MICRO-CHP: GLOBAL INDUSTRY STATUS AND COMMERCIAL PROSPECTS

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ABSTRACT

This paper presents the current status of micro-CHP markets worldwide – specifically in Japan, Europe and North America. Information current market size, product availability and commercial players is discussed. Headlines are as follows: approximately 16,000 units were sold worldwide in 2005, with a total market value of €135,000,000. The Japanese market currently accounts for over 75% of the market (by unit sales). Currently four micro-CHP manufacturers have product available for sale, with two additional manufacturers taking orders for product to be delivered in 2006.

The commercial outlook for micro-CHP through to 2010 is analysed. Markets for products already on the market are expected to continue to show strong growth. There is excitement – but also uncertainty – about the potential for exponential growth in micro-CHP markets. Such growth will primarily be due to the market introduction of new micro-CHP products suitable for single-family homes. Expectations for growth in Japan, Europe and North America are discussed, together with the factors that may drive or constrain these markets.
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1. INTRODUCTION

Micro-CHP sales are still a still a dot on the power generation landscape. In 2005 worldwide micro-CHP installations amounted to some 31-MW of installed capacity, up from 25-MW in 2004, with just four companies having product available for market. This alone is not impressive in terms of scale or growth. The interest in micro-CHP is not so much around markets and growth today, but about the explosive growth possible in the next three to five years.

This paper examines the current status of micro-CHP markets across the world (primarily in the U.S, Europe and Japan) together with the commercial prospects through to 2010. Delta Energy & Environment defines micro-CHP as generating less than 6-kW of electricity, with these products typically suitable for single-family homes and multi-family homes.

2. MICRO-CHP MARKETS AT THE BEGINNING OF 2006

Delta estimates that some 16,000 micro-CHP units were sold in 2005. Japan accounts for around 77% of these sales through the ECOWILL unit and Yanmar's Genelight unit. The German market contributes 17% of these sales, through the SenerTec DACHS unit and Power Plus Technolgies' Ecopower unit. Other markets include the UK (3%) and other European countries.

The value of these markets is estimated to be €135,000,000, up from €112,000,000 in 2004. Companies with product available for sale and delivery in 2005 are shown in Table 1 below.

Table 1: Global Micro-CHP Product Sales in 2005

<table>
<thead>
<tr>
<th>Electrical output (kW)</th>
<th>Unit sales in 2005</th>
</tr>
</thead>
<tbody>
<tr>
<td>SenerTec (owned by Baxi)</td>
<td>5.5</td>
</tr>
<tr>
<td>PowerPlus Technology (owned by Vaillant)</td>
<td>4.7</td>
</tr>
<tr>
<td>Honda and partners</td>
<td>1.0</td>
</tr>
<tr>
<td>WhisperTech</td>
<td>1.2</td>
</tr>
<tr>
<td>Yanmar</td>
<td>5.0</td>
</tr>
</tbody>
</table>

Note 1. Estimated out-turn for financial year 2005-6

Japanese Markets

In Japan the ECOWILL product continued to sell well, with most major gas companies offering the product to housing developers and homeowners, with the notable exception of Tokyo Gas. Annual sales for 2005 increased by around 25% compared to 2004. Yanmar made steady progress with it's Genelight product, increasing sales from about 300 to 340 units (figures based on financial year 2004 and financial year 2005). This product is typically sold to small businesses such as restaurants. Other CHP products in the 6-kWe to 10-kWe range sold in Japan include those from Aisin Seiki and Sanyo.

All of these products currently sold in the Japanese market are based on internal combustion engines. Japanese manufacturers have successfully controlled noise and emissions to acceptable levels, and have extended servicing requirements to long intervals. For example the Honda engine at the heart of the ECOWILL system only requires servicing
every 6,000 hours of operation (typically three years). Yanmar’s unit has even longer service intervals at 10,000 hours.

**European Markets**

In Germany SenerTec continues to successfully sell its DACHS micro-CHP product, with much of the sales growth in 2005 coming from the single-family and two-family home market. Annual sales increased by around 22% to 2,750, with the German market accounting for over 90% of these sales. Rising electricity prices helped to stimulate sales, as did continued strong marketing and sales activity through SenerTec’s network of regional SenerTec centres. SenerTec is owned by Baxi Group, one of Europe’s five largest boiler manufacturers. Vaillant, also one of Europe’s top five boiler manufacturers, owns Power Plus Technologies, which offers the Ecopower micro-CHP product. Sales of this product increased by 25% to 400 units, again with the German market accounting for over 90% of these sales.

The DACHS and Ecopower units are also both built around internal combustion engines. Noise and emissions, as with the Japanese engines, are controlled down to acceptable levels, although service intervals are less than the Japanese engines, stated at 3,500 hours to 4,000 hours respectively.

