Co-firing: Policies and Supply Chains

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Overview

✓ Policy framework
  ✓ Is co-firing supported? Are there any specific conditions to be met?

✓ Sourcing
  ✓ Internationally traded biofuels vs. local sourcing

✓ Sustainability
  ✓ Systems: (COM 2010) 11, Laborelec verification scheme, IWPB

✓ Fuel considerations / Technical requirements
  ✓ What are the main parameters to consider before selecting a fuel?

✓ Economic indicators
  ✓ Support scheme level, coal and CO₂ price

✓ Supply Chains in DEBCO:
  ✓ Wood pellets / GDF Suez
  ✓ Agrobiomass / PPC
  ✓ RDF / ENEL

✓ Conclusions
Policy framework

Is co-firing financially supported and recognized by the NREAPs?

• No support in several EU countries, e.g. FR, DE
• Supported in others, usually under specific conditions, e.g. NL, UK, DK

Conditions for support not common:

• Minimum biomass thermal share required → repowering to 100% biomass
• Sustainability / Traceability → development of relevant systems, sourcing
• Biomass types allowed → sourcing, switch to agrofuels
  • “Food vs fuel”
  • Restrictions in the use of wood (competitive industries)
  • Obligatory share of agrobiomass
  • Waste derived biomass?
• Technical restrictions → no co-firing in older units
  • Minimum plant efficiency
Sourcing of biomass

International Supply Chains

- Wood pellets
- Wood chips

Locally Available Biomass

- Woody biomass
  - Agro-biomass
- Waste derived fuels

- Existing market - numerous suppliers
  - Good / excellent fuel quality
  - Fuel cost
  - Transport cost increases when trucks are required for final delivery
  - Sustainability?

- Market status: case by case
  - Fuel quality and cost varies widely depending on biomass type
  - Local availability / collection radius?
  - Local competition

- Not covered by most support schemes
  - Gate fees
  - Fuel quality?
  - Social acceptance
Global production
6-7 Mt (2006), 13 Mt (2009), 80 Mt (2020, AEBIOM estimation)

Global consumption
12.5 Mt (2009) / EU: 10.4 Mt

Exporters:
• Canada, USA, Russia, Germany, Austria, Baltic Countries, Spain, Portugal, Finland

Importers:
• Denmark, Holland, United Kingdom, Belgium, Italy

Uses:
• Domestic heating (USA, Scandinavian Countries, Germany, Austria, Italy)
• Industrial use /co-firing: Netherlands, Denmark, Belgium, United Kingdom

(Sources: Poyry Forest Industry Consulting, Wood Pellet Association of Canada, IEA Task 40)
(COM 2010) 11 - recommended, non-binding criteria:
• protection of biodiversity and high carbon stock areas
• GHG minimum savings at least 35% compared to the EU fossil energy mix;
• diversification of national support schemes for higher energy conversion efficiencies;
• monitoring of biomass origin

Currently:
• No sustainability criteria in several member states
• Mandatory or voluntary schemes in other member states or adopted by utilities → cannot cover all traded biomass

Utilities / traders perceptive:
• Make biomass acceptable and therefore tradable
• Fulfill conditions to get green support
• Cover corporate risk assessment vs. public opinion and NGO’s
• Get access to broader market in more difficult countries
• Insure feedstock for large biomass power plants
Initiative Wood Pellets Buyers:
facilitate trade between utilities through uniform contracting → essential for covering long-term contracts for large plants

1. Similar legal requirements
2. Common specs for industrial pellets
3. Common sustainability principles

(Source: Laborelec)
Technical considerations

“Easy” biomass
- Mostly wood factions
- Typically low ash content, low alkalis and Cl
- Main issues: grinding for pf-boilers, moisture content

“Difficult” biomass
- Straw, maize residues, olive stones, sewage sludge and many others…
- Can have high content of K, Na, P, Cl → potential for corrosion, fouling, catalyst deactivation…
- Usually low melting temperatures

RDF
- Heavy metal contamination, alkali and chlorine content
- More strict legal limits → close monitoring required

Co-firing is about the interactions of two (or more) fuels
- Hard coal / lignite properties important in determining the impact of co-firing
- S/Cl ratio → control of fouling and corrosion by co-firing high-Cl and high-S fuels together
- At low thermal shares ( < 10%) literature and experience suggests that most biomass types are manageable
Wood pellets supply chains for GDF Suez
Policy framework - Belgium

**Flanders**: obligation 6% x 55TWh= 3,3 TWh, penalty=125 €
- green certificates granted according to energy balance of supply chain and reference CCGT

\#GC = net \ MWh_{el} – electricity use – fossil \ MWh_p \times 55\%

**Wallonia**: obligation 11,25% x 27 TWh=3,0 TWh, penalty=100€
- green certificates granted according to proven sustainability, CO₂ balance of supply chain and reference CCGT
- All fuels have reference CO₂ emission according to LCA
  - Natural gas = 251 kgCO₂/MWhp
  - Coal = 396 kgCO₂/MWhp
  - Wood pellets = 55 kgCO₂/MWhp

