Co-firing of Biomass and Coal

JAN SLEGL
CAPTURE AND TENDERING

ALSTOM

Options for Co-firing Biomass
Agenda

- Introduction
- Biomass Fuels
- Options for co-firing
- Experience
- Conclusions

Retrofit
Product portfolio

ALSTOM

Offering & strategy solutions for all needs

Fuel Flexibility

Environmental Compliance

Life Extension

Re-powering & Efficiency

Integrated Solutions

CO_2

Retrofit Experience

Alstom Retrofit Expertise

Type	Alstom Fleet	Other OEM *	Total
Boilers	**903 units**	557 units	1,460 units
Steam Turbines (since 1984)	**451 units**	320 units	771 units

* Other Turbine Original Equipment Manufacturer include GE, Siemens, Westinghouse, Parsons, MHI, Hitachi, Toshiba, Zamech, LMZ, Escher Wyss, Franco Tosi, Ansaldo, and Skoda

- All boilers and turbines (OEM independent)
- All boiler and turbine technologies
- Guaranteed redesign and rehabilitations
- Integrated retrofits

Alstom is a world leader

Co-firing Drivers

- Global awareness of greenhouse gases & commitment to reducing CO2
- Requirement to makes existing coal fired assets greener
- Fast access to environmental incentives, as relatively quick project implementation
- Best CO2 reduction per euro spend

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Biomass Fuels

Logs ~45% H_20

Woodchips 15- 45% H_20

Pelletized wood ~10% H_20

Miscanthus ~20% H_20

Coppiced Willow ~45% H_20

Biomass Fuel Challenges

- Fuel characteristics, importance of moisture content and density
- Volatility of Biomass fuels
- Spontaneous combustion – explosion risk
- ATEX/ DESAR/ NFPA directives
- Dust emissions / Biohazards
- Saleability of ash

