



ANDRITZ CAPITAL MARKET DAY 2021

HYDRO

WOLFGANG SEMPER





SEPTEMBER 15, 2021

ANDRITZ

ENGINEERED SUCCESS

REVIEW CMD 2019: ROADMAP 2020-2022

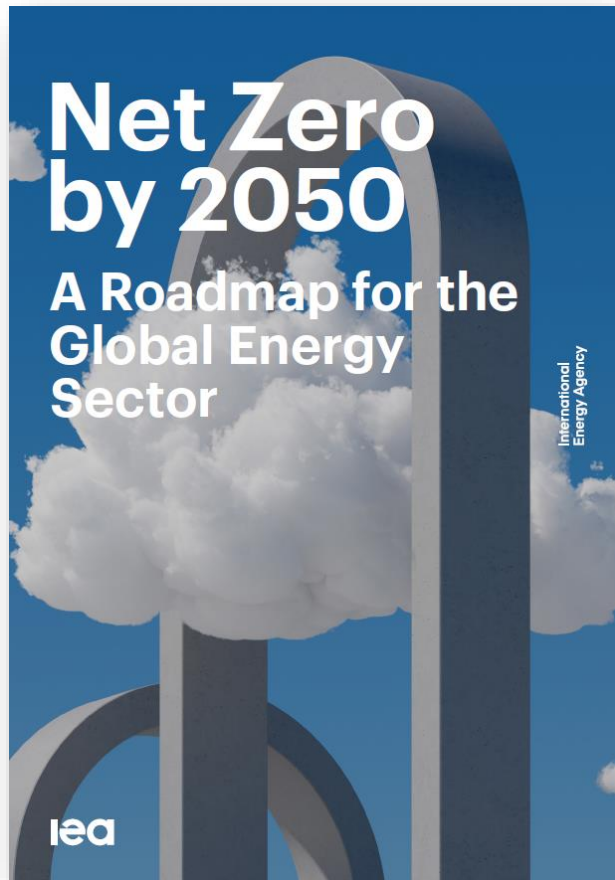


TARGET	STATUS
<ul style="list-style-type: none">• Continue with structural adjustments in Hydro	Hydro capacities adjusted to market volume  Achieved
<ul style="list-style-type: none">• Continuing capacity adjustments	Closing and right-sizing of locations in Europe and Latin America led to leaner business structures and headcount reduction  Achieved
<ul style="list-style-type: none">• Secure earnings and profitability by correct sizing and reducing negative project deviations	Significant reductions in OPEX and gross expenses ensured a reasonable profit before NOI in 2020 despite COVID  Achieved
<ul style="list-style-type: none">• Focus on O&M and digitalization	<ul style="list-style-type: none">• Good development of O&M contracts, Recent O&M contracts: Kidston, Cerro del Aguila, Preshago• HIPASE launching version 2.0, fully integrated control & protection of turbines and generators with embedded cyber security features  Achieved

INTERNATIONAL ENERGY AGENCIES



Net Zero by 2050 – A Roadmap for the Global Energy Sector



In its Net Zero Emissions scenario, while solar PV and wind power are projected as generating the vast majority of electricity, **global hydropower capacity will also need to significantly grow, “doubling by 2050”**.

The report **emphasizes the role pumped storage hydropower can play in the energy transition**, stating that it **“offers an attractive means of providing flexibility over a matter of hours and days”**.

