2nd World Biomass Conference, Workshop 4: Cofiring

Introduction and overview of technologies applied worldwide

TNO Environment, Energy and Process Innovation

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- Rationale for cofiring
- Most important challenges
- Plant configurations
- Involvement of IEA Bioenergy Task 32

Why cofire biomass?

- Co-firing makes use of existing plants: realization at short term and at low capital and operating cost
- High biomass to electricity conversion efficiencies
- Emissions (CO_2, SO_2, NO_x) reduce
- Saves on foreign exchange
- Avoiding disposal of residues

Most important challenges

- **Technical**
  - Experience for specific fuel – boiler configurations
  - Biomass handling and storage concerns
  - Ash deposition and corrosion concerns
  - Interference with/effectiveness of FGC systems
  - Plant reliability and O&M costs

- **Commercial / institutional**
  - Uncertain long term fuel supply
  - Lack of clear/reliable policy frameworks
  - Ash utilization options uncertain
  - Changes in legislative position requires modified environmental permits
  - Liberalization of electricity market leads to conservative technologies

Current coal ash utilization in Europe

Bottom ash utilization	Quantity (million tonnes p.a.)
Concrete addition	0.2
Non-aerated concrete blocks	1.0
Lightweight aggregate	0.3
Grouting	0.2
Subgrade stabilisation	1.1
Pavement base course	1.2
Blasting grit	0.7
Other uses	0.3
Reclamation/restoration	2.0
Disposal	2.6
Total	9.6

Fly ash utlization	Quantity (million tonnes p.a.)
Cement raw material	4.0
Blended cement	2.3
Concrete addition	4.9
Aerated concrete blocks	0.7
Non-aerated concrete blocks	0.7
Lightweight aggregate	0.3
Bricks and ceramics	0.2
Subgrade stabilisation	2.1
Infill	1.0
Other uses	0.2
Reclamation/restoration	9.2
Temporary stockpile	0.6
Disposal	19.4
Total	45.6

Cofiring configurations

- Direct cofiring
- Indirect cofiring
- Parallel combustion

Direct cofiring options

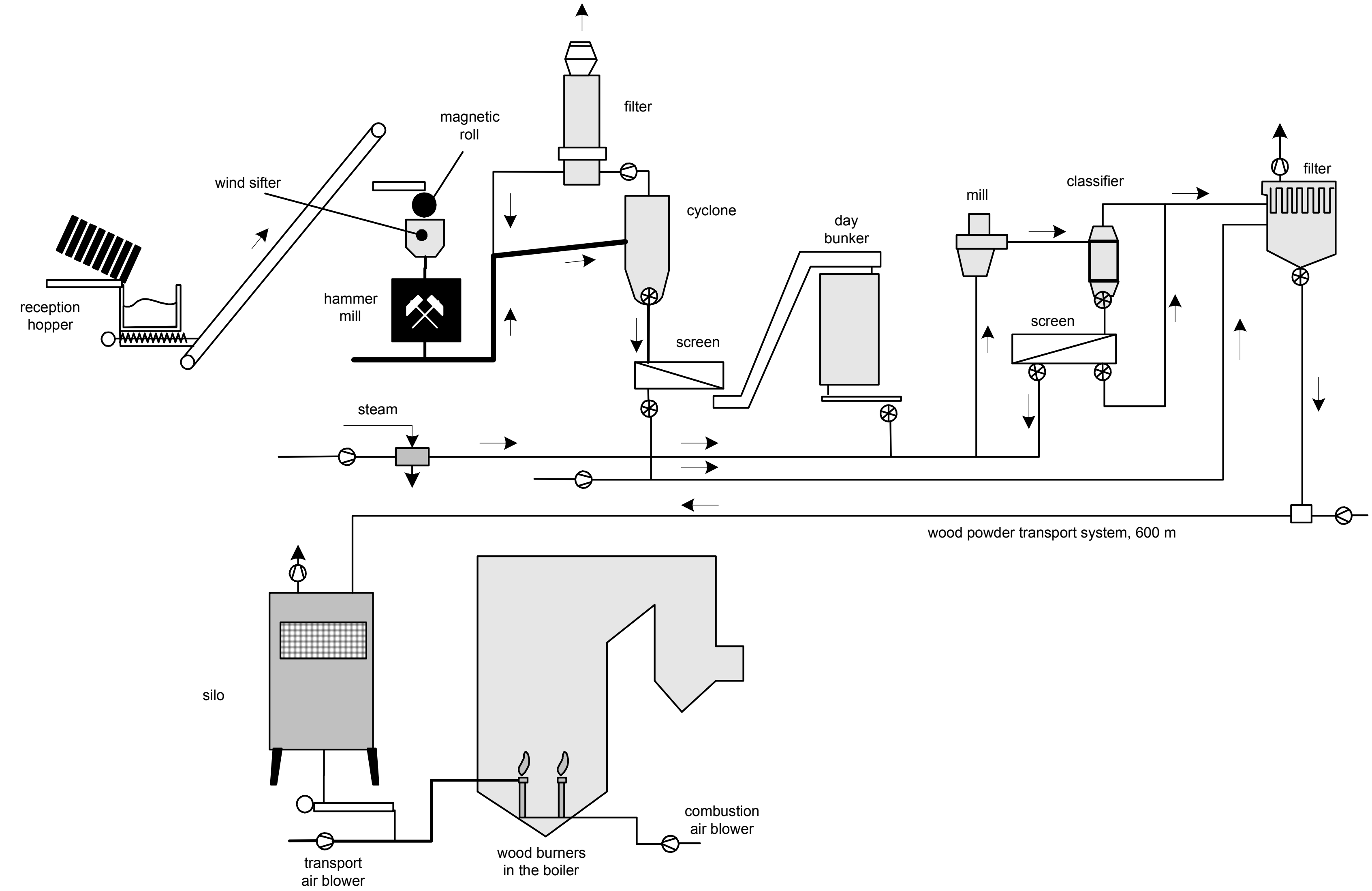
1. Use existing handling, metering and comminution equipment, use existing burners

