

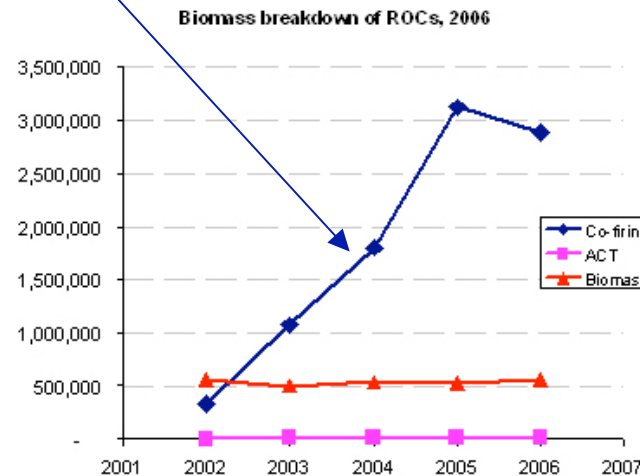
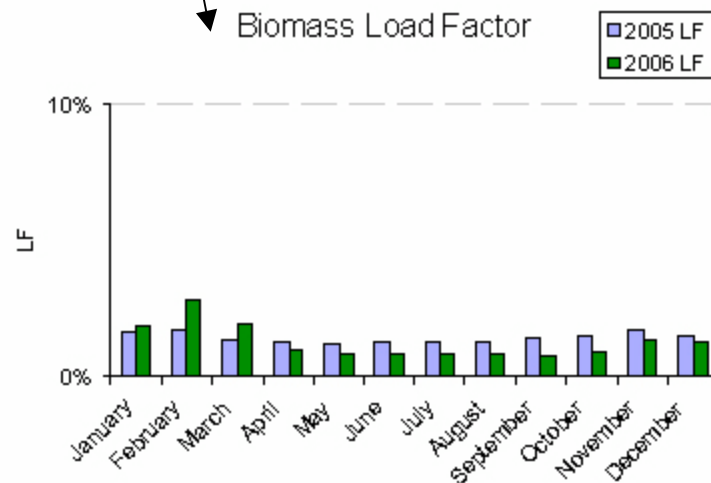
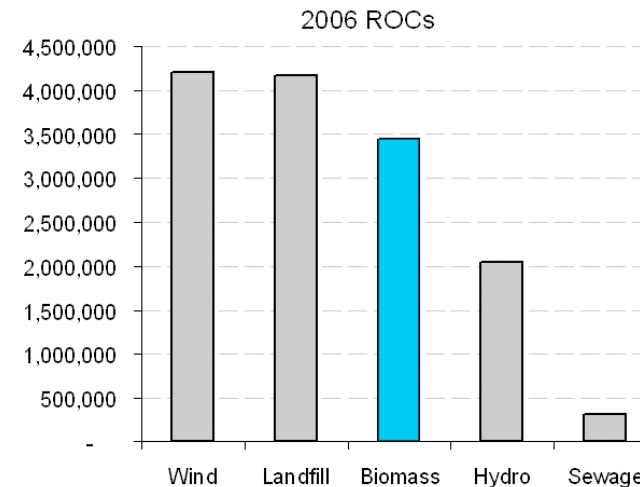
Renewable Energy Foundation
Renewable Energy Data
Technology Analyses:
Apr. 2002 – Jan. 2007
Biomass

1. Introduction
2. Dedicated Biomass Firing
3. Biomass with co-firing of fossil fuels
4. Biomass using advanced conversion technology (ACT)



Biomass contribution since 2002

- Biomass was the third largest generator of electricity under the Renewables Obligation in 2006
- The sector is dominated by burning of biomass in co-firing plant (i.e. renewable fuel mixed in with coal).
 - The renewable fuel contribution in co-firing is very small compared to the fuel content of coal and this makes the load factor for the Biomass sector very low (1.2% in 2006)



Fuel & Generator Types

- Biomass fuel is a term commonly used to describe biological material used as fuel
- These can be characterised into four types:-
 1. **Wood fuels:** Energy from wood or wood products (e.g. firewood and charcoal)
 2. **Agro-waste:** Waste associated with farming and crop processing (e.g. cereal straw and bagasse).
 3. **Animal waste:** Cow dung, pig dung, and poultry manure
 4. **Fuel crops:** Crops grown primarily for energy production (e.g. sugar cane).