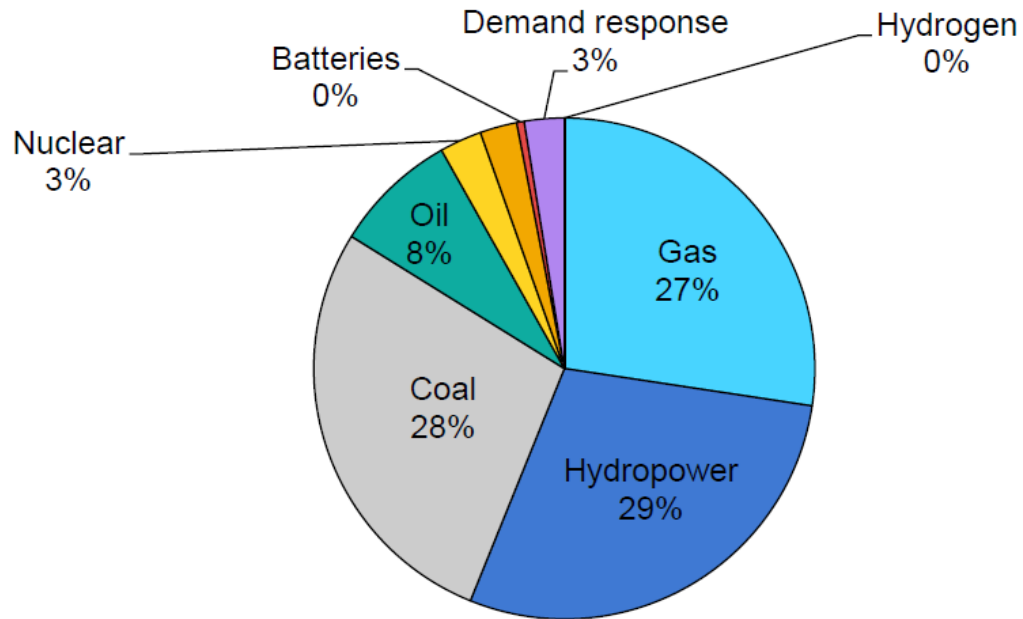
Francesco La Camera, Director-General of IRENA, said: “IRENA’s Global Renewables Outlook estimates that an **additional 850 GW of hydropower is required by 2050 for the world to stay on a climate-safe track** in line with the Paris Agreement. There is therefore an urgent need to boost sustainable hydropower.”

HYDROPOWER PLANTS ARE A PRIMARY CONTRIBUTOR TO SYSTEM FLEXIBILITY



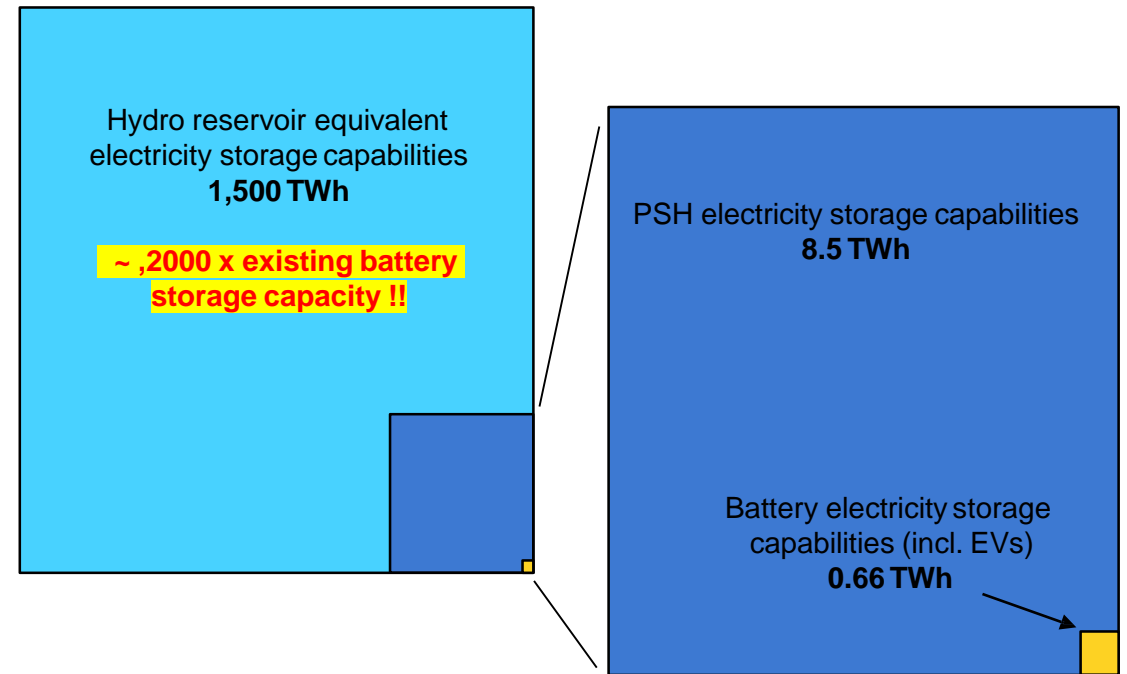
With low operational costs, existing reservoir hydropower plants are the most affordable source of flexibility today, while pumped storage and battery technologies are increasingly complementary in future power systems

Global electricity system flexibility by source, 2020



Source: IEA (2021b), Net Zero by 2050: A Roadmap for the Global Energy Sector.

