



ANDRITZ HYDRO

Company presentation May 2017



Hydropower

The multiple roles in water and energy

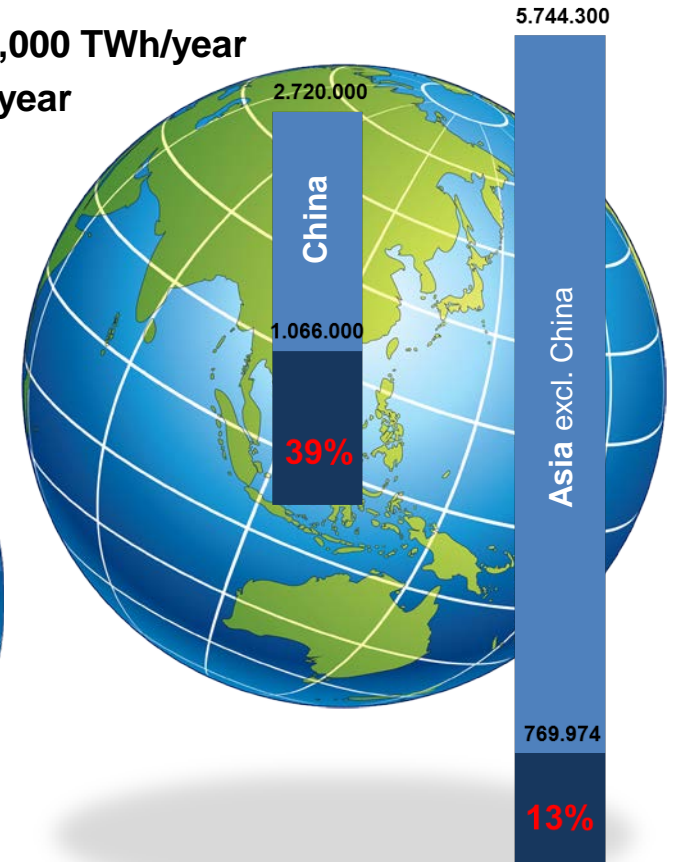
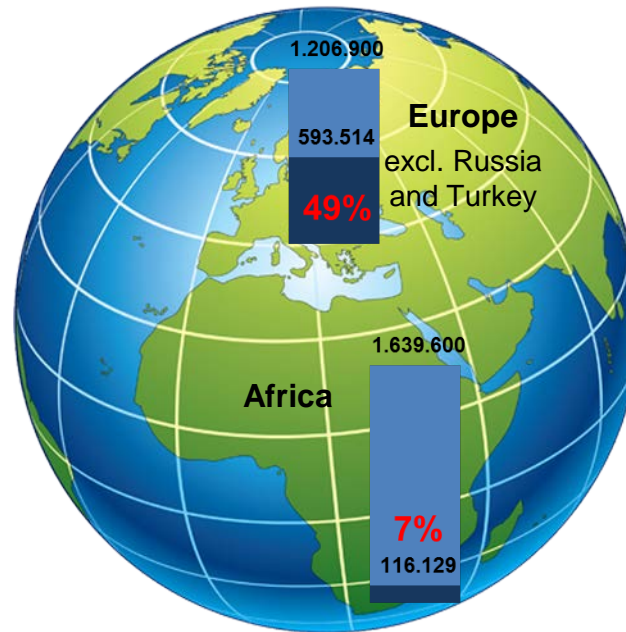
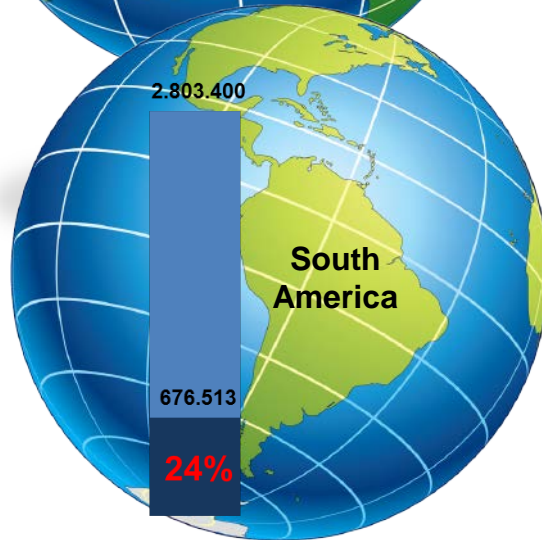
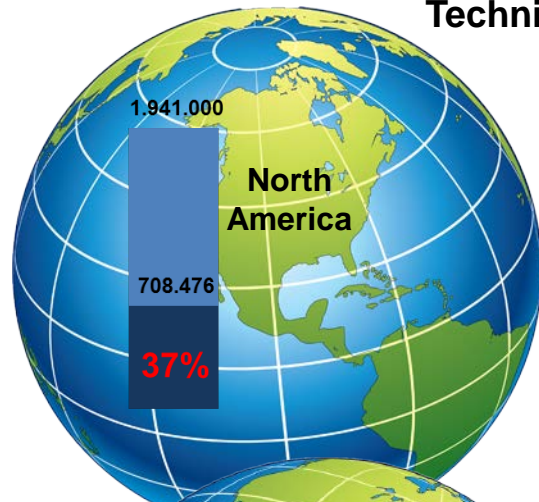