2. Use dedicated handling, metering, and comminution equipment, use existing burners

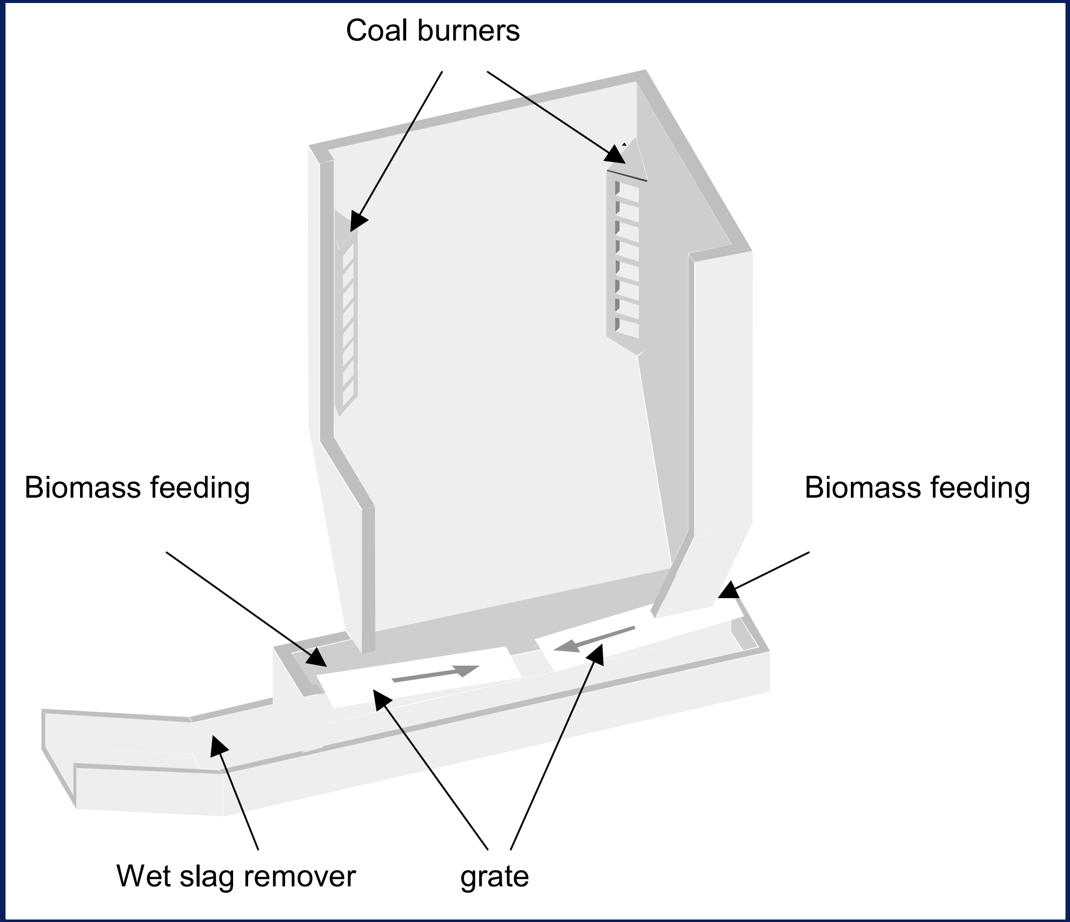
3. Use dedicated handling, metering, and comminution equipment, use dedicated burners