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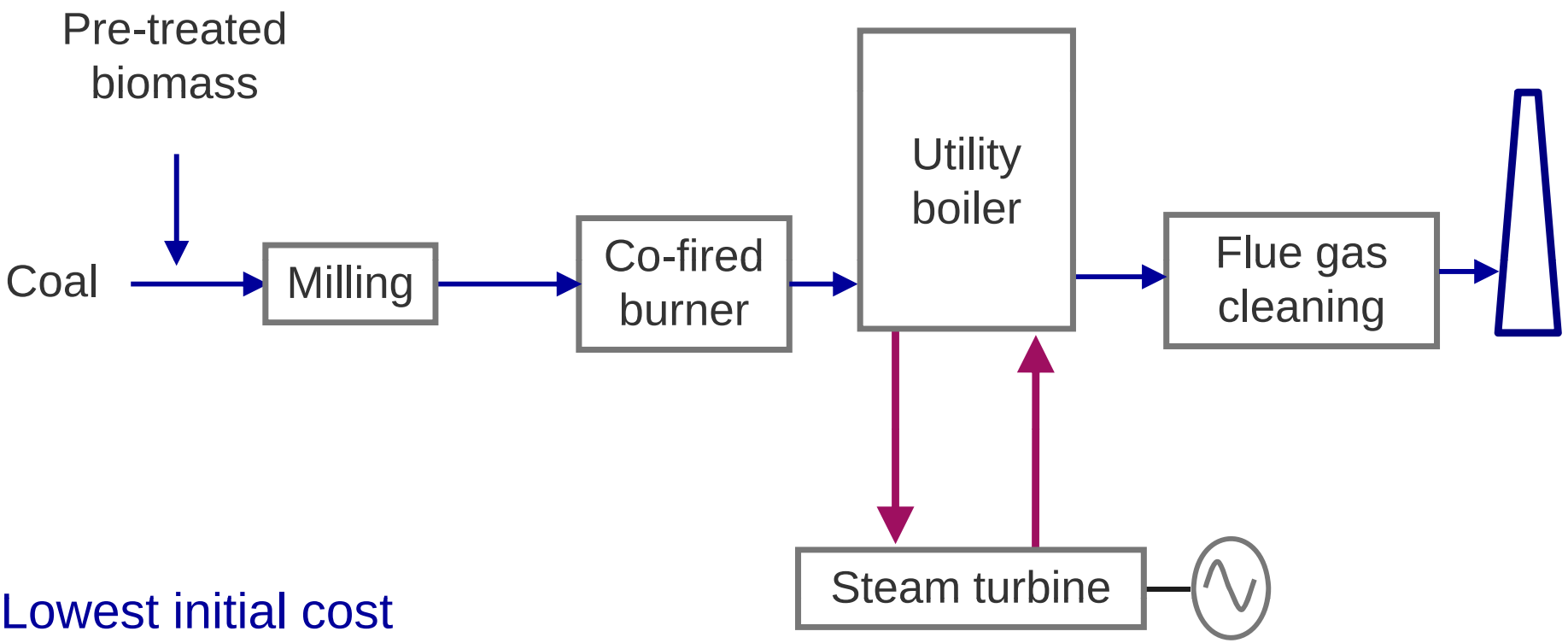
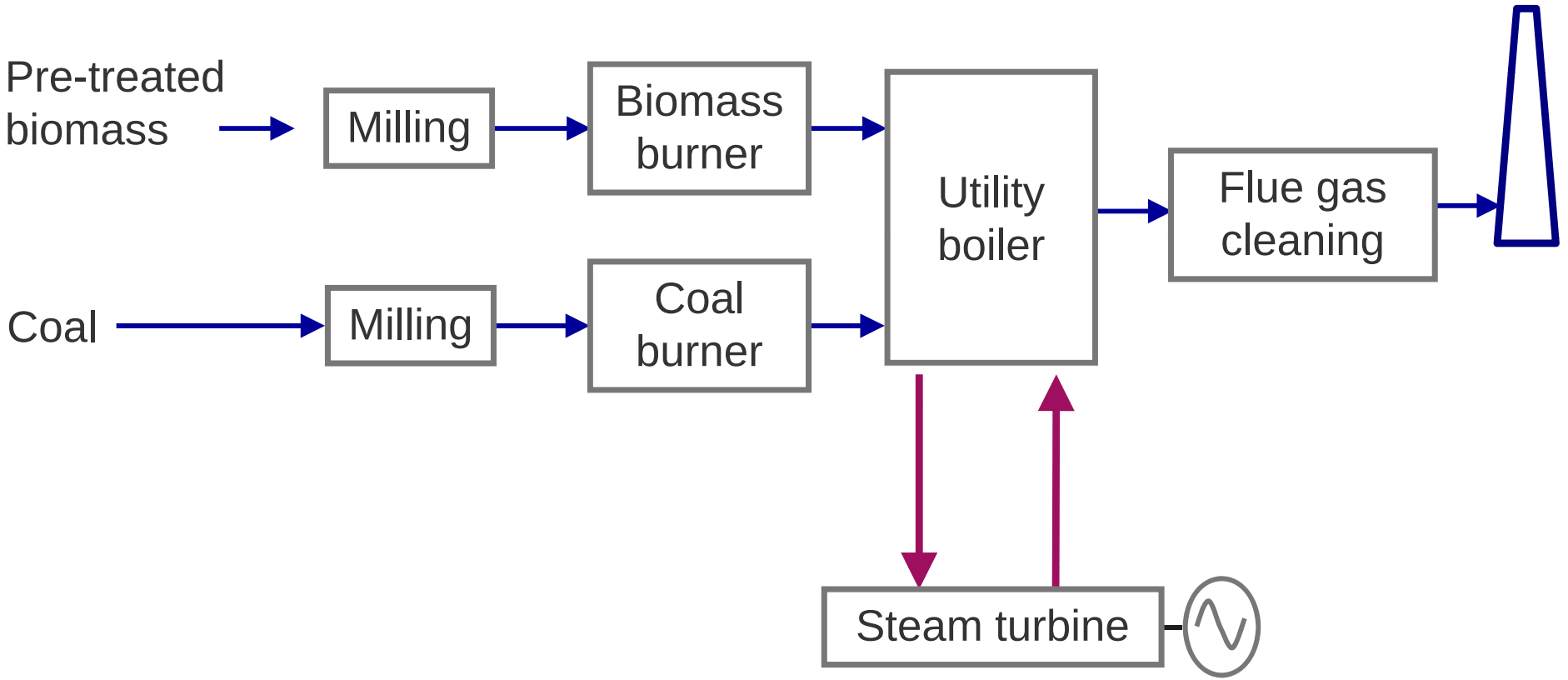
Biomass Co-milling – typically up to 3%



