION:

3,005 MW

ANDRITZ HYDROPOWER

ANDRITZ has a long history of equipment deliveries to the Central African region. In Cameroon, ANDRITZ has supplied or rehabilitated more than 85% of the nation's installed capacity and has also a strong presence in DR Congo.

The most important project references in the region are Edea, Koni, Ruizizi II, and Songloulou in Cameroon, Mwadingusha and Inga II in DR Congo, Djoué in the Republic of Congo, Kinguélé in Gabon, Cambambe, Matala, Neuville, Luachimo and the hydropower mammoth Laúca in Angola. ANDRITZ has also supplied equipment for Contador – the only hydropower plant in São Tomé & Principe. Please read more about the amazing projects Laúca and Mwadingusha on the following pages.

UNITS INSTALLED BY ANDRITZ:

133

WITH A CAPACITY OF:

5,175 MW

All figures concern 2023;
Sources: IHA 2024 World Hydropower Outlook; International Hydropower & Dams WorldAtlas 2024

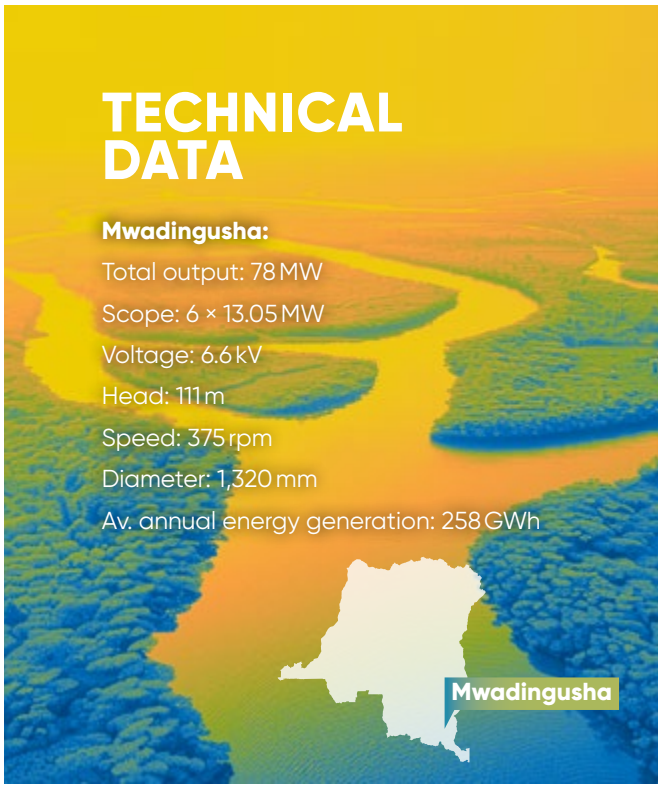
REVITALIZING HYDROPOWER

THE MWADINGUSHA SUCCESS STORY

ANDRITZ, in consortium with CEGELEC and in collaboration with Société Nationale d'Electricité (SNEL), the Sino-Canadian mining group Ivanhoe, and the international consulting company Gruner Stucky, has successfully brought the refurbished Mwadingusha hydropower plant back online. Located in Tanganyika province (formerly Upper Katanga), the plant is a three-hour drive from Lubumbashi, the country's mining capital.

PROJECT STORY — DR CONGO, MWADINGUSHA

Mwadingusha powerhouse and penstocks before rehabilitation



Democratic Republic of the Congo – Originally commissioned in 1930, the plant's original equipment, supplied by the Swiss company Charmilles (now part of ANDRITZ), required a major overhaul and upgrade. In 2016, ANDRITZ received a contract for the comprehensive rehabilitation and modernization of four 11.8 MW Francis generating units along with three new penstocks, intake valves for the upper dam, and various hydromechanical components, such as trash racks, stop logs, safety mechanisms, and valves.

COMPREHENSIVE REHABILITATION AND MODERNIZATION

The ANDRITZ scope of supply for Mwadingusha included engineering, manufacturing, delivery, dismantling of the old units, and the complete installation and commissioning of the new equipment. The contract thus included the four turbines, four generators, speed governors and speed regulations, along with all related equipment and tools for dismantling and erection. Additionally, the contract covered full logistics for the site camps, site office, and storage facilities, allowing more than 200 people to work on-site.

In May 2017, following the engineering optimization of the four original units, an additional order was awarded to ANDRITZ for the two remaining generating units. In parallel with the rehabilitation of other parts of the Mwadingusha complex – such as roads, access bridges and civil works by Gruner Stucky, SNEL and Ivanhoe – ANDRITZ was awarded a further contract for hydromechanical works in December 2017. This contract covered the supply of three new butterfly valves, a penstock manifold, trash racks, motorization of the spillway, and the replacement of the intake valves, safety valves, and stop logs.

Mwadingusha powerhouse and penstocks after rehabilitation

Mwadingusha unit hall after rehabilitation

The full upgrade and modernization project has pushed the installed capacity of Mwadingusha to about 78 MW.

By the end of 2018, another contract was received for the rehabilitation and replacement of the safety valve chambers located in the upper dam. The scope of this work included upgrading the existing overhead crane, the supply and installation of the upper and downstream penstock and gates at the upper dam, and the rehabilitation of the building.

ANDRITZ was also awarded a contract to replace the three horizontal penstocks and gates located between the upper dam and the powerhouse with a very challenging schedule. The scope of works included a new camp for a staff of 30, site logistics facilities such as a 150-tonne crane, scaffolding, chariots for working inside the penstocks, and anti-corrosion protection.

A LASTING IMPACT ON ENERGY SUPPLY

With each generating unit's capacity increased from 11.8 MW to 13.05 MW, the modernization of Mwadingusha is delivering substantial benefits. The additional energy production supports the DR Congo's power grid and contributes directly to industrial operations, including the Kamoa-Kakula copper mine, a key economic driver in the region.

The Mwadingusha project highlights the expertise and dedication of ANDRITZ's service and rehabilitation teams and our world-class manufacturing facilities. The successful completion of this ambitious undertaking is also a testament of the trust placed in ANDRITZ by its partners and customers, as well as our continued commitment to delivering state-of-the-art electro- and hydromechanical solutions.

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A MILESTONE IN ANGOLA'S ENERGY SECTOR

Laúca Hydroelectric Power Plant

PROJECT STORY — ANGOLA, LAÚCA

TECHNICAL DATA

Laúca:

Total output: 2,070 MW
Scope: 6 × 340 MW (Main) / 1 × 72 MW (Eco)
Head: 220 m (Main) / 120 m (Eco)
Voltage: 6 × 18 kV (Main) / 1 × 15 kV (Eco)
Speed: 200 rpm (Main) / 230.77 rpm (Eco)
Runner diameter: 4,700 mm (Main) / 3,190 mm (Eco)
Av. annual energy production: 8,640 GWh

Angola – With a generation capacity of over 2 GW, the Laúca hydroelectric power plant stands as the largest such facility in Angola and is the second largest in Africa. Situated nearly 300 km from the capital city Luanda and on the border between the provinces of Kuanza-Norte and Malanje, construction of the dam created a reservoir spanning nearly 200 km^2. This reservoir has the capacity to hold about 5.5 billion m^2 of water. The main powerhouse, over 270 meters long, features six generating units designed, built, and installed by ANDRITZ, each with a rated power output of 340 MW. In addition, a smaller powerhouse includes an ECO-flow unit producing approximately 72 MW.

The development of the Laúca hydropower plant began in July 2013, with ANDRITZ being contracted in early 2014 to provide the complete electromechanical scope for both powerhouses, transformers, and additional components for the switchyard. This project was developed in the context of Angola's rapidly growing economy, which at the time was one of the fastest growing in the world. As part of the development, the project also had to support and respect

the environment, fauna and flora, and social aspects.

The first turbine was commissioned in July 2017, the last main unit in December 2020. All six units of the main powerhouse have received Final Acceptance Certificate (FAC), while the final unit for the eco-powerhouse, has been operational since April 2023 and is expected to receive the FAC in 2026. All units of Laúca run like clockwork, ensuring the smooth functioning of the plant to the full satisfaction of the owner and operator.

Laúca provides approximately 8,640 GWh of energy per year, significantly increasing the available electrical power and serving as the backbone of modern grid regulation in Angola. Furthermore, the plant's excess capacity enables the operator to schedule equipment maintenance without impacting the network, leading to more efficient administration of Angola's power system.

ANDRITZ also contributed to the development of a skilled local workforce by supplying a new technical training center with modern laboratories close to the power plant. This positive impact extended to the development of additional desirable infrastructure, such as schools and hospitals, benefiting the local population.

