BIOMASS TECHNOLOGY SEMINAR
Biomass & it’s significance in the UK
CIBSE Yorkshire Region
20th October 2010, Holmfield Arms

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WHAT WE DO

• Large-scale grid-connected energy generation
  – Onshore and offshore wind
  – Solar PV and Concentrated Solar Power (CSP)
  – Biomass power generation
  – Tidal

• On-site and building-integrated renewables:
  – Solar PV and thermal
  – Biomass boilers
  – Ground source energy

• Sustainable built environments

600+ staff in 11 countries
Experts join forces to meet rising demand for renewable energy
- Technically impartial
- Not tied to manufacturers
- UK Market leading design and installation capability
## 2020 RENEWABLES TARGETS

<table>
<thead>
<tr>
<th></th>
<th>EU</th>
<th>UK</th>
<th>Current</th>
<th>Expansion</th>
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</thead>
<tbody>
<tr>
<td>Electricity</td>
<td>34%</td>
<td>~30%</td>
<td>6.8%</td>
<td>x4</td>
</tr>
<tr>
<td>Heat</td>
<td>18%</td>
<td>12%</td>
<td>1%</td>
<td>x12</td>
</tr>
<tr>
<td>Transport</td>
<td>12%</td>
<td>10%</td>
<td>~2.5%</td>
<td>x4</td>
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<tr>
<td><strong>All Energy</strong></td>
<td><strong>20%</strong></td>
<td><strong>15.0%</strong></td>
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*Image of a graph showing energy consumption and temperature over time.*
(1) Malta, not available.

Source: Eurostat (tsdoc110)
Beaufort Court
2500m² Office Space
Onsite renewables

- PV Cells
- Solar Thermal
- Heat Store
- Borehole Cooling
- Biomass Boiler
- Wind Turbine
AGENDA

- Who are Wood Energy
- Why biomass is going to be so significant in the UK
- The boilers - Binder and Hargassner
- Boiler accessories - Accumulator tanks, graphics, cyclones etc
- Emissions
- Fuel (the critical element)
- Containerised solutions
- Case studies

Winner of the Ashden Awards 2007-2008 for Sustainable Energy in the UK
Wood Energy Ltd

- **Wood Energy Ltd** is a leading UK provider of biomass boilers systems with over c.64,000kW of capacity & over 220 projects to date across UK since 2002

- **Exclusive Distributors of Binder GmbH boilers** – a leading Austrian medium & large scale biomass boiler manufacturer since 1982 with over 1,000MW of capacity world wide

- **Exclusive Distributors of Hargassner GmbH boilers** – a leading Austrian wood chip and wood pellet boiler manufacturer since 1984 with over 34,000 systems in operation across Europe
Wood Energy’s 220 Biomass Boiler Installations

- Strabane Mills 1.6MW (steam)
- 6 x Newcastle Schools 1.7MW (steam)
- Kernock Plants 3MW
- National Assembly Wales 400kW
- Devon County Hall 840kW
- Penrose Estate 30kW
- Pilgrim Hospital 3MW
- Park 25 840kW
- HMP Lewes 200kW
- RM Poole 500kW
Many Stakeholders – whose solution?

What am I trying to achieve by using biomass?

• Maximise cost savings?
• Provide a base load with biomass?
• Maximise carbon savings?
• Install 100% biomass boiler capacity?
• Provide a minimum renewable percentage?

...your answer changes your approach to biomass!
Key questions for any biomass project

Technical
- Space/location for boiler
- Boiler size (kW) and back-up fossil fuel
- Sufficient fuel storage & wood fuel logistics

O&M
- On-site operatives

Wood Fuel
- Type & quality of fuel
- Availability & price

Economics
- Financial payback

Carbon saving
- Tonnes CO₂/year saved

Legislatice
- Building Regulations/Planning Requirements
- AQMA/SCA - NOx emissions, PM emissions
CARBON FOOTPRINT

- A low carbon (not zero) and sustainable heating source
- 87% CO2 savings compared with gas, 91% savings compared with oil
The **Renewable Heat Incentive** (RHI) is due to come into force in April 2011. This is the Government Support Mechanism for Renewable Heat.

