Utility Case Study: Vattenfall

The Role of Biomass in Large Scale Renewable Generation Ambitions

European Biomass Power Generation Conference

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Director Business Development Biomass
Vattenfall

London, 1 October 2012
# Agenda

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<td>1</td>
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<td>2</td>
<td>Biomass as part of Vattenfall’s Ambitions</td>
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<td>3</td>
<td>Biomass on Large Scale: Technically Feasible?</td>
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<td>4</td>
<td>Biomass on Large Scale: Sustainable?</td>
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<tr>
<td>5</td>
<td>Economics and the Policy Developments</td>
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1. Which role can Biomass play in the Market?

Electricity from biomass is to increase globally

- In 2050, IEA estimates 2460 TWh of electricity to be produced from biomass and waste, a fivefold increase on 2010
- Still, in 2050, ~6% of all produced electricity will come from biomass

According the IEA’s BLUE Map scenario, in 2050 biomass will generate roughly as much electricity as nuclear does today
1. Which role can Biomass play in the Market?
Increasing need for dispatchable, renewably energy

- Globally, variable renewables (e.g. wind, PV) will increase from 1% today to 19% in 2050
- GIVAR project (Grid Integration of Variable Renewables) has been set up by IEA to address the issue of variable power in complex systems
- Recommendations to policy makers include assessment of adequacy of economic, market-based incentives for provision of flexibility services (e.g. dispatchable generation)
1. **Which role can Biomass play in the Market?**
   Why is biomass co-combustion important for the Energy Transition?

The 10 Reasons for using Biomass in Coal Power Plants:

1. **Short term GHG**\(^*\) reduction due to use of existing assets and logistics
2. **Significant GHG reduction** even considering production and transport of biomass.
3. **Reliable** renewable base load and regulating power supply
4. **Steady GHG Reduction**: Biomass co-combustion replaces the fuel emissions of coal directly; not only via grid emission factor. No GHG decreasing effect at increased volumes.
5. **Low CO\(_2\)** avoidance cost. Biomass co-combustion reduces significantly the average cost for renewable energies
6. **Substantial increase of renewables share** in energy supply.
7. Enables **Reduced Fluctuation** of overall renewable energy supply
8. Helps to **reduce grid enforcement needs**.
9. The renewable energy for **metropolitan areas**.
10. In CHP plants **combined renewable electricity and heat** generation

\(^*\) Green House Gases
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2. Biomass as part of Vattenfall’s Ambitions

“Vattenfall will strive to be one of the leaders when it comes to transforming the energy sector in Europe into something more sustainable and to decreasing our environmental impact.”

Øystein Løseth, CEO

Ambition to reduce CO$_2$ from the current level of 89 Mton/y down to 65 Mton/y by 2020
2. Biomass as part of Vattenfall’s Ambitions

Annual Report 2011, Vattenfall

"Biomass an important source of renewable energy - Biomass is the third most important source of renewable energy in Europe’s energy mix, after hydro and wind power. Co-firing biomass with hard coal in coal-fired power plants is an effective way of bringing about a swift reduction in CO2 exposure."

"Achieving high levels will depend on the availability and affordability of sustainable biomass [...], and receiving the right incentives from CO2 prices and direct subsidies."

2. Biomass as part of Vattenfall’s Ambitions

**Invest in low-emitting energy**
- Biomass plays an important role in Vattenfall’s ambition on renewable energy, especially within the next 10 years
- Investments in renewable energies, especially Wind Energy, are capital intensive
- Biomass co-firing quickly reduces fossil CO₂ emissions by substituting hard coal

**Biomass Growth plan**
- Need to secure long term supply of biomass in large volumes,
- Develop a supply chain at predictable cost, quality, volume and sustainability
- The biomass growth plan enables to multiply Vattenfall’s usage of energy biomass within the coming years

**Biomass supply portfolio**
- Vattenfall builds a biomass portfolio with a mix of sourcing agreements, sourcing contracts and upstream investments
- Vattenfall is evaluating and negotiating agreements and partnerships in Europe, North-America, South America and selected sources world wide

Biomass is a cornerstone of Vattenfall's strategy for near term CO₂ reduction efforts.
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3. Biomass on Large Scale: Technically Feasible?