Storage capabilities of hydropower plants and batteries (1 full cycle)



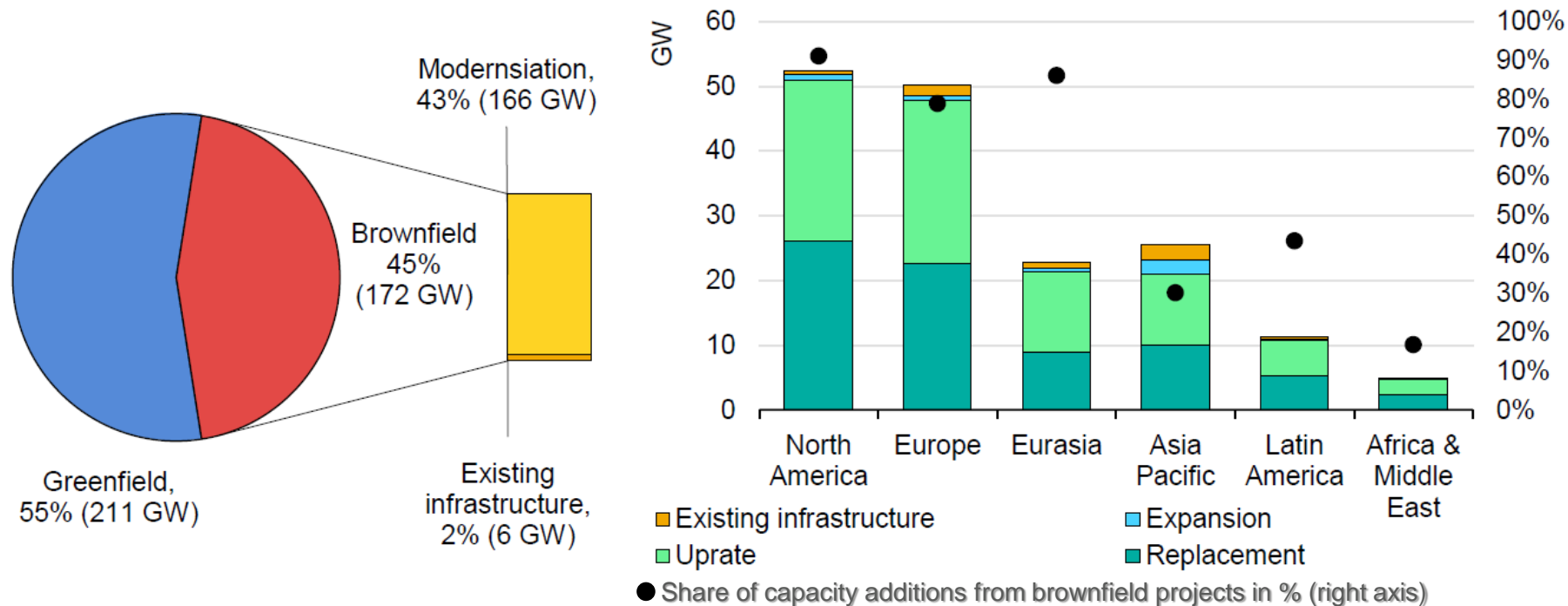
Source: IEA, June 2021, Hydropower Special Market Report

SOLID MARKET OUTLOOK FOR HYDROPOWER



Greenfield and brownfield outlook

Gross capacity additions by project type 2021-30 globally (left) and by region for brownfield projects only (right)



Between 2021 and 2030, **new hydropower turbine installations**, also referred to as **gross capacity additions**, are expected to reach more than **380 GW**.