It is proposed that payments will be made to owners of biomass heating plant based on actual or deemed energy usage (kWh/year) for a **15 year period** at a tariff of:

- up to 45kW = 9p/kWh
- up to 500kW = 6.5p/kWh
- above 500kW = 1.6 – 2.5p/kWh

This is likely to have a major impact on the expansion of biomass heating across the UK. For more information & a copy of the consultation document, Visit: [www.decc.gov.uk](http://www.decc.gov.uk)
THE BIOMASS FUEL

Wood Pellets
- High density, low moisture content
- Tanker delivery - flows similar to a liquid
- Many production facilities now in the UK

Wood Chip
- Up to G150 and 55% moisture content
- Widely available - sawmill residues, clean waste, forestry residues, energy crops...
- Lower cost per unit of energy
Modern high efficiency automatic biomass boilers incorporate state of the art control technology

- Modern, fully automated biomass boilers with high levels of efficiency (around 90%)
- Minimal on-site intervention is required
- Fully automatic feed
- Automatic ignition
- Capacity control
- Remote system control and monitoring
- Very low emissions and ash content
- High reliability
SAFETY FEATURES

• Rotary valve
  Provides an effective airtight seal, which prevents airflow within the stoker auger and thus inhibits burn back.

• Auger purge
  A capillary bulb thermostat monitors auger temperature when activated stops the transport auger and moves the burn in the stoker auger into the hearth.

• Douse Tank
  A capillary bulb direct acting thermostatic water valve monitors the surface temperature of the stoker auger coupled to a static douse tank. If the valve senses a temperature above its preset setpoint it will flood the stoker auger.
THE BOILERS - HARGASSNER

- Wood chip boilers 70 - 200 kW
- Pellet boilers 25 - 200 kW
- Fully automatic boiler cleaning system
- Automatic ash removal with sliding grate
- Automatic adjustment to fuel type by lambda sensor
- Automatic ignition
- Feeder screw made with stainless steel
HEARTH TYPES

UNDERFED HEARTH - 25kW to 650kW

• Drier fuels from 35% MC down to 10% - chips and pellets
• Fully modulating down to 20% MCR

STEP GRATE - 150kW to ~10MW

• Wider range of fuels from 50% MC down to 10% - chips and pellets
• Fully modulating down to 40% MCR (or 20% MCR for fuels < 35% mc)
• Take ~3 hours to come up to operating temperature from cold
• Automatic ash removal from the boiler

• High-velocity air cleaning system

• Cyclone to remove fly-ash from the emissions

• Exhaust Gas Recirculation (EGR) - cools combustion chamber - reduces NOx and increases efficiency - essential for pellet fuel and very dry chip
BOILER ACCESSORIES – CONTINUED

• Gas/oil burner back-up options

• Remote monitoring options
  - web-cams
  - modem-linked controls
  - education
  - carbon savings
ACCUMULATOR TANK SYSTEMS

Large well insulated energy store which allows greater flexibility for the biomass system

• Increases life expectancy of the boiler by avoiding low load cycling

• Lowers emissions by reducing number of starts

• Allows a higher peak load - c. 30% higher than boiler capacity

• Allows easy control of low load conditions in summer
AIR QUALITY

- Air Quality Management Areas (AQMAs) or Smoke Control Areas (SCAs) require Clean Air Act exempt boilers only.
- Particulate emissions can be reduced with cyclone technology.
- Ceramic filters are only rarely necessary in AQMAs or SCAs - These have significant cost (additional 20-30%) and footprint.
- There is currently no commercial solution to scrub NOx from emissions.
- [www.opsi.gov.uk](http://www.opsi.gov.uk) for a list of Clean Air Act exempt appliances.
THE BIOMASS FUEL

- Oil
- Wood Pellets
- Wood Chip
FUEL DELIVERY OPTIONS - PELLETS

Blown pellets - External silo or masonry store - Above ground & flexible design
PELLET FUEL STORE DESIGN - DSEAR

