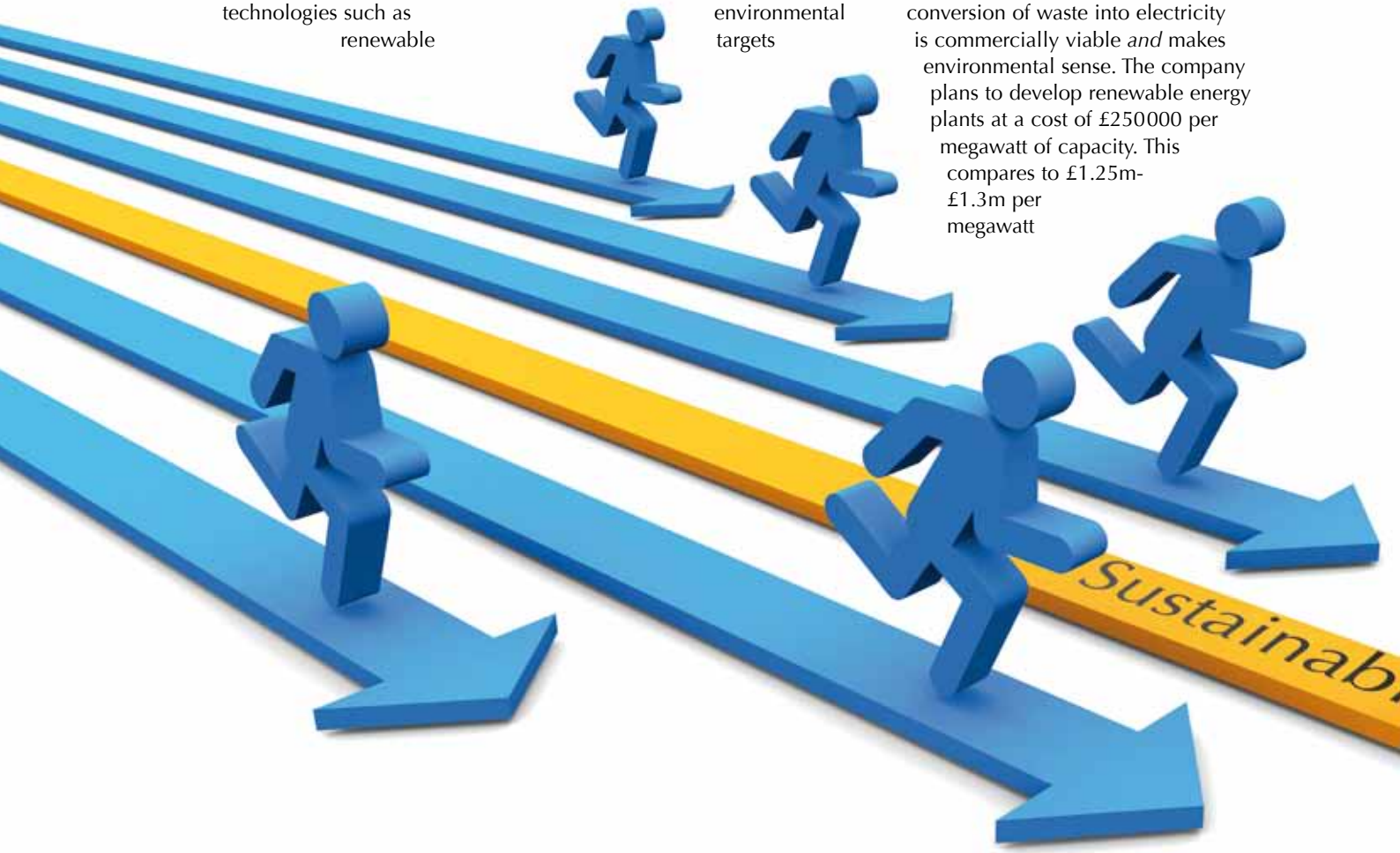
The Race Is On

Waste2Tricity believes EfW is vital in the sustainable energy race and one of its directors, Peter Jones, discusses developments in the industry, plasma gasification and the race to bring new technologies to market

