Delta
Energy and Environment
Research, Analysis & Strategic Solutions

Micro-generation: A Mass Market in the Making?

Delta Research Brief

January 2007

Micro-generation continues to rear its head above the parapet, and, in some countries, is gaining attention from the mainstream energy industry. Is the prospect of millions of homes generating their own power a green fantasy, or is there a secure source of power behind the micro-generation spotlight?

This Research Brief provides some highlights of recent market developments, future prospects and Delta's research.

Despite growing attention, the impact of micro-combined heat and power (micro-CHP), micro-wind turbines and photovoltaics has, to date, been insignificant on electricity market, with possibly the only exceptions being over 1 GW of photovoltaic capacity installed in Japan and over 2 GW in Germany (both on the back of large subsidy programmes). Elsewhere, take up of micro-generation technologies has mostly been negligible when considered against the wider power market. For example less than 40-MW of micro-CHP capacity was installed globally in 2006.

Why, then, is micro-generation punching way above its weight in terms of the attention it is receiving in certain markets – both from policy makers and the energy industry? The answer lies in the potential for millions of households and small business to install micro-generation products in the future – the mass market. This has focussed the minds of heating equipment manufacturers and utilities, both keen to exploit the micro-generation opportunity (or respond to the threat, depending on your point of view).

Figure 1: A Toshiba Fuel Cell Installed in a Japanese Home

Source: Toshiba

The smaller box on the left contains a PEM fuel cell, reformer and inverter. The larger box on the right contains a hot water storage tank and supplementary burner.

The system provides the home with hot water, under floor heating and over a third of their electricity.

Boilers in Japan are commonly installed outdoors.

Policy makers in some markets have jumped on the micro-generation bandwagon. On the back of a bold Government photovoltaics policy, Japan now accounts for four of the top five photovoltaic

manufacturers, and is driving towards a similar leading position in fuel cell market.

Japan leads the fuel cell micro-CHP charge. A recent Delta Micro-CHP Service report, "Japan: Leading the PEM Fuel Cell Charge" analyses the status and prospects of PEM fuel cell systems being developed and demonstrated for micro-CHP applications. Tokyo Gas, Osaka Gas and other fuel suppliers are driving much of action. Major corporations such as Sanyo, Toshiba, Matsushita, Toyota and Ebara are developing and manufacturing PEM fuel cells, with a system from Toshiba shown in *Figure 1* on the previous page.

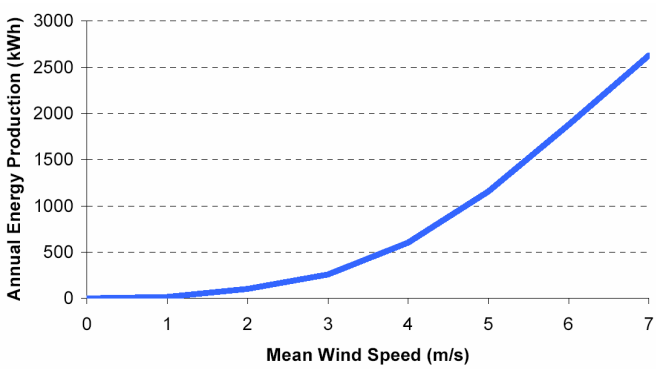
Over 1,000 systems are being demonstrated in Japanese households – a scale way beyond fuel cell demonstrations in Europe and Japan, each with well under 100 PEM fuel cells installed in homes. Developers are confident of reaching performance and lifetime targets required for widespread commercialisation, but a bigger question mark hangs over ability to meet the long term target system price of ¥500,000 (US$4,200, €3,200).

Solid oxide fuel cells are gaining ground. Another class of fuel cell, solid oxide fuel cells (SOFCs), are also making steady progress through research, development, demonstration and possibly by the end of the decade commercialisation. Some SOFCs could change the micro-CHP game with electrical efficiencies 40% already demonstrated, compared to the 10-15% typically seen from Stirling engines. Whilst SOFC developers Ceramic Fuel Cells, Acumentrics and Staxera-Webasto have teamed up with three of Europe's top seven boiler manufacturers, this technology has still has hardly yet cut its teeth in field tests. The Japanese government's recent announcement of a major SOFC micro-CHP demonstration programme will help to change this over the next few year. The critical issues affecting SOFC micro-CHP prospects are explored in a forthcoming Delta Micro-CHP Service report.

North America is traditionally seen as a tough market for micro-CHP, and will likely lag Europe and Japan in size. But there are some spots of activity. Climate Energy has demonstrated a number of systems and is starting to sell systems in north-eastern U.S, with Marathon Engine Systems currently getting their system certified for sale. Net metering arrangements in states such as Massachusetts and Wisconsin provide a favourable regulatory environment, and while many investor owned utilities are hostile decentralised energy, some municipal and cooperative utilities are keen to offer systems to their customers.