Hydropower

Global market overview

Technically feasible hydropower potential : ~ 16,000 TWh/year

Hydropower generation: ~ 3,930 TWh/year

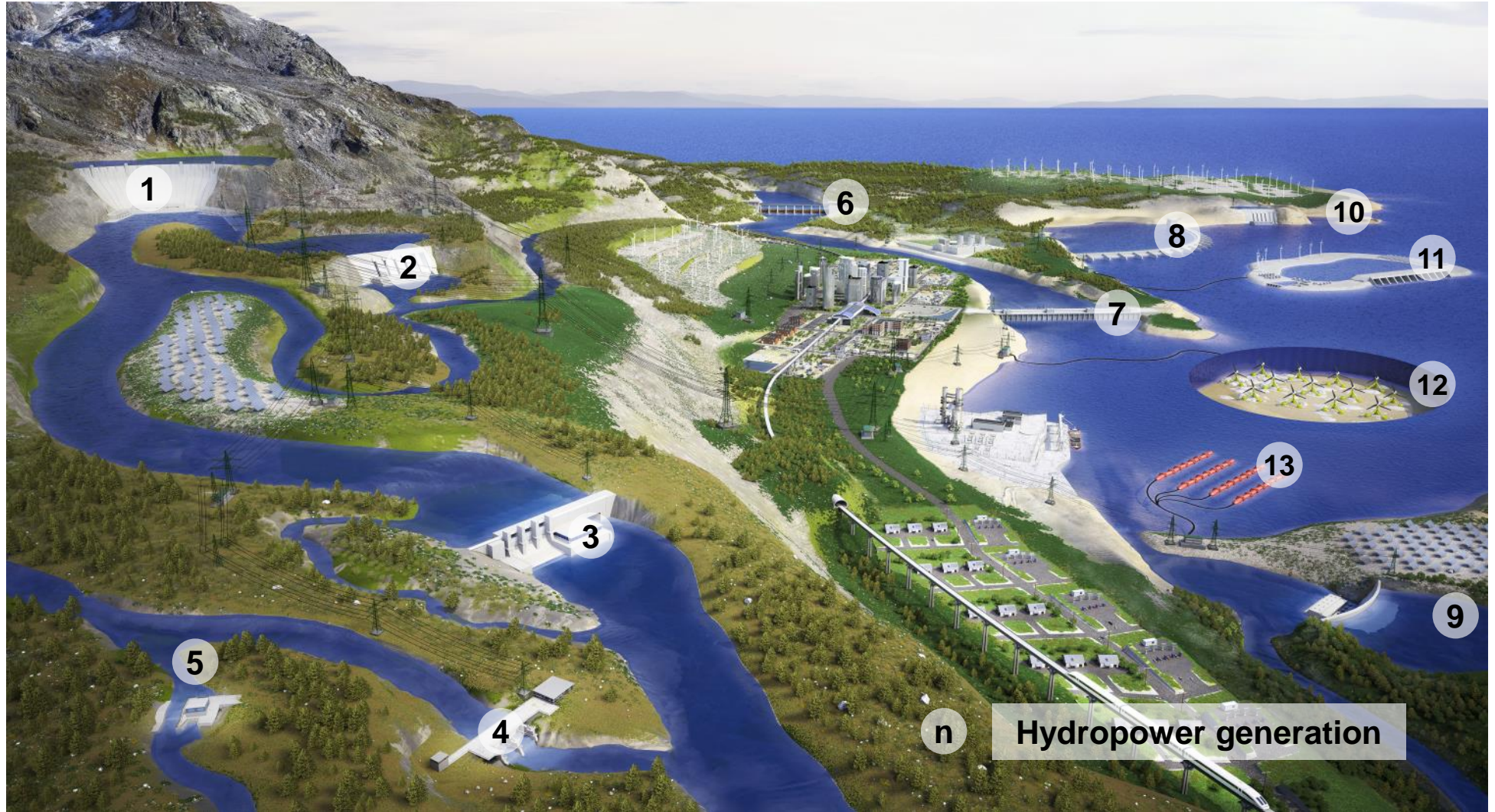


- Technically feasible hydropower potential (GWh/year)
- Hydropower generation in 2014 (GWh/year)

Source: Hydropower & Dams World Atlas, 2015

Hydropower

Electrical energy generation scenario 2050



We are a global supplier of electro-mechanical systems and services ("from water-to-wire") for hydropower plants and a leader in the world market for hydraulic power generation.

*More than **175 years** of turbine experience (1839)*

*Over **31,600 turbines** (more than 434,600 MW) installed*

*Complete range up to more than **800 MW***

*Over **120 years** electrical equipment experience (1892)*

*Leading in **service and rehabilitation***

*More than **120** Compact Hydro units per year*

ANDRITZ HYDRO

History



The ANDRITZ GROUP

Overview

ANDRITZ is a globally leading supplier of plants, equipment, and services for hydropower stations, the pulp and paper industry, the metal-working and steel industries, and solid/liquid separation in the municipal and industrial sectors.

Headquarters: Graz, Austria

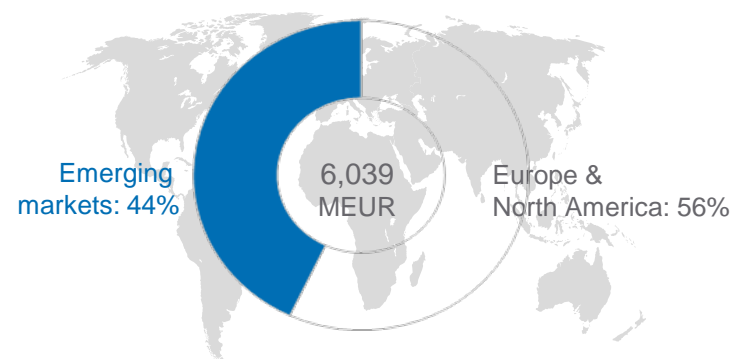
Global presence: over 250 production sites and service/sales companies worldwide

KEY FINANCIAL FIGURES Q1 2017 AND 2016

	Unit*	Q1 2017	2016