As highlighted by numerous reports, we are currently at a crossroads. Leading economists have called for an immediate £277bn international fund in a combined attack on the worldwide economic crisis and global warming by supporting low-carbon technologies such as renewable energy. The Institute of Mechanical Engineers' (IMechE) report *Energy From Waste, A Wasted Opportunity* highlights that waste should not be regarded as problematic, but rather as a valuable resource to help the UK meet its national and regional environmental targets and commitments by developing a network of energy from waste (EfW) plants. From discussions with IMechE, it is clear it refers to innovative, low carbon approaches, as well as tried and tested systems.

As a new British venture, Waste2Tricity is out to prove that the conversion of waste into electricity is commercially viable *and* makes environmental sense. The company plans to develop renewable energy plants at a cost of £250000 per megawatt of capacity. This compares to £1.25m-£1.3m per megawatt



capacity for clean coal without CO_2 capture or around 12 percent of the cost of on-shore wind farm generation. Waste2Tricity will bring cutting-edge technology to market and prove that EfW is viable – both carbon efficient and economical – using a unique combination of new generation alkaline fuel cells with plasma gasification and other existing proven technologies.

While similar methods do already exist, we believe the Waste2Tricity system will have significant environmental and cost benefits over existing systems, such as those that have been operating in Japan for the last six years, utilising the cupola method. Its technology will change the disposal of waste from being an environmental headache into a commercially viable proposition, providing local authorities or energy sink companies with a revenue stream and increasing the amount of renewable electricity, not only in this country but also on a global scale.

Waste2Tricity's distinctive advantage will be its exclusive rights – within the plasma gasification application – to new generation fuel cells under development by AFC Energy plc, a producer of low-cost new generation fuel cells targeting waste hydrogen in commercial applications.

This unique integration of alkaline fuel cells is projected to increase the net output of electricity by a minimum of 60 percent over an internal combustion engine and by more than 130 percent for a steam turbine. This will result in the most efficient and economic means of converting EfW, generating 2100kWh of electricity from every tonne of municipal solid waste (MSW) currently sent to landfill. Waste2Tricity estimates that the cost of generating electricity could be less than three pence per KWh (at today's prices).

The company will take carbon-based waste, either MSW or waste from business and industry, and convert it into clean electricity, thereby playing a major role in the reduction of rubbish going to landfill and potentially making a significant contribution to the UK electricity supply.

Benefits And Incentives

EXISTING LANDFILL waste streams can be diverted, and with less landfill the future emission of undesirable greenhouse gases can be reduced. In terms of reducing carbon emissions, it's a more efficient form of electricity generation than existing coal-fired, and most renewable or other waste to electricity models, such as incineration.

In contrast to incineration, plasma gasification emits fewer pollutant gases, and no fly ash or waste ash. Harmful emissions are destroyed in the process and the by-product, inert vitrified slag, if used as road-building aggregates, will reduce demand for gravel extraction.

No one claims there will be a single silver bullet technology to cater for scrap carbon in the economy, but the scalability of the Waste2Tricity's low carbon footprint package, combined with high electrical yield per tonne of feedstock, puts it in a formidable position to challenge accepted approaches.

By using waste with a short-cycle biogenic composition, electricity generated by this process will be eligible to apply for subsidies incentives, under the Government's offer of double Renewable Obligation Certificates (ROCs) for advanced gasification plants from April 2010, thereby helping electricity suppliers meet their renewable targets.

The real driver, however, will be the looming gap in electricity supply – with one-third of capacity going offline as ageing nuclear and coal plants need replacing.