In the UK, The Renewable Obligation defines fuel crops as either:

1. Crops planted after 31st December 1989 and grown primarily for the purpose of being used as fuel.

or

2. Miscanthus Giganteus, Salix (short rotation coppice willow) or Populus (short rotation coppice poplar)

- **OFGEM divides biomass plants into three main categories:**
 1. Dedicated biomass firing.
 2. Co-firing biomass with fossil fuels..
 3. Biomass and waste using advanced conversion technologies.

These are explained in the following slides



1. Dedicated Biomass

Plants whose fuel consumption is over 90% biomass are classed as dedicated biomass plants

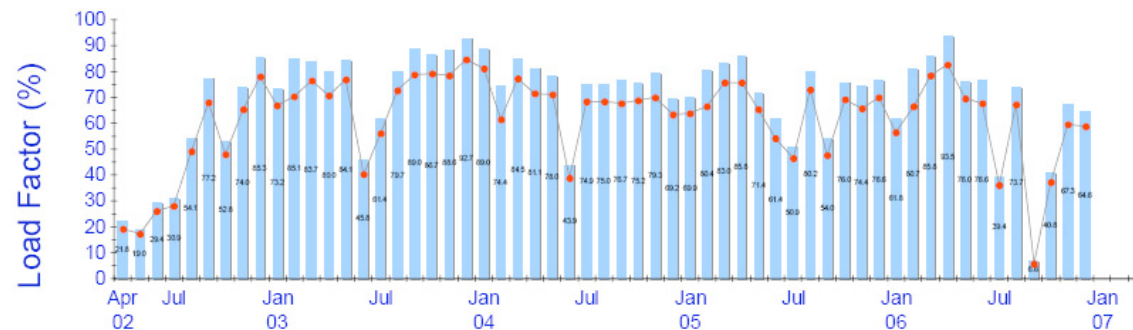


Dedicated Biomass Plants

- These plants, of which there are 15 in the UK, burn biomass fuels directly.
- Dedicated biomass plants typically operate at high load factors
- **Example: Ely Power Station (36MW).**¹
 - Fuel used: Cereal straw produced from wheat, barley and oats, but can also include corn, maize and rye.
 - Annual straw consumption = 200,000 tonnes.
 - Typical Net Calorific value: 13.48 MJ/kg
 - Ely Power has occasionally used more than 10% of fossil fuel to generate electricity. In this case it is classed as co-firing for the duration
 - Ely has operated at a load factor of between 60 and 80% since 2003 (based on Ofgem ROC records).



Generating Station Name: **Elean Business Park***



2. Biomass with Co-Firing of Fossil Fuels

Plants whose fuel consumption is less than 25% biomass are classed as co-fired biomass plants