The UK has seen rapid utility micro-generation engagement. The government is helping to oil the wheels, publishing a Microgeneration Strategy in 2006, and recently announced which companies will have access to £50 million of grant funding to reduce the cost of renewable micro-generation products.

Figure 2: Electricity Production from a Small Wind Turbine on a Residential Roof is Very Sensitive to Wind Speed



This graph shows how sensitive annual energy production is to wind speed.

It was constructed using a power curve similar to that published by micro-wind turbine manufacturers and assuming a typical distribution of wind speeds.

Source: Delta Energy & Environment

Centrica will be offering photovoltaics, with E.ON UK joining them in offering micro-wind turbines. With micro-CHP also increasingly under the spotlight, equity analysts covering the utility sector are increasingly aware of the potential long term impact of micro-generation on utility businesses, and Delta is helping analysts explore this the nature and size of this impact.

Micro-Wind is increasingly under the spotlight. With UK politicians seeking to install wind turbines on their homes, and Windsave micro-wind turbines now on sale to the public through do-it-yourself stores across the country, there's more and more awareness of rooftop wind turbines. According to Delta market research homeowners – particularly those green credentials to maintain – show a positive attitude to such products. But, in Delta's view, a number of questions need to be resolved before the potential for putting micro-wind turbines on houses is fully understood. A critical question relates to the wind resource over rooftops and the amount of energy turbines are likely to produce, as illustrated in *Figure 2* on the previous page.

Many developers use 5 m/s as a typical rooftop wind speed, but taking account of the complex wind flows over buildings, coupled with examining wind speed data suggests in some cases mean wind speeds will be lower with annual electricity output well under 1,000 kWh per year. Delta's Micro-Wind Multi-Client Study, available for purchase, explores global micro-wind developments and prospects for the UK micro-wind market.

Photovoltaics, compared to micro-CHP and micro-wind, is a mature technology. The PV market has grown at an outstanding rate in recent years, doubling in size every two years. Germany has been the engine behind this growth, with the PV industry now expecting new incentives in California and Spain in particular continuing to drive growth.

Global markets are expected to rise from around 2 GW in 2006 to a 2010 figure of 5-6 GW according to equity analysts, with some optimists gunning for 8 to 10 GW or more by the end of the decade. Although costs have actually risen in the last few years, partly due to growing competition for silicon, there are excellent prospects for cost savings across the value chain and significant price reductions.

Figure 3: Flexible Photovoltaics on a U.S. Rooftop

United Solar manufacturers thin film photovoltaic modules. Their products are flexible as they are deposited on a thin steel – rather than glass - substrate.

This picture shows their Premier Solar Flat product which is a self-ballasted and detachable PV solution.

One of the leading thin-film manufacturers, annual production capacity of 28 MW is just a fraction of companies such as Sharp and Kyocera. However forecasts estimate the annual thin film market at close to 1 GW in 2010.

Source: United Solar

Exciting new technologies are set to emerge on the PV market. Thin-film technology is expected to have costs significantly lower than crystalline silicon technology that currently dominates the market. Several companies are planning to join the likes of United Solar in producing flexible thin-film modules that can be literally rolled out onto rooftops (as shown in *Figure 3* above).

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Another promising area is solar concentrators, with mega-watt scale systems promising to be cost competitive with conventional power generation (in areas with high solar radiation) early in the next decade. Delta has recently provided an investor with an in-depth analysis of the photovoltaic industry status and prospects.

To summarise, micro-generation may just be a dot on the power generation landscape today, but it will certainly become a larger and larger feature in the future. Understanding how big it will become, the rate at which it will develop, which technologies will win (and which won't), the impact on energy businesses and strategies to adopt will become increasingly important to the energy sector. Delta's views on the prospects of each of the technologies discussed in this brief are as follows:

- Micro-CHP is a potentially mass market technology. Increasing utility, boiler manufacturer and investor engagement, coupled with more products nearing commercialisation, point towards significant markets developing in a number of countries.

- There is a clear appetite for building-mounted micro-wind products, particularly in the UK. Whilst such products are emerging, their performance is not yet fully understood. A market for such products will develop but may be smaller than the mass market expected by some.

- Photovoltaics will continue to surf the growing wave of subsidy and incentive schemes with markets continuing to rapidly expand. New technologies and lower costs will help existing markets to grow. Large concentrator systems are a strong candidate for the first application to be economically viable without subsidy.