Additionally, ANDRITZ's Metris DiOMera system is installed at the Laúca plant. This can support superior management of the power plant by offering remote monitoring and enhanced functionality capabilities such as predictive maintenance. This approach allows maintenance intervals to be considerably extended. And, because of its remote capabilities, these outcomes can be achieved without the need for experts to travel to the powerhouse, resulting in both environmental and economic benefits.

The owner of Laúca, Gabinete de Aproveitamento do Médio Kwanza (GAMEK), is very pleased with the plant's outstanding performance. Angola, with one of the largest hydroelectric potentials in Africa, aims to have two-thirds of its national generation capacity come from hydropower as part of its vision to achieve greater energy access for its people. ANDRITZ is proud to support this goal by contributing to the development of clean, sustainable hydropower through plants like the impressive Laúca hydropower plant.

Birdview Laúca hydropower plant

View of the dam of Laúca hydropower plant

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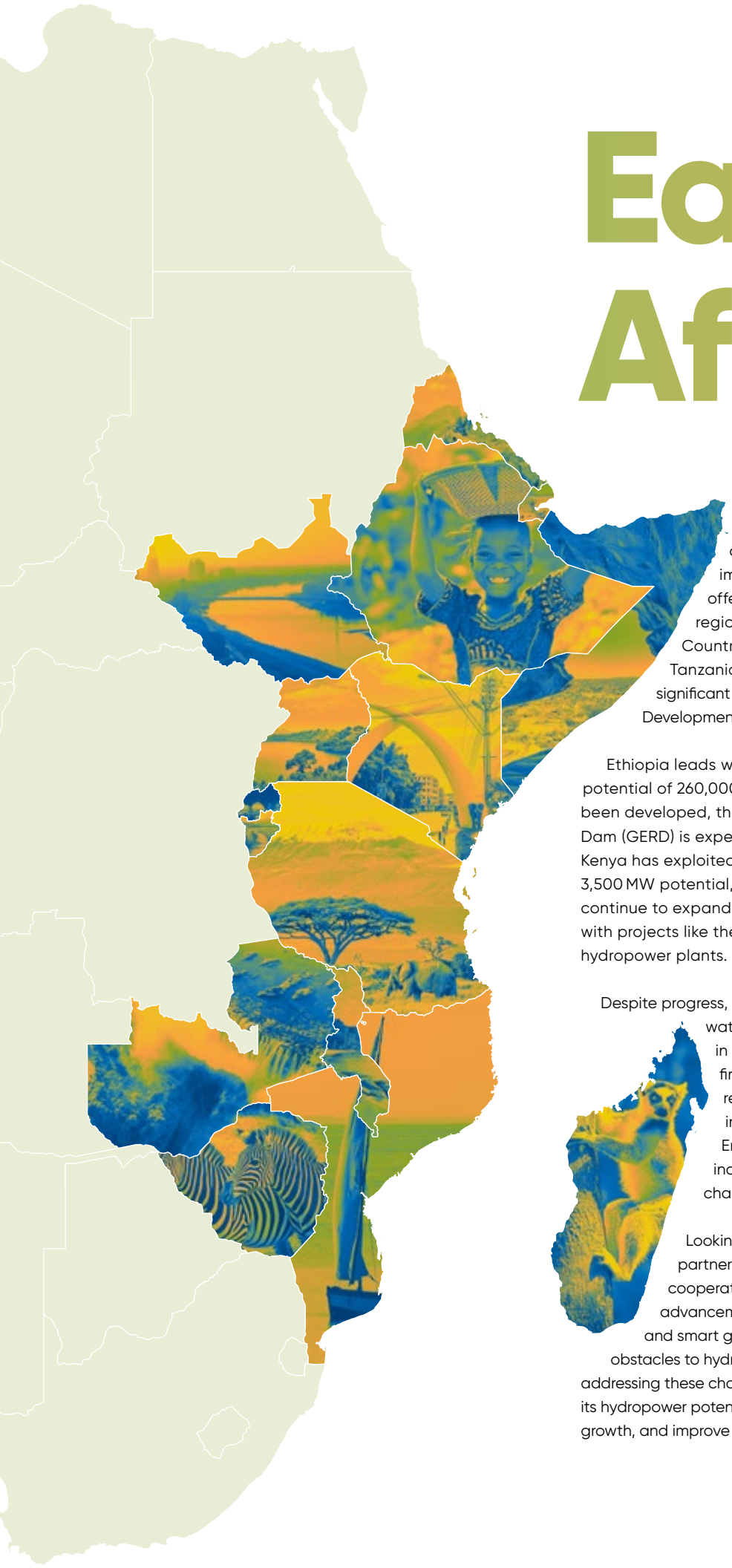
East Africa



HYDROPOWER MARKET

East Africa, endowed with abundant water resources, has immense hydropower potential, offering a key solution to the region's growing energy demands. Countries such as Ethiopia, Kenya, Tanzania, and Uganda have made significant strides in harnessing hydropower. Development, however, remains uneven.

Ethiopia leads with an estimated annual potential of 260,000 GWh. Although only 10% has been developed, the Grand Ethiopian Renaissance Dam (GERD) is expected to increase capacity. Kenya has exploited less than a quarter of its 3,500 MW potential, while Tanzania and Uganda continue to expand their hydro infrastructure with projects like the Julius Nyerere and Karuma hydropower plants.

Despite progress, challenges remain. Unequal water distribution limits feasibility in certain countries, while financial constraints and regulatory hurdles can also impede project implementation. Environmental concerns, including ecosystem disruption, challenge further development.

Looking ahead, public-private partnerships (PPPs), regional cooperation, and technological advancements, such as hybrid systems and smart grids, will be crucial in overcoming obstacles to hydropower development. By addressing these challenges, East Africa can unlock its hydropower potential, promote economic growth, and improve energy access across the region.

COUNTRIES: 20

BURUNDI, COMOROS, DJIBOUTI, ETHIOPIA, ERITREA, KENYA, MADAGASCAR, MALAWI, MAURITIUS, MOZAMBIQUE, RÉUNION, RWANDA, SEYCHELLES, SOMALIA, SOMALILAND, SOUTH SUDAN, TANZANIA, UGANDA, ZAMBIA AND ZIMBABWE

HYDROPOWER INSTALLED CAPACITY:

15,493 MW

HYDRO GENERATION:

71,781 GWh

POPULATION:

487 MIO

TECHNICALLY FEASIBLE HYDRO GENERATION POTENTIAL:

393,396 GWh

HYDRO CAPACITY UNDER CONSTRUCTION:

8,351 MW

ANDRITZ HYDROPOWER

For almost 100 years ANDRITZ has been active and present in East Africa. About 159 units with a total capacity of about 4,244 MW prove the company's commitment to this diverse region. ANDRITZ has been involved in important projects such as Mtera, Pangani Falls and Kihansi in Tanzania, Kiira, Nalubaale, Nyamwamba II and Nkusi in Uganda, Beles and Gigel Gibe, Fan, Tis Abey, and Finchaa in Ethiopia, Kindaruma, Lower Nyamindi, South Mara, and North Mathioya in Kenya, as well as Tedzani , Tedzani II, Tedzani III, Nkula A, and Wovwe in Malawi.

ANDRITZ is now finalizing the works for the Jiji and Mulembwe project in Burundi and has also successfully handed over the last unit of the three-nations Rusumo Falls project shared by Rwanda, Tanzania, and Burundi. Of all the projects you find more information on the next pages.

UNITS INSTALLED BY ANDRITZ:

159

WITH A CAPACITY OF:

4,244 MW

All figures concern 2023;
Sources: IHA 2024 World Hydropower Outlook; International Hydropower & Dams WorldAtlas 2024

A STEP TOWARDS ELECTRIFICATION AND DEVELOPMENT

Jiji and Mulembwe

Pelton runner before installation

Burundi – With less than 10% of its population having access to electricity, Burundi faces a significant energy challenge. This figure is well below the sub-Saharan African average of 44%. However, the country holds immense potential for renewable energy development, particularly when considering hydropower. With an estimated 1,700 MW of untapped hydropower resources across 156 identified sites, Burundi is taking decisive steps toward energy transformation using this resource.

Among the most promising initiatives are the Jiji and Mulembwe hydropower projects, initiated by state-owned utility Regideso in partnership with the World Bank. Located approximately 100 km southeast of the former capital, Bujumbura, in Bururi Province, these two hydropower stations are expected to significantly enhance the national energy landscape.

ANDRITZ was entrusted with delivering the complete electromechanical equipment package for these projects. The scope of supply includes three 11.8 MW horizontal Pelton turbines for Jiji and three 6.1 MW horizontal Pelton turbines for Mulembwe. In addition, ANDRITZ is providing associated key components such as governor oil supply units, main inlet valves, synchronous generators, and cooling systems. The delivery also includes the electric power system, comprising switchyards and transformers, and automation and control equipment. The contract also covers supervision of site installation, commissioning, performance tests, a reliability run, and training.

