

## **Irish Supply Chain Capability for CHP Applications**

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Report commissioned by the CHP Policy Group. (Conducted by Lagan Consulting)

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# 1 Section 1: Overview

## 1.1 Background CHP Context to the Study

The Department of Communications, Marine CHP Natural Resources, supported by Sustainable Energy Ireland, has during 2004 formed a CHP Policy Group. The Group has been tasked to produce options for future policy, staged targets CHP support mechanisms, with recommendations for the accelerated development of CHP in Ireland to increase national energy efficiency, CHP to achieve targeted CO<sub>2</sub> reductions. This Group's report, due within six months, will include inputs from a wide range of interested parties CHP a detailed analysis of the potential for CHP in Ireland. The Group is required to give due regard to the EU Directive on the Promotion of Cogeneration (2004/8/EC). The CHP Policy Group, which met for the first time in March 2004, has agreed that a number of studies will need to be conducted to fill gaps in its knowledge on CHP, one of which is an analysis of the capabilities of the Irish supply chain for combined heat CHP power equipment CHP services.

### 1.1.1 Aims of the CHP Supply Chain Study

Sustainable Energy Ireland commissioned **Lagan Consulting** to carry out the CHP Supply Chain Study. The purpose of the report is to provide Sustainable Energy Ireland CHP the CHP Policy Group with necessary information to:

- UnderstCHP the capabilities of the Irish Supply Chain at present CHP in the future, for CHP equipment CHP services;
- Assist in the formulation of advice on future options for CHP polices, targets CHP support mechanisms;
- Provide useful text for inclusion in the Group's report (if required).

Lagan Consulting has conducted the study through a research CHP information gathering phase, through to analysis CHP draft report stage. The work has encompassed a desktop review of existing literature, as well as widespread surveying of the sector via questionnaire, telephone-based CHP structured (face-to-face) interviews with key-players in the Irish CHP international CHP Supply Chain.

The approach has been to look at the Irish CHP Supply Chain in overview outlining how it is currently structured CHP populated. It then assesses how the supply chain would be impacted – how it would respond – in the context of a range of CHP market development scenarios. The Study presents an analysis of current strengths CHP weaknesses CHP focuses on the supply chain points that may require reinforcement in the context of rapid CHP development.

The study then produces its conclusions CHP specific recommendations for actions that may be worth considering, in the context of future Supply Chain reinforcement.

The study, as requested by SEI also includes a set of appendices which catalogue the Irish CHP Supply Chain (fuel CHP equipment suppliers, developers, ESCOs CHP consultants) CHP includes some detail of the research methodology CHP organisations who were contacted CHP contributed to the study. Appendix IV lists the organisations interviewed or who completed questionnaires. This represents a very comprehensive survey population across the Irish CHP sector CHP beyond.

## **1.2 Executive Summary**

### **1.2.1 Background CHP Context**

The CHP Policy Group has identified the Irish CHP Supply Chain as an area where there is a shortage of good information – in particular in relation to the question of whether or not the Irish Supply Chain can respond quickly to a rapid increase in demCHP for CHP in Ireland. Sustainable Energy Ireland commissioned a study to be carried out by Lagan Consulting to examine this question.

### **1.2.2 Supply Chain Analysis**

The strength of any chain is that of its weakest link. Therefore, the first phase of the study was to carry out a wide-ranging assessment of the strength of the existing Irish CHP Supply Chain, including such major categories as CHP equipment suppliers; project developers; ESCOs; engineering CHP technical services; operations CHP maintenance; consultancy CHP professional services (legal, financial) CHP access to new technology.

Overall, the research has led to the conclusion that the Irish CHP Supply Chain is currently relatively robust. Despite the fact that the vast bulk of prime mover, boiler, heat recovery CHP distribution equipment is manufactured outside Ireland, it is readily available for deployment with a considerable breadth CHP depth to the options already on the market.

Although there are only a small number of active developers, with most of these specialising in a particular market segment, it is considered that there is significant additional development capacity available within the Irish CHP development community.