Elsewhere in Europe most other micro-CHP activity focussed on the UK, where electric and gas utility E.ON-UK offered Whisper Tech’s WhisperGen micro-CHP unit to households and housing developers. Current activity is more akin to a market trial rather than a commercial launch. E.ON-UK’s current objectives appear to be to build a solid base for a mass launch of their system through establishing an installation and servicing network, and learning about installation, sales and marketing issues. Actual installations lagged sales in 2005, with relatively small numbers (less than one hundred) of units actually installed, although E.ON-UK reports much higher levels of sales.

The WhisperGen unit is designed to be installed inside a home (possibly even in living space such as the kitchen), with servicing requirements identical to a conventional boiler.

**North American Markets**

Two new micro-CHP manufacturers – both based in Germany - started taking orders for micro-CHP products in 2005, although none of these were available for installation until 2006. Otag took orders for it’s 3-kWe steam-driven LION micro-CHP product, which is designed for single family homes. Otag report already selling 600 units, their entire planned manufacturing run for 2006. Sunmachine sold distribution licences for it’s 3-kW biomass fuelled Stirling engine in 2005, and at the beginning of 2006 reported selling 70 licenses and over 1,000 units for delivery in 2006.

In North America activity was more muted in 2005. Vector Cogen, who had brought a 5-kWe micro-CHP product (built around a Kawasaki internal combustion engine) to market in 2004, closed their doors to business. Marathon Engine systems continued to plan to bring the Ecopower product to the U.S, and Climate Energy unveiled a micro-CHP prototype based on Honda’s internal combustion engine, to be launched in 2006.

**3. COMMERCIAL PROSPECTS FOR MICRO-CHP UP TO 2010**

Micro-CHP markets promise to take off, possibly with exponential growth in the next four years. The exact timing that this may happen is not clear, partly due to the uncertainty about product developers plans to commercialise their micro-CHP products. In this section we analyse the commercial prospects for micro-CHP in the U.S, Europe and Japan.

**Commercial Prospects in Japan**

Japanese micro-CHP markets are likely to continue to develop on two fronts. On one hand the market for the ECOWILL product is expected to continue to grow strongly,
particular with Tokyo Gas starting to sell the unit from the beginning of 2006. The Government target for financial year 2006 is for 22,000 systems to be sold. We expect to see gas utilities continuing to aggressively market this product, with this activity partly driven by an electric utilities marketing of all electric homes. By 2010 expectations of Government and gas trade associations are that in the region of 200,000 units will have been sold.

On the other front, fuel cell systems are currently the focus on intensive research, development and testing in Japan. In 2005 Tokyo Gas and others started offering fuel cell micro-CHP systems to homes through leasing packages. This is not termed as commercial sales, as the activity is more similar to a large scale field trial rather than the widespread launch number of product for purchase by customers. By the end of 2005 Tokyo Gas had installed 100 fuel cell micro-CHP systems, and had the target of reaching 200 installations by the end of March 2006. In total the Government expects 400 such systems to be installed by March 2006. Manufacturers of the fuel cells include Ebara Ballard, Matsushita, Toshiba and Sanyo.

Tokyo Gas and others are targeting a mass-launch of fuel cell micro-CHP systems in 2008, with the target of selling thousands of units a year. However further progress is necessary to reduce costs and improve lifetime in order for these targets to be met. It remains to be seen whether the necessary progress will in fact be made. If targets are reached, it is possible that in the period 2008 to 2010 several thousand fuel cell micro-CHP systems will be sold.

The overall market environment in Japan for micro-CHP is very favourable. Government support, together with gas utility action and investment, is leading to strong micro-CHP growth and development of new products – both PEM and solid oxide fuel cells. Japan is likely to continue to be the leading micro-CHP market in the world through to 2010.

Commercial Prospects in Europe

Micro-CHP markets in Europe currently are dominated by 5-kWe products sold into the German market. Whilst these markets are showing steady growth, it is unlikely that sales will rise above 5,000 to 10,000 units a year for these products by 2010.

Perhaps of greater interest is the emerging market for 1-kWe to 3-kWe sized products, designed for single-family homes. The initial markets for these products are likely to be the UK, Netherlands and Germany. This market is currently constrained by three issues:

- Product availability
- Engagement by utilities and boiler manufacturer
- Regulatory barriers and issues

A large number of companies are developing micro-CHP product for the European market, with several of these hoping to commercialise product in 2007 or 2008. Developers include:

- Microgen Energy Ltd, developing a 1-kWe Stirling engine micro-CHP system. They are planning field tests in the UK and the Netherlands (and possibly Germany) in 2006, with commercial launch in 2007. They have teamed up with boiler manufacturer Remeha to commercialise the product.

- ENATEC, developing a 1-kW Stirling engine micro-CHP unit. They have a manufacturing agreement in place with Japanese gas appliance manufacturer Rinnai, and plan to license their technology to boiler manufacturers for integration into their products.

