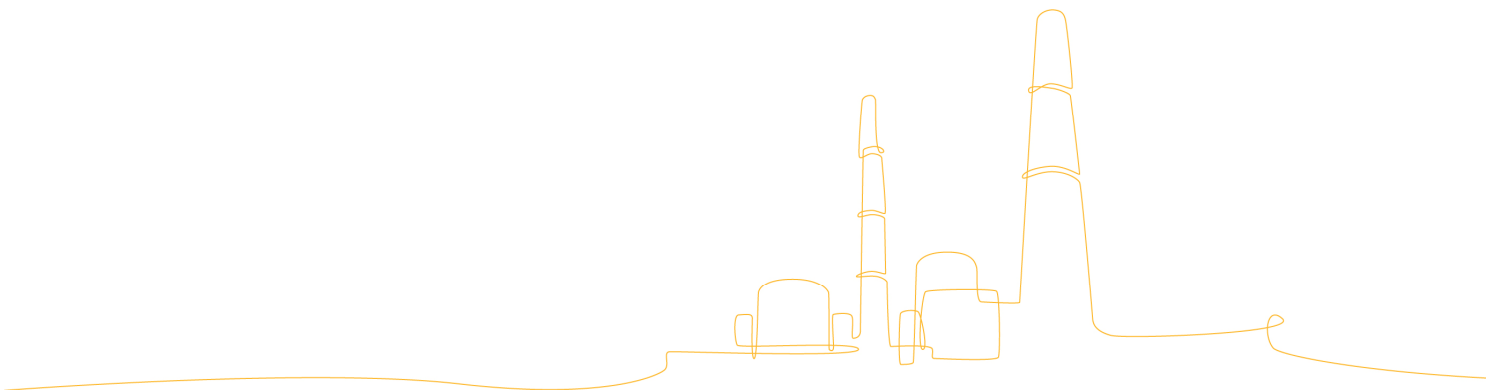


## **CHP Policy & Markets – Germany Update**

**Likely CHP market upswing after a recession-hit year**

March 2010

Michael Brown +44 131 625 1011; [www.delta-ee.com](http://www.delta-ee.com)



Based in Edinburgh, Scotland, Delta Energy & Environment Ltd ('Delta') is a consultancy and research provider focussing on decentralised energy, specifically Combined Heat and Power (CHP), Micro-CHP, Photovoltaics, Electric Vehicles, Electricity Storage and Wind.

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## The Future CHP Market in Germany

This short report is Delta's 2010 update of the current status and future market opportunity for combined heat and power (CHP). It represents an example of Delta's ongoing CHP market coverage and our capability to provide a sound future view of market development.

This summary charts developments since our last update in February 2009 – and highlights the current market slowdown, despite the new CHP incentives, which will be followed, in our view, by growth across several CHP sectors, especially the small gas engine market.

### 1 CHP today – well-established

#### 1.1 Installed base

CHP is already well-established in Germany, in many different applications. The reported 23 GWe represents 16.5% of the total national capacity. There is around 10 GWe of CHP in manufacturing industry, while the smaller-scale market (<10 MWe), the fastest growing sector, has a minority share. This sector is increasing its deployment in commercial and public buildings. **Table 1** below summarises the latest official data.

TABLE 1: OVER 23 GW OF CHP CAPACITY IN GERMANY

	Total	Industrial	Power sector (CHP with district heating)	Small (<10 MWe)
Capacity (GWe)	23.2	10.0	10.8 <sup>1</sup>	2.4
Generation (TWh)	83.5	38.0	32.0	13.5

Source: BMU, 2009

The three sectors also differ widely by fuel use. Coal is still the bedrock of power-sector CHP, although this could change as old plants are replaced by installations that do not recover heat, as is the trend. Coal, natural gas, biomass and industrial waste gases each take a roughly equal share in industry, while biomass dominates the fuel mix of small CHP plants, driven by attractive feed-in tariffs. **Figure 1** (page 4) summarises this mix.

