The case for biomass

The UK is facing a challenging renewables target. By 2020, 15% of its energy must come from renewable sources – this equates to roughly 35-40% of electricity produced. As New Power readers will know, onshore and offshore wind projects are likely to provide the bulk of that energy however in the last few months a rash of new biomass projects have emerged. In the following article, Ben Elsworth* examines the issues facing biomass developers in UK.

Has the UK gone biomass crazy? No fewer than six giant biomass power stations (*see table 1*) have been announced in the UK and are already at a reasonably advanced stage of planning.

On top of that, there are at least another four or five similar sized plants being talked about in ports around the UK, and a whole phalanx of sub-50 MW plants at various stages of development. Even if only six large plants are built, that still adds up to almost 1.5 GW of new plant, more than a five fold increase on what has been built to date.

So what is behind this incredible biomass surge? What are the fundamental drivers, the basic economics and the long term prospects? Is there enough fuel available, and, if so, will it be sustainable? Lastly, is there a biomass bubble?

Why build such large units? The answer comes in two parts. Firstly economies of scale drive down capital expenditure (capex) and operational expenditure (opex) costs on a per MW basis, and secondly the higher conversion efficiency of the larger steam turbines drives down the cost of fuel per MWh produced.

Traditionally biomass plants have been limited to a certain trucking radius around the plant beyond which it is not economic to transport the biomass. By limiting the amount of fuel available the economics are driven into reverse, the plant becomes smaller, more expensive per MW to build and run; and less efficient, and so in turn the economic radius of fuel shrinks.

The way to break this vicious circle is to escape the straitjacket of road transport, and most large projects have chosen to do this, by locating their projects in a deepwater port.

The cost of transporting wood chips 4,000 miles from the South East USA in a best-in-class wood chip carrier is only marginally more than the cost of transporting the same material 40 miles in a standard articulated tipping truck - a ratio of almost 100 to one. Of course, there will always be some inland logistics required before the biomass is loaded onto the ships but, because of economies of scale, the costs involved are not prohibitive.

Why now? Why here?

So why now? And the logical follow-up is why here? No other developed country has such ambitious

Planned biomass plant (over 50MW) in the UK

Location	Developer	Capacity (MW)	Status	Grid connection date	TWh per year	ROCs per year**
Teesport	MGT Power	300	Grid contracted awaiting consent	October 2012	2.4	4.8
Bristol	Helius	100	Awaiting consent, no grid	-	0.8	1.6
Drax	Drax	300	Grid contracted pre-application	October 2014	2.4	4.8
Immingham	Drax	300	Grid contracted pre-application	October 2014	2.4	4.8
Portbury	Eon	150	Grid contracting pre-application	January 2013	1.2	2.4
Port Talbot	Prenergy	300	Grid contracted consent granted	August 2011	2.4	4.8

** @ 1.5 ROCs/MWh (1,000,000)
Source : MGT

plans in place. Again the answer comes in two parts.

Firstly, in the form of the EU's Renewable Energy Directive, the UK is under a legally binding obligation to meet 15% of its total energy demand in the form of renewables by the year 2020. The current contribution of renewables to the mix in the UK is 1.5% (a figure which puts it at the very bottom of the European league table, ahead of only Malta and Luxembourg), which means we need a 10 fold increase in renewables by 2020.

In other words the UK needs to take everything it has achieved in the last three decades of renewable energy policy (five separate rounds of Non-Fossil Fuel Obligation and seven years of the Renewables Obligation) and do almost the same again every year for the next 10 years. If we harbour any hope of achieving this, or even to fail with honour, biomass will have to play a very significant part.

Secondly, I believe there is a more fundamental role for biomass in the energy mix in the future. With the exception of gas CCGTs, large biomass power stations will have by far the lowest capital cost per MW of the technologies which are competing to be built – namely wind, nuclear power, coal fitted with carbon capture and storage (CCS), tidal and other renewables such as solar and wave.

Given the significant amounts of capital required to replace the roughly 20 GW of coal, oil and nuclear that is scheduled for retirement by 2020, and the impending dramatic reliance on Middle Eastern liquefied natural gas (LNG), good biomass projects, with secure fuel streams from reliable countries, could be extremely attractive – perhaps eventually even without support from the Renewables Obligation.No other country has the combination of an attractive support mechanism in the short term combined with the need for energy diversification in the medium term which the UK has and this explains why so many more of these projects are being developed here than elsewhere.

The fuel question

Perhaps the most important component of these projects is fuel. The six large biomass projects will require about 110 million gigajoules of fuel which equates to about 12 million tonnes of fresh wood chips each year.