Order intake	MEUR	1,560.0	5,568.8
Order backlog (as of end of period)	MEUR	6,974.2	6,789.2
Sales	MEUR	1,386.2	6,039.0
EBITA	MEUR	97.4	442.1
Net income (including non-controlling interests)	MEUR	63.1	274.8
Employees (as of end of period; without apprentices)	-	25,247	25,162

* MEUR = million euros

Sales by region 2016 (%)



	Q1 2017	2016	2015
Europe	37	35	38
North America	21	21	19
China	14	12	12
Aisa (without China)	12	12	13
South America	12	15	14
Africa, Australia	4	5	4

Company profile (I)

Worldwide leading position in four business areas

ANDRITZ

ANDRITZ
Hydro



Product offerings:
electromechanical equipment for hydropower plants (turbines, generators); pumps; turbo generators

ANDRITZ
Pulp & Paper



Product offerings:
equipment for production of all types of pulp, paper, tissue, and board; energy boilers

ANDRITZ
Metals



Product offerings:
presses for metal forming (Schuler); systems for production of stainless steel, carbon steel, and non-ferrous metal strip; industrial furnace plants

ANDRITZ
Separation



Product offerings:
equipment for solid/liquid separation for municipalities and various industries; equipment for production of animal feed and biomass pellets

Company profile (II)

Key financial figures per business area

ANDRITZ Hydro

	Unit	2016
Order intake	MEUR	1,500.3
Sales	MEUR	1,752.4
EBITA	MEUR	127.6
EBITA margin	%	7.3
Employees ¹⁾	-	7,260