#### 1.2 Policy Framework – overall positive for CHP

##### 1.2.1 The Government attitude – CHP will play a key role in policy targets

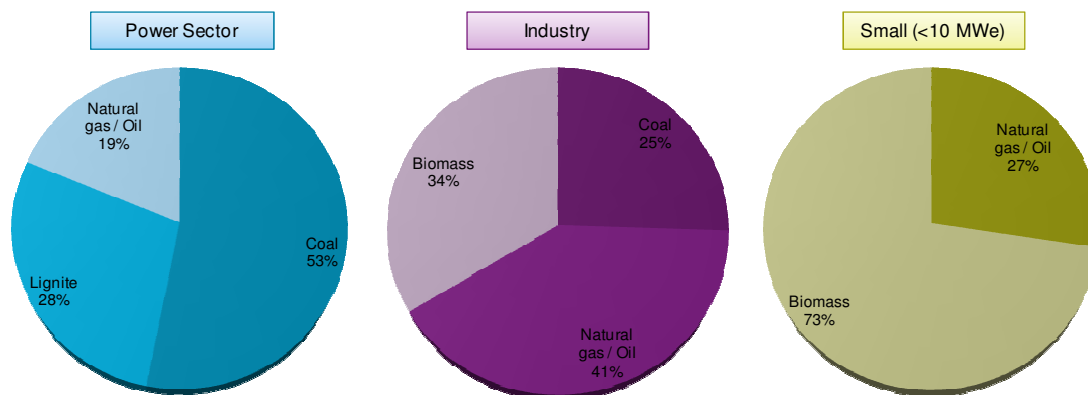
In 2009, the German Federal government introduced an impressive legislative package to deliver its Energy and Climate Strategy, showing strong commitment to supporting CHP. It aims to double the total share of CHP electricity to 25% by 2020, giving CHP a central role in meeting the need for new

<sup>1</sup> Many large German power plants capture some heat for use in district heating networks, but this usually only represents a small share of the total heat output.

power capacity. This makes the future of the existing financial incentives relatively secure, although budgets are under pressure in the effort to reduce deficits resulting from the financial stimulus packages introduced in the last year.

**FIGURE 1: FUEL SHARES FOR CHP**

Coal is the dominant fuel for large CHP, but natural gas and biomass are common at a smaller scale



Source: BMU, 2009

The 2009 CHP law (*KWK Gesetz*) and renewable energy legislation provide both economic and regulatory incentives for CHP, documented in detail in earlier Delta analysis. Combined with high electricity prices, this would be enough to boost market activity under normal conditions. But CHP electricity export prices have halved since peaking at €73 / MWh in Q3 of 2008. In addition, several developers are postponing investment decisions in the current uncertain economic climate, especially those in industrial sectors.

### 1.2.2 Support Mechanisms – great value, but a tough time for investment

The CHP law is at the heart of the support for CHP. It has also been supplemented by updated renewable energy laws (*Erneuerbare-Energien-Wärme-Gesetz* and *Erneuerbare-Energien-Gesetz*) **Table 2** provides a summary of the existing support mechanisms for CHP in Germany and Delta's evaluation of their effectiveness.

**TABLE 2: CHP INCENTIVES AND THEIR EFFECTIVENESS**

Support Mechanism	Eligibility	Economic Value	Effectiveness	Future Prospects
<b>Renewable Energy Law</b>	Renewable CHP	9.2 – 27.7 €c per kWh	★★★★★	Guaranteed until 2020
<b>CHP Law</b>	All CHP	1.50 – 5.11 €c per kWh	★★★★☆	Guaranteed until 2016
<b>Ecotax Exemption</b>	CHP with efficiency > 70%	Natural gas: 13.90 € per MWh Fuel oil: €130 / 1,000t	★★★★☆	Stable and secure

<b>Renewable Heat Law</b>	Renewable CHP Building-CHP DH CHP	Variable grants for innovative technologies	★★★★☆	Guaranteed until 2020
<b>EU ETS National Allocation Plan</b>	Thermal input > 20 MW	~ 0.3 €c per kWh (assuming €25 per t CO <sub>2</sub> )	★★★☆☆	Fixed to 2012; value subject to carbon price. Post 2012 impacts are uncertain.

