Biomass as a large scale source of energy

October 2017
Drax Group
Companies which change the way energy is generated, supplied and used for a better future
Drax Power Station
Once the largest carbon emitter in Europe, but now:

17% of UK’s renewable power in 2016

86% carbon savings from biomass vs. coal

4GW capacity; 2GW biomass, 2GW coal
Drax Power Station

- £700m Capital Investment
- Negligible impact on efficiency and no loss of output
- Flexible output from 200MW to 645MW per unit
Vertically integrated supply chain
A controllable supply chain:

Morehouse BioEnergy
Bastrop, LA
525kt pa – 69 Employees

Amite BioEnergy
Gloster, MS
525kt pa – 66 Employees

LaSalle BioEnergy
LaSalle, LA
450kt pa – 68 Employees

Corporate
Atlanta – 43 employees
Monroe – 5 Employees

Baton Rouge Transit
Port Allen, LA
2Mt pa – 5 employees
The ‘cons’ have to be mitigated

Our robust, independently audited, sustainability policy shows how

<table>
<thead>
<tr>
<th>Potential Risk</th>
<th>How it is managed</th>
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<tbody>
<tr>
<td>CO$_2$ from combustion</td>
<td>Fibre sourced from forests which grow faster than harvested*</td>
</tr>
<tr>
<td>CO$_2$ from supply chain</td>
<td>Carbon minimised 86% reduction ensured</td>
</tr>
<tr>
<td>Threat to biodiversity</td>
<td>Area based risk assessment</td>
</tr>
<tr>
<td>Better uses for the wood</td>
<td>Use wood which otherwise goes unused</td>
</tr>
<tr>
<td>Social rights</td>
<td>Workers rights protected</td>
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</tbody>
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Assurance provided by independent audit

* The latest evidence shows that a win-win is created where demand for wood causes more trees to be planted and an increasing carbon sink. Removal of that demand causes land to be repurposed or left unmanaged which harms the carbon sink.
The type of wood we use is crucial
In carbon (and cost) terms there is good biomass and bad biomass

Sawlogs
Highest value, must be large and straight

Wood Chips
Highest value residues, often used in pulp industry

Pulpwood
Low value, can be random size and shape

Sawdust
Lower value, often used on site in kilns or biomass boilers

Harvesting Residues
No value, waste product if no market, can be expensive to process

Slab-wood
Limited value as requires additional processing and contains bark
Two main benefits
Combination is unique to biomass at scale

Carbon Savings

Power System Services
Immediate carbon savings

Coal closes earlier

- GHG g CO2-eq/MJ
- Drax biomass CO2-eq % saving

<table>
<thead>
<tr>
<th>Category</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drax biomass average</td>
<td>33.9</td>
</tr>
<tr>
<td>BEIS 2015-20 Target</td>
<td>79</td>
</tr>
<tr>
<td>Gas average (*)</td>
<td>105.28</td>
</tr>
<tr>
<td>Coal average (*)</td>
<td>255.56</td>
</tr>
<tr>
<td>Drax biomass CO2-eq % saving</td>
<td>57</td>
</tr>
<tr>
<td>BEIS 2015-20 Target</td>
<td>68</td>
</tr>
<tr>
<td>Gas average (*)</td>
<td>87</td>
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</table>
Power generation is changing
Biomass helps provide the solution
Biomass can provide a range of system services
Other low carbon generation cannot do all of these

• Reserve
  - Ability to change output to support under / over supply

• Frequency response
  - Fast response to sudden shocks to the system

• Voltage control
  - Generators ability to push power around the system

  o Inertia
    - Protection large plants provide against rapid frequency change

  o Cost of key services expected to increase
    - 100% increase in cost by 2020 vs. 2014/15
    - Competitiveness of units helps keep costs down
To conclude
There is a strong case for biomass in the UK energy mix

- **The changes at Drax were transformative and fast**
  - Drax’s conversion was a quick win with carbon savings delivered before many other renewable projects had been built

- **Biomass sustainability criteria addresses concerns**
  - Use of robust, independently audited sustainability criteria is essential. Drax backs plans for EU sustainability policy

- **A balanced mix of technologies on the grid is best**
  - A mix of technologies is more robust and cheaper

- **System services provided by biomass are needed more than ever**
  - Biomass is the only renewable which provides these at scale