Innovations in Environmental Control for Coal Plants

U.S.-Poland Energy Roundtable

Phil Rader
April 24, 2013

We are shaping the future | ALSTOM

Introduction

Three main activities in 4 sectors

Equipment & services for power generation

Alstom Thermal Power

Alstom Renewable Power

Equipment & services for power transmission

Alstom Grid

Equipment & services for rail transport

Alstom Transport

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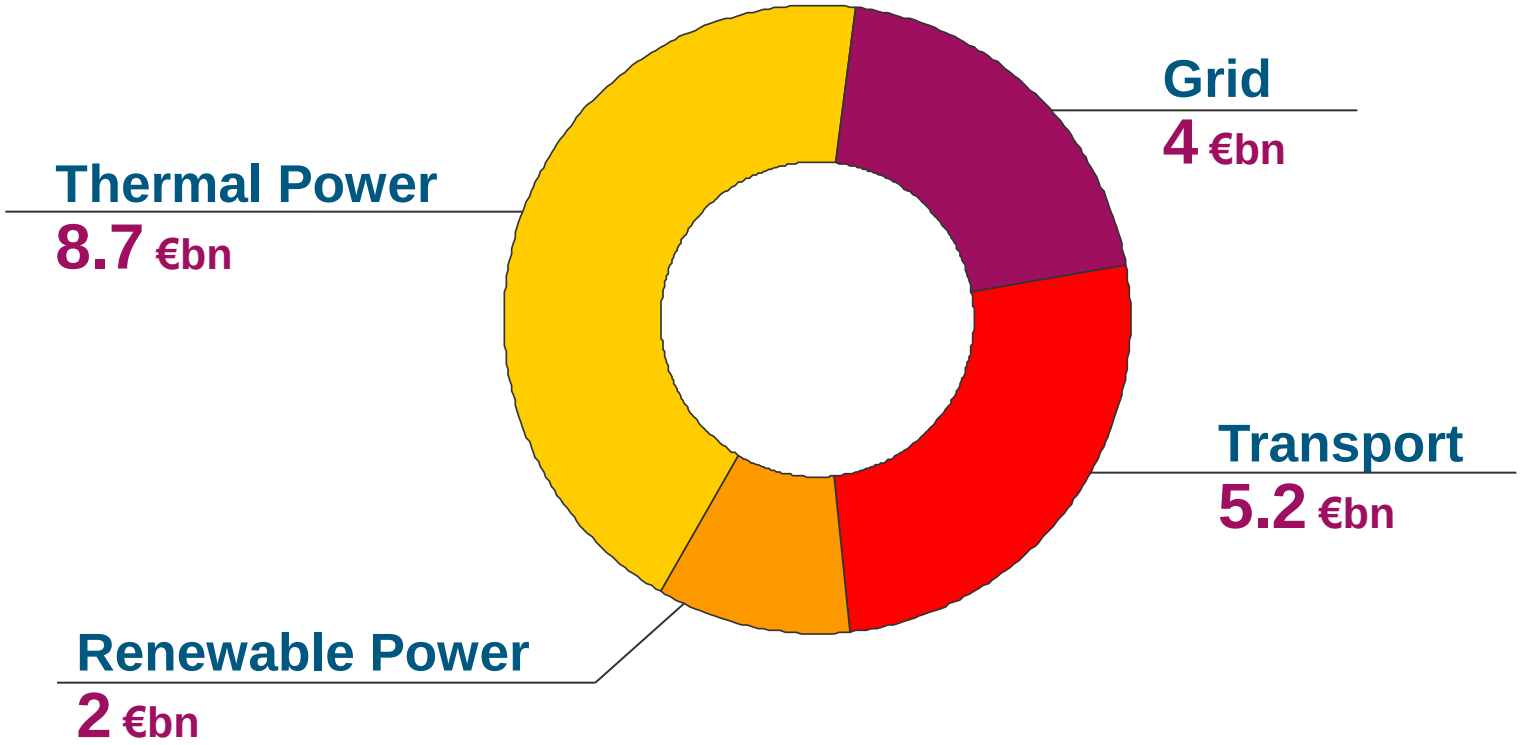
Three main activities in 4 sectors