- Lowest initial cost
- Uses existing mills, which limits output
- Poor mill performance-
  - Throughput & fineness
  - Risk of mill fires
  - Poor mix of coal and biomass

Dedicated Biomass Co-firing- > 10% by mass



- More flexible, higher throughput
- Minimal outage requirements
- Equipment is specifically tailored for project
- Best CO_2 reduction V cost, of all co-firing solutions

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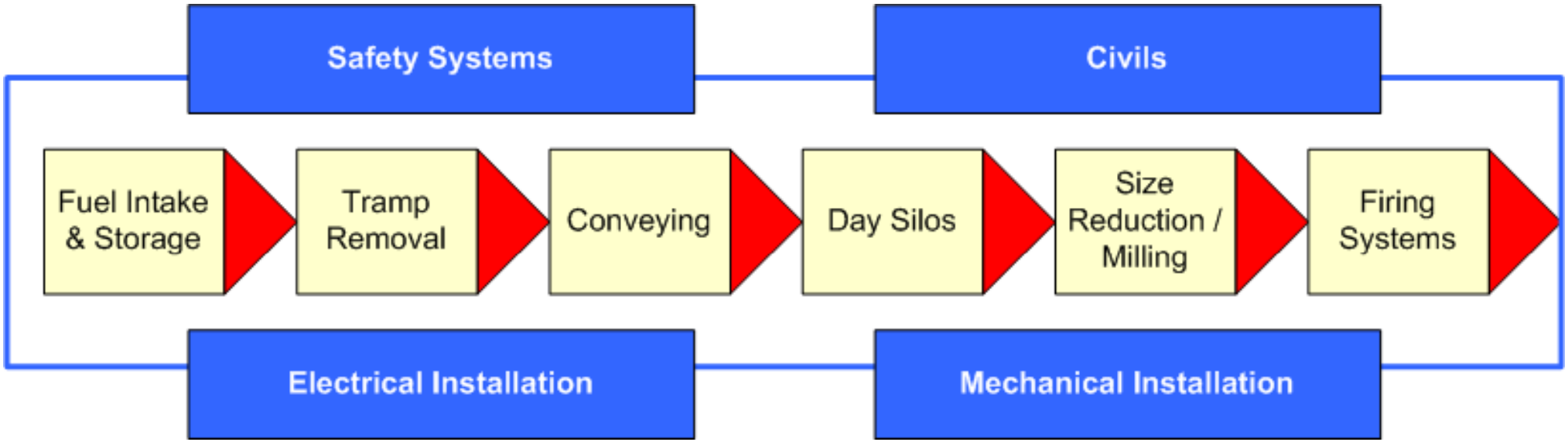
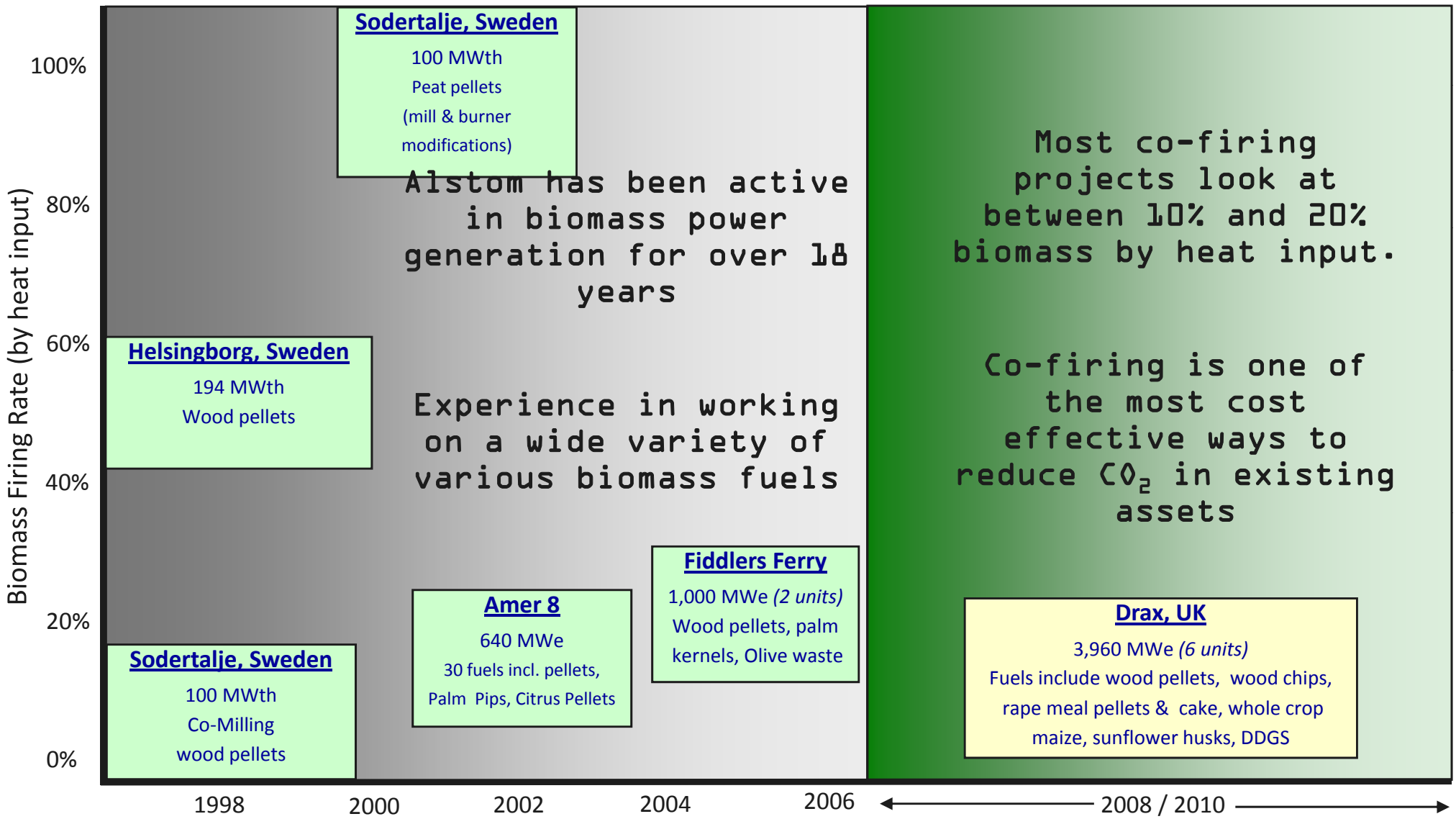
Alstom's offering