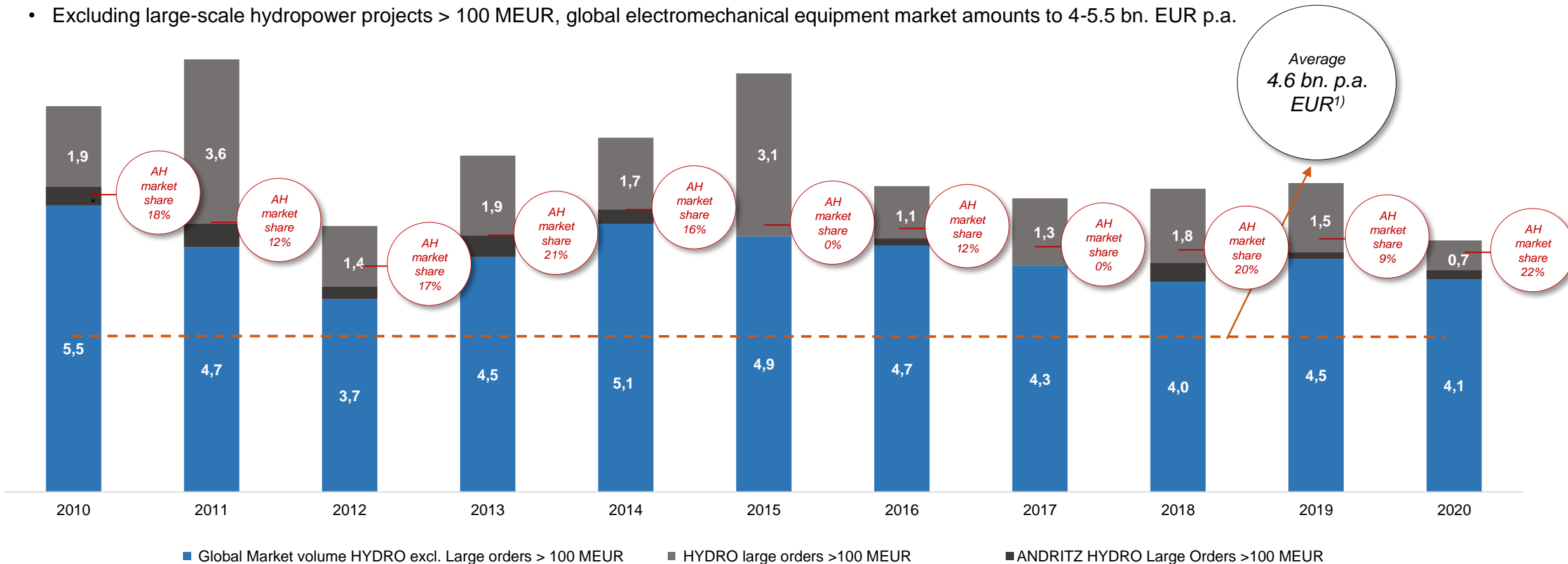
Note: Existing infrastructure refers to projects where there are some portion of the civil works already in place but is not yet powered. This includes non-powered dams, conduits, municipal water facilities and reservoirs that exist either naturally or man made.

GLOBAL MARKET FOR E&M EQUIPMENT



Market volatility mainly caused by large scale projects

- Change/reduction of global market volume mainly caused by large-scale hydropower projects > 100 MEUR
- Excluding large-scale hydropower projects > 100 MEUR, global electromechanical equipment market amounts to 4-5.5 bn. EUR p.a.



Source: ANDRITZ * bn. EUR ¹⁾ Average global market volume for electro-mechanical equipment below 100 MEUR per project

SUSTAINABLE SOLUTIONS/PRODUCTS



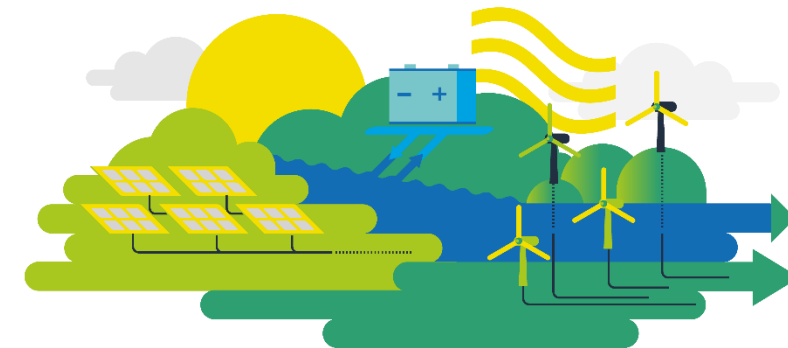
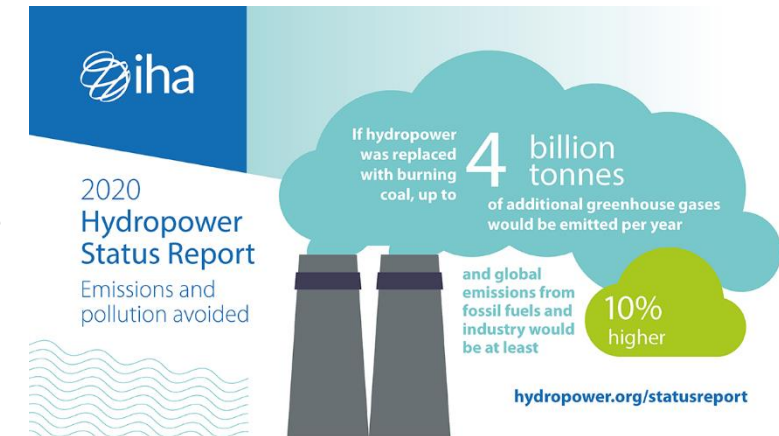
How can ANDRITZ contribute to climate neutrality and climate protection with our products?