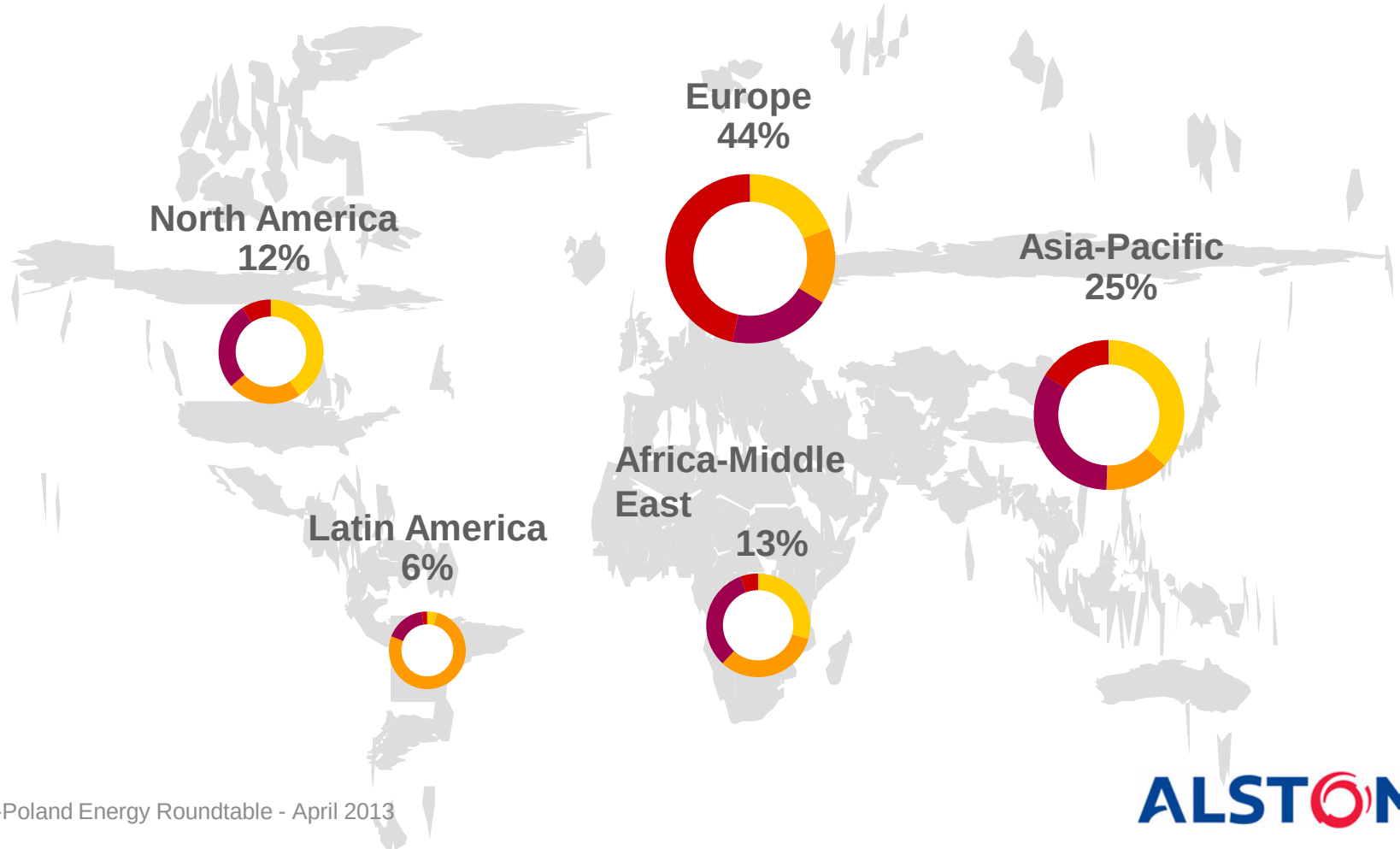
Total sales 2011/12 = €19.9 billion

Total orders 2011/12 = €21.7 billion

A global footprint

Orders by region and activity in 2011/12

Thermal Power | Renewable Power | Grid | Transport



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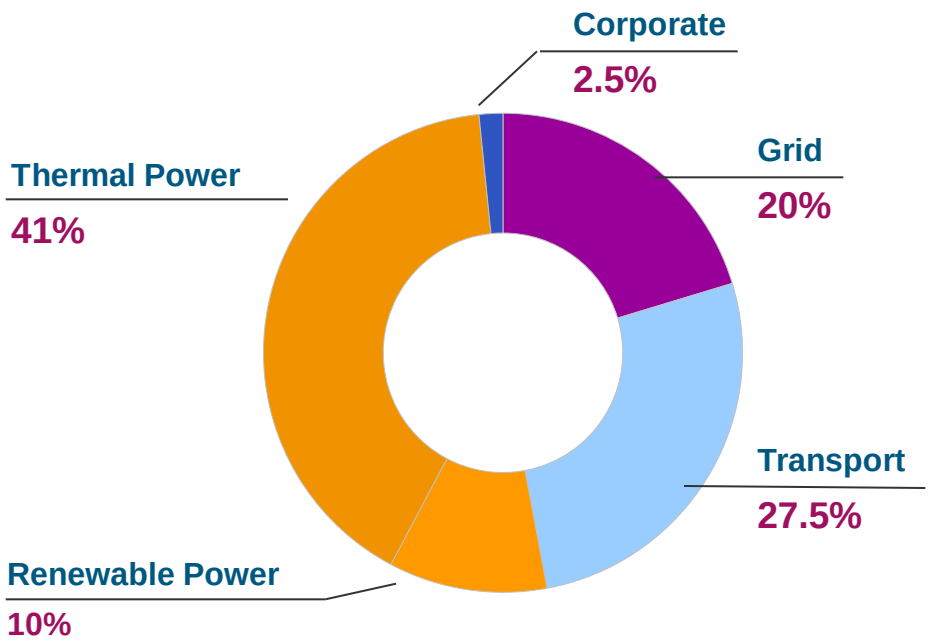
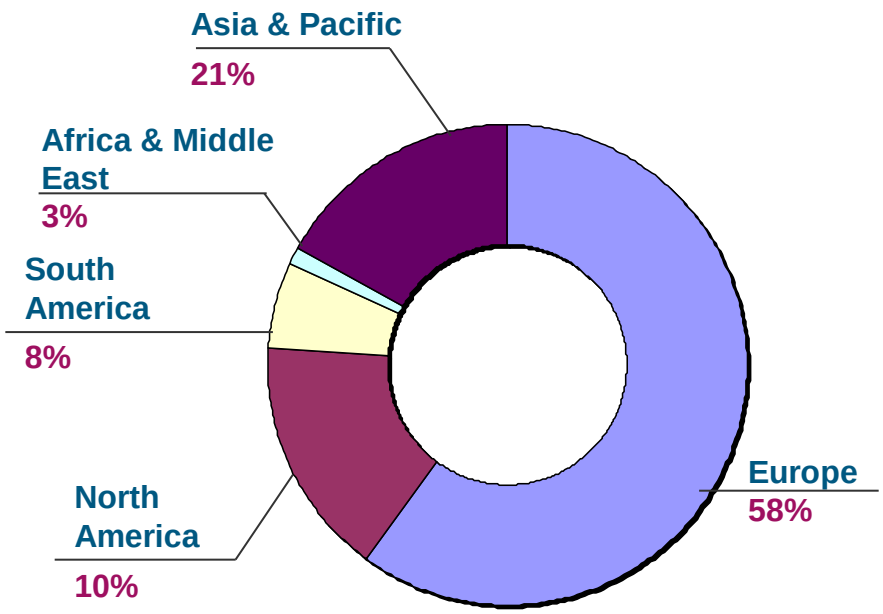
92,800 employees worldwide in 100 countries

By activity



By region



At end of September 2012

Balanced Portfolio in Power

Gas

Coal

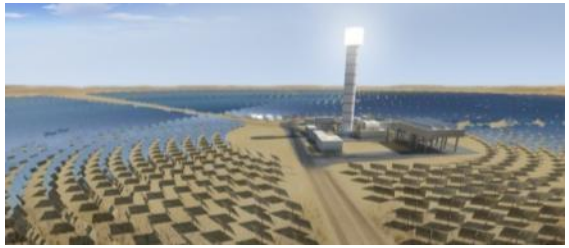
Oil

Hydro, Ocean, Tidal

Nuclear (turbine island)

Wind on and offshore

Solar



Geothermal

Biomass

Real challenges & realistic solutions

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Environmental Control Systems

North American Operations

Knoxville, Tennessee

We are 100% dedicated to design, engineering, procurement and commissioning of air quality control equipment and systems