Source: Delta Energy & Environment, 2009

### The CHP Law

The CHP Law came into effect from 1 January 2009 with an annual budget of €750 million. The law extends the feed-in bonus tariff to installations over 2 MWe, and guarantees dispatch priority and power off-take:

- ▶ Network operators are obliged to connect CHP plants and buy their electricity, equivalent to that for renewables.
- ▶ The feed-in bonus applies to refurbishment and to all new plants starting operation between 2009 and 2016, without capacity limits.
- ▶ Electricity for own consumption has now become eligible for the feed-in bonus, extending the arrangements for power exported to public networks. Exceptions are made for industrial sites.

### The Ecotax

The Ecotax (*Ökosteu*) exemption applies to CHP plants with a load factor of over 70%, aiming to promote the efficient use of fossil fuels. However, the power sector is also exempted from the Ecotax, so the only benefit for CHP plants is for the avoided boiler fuel.

### The EU ETS

The German NAP 2 of the EU ETS (covering the period 2008 – 2012) treats high-efficiency CHP plants (as defined by the EU CHP Directive) favourably compared to power-only generation:

- ▶ Double-benchmarking for CHP, allocating emission allowances for both heat and power outputs, taking into account the full emissions savings of CHP compared to separate generation.
- ▶ The compliance factor for high-efficiency CHP is 0.9875, compared to 0.85 for power-only generation. This means that CHP plants only have to reduce emissions by 1.25% from their baseline, while power-only plants have to achieve cuts of 15%. CHP plants not qualifying as 'highly efficient' are treated as power-only plants.

### The Renewable Energy Law

Under the Renewable Energy Law, the tariffs for biogas CHP are highly favourable as the overall tariff can be over €c27 per kWh, including a €c3.0 CHP bonus. Biogas CHP plants can receive this tariff for a maximum 20 years after the system becomes operational. Tariffs for new plants will be reduced by 1.5% per year for landfill gas and sewage gas and by 1.0% per year for agricultural biogas.

The Renewable Heat Law aims to increase the share of renewable heat to 14% by 2020. All new buildings with a floor area of 50 m<sup>2</sup> must meet a minimum share of their heating demand by renewables, varying by technology.

Packaged gas-fired CHP is also eligible for meeting this obligation, as well as district heating networks supplied by CHP. Fossil-fuel building-integrated CHP plants and district heating CHP can therefore also benefit from the Renewable Energy Law, as they are often more cost-effective than renewable heating technologies.

### 1.2.3 The Outlook for policy – support to continue but funding likely to be under pressure

The government is **unlikely to introduce new pro-CHP measures** in the next few years, as it will first assess the impact of the 2009 package. Minor adjustments in definitions and specific eligibility criteria may emerge as the law is implemented in practice, but we believe that major changes are unlikely.

However, pressure on government budgets creates some uncertainty for the next few years – **new funding is probably out of the question**. The feed-in tariffs are relatively safe, as they are paid by consumers through electricity bills, rather than coming directly from the national Treasury.

The **EU ETS – Phase III** scheme will bring major changes in allocation and auctioning of allowances on an EU-wide level. The allocation of allowances for high efficiency CHP is likely to be based on:

- ▶ Auctioning of allowances for electricity production and a growing share of heat.
- ▶ Partial free allocation of allowances from heat production based on benchmarks. In 2013, CHP plants will receive 80% of the benchmark emissions for free, falling to 30% in 2020.

## 2 CHP Market Prospects

### 2.1 Economic Modelling

#### 2.1.1 CHP Spark Spreads

Energy prices in Germany have dropped since 2008 as the economy went into recession and demand fell. The guaranteed CHP export power price is a good indicator, showing the average electricity wholesale price in the previous quarter. It halved from €73.17 per MWh in Q4 of 2008 to €37.03 per MWh in Q4 2009 (**Table 3**; contact Delta for fully updated data). Retail prices did not immediately follow this trend market, but did subsequently start to come down also.