4. Use of biomass as a reburn fuel (not much experience yet)

Gelderland plant, Nijmegen (Electrabel)



St Andrea, Austria (Verbund)

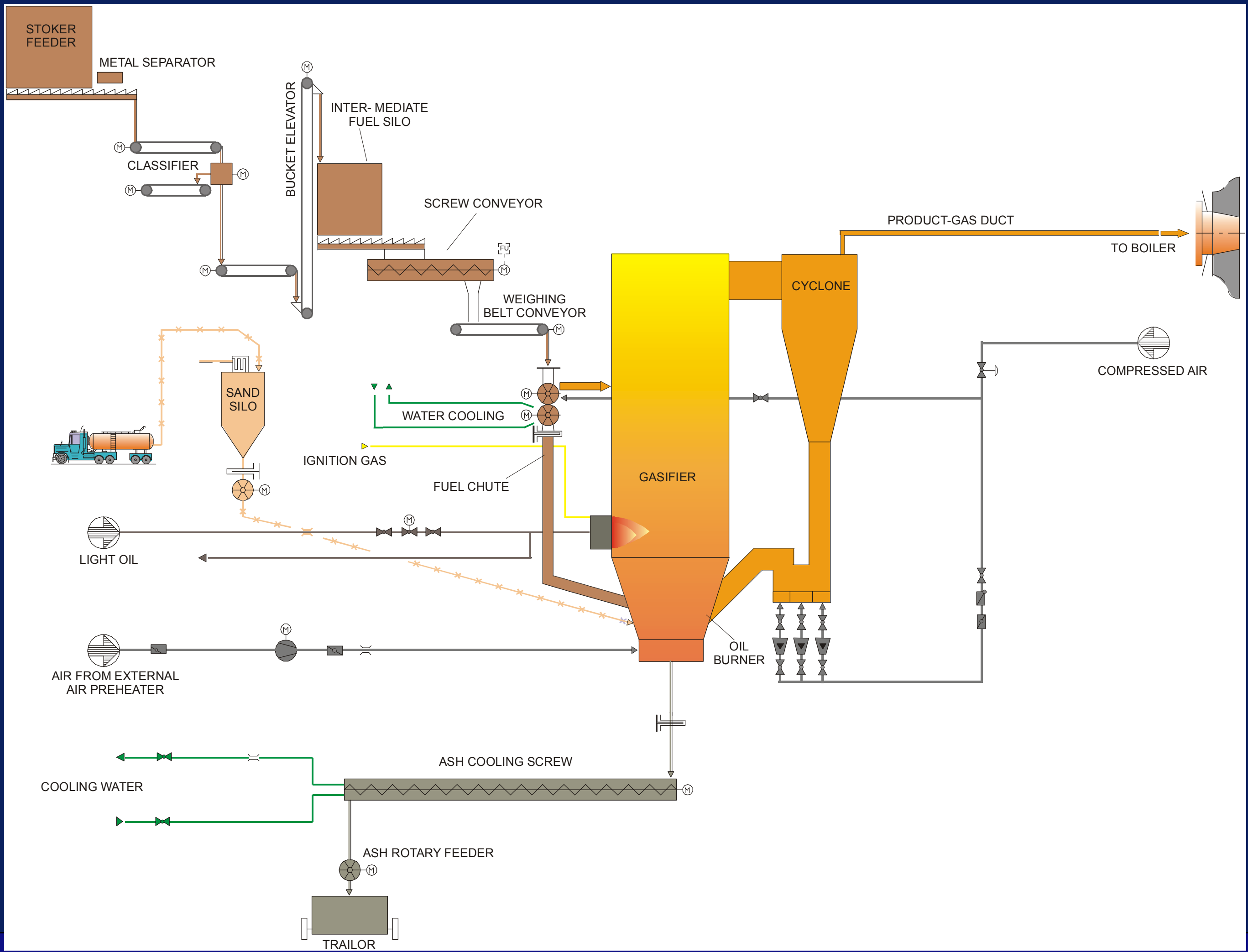


Indirect cofiring