- **Low-carbon and pollution-free**

- Hydropower generates more than 4,000 terawatt hours of electricity globally every year, enough to supply over 1 billion people with clean energy (IHA, IEA).
- If hydropower was replaced with burning coal, IHA estimates that more than 4 billion tons of additional greenhouse gases would be emitted annually, and global emissions from fossil fuels and industry would be at least 10 per cent higher.
- There would also be 150 million more tons/y of air polluting particulates emitted.
- **ANDRITZ with its globally installed fleet of turbines and generators contributes to these emission savings with about 900 mill t/y.**

- **Charging up variable renewables**

- Hydropower is an ideal complement and a catalyst to variable renewables like wind and solar, thanks to its flexibility and energy storage services.
- Hydropower can meet demand when these intermittent sources are unavailable.
Pumped storage hydropower, operating like a green, rechargeable battery, absorbs energy when supply exceeds demand.



SUSTAINABLE SOLUTIONS/PRODUCTS



Our products

- **Electromechanical equipment for hydropower plants**
 - 32,000 turbines with a total output of 470,000 megawatts have been installed or refurbished to date
- **Modernizations and retrofitting of turbines and generators**
- **Offshore solutions: Tidal current turbines, tidal lagoon hydropower plants**
- **Asset Management Services: O&M, long-term Service Agreements, Monitoring & Optimization**
- **Process Pumps for various industries**
- **Engineered Pumps for water transportation, desalination and special applications**