#### Energy prices down through 2009

TABLE 3: GAS AND ELECTRICITY PRICES FOR CHP PLANTS Q4 2009 (CONTACT DELTA FOR FULLY UPDATED DATA)

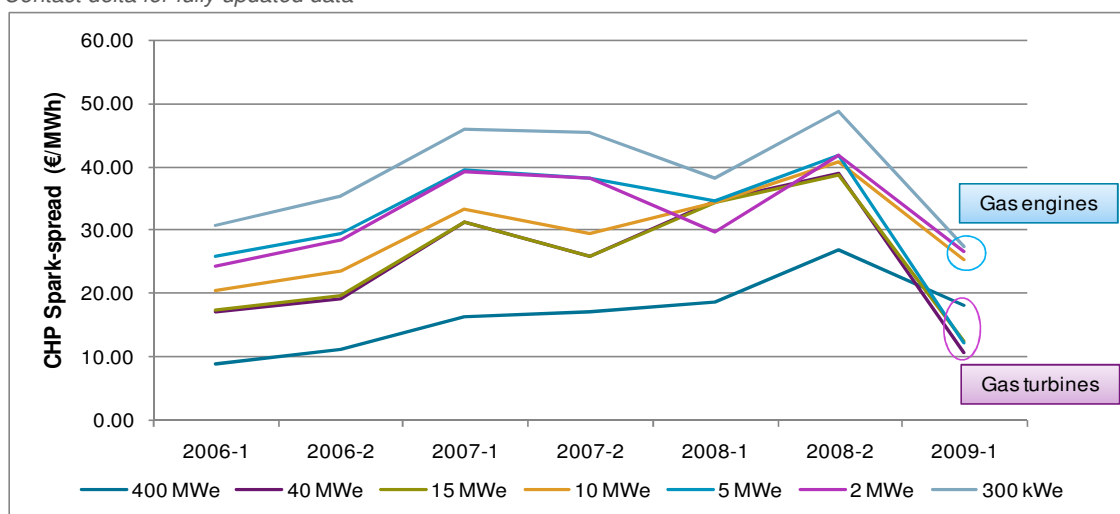
Technology	Capacity	Application	Electricity export (€/MWh)	Electricity import (€/MWh)	Gas (€/MWh)
Gas engine	300 kW	Hospital	37.03	110	29
	2.0 MW	Hospital	37.03	104	26
	10 MW	Airport	37.03	94	20
Gas turbine	5.0 MW	Food industry	37.03	103	15
	15 MW	Paper industry	37.03	94	13
	40 MW	Chemical industry	37.03	85	12
	400 MW	Refinery	37.03	60	11

Source: Delta Energy & Environment, 2010

Gas prices have also proven more resilient than power prices, so that the CHP spark spread in the second half of 2009 had effectively been cut in half (**Figure 2**). Gas turbine systems had spark-spreads between €10 and €20 per MWh, while gas engine applications still achieved around €28 per MWh.