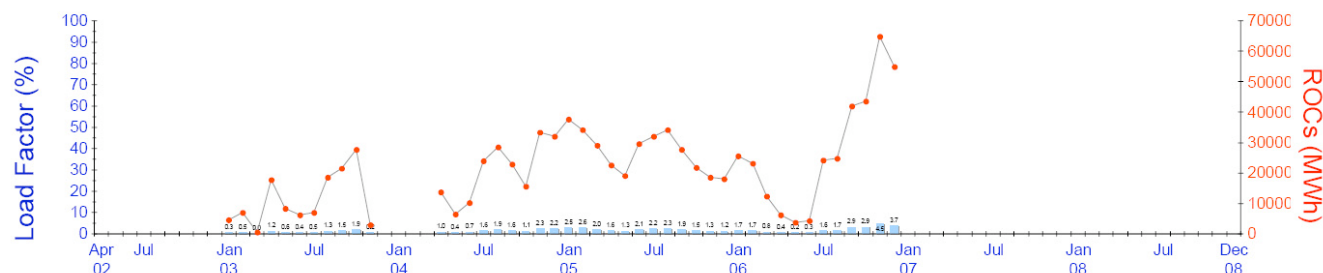
2. Co-firing Biomass

- Co-firing is the supplementary addition of Biomass to coal fired power stations.
 - There are 39 sites of this type in the UK
- Typically the fuel is wood fuel (inc. wood pellets) and imported food processing residues, e.g. palm kernel expeller, palm kernel shell, olive residue
- The biomass chosen depends on whether it can be easily milled in the same way as coal or added directly to the pulverised coal
- A total of 60,000 to 300,000 tonnes/month were used in the UK for co-firing biomass in the year 2005/2006.¹
- **Example: Fiddler's Ferry Power Station (1,995 MW)**
 - Biomass: Olive Residues, Palm Kernels & Shea Nuts
 - The biomass load factor is low since the plant is mostly fuelled by coal

Generating Station Name: Fiddler's Ferry Power Station
Technology Type : Co-firing of biomass with fossil fuel

R.O. ID R00006RBEN

TIGC (kW) : 1,995,000



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1. The sustainability of biomass in co-firing. Bates et al (Nov 2006), A study for British Energy by AEA Environment & Environment

3. Biomass using advanced conversion technology (ACT)

Turning biomass into gas



3. Biomass and Waste Using Advance Conversion Technology (ACT)

- Advanced Conversion Technologies convert biomass fuel into gas which is then burnt in an engine to generate electricity. A range of fuels is used
 - There are 6 sites in the UK.
- Conversion is carried out using either gasification, pyrolysis or anaerobic digestion,
 - Gasification is a sub stoichiometric oxidation or steam reformation of waste to produce a gaseous mixture of methane and hydrogen
 - Pyrolysis is the thermal degradation of a substance in the absence of any oxidising agent to produce a char and gas and liquid.
 - Anaerobic digestion (AD) involves breakdown of organic materials by using naturally occurred bacteria in a heated vessel to produce biogas that contains mainly methane.
- Holsworthy Biogas uses pig slurry and food waste to produce a steady output of electricity using anaerobic digestion

Biofuels for ACT

Pig slurry and food waste¹

Cattle, pig and poultry manure with food waste³

Meat, fish, dairy and vegetable wastes, animal manure and also sewage sludge⁴

Municipal waste⁵

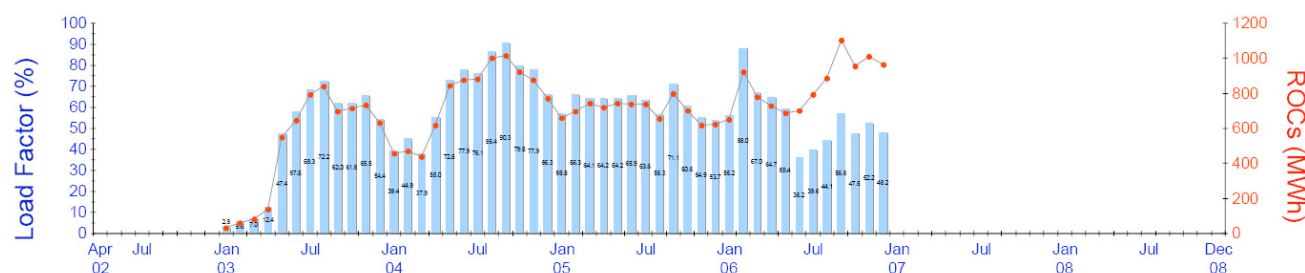
Household waste (food waste)⁶

Generating Station Name: Holsworthy Biogas Company Project

R.O. ID R00001RCEN

Technology Type : Biomass and waste using an advanced conversion

TIGC (kW) :2,696



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1. <http://www.ruraloxfordshire.org.uk/directory/page.php?id=20>

2. http://www.sepa.org.uk/pdf/ppc/ppd/PPC-A-1004448/final_permit.pdf

3. http://www.devon.gov.uk/renewable_energy_guide_case_study_2.pdf

4. <http://www.compactpower.co.uk/pdf/uploads/news/CPL%20Intro%20%20ix05.pdf>

5. <http://www.biffaleicester.co.uk/about/bursom.php>