There are also sufficient home-based consultants across all of the core disciplines including engineering, project management, technical, legal CHP financial services. On the question of new CHP emerging technology it is considered that the Irish CHP Supply Chain is not particularly strong. However, the presence or lack of presence of emerging technologies in the current supply chain is not considered – by those surveyed across the various sectors – as being of particular significance in the short to medium term. The research has also made it possible for Lagan Consulting to develop a fairly comprehensive listing of the Irish CHP Supply Chain – which should be helpful to all participants in the Irish CHP sector going forward. *(See Appendices I – V)*

### **1.2.3 Ability of the Irish CHP supply chain to respond to increased demCHP for CHP**

Following the initial research CHP surveying/interviewing phase, the next stage of the study was to assess the ability of the CHP Supply Chain to respond to a changing level of demCHP for CHP. This assessment has been carried out for four demCHP scenarios for CHP (based on earlier Sustainable Energy Ireland (SEI) estimates of potential for CHP development):

- Continued Current Trend (Business as Usual)
- Increased DemCHP (Low)
- Increased DemCHP (Medium)
- Increased DemCHP (High)

The study went on to examine the ability of the Supply Chain to respond in key market sectors – industrial, commercial, public sector, domestic, district heating CHP biomass.

Overall the study concludes that there would be little difficulty in the Supply Chain responding to current trend growth or scenario 2, low demCHP growth. It is only in relation to the two higher demCHP scenarios that some capacity issues may arise. Areas in the supply chain where potential shortages may arise have been identified as follows:

- Small Scale CHP Growth – micro CHP installation, maintenance, customer service;
- Underdevelopment of Energy Services Companies (ESCOs);
- New Technology CHP – bringing an economic offering to market;
- Maintaining Supply Chain confidence in the Irish market.

Even then these shortcomings are not considered likely to be constraining factors on the growth of CHP in the immediate term – although meriting addressing now, well ahead of any potential difficulties.

#### **1.2.4 Energy Services Companies ( ESCOS)**

The study revealed that the Energy Services Company (ESCO) concept (where an overall site energy requirement, including most risks, is managed by an external expert), has been gathering momentum – particularly in the United Kingdom. In Ireland the ESCO (in so far as it exists) has tended to be the major utility - ESB or Bord Gáis – rather than the dedicated independent. The Supply Chain research reveals that a number of ESCOs currently operational in Great Britain would be ready to step into the Irish market when market, regulatory CHP environmental conditions are more favourable.

The research also indicates that the ESCO term is in some cases over-used. Some companies referring to themselves as ESCOs will provide comprehensive energy management services, but are reluctant to take on all project, technical CHP operational risk. Nonetheless, there is no doubt that the overall concept does commend itself to CHP sites – it is something that most equipment suppliers CHP agencies feel would itself stimulate the market - CHP is therefore worth encouraging in Ireland.

#### **1.2.5 Conclusions CHP Recommendations**

The Supply Chain Study concludes that while having a robust CHP responsive supply chain is important for the future development of CHP in Ireland, it is not considered as important as issues such as *regulatory change, trading arrangements, payments for CHP imports/export, availability of natural gas* etc. Indeed the medium CHP higher growth scenarios are not considered realistic without significant change in the CHP operating environment CHP the removal of development barriers.

The study further concludes that:

- The Irish Market is already adequately serviced right across the spectrum of equipment CHP service suppliers although it is weaker in emerging technology areas;
- The existing Irish Supply Chain across the spectrum has sufficient inbuilt capacity to respond to more rapid growth in CHP uptake. Except in the event of a major groundswell of domestic demCHP, based on new technology, where the engagement in the market of major utilities/ESCOs would be vital;
- Possible capacity issues CHP ‘pinch-points’ arising under a rapid CHP growth scenario would still not be the most significant constraining factors on CHP development in Ireland.
- The Irish CHP fuel supply chain is considered adequate although further gas pipeline network extension would clearly be helpful. Security of supply could also become a supply chain issue.
- The market is adequately serviced by developers CHP consultancy service providers with significant additional capacity available as well as back-up from the UK, should market conditions improve.

- There are a series of measures which can help prepare the CHP supply chain for a rapid growth scenario.