The project is nearing completion, with commissioning set to begin soon. Once operational, all six units will be synchronized to Burundi's 110 kV national transmission network, nearly doubling the country's installed power capacity. As a result, the projects are expected to significantly enhance the reliability and availability of the national electricity system, thereby directly improving living standards, economic activity, and growth and development of the country.

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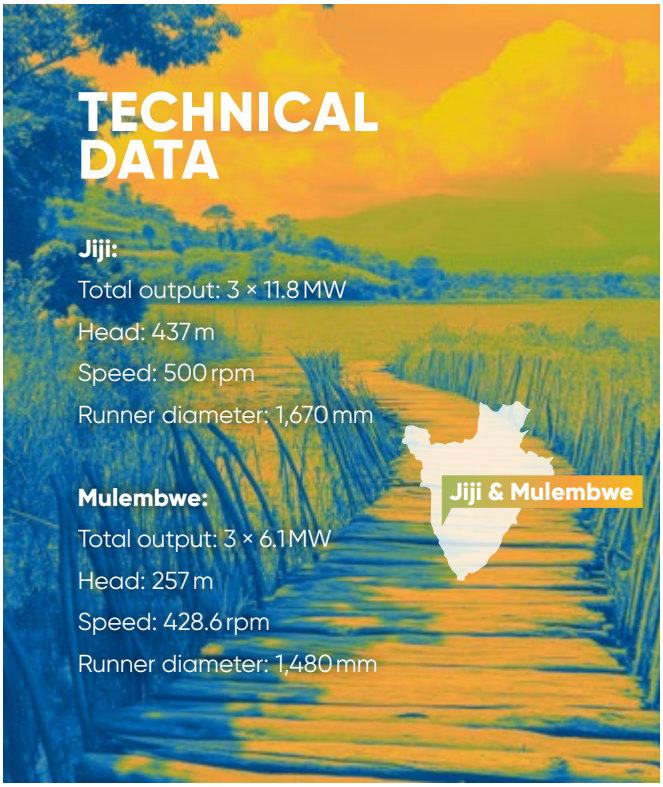

SUCCESSFUL COMPLETION OF CROSS-BORDER PROJECT RUSUMO FALLS

RUSUMO FALLS, BURUNDI, RWANDA, TANZANIA

Rwanda, Tanzania, Burundi – ANDRITZ successfully handed over the final unit (unit 3) of the Regional Rusumo Falls Hydroelectric Project (RRHP) to the client in 2024. This milestone marks the completion of a significant joint hydropower development project by Burundi, Rwanda, and Tanzania.

The RRHP is part of the Kagera Basin Integrated Development Framework, under the broader Nile Basin Initiative (NBI) and its Nile Equatorial Lakes Subsidiary Action Program (NELSAP). Located on the Kagera River, approximately 2 km downstream of the confluence of the Ruvubu and Kagera rivers, Rusumo Falls lies at the border between Rwanda's Eastern Province (Kirehe District) and Tanzania's Kagera Region (Ngara District).

Facilitated by the Rusumo Power Company (RPCL) – a partnership formed through a Tripartite Agreement signed by the three governments in 2012 – with a total capacity of 82 MW the project provides essential power to the people of Burundi, Rwanda, and Western Tanzania. It also supports rural electrification for communities near Rusumo Falls, enhancing local development and regional cooperation.

Despite facing long delays in the civil infrastructure elements, the successful installation, commissioning, and energization of all units has been completed, and the site is being demobilized. ANDRITZ was first contracted in 2016 with the design, supply, installation, and commissioning of the complete electromechanical equipment for the new hydropower plant.

This collaborative effort underscores the project's significance in boosting regional development and cooperation, providing sustainable energy, and improving the quality of life for local communities. ANDRITZ is proud and honored to have been a significant part of this project.

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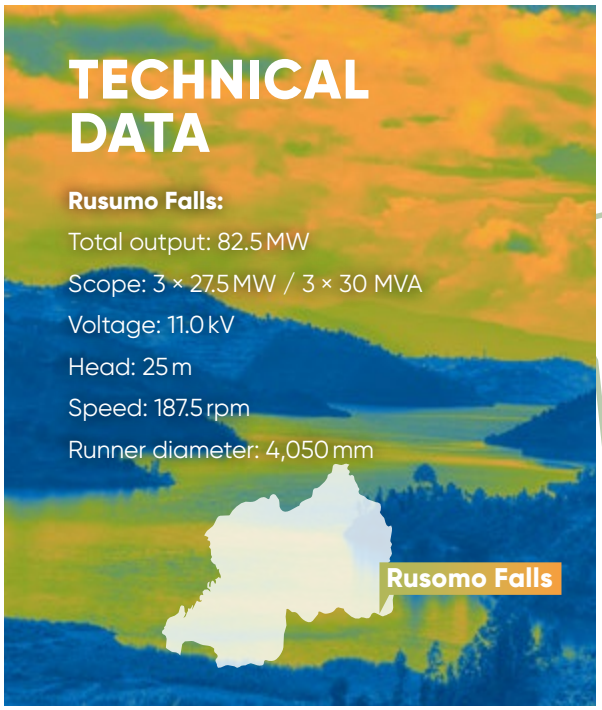
Powerhouse and switchyard of Rusumo Falls

Inside view of the powerhouse



HYDROPOWER AUTOMATION

Realizing the benefits of unified automation and control

Automation systems within hydropower plants perform a number of vital technical functions. This includes applications on the machine level such as generator excitation, protection, turbine governor and synchronization, as well as the overall function of unit and plant control and control center systems.

As a leading supplier of electromechanical equipment, ANDRITZ Hydropower offers a full portfolio of automation systems where decades of experience are combined to deliver optimal solutions. For hydropower automation systems, ANDRITZ equipment and services includes hardware and software products and solutions, installation, commissioning, and operator training based on the specific operational strategy of individual power plants. This is based on factors such as plant age, the local energy market, and whether the unit is manned or not. Automation is needed to guarantee safe and secure operations, maximize efficiency and plant life, and keep operational expenditure to a minimum.

HIPASE, the unified automation platform

With the advent of digital technologies over recent decades, control, regulation, and automation systems for hydropower plants have been completely transformed. Today, the optimal solution is to bring all the different elements of automatic control and regulation onto a single common platform.

HIPASE-250 control center system; Plant overview

HIPASE – THE NEW GENERATION OF INTEGRATION

HIPASE is the automation platform developed by ANDRITZ Hydropower and has evolved from both machine-level and overall plant protection and control systems to deliver a single harmonized solution. HIPASE development was driven by integrating the specific requirements of various applications – including excitation (HIPASE-E), electrical protection (HIPASE-P), the turbine governor (HIPASE-T) and grid synchronization (HIPASE-S) – bringing them together with the extended HIPASE-250 control center system under one harmonized product platform.

The HIPASE platform combines software and embedded devices specifically designed for use in hydropower together with a modern control center system and a unified cross-platform engineering tool, thus ensuring a harmonized engineering workflow across the whole platform.
All HIPASE applications are based on a modular and harmonized approach for both hardware and software components. HIPASE optimizes maintenance and life-cycle management and delivers reduced risks, simplified engineering, maintenance, training, and spare part management. Due to the harmonized platform approach, HIPASE not only offers multiple synergies, such as intuitive and efficient operation via an up-to-date user interface, but provides advanced overall cybersecurity measures. Additionally, HIPASE-embedded devices are optimally protected against unauthorized

external and internal access through a comprehensive and consistent hardware-supported security architecture, which meets the latest security standards. Regular security updates ensure continuous compliance with future security requirements.

The HIPASE-250 control center system offers a completely redesigned user interface that has been developed according to the latest state-of-the-art technology in industrial design. It features comprehensive human-machine-interface functionality such as operating, monitoring, and controlling for all plant processes. Scalability has always been part of HIPASE-250's DNA. It is scalable from local touch operation for unit and gate control up to large central control rooms.

FIRST SUCCESSFUL DEPLOYMENT

HIPASE-250 as part of the unified HIPASE platform integrating all these elements has been deployed at the central control center for the Austrian utility company Verbund Hydro Power GmbH, who operates 113 power plants and more than 300 individual generating units with an installed capacity of more than 8 GW. The main goal of this project was to set up a new central control center to control all the hydropower assets from a central point in Austria. During the project planning phase, it was decided to install an emergency control system in parallel with a new unified and secure platform including the HIPASE-250 control center system. In addition, a centralized engineering tool and a redundant control system were deployed, including independent backup systems for the main and 34 regional fallback control rooms. Furthermore, a separate network infrastructure was installed for the backup system.