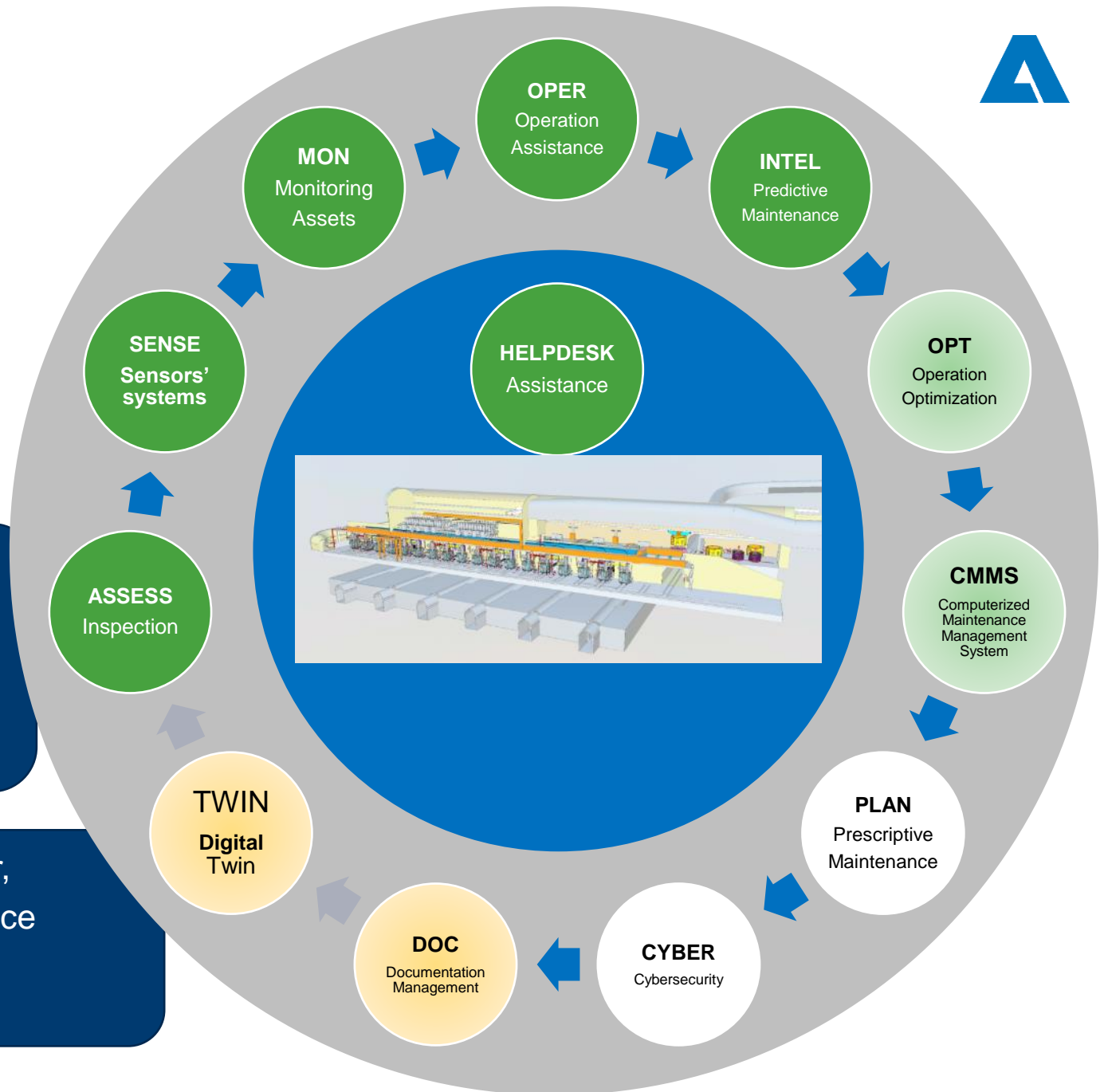
METRIS DIOMERA: ASSET MANAGEMENT PLATFORM



→ Tools, processes and techniques supporting the management of assets on a day to day basis within the O&M life cycle of the asset

Continuous real-time risk based fingerprint of hydropower assets that helps for diagnostics, supports maintenance planning and operation optimization, with respect to defined short and long term KPIs.

Delivered as a service and used jointly with operator, DiOMera is continuously enriched from the experience gained from all plants that are followed via DiOMera worldwide.



ENVIRONMENTAL PERFORMANCE



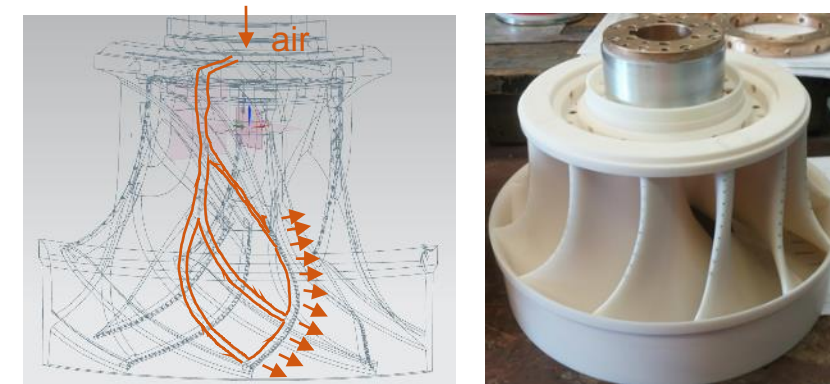
Oil-free design / Fish friendliness / Dissolved Oxygen

TARGET

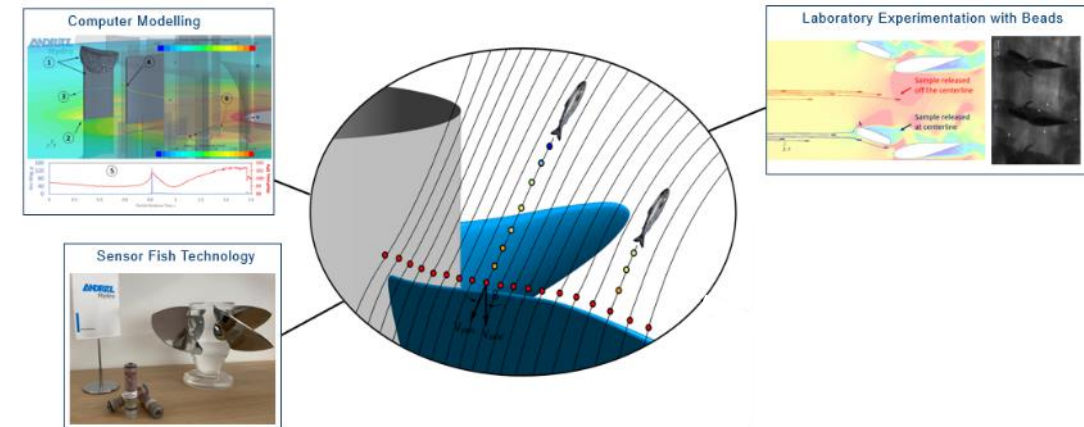
- **Continue R&D efforts** to maintain position as a competent and **leading partner in environmental questions**

