



SUN, WIND AND HYDROPOWER

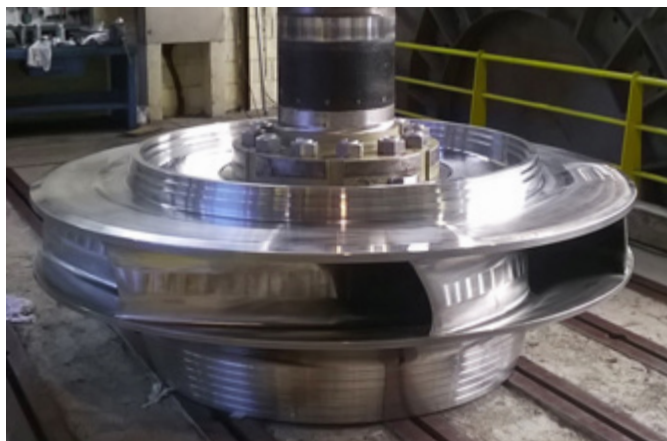
Once at the heart of the world's first global empire, today Spain is a modern and developed country with the world's 14th largest economy. Spain's enduring cultural legacy includes half a billion Spanish-speaking people worldwide, making it the second most widely spoken language.

Spain has a strong commitment to the development of renewable energy. By 2017 renewables represented 46% of the total installed power generation capacity in Spain. With 23,132 MW of wind power capacity installed, the country is one of the world leaders. A further 4,687 MW of solar PV puts the country into the top 10 countries in terms of installed solar PV capacity too. Spain also led the world as the first country to develop concentrated solar power (CSP). However, although Spain already has a very high share of renewables, there is still a long way to go to achieve its ambitious renewable energy targets of 70% of total electricity production by 2030 or the goal of zero emissions by 2050. To reach these goals much more investment into renewables and deployment of smart-grids will be needed, alongside

government support in the form of development programs, as well as the closure of existing thermal power plants.

Most of the installed hydropower base of 20,360 MW is conventional hydropower with some 3,329 MW of pumped storage within this total. Pumped storage plays a major role in balancing the intermittent resources of renewable electricity generation, helping to stabilize the grid and provide peak power load. As a result, throughout Spain there are a number of pumped storage hydropower projects in the planning and permission phase. In addition, an interesting market for service and rehabilitation of hydropower plants exists as the average age of the country's hydropower fleet is more than 40 years.

Bolarque, Tagus River



San Pedro, Sil River, Galizia





Aldeávila, Douro River

“Spain is home to the world’s largest renewable energy operator.”

ANDRITZ HYDRO IN SPAIN

ANDRITZ Hydro has contributed to the development of hydropower in Spain since its beginnings at the end of the 19th century. The company has played an active role in Spain ever since and some 60 years ago established a Spanish company and workshops in Algete/Madrid. This organization provides customized solutions and products not only to the Spanish market and neighboring Portugal, but also to numerous projects in Central and South American markets.

RIBARROJA, EBRO RIVER, TARRAGONA

In 2018, ANDRITZ received a contract for the refurbishment and environmental improvement of Kaplan turbine units #1, #3, and #4 at the Ribarroja hydropower plant. Rated at 79 MW each, the scope of supply includes conversion into oil-free units. With a diameter of 5,800 mm, these will be the biggest Kaplan runners in Spain using oil-free

technology. Commissioning of the first unit took place at the end of 2018. The second and third units are scheduled for commissioning in 2019 and 2020 respectively.

SAN PEDRO, SIL RIVER, GALIZIA

To meet current environmental standards, a contract for the conversion of two 16 MW Kaplan turbines into oil-free units was awarded to ANDRITZ in 2018. These will be the biggest Kaplan runners refurbished to date in our Madrid facilities. Commissioning of the second unit is expected to take place in December 2019.

BOLARQUE, TAGUS RIVER

Repowering of four pump-turbine units together with the main inlet valve was the objective of a contract awarded to ANDRITZ in 2015 for the Bolarque pumped storage plant. The units each have a capacity of 55 MW. High efficiency levels in both turbine and pump mode will be achieved after the rehabilitation is complete. The commissioning of the last unit is scheduled for 2019.

ALDEÁVILA, DOURO RIVER

ANDRITZ received a contract for new runners in order to extend the lifetime of the largest hydropower plant in Spain, the Aldeávila hydropower plant. As a fundamental element in the regulation of the Spanish national grid, the units run over a very wide operational range, alternating from very low partial load to full load frequently. This regime exposes the units to severe operational conditions. The successful recommissioning of the units was completed in 2017.

EL HIERRO, CANARY ISLANDS

ANDRITZ supplied the electro-mechanical equipment for a small pumped storage power plant on El Hierro, the smallest and most southerly of the Canary Islands. This hydropower facility is replacing a diesel-fueled generation plant and is stabilizing variable energy production from a wind farm on the island. This not only ensures energy self-sufficiency for the island, but also allows energy exports to neighboring islands.

GENERAL FACTS

Population: **46,572 Mio.**
 Access to electricity: **100%**
 Installed hydro capacity: **20,360 MW**
 Share of generation from hydropower: **7%**
 Hydro generation per year: **18,364 GWh**
 Technically feasible hydro generation potential: **61,000 GWh**

ANDRITZ HYDRO IN THE COUNTRY

Installed and/or rehabilitated capacity: **9,323 MW**
 Installed and/or rehabilitated units: **630**
 Locations: **Algete/Madrid**

TO KNOW