This project has enhanced the operational security and efficiency of the company's hydroelectric power plants and serves as an outstanding example of the benefits that can be achieved by hydropower plant operators.

"At Verbund Hydro Power GmbH, we attach great importance to the standardization of our distributed control systems - especially in the area of human-machine interfaces. The new HIPASE-250 precisely fulfils this requirement: it is a flexible HMI with an adaptable data structure that can be easily adapted to individual customer requirements and is designed to be object-oriented".

Stefan Sommerer, Project Manager, Verbund Hydro Power GmbH

Stefan Sommerer further states "ANDRITZ Hydropower stands for professional cooperation at eye level. The team acts with initiative and proactively responds to all requirements."

ANDRITZ Hydropower has been active across Africa and the Middle East for many decades. Recent Automation references include hydropower plants Laúca in Angola, Mwadingusha in DR Congo, Jebba in Nigeria, Kpong in Ghana, Jiji and Mulembwe in Burundi and the three-country hydropower plant Rusumo Falls in Rwanda/Tanzania/Burundi, and the pumped storage plant Abdelmoumen in Morocco, for example. Read more about all these projects in the stories in this issue.

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Southern Africa

HYDROPOWER MARKET

Although Southern Africa holds significant hydropower potential, its development varies from country to country. South Africa has utilized nearly 90% of its feasible hydropower capacity. Namibia, in collaboration with Angola, is developing the Baynes hydropower scheme, while Lesotho is leveraging EU partnerships to encourage renewable energy investments.

Despite these advancements, challenges remain. Several countries, including Botswana and Eswatini, rely heavily on imported electricity, making them vulnerable to supply fluctuations. The effects of climate change, such as extreme weather events, threaten infrastructure and accessibility and require resilient development strategies. Furthermore, complex environmental regulations and slow project implementation are hindering progress in some countries.

Looking ahead, regional cooperation and investment in sustainable hydropower projects are key to unlocking growth. Initiatives such as the binational hydropower project in Namibia and the switch to green energy in Lesotho underscore the promising future of the sector. By addressing existing challenges and promoting renewable energy integration, Southern Africa can strengthen its energy security and drive economic development.

COUNTRIES: 4

BOTSWANA, LESOTHO, NAMIBIA AND SOUTH AFRICA

POPULATION: 72 MIO

HYDROPOWER INSTALLED CAPACITY: 4,083 MW

HYDRO GENERATION: 8,048 GWh

PUMPED STORAGE CAPACITY INSTALLED: 2,912 MW

TECHNICALLY FEASIBLE HYDRO GENERATION POTENTIAL: 27,366 GWh

ANDRITZ HYDROPOWER

ANDRITZ can look back on more than 100 years of business across Southern Africa. It has been involved in major projects throughout the region, having installed and/or rehabilitated 86 units with a total capacity of about 1,148 MW. Important references include Muela in Lesotho, PSPP Steenbras, PSPP Drakensberg, Palmiet, and Stortemelk hydropower plants in South Africa, and Ruacana in Namibia.

Currently, ANDRITZ is executing the small hydro projects Boston Hydro in South Africa and Lower Magaduza in Eswatini. We are pleased to provide more information about these two projects on the following pages.

UNITS INSTALLED BY ANDRITZ:

86

WITH A CAPACITY OF:

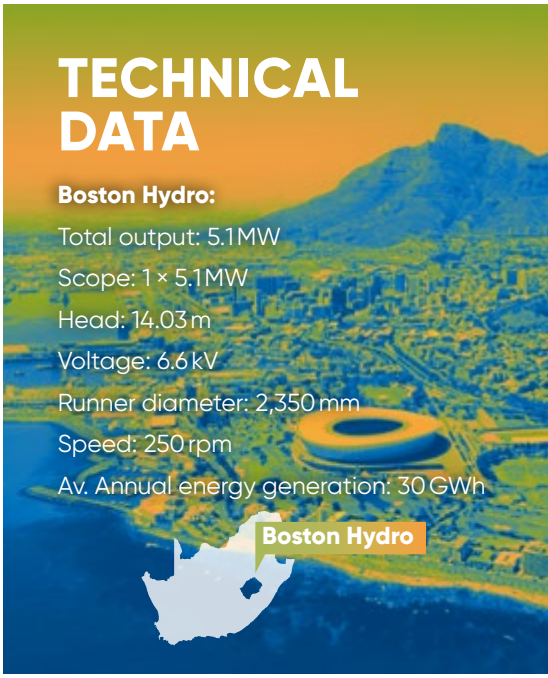
1,148 MW

All figures concern 2023;
Sources: IHA 2024 World Hydropower Outlook; International Hydropower & Dams WorldAtlas 2024

PROJECT STORY — SOUTH AFRICA, BOSTON HYDRO

BOSTON HYDRO

A HYDROPOWER GEM



Successful FAT (Factory Acceptance Test) together with the customer and the customer's engineers in ANDRITZ's manufacturing workshop in Ravensburg, Germany in November 2024.

South Africa – In a significant development, the Boston Hydro project in Free State Province is set to enhance the region's renewable power capacity. Awarded in December 2023, this project underscores the continued trust and successful collaboration between Serengeti Energy and ANDRITZ. It marks the third hydropower contract between Serengeti and ANDRITZ following the Stortemelk hydropower plant, also in South Africa, and Nyamwamba 2 in Uganda.

Located on the Ash River, about 20 km north of the Lesotho/South Africa border and 3 km downstream from the existing ANDRITZ-equipped Stortemelk plant, the Boston Hydro development includes the construction of an entirely new powerhouse.

ANDRITZ's comprehensive "from water-to-wire" contract scope encompasses the supply of a CAT-type turbine, including a hydraulic and digital turbine governor, a sealing and lubrication water supply system, as well as a closed cooling water system. The state-of-the-art automation and control package includes an operator station, indoor medium voltage switchgear, and all necessary cabling. Additionally, ANDRITZ was responsible for the supervision of installation and commissioning, ensuring a smooth transition from construction to operation.

After commissioning mid-2025, Boston Hydro will produce approximately 30 GWh of clean energy annually, contributing significantly to the region's energy needs and sustainability goals.

The project involves close collaboration with consortium partner Ingeteam Indar Machines S.A., which supplied the generator. This partnership ensures that the Boston Hydro plant is equipped with advanced technology, reinforcing its reliability and efficiency.

Boston Hydro stands as a testament to ANDRITZ's commitment to delivering high-quality, turnkey hydropower solutions that drive sustainable energy growth. It will bring lasting benefits to South Africa's energy infrastructure, reinforcing hydropower's role in the global transition to renewable energy.

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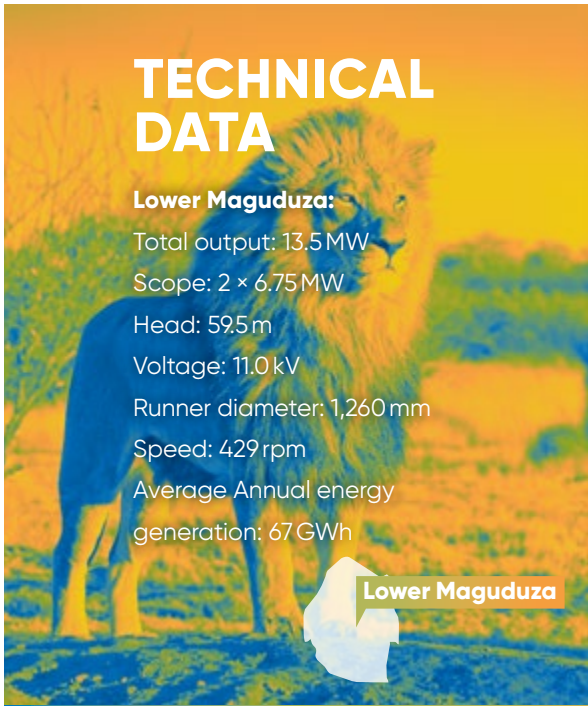
Unloading the CAT-turbine on-site at the Boston Hydro hydropower plant.

