

Toward New Technologies for the Gas Market

By Jean Schweitzer and Thorsten Formanski

Micro cogeneration (μ CHP) is an important technology for the gas industry as it allows natural gas to remain a competitive energy source for the home of tomorrow. Traditional gas-fired heating boilers will play a declining role in the residential sector as new energy saving regulations demand greater efficiency, and improved insulation standards reduce the demand for heat.

With this in mind and on the initiative of IGU's Working Committee 5, Marcogaz and GERG, organisations that are committed to the development of new gas technologies, a workshop was organised on May 29 and 30 in the premises of Gaz de France R&D in Paris, France. The goal of the workshop was to gather together the main actors from the gas industry, manufacturers and European authorities in order to define a gas

WHAT IS MICRO CHP?

CHP is combined heat and power generation through appliances that can be based on different technologies. Micro CHP designates applications targeting the domestic residential sector. More information can be found at: www.gerg.info/publications/brochure_asue.pdf.

industry strategy to facilitate the development and integration of μ CHP technology.

The workshop was organised by a steering group (see *Table 1*) led by Daniel Hec, Secretary General of Marcogaz, and Jean Schweitzer, Manager for International Projects at the Danish Gas Technology Centre (DGC), who are both active in IGU work: Jean Schweitzer as Chairman of WOC 5 and Daniel Hec as a member of several committees.

Special thanks are due to Marcogaz for taking on the administration of invitations and registra-



The first session was addressed by Guido de Wilt of DG TREN (LEFT), Stephan Ramesohl of E.ON Ruhrgas (CENTRE) and Marc Florette of Gaz de France (RIGHT). Daniel Hec of Marcogaz was the workshop moderator (INSET).

RIGHT, BELOW RIGHT AND BOTTOM RIGHT
The workshop was attended by 80 invited participants (RIGHT) and a showroom was open throughout the two-day event (BELOW RIGHT AND BOTTOM RIGHT).



BELOW LEFT
Table 1.

tions as well as the chairing of the workshop, and to Gaz de France for the practical organisation of the event. The sponsors were Gaz de France, GasTerra and GERG.

The workshop was restricted to 80 invited participants and was a great success as evidenced by the wide-ranging and animated debates. Real appliances were presented in the showrooms during the duration of the two-day event. From the initial feedback received from the participants it seems that they were unanimously impressed by:

- The high quality attendance (including representatives of the European Commission, Japanese and US experts, the European Association for



STEERING GROUP MEMBERS

- Daniel Hec (Marcogaz)
- Jean Schweitzer and Jan de Wit (Danish Gas Technology Centre/IGU)
- Henk Ensing and Hans Overdiep (GasTerra)
- Thorsten Formanski (ASUE/IGU)
- T. Williams (Advantica/GERG)
- D. Pinchbeck (GERG)
- P. Mela and P. Canal (Gaz de France)



the Promotion of Cogeneration (COGEN Europe), leading manufacturers and managers, researchers and decision-makers from the main EU gas companies);

- The high standard of presentations made by leading experts in the field of μ CHP; and
- The excellent organisation by Gaz de France.

The workshop produced a valuable summary of the state-of-the-art of the technology and of the different on-going projects worldwide. One of the aims was to initiate common action to accelerate the integration of the new technology into the market. This target was achieved: together with the manufacturers, the gas industry agreed to take action and the ideas discussed at the workshop will soon turn into collaborative projects within the EU and also worldwide.

The workshop was organised into five different sessions including one dedicated to manufacturers.

● **Setting the scene**

The introductory session was chaired and opened by Marc Florette (Director of Gaz de France R&D).

He demonstrated that μ CHP is competitive even in countries like France with relatively cheap production of nuclear electricity.

Stephan Ramesohl (E.ON Ruhrgas) outlined the positive impact of μ CHP and the opportunity it represents for the gas industry to maintain the role of gas in the residential sector. In Germany due to the new regulations, he said, a condensing gas boiler is no longer an option and gas either has to be combined with renewables or be used in new technologies like μ CHP to have a chance in the market.

Guido de Wilt (European Commission Directorate-General for Energy and Transport – DG TREN) emphasised that for the Commission primary energy savings and reductions of greenhouse gas emissions are the leading principles. Therefore, the Commission will not promote a given technology as such or prefer one fuel over the other. In order to realise the potential for μ CHP, he invited the industry to make the best possible use of the existing tools that are available in the EU. These include: Directives on CHP (including guarantee of origin and national potentials in the Member States), eco-design, labelling, the energy performance of buildings (being revised), energy services and end-use efficiency (including national energy efficiency action plans), and financial support through various programmes such as Intelligent Energy Europe and the Strategic Energy Technology Plan.