These are not significant numbers. Here are a few statistics for comparison:

■ 48 million tonnes – roughly the amount of wood which needs to be salvaged after strong winds damaged forest plantations in Southern France earlier this year;

■ 530 million tonnes – roughly the amount of standing pine wood killed by the Mountain Pine Beetle in British Columbia in Canada, which also needs to be salvaged in a hurry;

■ 350 million tonnes – the amount of annual forest growth in the United States which is not used by any industry (not including conservation areas).

Bringing it closer to home, 12 million tonnes of wood per year is actually slightly more than the Forestry Commission forecasts will be harvested in the UK in any one year between 2012 and 2016 (when the power stations will come on line). Most of that wood will be used for timber and paper, not for biomass at all. So, in the short term at least, the vast majority of the feedstock for these plants will be imported from abroad.

So how feasible is it that the UK can import 12 million tonnes of wood chip each year? In terms of import facilities there is no problem, all but one of the six big plants are based in a port and have their own import arrangements. So the spotlight turns to supply.

Aside from the very high volumes of pulp and biomass grade wood which is currently looking for a home in North America and Northern and Central Europe, there is always the potential to plant new trees on degraded marginal land – ie. land that has already been altered by human activity and is not fertile enough to grow traditional crops without using more inputs than can be economically justified (the definition excludes land that has a high conservation value).

For many in the industry, this is the real benefit of biomass as an energy source – to enable the conversion of degraded marginal land (most of which should never have been cleared in the first place) to forest. Trees themselves as a good thing, and although a plantation will never be as bio-diverse as a natural forest, the benefits of forest plantation versus fallow land, scrub or marginal high-input agriculture are immense, both on a local and global scale.

The best example of this is the South-Eastern USA where much of the vast productive timber basket that stretches from Virginia to Louisiana was planted on land that once produced cotton or tobacco. Most of it is plantation pine but a short walk through one of these stands will very quickly convince anyone of the benefits to the environment and wildlife.

The global marginal land resource which would benefit from forest plantations is conservatively estimated by the UN's Food and Agriculture Organisation to be over one billion hectares. A reasonably productive plantation system might require about 600,000 hectares to produce the 12 million tonnes required to fuel 6 large plants, or about 0.06% of the total available resource.

Of course there is no real reason why the UK should not itself benefit from some of this reforestation. The barriers that prevent it here are political, cultural and bureaucratic, not technical or economic.

The UK's soil and climate are ideally suited to tree growth which is why more than 90% of the country was originally forested. The European Environment Agency[1] has carried out the most authoritative work so far in this area and concluded that 8.8 and 1.5 million tonnes of oil equivalent of biomass could come from UK agriculture and forestry respectively per year by 2020 without harming the environment or food production. In energy terms that would equate to roughly 40 million tonnes of wood chips, although clearly this potential resource would be shared with transport and heating uses.

Whether the UK does end up becoming a significant producer of forestry biomass or not depends largely on the external drivers. Should energy security and resource nationalism become enough of an issue to remove cultural and political barriers, then the rapid establishment of significant biomass production is feasible.

Carbon balance

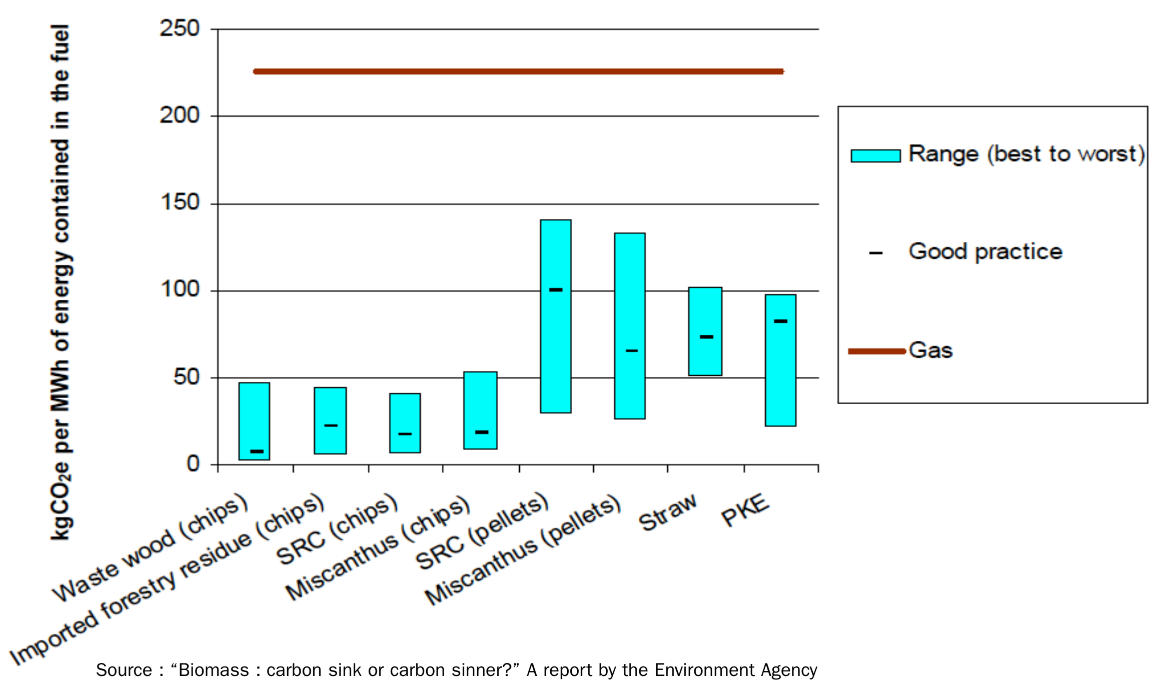
However, the carbon balance of imported wood chips has frequently been questioned.

