TOLVIK CONSULTING

The Waste and Bioenergy Experts

Briefing: Residual Waste as a Fuel in a Low Carbon Economy

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INTRODUCTION

The Climate Change Committee ("CCC") is an independent, statutory body established under the Climate Change Act 2008 to provide independent advice to Government on setting and meeting carbon budgets and preparing the UK for climate change. In addition the CCC also issues annual progress reports to Parliament which provide an update on Government's progress towards meeting climate targets.

In early December 2020, the Committee on Climate Change ("CCC") produced its sixth Carbon Budget ("Budget")[1] setting out the UK's path to Net Zero and advice on emissions during the period 2033-37.

The Budget includes a complex, inter-dependent series of actions needed across a number of sectors (including waste) if the UK is to be net zero by 2050. It notes that *"sustainable bioenergy is essential for reaching Net Zero"* and whilst solid biomass is the Budget's feedstock of choice for bioenergy the Budget recognises that there are limits to the tonnages which can be sustainably sourced and be available to the UK.

The Budget therefore also includes Residual Waste amongst the other identified potential sources of bioenergy, whilst highlighting that, as approximately half of the waste carbon content is of fossil origin, waste-based fuels save less CO_2 than those derived from solid biomass. Residual Waste is therefore very much regarded by the CCC as a secondary source of bioenergy.

Using the Budget as a guide, this Briefing Note therefore considers the potential role for Residual Waste in helping to fuel a low carbon economy in the UK.

As previously in our reports, Residual Waste is defined as non-hazardous, solid, combustible mixed waste which remains after recycling activities and is capable of being processed alongside Residual Household Waste.

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RESIDUAL WASTE AND THE SIXTH CARBON BUDGET

The Budget

The Budget sets out in some detail the challenges the waste sector itself faces in decarbonising further, noting that to achieve a true circular economy in the UK there will need to be *"greater ambition for efficiency in manufacturing and construction, material substitution for more sustainable alternatives, and reduction in consumer demand for products".*

The Budget identifies a number areas in the waste sector requiring further policy development including the need for accelerated recycling and suggests a 68% recycling rate across all waste streams by 2030. For Energy from Waste ("EfW") it sets out requirements for increased use of Carbon Capture and Storage ("CCS") whilst being very clear on its ambition to phase out landfill.

It warns:

"Without substantial increases in policy ambition, and new policies in a range of areas, waste will become an increasing share of emissions and could still have substantial emissions by 2050. Given lead-times for changing waste management practices without a risk of unintended consequences, the waste sector requires new policy urgently."

Projecting Residual Waste in 2030

In November 2017, Tolvik was commissioned by the ESA to independently review third party projections of the impact of various recycling scenarios on the projected tonnage of Residual Waste in the UK by 2030[2].

Scenario	Combined 2030 UK Recycling Rate	2030 Residual Waste (Mt)
No Change	52%	29.5
50% Household	57%	26.8
55% Household	60%	24.5
CE Target	65%	21.0
High Recycling	71%	17.3

Figure 1: Projected 2030 UK Residual Waste Source: ESA Report[2]

Extrapolating between data points in Figure 1, that if the Budget's 68% recycling rate were to be achieved, it is estimated that by 2030 there would be c.18.8Mt of Residual Waste in the UK. To put this into context, in 2019 c. 27.5Mt of Residual Waste was generated in the UK , so highlighting the step change in waste management needed if the Budget targets are to be achieved.

During 2020 Tolvik produced a series of Briefing Notes considering the impact of COVID-19 on the Residual Waste sector in the UK. In the central scenario modelled in the latest edition[3], it was estimated that the long term effect of COVID-19 would be to reduce Residual Waste in England by around 0.8Mtpa. Extrapolating this to the UK as a whole points to a total c.1.0Mtpa reduction.

Combining these high level estimates, it therefore does not seem unreasonable to assume that, if the Budget's recycling aspirations are met, by 2030 there would be c.17.8Mt of Residual Waste in the UK.