MARKET POTENTIAL FOR PRODUCTS AND RELATED SERVICES

- **Oil-free design** – ANDRITZ with 120+ references is leading the industry
- **Fish friendliness** – increasing awareness in the US and just recently in Europe, in particular cases (Xayaburi) in Asia; international institutes confirm encouraging results of efficient ANDRITZ design with sensor fishes
- **Dissolved Oxygen via Runner** – downstream oxygen content will be raised to the ecologically favorable range via turbine operation



Aerated runner blade



Methods to assess fish mortality properties

FLEXIBILITY AND GRID STABILITY



New Generator Technologies

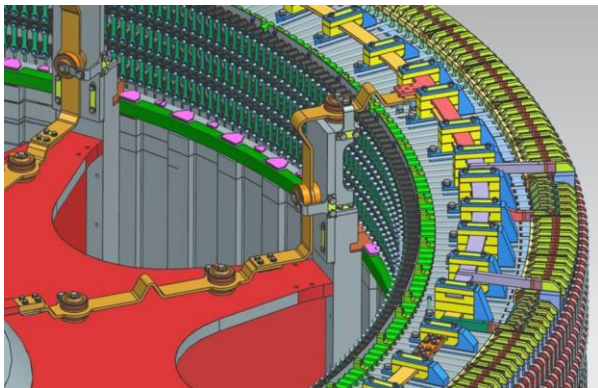
- **Variable Speed DFIM (Double Fed Induction Machine):** approx. +/- 7 % speed range
- **Variable Speed (full size converters):** ≈ 50% speed range, other base frequency
- **Synchronous Condenser:** Providing reactive power and inertia to the grid, new customers

Why Variable Speed?

- Regulation of pump input power
- Speed adjustment for optimum operation (efficiency, stability)
- Needed for large head variation and special grid services

Variable Speed DFIM:

ANDRITZ took the lead: 4 projects now

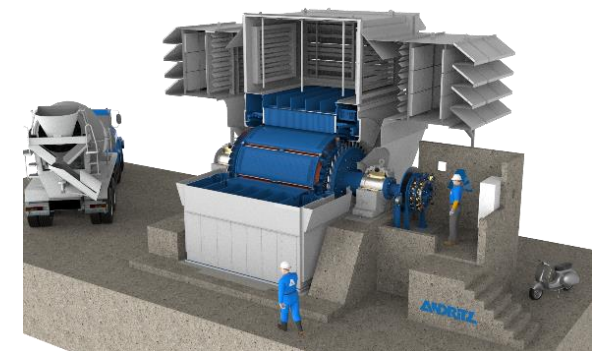


Kühtai II: 2 x 95 MVA, first full size converter fed synchronous generator



Synchronous Condensers:

first projects in execution in Brazil, Australia, USA



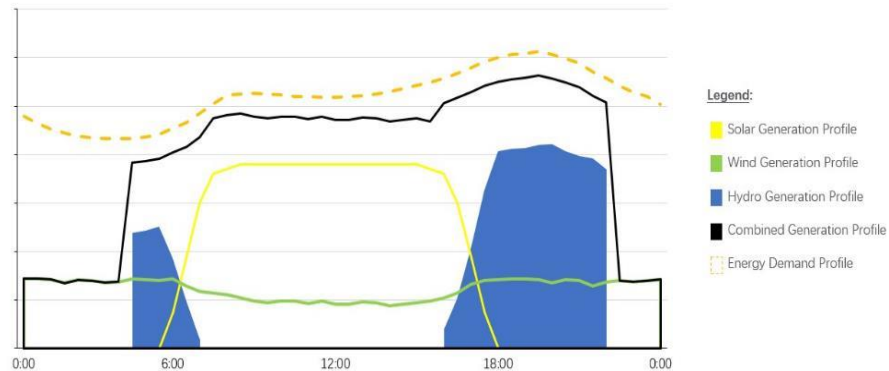
KIDSTON RENEWABLE ENERGY HUB



The World's first dispatchable renewable energy plant

**New energy concepts based on hybrid solutions
balancing the energy before stressing the grid**

- Combination of a solar and wind power station with a pumped storage plant



Kidston / Australia

2 x 125 MW reversible pump turbines

Main focus: **supply balanced energy into the grid!**



NORTH AMERICA – MODERNIZATION AND UPGRADE



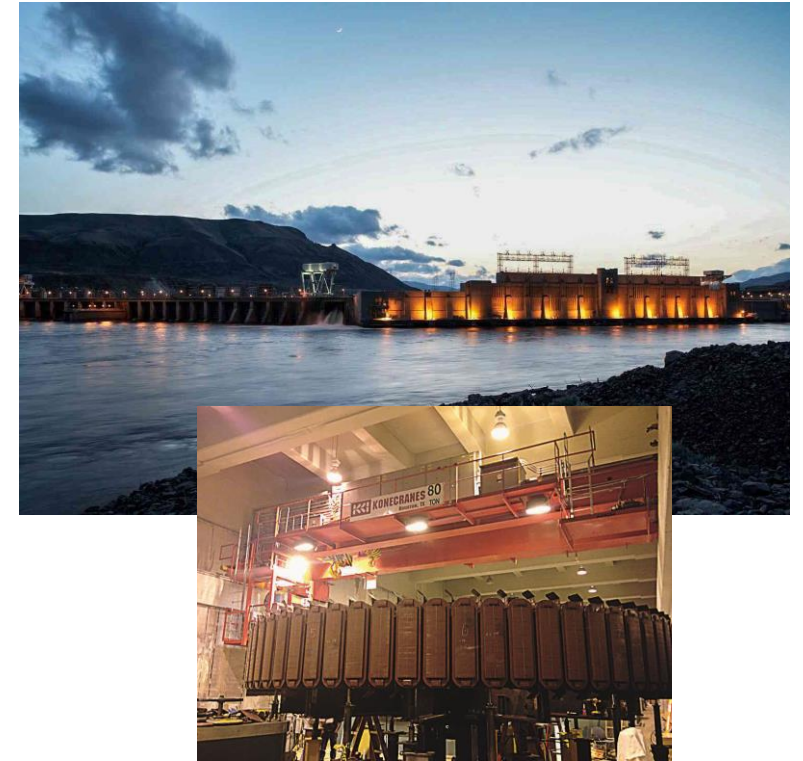
Selected projects



Temascal / Mexico (4x 38.5 MW)
Full-scale EM rehab



Carillon Generator station / Canada (14x 54 MW)
Scope: re-equip turbine generator units and rehabilitation of hydraulic passage



Rock Island / USA (18 units, 624 MW total)
Scope: 4 units T&G
first dam span the Colombia river

SUSTAINABLE SOLUTIONS/PRODUCTS



HYDRO / XFLEX HYDRO Demonstrator Vogelgrun

- **Improving grid services by coupling hydropower and batteries**
- **Key Objectives:**
 - Hybridize the turbine unit with a battery of suitable energy capacity and power converter rating, to improve fast and dynamic frequency response of the combined system.
 - Significantly reduce turbine wear and tear, and quantify it.
 - Evaluate the possibility of upgrading the 39 MW fixed-speed, double-regulated Kaplan turbine unit – with an enhanced variable speed, single-regulated propeller unit.



The Hydropower Extending Power System Flexibility (XFLEX HYDRO) project has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No 857832

ROADMAP 2022-2024 (I)



Traditional Business Model

- **Cost Competitive Solutions** keeps Levelized Cost Of Electricity at a considerable low level; engage in project development – greenfield as well as brownfield – at an early stage as preferred partner to secure our position and benefit from potential project optimization gains
- **State-of-the-Art Technology** ensures a tailor-made top plant performance; most modern and powerful High Head Test Rig to be commissioned in spring 2022
- **Innovative Services** with a lifetime customer orientation leads to growing sustainable high margin business; foster leading position by enlarging our digital service offerings and expanding our regional control centers

→ **Secure profitability at 7% ROS at a business volume of 1.5 bn. EUR by keeping operating expenses and structural costs at a competitive level**



ROADMAP 2022-2024 (II)



Green Deals / Carbon Neutrality

- **Renewables Integrated Plant** combining variable renewables like solar PV, wind with (pumped) storage, e.g. Kidston / Australia
 - **Synchronous Condenser** a bespoke smart solution for modern grid requirements
 - **Batteries:** possible extension of services for our customers, especially for instant grid services, e.g. fast frequency response
 - **Cooperation with Mercedes-Benz Energy** to promote and supply the most modern hybrid energy solutions HyBaTec for the hydropower market based on large battery energy storage systems.
 - **Green Hydrogen:**
 - Demand in green electricity will increase, large scale hydropower plants could become feasible even in remote areas (as for Aluminum)
 - High plant factor of hydropower (24/7) compared to wind and solar energy, Solar+H2 require energy storage and new electrical concepts
 - **ANDRITZ and MAN Energy Solutions** have concluded a strategic framework agreement to jointly develop international projects for the production of green hydrogen from hydropower
- **Participate in future growth potential as first mover**



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MANY THANKS!

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