Dear Sir/Madam,

Re: Application by Biomass UK No. 2 Ltd for a bespoke environmental permit for a waste wood gasification plant at Woodham Road, Barry, Ref: PAN-000869

I am writing on behalf of Biofuelwatch, an organisation which carries out research, advocacy and campaigning in relation to large-scale industrial bioenergy (www.biofuelwatch.org.uk). We wish to object to Biomass UK No. 2 Ltd's permit application on two grounds:

1) Inefficient use of raw materials for energy generation;

2) Lack of persuasive evidence about compliance with the Waste Hierarchy Principle.

We are aware of a range of other concerns which have been raised by local groups and residents, and of the critique of the permit application provided by Capita Property and Infrastructure Services on behalf of Barry Town Council. However, we have chosen to limit our comments to the two issues about which we can add additional information and comments, not raised in the Capita report.

In addition to the two grounds for our objection set out below, we would also like to point out that we have been unable to find evidence of the Outec gasification technology on which this project would rely having been successfully deployed anywhere so far. In the Outline Planning Application which was approved on 31st July 2015 and which forms the basis for this development, the developer (then Sunrise Renewables) stated, accompanied by a picture a pilot plant in Idaho:

> It is proposed to replace the system detailed in the 2010 Permission manufactured by Prestige Thermal Equipment (which produced a 9 MW average net output) with an alternative system made by the globally established manufacturer Outotec (www.outotec.com). The Outotec technology is more efficient and will result in the average net output increasing to 10MW for the same amount of fuel input.[1]

Outotec is indeed an "established manufacturer", but not of waste (including waste wood) gasifiers. It focuses on technologies and processes for the metal and mining industries. In the energy sector, Outotec focuses primarily on fluidised bed combustion plants. In 2012, Surrey Council commissioned Mott MacDonald to carry out a technology review for Advanced Thermal Treatment technologies (finalised August 2012)[2]. According to that report, Outotec's gasification technology was developed

[1] Waste Planning Assessment, dated 17th June, vogonline.planning-register.co.uk/PlaRecord.aspx?AppNo=2015/00031/OUT

[2] whatdotheyknow.com/request/153450/response/379390/attach/3/Mott%20MacDonald%20Technical%20Review%20pt%201.pdf and https://www.whatdotheyknow.com/request/153450/response/379402/attach/3/Mott%20MacDonald%20Technical%20Review%20pt%202.pdf

by Energy Products of Idaho (EPI), who were taken over by Outotec in January 2012. EPI had built one single test facility – the one in Idaho pictured in the planning document. The Mott MacDonald report states:

A test facility to accommodate various fuels, including biomass, tyres, municipal and paper sludges, carpet scraps, waste and industrial plastic was built to provide data suitable for design of full-scale process equipment. The plant in Coeur d'Alene, Idaho was built in May 1986 and modifications have been made frequently to test new fuels and technology. EPI's experience is primarily based on fluidised bed combustion, with fluidised bed gasification a newer area for the company.

Thus, the plant shown in the planning document is not an operating gasifier, but a test facility for different, mainly standard combustion, technologies. Although companies have entered into contracts to purchase Outotec gasification technology since then, we understand no gasifier using that technology has actually been operated for electricity generation so far.

1) Inefficient use of raw materials for energy generation

In the permitting application, Biomass UK No.2 Ltd acknowledges the need to maximise energy efficiency. It states:

> The overall energy efficiency of the plant, even when in open cycle when taking account of ancillary uses, has been designed around to achieve 27.1% efficiency, which compares well with the 25% efficiency target stipulated for incineration processes.

If the development supported a district heat network or otherwise supplied heat, i.e. if it operated as an efficient combined heat and power plant, it could achieve far higher conversion efficiency, potentially above 70%.

However, we would like to question the accuracy of the claim that the plant could achieve 27.1% efficiency. We believe that this figure is based on an unrealistically low calorific value figure.