FIGURE 2: CHP SPARK-SPREADS IN GERMANY FELL THROUGH THE RECESSION

Contact delta for fully updated data

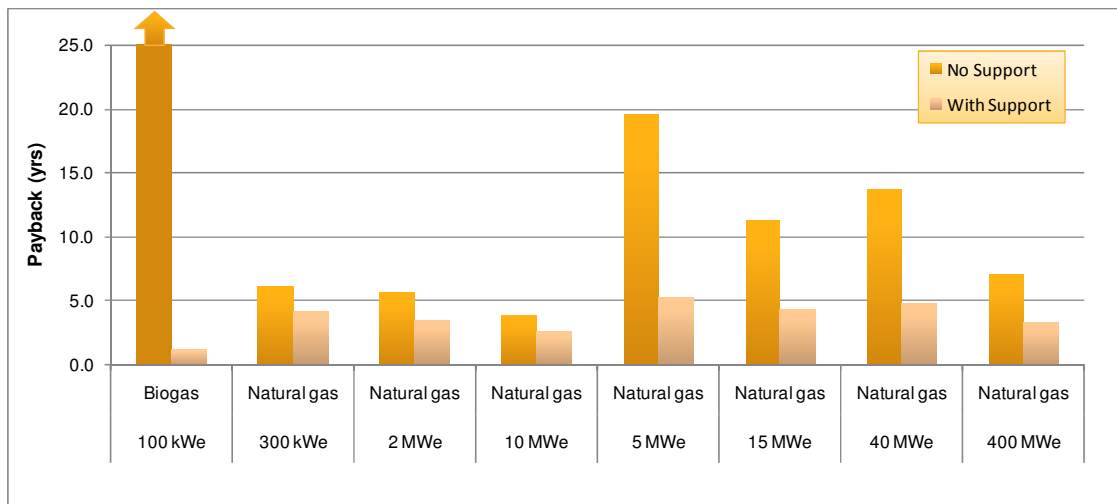


Source: Delta Energy & Environment, 2010

### 2.1.2 Project Economics – incentives make a major impact

The CHP feed-in tariffs are all the more important with the 2009 fall in spark-spreads. Gas turbine plants benefitted significantly, with paybacks falling from 10 to 20 years to below five years thanks to the government support (**Figure 3**). This makes the extension of the tariffs to installations larger than 2 MWe a real deal-maker. For gas engines, the impact was less dramatic, bringing project payback down from 6 to 7 years to 3 to 4 years – also pushing them into more commercially viable territory.

**FIGURE 3: THE FEED-IN TARIFFS MAKE CHP AN ATTRACTIVE INVESTMENT**

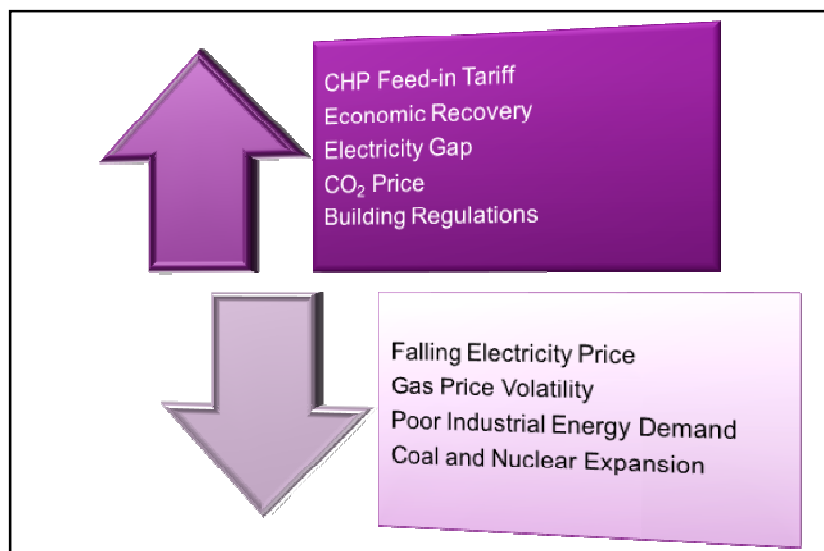


Source: Delta Energy & Environment, 2010

## 2.2 Future CHP market trends – our overview of drivers and barriers

**Figure 4** below summarises the current main drivers and barriers in the German market.

**FIGURE 4: DRIVERS AND BARRIERS FOR CHP IN GERMANY**



Source: Delta Energy & Environment, 2010

Overall, in our opinion, the balance between the two sets of drivers is now set at 'positive' based on the existence of the CHP law. The main ones are summarised, in turn, below.