The National Audit Office report and Defra's *Managing The Waste PFI Programme* report recently highlighted the fact that recycling would not be enough to meet Britain's 2013 landfill targets. With local authorities looking to invest in new waste infrastructure, well-proven, cutting-edge technology could be the answer to bypassing higher Council Tax bills to cover the fines, but this is not a licence to build more non-combined heat and power (CHP) mass burn thermal plants.

The plasma gasification method of waste management works hand-in-hand with recycling, which is a good solution for certain types of waste where there are already established collection, sorting and handling facilities, as well as a steady market for the recovered materials. But due to cross contamination, much useful material is rendered of no value for recycling. So, the advice remains to reduce, re-use, recycle and compost as much as possible, but whatever waste is left over should be utilised for EfW.

Low-Risk Approach

WASTE2TRICITY IS working closely with Air Products and Alter NRG towards securing a strategic partnership to build a 50000 tonne pilot plant that will integrate the available technologies in two stages.

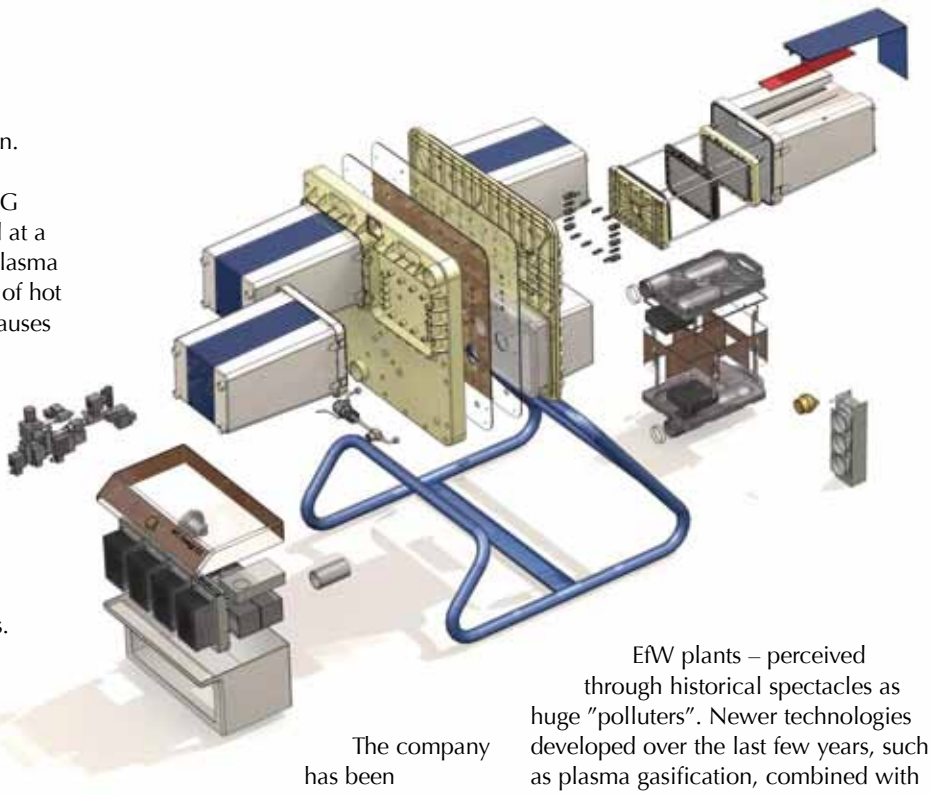
Stage one uses known, proven and commercial applications, while stage two will introduce fuel cells, increasing the efficiency and net output of a waste to electricity facility by 60 percent plus.

