Can fuel cells help sweeten the EfW pill?

A company recently launched into the EfW market claims it can develop power-generating plants at a cost of £250,000 per MW of capacity through the help of alkaline fuel cells. *Tom Freyberg* looks at Waste2Tricity technology and speaks to Peter Jones about developing UK infrastructure.

THE RECENT report on Energy from Waste (EfW) from the Institute of Mechanical Engineers (IMechE) hardly made for surprising reading. Anyone involved in the EfW or recycling and waste industries will be aware that more infrastructure is needed to divert waste from landfill and generate power. The problem is getting the required waste treatment capacity through the planning stages.

What the *Energy from Waste: A Wasted Opportunity* report did highlight, which has been called for before, is the need for a government-led awareness campaign on the benefits of modern EfW plants. In its findings, IMechE accused the government of "deceiving the public" by concentrating awareness activities on the need to recycle to stop waste going to landfill.

"Recycling should only be for waste products which cannot be more sustainably converted into electricity, heat and/or transport fuels," it said.

Regarding the "myth" of polluting EfW plants, the report went on to say that: "The dioxin emissions limit for an EfW plant is an equivalent concentration to one third of a sugar lump dissolved in Loch Ness."

While the image of EfW technology is still recovering from a past hangover of poorer performing plants from the 60s and 70s; new solutions are coming online that aim to get the needed end product of energy, but in the form of a pill that is sweeter for the public to swallow.

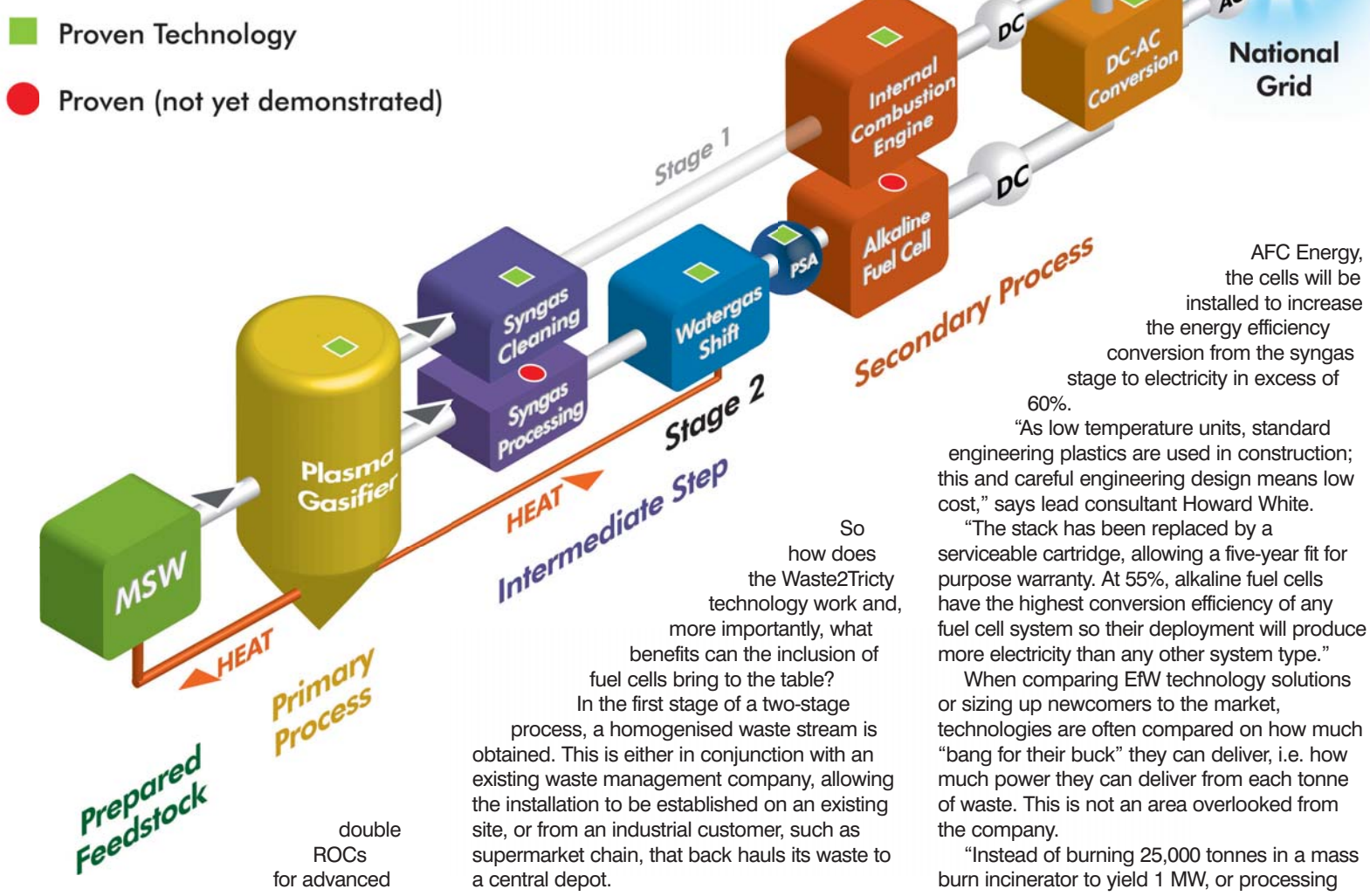
At the end of last year, one such company, Waste2Tricty was launched that claims it could develop energy plants at a cost as low as £250,000 per Mega Watt (MW) of capacity.