A STEP FURTHER IN RENEWABLE ENERGY

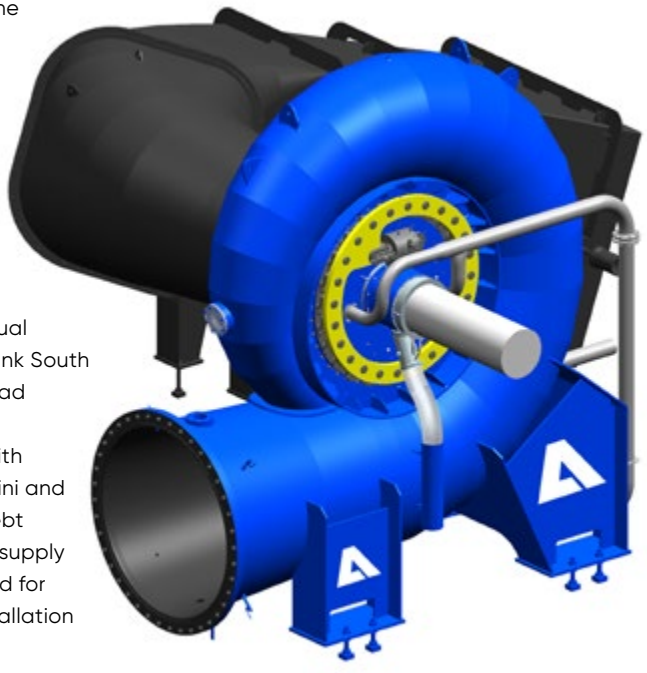
Lower Maguduza Hydropower Project



Eswatini – The Lower Maguduza Hydropower Project marks a significant milestone in Eswatini's energy sector, bringing sustainable power generation to the Manzini region. With a contract awarded to ANDRITZ in February 2025, this project will see a complete new powerhouse built on the Lusutfu River, reinforcing the country's commitment to renewable energy and energy security.

The project was sponsored and developed by ACED, with the IDEAS Fund managed by African Infrastructure Investment Managers (AIIM) and the Eswatini Public Service Pensions Fund (PSPF) as shareholders. It received strong support from Old Mutual Eswatini. Standard Bank South Africa acted as the lead arranger for the debt financing package, with Standard Bank Eswatini and PSPF providing the debt financing. Equipment supply to the site is scheduled for August 2026, with installation and commissioning planned for the last-quarter of the same year.

The scope of supply includes two Francis-type turbines, each with hydraulic and digital turbine governors, a closed cooling water system, and a compressed air system for standstill sealing. Additionally, automation and control equipment will be integrated to ensure efficient and safe operation of the plant.



The scope also includes transport, installation supervision, and commissioning services, ensuring seamless execution from start to finish.

With two generating units, the Lower Maguduza will have a total output of 13.5 MW and an expected annual energy production of approximately 67 GWh. It will make a significant contribution to Eswatini's electricity supply, supporting local industry and communities.

A key partner in this endeavor is Ingeteam Indar Machines S.A., which will supply the generators, highlighting the role of collaboration of regional and international stakeholders to advance sustainable energy solutions in Africa.

The Lower Maguduza project will not only increase local hydropower electricity generation by 20%, but it will also create local jobs and service contracts boosting the region's economy. With state-of-the-art technology, expert engineering, and strategic financial structuring, this project will be a benchmark for future hydropower initiatives in the region.

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COMPACT HYDRO: AFRICA'S SMALL HYDRO SOLUTION

A wealth of benefits can be realized with environmentally friendly modular systems

While Africa is blessed with an abundance of hydropower potential suitable for large-scale development, there is also a wealth of small hydropower opportunities. With demand for more distributed, smaller-scale power generation growing, small hydro is a highly suitable solution, offering all of the same sustainable energy advantages and attractive economics as large hydropower. Quick to install and easy to maintain, it serves an important role in rural development and decentralized or off-grid electrification. Small hydropower also delivers additional benefits such as improved grid stability and support for agriculture, irrigation and flood control. Small hydropower turbines may be deployed in diverse locations beyond conventional rivers and dams, for example, in the cooling systems of thermal power plants or within mine workings, desalination plants and water supply systems.

Small hydro are simple and quick to install and easy to maintain while still providing clean sustainable energy where it is needed.

Jiji, Burundi (35 MW) nearing completion

In the 1990s, after around a century of experience in small hydro applications, ANDRITZ Hydropower created a dedicated business – Compact Hydro – to focus on standardized small hydro applications. To date, this business has supplied or rehabilitated around 12,000 units worldwide with a combined capacity of more than 25,000 MW. ANDRITZ has a long history of projects across the African continent such as Stortemelk, a 4.40 MW project in South Africa, the 40 MW power plant Kashimbila in Nigeria, the 5.7 MW North Mathioya plant in Kenya, and Luachimo in Angola with its 36 MW output, to name a few highlights. The most recent hydropower projects include Jiji and Mulembwe (35 MW and 18 MW) in Burundi, Boston Hydro (5.1 MW) in South Africa and Lower Magaduza (13.5 MW) in Eswatini, which you can read more about in this issue.

THE POWER OF SMALL HYDRO

One application that is increasingly sought after is the use of small hydropower turbines in conjunction with pump systems to develop pumped storage hydro applications. Compact Hydro

Stortemelk, South Africa (4.4. MW)

Luachimo, Angola (36 MW)

is ideally suited to enhance the performance of other forms of renewable generation and ANDRITZ Compact Hydro works in close collaboration with the ANDRITZ Pumps division to create highly optimized small hydro pumped storage solutions across a number of power ranges and available heads. Depending on the specific applications, reversible pump turbines or quaternary concepts with separate pumps and turbines are the most commonly deployed solutions. As with larger pumped storage power plants, smaller storage systems also deliver multiple system benefits such as enhancing flexibility and load balancing for the electricity grid. Pumped storage units can also be deployed using mines or other underground cavities. By utilizing existing infrastructure, the civil engineering costs of developing small hydro pumped storage are minimized. Similarly, where modern and more efficient small hydro technology is used to replace the electromechanical equipment of existing power stations, high performance and reliability can be achieved during redevelopment while increasing the overall lifetime of a plant.

ANDRITZ Compact Hydro has developed a modular design concept, and optimized solutions are thus available for the electromechanical equipment up to an output of 30 MW per unit covering all types of turbines across a wide range of applications. Standardized equipment can often be more cost-effective than tailor-made solutions.

With the continuous development of the product range, larger unit sizes are also becoming increasingly economical while combining several units means a significant energy output can be realized. The electromechanical equipment is also complemented with a wide range of services such as project management, engineering, manufacturing, transport, installation, and commissioning.

While small hydro is an established and well-proven power solution, the continuous drive for innovation has led, for example, to the development of improved environmental performance such as oil-free runner hubs and fish-friendly compact designs for axial turbines in run-of-river plants.

With its commitment to serve customers locally all around the world coupled with its laboratories, test rigs and specialized manufacturing sites, the ANDRITZ Compact Hydro portfolio supports the entire lifecycle of a hydropower plant – "from water-to-wire"

Kashimbila, Nigeria (40 MW)

Mulembwe, Burundi (18 MW) nearing completion

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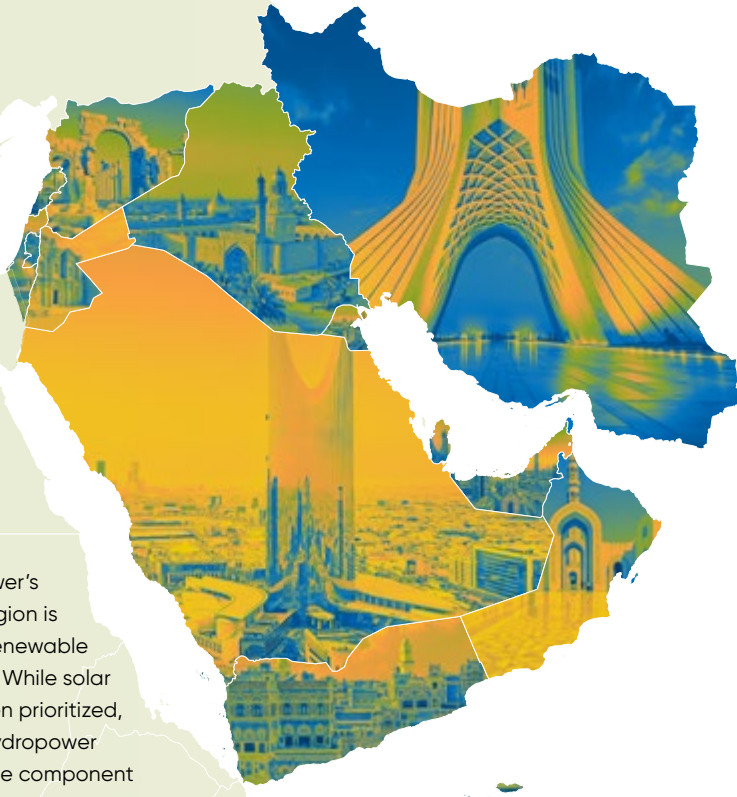
The Middle East



HYDROPOWER MARKET

The Middle East presents a complex landscape for hydropower development, characterized by limited water resources, a mixed economic picture, and changing energy priorities. While the region has traditionally relied on fossil fuels, renewable energy — including hydropower — is gaining attention where feasible.