Alstom's European Experience



SSE - Fiddlers Ferry Power Station
Warrington, UK – 4 x 500 MWe

Fiddlers Ferry Co-Firing

- 4 x 500 MWe T-Fired Boilers - unit 2 and 4
- First dedicated Biomass co-firing plant in the UK
- Previously co-milling, decision made to move to dedicated co-firing system,
- 20% MCR Biomass by heat input basis
- Multi Biomass fuels; wood pellets, palm kernels, olive stones, olive cake <15% moisture
- Fast track project; executed in 2 phases
  - Phase 1, 4 month design study, customer engaged at all stages of project development, inc HAZOP
  - Phase 2, (EPC) Engineer, Procure and Construct two dedicated streams of Biomass co-firing, inc civils, mechanical & electrical installation and commissioning

Alstom Drax Biomass Project

Project drivers

- UK's largest Power Station- producing ~7% of UK power generation
- To produce 10% of output (6 x 660 MWe) from Co-Firing (400MWe)
- To save over 2 million tonnes of carbon dioxide per annum
- To co-fire 1.5 million tonnes of biomass per annum, through the development of new 'Direct Injection' facilities
- Multiple fuel flexibility, mitigating supply risk

Alstom Drax Biomass Project

- Fast track project; in 2 phases
  - Phase 1, 4 month Design Study, Drax engaged at all stages of project development, inc HAZOP
  - Phase 2, (EPC) Engineering design, supply and installation of equipments associated with the main processing works (road unloading, storage & biomass milling) inc civils, mechanical & electrical installation and commissioning.

System in operation since Dec 2009

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Conclusions

- Dedicated system allows higher firing rates with greater reliability and availability
- Optimization of the biomass milling equipment without compromising existing mills
- Co-firing biomass is a cost effective way of offsetting CO2 whilst utilizing existing assets

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