E4tech

Newsletter

Introduction

It has been 18 months since our last newsletter and a lot has happened both in the world of sustainable energy and here at E4tech. We hope that you will enjoy this glimpse of our activities. If you would like to know more please do not hesitate to get in touch.

Economy slows but E4tech Grows

By Adam Chase

If a week is a long time in politics then 18 months is a lifetime in sustainable energy. We have seen upheavals in many areas relating to our work, such as a boom and bust in energy prices, a volte-face in US energy and climate policy, public mood swings on biofuels, a nuclear revival in the UK, the rise of the electric vehicle, increasing acceptance of tight building standards and, of course, the global recession.

For E4tech there is a constant in all of this, which recent events have only served to reinforce. This is that the fundamentals are what matter most. Some of the past hyperactivity in the consulting market was driven by companies reaching for 'greenery' to cloak unsustainable activities or by investors seeking to make a quick buck from an asset class that they barely understood. E4tech has always tried to remain close to the fundamentals, rather than the 'next big thing'. A key fundamental in the context of the ongoing recession is the economic opportunity presented by sustainable energy – innovation benefits, jobs, import reduction and, of course, reducing the long term threat of climate change. Much of our work centres on these factors.

Happily, recent months have seen a general increase in demand for E4tech's consulting services and software and the team has evolved to meet this need. Our offices in London and Lausanne comprise a strong team of sector and functional experts who can address many areas of sustainable energy. New additions to the E4tech team include Luca Bertuccioli (with a breadth of engineering experience from UTC), Richard Taylor (with a background in wind farm operations), Fabio Montemurro (a satellite engineer now working on electric vehicles), Kathrine Vad (who applies a strong knowledge of industrial life cycle issues) and Raffaella Chanson-Candiloro (who brings a long experience of architecture and software). We hope that you will have a chance to meet them and other team members soon.

Bioenergy

Bioenergy Report for the International Energy Agency

By François Vuille and Ausilio Bauen

Bioenergy, that is the use of biomass in its various forms (wood, agricultural crops and residues, manure and sewage sludge, algae, etc.) to produce heat, power or fuel, currently contributes 10% to our global energy use. It is presently by far the largest global contributor of renewable energy, and has significant potential for expansion.

Triggered by the introduction of specific support policies in many countries, the bioenergy sector has witnessed significant growth in recent years, in particular in relation to biofuels for the road transport sector. However, the development of bioenergy is facing several sustainability challenges. Public scepticism about the potential greenhouse gas savings that biofuels might achieve has increased, alongside concerns about their broader environmental and social impacts such as competition with food, impact on biodiversity, water scarcity and land use change.

Bioenergy has become a hot topic both at political and public level. Badly informed debates have contributed to confusion about the real potential of bioenergy to contribute in a sustainable way to our future energy supply. In this context, the International Energy Agency (IEA) has felt the need to publish an authoritative review of the entire bioenergy sector to provide decision makers, and the public at large, with sound information regarding the opportunities and risks of future bioenergy deployment. E4tech has been appointed lead author on this review, which will be published by the IEA this summer.

The report provides a concise review on resource, technology, economic, environmental, social and policy aspects of bioenergy at a global level. It discusses the future bioenergy potential and the main opportunities for deployment in the short and medium term. It also addresses the risks and barriers associated with the development of the sector, and how they may constrain its development.

The report shows that biomass can contribute up to a third to our future primary energy demand in a sustainable way. It also shows that bioenergy can contribute significantly to environmental and social objectives, such as climate change mitigation, waste treatment and rural development. The "bioenergy review" provides decision makers with information conducive to exploiting these opportunities while mitigating any associated risks, in order to assist the sustainable development of the bioenergy sector.

Please contact us if you wish to receive more information on this project or a copy of the report.

E4tech Newsletter

Hydrogen and fuel cells

Fuel Cell MicroCHP – where is the sweet spot?

