STATUS OF COFIRING FOR SELECTED COUNTRIES

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8TH IEA CCC COFIRING BIOMASS WITH COAL WORKSHOP
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PRESENTATION OUTLINE

• Cofiring technologies options
• Cofiring in Europe
  The Netherlands and the UK
• Cofiring in North America
  Canada and the USA
• Cofiring in Asia
  China and Japan
• Summary and closing messages
COFIRING TECHNOLOGIES OPTIONS

- Direct cofiring:
  - Biomass
  - Coal
  - Milling <5%
  - Milling
  - Burner
  - Furnace
  - Boiler
  - Steam turbine

- Indirect cofiring:
  - Biomass
  - Coal
  - Milling
  - Gasifier
  - Burner
  - Boiler
  - Steam turbine

- Parallel cofiring:
  - Biomass
  - Milling
  - Burner
  - Boiler
  - Steam turbine
  - Coal
  - Milling
  - Burner
  - Boiler
COFIRING IN EUROPE

THE NETHERLANDS AND THE UK
Starting in the early 2000s, Europe has led the world in biomass cofiring.
**Cofiring in the Netherlands**

- **2003-2006: MEP**
  Fixed premium, project subsidy contracts 10 years
- **2008-2010: SDE**
  Feed-in premium; biomass cofiring only <50 MW
- **2010-now: SDE+**
  ➢ Feed-in premium with competitive tendering between different renewable energy project proposals
  ➢ Proposals granted starting with cheapest cost price until total budget is allocated
  ➢ Large scale biomass cofiring included in 2015 for 8 years
  ➢ 4 cofiring proposals worth more than €3.5bn were granted in 2016 call
  ➢ Provisional correction rate in 2017 (to be deducted from cost price): 0.032 €/kWh

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**Dutch wood pellet imports 2012-2016 '000t**

- 2012: 1,200
- 2013: 800
- 2014: 400
- 2015: 200
- 2016: 200

*Argus (2017)*
## Cofiring in Europe – The Netherlands 2017

<table>
<thead>
<tr>
<th>Power plant</th>
<th>Type of combustion</th>
<th>Total capacity, MW</th>
<th>Commission year</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGIE Rotterdam</td>
<td>USC PC, 10% direct cofiring</td>
<td>731</td>
<td>2015</td>
</tr>
<tr>
<td>Eemshaven A &amp; B</td>
<td>USC PC, 10-15% direct cofiring</td>
<td>1,560</td>
<td>2015</td>
</tr>
<tr>
<td>Amer 9</td>
<td>SC PC, direct cofiring - biomass is milled separately; indirect cofiring - gasification in an atm circulating bed gasifier; 35-80% cofiring</td>
<td>660</td>
<td>1994</td>
</tr>
<tr>
<td>Maasvlakte MPP 3</td>
<td>USC PC, 15-25% direct cofiring, biomass is milled separately</td>
<td>1,100</td>
<td>2017</td>
</tr>
<tr>
<td>Hemweg 8</td>
<td>SC PC, missed out 2016 subsidy for biomass cofiring, plan to close by 2024</td>
<td>630</td>
<td>1995</td>
</tr>
</tbody>
</table>
RWE/ESSENT AMER 9 POWER STATION
Commissioned in 1994, 660 MWe + 350 MWth, direct cofiring 35-80% wood pellets (photo courtesy of Essent)
• Gross capacity 1,100 MW
• Designed efficiency 47%
• Steam conditions 620°C, 28.5 MPa
• Direct cofiring 15-25%, biomass is milled separately
• CO₂ capture ready
• Ready for heat supply to the region
• Commissioned 2017

Maasvlakte MPP 3 coal-fired power plant (photo courtesy of E.ON)
COFIRING IN THE UK

• 2002-2017: Renewable Obligation (RO) was main subsidy scheme. Ofgem issued Renewable Obligation Certificates (ROCs) to power generators for the renewable electricity generated.
  - 2002: 1 ROC → 1 MWh of renewable energy, up to 25% of a supplier’s obligation
  - 2006: proportion of cofired ROCs reduced to 10%
  - 2009: cofiring band with different support levels was introduced, cap backed to 12.5%
  - 2011: proportion of cofired ROCs reduced to 5%
  - 2015: grandfathering support for new cofiring and retrofit units removed from RO
  - 2018: cofired ROCs are capped at 125,000 per unit per year

• 2017 – now: Contracts for Difference (CfD) are based on the difference between the market price for electricity and an agreed ‘strike price’ for renewable electricity.

• Other related legislation: Energy Crop Scheme, Renewable Heat Incentive (RHI), Feed-in Tariffs (FIT)
## UK RO banding levels for biomass cofiring units (UK DECC, 2012, 2015)

<table>
<thead>
<tr>
<th>Band</th>
<th>Description</th>
<th>Support level (ROC/MWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low range cofiring of biomass</td>
<td>Less than 50% biomass cofired in a unit</td>
<td>0.5 in 2010-2013; 0.3 in 2013-2015; 0.5 from 2015</td>
</tr>
<tr>
<td>Mid-range cofiring of biomass</td>
<td>50-84.9% biomass cofired in a unit</td>
<td>0.6</td>
</tr>
<tr>
<td>High range cofiring of biomass</td>
<td>85-99.9% biomass cofired in a unit</td>
<td>0.7 before April 2014; 0.9 from 2014</td>
</tr>
<tr>
<td>Biomass conversion unit</td>
<td>100% biomass fired in a unit</td>
<td>1.0</td>
</tr>
<tr>
<td>Dedicated biomass</td>
<td>New build 100% biomass fired unit</td>
<td>1.5 until 2016; 1.4 from 2016</td>
</tr>
</tbody>
</table>
Most UK coal-fired generators have cofired, 2011 peak of 2,964 GWh