Alstom in Poland

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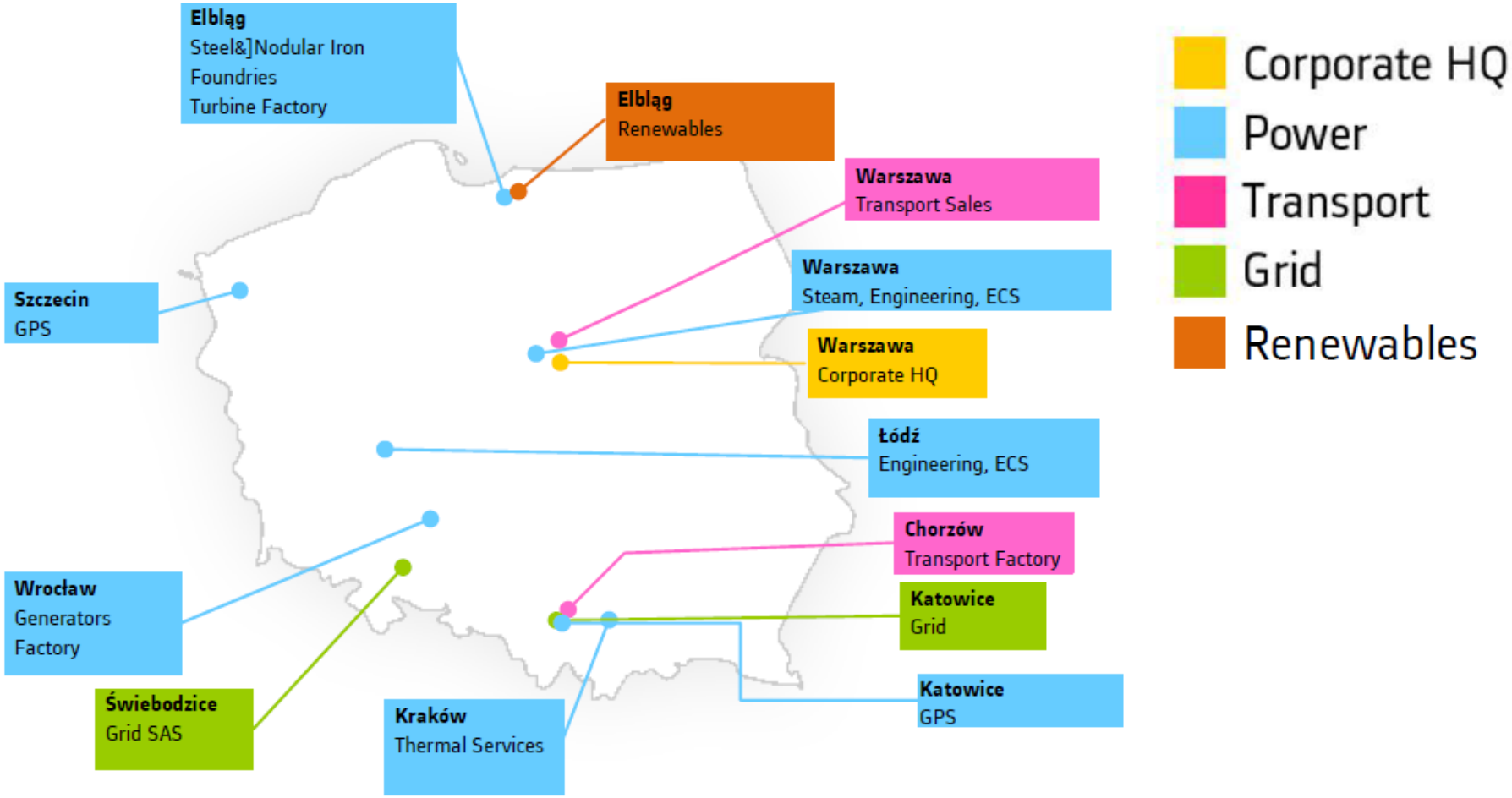
Alstom in Poland – Locations



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Alstom in Poland – Key Data

- 3200 employees in power generation, grid, and transport sectors
- 13.5 MEUR investments in years 2011/2012
- State-of-the-art manufacturing base in Poland
- Poland is a key sourcing country for Alstom
- Alstom's European excellence center for turbogenerators is located in Wroclaw
- Alstom Konstal supplies railway equipment to major European operators