- Stirling Systems Ltd, also developing a 1-kW Stirling engine micro-CHP unit. They currently have several units on field trial, which will run during 2006. Commercialisation is possible an estimated 1-2 years later, perhaps in 2008.
- Baxi, one of Europe’s leading boiler manufacturers, developing a 1-kWe organic Rankine cycle micro-CHP unit, which they target commercialising by 2008.

- Honda, working to commercialise their 1-kWe internal combustion engine in a package suitable for European homes.

Additionally other companies hope to commercialise product by 2010. These include Micro Turbine Technology, and perhaps fuel cell developers such as Hexis, Ceramic Fuel Cells, European Fuel Cell, Plug Power/Vaillant, Viessmann and Ceres Power – although it is by no means yet clear whether these fuel cell developers will achieve true commercialisation by 2010.

Utilities interest in micro-CHP in Europe is still patchy. In the UK E.ON-UK are leading the market by offering the WhisperGen unit to households. Of the other six major utilities involved in electricity and gas retail, Centrica have a heads of terms agreement with Microgen, and an agreement with Ceres Power. There are signs that some of the other four utilities may follow these two utilities in offering micro-CHP products to customers. But they face significant challenge in developing a brand in the heating business and building up an installation and servicing infrastructure.

In the Netherlands gas wholesale company Gasunie Trade and Supply is encouraging the development of the Dutch micro-CHP market. They have sponsored a field trial of WhisperGen units, involving most of the electricity and gas retail companies. They are also working with Microgen to develop a combi-version of their micro-CHP product. Although the Dutch electricity and gas retailers are currently very focussed on the opening of electricity and gas residential markets, there are signs that at least one, and possibly more, are keen to offer micro-CHP products to their customers.

The situation amongst German utilities is harder to read. Several have been involved in, and a number continue to be involved in, fuel cell micro-CHP field trials. However only a few are also testing other micro-CHP technologies that are arguably nearer to market than fuel cells. With fuel cell micro-CHP products unlikely to be commercially available much before 2010 (if at all), it will be interesting to see the degree to which German utilities engage with other forms of micro-CHP.

The engagement of European boiler manufacturers is important as:

- A number of boiler manufacturers are developing their own micro-CHP products, or are working with technology developers to develop a micro-CHP product.
- Independent micro-CHP product developers (such as Whisper Tech and Microgen for example) will need the manufacturing capability of boiler manufacturers to help them commercialise their micro-CHP products.
- Some micro-CHP technology developers such as ENATEC and Micro Turbine Technology have a business model to licence their technology to boiler manufacturers, so they need to see interest from boiler manufacturers in order for their technology to reach the marketplace.

The degree to which European boiler manufacturers further engage in micro-CHP is not yet clear (all have at least some micro-CHP activity at present), and this area should be closely watched.

Finally in Europe, regulatory issues need to be resolved in order for micro-CHP market to develop. There are no major issues, but minor issues are capable of acting as significant barriers to the development of micro-CHP markets. Activity is already underway in the UK, Netherlands and Germany to resolve these issues, and it is likely just a matter of time before they are resolved.

Commercial Prospects in North America
The North American market is, generally, a more challenging market for micro-CHP. This is due to low electricity prices in much of North America, resistance (in the form of interconnection arrangements and tariffs) from electric utility companies, the penetration of low cost warm air furnaces rather than the boilers found in Europe and Japan, and a greater focus on local air pollutants rather than greenhouse gas emissions.

However modest micro-CHP activity is likely in the next few years in North America. Climate Energy is field testing their Honda engine-driven micro-CHP product in winter 2005-6, with a target of launching commercial sales later in 2006. Marathon Engine Systems, manufacturers of the engine at the heart of the Ecopower micro-CHP system sold in Europe, are also expected to launch their product in 2006 or 2007. But both of these products are likely to play initially in niche markets, at least for the first few years of availability.

Some of the major HVAC manufacturers – AO Smith, Trane, UTC Corporation, are involved in micro-CHP research projects, as is the Gas Appliance Manufacturers Association. The degree to which they take forward these plans to develop micro-CHP products will have a big impact on if and when micro-CHP moves out of niche markets in North America.

4. CONCLUSION

Micro-CHP sales are likely to continue growing strongly over the rest of the decade. From 2008 there is the chance that an inflexion point may occur in market growth, leading to very rapid growth as new products suitable for mass-markets become available.

Japan is likely to continue to be the world’s leading micro-CHP market. The major point to watch here is whether fuel cells have been sufficiently developed to be widely commercialised in 2008.

In Europe there is more uncertainty. Niche micro-CHP markets are currently showing steady growth, but there is the potential for explosive growth if new micro-CHP products suitable for single family homes are brought to market and utilities and boiler manufacturers aggressively push micro-CHP to customers.

North America has lagged these other two markets, and is expected to continue doing so. Micro-CHP is expected to establish itself in niche markets over the next few years. More aggressive growth is possible towards the end of the decade if HVAC manufacturers engage more firmly with micro-CHP, and other barriers are removed.
Table 1: Global Micro-CHP Product Sales in 2005