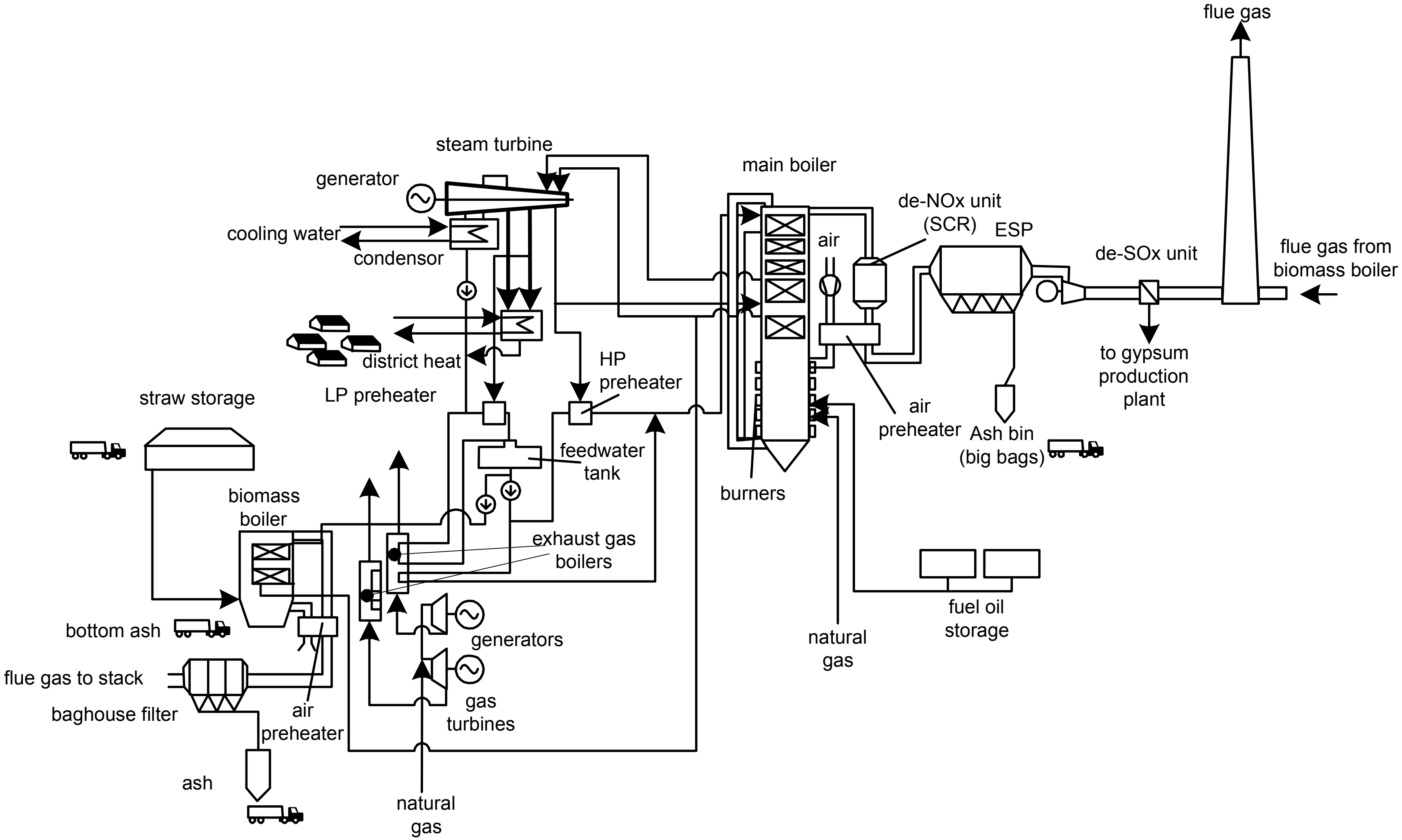
- **Gasification:**
  - Replace fuel treatment by (usually) air-blown, atmospheric pressure, circulating fluidised bed gasifier
  - Key technical decision concerns degree of gas cleaning