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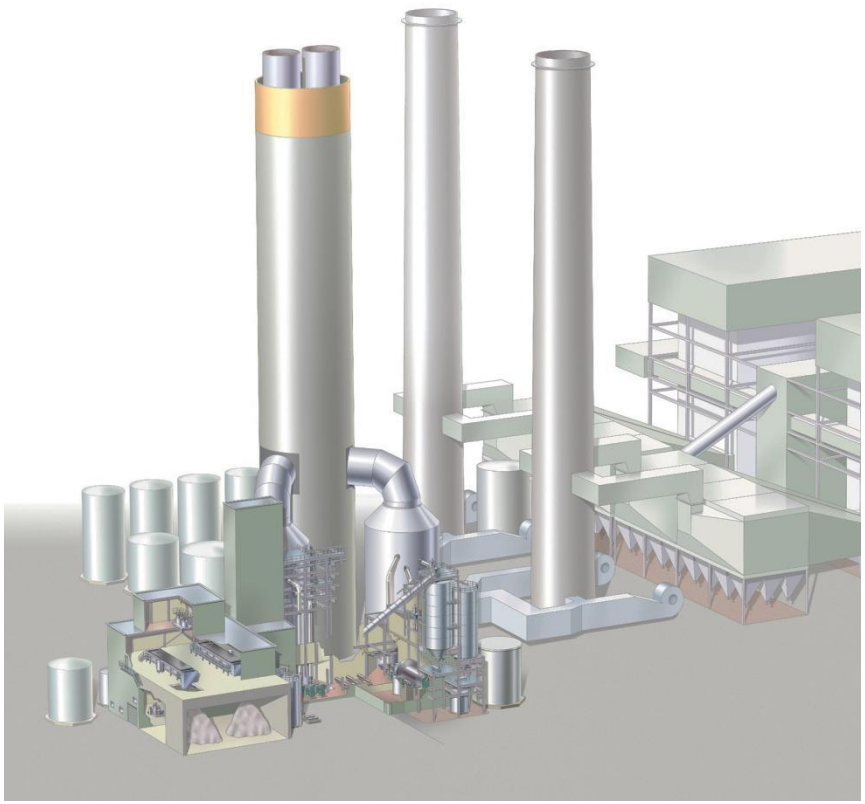
Alstom in Poland – ECS

- Offices in Warsaw and Lodz
- Staff of 35 supported by 100 individuals in Steam Plant engineering office
- Recently executed projects
  - Janikowo NID for SODA CIECH POLSKA S.A. (2009-2012)
- On-going projects
  - Belchatow ESP for PGE S.A. (2010-2016)
  - Bialystok WTE for Keppel Seghers (2013-2014)

Conventional AQC System

- Electrostatic precipitator with wet flue gas desulfurization is globally dominant technology
- Efficient collection of particulates, SO_2, and acid gases
- Limestone reagent; gypsum byproduct
- High capital investment; relatively low operating cost



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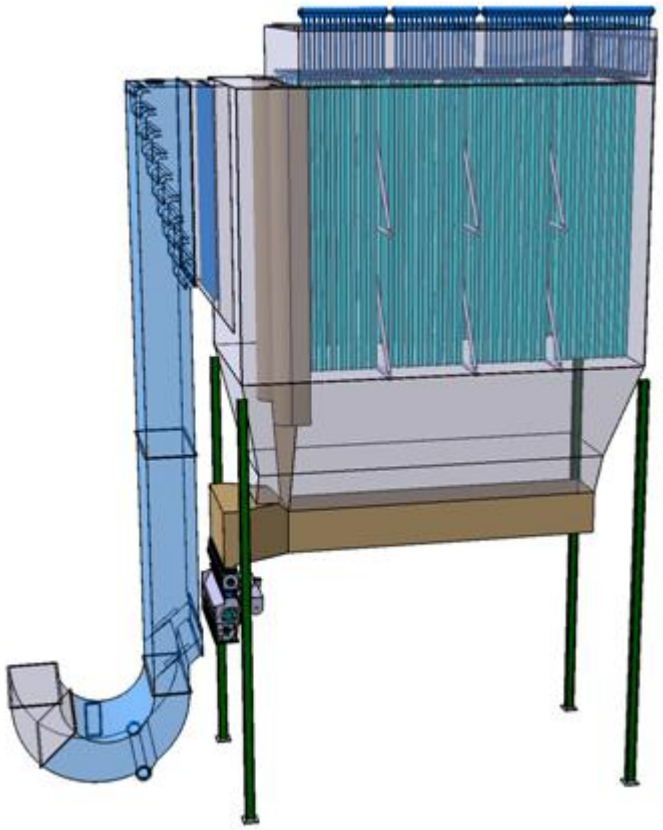
Alstom NID Technology