Biomass seen as a Fuel Development over Time

- Wood chips (residues)
- Wood chips (logs)
- White pellets/briquettes
- Refined pellets/briquettes*
  - Steam explosion
  - Torrefaction
- Carbonization R&D stage

*REFINED PELLETS:
- consist of a woody biomass that is compressed under heat and high pressure
- is a biomass fuel with characteristics of hard coal: low moisture content, water-resistant, groundable in hard-coal mills
- can be stored, handled and used in existing plants without the need for major, additional investments or plant modifications

The challenge is to find a method for producing a sufficient volume of refined wood pellets with the right quality and at a reasonable cost.
3. Biomass on Large Scale: Technically Feasible?
Biomass in existing power plants

Vattenfall has taken the first step to secure feasibility.

• Vattenfall conducted a Large Scale Test with
  - 4300 t refined pellets
  - July 2011
  - at the Power Plant Reuter West in Berlin

• Covering
  - unloading and storage
  - conveying and handling
  - milling and co-firing

CHP Reuter West (2 x 300 MWel) ¹

¹ Steam data: 540°C; 196 bar, Max 1.000 t/h,
Mills: 4 mills/unit, Max. 28t/h hard coal
3. Biomass on Large Scale: Technically Feasible?
Storage test at Reuter West hard coal yard

- May – July, 4.318 tonnes were stored and tested at Reuter West hard coal yard
- Storage facilities were used without any adaptation
- Laboratory analysis resulted in higher COD values of the leaching water, so that a ground insulation was installed
3. Biomass on Large Scale: Technically Feasible?
Successful co-firing tests

**Reasons for the Tests**
- Refined wood pellets is the fuel of the future
- Inquiring into the performance of refined pellets during power plant operation
- Inquiring the overall power plant process from unloading the ships

**Results from the testing in Berlin**
- A co-firing rate of 20 percent at an average-size hard coal fired power plant
- Achieved the same renewable electricity quantities over one year as an offshore wind farm’s output
- CO$_2$ Reduction of over 430,000 tonnes/a compared to normal operation
### 3. Biomass on Large Scale: Technically Feasible?
#### Successful co-firing tests

Large variations in investments for the same CO2 reduction:

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<th>Reuter West Co-Combustion 20%mass</th>
<th>Biomass CHP Mono combustion</th>
<th>Offshore Wind</th>
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<tr>
<td><strong>CO2-Reduction</strong>*</td>
<td>435 kt/a</td>
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<td>Installed Capacity</td>
<td>96 MW_{el}</td>
<td>~ 3 units @ 20 MW_{el} (58 MW_{el})</td>
<td>156 MW_{el}</td>
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<td>Produced Green Electricity</td>
<td>425 GWh/a</td>
<td>525 GWh/a</td>
<td>550 GWh/a</td>
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<td><strong>Investment</strong></td>
<td>5-30 M€</td>
<td>150-225 M€</td>
<td>390-470 M€</td>
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* Co-Combustion: Replacing ~180 kt hard coal, 90% CO2-Efficiency
Biomass and Offshore Wind: Fraunhofer Institut for UBA (2009)
(„CO2- Minderung im Stromsektor durch den Einsatz erneuerbarer Energien im Jahr 2006 und 2007“)
3. Biomass on Large Scale: Technically Feasible?

Positive Media Response

Mit einem neu entwickelten Brennstoff will Vattenfall das Klima retten – und sich selbst. Holz, als Kohle verkleidet.
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The Discussion about Sustainability is triggered by
a) Biomass becoming “large scale” and
b) “internationally traded”,

hence new players entering the market…

But: General acceptance is precondition for expanding the Biomass use.

Questions to be answered:
1. Is there enough Biomass?
2. When is sustainability perceived to be achieved?
3. Can it be organised in a sustainable way?
4. Biomass on Large Scale: Sustainable?
Technical and available Potential

The technical and sustainable biomass supply potentials are significant beyond the expected demand for biomass in 2050!

