

# CHP – A Revolution in the Making

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## Introduction

Liberalisation, globalization, climate change – all are concepts that are causing people to think differently. How we produce and use energy is a feature of this. Internationally, the challenge is to cut greenhouse gas emissions; locally the challenge is to meet customers' needs flexibly and effectively. The goal is to do both competitively and creatively.

Thinking differently is not just about policy – it is also about technology. The shift from big to small, from corporate supplier to consumer. In the USA this is happening, in Europe it is underway. In the UK we have learnt a lot and a new wave of policies is now coming through following the election of the new Labour government in 1997.

A whole raft of important Government-led energy policy reviews have either reported or are still ongoing: reviews of energy sources for power generation; regulation of the utilities; new economic instruments (including a potential tax on the business use of energy) to encourage energy efficiency; and reform of electricity trading mechanisms. Meanwhile we are also seeing the completion of UK's electricity and gas market liberalisation and the country's first combined *energy* Regulator has just completed his first six months in office. This is also the year in which the Government is consulting on the details of its Climate Change Programme.

Meanwhile, in Europe earlier this year the first steps were taken to implement a European Commission directive to create a single market for electricity across the continent. Last year the European Union set a target to double the proportion of European electricity generated by CHP from 9 to 18% by the year 2010, and the US has echoed this with its own target to double CHP by 2010.

However. Before examining these measures in detail, I do want to put the case for combined heat and power (CHP) in the wider context of the environment, and consider why the business and political case for CHP is so strong.

## Climate Change

Progressive industry sectors, sustainability groups and many governments agree that there is no longer much doubt that climate change is real, is beginning to be seen and needs tackling now with practical programmes of action. The main manifestation of climate change is predicted to be not a warmer planet, but more frequent and more severe peak weather events.

European Governments are agreed that, to limit the effects of climate change, the main challenge is to cut emissions of the main greenhouse gas - carbon dioxide. The main source of carbon dioxide in the industrialised world is the energy industry, particularly electricity generation. In the UK, for example, power stations are the largest source of emissions of carbon dioxide, responsible for a third of the overall total.

Traditionally, policy-makers have identified improving the energy efficiency of a nation's buildings and industries as being the main way of reducing energy use and thus tackling climate

change. Historically the USA has been held up by many commentators as showing the way ahead through regulator-driven measures such as demand side management (DSM). Yet, as the trend towards liberalised energy markets sweeps across the globe new initiatives, outside of the confines of purely regulatory solutions to energy efficiency, will be needed.

In the long-term, climate change will have to be tackled by a combination of improved energy efficiency and the use of carbon-neutral sources of energy such as renewables. However, transforming developed energy economies in this way will take decades and there is much that we could be doing today to reduce the environmental effects of a fossil-fuel dominated energy economy.

## Raising Efficiency

Industrialised countries around the world continue to allow their power plants to waste as much as two-thirds of the energy they consume, undermining even the most effective end-use energy efficiency achievements. Fossil-fuelled power stations typically throw away between half and two-thirds of the energy content of the fuel they burn - pumping warm water into cooling towers where vast quantities of heat are discarded to the atmosphere.

These power stations - typically very large and sited well away from their energy users (itself a cause of energy losses) - belong to an age when it was acceptable to operate at efficiencies less than 50% as fuel was so cheap.

Now we have begun to recognise the *environmental* cost of such wastage and, as countries begin to liberalise their generation markets, major commitments have been made to the development of new, combined cycle gas turbine power plants (CCGTs). However, despite the enthusiasm of their advocates, CCGTs are only around 45-55% efficient, and, in the UK at least, the Government has taken steps to slow down their development.

Increasingly we need to find another way forward - one which complements the benefits of regulatory actions such as DSM but also responds effectively to the drive for liberalised markets. We need the much talked about 'third way' of the New Labour - New Democrat political axis.

