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Editorial

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Editorial

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Circular economy brings the promise of making better use of resources, by minimising natural resource extraction, maximising waste prevention and optimising the environmental, social, technical and economic values of materials and products throughout their consecutive life cycles (Velenturf and Purnell, 2021). That is the theory.

In practice, linear patterns of production and consumption persist in which we take resources from the environment, use them for a relatively short amount of time before disposing of them, often unsustainably. The world was only 8.6% 'circular' in 2020, down from 9.1% in 2018 (Circle Economy, 2021).

Diverse types of circular economy are strived for by actors across society, from academia to governments, companies and communities. This is also the case in the United Kingdom (UK), where the consensus appears to centre on a circular economy that relies primarily on resource recovery from waste (Velenturf and Purnell, 2021). But investment is heavily skewed towards energy from waste facilities (Peake and Brandmayr, 2019) with recycling rates remaining essentially static for nearly a decade (Eurostat, 2021). This editorial discusses the role of energy from waste in the transition towards a sustainable circular economy, offering context for a themed issue planned on this subject by *Proceedings of the Institution of Civil Engineers – Waste and Resource Management*.

Legal definitions of energy from waste vary across countries, but generally include (Purnell, 2017):

- anaerobic digestion, using bacteria to break down biodegradable waste into biogas and nutrient-rich sludge
- burning waste-derived fuels such as biogas, landfill gas and refuse-derived fuel to generate energy
- advanced thermal treatments such as pyrolysis, gasification and mechanical heat treatment.

Energy from waste is in the lower tiers of the waste hierarchy, following waste prevention and minimisation, preparation for reuse, and recycling and composting (Defra, 2011). Following waste prevention, energy recovery is considered as a key component of sustainable integrated waste management, arguably working in synergy with recycling (Roll and Streisselberger, 2013; Wilson *et al*., 2013).

In the UK, however, the balance in implementing sustainable integrated waste management and the waste hierarchy has been lost in the last decade with short-sighted policies narrowly focused on 'decarbonisation' and austerity (Chilton, 2012). Unlike in other countries such as Germany, in the UK the biodegradable fraction of waste going to incineration facilities was considered renewable and energy from waste was thus promoted as part of climate policy (Roll and Streisselberger, 2013). At the same time, the UK government sought to save money by delivering only on the minimum landfill diversion targets set out in the EU Waste Framework Directive (Chilton, 2012; EU, 2008). Waste incineration, being a well-developed technology with an economically attractive business case, tipped the balance against recycling and lost the precautionary and sustainability criteria that ought to accompany waste hierarchy implementation (Chilton, 2012; Gerstrom, 2000).

A much-heard argument from the incineration industry is that investment into waste combustion would not crowd out recycling (Policy Connect, 2020). However, such claims cannot be held up when analysing trends across Europe (Eurostat, 2021). In some countries such as Germany, the Netherlands and Poland, energy from waste and recycling did/still are develop(ing) in synergy with volumes of waste recycled exceeding energy from waste. However, others such as Denmark and Sweden have been locked into approximately 50/50 recycling and energy from waste for years, while Finland, Estonia and the UK have rapidly diverted wastes from landfill to energy from waste while recycling was left behind (Eurostat, 2021). The latest evidence from the

Resources and Waste Strategy for England suggests that 53% of residual waste is readily recyclable, and a total of 92% of residual waste could be recycled and/or avoided by better design (Defra, 2020). In other words, much of the waste currently incinerated or landfilled does not have to be.

Another regular argument is that energy from waste investment would be driven by 'the market' and that governments should cut red tape to let industry get on with it. However, even representatives from the energy from waste industry discussed how investment in waste management is directed by government policy – that is, it is not a 'free market' (e.g. Chilton, 2012; Roll and Streisselberger, 2013). It is hence also crucial that governments maintain a balance in infrastructure investment for product reuse, material recycling and energy recovery.

The latest arguments revolve around the social value that energy from waste could generate. For example, recovering the heat from incinerators is purported to have the potential to combat fuel poverty through district heating networks which, it should be noted, are still relatively rare in the UK (Policy Connect, 2020). This is on the one hand a 'sticky plaster' policy against the deepening inequalities in the UK, and at the same time ignores the fact that a higher-value circular economy that proactively maximises opportunities for practices such as reuse, repair and remanufacturing could generate higher social value by creating 10–16 times more jobs than a linear economy in which the waste problem is solved at 'end of pipe' with incineration (Peake and Brandmayr, 2019).