ANDRITZ Metals

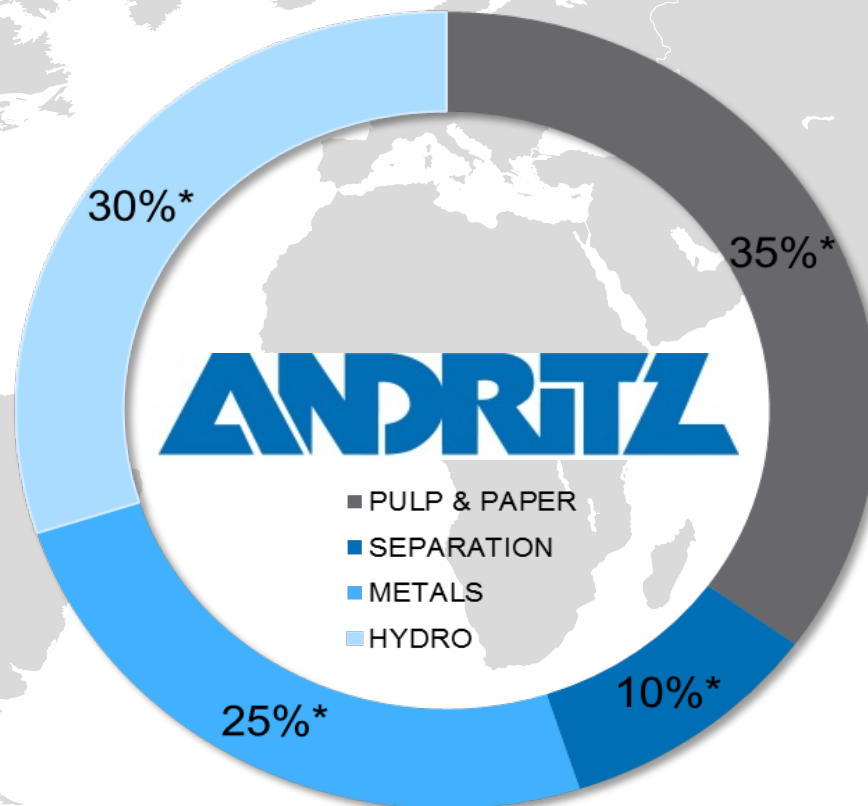
	Unit	2016
Order intake	MEUR	1,551.5
Sales	MEUR	1,598.4
EBITA	MEUR	115.2
EBITA margin	%	7.2
Employees ¹⁾	-	7,608

ANDRITZ Pulp & Paper

	Unit	2016
Order intake	MEUR	1,919.5
Sales	MEUR	2,094.4
EBITA	MEUR	182.2
EBITA margin	%	8.7
Employees ¹⁾	-	7,522

ANDRITZ Separation

	Unit	2016
Order intake	MEUR	597.5
Sales	MEUR	593.8
EBITA	MEUR	17.1
EBITA margin	%	2.9
Employees ¹⁾	-	2,772



¹⁾ As of end of period; without apprentices

* Average share of ANDRITZ GROUP's total order intake

ANDRITZ HYDRO

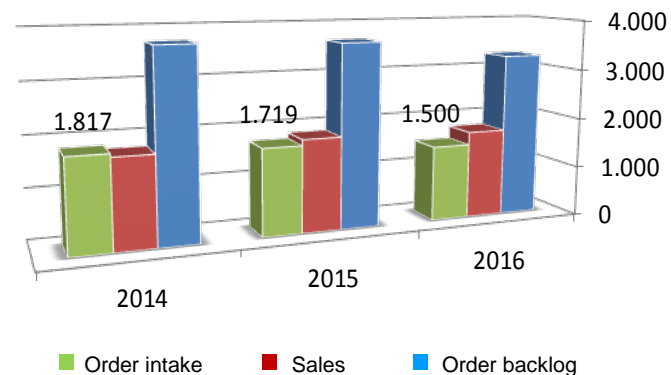
Facts and figures

ANDRITZ HYDRO

Central Function					
	Large Hydro	Compact Hydro	Service & Rehab	Pumps	Turbo Generator

