Energy technologies: some forecasts for the next decade

By Grace Segran

Affordable energy that is clean and consistent, delivered in a single system at a fraction of the price that people are paying today – 4.5 pence (US$0.07) per kilowatt hour (kWh) to be precise – isn't that too good to be true? Sir John Banham, Chairman of Johnson Matthey, doesn't think so because these are the very benefits from fuel cells which are already powering homes and buildings in the US today. And it often comes from an unlikely source – methane gas from human waste.

"The home fuel cell is five kW (thousand watts), silent and you simply plug it into the gas supply. It's about the size of a refrigerator and could operate on methane." Banham says there's no reason why all the buses for the London Olympics couldn't be run with fuel cells or why all new buildings constructed for the Olympics could not use electricity from fuel cells with the methane from London sewage. "(It's) totally possible," said Banham at The Economist's Energy Summit here recently.

One 'tangible' example is the Freedom Towers redevelopment of the World Trade Centre site in Manhattan, he told INSEAD Knowledge, as fuel cells will

be installed to provide electricity and heat.

Rolling it out in the UK

The most obvious place to start regarding rolling this out in the UK, according to Banham, is with affordable homes, of which there is a huge shortage of about 2.5 million, in areas where poverty is concentrated. All that's needed are home financing arrangements and feed-in tariffs, which, in his view, need be no more than the wholesale price with no new subsidies. Such a programme would put the UK construction back in business, and the government would be saving billions of pounds on housing subsidies.

"We need to replace Stalinist thinking about how you plan housing and how you plan future energy with letting the markets operate," he argues.

Professor Sir David King, director of the Smith School of Enterprise and the Environment at Oxford University says: "If every system in the home, instead of having a gas heating system, had one of these units, you would be producing all of your electricity and all your heat requirements from a single system; it's a combined heating power. There's a massive advantage to doing that." Otherwise, we have to pay to heat homes, when we could have used the heat from the generation of electricity in the first place.

"I do think we are talking about a very important technology," he says.

Leading technologies

Looking ahead to the coming decade and the implementation of the UK's legislatively-agreed target of 50 per cent renewable energy by 2020, Bernie Bulkin, chair of the UK Office of Renewable Energy Deployment, expects some 20 technologies could possibly make a contribution. But he believes that the bulk of the technologies, at least 85 per cent of them, will come from three broad groups: wind – onshore and offshore; biomass – for electricity, heat and transport; and heat pumps. Everything else is probably going to be marginal.

What's important is the rate of improvement of these technologies over the decade. Let's say we want to build a 30-40 gigawatt (billion watts) offshore turbine over the coming decade. If the cost of the 39th GW is the same as the cost of the first GW we are going to install, we might as well just shoot

ourselves and give up right now, Bulkin says. “In fact there are many projections about rather steep declines. We’ve got to have an incentive programme that rewards the people who deploy early and drive the cost down and doesn’t over-reward those who hang back and deploy late. That is what our government policy is designed to do.”

Step changes

If we want to look at where the technology breakthroughs are going to occur over the coming decade - that is, where we could possibly get step changes – Bulkin suggests looking at where the action is in science – in information technology (IT), both software and hardware; material science including nanotechnology; and biotechnology.

IT is central to everything in green technology: smart grids, smart transport, how we actually run electric vehicles, refuel and how we route vehicles through a city. All these can be developed through IT.

With regards to material science, products coming out of the nanotechnology labs in the US and Europe in particular -- and to some extent in Japan and China -- are bringing new advances in lighting through LEDs (light-emitting diodes), says Bulkin, and these allow big savings in a large portion of our energy use.

According to Bulkin, the promise for biotechnology clearly lies in biofuels. But the next generation of biofuels through biotechnology hasn’t delivered yet. It still might. “We may see biotech revolutionising the chemical industry. As we go through big changes in how we fuel our vehicles, we have to look at how the chemical industry is going to be transformed and biotech can do that.”

Engineering progress

For just about anything else in energy, we are not going to have revolutionary change, rather engineering progress, says Bulkin.

For wind it’s about incremental improvement: a learning curve in size, cost and reliablilty. As for heat pumps, the ones we buy today are not good enough in terms of performance; they need to be engineered to a higher level to be cost-effective in businesses and homes , says Bulkin.

In the case of technologies which are still at an early stage of engineering, there has been no emergence of a dominant design, he says. For example, in tidal stream and wave technologies, there's nothing that can be rolled out commercially yet. There are a couple of working wave devices that can only generate at the kilowatt levels so far.

Area of uncertainty

Bulkin feels that the biggest uncertainty at the moment is how much more can we do in terms of using biomass in generating electricity on a large scale. "It's not a high-tech problem - you need facilities to chop it up, to store it, and to feed it in. But this is the cheapest renewal energy source that we have today and the impact is enormous because you are backing out coal."

Technology identification and demonstration

The Energy Technologies Institute (ETI) does strategic modelling of the UK energy system and identifies major engineering technology opportunities. Their work is urgent as they have to move quickly in terms of climate change targets.
David Clarke

"Because the CO2 challenge is compelling, cost is critical for UK consumers both on the business and the domestic side. We are always challenging everybody on cost and looking for cost-effective solutions," ETI's chief executive David Clarke says.

In the engineering space, a fuel conversion process normally means that bigger will be more efficient. This affects manufacturing costs as well.

However, the opposite is the case for distributed energy and transport systems. It involves bringing about very big broad integration to make things happen. So there are two very different games to play.

"The important point is that they are both very big challenges you've got to face and once you step into that kind of arena, a university or SME cannot do this. You've got to get big players like the Shells, the Rolls Royces, the Johnson Mattheys to drive the technology and deploy it into the market because they've got the infrastructure and the financial support and they are able to make it work in an efficient way," argues Clarke. "We try to put

together big industry with the SMEs and the universities who’ve got the bright ideas then through the modelling work we do, we inform government policy, and then try to develop sustained direction through industrial involvement.”

The Economist's UK Energy Summit was held on 24 June, 2010.

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