● **Gas industry activity**

Chaired by Jean Schweitzer (DGC/IGU), this session sought to list current activities in the field of μ CHP in the gas industry to facilitate collaboration and synergies. There were eight presentations (see Table 2) including valuable input from two leading countries for μ CHP outside Europe: Japan and the USA.

The fuel cell introduction programme of Japan is an example of how the integration of the tech-

BELOW
Table 2.

PRESENTATIONS IN SESSION "GAS INDUSTRY ACTIVITY"

- 1 The Japanese experience
K. Nishizaki (Tokyo Gas Co.)
- 2 The Netherlands
H. Overdiep (GasTerra) and H. Sijbring (Smart Power Foundation)
- 3 The UK
M. Orrill (British Gas)
- 4 Germany
M. Wilmsmann (E.ON Ruhrgas) presented by S. Ramesohl
- 5 French field tests
D. Le Noc (Gaz de France)
- 6 Denmark: Gas industry support to fuel cell development
J. de Wit (DGC)
- 7 USA: μ CHP as a strategic business tool in the US
S. Bernstein (National Grid)

SPEAKERS AT THE SESSION ON GAS INDUSTRY ACTIVITY



Jan de Wit of DGC



Kunihiro Nishizaki of Tokyo Gas



Martin Orrill of British Gas



Henk Sijbring of Smart Power Foundation



Sam Bernstein of National Grid



David Le Noc of Gaz de France

nology is possible when the government, gas industry and manufacturers are working together toward the same goal. The presentation of Kunihiro Nishizaki (Tokyo Gas Co.) highlighted the high motivation of the local gas industry in pushing μ CHP both in the development phase and integration phase to get the products into the homes of consumers.

At the present time, most of the work is being carried out at national level without coordination

between the different initiatives. The type of projects and degree of effort vary from country to country. While Japan is looking into the long term with heavy support for fuel cell technology, European industry seems in general to be looking at the shorter term with e.g. Stirling engines. However, the picture is not quite that clear-cut as there are European initiatives in, for example, fuel cell development (in Denmark) and energy service with μ CHP (in the UK).



It was also interesting to see that, in some countries, the whole industry has chosen to federate efforts. Examples include the Smart Power Foundation in The Netherlands and the Combined Heat and Power Association (CHPA) in the UK. But again this cooperation is at the national rather than international level.

One of the main activities of the gas industry in supporting the technology is via field tests (to evaluate if the appliance is mature to enter the market), and while such national activities in Denmark, France, Germany, Japan, The Netherlands and the UK, were outlined in various presentations, there was no form of coordination.

The presentations outlined a number of ways for the gas industry to support manufacturers:

- Helping to make sure that μ CHP technology is within the EU research policy and programmes;
- Helping with the development of standards;
- Demonstrating appliance qualities (such as low CO₂ impact), modelling and performance assessment;
- Informing the customer and developing marketing tools;
- Working to offer affordable packages for installed appliances; and
- Helping to develop a network of installers and training.

R&D and laboratory assessment/evaluation of the appliances (for safety and performance) are

also undertaken in some countries. However, in many instances, the gas industry is reluctant to help a specific manufacturer and to give him a commercial advantage over competitors.

● Conditions for the success of μ CHP

Five presentations were made during this session (see Table 3), which was chaired by Henk Ensing (GasTerra).

To succeed in developing the market it is not sufficient for appliances to be available, reliable and cost effective, we also need to ensure that the overall operating environment is ready. What will be the requirements for the installation and installers? Will traditional gas installers do the job? Will available units cover heat, hot water and power for houses? Or will there be a need for additional/backup traditional gas appliances as well? Connection to the grid raises many questions, as does product certification. Which European Directives do μ CHP products have to meet to obtain the "CE" mark?

It is possible today to get a CE mark for the commercialisation of μ CHP in the EU. However, the basis for getting the mark is far from being clear. Many Directives are relevant to μ CHP and many standards can apply, so clarification to avoid duplication of norms would be very useful. Also the standards for the performance evaluation of the appliances are missing (e.g. for the application of the Eco-design Directive). It was stressed that those

BELOW
Table 3.

PRESENTATIONS IN SESSION "CONDITIONS FOR SUCCESS OF μ CHP"

1	Certification of μ CHP appliances: What is the present situation? Standards, CE marking	F. Thuis (Kiwa Gastec)
2	Commercial and marketing aspects: How do we convince the users to invest in μ CHP?	H. Ensing (GasTerra)
3	Interactive website presenting technologies and products	T. Formanski (ASUE)
4	Connecting μ CHP to the grid: Challenges, advantages, costs? (European Distributed Energy Partnership project)	J. Deuse (Tractebel)
5	Subsidising μ CHP: What is the situation? Impact of different models	A. H. Pedersen (DONG)



Henk Ensing of GasTerra chaired the session on conditions for the success of μ CHP (ABOVE LEFT) and Jacques Deuse of Tractebel gave one of the presentations (ABOVE RIGHT).

should comply with the existing procedures for the testing of e.g. condensing boilers. Guido de Wilt informed the session that the Commission will issue a mandate to the European Committee for Standardisation (CEN) to tackle the issue of measurement methodology for energy efficiency in μ CHP.