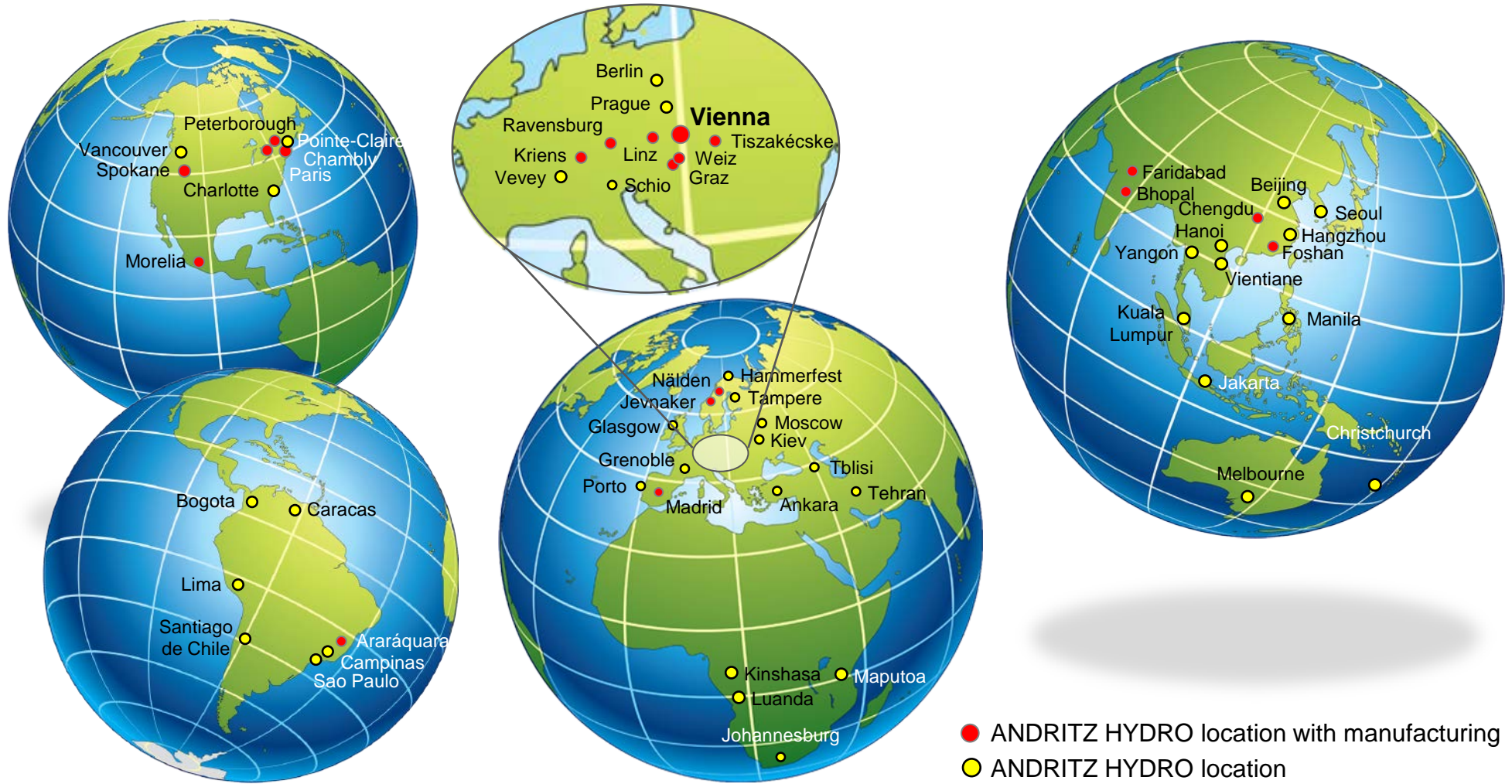
ANDRITZ HYDRO FIGURES 2016

	Unit	2016
Order intake	MEUR	1,500.3
Order backlog	MEUR	3,269.6
Sales	MEUR	1,752.4
EBITA	MEUR	167.2
Employees (without apprentices)		7,260



ANDRITZ HYDRO

Global presence



● ANDRITZ HYDRO location with manufacturing
● ANDRITZ HYDRO location

ANDRITZ HYDRO

Global research and development

▪ Global test facilities

- 14 hydraulic test rigs
- 5 generator laboratories
- Pump laboratory

▪ Advanced numerical calculation methods

▪ Highlights

- Turbine test facilities including all types:
 - High heads up to 2,000m
 - Low head Bulb turbines
 - Pump turbines
- Generator test fields for:
 - Large rotating electrical machines up to 850 MVA
 - Bearings
 - Electrical insulation