In a nutshell, Waste2Tricity's proposed solution uses plasma gasification application. Any EfW enthusiasts will immediately say that similar methods are already being trialled elsewhere. Take Advanced Plasma Power's gasplasma, which combines gasification and plasma arc treatment technologies. But it is through the use of alkaline fuel cells where the company aims to differentiate itself from what is already becoming a crowded market.

The incentive from subsidies like the Renewable Obligation Certificate (ROC) system, on paper, should also prove an incentive for such companies entering the market. Added to which the government has said it will offer double ROCs for advanced gasification plants from April 2010. But the incentive of ROC paybacks is not the primary reason behind Waste2Tricity breaking into the market.

"My personal view is that with incentives like ROCS, the government has extended their life, but this is only the icing on the bun," says Peter Jones, former Biffa director, now on the board of Waste2Tricity. "Really these things have to stack up in terms of the hard economics in the market place. The real driver is the looming electricity supply gap, with the third of capacity going offline and the dirty coal and ageing nuclear plants that need replacing.

"We need to spend about £20 billion in the waste industry to manage the 30 to 40 million tonnes of carbon-based waste going to landfill. Big chunks from the domestic and commercial sectors still go down this route. On top of that you have agricultural and forestry waste."



So how does the Waste2Tricty technology work and, more importantly, what benefits can the inclusion of fuel cells bring to the table?

In the first stage of a two-stage process, a homogenised waste stream is obtained. This is 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 supermarket chain, that back hauls its waste to a central depot.

The proposed mix will be made up of 35% organics, 35% paper and cardboard, 25% plastic and 5% other materials.

A plasma gasification process from Alter-NRG Westinghouse, who was involved with small scale plant starting up in Japan, will then be used to treat the material. This is where the fun starts.

The process uses plasma torches at 8000°C to create a bed of hot gas, which, with limited oxygen, causes the waste to convert to its gaseous components, called syngas. The syngas is H2, CO and CO_2, with the energy in the H2 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. Firstly, the syngas is treated to remove certain contaminants and is then put into internal combustion engines where energy in the syngas is converted into electricity at about 30% efficiency.

During the second stage, the syngas is cleaned more stringently. The energy in the CO is moved into hydrogen by way of a gas water shift reaction, whereby steam at 200°C is mixed with the syngas. The oxygen in the H2O binds with the CO leaving H2 and CO_2. The H2/CO_2 mixture is then put through a pressure swing absorption (PSA) system, which splits the H2 into a sufficiently pure stream to operate the next phase.

Cue the alkaline fuel cells.

Supplied by alkaline fuell cell manufacturers, AFC Energy, the cells will be installed to increase the energy efficiency conversion from the syngas stage to electricity in excess of 60%.

"As low temperature units, standard engineering plastics are used in construction; this and careful engineering design means low cost," says lead consultant Howard White.

"The stack has been replaced by a serviceable cartridge, allowing a five-year fit for purpose warranty. At 55%, 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."

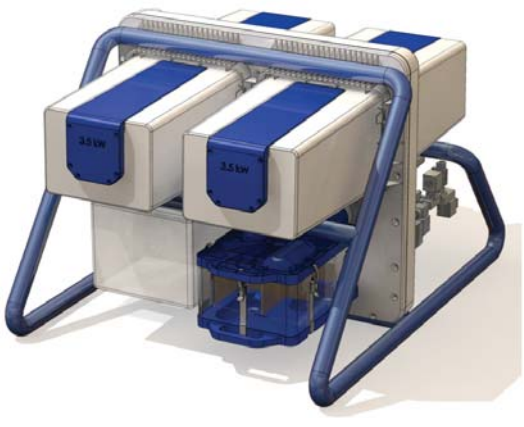
When comparing EfW technology solutions or sizing up newcomers to the market, technologies are often compared on how much "bang for their buck" they can deliver, i.e. how much power they can deliver from each tonne of waste. This is not an area overlooked from the company.