By David Hart

A desire to improve energy efficiency and reduce emissions is opening opportunities for new technologies in many areas, not least fuel cells that can generate both heat and power in the home. But different countries have different requirements, and even within countries the best ratio of heat, power and price varies by end-user requirement.

In Japan the picture is comparatively homogeneous, and the EneFarm programme is the early commercial evidence of a concerted effort towards standardisation, backed by very large government and corporate investments. Several organisations now offer 1kW fuel cell CHP products for Japanese consumers, promising to save them money while giving them power and hot water. But purchase price is still very high, and only continued government backing makes the products attractive. In Germany the announcement of the *Callux* programme has encouraged companies struggling to enter the domestic fuel cell CHP market despite years of development effort. This government programme provides support for what will be an estimated 800 units to be installed across Germany.

In other countries, the picture is somewhat less clear. In the UK, solid oxide fuel cell developers such as Ceres Power and Ceramic Fuel Cells (CFCL) have units in development and on trial for 1-2kW domestic CHP. But their approaches differ significantly: Ceres Power has a highly variable heat to power ratio with lower electrical efficiency and a technology robust to thermal and dynamic shock, while Ceramic Fuel Cells claims a net electrical efficiency of 60% – deeply impressive for any generator, never mind such a small one – but specifies that the unit should run all the time at full load if possible, as it takes considerable time to heat and cool.

Analysts and commentators argue about which will win, about what the optimal technology is – and which one to invest in. Increasingly sophisticated modelling is conducted to optimise around different operating points and strategies. But this disguises the real issue, which is that the fuel cell, with characteristics that no other technology offers, and in times of considerable regulatory change, has to make its own market. Markets for products and services exist due to specific technology, policy and infrastructure boundary conditions, and evolve with them. All these are open to change. So both Ceres and CFCL could be right, given their inherent technology characteristics. They do not directly compete. And other manufacturers with other technologies must find other sweet spots – they could be right too.

Energy Efficiency

LED Lighting

By Robert Ball

"Using energy more efficiently is the fastest and most cost effective way of cutting carbon dioxide emissions" (UK Energy Efficiency Action Plan, 2007). LED lighting is among the key efficiency technologies identified in the Action Plan, and in the last two years, the efficiency and quality of LED lighting has advanced to the point where conventional lighting is being replaced by LEDs in many applications.

Over the past five years, LED lighting technology has developed at an astonishing pace. Today's commercially available LED lighting products are already at least five times as efficient as conventional incandescent and halogen equivalents, and over twice as efficient as compact fluorescent lamps, popularly termed "energy efficient" bulbs. However, despite the efficiency advantage of LEDs, they have suffered from poor public perception due to the influx of (relatively) cheap, poor quality products, with inferior light output, colour temperature and colour rendering. Nevertheless, LEDs' reputation is now improving, due to an increasing number of high-quality LED lighting products, particularly luminaires (the full light fixture, rather than just the bulb).

The purchase cost of LED lighting is still noticeably higher than conventional lighting; however, even neglecting possible future rises in the price of electricity, the in-use savings from increased efficiency typically result in a payback period of less than a year in many general lighting applications. As the efficiency and cost continue to improve, and as LED technology is taken up in new applications (e.g. automotive headlights, street lighting), the LED lighting market is expected to accelerate rapidly.

Venture capital and private equity investors recognise the potential of LED technology, but can be put off by perceived market barriers. In fact, contrary to common perception, the structure of the LED market is different to that of conventional lighting – the 'big three' players in conventional lighting have publicly recognised that LED lighting is the future of illumination, but none of these companies have been able to establish dominance in the LED space. The supply chain is quite different, and more fragmented than it may at first seem, involving semiconductor manufacturers, other power and control electronics companies, and many others, both large and small. The fragmented nature of the market is often perceived as a risk, but also brings great opportunities for investors.

As the LED market continues to grow, there are significant returns to be made for investors armed with good knowledge of the technology, market and supply chain.