- **Other technical options:**
  - Pyrolysis oil
  - Charcoal
  - HTU biocrude

Biococomb, Zeltweg, Austria

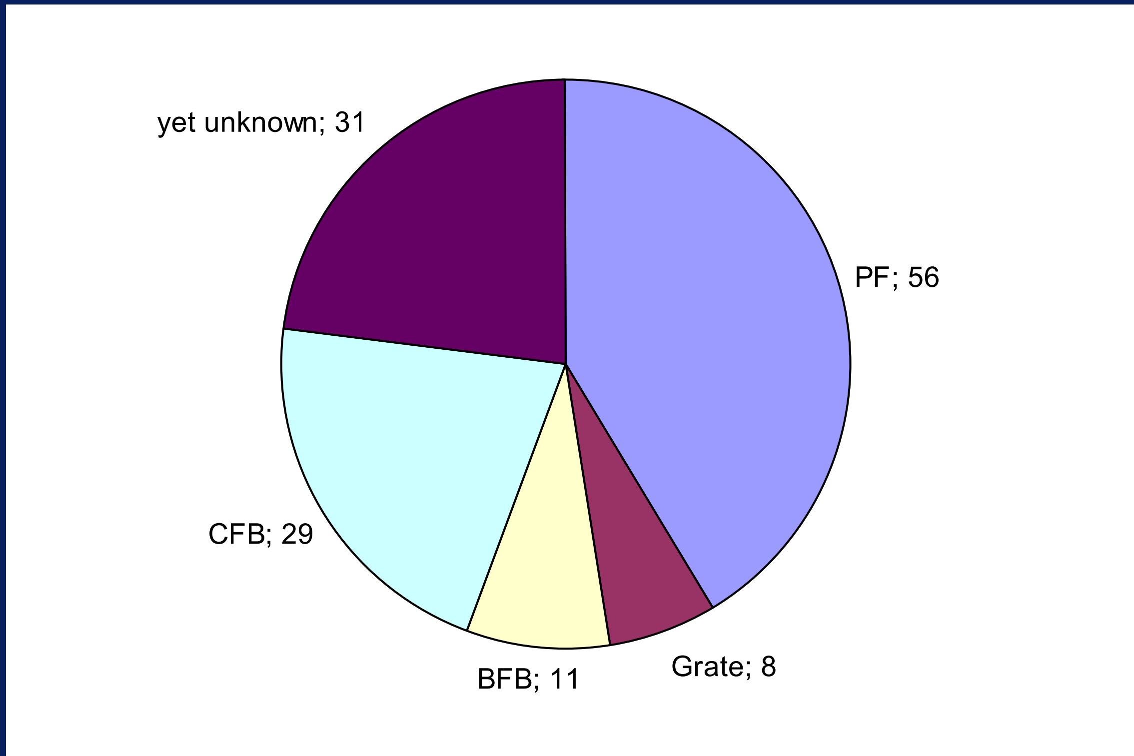


Parallel firing



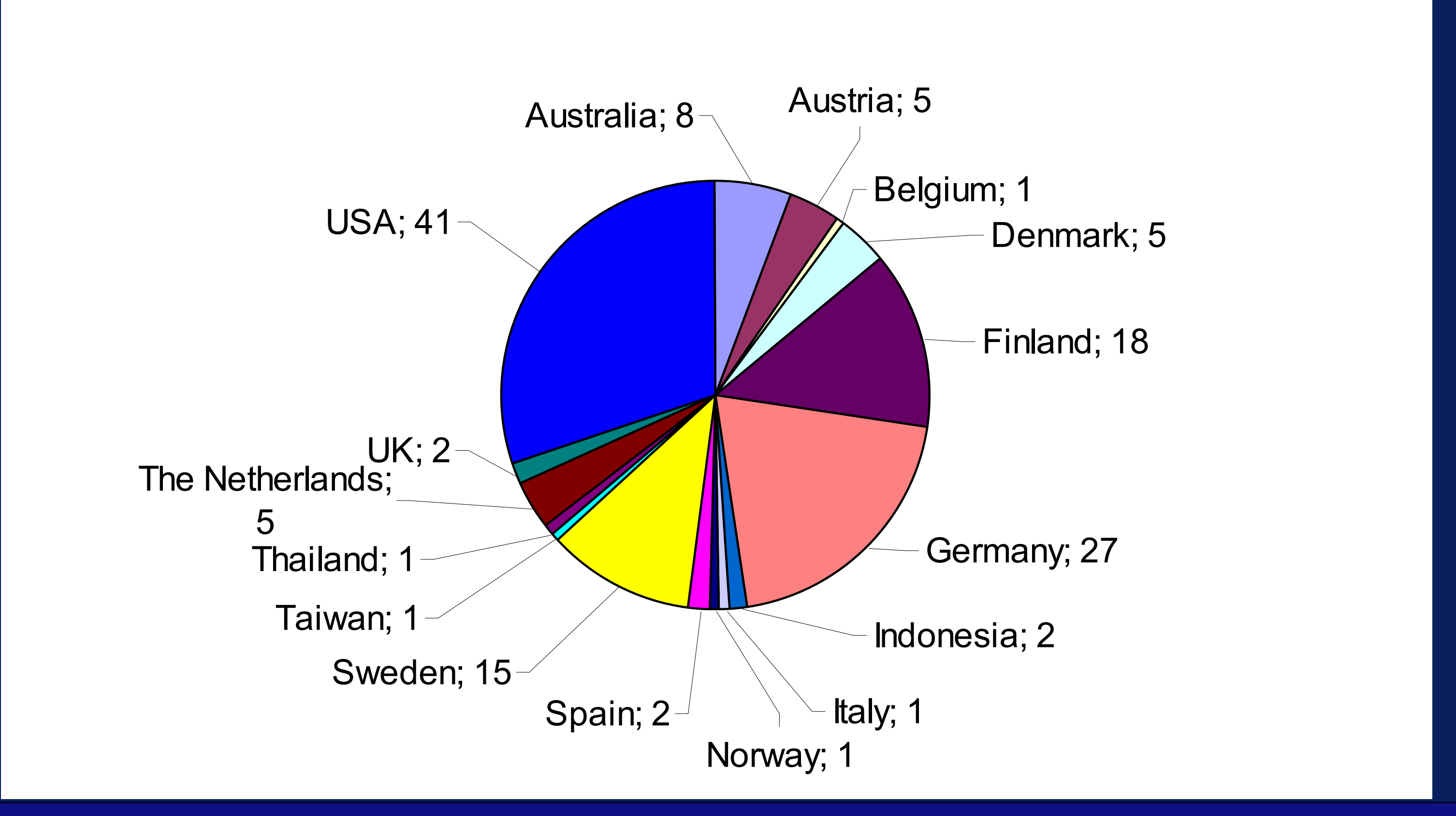
IEA Task 32 co-firing overview

- 135 plants identified sofar with experience on co-firing biomass with coal
- Biomass is usually direct fired, only few are indirect or parallel firing