The design values cited in the permit application are:

- Moisture content: 20%
- Higher Heating Value for dry wood (gross calorific value): 19.599 MJ/kg
- Lower Heating Value for wood as arrived: 14.275 MJ/kg

By comparison, the UN Food and Agriculture Organisation's Wood Fuels Handbook[3] states:

> The net calorific value (NCV) of oven-dry wood of different species varies within a very narrow interval, from 18.5 to 19 MJ per Kg. In conifers, it is 2 percent higher than in broad-leaved trees.

[3] http://www.fao.org/3/a-i4441e.pdf

NCV is equivalent to Lower Heating Value (LHV). In the UK, almost all timber production consists of softwood, i.e. conifers[4]. Therefore, it would seem reasonable to assume the higher NCV figure of 19 MJ/k. This would translate into a NCV figure of 15.2 MJ/kg for wood with a 20% moisture content (not 14.275 MJ/kg).

According to the permit application, "The Installation will typically accept approximately 86,400 tonnes of mixed waste wood per annum, for the purpose of the generation of a synthetic gas which will be utilised in a steam turbine to produce renewable electricity with a continuous export capacity up to 10MWe". Thus, the plant will gasify up to 18,400 tonnes of wood with an average 20% moisture content a year and continuously operate with 10 MWe capacity. The air quality document states that "*The facility is designed to operate 24 hours a day, 365 days per year*", however given the need for maintenance, we assume a maximum operation of 8,000 hours a year (the most common figure used in air quality assessments for power plants that are expected to operate continuously).

We therefore calculate the plants net energy efficiency as follows, using the FAO's NCV figure of 19 MJ/kg:

Energy input:

86,400 tpa of wood with an 80% moisture content = 69,120 tpa of oven dry waste wood.

69,120,000 kg x 19 MJ = 1,313,280,000 MJ = 1,313,280 GJ = 364.8 GWh

Net energy output:

10 MWe x 8,000 hours a year: 60 GWh

Calculation:

80 GWh is 21.93% of 364.8 GWh.

Therefore, the net efficiency of the plant would be less than 22%.

We have used Net Calorific Value rather than Gross Calorific Value for this calculation because that it is used for R1 calculations under the Waste Framework Directive. However, Gross Calorific Values are higher, so using those would produce an even lower efficiency figure.

We note that the developer's Sankey Diagram shows a net efficiency of 23.88%, which is far lower than the 27.1% efficiency claimed elsewhere in the permit application. However, in light of the above, we would question the fuel input figure used for the Sankey Diagram. We believe it the correct figure would be around 45.6 MWth, not 42.84 MWth.

We are baffled by the relevant figures in the Flow Sheet. The flowsheet states that 10.842 tonnes of waste wood would enter the plant every hour, with a small amount being removed as unusable for the process before entering the gasifier. Those figures suggest that the developer expects the plant to operate for 7,969

[4] https://www.forestry.gov.uk/pdf/Ch2_Timber_FS2016.pdf/$FILE/Ch2_Timber_FS2016.pdf

hours a year. The energy input figure is 42.92 MW (i.e. MWh/h). It is slightly higher than the figure used in the Sankey diagram. It coincides with a net calorific value of 14.25 MJ/kg for the waste wood entering the gasifier, or 14.22 MJ/kg for the waste wood entering the plant. Both figures are marginally lower than that cited elsewhere in the permit application, yet significantly lower than what we believe the correct figure to be. The electricity output, on the other hand, is given 36.83 GWh, which is 36,830 MWh. We can only assume that this is meant to be an annual figure. If was an annual figure, however, then the net efficiency of the plant would be a mere 10.76%:

36,830 MWh / 7,969 hours = 4.62 MW[h/h]

This is 10.76% of the hourly fuel energy input of 42.92 MW[h/h]

Clearly this cannot be accurate. It is less than half of the 21.93% net efficiency we estimate. ***The figures given in the Flow Sheet, in the Sankey Diagram, and in the main report are highly inconsistent.***

A power plant with a net conversion efficiency of less than 22% is extremely inefficient. However, it corresponds with figures for other biomass and waste gasification proposals which we have seen, particularly those which rely on a steam turbine. For such a plant with a capacity of 10 MWe, a conversion efficiency of more than 27% without external heat supply would be extremely high.