Building Physics and Software

Novelties in the regulation on energy consumption of buildings in 2009

By Flavio Foradini

2009 brings several changes to the regulation on energy consumption in buildings (both new and old) in Switzerland. First, MoPEC (Proposed Cantonal Energy Regulation) is being implemented by the cantons. MoPEC shows the cantons' will to regulate the energy consumption of new buildings. Indeed, the cantons have seriously tightened the recommendations of the SIA (the Swiss society of engineers and architects): the maximum allowable energy intensity under MoPEC corresponds to the 2008 Minergie® level. MoPEC also promotes the use of renewable energies (at most 80% of the maximum allowable building needs can be met by energy sources that emit CO_2).

Besides, two important technical documents have been published by the SIA this year: the SIA2031 – Energy certification of buildings, and the SIA2032 – Embodied energy.

SIA2031 defines how to calculate the energy label for a building (as already exists for other consumables such as fridges), based partly on the EPBD (Energy Performance of Buildings Directive) published by the European Union. The methodology proposed by the new standard has been agreed to by all the relevant Swiss partners, in contrast to the label defined in the cantonal energy certification of buildings (CECB) which is based on measured data and is different for the cantons and the SIA (and the cities in the European Energy Award program). Both labels will be tested for one year.

The SIA2032 standard describes the methodology for the calculation of the energy embodied in a building. This calculation becomes important in the case of buildings with very low energy consumption (e.g. Minergie P®), where an increase in insulation, for instance, can lead to a greater energy consumption during material production (embodied energy) than the amount of energy actually saved during the life of the building. Starting in 2010, this methodology will be integrated into the Minergie ECO label, which adds to the Minergie P® label extra demands concerning environmental and health impacts.

All these methodologies and standards have been integrated into our flagship software: Lesosai 6.0

www.lesosai.com

Solar Energy

3rd Generation Photovoltaics – Toward Full Spectrum Utilization

By Fabio Montemurro and François Vuille

Photovoltaics (PV) is currently one of the most expensive options to produce renewable power and its deployment therefore relies on heavy subsidies. The PV industry is thus striving to drastically reduce its production costs so that solar electricity becomes cost competitive with grid power. Manufacturing costs are steadily being reduced by using increasingly automated processes to produce ever-thinner cells (thus reducing material costs) in greater volumes. Increases in cell efficiency have also enabled a reduction in the cost of PV electricity, but the potential for further improvement is intrinsically limited by the fact that current PV technologies can only convert a small portion of the sunlight spectrum to electricity. Light with energy below the so-called "cell bandgap" (e.g. infrared light) is simply not captured, while only part of the energy of photons above the bandgap (e.g. UV light) gets converted to electricity.

A breakthrough in PV cell efficiency can only happen if new physics and material science approaches are adopted. This is the promise held by the novel 3rd generation (3G) PV concepts, which aim at drastically reducing the intrinsic loss mechanisms of classical crystalline silicon and thin film solar cells. First, the spectral absorption range of a cell can be extended either by superimposing several cells with different bandgaps (multijunction cells) or by using nanoscale structures (quantum well and intermediate-band cells). Second, the incoming sunlight spectrum can be modified to better match the cell bandgap (up/down converter cells). Last, more electricity can be extracted from the absorbed sunlight either by preventing the high energy electrons (that originate from above bandgap photons) from naturally "cooling down" and loinge their extra energy as heat (hot carrier cells) or by generating multiple bandgap electrons per impinging high energy photon (impact ionization cells).

Most 3G approaches are still in a proof-of-concept stage in labs. The exceptions are the multijunction cells that are commercial but so expensive that their market is currently limited to space applications; and the quantum well solar cell which is in the advanced demonstration stage and which has already beaten the existing cell efficiency record. Those approaches that modify the sunlight spectrum appear particularly promising, as these concepts can be used in conjunction with existing low cost silicon-based cell to boost their efficiency.

One of E4tech's recent relevant projects was a technology review and assessment of all existing 3G concepts for a leading global industrial corporation interested in long term investment in R&D. This project included interviews of leading scientists and developers in the EU and visits to several key research laboratories.