ANDRITZ HYDRO

Global manufacturing

▪ Main Products

- Hydro mechanical components
- Turbine components
- Hydro and turbo generators
- Electrical components

▪ Locations

- Europe
- Asia
- North America, South America

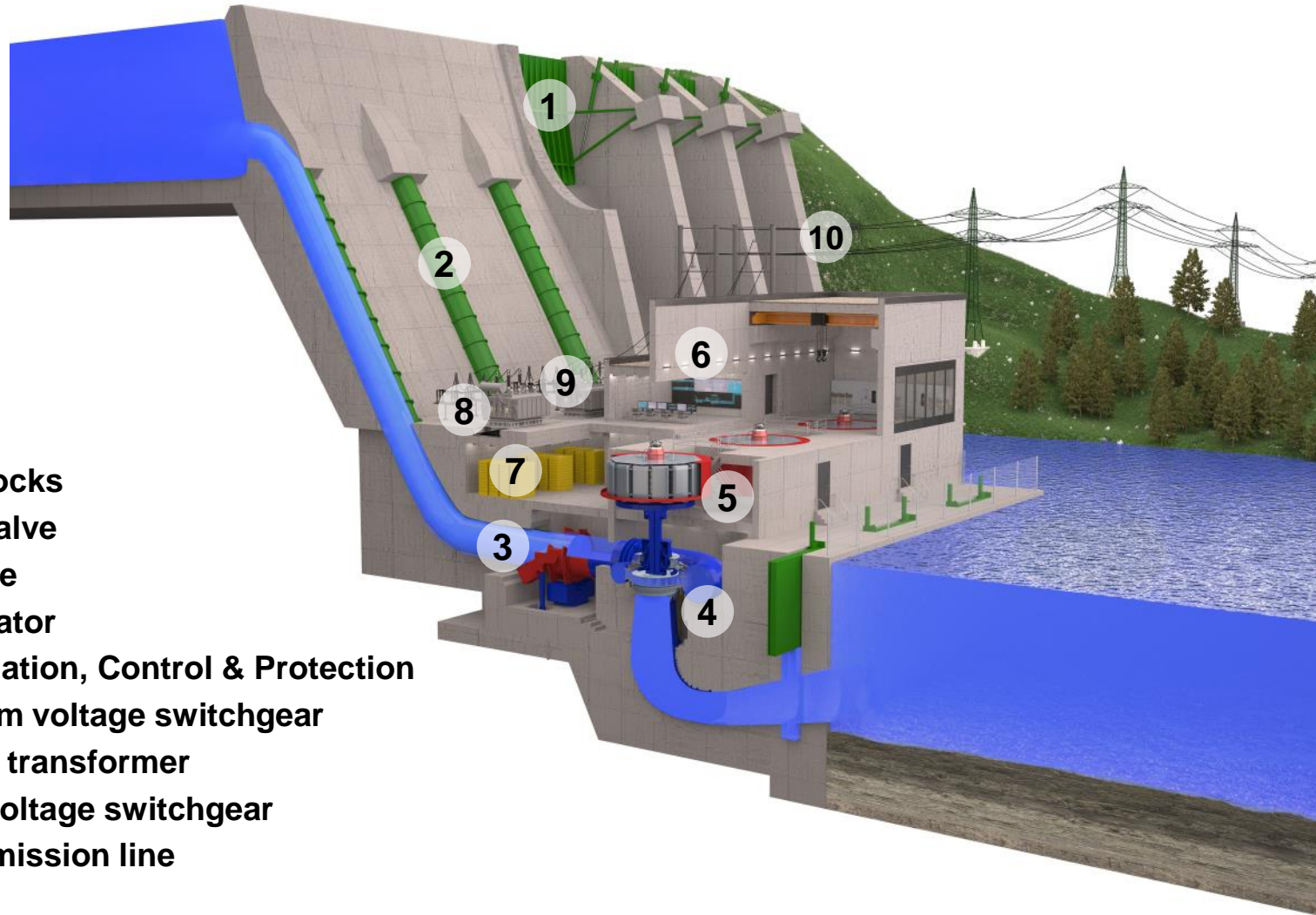
▪ Capacity

- In-house manufacturing capacity
 - ~ 2,500,000 hours/year
- On-site assembly capacity
 - ~ 800,000 hours/year
- Total manufacturing area
 - > 170,000 m²



