

## Energy Technologies Institute (ETI) submission to Environmental Audit Committee's inquiry into Growing a Circular Economy

### **The benefits of a circular economy – key role in UK decarbonisation**

1. 'Circular economy' approaches can deliver important benefits to the UK economy and environment, so the ETI welcomes this inquiry. Given our mission to accelerate the development of low carbon energy technologies, our response focuses mainly on the potential benefits to UK decarbonisation, although circular economy models and more effective utilisation of waste can clearly offer a wide range of benefits.
2. The existing UK waste hierarchy provides clear and successful template for initial resource efficiency measures in the UK, guiding people to consider their waste material through a priority list of "reduce", "re-use", "recycle" (which includes composting), "recover" (i.e. energy from waste) and "dispose". However, it should also be noted that it isn't possible to have a perpetual circular economy – some materials will be lost or degrade as they pass around the loop, which may affect the optimal pathway for them at particular points. The ETI hopes that the inquiry can help to improve clarity around the application of the waste hierarchy, taking in to account newer recycling and recovery technologies, the more evolved distinction between the relative value of material, chemical and energy recycling from waste resources, and how this varies over time.
3. In order to encourage greater investment and delivery of a circular economy more confidence is needed around the understanding, interpretation and associated policy support for extracting and utilising the different embedded resources within waste. This necessitates a system-level understanding of the relative importance of different value chains – i.e. when would it be better to recover energy before chemicals; or chemicals before materials (e.g. carbon and hydrogen recovered in their basic forms rather than plastics remaining in the form collected). Some plastics cannot be well recycled (e.g. composite films consisting of several types of plastics used in food packaging). Clarity around when support would be given for turning these in to syngas, and subsequently energy or other chemicals such as polyethylene, would be helpful within the waste hierarchy. The suitability of different approaches at different scales is also important. This level of understanding would enable policy support to drive investment in the right direction, and right priority order.

### **Responses to specific questions in the consultation**

#### **The potential economic value of resources contained in 'waste' and key domestic value chains**

4. From an energy perspective, we believe the resources contained within waste are of significant value, and support should continue to be given to enable the development of these key value chains. In turn – early projects are often building blocks for future technologies – for example, support given to high efficiency syngas production now, will

enable progress to be made on cost-effectively producing bio-methane and high value chemicals in the future. At the ETI, we have commissioned a Waste Gasification project ([http://www.eti.co.uk/news/article/eti\\_announces\\_shortlist\\_of\\_companies\\_in\\_2.8m\\_competition\\_to\\_design\\_energy\\_f](http://www.eti.co.uk/news/article/eti_announces_shortlist_of_companies_in_2.8m_competition_to_design_energy_f)) to develop and demonstrate an integrated waste gasification plant at the 5-20 MWe (town) scale, as a key need for technology acceleration is around high efficiency, cost-effective smaller-scale waste from energy plants. In this project, we are assessing the economic and environmental viability of generating energy from waste via three different technology designs. This involves detailed engineering due diligence activities, including a review of the energy and mass balances of each integrated system design.

5. Preliminary analysis of the potential value of the waste gasification technologies developed under the ETI Waste Gasification project described above, suggests a *cumulative* (net present) economic value between now and 2050 of £1.4-£4.6bn; 2000-7000 jobs secured; and 25 – 94 Mt CO<sub>2e</sub> avoided.
6. Fundamental to our vision for waste to energy plants, are the principles set out in Defra's Waste Strategy – firstly, following the waste hierarchy – recycling and recovering materials of high-value, prior to any conversion to energy - hence the plant design must include provision for the activities of a Material Recycling Facility. Secondly, following the principle that waste is best treated and managed 'locally', keeping transportation (and associated GHG emissions) to a minimum – hence our focus on integrated waste gasification plants at the 'town' scale of 5 – 20 MW (electrical) which would see a kerbside waste throughput of 50,000 – 200,000 tonnes per year.