Source: Dornburg et al. (2008)
Global Wood Supply

Wood supply in central Europe remains more or less stable. Regions with significant growth are mainly Russia, US South, South America and Africa. In the short run Canada has to be considered due to large resources and additional insect calamities.

![Map of Global Wood Supply]

Source: Pöyry (2011)

Legend:
- **Green**: Growing supply
- **Yellow**: Stable supply on high level
- **Red**: Low export potential to Europe
4. Biomass on Large Scale: Sustainable? Producing Proof of Sustainability

Vattenfall has taken the first step to secure sustainability.

Agreement with the State of Berlin on Sustainability of Biomass, (valid 2011-2020)

... referring to solid woody Biomass produced, purchased, transported and used as a fuel; criteria for

• GHG Reduction,
• Environment (Biodiversity),
• Social Indicators (VF Code of Conduct)

→ often referred to as role model
Reasons for the Sustainability Agreement

1. Existing “Klimaschutzvereinbarung” Berlin-Vattenfall since 2008: common strategy and targets to reduce CO₂ until 2020
2. Increased use of Biomass in Berlin is politically welcome
3. Biomass operations becoming international: the sustainability of Biomass was questioned
4. No existing binding international regulation on the sustainable use of Biomass

Requirements

1. Deal with existing questioning on sustainability of sourcing woody biomass
2. Competition aspects of Biomass sourcing to be considered
3. Based on our own criteria, consider development of international standards
4. Producing proof of sustainability: transparent assessments, documentation, ➔ external third party assessment and verification after 2 years
4. Biomass on Large Scale: Sustainable?

Vattenfall’s Sustainability ToolBox

- Carbon Footprint Tool
- Life Cycle Assessment
- Assessment of Environment and Biodiversity of sources
- Vattenfall’s Code of Conduct (tackling HSE, Social Indicators, Human Rights)

![Breakdown by Step and Comparison of Total to Coal](image-url)

**Exemplary values**

- E&C: 4.6
- Harv.: 2.7
- Log 1: 16.5
- Process 1: 23.8
- Log 2: 8.3
- Sea T.: 20.8
- Log 3: 7.5
- Process 2: 18.3
- Total: 105.8
- Coal: 950
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5. Economics and the Policy Developments
Cost variations for Renewable Energies are large

Range in recent levelized cost of energy for selected commercially available RE

Source: IPCC (2011)

Co-Firing forms the low range of Biomass!

Range of Non-Renewable Electricity Cost

Range of Oil and Gas Based Heating Cost
5. **Economics and the Policy Developments**

**Potential and Cost for an Economic GHG Reduction**

**GHG Avoidance Cost [€/tCO\textsubscript{2eq}] for e.g. the German Power Market**

*Increasing co-combustion leads to decreased CO\textsubscript{2} avoidance cost in average*

Source: Dena-Study „Die Mitverbrennung holzartiger Biomasse in Kohlekraftwerken“

- CO\textsubscript{2} avoidance cost for ~10% * co-combustion in coal power plants
Although among the least cost renewable energies, biomass is more costly than coal + CO₂ certificates.
5. **Economics and the Policy Developments**

Policies in EU generally support biomass for power and heat

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"Green Deal" with new Government?

Is there a renewable energy support revision?

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1. Stronger support for locally sources biomass
2. Forest biomass decreasingly qualifies for support
3. In practice, only limited co-combustion support granted, and rarely support for large dedicated biomass plants
4. No limit on plant size for co-combustion
5. Support for already co-combustion plants based on former support system but no support for newly co-combustion plants
6. New support system under development

Source: McKinsey und Vattenfall 2010
Summary and Outlook

Technical Feasibility

- Proof of General Concept has been achieved
- Refined wood pellets: preferred option for biomass in existing coal power plants

Sustainability

- Vattenfall is already committed to only using sustainable biomass
- EU needs to finalise the common sustainability criteria

Scale up and Economics:

- Biomass costs still higher than Coal+CO$_2$ with potential to reduce total cost
- Co-Combustion is one of the least cost options for reducing GHG in Europe

Upstream Strategy:

- Invest in cases for biomass production and supply
- Resume partnerships and JV along the value chain
Thank You!

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