ANDRITZ HYDRO

System and service scope of supply – “from water-to-wire”



- 1 Gates
- 2 Penstocks
- 3 Inlet valve
- 4 Turbine
- 5 Generator
- 6 Automation, Control & Protection
- 7 Medium voltage switchgear
- 8 Power transformer
- 9 High voltage switchgear
- 10 Transmission line

Large hydropower plants

Large Hydro

▪ Scope:

- Turnkey electro-mechanical package for hydropower plants
- New hydropower plants
- Large rehabilitations and upgrades
- “from water-to-wire” (W2W)
- Project development

▪ Highlights:

- Market leader Pelton turbines
 - 423 MW, 1,874 m – 2 world records
Bieudron / Switzerland
- Large Francis turbines
 - 770 MW – Guri II / Venezuela
- Market leader Bulb turbines
 - 76.55 MW – St. Antonio / Brazil
- Large hydro generators
 - 840 MVA – Three Gorges / China



Hydro-mechanical structures

Penstocks and Gates

▪ Scope:

- Steel structures for hydropower plants, water supply and irrigation
- Exposed and embedded penstocks
- Pipe bridges and steel tunnel linings
- Manifolds and bifurcations
- Gates and hydraulic steel constructions

▪ Highlights:

- Large gates:
 - Pimental / Brazil
- Large penstock
 - Ø 13.26 m – Tarbela Dam 3 / Pakistan
- Large manifold
 - 16 m high – Tarbela Dam 3 / Pakistan
- High head
 - 2,070 m – Cleuson-Dixence / Switzerland



Small and mini hydropower plants

Compact Hydro

▪ Scope:

- Small hydropower plants (units up to 30 MW)
- Mini hydropower plants (units from 20 kW up to 5,000 kW)
- “from water-to-wire” (W2W)
- Modular system design
- Pre-assembly at workshop

▪ Highlights:

- Small hydro supplied to Turkey
 - More than 1,000 MW
- Large Compact Pelton turbine
 - 30.3 MW – Renace II / Guatemala
- Drinking and waste water turbines
 - 200 kW – Val Mila / Switzerland
 - 6 MW – Las Vacas / Guatemala
- Energy recovering turbine (mines)
 - 3x 1.54 MW – Saaiplaas / S-Africa



Each week two new Compact Hydro units start working!

Modernization

Service & Rehabilitation

▪ Scope:

- Solutions, products and services over the entire life cycle of a hydropower plant
- General overhaul / rehabilitation
- Uprating / upgrading / modernization
- Plant assessment
- Technical studies
- Residual life analysis
- Risk assessment

▪ Highlights:

- Uprating
 - + 40% - Ambuklao/Philippines
 - + 400 MW – Guri II / Venezuela
- Replanting and uprating (replacement of 12 units by 5 units)
 - + 20% (5x 17.3 MW) – Lochaber / UK
- Rehabilitation of largest single phase hydro generator
 - 94 MVA, 34 t pole weight
 - Langenprozelten / Germany



Electrical power train

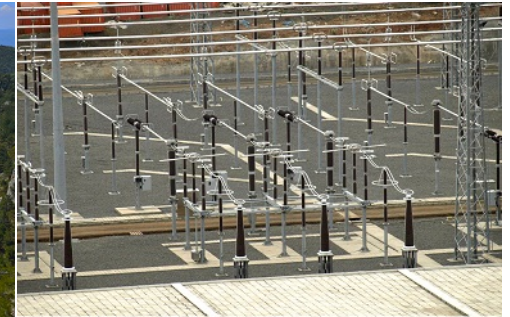
Electrical Power Systems

▪ Scope:

- Solutions, products and services for complete range of electrical equipment for hydropower plants
- Plant and power engineering including system and grid studies
- Integration of all systems (“from water-to-wire”)

▪ Highlights:

- Electrical system for pumped storage
 - 4x 300 MW – Tong Bai / China
- Complete electrical equipment for
 - 6x 130 MW – Karahnjúkar / Iceland
- Complete electrical equipment for
 - 2x 55 MW – Chacayes / Chile
- Turnkey electrical equipment including 420 kV high-voltage substation
 - 4x 130 MW – Beles / Ethiopia