## CHP at Work

Combined heat and power (CHP) is a practical manifestation of the third way for energy policy. And, in the right circumstances, CHP can thrive in a liberalised market where the state no longer has a direct stake in the energy sector. Yet, to *maximise* its beneficial effects, it also needs a market in which the government is explicitly driving forward an agenda of sustainable development. Market forces need to be balanced by a system of incentives to encourage progress towards clear social and environmental objectives.

This is what is emerging in the UK - liberalised energy markets in which the role of CHP is explicitly recognised.

CHP is a well-proven technology which has supplied key markets in both the US and the UK for several decades. Since electricity privatisation in 1990, there has been a 100% increase in CHP capacity in the UK and CHP is increasingly becoming the obvious choice for consumers. Now, some 6% of Britain's electricity comes from CHP - and we are getting towards the official target of 5 GW of CHP by the end of 2000.

CHP typically operates at efficiencies greater than 70% and emits less than half the carbon dioxide per unit of useful energy compared to conventional coal-fired power generation, and more than 10% less than modern CCGT power stations.

In the UK, CHP operates at some 1500 sites, from small hotels to the largest industrial complex. The biggest users – by capacity – are the chemicals, refining, paper and food and drink industries, while the largest number of units serve commercial and public buildings. Table 1 summarises the position in 1997.

**Table 1. UK CHP Use in 1997**

Sector	CHP Electrical Capacity (MW)
Chemicals	1226
Oil refineries	496
Paper, publishing and printing	438
Food, beverages and tobacco	218
Iron and steel	130
Extraction and mining	37
Metal products	37
Other industrial sectors	687
Transport and commerce	191
Non-industry	272
<b>Total</b>	<b>3732</b>

Source: Energy Trends, UK Department of Trade & Industry, August 1998

To mention a few examples:

- Industrial CHP schemes meet the energy needs of complete manufacturing sites or companies. In the UK, a 4.8 MW scheme installed at a Heinz factory in London by BP Energy - financed off Heinz's balance sheet by BP - is now reducing the site's energy bills by nearly \$800,000 a year. It has also cut carbon dioxide emissions by over 30,000 tonnes a year.
- Small-scale CHP schemes - typically less than 1 MWe in size - provide the energy for a major building or group of buildings. In the UK, Landrover uses a total of 15 small-scale units at its vehicle manufacturing plant in the Midlands. These plants - supplied, financed and operated by Nedalo - have reduced Landrover's energy bill by \$550,000 a year. Small-scale CHP is also used at Buckingham Palace, Windsor Castle and in large parts of the UK Government's own estate in Whitehall.
- Urban scale CHP schemes can supply whole communities with electricity and heat (and increasingly cooling as well). In the UK, for example, Nottingham's city-wide system supplies heat to some 5,000 homes as well as generating 10 MW of power for sale to the local electricity company.

Whatever the scale or application, customers can benefit from CHP without having to find the up-front capital cost. As the examples show, UK suppliers will usually install the equipment with no capital contribution from the customer, sharing the resulting energy cost savings with the customer under a long-term energy services agreement.

## Liberalisation Aids CHP?

In Europe, two main factors have stimulated the growing use of CHP - the liberalisation of the energy industries, and the widespread availability of natural gas.

The UK has led the march to a liberalised energy economy in which the economic benefits of CHP are easier to recognise.

Previously, the former, state-owned UK Central Electricity Generating Board operated a policy of building ever larger, remotely-sited power stations and ignored the potential benefits of decentralised power production. Now, since the restructuring of the electricity industry begun in 1989, the amount of CHP has doubled, from two gigawatts to four.

Yet CHP still generates just 6% of the UK's electricity and some 9% of Europe's. Table 2 summarises the position of cogeneration across Europe.

**Table 2. European CHP Use in 1997**

Country	Proportion of Electricity Generated by CHP (%)
Austria	23
Belgium	3
Denmark	40
Finland	30
France	2
Germany	15
Greece	3
Ireland	4
Italy	11
Netherlands	30
Portugal	13
Spain	9
Sweden	7
UK	6
EU average	9

Source: European Cogeneration Review, COGEN Europe, 1998

Both the UK Government and the European Parliament cite CHP as a central technical plank in their strategies to tackle climate change.