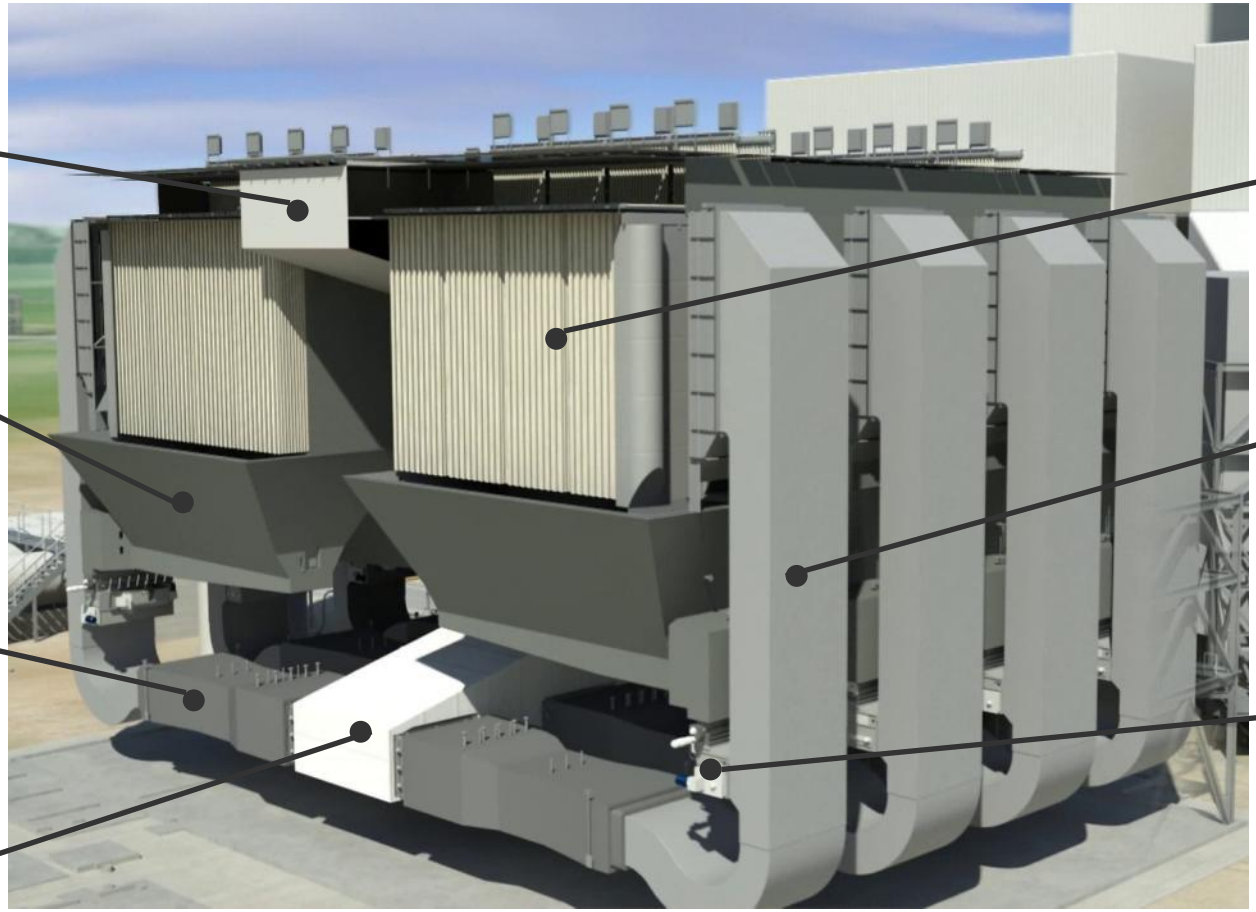
- Multi-pollutant control: High efficiency removal of SO_2, SO_3, PM, HCl, HF, and Hg
  - SO_2 removal: up to 98%
  - SO_3 emissions: < 1 ppm
  - PM (filterable): < 0.010 lb/MBtu (5 mg/Nm^3)
  - HCl: <0.002 lb/MBtu (2 mg/Nm^3)
  - Hg: <1.2 lb/Tbtu (1.2 µg/Nm^3)
- Lime-based dry FGD technology
  - Integrated hydrator/mixer – no slurry handling
  - Zero liquid discharge
  - Low water consumption; ability to use low quality water: CTB, WFGD purge
- Simple, compact design
  - Small footprint offers retrofit advantage
  - Low capital cost
  - Low BOP/construction cost
  - Low O&M cost
- Modular design
  - High reliability
  - Excellent turndown
  - No scale up issues

NID Concept

- Multiple, independently isolatable modules
- Dampers
  - Upstream of reactor
  - Downstream of FF compartment
- Nominal gas flows corresponding to 15 - 90 MW per module
- Can be designed to achieve emissions guarantees at full load with one module out of service