The Environment Agency's report on biomass carbon balance (Biomass: Carbon Sink or Carbon Sinner), highlighted the fact that imported wood chips have between 4% and 18% of the lifecycle emissions of natural gas prior to conversion (*see figure 1 below*).

I believe that the lifecycle emissions for natural gas were severely understated due to a failure to recognise that the marginal source of gas is now LNG imported from Qatar, which suffers very large emissions from the energy required to process and freeze the gas.

Nevertheless I believe the numbers are satisfactory, and broadly[2] concur with the biomass figures. Since the main fuel being displaced is actually coal (imported from Russia, Colombia, Indonesia or South Africa) the comparative carbon cost from biomass is really in the range of 2 – 8% (we calculate about 5%, ie. a 95% saving).

Greenhouse gas emissions from producing different biomass fuels, best to worst practice



Source : "Biomass : carbon sink or carbon sinner?" A report by the Environment Agency

Where the ROCs will come from

Technology	Assumptions	TWh per year by 2020	ROCs per year by 2020
Demand for ROCs	20% of total electricity supply of 350 TWh per year	70 TWh	70 million
Mainstream Technologies (onshore wind, hydro, landfill gas, sewage gas and small waste-wood biomass and others)	Continuation of historical growth of 1.8 TWh per year, with an average banding of 1 ROC per MWh	38 TWh	38 million
Large scale biomass	Six large biomass plants constructed by 2020, running baseload and banded at 1.5 ROCs per MWh	11.6 TWh	17.4 million
Offshore wind	3.6 GW of offshore wind at 37% load factor and earning 2 ROCs per MWh	11.6 TWh	23.2 million
Co-firing	No co-firing due to lack of competitivness at 0.5 ROCs per MWh	0 TWh	0 million
Total		**61.3 TWh**	**78.6 million**

Source : MGT

So to recap, fuel is available or can be easily produced to support the development of several large biomass plants in the UK, it can be delivered sustainably and the requisite economic drivers are also in place.

A biomass bubble?

But is this enough to answer the final question – is there a biomass bubble?

Perhaps not. There is no doubt that in the short term, biomass still needs a support mechanism – in this case the RO - to make economic sense. There is not a limitless demand for Renewables Obligation Certificates (ROCs) and that, even when using some quite conservative numbers (see table two), supply could easily outstrip demand by 2020, which could cause a crash in the ROC price.

It seems unlikely that the government would really allow that to happen, given the need to meet the Renewable Energy Directive, but as project developers we always need to work with the mechanisms that we have in place – not the ones we think should be.

So does that mean the biomass bubble is real? In some areas I think the answer has to be yes. A huge number of small sub 50 MW biomass plants are planned at various locations around the country. The commercial logic of such plant is questionable. Unless these plants are able to burn recycled or treated woods (which is a different business model and one which falls outside of this discussion) they can not possibly hope to compete with the greater economies of scale of the 300 MW plants. I struggle to see any of these plants being financed.

Biomass is a growth market in its infancy and, as such, people will have different ideas about where the market is going and what strategy is a sensible one. There will be winners and losers, but I believe that the large biomass power station concept is well thought out and designed to survive rigorous competition. Ultimately I expect to see most, but probably not all, of the large projects to be built and make a huge contribution to the energy security and carbon reduction targets in the UK.

References

1.www.eea.europa.eu/publications/eea_report_2006_7/eea_report_7_2006.pdf
2. http://www.environment-agency.gov.uk/static/documents/Research/Minimising_greenhouse_gas_emissions_from_biomass_energy__generation.pdf

* *Ben Elsworth is a director at MGT.*