The UK currently has a target to achieve 5 GW of capacity by the end of the year 2000, and is considering a target of at least 10 GW by 2010. (Present capacity is around 4 GW).

The economic potential has been calculated by Government advisors at between 10 and 17 GW, with an additional 2 GW for CHP schemes linked to community heating.

My own organisation, the UK CHP Association<sup>1</sup>, has calculated that achieving a new UK target of some 10 GW of CHP by 2010 would contribute some 21% of the Government's manifesto commitment to a 20% cut in carbon dioxide emissions by 2010.

All this seems to paint a healthy picture for CHP in the UK and Europe. But the crucial point is, that to meet environment objectives, recognition of CHP's environmental benefits and the setting of aspirational targets are not enough. To maximise savings in carbon dioxide emissions and to move CHP towards its full potential is going to require something stronger than *encouraging words* by government.

## Intervention to End Waste

Something stronger means *intervention* into liberalised markets specifically to pursue sustainable development objectives.

In the UK, the CHPA has argued for an end to the development of inefficient, electricity-only power stations, and at the end of last year the Government agreed, confirming a new, and tighter planning regime for power stations which will halt, for the time being at least, all non-CHP power stations.

The UK Government's White Paper on *Energy Sources for Power Generation* makes a clear link between CHP and sustainable development:

*"The policy of sustainable energy supplies, tied in with the wider objective of sustainable development, means minimising the environmental impact of energy production, transformation, transmission, distribution and use; it also includes social, economic and resource management issues, CHP plays an important part in achieving this".*

But the particularly attractive aspect of CHP is that it delivers *economic benefits* as well as environmental advantages. As the White Paper puts it:

*"CHP reduces industry's costs and improves competitiveness ..... it is a win-win technology that will make both a long term contribution to meeting environmental targets and improve industrial energy efficiency".*

So CHP's economic advantages alone make it worthwhile, even for those who doubt the need to reduce carbon dioxide emissions.

The lesson from the UK - where in the first eight years since the electricity industry was restructured, some 2 GW of new CHP plant has been commissioned compared to 15 GW of less efficient CCGT plant - is that markets alone are unlikely to deliver environmental objectives. Measures to ensure the market recognises the value of the environment are needed, or major opportunities will be wasted.

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Similar opportunities to influence power station permits are bound to arise in other countries in the early stages of electricity industry liberalisation - the US is one example. The opportunity should not be missed if environmental targets are to be met.

## Policy Options

For the future, the two critical areas for CHP in the UK are probably:

- the currently proposed tax on the business use of energy – with recycling of revenues back to business in some form, and
- the current reform of electricity trading arrangements – which could be disastrous for CHP, but has the potential to deliver real benefits for CHP-based energy schemes by, for example rewarding ‘embedded’ schemes for the avoided costs of importing power.

Modelling of the potential impact of various policy instruments on the economics of CHP plants show how important these two measures are. Our work suggests that recycling of revenues from a modest energy tax would improve the net present value (NPV) of a medium-sized CHP plant by 12%. Similarly, rewarding CHP schemes for the costs of avoided power imports increases the NPV by 24%.

Energy prices are critical in giving a signal to the market about using energy more efficiently as well as shifting towards less carbon-intensive fuels. In the UK, liberalised energy markets and competition have moved consumers towards the lower end of prices among European and other OECD countries, thus weakening the incentive to invest in CHP and energy efficiency.

Yet environmental benefits - such as those delivered by CHP - have no formal financial value at present. Cutting a company’s greenhouse gas emissions has no real impact on the bottom line.

However, the recently completed Marshall Review<sup>2</sup> on economic instruments was intended as one response to this challenge. The former President of the UK Confederation of British Industry, Lord Marshall, was asked by the Government to make recommendations on the use of economic instruments, including new taxes, to help curb industrial emissions of carbon dioxide as part of the Government’s strategy to tackle climate change.