Different models of subsidy were also presented and it is clear that support from government would help as it did for the introduction of the condensing boiler. Rather than waiting for public support to materialise, however, some manufacturers preferred to develop appliances with competitive prices and performances on their own account.

The Commission stated that it does not support specific categories of appliances like μ CHP, but it certainly allows Member States to use instruments (such as financial support and building regulations) that will lead to energy savings and emissions reduction through μ CHP. Indeed, governments can influence the economic balance of μ CHP technology by acting on CO₂ emission taxes and the electricity feed-in tariff. There are technical and cost issues in connecting appliances to the grid but they can be offset if the feed-in tariff is set at a level that offers a strong incentive.

During discussion of the CO₂ emission issue the fact that μ CHP will operate in the non-regulated sector of CO₂ certificates was highlighted. This means that there needs to be some transfer mechanism so that credit for reductions in domestic CO₂ emissions may be taken for production in the regulated sector or sold elsewhere. Support for μ CHP could also be linked to guarantees of origin for CHP appliances under the CHP Directive.

Marketing was also on the agenda with presentations from GasTerra and ASUE. More and more consumers want to show that they are green and μ CHP might not be as visible as solar panels on a roof. Here also, guarantees of origin as available under the CHP Directive (possibly linked with green certificates) could be useful. Some customers are also conscious of the argument that μ CHP gives them a degree of energy independence. In Germany, efforts are being made to find a different name to describe the technology as the term “ μ CHP” was thought to be too obscure for many customers.

● μ CHP – state of the art

Chaired by Thorsten Formanski (ASUE), the aim of this session was to shed light on the state-of-the-art of the technology and the current market status of μ CHP systems. One overview presentation and several presentations given by manufacturers of μ CHP units answered many questions and brought workshop participants up to speed in these areas.

Dr Formanski presented the benefits and the state-of-the-art of μ CHP, the current market situation and the requirements for μ CHP units, especially of the 1 kW electrical (kW_{el}) class. Reliability, reasonable pricing, easy handling and installation in newly-built and existing buildings together with convenient operation for the end-user are the key requirements. Honda’s 1 kW_{el} “Ecowill” system with more than 60,000 units sold in Japan and Senertec’s 5 kW_{el} “Dachs” with nearly 20,000 units sold in Europe are the current market leaders.

APPLIANCES



Appliances made by Baxi (FAR LEFT), Remeha-De Dietrich (SECOND LEFT), Gennex (THIRD LEFT), and WhisperGen (LEFT).

There are also several developments based on internal combustion engines, Stirling engines and fuel cell technology underway, which are either close to reaching the market or offer potential in the near future. Generally speaking, given the potential for μ CHP systems and the interest of the customers, the market needs reliable systems for a reasonable price supported during the market introduction by all involved groups.

Guido Gummert (Baxi Innotech, Germany) presented the whole range of products with the available "Dachs" system, the Stirling engine based "Ecogen" system and the fuel cell development with the current beta field test unit. Gummert mentioned that a pre-series of the "Ecogen" is expected for 2009. For the fuel cell development the market introduction is scheduled for 2013.

Marco Bijkerk (Remeha, The Netherlands) presented the combi boiler with a Stirling engine, which is based on the former Microgen development as are the developments of Baxi and Viessmann. The commercial availability of the 1kW_{el} and with the integrated condensing boiler up to 28 kW thermal output system is scheduled for 2009.

Meanwhile, 500 units of the Bosch Thermotechnology Stirling system are being field tested in

Germany, The Netherlands and the UK, according to the company's Gary Mitchell. The tests will run to 2010 and, if successful, roll-out could start in 2011.

WhisperGen, the Stirling engine based system which is closest to the market, will be manufactured in Spain under a joint venture of WhisperGen, New Zealand and Mondragon Cooperative Corp., Spain, said Len Damiano from WhisperGen. After intensive testing and system improvement over several generations production is now starting. Damiano was one of the speakers who pointed out that the setting of fair and collective standards will be a common challenge for manufacturers and all interested parties.

Bob Flint, CeresPower, UK and Brandon Bilton, CFCL Europe, UK, presented the solid oxide fuel cell (SOFC) development of their companies, the current technical status and future activities in order to bring their products to the market. They also described the alliances and the partners who will support them during development, field testing, production planning and preparation of manufacturing.