Based on our estimates, we believe that the design of the proposed plant is not compatible with efficient use of resources. However, we believe that the developers should be required to supply new and consistent data about fuel input and output, and to give evidence to back up their choice of a Net Calorific Value input.

2) Lack of persuasive evidence about compliance with the Waste Hierarchy Principle:

We believe that compliance with the Waste Hierarchy Principle is an important consideration for such a permit application.

Schedule 9 of the Environmental Permitting (England and Wales) Regulations 9 states: "*4. The regulator must exercise its relevant functions— (a)for the purposes of implementing Article 4 of the Waste Framework Directive; and (b)so as to ensure that the records referred to in Article 14 of the Waste Framework Directive are kept and made available to the regulator on request*." Article 23 of the EU Waste Framework Directive says: "*4. It shall be a condition of any permit covering incineration or co-incineration with energy recovery that the recovery of energy take place with a high level of energy efficiency.*"

The developer states: "*All waste wood feedstocks will be prepared to meet the requirements of Waste Wood Grade B and Grade C (Fuel Grade) materials as defined by BSI PAS 111 Processing Waste Wood*". According to that definition[5], Grade B waste wood is "*a feedstock for industrial wood processing operations,*

[5] www.woodrecyclers.org/wp-content/uploads/2015/04/PAS111.pdf

such as the manufacture of panel products, including chipboard and medium density fibreboard." And Grade C waste wood is "*biomass fuel for use in the generation of electricity and/or heat*". However, typical Grade B materials "may contain up to 60% Grade A material as above, plus building and demolition materials and domestic furniture made from solid wood." Typical Grade C materials contain "*all of the above plus fencing products, flat pack furniture made from board products and DIY materials. High content of panel products such as chipboard, MDF, plywood, OSB and fibreboard*." Grade A waste wood is "*a feedstock for the manufacture of professional and consumer products such as animal bedding and horticultural mulches. May also be used as fuel for renewable energy generation in non-WID installations, and for the manufacture of pellets and briquettes*." In short, the feedstock which Biomass UK No.1 LLP seek to use includes all types of waste wood (except for those classed as 'hazardous'), much of it in high demand for the production of wood panel products, animal bedding and horticultural uses. All of those uses qualify as 'recycling' and are thus higher up the Waste Hierarchy than energy recovery.

Compliance with the Waste Hierarchy Principle is not addressed in the permit application. As part of the planning application which was subsequently approved, the then developer, Sunrise Renewables, had submitted a document called "Waste Disposal Status of the Project". In that document, the company claimed that the plant would not be regulated by the Waste Framework Directive and that it did not fall within the definition of a "Waste Incineration Installation".

The permit application, however, rightly states: "*The proposed process meets the definition of an Installation as defined by Section 5.1 'Incineration and Co-Incineration of Waste' paragraph A(1)(b) namely: 'The incineration of non-hazardous waste in a waste incineration plant or waste co-incineration plant with a capacity exceeding 3 tonnes per hour.'*" Elsewhere, it acknowledges that the development does fall within the scope of the Waste Framework Directive.

The Planning Officer's report had agreed with us and other objectors that the development would need to meet the Waste Hierarchy principle. The report stated, however: "*In this instance, the developer has provided additional information, attached to this report as Appendix D that identifies that the energy recovery at the proposed plant would be efficient enough to meet the efficiency levels set out under the R1 formula. Accordingly, the proposal complies with the efficiency set out in TAN21 to be considered a recovery plant rather than a Waste Disposal*."

Yet the R1 calculation relied on the same net calorific value figure for energy inputs which we have critiqued above. We therefore do not think that the results could have been credible. This means that it is not clear whether the plant could be regarded as an energy recovery as opposed to a waste disposal operation. Even if it was an energy recovery operation, accurate information about the likely net calorific value of the waste wood would be needed for a comparison with recycling options in terms of greenhouse gas impacts.

This is another reason why we believe NRW must require the developer to supply credible evidence for their choice of a Net Calorific Value figure as well as

accurate and consistent energy efficiency calculations, which should inform a greenhouse gas impact comparison with other forms of waste treatment.

Yours sincerely,

Almuth Ernsting
Co-Director
Biofuelwatch