The Review’s recommendations to Government provide clear support for the introduction of a downstream energy tax for industry, with full recycling of tax to include a proportion available for energy efficiency tax credits and related investment support. CHP is clearly a technology that should benefit from this approach.

Some have opposed the very concept of an energy tax, suggesting a negative impact on competitiveness. Yet this does not stand up to serious examination. Now, even some of the major oil companies have softened their negative stance on energy taxes, so long as effective recycling of revenues takes place.

Recent work by Government energy advisors analysed the overall impact of an energy tax with energy efficiency tax credits, including allowing companies to trade these credits. The

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<sup>2</sup> Economic Instruments and the Business Use of Energy, HM Treasury, November 1998

conclusions are that, apart from the cement industry, all the other sectors would be net beneficiaries of the new tax regime, as well as being more competitive internationally.

Many of these sectors have significant potential for new CHP capacity. An approach which reduces labour costs and which encourages industry to be more competitive through improved energy efficiency, is surely attractive.

Secondly, fundamental changes have and are continuing to take place within the electricity market with the proposed reform of electricity trading and the status of embedded generation. This is a complex area, but we believe that, if consumers are to really benefit from competition the current plans to reform electricity trading must not just benefit the big players - they must also enable localised power, including CHP, to prosper. This is where the real long-term energy and cost savings will result, for both business and domestic customers.

A fairer regulatory environment for CHP, ie one in which high efficiency and low carbon-emitting technologies are encouraged through the taxation system, would allow the technology to expand both in its traditional industrial and building sectors, but also, and perhaps more importantly, in a number of new areas too.

## Lobbying for Sustainability

The British Government's move to intervene in support of CHP has not taken place in a vacuum. The UK CHP Association has lobbied hard over several years for effective treatment for CHP in the legislative and regulatory framework which surrounds the energy market. We have also called for its environmental advantages to be rewarded.

Internationally, the CHPA and its European equivalent, COGEN Europe<sup>3</sup>, both work within the International Cogeneration Alliance<sup>4</sup> to press the case for CHP world-wide. Now, with new opportunities being created as governments begin to implement the flexibility mechanisms provided in the Kyoto Protocol, the Alliance will continue to ensure that the dynamics of decentralised power systems, such as CHP, are recognised and increasingly become the option for the future. The new US CHPA is a welcome ally in this work.

The experience of the UK and European markets is clear. Climate change is almost upon us and Governments are currently drawing-up their carbon reduction strategies.

CHP should be at the heart of an energy policy that promotes sustainable development, as it is both energy-efficient and customer-focussed, whilst also delivering much needed local power. Liberalised markets are good for CHP as they allow its *economic* benefits to be recognised.

Yet without an effective legislative and regulatory framework, CHP is unlikely to reach its full potential. Indeed, at a time when electricity prices are falling and UK gas prices are expected to increase slightly, the position of CHP may deteriorate.

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Governments need both to recognise and reward its *environmental* advantages if CHP is to deliver its full contribution to meeting global sustainability objectives and to become a key part of the ‘third way’ for energy policy.

## **Summary and Conclusions**

Liberalisation, globalization, and particularly climate change are changing energy thinking. In the future, climate change will be tackled by improved energy efficiency and carbon neutral sources of energy, but we could be doing much more today by the more widespread use of CHP.

CHP has made reasonably good progress in the UK and Europe, due to energy industry liberalisation and the widespread availability of gas. But the pursuit of sustainability objectives requires government intervention into liberalised markets. While the current UK Government is a strong supporter of CHP, major opportunities to develop CHP were missed in favour of less efficient CCGT power stations over the last decade.

The two critical policy issues in the UK now are the proposed tax on the business use of energy and the current reform of electricity trading arrangements. Both could impact favourably on the development of CHP.

The UK CHP Association, COGEN Europe and the International Cogeneration Alliance continue to press the case for CHP.