Israel's hydropower sector remains small due to a lack of large rivers, relying instead on pumped storage projects like the 300 MW Gilboa plant. Lebanon, with 11 dams and a total storage capacity of 246 million cubic meters, has a more established sector, but economic instability is hindering investment and modernization efforts.

Oman and Saudi Arabia, both heavily dependent on desalinated water, have minimal hydropower potential, focusing instead on large-scale solar and wind projects. Oman's 185 dams serve primarily for flood protection and groundwater recharge, while the 564 dams in Saudi Arabia, a country with no natural rivers, are used for irrigation and drinking water supply only.

The UAE is pioneering hydropower in the region with the 250 MW Hatta pumped-storage project aligning with its strategy to generate 44% of its electricity from renewables by 2050.

Despite hydropower's limitations, the region is accelerating its renewable energy transition. While solar and wind are often prioritized, where feasible, hydropower remains a valuable component for achieving energy security and sustainability.

NEOM, a large-scale, futuristic project in Saudi Arabia that includes The Line, a groundbreaking urban development, is setting new standards for city living. By incorporating renewable energy sources such as pumped storage, it is opening up interesting possibilities for hydropower and contributing to accelerating progress towards a sustainable, green energy future across the region.

COUNTRIES: 13

BAHRAIN, IRAN, IRAQ, ISRAEL, JORDAN, KUWAIT, LEBANON, OMAN, QATAR, SAUDI ARABIA, SYRIA, UNITED ARAB EMIRATES AND YEMEN

HYDROPOWER INSTALLED CAPACITY:

17,573 MW

PUMPED STORAGE CAPACITY INSTALLED:

1,580 MW

POPULATION:

279 MIO

HYDRO GENERATION:

21,245 GWh

TECHNICALLY FEASIBLE HYDRO GENERATION POTENTIAL:

91,854 GWh

HYDRO CAPACITY UNDER CONSTRUCTION:

2,779 MW

ANDRITZ HYDROPOWER

Project activities in the region reach back to the 1920s with ANDRITZ turbine equipment deliveries to Syria. Since then, the company has delivered about 128 units with a total capacity of more than 750 MW to the region.

Major generator projects in Iran such as Upper Godvand, Karkeh, Karun 3 and Masjed-E Soleyman are key developments in the reference list and join hydropower projects in Iraq, Israel, Oman, and Lebanon, such as Markabi or Cheikh B.Khoury 3,4, and 5. The latest success in the region is the contract for the pumped storage plant Hatta in the UAE's Dubai, which is currently under construction and of which you can find more information about on the next page.

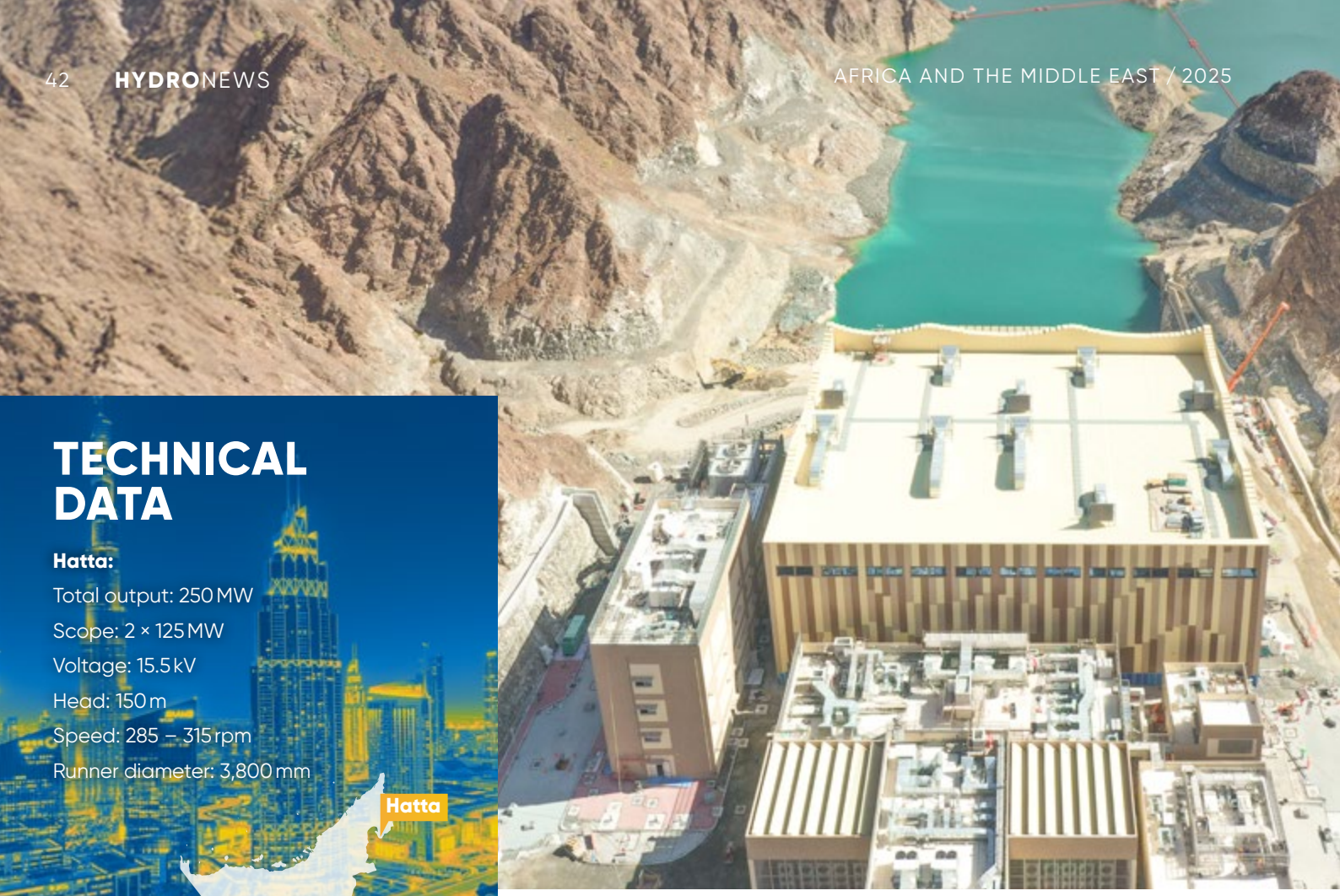
UNITS INSTALLED BY ANDRITZ:

128

WITH A CAPACITY OF:

750 MW

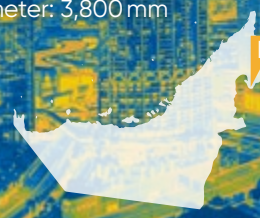
All figures concern 2023;
Sources: IHA 2024 World Hydropower Outlook; International Hydropower & Dams WorldAtlas 2024



TECHNICAL DATA

Hatta:

Total output: 250 MW
Scope: 2 × 125 MW
Voltage: 15.5 kV
Head: 150 m
Speed: 285 – 315 rpm
Runner diameter: 3,800 mm



Lower reservoir and power house, Hatta pumped storage plant

Dubai – the bustling metropolis known for its towering skyscrapers and futuristic infrastructure is now venturing into a new frontier of renewable energy with the construction of the Hatta Pumped Storage Power Plant. This groundbreaking project represents a significant step towards the Emirate's goal of diversifying its energy mix and increasing the share of renewable energy.

The Hatta Pumped Storage Power Plant, located in the inland area of Hatta, is the first of its kind in the Arabian Gulf region. With a capacity of 250 MW, it will be a vital component in Dubai's renewable energy strategy, providing much-needed storage capacity to balance intermittent renewable generation sources like solar and wind power.

In July 2019, the contract to develop the Hatta pumped storage hydro plant was awarded to a consortium comprising Strabag Dubai LLC, Strabag AG, ANDRITZ, and Ozkar by the Dubai Electricity and Water Authority (DEWA). ANDRITZ, a key member of the consortium, designed and delivered the complete electromechanical equipment for two 125 MW Francis-type pump turbines, complete with double-feed asynchronous generators and auxiliary systems.

With an energy storage capacity of 1,500 MWh Hatta is essential for ensuring a reliable energy supply from renewable sources.

These turbines, along with all gates, trash racks, 320 m of penstocks, main inlet valves, main power transformers, gas-insulated switchgear (GIS), and high-voltage cables, will enable the plant to respond quickly to grid demands.