### 2.2.1 Drivers – macro view

#### **The CHP Law – a strong initiative, but dampened for now by the current economic uncertainty**

The regulatory conditions for CHP are the best in years now the new feed-in tariffs have become available, but the market has generally remained quiet. The economic downturn and associated uncertainty are the main culprits.

The extension of the tariffs to systems over 2 MWe aimed to stimulate industrial applications and many industries are now indeed dusting off plans for CHP installations - but few have the confidence just yet to commit to investing. Those that do cannot always secure financing. This is unlikely to change much in early 2010, so that the full effect of the law could only emerge in 2011. However, the new law has already made an impact in two sectors:

- ▶ **Stadtwerke** have been gearing up to take advantage of the support for heat networks, expanding or upgrading their existing grids. Building new CHP plants to feed these is a likely second step in the next few years.
- ▶ The **gas engine market** was already the most active CHP market segment, as we have mentioned – and 2009 saw around 570 MWe of new capacity, a 43% upswing from a disappointing 2008. The slow return to economic growth clearly helped, but the CHP law directly improved conditions too. In particular, the eligibility of electricity used on-site for feed-in support has enabled housing associations to install and operated CHP systems in apartment blocks, selling the energy to their tenants, and still receive the tariffs.

#### **Macro-drivers – the capacity gap and CO<sub>2</sub> costs fail to stimulate CHP in the power sector**

The German government and power sector experts are increasingly concerned about '*die Lücke*' – a **capacity gap** emerging as old units close and the commissioning of new coal and gas plants stalls due to lack of financing or regulatory uncertainty surrounding carbon costs and abatement requirements. A drop in power demand as the economy turned sour has taken off the pressure somewhat, but has likely only postponed potential problems. CHP could indirectly benefit from the capacity gap, and not only from increasing electricity prices. The CHP law gives power companies and other developers a concrete financial incentive to consider the use of heat when building new plants – in addition to the need for new electricity.

The rising **costs of CO<sub>2</sub> emissions** for electricity companies, which will need to buy all their allowances for the EU ETS from 2013 onwards, is likely, we believe, to strengthen the financial case for investing in CHP, but certainly not for the immediate future.

#### **Building regulations – a post-recession driver for small-scale CHP**

The building regulations of the Renewable Heat Law could give CHP a great boost in theory, but the slump in the construction sector has stifled its impact, because the number of new buildings, to which the law applies, has fallen too. Over time, micro-CHP could benefit in particular, however, as gas suppliers promote its use to gain access to new housing developments.

### 2.2.2 Market Barriers – macro view

The main barrier currently is probably the adverse 2009 trend in CHP spark spreads described above. A return to economic growth and rising energy demand, together with increasing CO<sub>2</sub> costs, is likely to reverse the downward trend. As an indication of this, over 100 regional and national electricity suppliers announced price increases for January 2010 – up to 16% for residential customers. They ascribe these to the costs of the renewable energy feed-in tariffs, singling out PV.

CHP plants owned by the heat customer are exempt from the levy associated with these tariffs, so this would make developing CHP even more attractive. Contractor-owned installations, however, are not eligible for this exemption, and would therefore see no benefit.