As at May 2017, there are 8 coal-fired power plants. All cofire, apart from Drax (2 coal units, 4 biomass units)

All are direct cofired

Wood pellets used mainly. Other biomass includes agricultural and forestry residues, and energy crops

Transitional role in decarbonising in short to medium term

Extended plant life

Photos courtesy of Fiddlers Ferry power station
COFIRING IN NORTH AMERICA

CANADA AND UNITED STATES
• Canada is world leader in wood pellet production
• No national governmental support for cofiring
• Cofiring activities were concentrated in Ontario and owned by OPG. However, OPG closed all coal-fire power plants in 2014
• Biomass cofired: agricultural residues, forestry products, domestic and municipal wastes, and energy crops
• Direct cofiring in PC boilers
• Interest from NSP in 2017
At the federal level, only the Production Tax Credit (PTC) supports biomass electricity generation with a flat rate of 1.1 ¢/kWh. But not clearly specified for cofiring.

At the state level, Renewable Portfolio Standards (RPS) mandate power plants to generate more renewable energy by using sources like biomass.

By 2010, 40 of 560 coal-fired plants in USA cofired biomass.

All direct cofire in PC boilers.

50% cofiring use wood products. Railroad ties are another major source.

USA has huge wood resources. Cofiring can extend coal-fired power plant life.
COFIRING IN ASIA

CHINA AND JAPAN
2006: Renewable Energy Law

2009: Amended Renewable Energy Law, biomass power generation benchmarking price is 0.75 yuan/kWh, paid by the grid and the National Renewable Development Fund

Dec 2016, NEA announced Coal Coupling Power Demonstration Programme as part of the Clean Power Plan in China’s 13th Five Year Plan to reduce local air pollution from burning agricultural and forestry wastes and sludge

Dec 2017, Ministry of Environmental Protection and NEA jointly issued a Notice for Implementation Pilot Project on Technological Innovation of Coal-Biomass Cofiring Generation

Jun 2018: NEA and Ministry of Ecological Environment announced 89 pilot projects at 84 power plants, including 58 agricultural and forestry wastes cofiring, 29 sludge cofiring, and 2 residential wastes cofiring

Jun 2018: Ministry of Finance and NEA published the List of Supplementary Subsidies for Renewable Energy Tariffs; did not include cofiring
• 56 of the 58 agricultural and forestry wastes cofiring projects are indirect gasification cofiring and 2 are direct cofiring

• Gasification is expensive but has less impact on boilers and ash utilisation. It can easily measure how much biomass is cofired

• Jingmen 10.8 MW biomass gasification project is the Chinese pioneer, operational for 6 years
• 1996: Renewable Energy Target for 2010, included biomass
• 1997: Support for Deployment of New and Renewable Energy
• 2003-2012: Renewable Portfolio Standard (RPS) utility companies had to generate electricity from new and renewable sources at a certain level or above
• 2012: Feed-in Tariff (FIT) utility companies to supply a portion of their electricity from renewable energy source on a fixed period contract (20 years in 2017) at a fixed price. Support for new plants only
• 2014: Strategic Energy Plan confirms coal power remains as base load power source through 2030 and beyond
• 2015: Long-term Energy Supply and Demand Outlook draws up Best Energy Mix 2030, 26% coal power and 3.7-4.6% biomass power, power efficiency 44.3%, biomass can be deducted from fuel input when calculating efficiency
Biomass Cofiring Units in Japan
(Japan Woody Bioenergy Association, 2017)
COFIRING IN JAPAN

• Before FIT system (pre-2012), 12 coal power plants were cofiring 2-3% biomass

• Although the FIT scheme does not support retrofitting to cofire biomass, there are still 29 large coal-fired units cofiring biomass (2017)

• 17 of the 42 planned new coal-fired units will cofire biomass. Many smaller projects (<112.5 MW) plan to cofire to meet the 44.3% electric efficiency standard

• Most plants use direct cofiring

• Biomass includes forest thinning, forest and agricultural residues, construction waste, and general wood (mainly imported wood pellets)

• Concerns about biomass sustainability

• Japan is working on increasing the cofiring ratio. The highest so far is 34%

Sherrard (2017)
SUMMARY
Cofiring biomass in large scale coal power plants ensures a higher efficiency than firing in a small biomass-only unit. It can also result in lower GHG emissions due to less coal being burned per unit of output.

Cofiring has played an important transitional role for renewable energy in Europe but is in decline, replaced by 100% conversion. Although there are some demonstration projects, cofiring is not well established in the USA and Canada. Cofiring is booming in Japan but some management and technical issues have been raised. China is starting cofiring.

Cofiring is a cheap technical route to partially decarbonise coal fleet, governmental subsidies are needed to make high ratio cofiring financially viable.

Supportive policies, regulatory and economic, are essential for biomass cofiring deployment.

Sustainability of the biomass fuel is essential.

Cofiring does have some technical issues for the power plant. Europe has substantial experience in tackling these challenges. An international cooperation programme is useful for technology transfer. Our workshop has created a platform for knowledge sharing.
THANK YOU FOR LISTENING
ANY QUESTIONS?

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