### **The importance of waste gasification within a circular bioeconomy is highlighted by the range of benefits it can deliver**

7. Avoidance of biodegradable waste to landfill – the EU Landfill Directive requires the complete diversion of biodegradable waste from landfill by 2025 (2029 in the UK under the UK enabling act "Waste and Emissions Trading Act 2003"). Therefore alternative waste management strategies are required. The integrated waste gasification system the ETI is seeking to develop and demonstrate under the Waste Gasification project, takes in to account the requirement for maximum recovery and recycling of higher-value materials, prior to its eventual treatment and conversion to energy (i.e. honouring the UK Waste Hierarchy set out in Defra's Waste Strategy). This landfill diversion will contribute to the Greenhouse gas (GHG) emission reduction targets by reducing leakage of methane from landfill.
8. Avoidance of direct emissions from the UK waste sector are equivalent to ~18Mt CO<sub>2</sub> equivalent per annum. Therefore the development of new high efficiency waste to energy systems will help contribute to the future UK low-carbon energy system, both in terms of the low-carbon energy being produced, and emissions avoided from landfill diversion. ETI estimates that advanced energy from waste technologies could yield a net decrease in UK GHG emissions of 5-10 million tonnes CO<sub>2e</sub> per year, and generate up to 25 TWh per annum of electricity (5-8% of UK demand).
9. Avoidance of air pollutants. Gasification offers particular benefits in terms of air quality, especially in urban areas where air quality can be difficult to maintain, as the conversion technology generates significantly cleaner emissions than many existing combustion

plants (e.g. less NO<sub>x</sub>, SO<sub>x</sub>, and Particulates). This is important in securing planning permission, and the evidence collected during the ETI's Waste Gasification project will accelerate the ability to provide clean Combined Heat and Power (CHP) in challenging air quality locations.

10. Avoidance of waste exports. Current waste exports of ~900,000 tonnes of Refuse Derived Fuel waste per year could be avoided if there was development of substantial domestic markets that can utilise significant waste arisings.

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## Background on ETI

The Energy Technologies Institute (ETI) is a public-private partnership between global energy and engineering firms and the UK Government. ETI carries out three primary activities:

- modelling and strategic analysis of the UK energy system (power, heat, transport, infrastructure) to identify the key challenges and potential solutions to meeting the UK's 2020 and 2050 energy and climate change targets at the lowest cost,
- investing in major engineering and technology demonstration projects through targeted procurement to address these challenges with the aim of de-risking solutions – both in technology and in supply-chain development – for subsequent commercial investors
- providing support to enable the effective third party commercialisation of project outcomes.

Recognising the need to focus and target investments to ensure value for money and leverage from public sector support, the ETI's techno-economic modelling and strategic analysis of the UK energy system is a critical tool for supporting effective system planning and innovation delivery. The ETI approach is termed 'ESME' and is now used by DECC and the Committee on Climate Change to aid with policy development, planning and effective investment targeting.

Insights from ESME analysis have been reviewed with the European Commission and the JRC. With their support ETI have now developed a prototype tool for use in assessing energy system design for the European Union area using the same approach used for the UK. A local (urban area) energy system planning tool 'EnergyPath' is in development as part of the ETI Smart Systems and Heat programme.

The UK energy system development and decarbonisation priorities identified by ETI are:

- **Efficiency** – introducing systems and technologies to reduce cost and improve buildings and transport efficiency.
- **Nuclear** – establishing a new build programme based on new supply chain capacity and increased investor confidence.

- **Bioenergy** – informing the science, technology and business cases for decisions on how to optimise the use of sustainable bioenergy resources as solid, liquid and gaseous fuels.
- **Carbon Capture and Storage** – providing system demonstration and strategic insights for capture, transport and storage building investor confidence.
- **Gas** – enabling long-term use of a critical fuel for power, heat, storage and potentially transport ('gas' = natural gas, synthetic combustion gases, biogas and hydrogen).
- **Offshore renewables** – reducing cost and building investor confidence.