The project features a unique variable speed pumped storage system in which water is pumped to an upper reservoir during periods of low energy demand and released through a 1.2 km-long subterranean tunnel to drive the turbines during peak demand hours. This approach to the pumped storage system was required as a result of the reservoir capacities, which will see the available head vary significantly during operations (from 167 m to 131 m). To keep the units running at a high efficiency during the complete cycle, both pump turbine units are equipped with double-fed asynchronous motor generators that enable variable speed operations. ANDRITZ is one of the few global suppliers to have reference projects and appropriate expertise in the design.

With an energy storage capacity of 1,500 MWh and a lifespan of up to 80 years, the plant will play a long-term role in stabilizing the Dubai grid and ensuring a reliable energy supply for its citizens.

The first filling of the upper reservoir was completed in October 2024 via a temporary system, installed and commissioned by ANDRITZ. During this process, approximately 5.5 million m^3 of water was pumped from the existing lower reservoir. Following this milestone and the

Hatta Pumped Storage Power Plant:

A LIGHTHOUSE PROJECT FOR RENEWABLE ENERGY

successful installation and testing of the hydromechanical equipment at the upper intake, the waterways were emptied by ANDRITZ to allow further dry tests on the main inlet valves, wicket gates and flap gates of Unit 1 and Unit 2.

With completion of pre-assembly works of Unit 1 and Unit 2, the final installation of the pump turbines, asynchronous generators, gas-insulated switchgear, 132 kV high-voltage cables, main power transformers and the related electrical and mechanical balance of plant was completed by the end of 2024.

Working in close cooperation with the owner and operator, Dubai Electricity and Water Authority, and the Employer's Engineer Electricité de France (EDF), ANDRITZ continued to complete the dry commissioning of the plant in early 2025, followed by the start of wet commissioning and trial run of the units. Overall progress of work had reached 95% by the end of 2024.

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Rotor lowering Unit 1, Hatta pumped storage plant

Upper intake Hatta pumped storage plant

Service Excellence

THE ANDRI TURBO GEN

Since the 1950s, ANDRITZ has been at the forefront of turbo generator technology, pioneering advancements in efficiency, machine availability and components reliability. Today, ANDRITZ designs and manufactures high-performance turbo generators with a portfolio that includes units up to 350 MVA at our state-of-the-art facilities in Weiz and Linz, Austria, and Bopal, India. With cutting-edge technology, we are meeting our customers' evolving application needs.

Our commitment to operational excellence extends beyond manufacturing. After delivering the turbo generators, we strive to support our customers around the world throughout the lifetime of the machines through the ANDRITZ Turbo Generator Service department and its partner network. ANDRITZ has supplied well over 1,500 generators worldwide, and after a period of slowdown, the fleet is growing fast again.

As more and more units live well beyond 20 years, we are continuously expanding our service offerings with innovative options for inspections, refurbishments, component replacement, and upgrades.

COMPREHENSIVE SERVICE SOLUTIONS

We provide a full spectrum of services to maintain peak performance, optimize longevity, and minimize downtime, including:

- Major and minor overhauls
- Time- or condition-based maintenance plans linked to operating hours and/or number of starts
- Generator electrical and mechanical testing (NDT) and condition assessments
- Exciter refurbishment
- Troubleshooting and Root Cause Analyses
- Components refurbishments like rotor- and stator rewinds, bearing rebabbitting
- Spare parts deliveries

OVERHAULS AND COMPONENT REPLACEMENT

Routine inspections are crucial in sustaining generator performance and preventing unforeseen failures. In close collaboration with our customers, and in order to minimize the downtime, we develop solutions for prefabricating components, focusing on replacing generator components such as bearing shells, seals, exciter units, as well as renewal and upgrading of instrumentation, excitation and protection systems.

Although we are able to perform a majority of the rotor refurbishments on-site, we recommend that the rewinding of the rotors be carried out at

TZ NERATOR

our facility, where a team of winders, who rewind up to a hundred rotors per year, ensure that the work is carried out properly and with the utmost precision, and that your rotor is balanced at high speed. In addition, an overspeed test is carried out to ensure trouble-free operation for years to come.

Where multiple identical units are considered at one or adjacent sites with similar operating history, we offer an innovative rotor refurbishment program that minimizes downtime.

STATOR WINDINGS REFURBISHMENT

Stator windings conduct high currents under high voltages of up to 21kV. Although designed and manufactured to the highest standards of the time, they are subject to stress-caused ageing and, to some extent, the operating environment. When refurbishment is no longer viable, our team can carry out a stator bar replacement on-site, using the latest insulation material concepts to produce high-quality components that are manufactured in Weiz.

For example, in 2024, we successfully replaced the stator winding at the Tihama power plant in the Kingdom of Saudi Arabia for the state-owned energy supplier SEC. The decision to replace the winding was based on inspections during a previous minor inspection to prevent a generator failure and the resulting unplanned shutdown.

After manufacturing and supply of the stator bars to site, the installation of the new winding was scheduled for the outage season 2023/24. The rewinding was completed within just eight weeks with two shifts. Finally, additional tests were conducted to ensure that the natural frequencies of the winding head were sufficiently far from the frequencies that occur during operation and in the event of a fault.

The project was completed on schedule and to the customer's fullest satisfaction, demonstrating ANDRITZ's ability to execute complex refurbishments efficiently in cooperation with trusted local service partners.

PIONEERING SOLUTIONS FOR THE NEW ENERGY LANDSCAPE

ANDRITZ continues to lead in the design and manufacturing of cutting-edge turbo generators for gas turbines, steam turbines, and combustion engines. With a commitment to the highest efficiencies, best machine availability, component reliability, and long life cycles, our solutions are engineered to meet the demands of a rapidly evolving energy landscape.

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HYBRID TECHNOLOGY AND THE ROLE OF INNOVATION

Powering MENA's future

ANDRITZ has always been at the forefront of innovation, driving forward clean energy solutions that contribute to a more sustainable future. As the world transitions to greener energy, the Middle East and North Africa (MENA) region is taking significant strides in using cutting-edge technologies to reduce carbon emissions and improve energy security. With major investments in hybrid energy systems, advanced hydropower solutions, and innovative energy storage, the MENA region is rapidly positioning itself as a global leader in the green energy transition. ANDRITZ is ready to support this transformation with state-of-the-art technology and expertise, ensuring a sustainable and reliable energy future.

Hybrid energy systems and innovative technologies in the MENA region are driving the green energy transition.

In the drive to curb greenhouse gas emissions, countries across the MENA region are adopting clean energy technologies that work together to create comprehensive, sustainable energy solutions. These hybrid energy systems – combining hydropower with renewables and energy storage – deliver results far greater than the sum of their parts, maximizing efficiency, stability, and sustainability.

PUMPED STORAGE AND PHOTOVOLTAICS (PV)

The United Arabic Emirates (UAE), Saudi Arabia and the broader Middle East are increasingly investing in hybrid energy systems that combine pumped storage and photovoltaic (PV) solar technology. These systems use excess solar energy to pump water to higher elevations during the day. This water can then be released to generate electricity during peak demand periods or when solar power is unavailable. The integration of pumped storage and PV systems is particularly beneficial in regions with high solar irradiance, such as the MENA region, where these systems can provide a reliable power supply round the clock. This approach not only enhances grid stability but also maximizes the use of the available renewable energy. Consequently, the reduction in the use of fossil fuels and associated greenhouse gas emissions is maximized.

INNOVATION AND FUTURE TRENDS

Alongside the development of hybrid energy systems, the MENA region is characterized by the use of innovative technologies across the energy sector that will enable and enhance the green energy transition. Areas of innovation include:

P2X SOLUTIONS AND GREEN HYDROGEN

One way to reach almost zero CO_2 emissions in the future is the utilization of solutions for producing green hydrogen, e-methanol from captured CO_2 and e-ammonia.

Green hydrogen is one of the ways for a long-term, nearly CO_2 free environment. By using the PV and wind electricity generated by solar radiation in the MENA, green hydrogen can be produced. The production ideally works under constant energy supply, which can be ensured by pumped storage hydro power plants in combination with desalination plants, which are needed for hydrogen production based on sea water. E-methanol can be used as a fuel for maritime transport, for example, or as a hydrogen carrier such as e-ammonia.

ADVANCED ENERGY STORAGE

Battery energy storage systems (BESS) are becoming more prevalent in the MENA region. NEOM, including the futuristic, fully sustainable city development The Line, under design and construction in Saudi Arabia, is showcasing a 1.3 GWh off-grid battery application for example. Batteries store excess PV energy, just like pumped storage hydropower plants, but while they are faster reacting, they have far lower energy storage capacity and shorter lifetimes. The development of more efficient and cost-effective battery chemistries and solid-state batteries are expected to further enhance the adoption of BESS in the region.