Secondary equipment

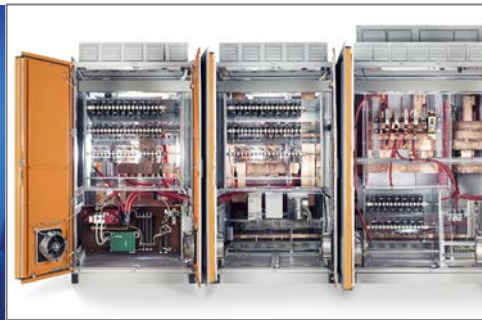
Automation

▪ Scope:

- Complete automation solutions for
 - All sizes of power plants
 - Newly built power plants
 - Rehabilitation
 - Upgrading and modernization
 - Integration of existing systems

▪ Highlights:

- Large excitation (field current 3,200 A)
 - 10x 850 MVA – Guri II / Venezuela
- HIPASE – Integrated platform for protection, excitation, turbine governor and synchronization
- Large dispatch center applications
 - Regional dispatch center
110 HPP's of EON – Landshut / Germany
 - Dispatch center for Norway
Statkraft / Norway



Pumps, motors and hydrodynamic screws

Pumps

▪ Scope:

- **Standard and customer-specific pumps:**
 - **Water, waste water or sea water**
 - **Cooling water pumps** (power plants)
 - **Offshore**
 - **Mining**
 - **Industry**
(pulp, paper, sugar, chemical or food)
 - **Mini hydro power generation**

▪ Highlights:

- **Very large flowrates**
(e.g. water infrastructure in India and China)
- **Highly abrasive applications**
- **Modular multistage concept with highest efficiencies**
- **Engineered multistage pumps up to 35 MW**
- **Pump storage operations**



Gas and steam turbine generators

Turbo Generator

▪ Scope:

- Turbo generators for gas and steam turbines from 8 MVA up to 350 MVA
- 50 and 60 Hz
- Type
 - Air-cooled
 - TEWAC (air-water-cooled)
 - Open ventilated
 - CACA (air-air-cooled)
 - Hydrogen-cooled

▪ Highlights:

- > 1,265 turbo generator units
- > 137,000 MVA total output ever built
- Turbo generators for
 - Heavy duty gas turbines (HDGT)
 - Aeroderivative gas turbines



Hydropower market outlook

Low head applications for existing structures

▪ Trends:

- Innovative solution for:
 - existing dams, gates, weirs, etc.
 - greenfield projects
- Usage of ecological flow for additional power generation

▪ Highlights:

- Largest HYDROMATRIX® plant
 - 45x 534 KW – Ashta I / Albania
 - 45x 1,003 kW – Ashta II / Albania
- Usage of abandoned shiplocks
 - 5x 270 kW StrafloMatrix™
Chievo / Italy



Hydropower market outlook

Develop ocean energy

▪ Trends:

- Technology for power generation from tidal lift and tidal currents
 - Tidal lagoon (energy island)
 - Tidal array
 - Tidal barrage

▪ Highlights:

- World largest tidal power plant
 - 10x 26 MW – Sihwa / South Korea
- Rehab of first tidal power plant
 - 24x 10 MW – La Rance / France
- First commercial tidal current turbine
 - 1x 1,000 kW (HS1000) – EMEC / UK
- First commercial array
 - 3x 1,5 MW – MeyGen / Scotland
- New developments for tidal lagoons



Hydropower market outlook

Pumped storage power plants

▪ Trends:

- Solution as “battery of the grid”
- “from water-to-wire” (W2W)
 - Fixed or variable-speed
- Electrical grid compatibility
 - Grid code compliance

▪ Highlights:

- First variable-speed pumped storage plant in Europe
 - 4x 325 MW – Goldisthal / Germany (2x variable-speed units á 340 MVA)
- High speed pumped storage (750 rpm)
 - 2x 240 MVA – Reisseck II / Austria
- Quick change (+540 / -540 MW in 20 sec)
 - 3x 200 MVA – Kops II / Austria



Quality



All operational Divisions and Subsidiaries are certified according to the Standards ISO 9001, ISO 14001 and OHSAS 18001.

Quality one can rely on!



ANDRITZ HYDRO
Your partner for renewable and clean energy