It has recently been announced that two further EfWs have reached Financial Close – adding 0.9Mtpa of additional EfW capacity. When this is combined with the 17.1Mtpa of EfW capacity previously identified in Tolvik's 2019 EfW statistics[4], and assuming that in the interim no EfWs are decommissioned, it is estimated that there will be just over 18.0Mtpa of operational EfW capacity in the UK in 2030.

Market Balance

The above analysis suggests that **if the Budget's proposed recycling targets are met, in 2030 the UK Residual Waste Market will be largely in balance** with negligible tonnages of Residual Waste being landfilled or exported to Europe.

In reality the barriers to achieving the Budget recycling targets are so significant that Tolvik remains of the view that, without what is could well prove to be politically unacceptable and radical Government economic and legislative intervention (for example "Pay as You Throw", mandating recycled content across a range of products), the targets will not be achieved in the timescales set out in the Budget.

RESIDUAL WASTE AS A FUEL - AVIATION

Just like waste, aviation is identified as a challenging sector with the Budget noting that *"aviation is one of the sectors in which we expect there to be significant remaining positive emissions by 2050, given the limited set of options for decarbonisation."*

Residual Waste and SAF

The Budget suggests that one means by which the aviation sector can improve its carbon footprint is through increased use of "drop in" Sustainable Aviation Fuel ("SAF"). Whilst this bioenergy could be derived solely from solid biomass, it is only for aviation that the Budget explicitly models a potential role (under the "Widespread Engagement" scenario) for the biogenic fraction of Residual Waste to be used as a source of bioenergy. In this scenario SAF derived from Residual Waste is assumed to meet 5% of aviation's energy demand by 2050.

In modelling Residual Waste in this way, the Budget acknowledges that Residual Waste is less desirable than pure biomass as a source of SAF but that there are limits to the availability of such biomass. The Budget methodology would also seem to indicate that, from a carbon perspective, it is preferable to utilise Residual Waste in SAF production than for it to be combusted in an unabated EfW (i.e. one without CCS).

An Example – Altalto Immingham

The potential demand for Residual Waste from the aviation sector is easier to understand with a specific example. Altalto Immingham is a current development project with the aim of producing SAF from Residual Waste – see the box below.

Planning consent has been granted for a commercial jet fuel production facility being developed by Velocys – **Altalto Immingham.**

Working alongside British Airways and Shell, the project will take up to 600,000 tonnes of Refuse Derived Fuel (a form of Residual Waste) per annum and convert it into 60m litres of jet fuel and naphtha each year.

Altalto Immingham

According to the planning application the Immingham project requires up to 0.6Mtpa of Refuse Derived Fuel ("RDF") each year which would be converted to jet fuel and naphtha using a patented Fischer-Tropsch technology. Whilst there are few details in the public domain with respect to the required specification of the RDF input, Fischer-Tropsch[5] technologies typically require an RDF in which Residual Waste has been subject to significant pre-processing. It is quite possible therefore that in excess of 1.0Mtpa of unprocessed Residual Waste will be needed to provide sufficient RDF of the required specification to the proposed Immingham facility.

If, for illustrative purposes, it is assumed that all 60m litres of the resultant fuel generated by the Immingham facility is SAF, Tolvik estimates that the Immingham facility would generate enough SAF to meet just over 1% of British Airways' 2019 global fuel requirement. Clearly, given expected changes to the aviation sector post COVID-19, the potential contribution of the project to British Airway's fuel requirements post COVID-19 is likely to be higher than the 2019 estimate.

Implications

Nevertheless, as the Immingham project highlights, it's difficult not to conclude that **whilst the potential for Residual Waste as a feedstock for SAF is likely to have only a very modest impact on the aviation sector, it could have proportionally very significant impact on the UK Residual Waste market.**

This is, in fact, implicit within the Budget. In the modelling, under the Widespread Engagement scenario, 70% of all UK Residual Waste is allocated to SAF manufacture by 2050 to meet just 5% of aviation's assumed energy demand.