\#GC = \frac{CO₂_{ref (elec)} - CO₂ (PP)}{CO₂_{ref (elec)}} \times MWh_{el} = \left(1 - \frac{55}{251} \times \frac{55\%}{34\%} = 65\%\right) \times MWh_{el}
# GDF Suez – Co-firing plants

## GDF-SUEZ CFPP (CO-)FIRING BIOMASS POWER PLANTS

<table>
<thead>
<tr>
<th>SITE + % biomass</th>
<th>UNIT</th>
<th>Hardcoal MWe</th>
<th>Biomass products</th>
<th>CAPACITY ton ar/year</th>
<th>Green power MWe</th>
<th>DATE COD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belgium RUIEN 18%</td>
<td>UNIT 3</td>
<td>130</td>
<td>Olive cake</td>
<td>20.000</td>
<td>7</td>
<td>2003</td>
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<tr>
<td></td>
<td>UNIT 4</td>
<td>122</td>
<td>Wood dust</td>
<td>35.000</td>
<td>10</td>
<td>2002</td>
</tr>
<tr>
<td></td>
<td>UNIT 5</td>
<td>190</td>
<td>Wood chips gas</td>
<td>120.000</td>
<td>20</td>
<td>2003</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Wood milling</td>
<td>150.000</td>
<td>30</td>
<td>2007</td>
</tr>
<tr>
<td>Belgium MaxGreen RODENHUIZE 60% → 100%</td>
<td>UNIT 4</td>
<td>240</td>
<td>Wood pellets</td>
<td>850.000</td>
<td>190</td>
<td>2011</td>
</tr>
<tr>
<td>Belgium AWIRS 100%</td>
<td>UNIT 4</td>
<td>130</td>
<td>Wood pellets</td>
<td>400.000</td>
<td>80</td>
<td>2005</td>
</tr>
<tr>
<td>Netherlands GELDERLAND 7% → 20%</td>
<td>UNIT 13</td>
<td>635</td>
<td>Wood pellets</td>
<td>500.000</td>
<td>138</td>
<td>2010</td>
</tr>
<tr>
<td>Poland POLANIEC 10% → 15%</td>
<td>7 UNITS</td>
<td>1575</td>
<td>Wood chips 2012</td>
<td>150.000</td>
<td>50</td>
<td>2009</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Agri biomass 2012</td>
<td>300.000</td>
<td>100</td>
<td>2009</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Green Unit</td>
<td>1.100.000</td>
<td>190</td>
<td>2012</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>80% wood-20% agri</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EUROPE (BE + NL + POL) 25%</td>
<td></td>
<td></td>
<td>Essentially imported</td>
<td>1.770.000</td>
<td>601</td>
<td>2012</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Essentially local origin</td>
<td>1.855.000</td>
<td>214</td>
<td></td>
</tr>
</tbody>
</table>

10% share of the world market for wood pellets
Laborelec – Certification scheme

Minimum criteria:
- energy balance or CO₂ balance for the supply chain (yearly)
- overall traceability of the primary resources and final product (yearly)
- independent report over local resource management and respect of local and international legislations (once)

Operational:
- not expensive ( < 0,05 €/ton)
- can be fast ( < 2 weeks)

Pragmatic approach:
- implement first a scheme that works in practice and is affordable
- then improve the certification scheme in time

Dissemination of approach to other utilities

Other utilities

1. Independent reporting

2. Yearly Sustainability Certificate

3. Track & trace system

Electrabel Fuel Logistics
Co-firing with agrobiomass in Greece
Policy and market framework

**RES / biomass sector**
- Ambitious RESe targets (40% electricity consumption by 2020), emphasis on wind and solar energy
- Biomass power → limited targets, no strategy for co-firing (however support scheme exists)
- Emerging solid biomass market for domestic heating
- Investor interest in biomass power, no projects realized yet
- Opportunities in the agricultural sector: availability of residues, interest in energy crops, however lack of coordinated efforts

**Lignite sector**
- Lignite power production to decrease from 50% to 27% by 2020 (NREAP)
- Old age, low environmental performance & efficiency for many units – limited operation / decommissioning under IED
- Many uncertainties over the liberalization of the market
- Implementation of co-firing – possible target units:
  - North Greece – 1365 MWe (Agios Dimitrios V, Meliti I, Ptolemaida V)
  - South Greece – 600 MWe (Megalopolis III & IV)

**Socio-economics:** transition to low lignite economy and sustainable development
Supply chains for Greek lignite plants

- Transport by trucks required for imported pellets, high CIF Thessaloniki cost \(\rightarrow\) no wood pellets import
- Development of local supply chains required for co-firing
- Activities within DEBCO:
  - Demonstration program for cardoon cultivation (400 ha)
  - Investigation of straw supply chains for Meliti PP
  - Currently: maize residues for Kardia PP
- Future perspectives good but effort must be undertaken in:
  - Fuel management / feeding system
  - Long term contracts / business model

- Individual contracts with \(\sim\) 80 farmers
- Low yields in the 1st year of harvesting
- Currently aborted
- Low GHG emissions of supply chain
- Pelletization for transport distances up to 300 km
- Acceptable fuel cost
- Ease of management
- 2 main fuel providers
- Good availability / low usage competition
- Problematic fuel management
RDF Supply for Fusina Power Plant
Quality monitoring of RDF

