Waste wood to renewable heat – a woody biomass closed loop supply chain

Elliot Jones
Stoke-on-Trent City Council

Overview of action

Action 4 - Establishing a cradle to grave supply chain within Stoke-on-Trent using clean waste wood from municipal parks and land

Why Stoke-on-Trent?
• 1,380 hectares of park and open space
• Compact urban area – minimum transport costs
• Wood waste circa 40,000 tonnes within the City
• No biomass boilers, opportunity to start from scratch
• Political & economic drivers
Situation

- Significant quantifies of wood waste:
  
<table>
<thead>
<tr>
<th>Source of wood</th>
<th>Tonnes/year</th>
</tr>
</thead>
<tbody>
<tr>
<td>City Council Stock</td>
<td></td>
</tr>
<tr>
<td>Civic amenity sites</td>
<td>Unknown</td>
</tr>
<tr>
<td>Tree maintenance</td>
<td>750</td>
</tr>
<tr>
<td>Private Sector within the City</td>
<td></td>
</tr>
<tr>
<td>Local tree surgeons</td>
<td>2,236</td>
</tr>
<tr>
<td>Local wood processing businesses</td>
<td>14</td>
</tr>
<tr>
<td>Forestry Holdings</td>
<td>33,000</td>
</tr>
<tr>
<td>Waste Wood Recyclers</td>
<td>7,000</td>
</tr>
<tr>
<td>Estimated Total</td>
<td>43,000</td>
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</tbody>
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- City Council Tree Maintenance works:
  - Contracted out to third-party
  - Previously being chipped at roadside or left at site with a small quantity sold as logs to public

Technology

- Technology selection:
  - Gasification/pyrolysis vs direct combustion
    - Pyrolysis combustion technology not proven at the scale required
  - Chip vs pellet

  Key decisions: Wood waste sourced from tree maintenance arisings & wood chip preferred medium

- Installed biomass boiler at St James House in October 2013
  - building that had previously had an electric heating system - Allowed for increased savings and maximum carbon impact
  - Created demand for 75 tonnes of wood fuel
  - Saved 100 tonnes per year CO₂
Supply Chain

- Tree maintenance currently carried out by third party

- Alteration of tree works contract to require contractor to deliver waste to location of our choice

- Actually solved a waste problem for contractor

- Long term economics still to be proven
Supply Chain - Processing

- Processing capacity
  - 3 Scenarios explored:
    - **Purpose Built Wood Fuel Hub processing 1,000 tonnes wood waste per year**
      - No suitable site found – 200 investigated, 2 thought suitable
    - **Utilise existing location to process 100 tonnes wood waste per year**
      - One site possible – later ruled out
    - **Let the processing capacity to third party – Implemented solution**
      - Allows us to be flexible with quantities
      - Directly replicable with little upfront expenditure
      - Allows us to get assurances on quality
      - Does require a higher quality of wood waste

Supply Chain - Delivery

- Wood chip purchased as heat to incentivise quality
- Year 1 (2013-14) the boiler consumed 65 tonnes or 190MWh
Outcomes

- Economic viability
  - All three scenarios modelled over minimum 5 years:

<table>
<thead>
<tr>
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<th>€/MWh over five years</th>
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<tbody>
<tr>
<td>Commercial price</td>
<td>69.47</td>
</tr>
<tr>
<td>Wood Fuel Hub (1,000+ tonnes)</td>
<td>69.45</td>
</tr>
<tr>
<td>Pilot Hub (100 tonnes)</td>
<td>282.54</td>
</tr>
<tr>
<td>Third Party Processing (100 tonnes)</td>
<td>48.35</td>
</tr>
</tbody>
</table>

- Third party most economical as no start-up costs
- Wood fuel hub becomes far more competitive in year 7+

Outcomes

- Life cycle analysis
  - GHG assessment through UK Solid and Gaseous Biomass Carbon Calculator (B2C2)
  - Takes into account emissions resulting from Harvesting, transport, drying, conversion, storage etc. but not embodied carbon – i.e. equipment, construction
  - Implemented supply chain results in **1.71 kgCO₂e/GJ** - 12% less CO₂e emissions against standard wood chip values.
  - The wood fuel hub solution would have resulted in **0.87 kgCO₂e/GJ** – demonstrates the transport burden
  - Overall – Supply chain solution has delivered 97% reduction in CO₂e at St James House
Outcomes

- Lessons learnt
  - There is a large source of viable wood fuel in the city – technology and cost will increase the economic viability in the future
  - The implemented solution is most risk averse for the City Council and still allows for future growth
  - Don’t underestimate difficulty in selecting wood fuel hub site
  - Demand is key
  - Limiting transport distances is important both environmentally and economically
  - Considerable interest from both suppliers and consumers

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