Per Balslev, Danfoss, Denmark, described a joint demonstration project by fuel cell manufacturers, energy companies and component manufacturers to test low and high temperature fuel cell-based



Ian Manders of CHPA (ABOVE LEFT) and Fiona Riddoch of COGEN Europe (ABOVE RIGHT) introduced the Round Table session.

μ CHP systems for private homes. Both the operation in a single-family house and the connection/interaction of different μ CHP systems are aspects of the project.

The session showed that more and more μ CHP systems are getting close to market entry so that in the near future μ CHP could be an alternative for the customer. In order to be successful the systems must fulfil different requirements regarding the specifications, installation and operation. In addition, all manufacturers pointed out that fair standards must be set, with respect to national circumstances, and different kinds of support have to be given to ensure a smooth market introduction of μ CHP systems within the next few years.

● **Key points from the Round Table**

The Round Table session aimed to summarise the results of the workshop. It was introduced by Ian Manders (CHPA) and Fiona Riddoch (COGEN Europe), who emphasised the importance of prioritising energy efficiency and energy saving in a debate where renewables were discussed at many occasions during the workshop.

The Round Table chaired by Daniel Hec was organised with the participation of G. de Wilt (DG TREN), F. Riddoch (COGEN Europe), D. Hec (Marcogaz), J. Schweitzer (DGC, representing IGU and GERG), H. Sijbring (Smart Power Foundation) and S. Bernstein (National Grid).

From the discussion, a number of pragmatic suggestions were made in order to solve some of the problems identified:

- A fair methodology to establish performances is needed (energy efficiency, energy savings, CO₂ savings etc.) to bring some consistency to the information on performances given for the appliances. This could be done very soon with the knowledge and experience already available.
- No appliance can be put on the market without respecting the safety requirement of the Gas Appliance Directive. In that regard a standard is being prepared (by the CEN/European Committee for Electrotechnical Standardisation Joint Working Group on Fuel Cell Gas Heating Appliances chaired by Jörg Endish) and the industry should support the work by sending experts to the group.

- In order to execute a mandate to assess performances of μ CHP appliances, pre-normative studies will be undertaken to adapt the testing procedure to the specificity of the appliances, and it was recommended that existing expertise from laboratories within the networks LABNET and LABTQ be drawn upon.
- Standardisation work should be clarified and harmonised which seems not be the case today. To a certain extent this will also apply to Directives and a clarification of which Directives apply to which products would be useful.
- μ CHP is typically sold by installers; new business models may be needed.
- The industry is demanding field tests. The gas industry could coordinate those tests at EU level through GERG. Collaboration with the Japanese Gas Association could be possible on this topic as well as on measurement and testing aspects.

In order to coordinate the action needed to promote μ CHP efficiently, it was decided to establish a joint μ CHP voice/representation for dealing with the EU. Marcogaz will soon take the initiative and send an invitation for a meeting to organise this with delegates representing manufacturers, the gas industry, Notified Bodies, laboratories and associations dealing with the topic. A preliminary list of topics that could be included in the programme is given in *Table 4*.

● **Conclusions of the workshop**

The main feeling at the workshop was that the whole industry was highly motivated to introduce the technology into the market. The fact that gas sales are decreasing in important markets is making μ CHP technology more important than ever. Even though μ CHP is still costly compared to alternative technologies, there is a clear potential for improvement and the Japanese model shows that it is economically sustainable. Moreover, there is a new young industry with products that

are already available and also with a lot of new products to come.

μ CHP, therefore, seems to have a promising future. Fuel cell technology can also be a technological bridge from natural gas to renewables, when in the long term natural gas may gradually be replaced by hydrogen produced by cheap renewable sources.

The workshop was a first initiative for a global and common action within the gas industry associating all partners. This action will now continue with the above-mentioned joint representation.

All communications and papers can be downloaded from www.marcogaz.org.

Jean Schweitzer is the Chairman of IGU's Working Committee 5 and prepared the bulk of this report. Dr Thorsten Formanski of the German Association for the Efficient and Environmentally Friendly Use of Energy (ASUE) contributed the section "μCHP – state of the art".

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Table 4.

TOPICS FOR PROGRAMME TO PROMOTE μ CHP

Technical

- R&D
- Demo
- Sharing information.
- Establish courses and training
- Pre-normalisation
- Models, calculation of CO₂ impact of μ CHP compared to traditional heating etc.

Standards and regulations

- Development of standards
- Harmonisation/coordination of relevant standardisation activity

Marketing

- Offering packages for installed appliances to customers
- Integrating μ CHP in energy service? (energy services company – ESCO)
- Incentives
- Raising awareness/identifying a message

Coordination lobby

- Follow up and lobby, representation