Cofiring overview

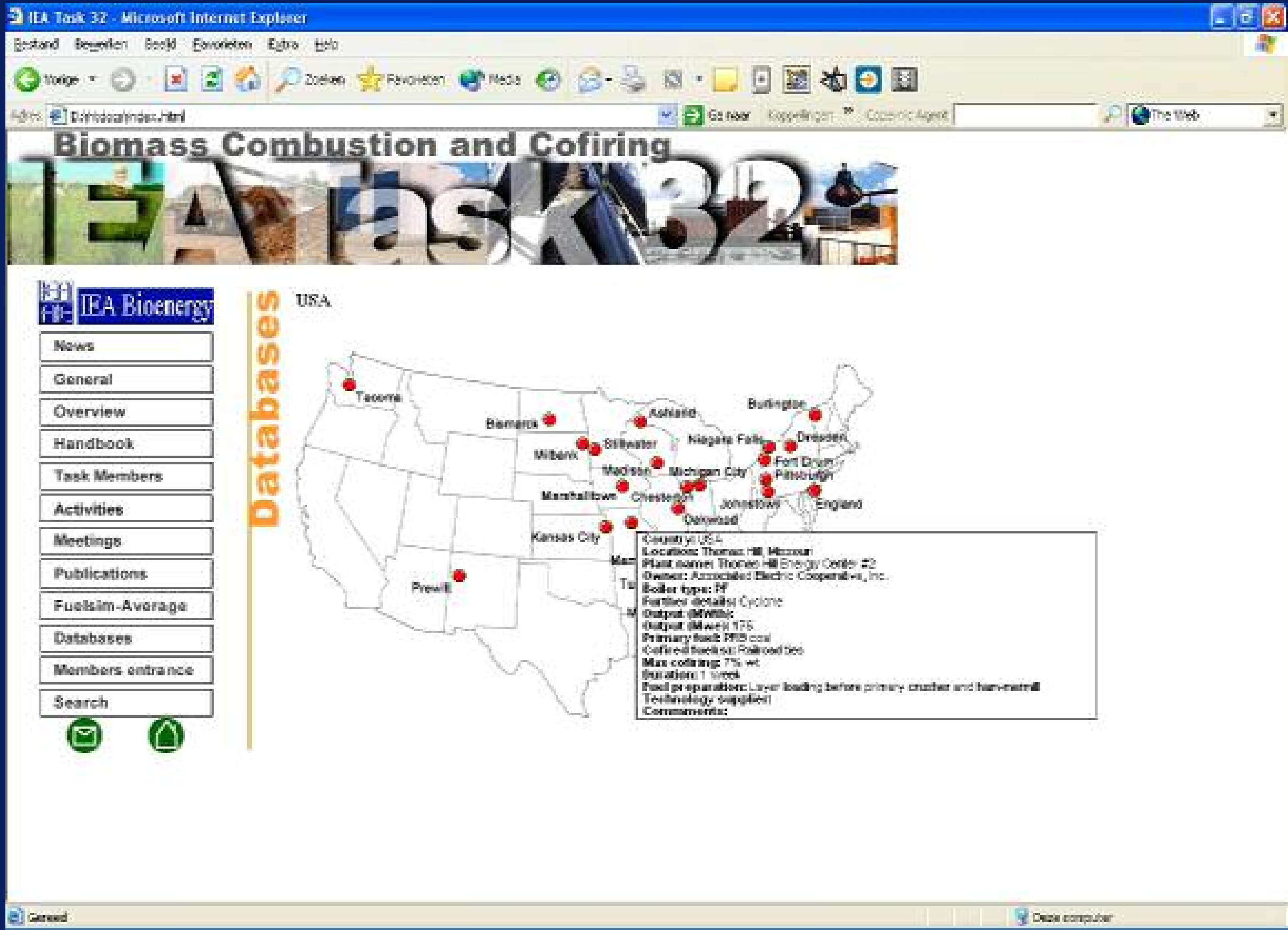
- **Data on 16 countries found:**



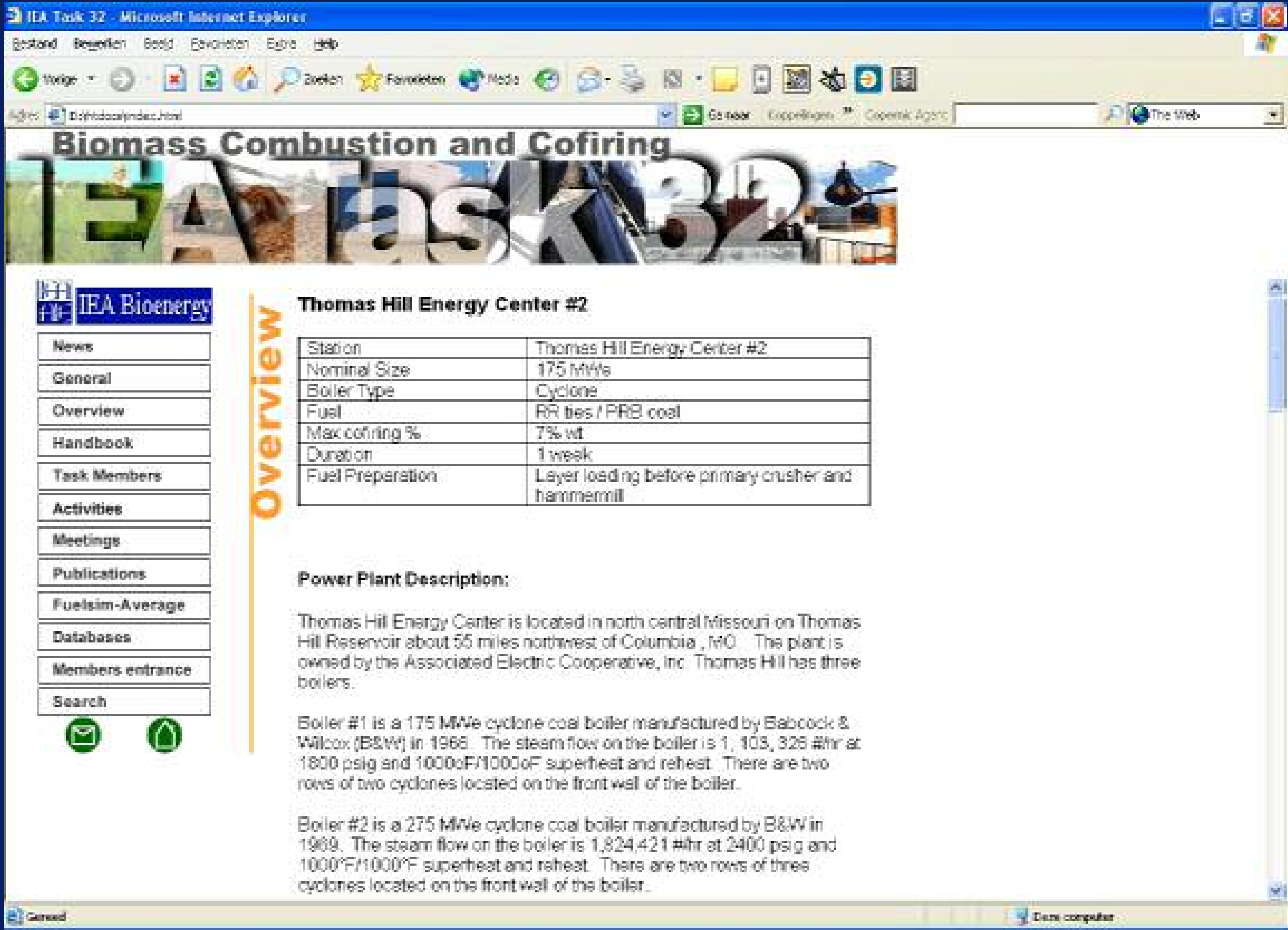
General observations

- Commercial operation with fluid beds in Scandinavia up to 100% biomass
- Up to 10% heat input in PC boiler plants
- PC plants (Lignite and coal) in Germany:
  - sewage sludge commercially,
  - trials with straw and wood
- Trials with wood and switchgrass in many PC plants in USA
- Australia: Some commercial operation, some trials up to 5% heat basis with PC plants
- Several fuels in PC plants in Netherlands (commercial and trials)

Cofiring overview



Cofiring overview



Thomas Hill Energy Center #2

Station	Thomas Hill Energy Center #2
Nominal Size	175 MWe
Boiler Type	Cyclone
Fuel	RR ties / PRB coal
Max cofiring %	7% wt
Duration	1 week
Fuel Preperation	Layer loading before primary crusher and hammermill

Power Plant Description:

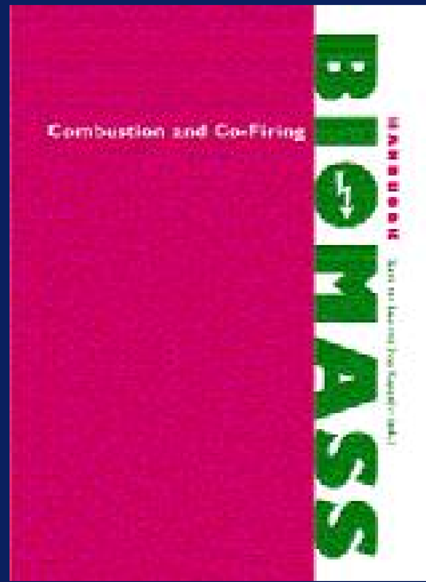
Thomas Hill Energy Center is located in north central Missouri on Thomas Hill Reservoir about 55 miles northwest of Columbia , MO. The plant is owned by the Associated Electric Cooperative, Inc. Thomas Hill has three boilers.

Boiler #1 is a 175 MWe cyclone coal boiler manufactured by Babcock & Wilcox (B&W) in 1966. The steam flow on the boiler is 1, 103, 326 #/hr at 1800 psig and 1000oF/1000oF superheat and reheat. There are two rows of two cyclones located on the front wall of the boiler.

Boiler #2 is a 275 MWe cyclone coal boiler manufactured by B&W in 1969. The steam flow on the boiler is 1,824,421 #/hr at 2400 psig and 1000°F/1000°F superheat and reheat. There are two rows of three cyclones located on the front wall of the boiler.

Detailed technical information

- **Detailed discussion and guidelines included in IEA Bioenergy Task 32 handbook on Biomass Combustion and Cofiring**
- **Available at TNO-stand in Dutch pavilion**



Conclusions

- Cofiring represents a cost effective, short term option at a large scale
- Although more needs to be done, there is already a wealth of practical experience under different conditions
- Recent work indicates there are no irresolvable issues but there are poor combinations of fuel, boiler, and operation.
- IEA Bioenergy Task 32 collates and distributes information on experiences with cofiring:

  www.ieabcc.nl