First, a homogenised waste stream is obtained, either in conjunction with an existing waste management company, allowing the installation to be established on an existing site; or from an industrial customer, such as a supermarket chain, that back hauls its waste to a central depot. Ideally, a mix of 35 percent organics, 35 percent paper and cardboard, 25 percent plastic and five percent other materials works best and, if sorted in advance, the mix can be checked before entering the gasification process. ▸▸

The waste stream goes into the first process, the same for both stages, which is plasma gasification. Waste2Tricity is to use a plasma gasification process from Alter NRG Westinghouse, similar to that used at a plant in Japan. This process uses plasma torches at 8000°C to create a bed of hot gas which, with limited oxygen, causes the waste to convert to a syngas. The syngas comprises H_2, CO and a small amount of CO_2, with the energy contained in the H_2 and CO. The remaining by-product is a vitrified slag, an inert material that can be used for aggregates in road building. The syngas is then processed in one of the two stages.

The gasification process has been confirmed by advanced waste treatment technology specialists, Juniper Consulting, and Waste2Tricity is also in discussions with US firm Air Products to secure systems to prepare syngas from the gasification process ready for use in fuel cells. The syngas is treated to remove certain contaminants and is then put into internal combustion engines where the syngas energy is converted into electricity at about 30 percent efficiency.

During the second stage, the syngas is cleaned more stringently, and is then steamed at 200°C by a gas water shift reaction; the oxygen in the H_2O binds with the CO leaving H_2 and CO_2. The H_2/CO_2 mixture is then put through a pressure swing adsorption system, which splits the H_2 into a sufficiently pure stream to operate the next phase. AFC Energy's alkaline fuel cells will be installed to increase the energy efficiency. Alkaline fuel cell technology is the most well-known and proven of all fuel cell technologies, as used today by NASA. The fuel cells developed by AFC Energy offer three key advantages. First, as low temperature units, standard engineering plastics are used in construction; this and careful engineering design means low cost. Second, the stack has been replaced by a serviceable cartridge, allowing a five-year "fit for purpose" warranty. Third, at 55 percent, alkaline fuel cells have the highest conversion efficiency of any fuel cell system, so their deployment will produce more electricity than any other system type.



The company has been launched purely from a commercial perspective and is in discussions to establish a pilot plant for 50000 tonnes per annum of throughput. Ideally, a partnership could be formed with a major waste management company to supply a homogenous stream of refuse-derived fuel or a homogenised mix of waste.

Facilities can be built on existing landfill sites, reducing the likelihood of opposition to their construction, and can utilise existing infrastructure, such as roads built for waste transport. This would preferably be close to electrical energy demand "sinks" to minimise transmission losses via a centralised grid.

Cleaner Technologies

FOR THE first time there's an overwhelming business case to drive development of low carbon footprint EfW technologies to successful operation. However, more infrastructure is needed to divert waste from landfill and generate power; the difficulty lies in obtaining the required planning permission, which is influenced by the capacity of the plant.

What is needed is more government-led awareness campaigns incorporating benefits and an outright need for modern EfW plants. This will help evolve the public's attitude about EfW plants – perceived through historical spectacles as huge "polluters". Newer technologies developed over the last few years, such as plasma gasification, combined with strict emission monitoring, allow us to recover energy from waste, all part of a greater plan in the fight to reduce the UK's landfill, produce renewable energy and lower CO_2 emissions.

If we are ever to fully harness the benefits of EfW, then governments the globe over must stop managing energy and waste as separate entities, and instead accept the fact that they are part and parcel.

The question that must then be asked is whether local UK councils will have enough budget to convert existing incineration plants into more efficient EfW plants harnessing technologies like plasma gasification and fuel cells, thereby eliminating issues of air pollution and waste ash and ultimately producing at least twice as much electricity for the National Grid for every tonne of MSW processed.

We have a looming energy gap – with or without the recession – and if there is a role for the waste industry to fill the gap (in part) for heat, electricity and hydrogen or fuel gases, then we must grasp the nettle and widen the horizon of our technological aspirations and delivery. CIWM

Pictured above: an expanded diagram of SFC Energy's alkaline fuel cell, used to increase energy efficiency in the process

For more information visit www.waste2tricity.com and www.afcenergy.com