NID Arrangement



Project Profile – NID

Elektrownia Power – Laziska Power Plant Units 1 & 2

Location: Laziska, Poland

Application: PC Boiler

Fuel : Coal – 1.4%

Inlet Loading: 1400 ppm

Gas Flow: 550,000 Nm^3/hr

Commercial: Unit 1,1996, Unit 2,1997

SO_2: 95% Removal Measured

Opacity: Less than 20%

Unit size: 2 x 125 MW

Reagent: Lime

Scope of Supply: Turnkey supply

Byproduct: Landfill

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Project Profile – NID

GE Capital/Kiewit – Homer City Units 1&2

Location: Homer City, PA

Application: Power

Unit size: 2 x 670 MW

Scope: Material supply

Fuel : Bituminous coal

Inlet Loading: Up to 4.5 lb SO_2/MMBtu

Gas Flow: 2,630,000 acfm/boiler

Commercial: December 2013

Emissions:

SO_2: 98% removal

Filterable PM: 0.010 lb/MMBtu

Reagent: Lime

Byproduct: Landfill

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Project Profile – NID

Eesti Energia Narva Elektrijaamad AS – Narva

Location: Narva, Estonia

Application: Power

Unit size: 4 x 200 MW

Scope: ESP/FF conversion with NID addition

Fuel : Oil Shale

Inlet Loading: 1.6% S in fuel

Gas Flow: 1,200,000 Nm^3/hr per boiler

Commercial: 2010, 2011, 2012

Emissions:

SO_2: <400 mg/Nm^3

Filterable PM: <50 mg/Nm^3

Reagent: Lime

Byproduct: Landfill

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Carbon Capture Technologies

CO_2 capture technologies pursued by Alstom

Post-Combustion

(New + Retrofit)

Advanced Amines Process
Chilled Ammonia Process

2nd Generation

Regenerative Calcium Cycle (RCC)

Oxy-Combustion

(New + Retrofit)

Oxy-Combustion with ASU

2nd Generation

Chemical Looping Combustion (CLC)

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Advanced Amine Process

Update on Alstom roadmap

2007

2009

2011

2015-2016

Pilot → **Industrial / Validation** → **Large-scale demonstration** → **Commercial**

University of Texas
USA

Dow Chemical Co.
USA - 2MWth, Coal

EdF Le Havre
France - 5 MWth, Coal

Tests completed
In operation
In commissioning/start-up
Targeted

Moving forward to scale-up the technology

Chilled Ammonia Process

Update on Alstom roadmap

2006 — Test Rigs

2008 — Industrial Pilots

2009 — Validation Pilots

2015 — Large-scale demonstration → Commercial

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Vaxjö Sweden
0.25 MWth

We Energies
Pleasant Prairie
USA - 5 MWth, Coal

EoN Karlshamn
Sweden - 5 MWth, Oil

Tests successful

AEP Mountaineer
USA - 58 MWth, Coal

TCM Mongstad
Norway - 40 MWth, Gas

Getica Turceni Feasibility
Romania - >250 MWe net, Lignite

CO_2 Capture Mongstad (CCM)
Norway- 280 MWe + 350 MWth, CCPP

Tests completed | In Operation | Key Targets

Roadmap to commercialization

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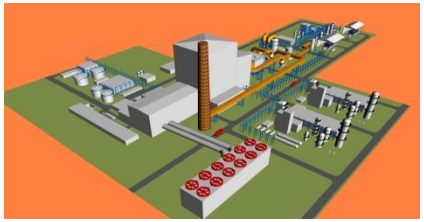
Oxy-Combustion Process
Update on Alstom roadmap



1990's — **R&D and Lab scale**

2008 — **Pilots**

2012 — **Large –scale demonstration**

2017/18 — **Commercial**

Vattenfall
Schwarze Pumpe
Germany - 30 MWth,

Total Lacq
France - 30 MWth,

Alstom BSF
USA - 15 MWth,

White Rose 426 MWe g - Selby (UK)

Daqing 350 MWe g
Datang (China)

In operation **Targeted** **GPU mobile pilot**

Moving forward to scale-up the technology

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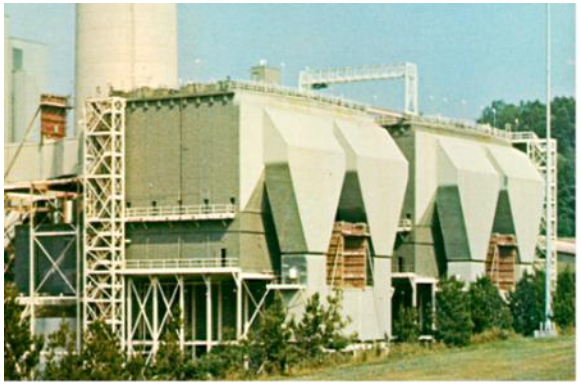
Particulate Collection