- Dangerous Substances and Explosive Atmosphere Regulations 2002
- Applies to wood pellet-dust (wood-flour) but not wood-chips due to particle size
- Also applies to gas boiler installations
- End user responsible for compliance but installation companies have a duty of care to advise users.
- Risk Assessment required at Design Stage & after installation to identify explosion risk Zones
- Verification also required
- Good design is best way to mitigate risk
POOR DESIGN PELLET FUEL STORES

- Fill pipe too near ceiling & not conductive nor earthed
- No Impact Mat - pellets smash against the wall forming dust
- Electrical current, fire sensor in flight path, hence compromised
GOOD DESIGN PELLET FUEL STORES

Internal masonry store
Store sizes typically 10\text{m}$^3$ to 60\text{m}$^3$+

External Pellet silo
Steel silos ~ 8\text{m}$^3$ to 50\text{m}$^3$+
CHIP FUEL DELIVERY OPTIONS – HOOK BINS

Hook Bins (chips or pellets) - ~30m$^3$ above ground store - Clean, quick & easy
HOOK BIN STRATEGY – 3 BINS & 3 BASEs

Advice from South East Wood Fuels

- 3 journeys
- Load at leisure
- Turnaround allowed by bin volume
- No multi-handling

Overall solution:
- Very Good
- Similar to (5)

The best!
FUEL DELIVERY OPTIONS - CHIP

Tipper lorry → Subterranean fuel stores → Rotary agitator or walking floor
CHIPS BIGGEST ISSUE - QUALITY CONSISTENCY

Wood Chip

- Chip sample September 2006
- Cheap and cheerful and no adherence to chip spec and you will be in trouble
- Chip Sample May 2007
CONTAINERISED SOLUTIONS

Manor House Hotel, N.Ireland

• 500kW pellet boiler heating an 81 bedroom hotel and swimming pool.

• Commissioned May 2006
Larger and rural installations are generally always chip (small, urban installations are generally always pellet).

- Tremadog Hospital - 840kW hospital - N Wales
- Park 25 heat network, Redhill, 840kW Binder boiler for 250 apartments & houses (walking floor fuel store, 50,000l buffer tanks & full gas back up)
- 2nd Rhondda Hospital, Wales - 1MW, heating and cooling system (absorption chiller), new build South Wales
- Pilgrims Hospital, Lincs - 3MW steam system
Langley Academy, Reading

- Boiler Commissioned 2008
- 250kW Binder boiler
- 4,000L Accumulator tank
- Below ground fuel storage
County Hall, Exeter, Devon 2009

- 840kW Binder boiler commissioned 2009
- 2 x 1,000KW gas boilers
- Peak heating demand c. 1,600kW
- Lead boiler supplying c. 80% of heat demand
- Saving c. 400 tonnes CO₂/year
• A 400kW Binder wood chip boiler commissioned October 2005
• Sized to supply 100% of peak demand with 400kW gas standby
Newcastle Schools Case Study...
CASE STUDY – drivers into the mixing pot

- Contractually required minimum percentage of on-site renewable energy
- Maximise the learning opportunities
- Availability of fuel - quality and quantity
- Long-term boiler running cost implications
- Capital cost of equipment
- Long-term fuel cost implications
- Fuel delivery logistics
- On-site spatial constraints
- Consistency across schools
- Cost savings vs. fossil fuels
CASE STUDY – the results

149kW – Walkergate School (471 pupils)
149kW – Stocksfield Avenue (454 pupils)
149kW – Thomas Bewick (85 pupils)
  93kW – West Jesmond Primary (583 pupils)
840kW – Walbottle School (1783 pupils)
500kW – Kenton School (2042 pupils)

The results in summary…
- estimated 550 tonnes of carbon saved per year
- cost savings against fossil-fuels
- educational tool
- minimal maintenance requirements
FINAL COMMENTS

• Early engagement with biomass boiler specialists and fuel suppliers

• Visit installed boilers that match your specification

• Understand the capability of the end-user/operator and specify accordingly

• Police the specification to protect ‘essential accessories’ – accumulator tanks, high-velocity air cleaning etc

• This is not like a gas boiler - does the fuel process work? **Follow the fuel through your design**………. 
SAVES A LOT OF CARBON

And saves money....
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