Incineration destroys the technical value of products and materials, which are then replaced to maintain materialistic lifestyles; as such, waste incineration is not a closed loop. It perpetuates a linear model of production and consumption, contributing to continued resource extraction, processing and manufacturing with adverse social and environmental impacts falling primarily in lower-income countries (Schandl *et al.*, 2018); going directly against numerous UN Sustainable Development Goals (UN, 2015). Moreover, burning wastes cannot be considered 'low-carbon'. Firstly, incinerators in Europe 'generate a significant amount of direct CO2 [carbon dioxide] emissions (580 g CO2eq/kWh), which is twice the current EU28 average electricity grid intensity (298 g CO2eq per kWh) and significantly greater than energy produced through conventional fossil fuel sources such as gas' (Vähk, 2019: p. 6) and secondly, because of the carbon dioxide emissions associated with the replacement of incinerated resources for continued production and consumption. A high reliance on energy from waste goes against global climate change agreements.

Since 2011, times have moved on and the UK government, like many others, has committed to an industrial strategy that realises a circular economy that will leave the environment in a better state for the next generation (BEIS, 2017; HMG, 2018). Such a regenerative circular economy requires a reduction in average material consumption per person by more than 50% in Europe (EAC, 2020; O'Neill *et al.*, 2018). But this fact was not reflected in the transposition of the EU circular economy package into the UK (Defra *et al.*, 2020; EU, 2020). A sustainable regenerative circular economy, that the UK government apparently wants, goes well above the requirements set out in the EU Waste Framework Directive and demands investment into hard and soft infrastructure (Macaskie *et al.*, 2020):

- taking stock of current physical circular economy including for reuse, repair, remanufacturing and higher-quality recycling
- repurposing high street spaces for reuse, repair and remanufacturing
- developing the essential data infrastructure for resources and waste in support of investment and policy decision making as well as better information for consumers
- supporting programmes for education and lifelong learning
- engagement facilities to make global circular economy expertise available to local communities
- joined-up governance with funding to collaborate across national, regional and local levels of government.

Implementing a circular economy is crucial for sustainable development and decarbonisation (Velenturf and Purnell, 2021). Some circular economy proponents argue that economic growth can be decoupled from increasing resource use and waste generation; but practical evidence of this is lacking (Roll and Streisselberger, 2013; Wilts, 2019). Changing behaviours for recycling was challenging, and the same is evident for waste-minimisation practices (Goldsmith and Lasaridi, 2020; Wilts, 2019). In the implementation of a circular economy in high-income countries, more efforts ought to go to: (*i*) reducing average material consumption per person; (*ii*) recovering products and materials; and (*iii*) recovering energy – in that order (Velenturf and Purnell, 2020).

In lower-income countries the situation is different. Here, increasing average materials use per person is generally still essential, for example to develop infrastructure crucial for basic levels of well-being. Formal waste infrastructure is generally lacking, with informal sectors capable of reaching 20–30% recycling rates (Wilson *et al.*, 2013). Here, the development of waste incinerators risks the displacement of livelihoods. Conversely, with a more context-sensitive approach it may be possible to leapfrog towards a sustainable circular economy that incorporates informal sectors – for example, for repair and recycling.

Ultimately, waste incineration is a linear economy practice that should be minimised within a sustainable circular economy. In higher-income countries it is of paramount importance, for sustainability purposes, that the reliance on waste incineration as a transition technology is kept as short as possible, combined with a much greater emphasis on behaviour change to reduce materials consumption and thus prevent wastes.

A strong evidence base is essential to support practitioners, and therefore more research should focus on waste prevention and minimisation. This issue of *Waste and Resource Management* presents three articles that demonstrate how wastes can be kept out of the residual stream with measures to prevent wastes, such as with proactive design and process optimisation, and how industrial symbiosis can help to turn wastes and by-products into valuable outputs – for example, turning food processing waste into animal feed and using ash in cement (Chidiobi *et al.*, 2021; Fagbohungbe *et al.*, 2021; Kar *et al.*, 2021). Studies on energy from waste should critically reflect upon its sustainability potential from a whole system perspective. *Waste and Resource Management* welcomes such articles and is planning a themed issue on 'Sustainable waste management via material recovery and energy production'.

Announcements on themed issues and recent published articles can be read ahead of print in the virtual library on the journal's website https://www.icevirtuallibrary.com/toc/jwarm/current.

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