- Quality monitoring of the RDF burned in Fusina power plant and produced by Ecoprogetto according to UNI 9903 (January 2009 to June 2011)
- The analyses have been carried out on monthly lots, everyone made by 5 weekly sub-lots

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Unit</th>
<th>Standard Method</th>
<th>Equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immediate analyses (Moisture, Volatile, Ash)</td>
<td>%</td>
<td>ASTM D5142</td>
<td>Las Navas TGA 2000</td>
</tr>
<tr>
<td>Elementary analysis (C, H, N, S)</td>
<td>%</td>
<td>ASTM D5373</td>
<td>Vario Macro CHNS Elementar</td>
</tr>
<tr>
<td>LHV</td>
<td>kJ/kg</td>
<td>ASTM D5865</td>
<td>Calorimeter Parr 6300</td>
</tr>
<tr>
<td>Chlorine and Fluorine</td>
<td>ppm</td>
<td>ASTM 5865+IC</td>
<td>Calorimeter Parr 6300 + IC Dionex</td>
</tr>
<tr>
<td>Major elements (Al, Ca, Fe, K, Mg, Na, P, Si, Ti)</td>
<td>ppm</td>
<td>ASTM D 3682+D6357</td>
<td>ICP/OES Ottico Spectro Genesis</td>
</tr>
<tr>
<td>Hg</td>
<td>ppm</td>
<td>ASTM D-6722-01</td>
<td>DMA 80 Milestone</td>
</tr>
<tr>
<td>Minor elements (As, Ba, Be, Cd, Co, Cr, Cu, Ni, Pb, Sb, Se, Sn, Sr, V)</td>
<td>ppm</td>
<td>EPA3052+ASTM D6357</td>
<td>ICP-MS Ultramass 700 Varian</td>
</tr>
<tr>
<td>Ash Fusion Temperature</td>
<td>°C</td>
<td>DIN 51730</td>
<td>HSLM Expert Ssytem Solution</td>
</tr>
</tbody>
</table>
Quality monitoring of RDF

- RDF meets the requirements for “normal quality” categorization for moisture, LHV, Cl, S, ash content and heavy metals according to UNI 9903.
- Chlorine occasionally close to the normal limit.
- Seasonal trend for LHV and ash content observed. Quality has improved in recent years.
- Operational experience: increased slagging (manageable), no corrosion.
Conclusions
Conclusions

- Policy requirements and access to “unproblematic” (wood) biomass through global markets or locally (in cases) → increase biomass share beyond 10%
- Common sustainability criteria pushed by utilities/traders, not policy makers
- Financial support for bioenergy required vs. future reductions + competitive industries → diversification of biomass sourcing and cost reduction
- Torrefied wood
  - decrease of logistics cost
  - decrease of operating cost
- Agricultural biomass
  - international trade / sustainability criteria?
  - (wet) torrefaction
The European Renewable Heating and Cooling Platform (RHC Platform, [www.rhc-platform.org](http://www.rhc-platform.org)) was formed to:

- support the European Commission to define the next priorities under FP7 & Horizon 2020 and increase R & D budgets for Renewable Heating & Cooling

- contribute to European Industrial Priorities for SMART CITIES

- have an impact on the National Renewable Energy Action Plans (RE Directive)

- increase awareness: the actual weight of RHC must be reflected in the SET-Plan
## R&D priorities for biomass

<table>
<thead>
<tr>
<th>RHC.47</th>
<th>Development of highly efficient large-scale or industrial CHP with enhanced availability and high temperature heat potential</th>
</tr>
</thead>
</table>

### Objectives

Increase of steam data, i.e. pressure and temperature (advanced steam data), from 540°C to 600°C for 100% biomass-fired plants;

Investigation of alternative technology options, e.g. biomass gasification and **in-direct co-firing**;

Process adaption of **fuel pretreatment** (e.g. torrefaction to reduce alkaline content of biomass and improve grindability (higher HGI) in order to make biomass 'coal mill ready');

Reduction of corrosion, fouling and agglomeration (in FBs) from alkali chlorides and heavy metals (Pb, Zn, etc) in biomass-fired plants and co-firing units by:

- Research and demonstration of **new materials** (austenitic alloys, Ferritic alloys, FeCrAl alloys, Ceramics) suitable for combustion of problematic biomass types. The materials should be able to handle problems such as creeping, cracking, TMF and corrosion, erosion, fouling

- Development and testing of **new additives** that result in the formation of less corrosive substances: (i) sulphur containing additives: ammonium sulphate, elemental sulphur, sulfur granules, (ii) phosphorous containing additives: dicalcium phosphate, monocalium phosphate, AlSi containing additives: kaolin, dolomite, bentonite;

- Development and testing of **suitable co-firing matrices** for problematic biofuels, e.g. co-firing high alkali biomass with high sulfur fuels;

- Demonstration of **new types of boiler design** for optimal conditions in the critical areas for fouling/corrosion, e.g. changes of excess oxygen, flue gas temperature and velocities.
Thank you for your attention

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