BIOMASS GASIFICATION & PYROLYSIS:

How UK support for 'energy innovation' leads to business failures and particularly inefficient and dirty biomass power stations

A report by Almuth Ernsting, June 2015

Full report: http://www.biofuelwatch.org.uk/2015/gasification-and-pyrolysis-report

EXECUTIVE SUMMARY

Biomass and waste gasification and pyrolysis are being heavily promoted by the UK government. According to the UK Bioenergy Strategy 2012, developing advanced gasification technologies, especially biomass gasification, is vital to achieving low-carbon targets in different sectors. The government has made particularly generous subsidies available for electricity from biomass and waste gasification and pyrolysis.

This Biofuelwatch report focuses on biomass (including waste wood) rather than non-biomass waste gasifiers and pyrolysis plants. However, the policy framework and subsidies are largely identical for both, and the technologies – and therefore the technical challenges – are very similar. The findings in the report will therefore be relevant to Municipal Solid Waste gasifiers and pyrolysis reactors, too.

Biofuelwatch has identified 40 biomass and pyrolysis plants with a capacity of at least 1 MW which have been proposed across the UK in recent years. At least 9 such plants have been built, though some of them may never have been fired up. 8 of these gasifiers have failed and been shut down. Two have been redesigned and re-opened. One of them (supposedly a pyrolysis plant rather than a gasifier) appears to have generated no energy as yet and the other one, according to the most recent published evidence, was operating at less than one-tenth of its capacity for the first five months, indicating technical problems. One company claims to have built another biomass gasifier but Biofuelwatch could find no planning consent for that one and there are contradictory statements from two other companies that also claim to be behind this plant. By comparison, Biofuelwatch is aware of 13 conventional biomass power stations built in the UK with at least 15 MW capacity, none of which have been shut down.

Despite the failure of eight biomass gasifiers, at least 14 biomass gasification and pyrolysis plants hold planning consent as of May 2015 (including those reportedly built) and at least two of them are under construction. Clearly, biomass gasification and pyrolysis has attracted significant interest from companies – but the technologies have been beset with serious problems.

Biomass pyrolysis linked to electricity generation is a new and entirely unproven technology – so far it has not been done successfully anywhere in the world.

Biomass gasification, on the other hand, is not a new technology. It was discovered in the 18th century and there were attempts to develop it for 'town gas' in the 19th century. It was used to drive hundreds of thousands of cars in Europe during World War 2 (although not without technical and health and safety problems) and it has been promoted for heat and electricity in many countries since the 1970s. Despite this long history, biomass gasification technologies remain beset with technical difficulties and a very high failure rate. This is particularly the case for biomass gasifiers designed to supply electricity rather than steam for heating or cooling only. Some biomass gasifiers have been generating electricity for several years but these tend to be ones involving either collaborations between companies and research institutes or collaborations between companies with different types of expertise. Success appears to depend on companies being able and willing to invest in overcoming technical problems and upgrading plants over long periods. Such plants are expensive to build, expensive to operate and prone to far greater problems than conventional

biomass plants. At best they offer just minor efficiency gains, with the worst being less efficient than most conventional plants.

Globally, interest in biomass gasification revolves around the potential for producing clean syngas, which is chemically similar to natural gas (though less energy dense). Syngas can be burned in gas engines and gas turbines, which are more efficient than the steam turbines used by conventional power stations burning solid fuels. Burning clean syngas would in theory also emit less pollution than burning biomass, but only where gasifiers operate without technical problems. Furthermore, research and development is underway in various countries to refine syngas into transport fuels and to use it for various industrial purposes.

In the UK, however, the recently built gasifiers and two new ones which have received sufficient investment to be built, as well as most of the currently proposed gasifiers, do not involve producing and using any clean syngas at all. They involve burning dirty gas to power a steam turbine, in particularly inefficient plants. These developments consequently make no meaningful contribution to any technology developments worldwide and, like other biomass gasifiers, are beset with key technical challenges. These challenges are mostly due to the highly explosive gases involved and the fouling and corrosion of key plant components.

This report examines individual biomass gasifier developments and most of the companies involved. The first biomass gasifier ever built in the UK remains the most ambitious project yet. The company set up to build it went into liquidation in 2002. A peer-reviewed study was subsequently conducted about the project. The authors found that a lack of effective scrutiny and oversight contributed to the failure of it and that the offer of deployment-related subsidies (i.e. renewable electricity subsidies paid per unit of electricity generated) may have led to poor technology choices. The lessons from this project's failure have not been learned. Subsidies for electricity generation coupled with deregulation or 'barrier removal' are cornerstones of the UK government's strategy for supporting 'energy innovation' in general. The experience with biomass gasification and pyrolysis plants suggests that this policy approach has had entirely unintended consequences:

Rather than driving 'technology innovation', it has driven a proliferation of small companies, many of them sharing the same directors and none of them with any track record in designing and operating such complex and challenging technologies. Failed gasifier schemes have led to tens of millions of pounds of investors' money being lost. For example, two company directors, David Pike and David Nairn, have been directors of companies directly responsible for two failed biomass gasification schemes, which lost investors a total of £50 million. They were also behind another ultimately unsuccessful biomass gasifier venture which was taken over by another company that subsequently went into liquidation.

Remarkably, the companies associated with these same directors, despite the disastrous track records of their gasifier ventures, have been greatly boosted by the Green Investment Bank, which recently joined a consortium building a waste wood gasifier in Tyeseley, Birmingham. The consortium has chosen a main developer with directors linked to three failed biomass gasifiers, and on top of this has chosen a Canadian company, Nexterra, to deliver the key technology. Nexterra has built three biomass gasification power plants to date, and not a singel one has been successful. One was closed after three accidents described as 'potentially lethal' by a spokesperson of the university where it was installed, another failed soon after it opened, and commissioning of the third has so far been delayed by over a year. Furthermore, if this new gasifier is to succeed, it will be less than 21% efficient – far below what many conventional biomass plants achieve.

The key losers of the government's unsuccessful policy of promoting biomass gasification and pyrolysis have primarily been investors, including investors participating in the government's subsidised Enterprise Investment Scheme. Health and safety and air emissions risks associated with both technologies have also put local residents at a particularly high risk, one even greater than living close to conventional biomass plants. Fires, explosions and excessive pollution have been associated with biomass gasifiers and pyrolysis pilot plants outside the UK and, in Scotland, a waste gasifier was responsible for hundreds of air quality permit breaches, a fire and an explosion.