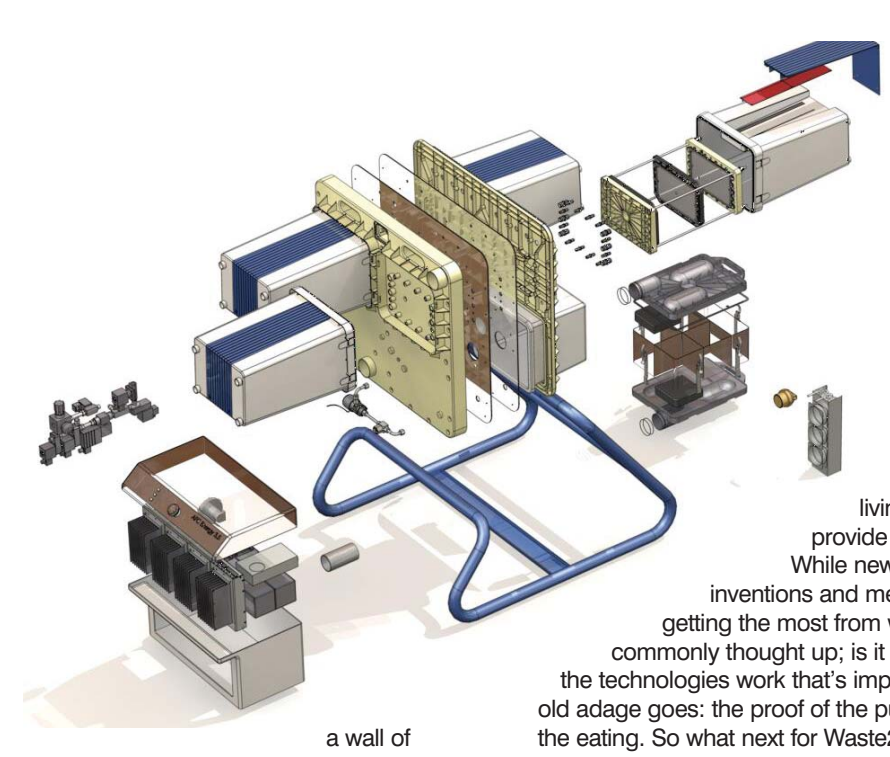
"Instead of burning 25,000 tonnes in a mass burn incinerator to yield 1 MW, or processing 12,000 to 16,000 tonnes through traditional gasifiers to get this MW, the Waste2Tricity option can deliver this electricity through only 4,000 to 5,000 tonnes," adds Jones. "The underlying issue for required plants is the cheapness and potential for their yield and flexibility. The EfW market is a crowded field, but the test will be the cost per MW of online capacity and the investment cost to get that capacity."

'The process uses plasma torches at 8000°C'

As the industry is aware, it is one thing having technology that can do what it says on the tin, but it is another getting infrastructure through the planning system and jumping through the various hoops that can delay projects.

"The waste industry is still struggling against





a wall of difficulty imposed by gaining planning permission. Instead we need to accelerate this process," continues Jones. "A third of electricity capacity is going to come offline in the next three years. Compost and recycling are always going to be significant, but they are not big money spinners.

"Supplying waste-based solutions that produce hydrogen, gas and electricity is where the money is, considering the UK already spends over a £100 billion a year on energy."

He goes on to say: "We're in a rut in this industry where people see us as people who deliver solutions to a problem. Nobody sees the car industry, which makes cars from 85% recovered materials such as scrap metal and plastic, as a collection of waste companies.

"We need to get ourselves seen as an industry that produces power, can help keep the cost of living down and provide jobs."

While new ideas, inventions and methods for getting the most from waste are commonly thought up; is it the proof that the technologies work that's important. As the old adage goes: the proof of the pudding is in the eating. So what next for Waste2Tricity?

The company plans to build a 50,000 tonne per annum pilot plant.

"We are currently looking into the context of PPC [Pollution, Prevention and Control] requirements and are in open dialogue with about 30 to 40 potential energy sink users," says Jones. "We will identify suitable locations for the technology alongside existing fossil energy users and will help these companies, such as banks, hospitals and prisons, evolve.

"Possible partners would be big users of electricity and heat who will be invited into a heat consortium, together with a waste management company and a power company. They will collectively form a company that shares the risk of the project, similar to a PPP [Public-Private-Partnerships] set-up.

"Even if a series of 100,000 tpa plants are installed, we would still need about 500 to 600 of these sites to manage the volume of waste going to landfill. For a series of 50,000 smaller plants, you would need over a thousand of these facilities.

"We are currently up to around 10 plants in the UK and ideally all [the thousand] are needed by 2013 to avoid fines. We are nowhere near this. Very few of the people involved with planning decisions have ever been to a landfill and witnessed 95 yarders rolling in every minute. We need a major rethink in the system to deliver what the industry needs."

'In the future we could see waste in short supply'

The former Biffa director believes that contrary to the present situation where we have reports of waste and recyclables being stockpiled due a weak market, in the future we could see waste in short supply.

"As the technology expands, the price of taking waste away from people will crash," he says. "If you have an infrastructure of plants with expensive kit at the back end, these plants have to be run 98% of the time so by 2016 waste could be in short supply. By 2016-17, most of the added value will be coming from output income streams rather than collection fees. It will prove cheaper to collect waste and resources as separate materials and then mix and sell them as different blends."

The situation of waste being in short supply would be most welcome for an industry currently feeling the bite of the downturn.

EfW technologies that can efficiently produce power at a relatively low cost couldn't come any sooner for a country that needs to get waste treatment infrastructure in place, and in place quickly. RWW

Former BIffa director Peter Jones believes there should be a rethink in the planning system