Above all else, however, the key issue is the technical reliability of commercial scale Fischer-Tropsch, or similar, based technologies to use an RDF feedstock to generate a range of distinctive and highly specified product streams. **To date, despite significant research over a number of years, as far as Tolvik is aware, no standout technical solutions have emerged at commercial scale.**

CONSIDERATIONS

Based on the Budget, the analysis in this Briefing Note therefore suggests that if:

- The UK were to reach the Budget's 2030 recycling targets;
- A reliable technology is identified to convert Residual Waste to SAF;

there would be no need for any further EfW capacity to be developed in the UK. Furthermore. In such circumstances SAF production facilities such as Altalto Immingham would need to charge a market disruptive, discounted gate fee in order to be able to outcompete EfWs so as to secure the sufficient tonnages of Residual Waste (in the form of RDF) which they require as a feedstock.

In practice the aviation sector is unlikely in the coming years to be alone in looking to the potential of Residual Waste as a source of lower carbon bioenergy – particularly if, as expected the economics of Residual Waste are more favourable than those for solid biomass.

Just like aviation, most of these other sectors (shipping, road transport, chemicals) are likely to require some form of Fischer-Tropsch process to create a suitable specified product. The only exception to this is likely to be the cement sector where around 0.4Mtpa of Residual Waste derived Solid Recovered Fuel ("SRF") is already being used as an alternative fuel and where there is the potential for an increase in the use of such waste as part of the sector's plans to reduce its carbon footprint.

For policy makers the Budget therefore highlights a potential issue which may need consideration sooner rather than later.

If the Budget's recycling rates are met and/or technical issues around Fischer-Tropsch can be successfully overcome, demand for Residual Waste could relatively quickly exceed supply, leading to a potentially significant reduction in Residual Waste gate fees. But declining Residual Waste gate fees brings a risk that the economics of recycling could be undermined - and so limit recycling rates. From

a policy perspective, this would clearly be an unwelcome development, possibly one of the "*unintended consequences"* referenced in the Budget.

For Government, one potential response to such a market risk, were it to arise, would be to consider the introduction of a carbon tax on EfWs sooner rather than later. The Government could then argue that it is both supporting recycling whilst at the same time encouraging alternative uses for Residual Waste (such as the production of SAF) which, from a CO_2 perspective, may be seen as preferable to sending Residual Waste to an unabated EfW with no heat offtake.

The Government could also argue that such a carbon tax would have the potential to function in a similar way to the landfill tax – only this time "squeezing" unabated EfW in favour of alternatives in much the same way that landfill tax "squeezed" landfill in favour of EfW.

However, as the debate in 2019 with respect to an incineration tax highlighted, there are likely to be significant objections to such a tax, particularly from Local Authorities committed to long term contracts with EfWs.

What is clear from the Budget is that in the future those active in the waste and bioenergy sectors will need to closely monitor and understand the risk profiles around:

- The UK's progress against the Budget's proposed 2030 recycling target of 68%;
- Demand for solid biomass (including the biogenic component of Residual Waste) across other sectors as they progress their decarbonisation agendas;
- The progress of the development of technologies to convert Residual Waste to SAF (or equivalent in other sectors);
- The potential for Government to deploy fiscal levers (either subsidies and/or taxation) in order to deliver desired outcomes.

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Sources

(1) https://www.theccc.org.uk/publication/sixth-carbon-budget/

(2) https://www.tolvik.com/published-reports/view/uk-residual-waste-2030-market-review/

(3) https://www.tolvik.com/published-reports/view/briefing-covid-19-and-uk-waste-sector-autumn-2020/

(4) https://www.tolvik.com/published-reports/view/uk-energy-from-waste-statistics-2019/

(5) The Fischer–Tropsch process is a collection of chemical reactions that converts a mixture of carbon monoxide and hydrogen into liquid hydrocarbons. These reactions occur in the presence of metal catalysts (cobalt, iron, ruthenium), at temperatures of 150–300 °C and pressures of 1-10 bar. The process was first developed by Franz Fischer and Hans Tropsch at the Kaiser-Wilhelm-Institut für Kohlenforschung in Mülheim an der Ruhr, Germany, in 1925. *Source: Wikipedia*

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