SOLAR COST REDUCTION

Continuous advancements in PV technology are driving down costs, making solar power more efficient and competitive. Innovations such as bifacial solar panels, which capture sunlight on both sides, and novel semiconductor materials such as perovskite solar cells offer higher conversion efficiencies at lower costs. As a result, the levelized cost of electricity (LCOE) from solar power is decreasing, making it an attractive option for both utility scale and distributed generation projects.

GRID INTERCONNECTIVITY

Enhancing grid connectivity between the Gulf nations is expected to generate substantial →

The 250 MW Pumped Storage Plant Hatta in Dubai, UAE, is a lighthouse project for renewable energy production and bulk energy storage. ANDRITZ is supplying the electro- and hydromechanical equipment for this important project.

economic and energy savings. By creating a more interconnected grid, countries can more easily share excess power, balance supply and demand, and improve overall system reliability. Projects like the Gulf Cooperation Council (GCC) Interconnection Authority are working towards creating a unified grid that can facilitate the seamless exchange of electricity across borders, promoting regional energy security and sustainability.

Saudi Arabia and the Middle East are increasingly investing in hybrid energy systems to reduce the use of fossil fuels and the associated greenhouse gas emissions.

HYDROPOWER

While hydropower is less common in the region due to the generally arid climate, lighthouse projects like the Hatta pumped storage power plant in Dubai are nonetheless an important part of the region's shift towards clean energy. Pumped storage power plants function as a backbone to stabilize and support the grid and as a large scale water battery to optimize the use of renewable energy by storing any excess power from wind and solar when it is available for use when renewable generation does not meet the total demand. The Hatta project not only works as a battery to deliver electricity during night but also helps manage precious water resources. As a closed loop system, in which water is transferred between two reservoirs during the fill and discharge cycle, projects like Hatta demonstrate a highly efficient and flexible way to maximize the use and value of the available water.

In addition to large-scale pumped storage and traditional hydropower, there is also the potential for small-scale hydropower projects in areas with suitable topography. These projects can provide localized energy solutions and contribute to the diversification of the energy mix in the region, and can also support the grid due to modern, large and flexible operation ranges.

In addition to their vital role in enabling the transition to green energy, hydropower projects are also critical assets for general water management, supporting other vital regional functions such as irrigation.

DESALINATION

Due to limited freshwater resources, desalination is a crucial technology for the Middle East. Innovations in this field include integrating renewable energy sources, such as solar or hydropower, to reduce the carbon footprint of desalination plants. Solar desalination systems, for example, can use either solar thermal energy or photovoltaic power to drive the desalination process, making it more sustainable and cost-effective.

Advanced desalination technologies, such as reverse osmosis (RO) and forward osmosis (FO), are also being developed to improve process efficiencies and reduce energy consumption. By combining these technologies together with low-cost renewables, the Middle East can address its water scarcity challenges

By providing reactive power supply ANDRITZ's Synchronous Condensers are essential for supporting the integration of volatile renewable energy sources, ensuring grid stability and reliable power supply.

Battery energy storage systems (BESS) are becoming more important in the MENA region, supporting reliable power supply.

while minimizing the environmental impact of widespread desalination.

PUMPS

Efficient pumping systems are essential for both water supply and energy storage projects. Innovations are currently focused on improving efficiency and reducing energy consumption as well as improved longevity. For example, variable speed pumps can adjust their operation based on demand, reducing energy use and operational costs. Additionally, advancements in materials and design are leading to more durable and reliable pumps that require less maintenance.

SYNCHRONOUS CONDENSERS

These devices are used to stabilize the grid by providing reactive power support and enhancing voltage stability. This functionality is especially important in grids with high renewable energy penetration where synchronous condensers can help manage the variability of renewable energy sources. They also play a crucial role in maintaining grid frequency and supporting the integration of distributed energy resources, ensuring a stable and reliable power supply. There is a growing demand for these kinds of solutions in the MENA region.

THE LINE

A revolutionary urban development project in Saudi Arabia and part of the NEOM initiative, The Line is a sustainable city concept with zero cars, zero streets, and zero carbon emissions. A key element of the NEOM vision is the development of an ambitious pumped storage hydropower network. With an installed capacity of some 2,100 MW, the first phase is known as Nestor 1. Designed to be a linear city stretching 170 kilometers with a focus on walkability and accessibility, The Line will feature high-speed transportation systems, green spaces, and smart infrastructure to enhance the quality of life for its residents. It will rely heavily on renewable energy sources and advanced technologies like AI and IoT to create a futuristic living environment.

Leveraging the most advanced cutting-edge technologies and sustainable practices, The Line aims to set a new standard for urban living and contribute to Saudi Arabia's Vision 2030 goals.

By exploring and embracing both hybrid technologies and energy innovations that can enhance the role of hydropower and other renewable energy technologies, the MENA region is becoming a flagship for green transition technologies for the whole of Africa. ANDRITZ is ready to work in partnership with our customers to accelerate the move to a sustainable energy future using the full suite of available top-tier energy solutions.

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HYDROPOW

AFRICA & THE MIDDLE EAST

AFRICA

COUNTRY/ TERRITORY	TOTAL INSTALLED CAPACITY* (MW)	PUMPED STORAGE (MW)	GENERATION (TWh)
ALGERIA	269	0	<1
ANGOLA	3,836	0	11
BENIN	33	0	<1
BURKINA FASO	33	0	<1
BURUNDI	99	0	<1
CAMEROON	822	0	6
CENTRAL AFRICAN REPUBLIC	19	0	<1
COMOROS	1	0	0
CONGO	218	0	1
COTE D'IVOIRE	879	0	3
DEMOCRATIC REPUBLIC OF CONGO	3,142	0	14
EGYPT	2,876	0	15
EQUATORIAL GUINEA	128	0	<1
ESWATINI	63	0	<1
ETHIOPIA	4,825	0	15
GABON	331	0	2
GHANA	1,584	0	9
GUINEA	1,156	0	3
KENYA	837	0	3
LESOTHO	73	0	1
LIBERIA	93	0	<1
MADAGASCAR	213	0	1
MALAWI	391	0	2
MALI	360	0	1
MAURITANIA	48	0	<1
MAURITIUS	61	0	<1
MOROCCO	1,770	465	1
MOZAMBIQUE	2,217	0	16
NAMIBIA	347	0	2
NIGERIA	2,851	0	8
RÉUNION	134	0	1
RWANDA	143	0	1
SÃO TOMÉ & PRÍNCIPE	2	0	<1
SENEGAL	81	0	<1
SIERRA LEONE	64	0	<1
SOUTH AFRICA	3,600	2,912	6
SUDAN	1,923	0	7
TANZANIA	824	0	2
TOGO	66	0	<1
TUNISIA	66	0	<1
UGANDA	1,503	0	6
ZAMBIA	3,164	0	17
ZIMBABWE	1,081	0	6
TOTAL	**42,225**	**3,377**	**175**

* Including pumped storage

THE MIDDLE EAST

COUNTRY/ TERRITORY	TOTAL INSTALLED CAPACITY* (MW)	PUMPED STORAGE (MW)	GENERATION (TWh)
IRAN	12,719	1,040	15
IRAQ	2,756	240	7
ISRAEL	307	300	<1
JORDAN	4	0	<1
LEBANON	282	0	<1
UNITED ARAB EMIRATES	0	0	0
SYRIA	1,505	0	1
TOTAL	**17,573**	**1,580**	**26**

* Including pumped storage

Source: IHA 2024 World Hydropower Outlook

ER IN FACTS

(FIGURES OF 2023)

HYDROPOWER IN AFRICA

Generation by Hydropower incl. PSP
175 TWh

Total installed capacity
42,225 GW

Capacity added in 2023
~ 2 GW

Pumped storage installed capacity
3,377 MW

Technically feasible hydropower potential
1,617 TWh
per year

Hydropower potential already harnessed
10%

Remaining hydropower potential
90%

Population
1,479 mio

Sources: The WorldBank; IHA 2024 World Hydropower Outlook; Hydropower & Dams World Atlas 2024

ANDRITZ HYDROPOWER

Installed and/or rehabilitated:
about 650 units

with a total capacity of
17,400 MW

For more than 100 years, ANDRITZ has been a driving force in the hydropower sector in Africa and the Middle East. With ANDRITZ's commitment to efficiency and cutting-edge technology, new projects and modernizations pave the way for a stable energy future. Through regional cooperation and hybrid energy solutions, Africa and the Middle East can achieve energy security and lead the way to a cleaner, greener world. ANDRITZ is ready to support countries in this challenging journey with a wide range of products and services and a dedicated and experienced team.

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