Electrostatic Precipitators



DESP—Dry Electrostatic Precipitator

WESP—Wet Electrostatic Precipitator

Fabric Filters

LRFF—Low-Ratio Fabric Filter

HRFF—High-Ratio Fabric Filter

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SO_2 and Acid Gas Control

Wet Flue Gas Desulfurization

Open Spray Tower

Integrated Emission Control System

Dry Flue Desulfurization

Spray Dry Absorber

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NO_x Control

SCR Systems

SCR – Selective Catalytic Reduction

Combustion Modification

Low NO_x Burners

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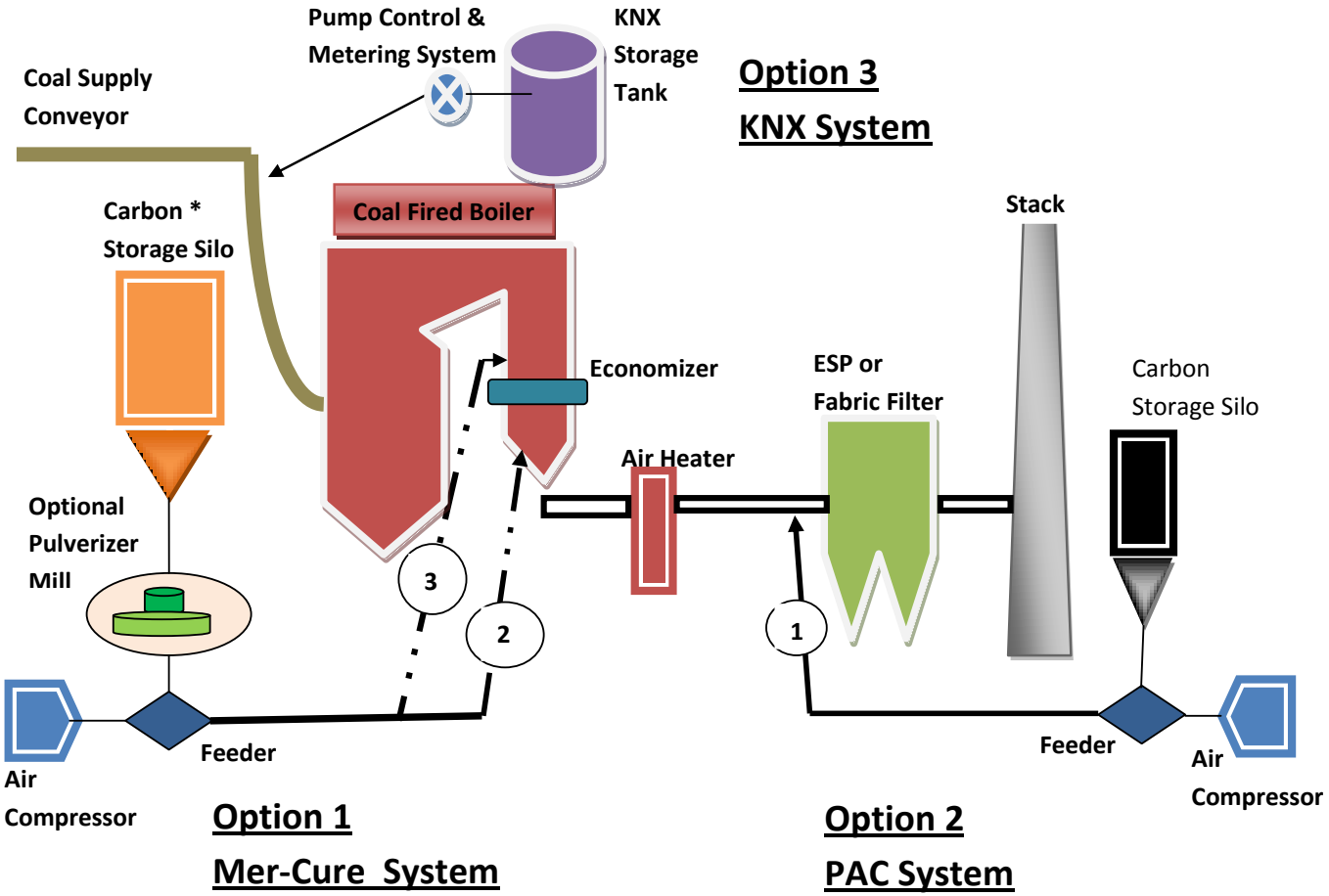
Mercury Control



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Questions?

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