#### **Power gap is today filled by new coal and gas plants – but little CHP**

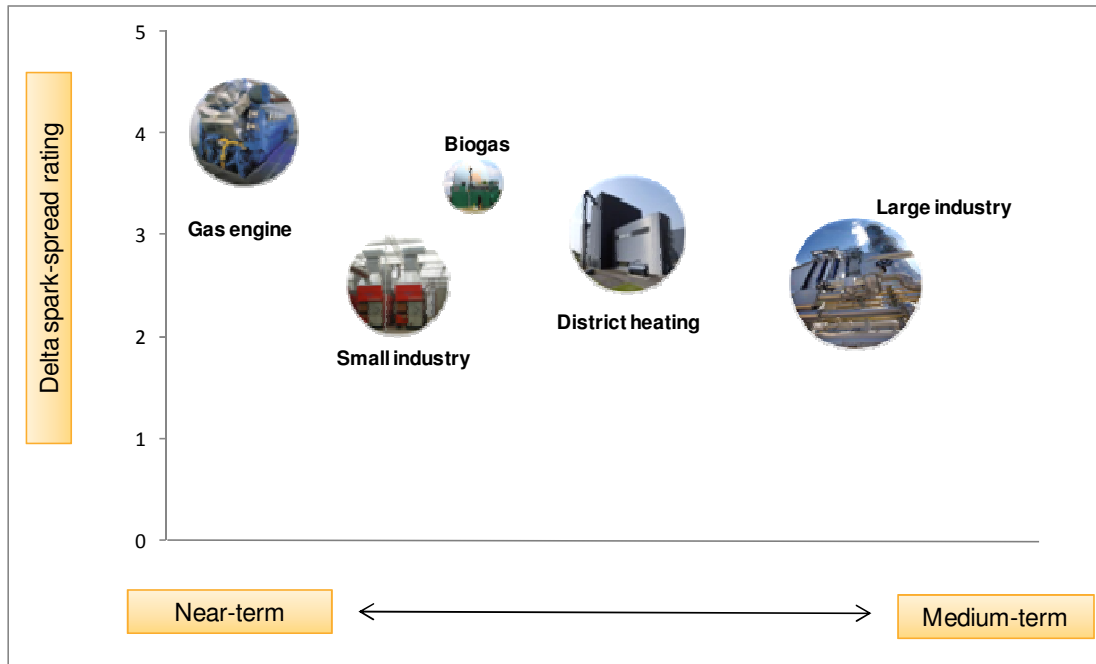
The power gap is a double-edged sword. The favourable regulatory conditions could ensure that CHP replaces decommissioned power plants, but it may be crowded out by large coal and gas-fired installations without heat recovery. For now, neither is happening, as utilities postpone decommissioning old assets because of delay to new investment.

Nuclear power is still the big unknown. The lifetime of existing plants will probably be extended to secure supply for the immediate future. The official government line still rules out building new reactors, but the new right-centre government supports nuclear for its carbon saving potential.

## Delta's five-year outlook – where is the market moving from 2010?

**Figure 5** below summarises Delta's view of the future market activity based on our analysis of policy and market drivers. **Figure 6** (page 11) then provides an accompanying summary of each market opportunity.

**FIGURE 5: GAS ENGINE CHP IS THE MOST PROMISING NEAR-TERM OPPORTUNITY (CIRCLE SIZES REPRESENT RELATIVE SIZE OF THE OPPORTUNITIES)**



Source: Delta Energy & Environment, 2010

**FIGURE 6: FUTURE MARKET OVERVIEW AND TRENDS**



The market for **multi-hundred MWe CHP plants** is small at any time, but the economic downturn has reduced it further. The new CHP law has initiated interest from large industrial companies, but few have the economic confidence to invest. Large national utilities continue to show little interest in CHP.



**Small industries** are keen to explore CHP opportunities (1 to 5 MWe), but getting commitment to invest takes time. Altogether, project development can take anything from one to three years. Projects could proceed more rapidly as the economy recovers and confidence returns.



The **district heating CHP** market is gearing up for renewed activity. Over 10 GWe of existing capacity needs replacement by 2020. Stadtwerke are also extending heat networks to tie in new customers, increasing demand for DH CHP. Modernisation or new-build CHP plants are a likely next step.



The German **gas engine CHP** market has just finished a good year, with sales up 43% - and it shows no signs of slowing down. The 2009 CHP law has opened up the potential in apartment buildings in particular, now that electricity used on-site also receives the feed-in tariff.



**Biogas CHP** development is slowing down. Uncertainty about implementation of the CHP law affected the market in 2009, and the sector suffers from other problems. The obvious sites have been developed, and bio-methane preparation for insertion in the gas grid is diverting feed-stocks. German installers are now looking across the border for new markets in the Netherlands, France, Belgium and Poland.

Source: Delta Energy & Environment, 2010