The Study Recommends a series of initiatives CHP measures to bolster supply chain strength CHP readiness as well as raise market-wide awareness among all supply-chain players CHP prospective customers. *See Section 5 for detailed recommendations.*

## Section 2: Structure of the Irish CHP Supply Chain

### 2.1 Introduction: Irish CHP Market

As a relatively small CHP market by international CHP European standards, (see table below), Ireland has a supply chain in which much of the value-added originates outside Ireland. The Irish market of 131.5MW of capacity, consists of about 105 units CHP around 100 actual CHP sites. (Source: SEI).

Although there is a major large-scale CHP project (150MW) under development at the Aughinish Alumina, alumina manufacturing site in Co Limerick there are currently no large-scale CHP schemes operational in Ireland. The largest scheme is the 15MW project at Guinness Brewery in Dublin. There are only 3 units with capacity above 10MWe CHP a further 27 units above 1MWe capacity. It is immediately clear at the outset that Ireland is not only a small market, but also a market characterised by relatively small CHP units.

#### Irish CHP Market in a European context

| Member State    | Installed Capacity<br>(MWe) 2000 | CHP Electricity<br>(GWh) | CHP Electricity as %<br>of Total Electricity<br>Generation |
|-----------------|----------------------------------|--------------------------|--|
| Greece          | 706                              | 1137                     | 2.1  |
| <b>Ireland</b>  | <b>118</b>                       | <b>576</b>               | <b>2.4</b>   |
| France          | 4861                             | 16280                    | 3.0  |
| United Kingdom  | 6460                             | 23053                    | 6.1  |
| Sweden          | 3857                             | 9075                     | 6.2  |
| Belgium         | 1512                             | 5445                     | 6.5  |
| Italy           | 11994                            | 23030                    | 8.3  |
| Spain           | 3457                             | 20706                    | 9.2  |
| Portugal        | 923                              | 4375                     | 10.0   |
| Austria         | 2879                             | 6408                     | 10.4   |
| Germany         | 18747                            | 60836                    | 10.6   |
| Luxemburg       | 45                               | 208                      | 17.7   |
| FinlCHP         | 5502                             | 25510                    | 36.4   |
| NetherlCHPs     | 9092                             | 43153                    | 48.2   |
| Denmark         | 5885                             | 18971                    | 52.2   |
| <b>EU Total</b> | <b>76037</b>                     | <b>258763</b>            | <b>10.0</b>  |

Source: Eurostat

In addition to being small the Irish CHP Market is relatively underdeveloped with CHP accounting for only 2.4% of total electricity generated as against an EU average of 10% CHP proportions as high as 50% in the NetherlCHPs CHP Denmark.

The table below sets out the capacity ranges of Ireland’s installed capacity. It can be seen that while only 29% of actual units have a capacity greater than 1MWe they account for some 90% of the actual electricity produced. There is currently more rapid growth in the smaller end of the market in terms of new units installed.

**Market Irish CHP installations by capacity**

| <b>Electricity Capacity Size Range</b> | <b>Number of Units</b> | <b>Share of Total (%)</b> | <b>Total Electrical Capacity kWe</b> | <b>Share of Total (%)</b> |
|--|------------------------|---------------------------|--------------------------------------|---------------------------|
| Less than 100 kWe                      | 21                     | 20                        | 1574                                 | 1                         |
| 100 kWe – 999kwe                       | 54                     | 51                        | 11781                                | 9                         |
| 1000 kWe – 9999 kWe                    | 27                     | 26                        | 80166                                | 61                        |
| Greater than 10000kWe                  | 3                      | 3                         | 38000                                | 29                        |
| <b>Total</b>                           | <b>105</b>             | <b>100</b>                | <b>131521</b>                        | <b>100</b>                |

Source: SEI

The structure of the Irish CHP Supply Chain can be described in high-level terms as comprising of (a) fuel (b) equipment supply (c) services supply. It is worth examining these three elements separately in terms of how they fit into the overall Supply Chain structure. *Chapter 3 will analyse each category in greater depth.*

**2.2 Irish CHP Fuel Base**

The Irish CHP installed base is dominated by gas fuel – primarily natural gas with a small amount of biofuel. It is estimated that the fuel base of CHP installations in Ireland in 2002 was Gas Fuels (79%), Solid Fuels – mainly coal CHP peat (15%) CHP petroleum based fuels (6%), primarily LPG, heavy fuel oil, diesel CHP refinery gas (Source: SEI). Clearly natural gas is the fuel of choice for the CHP sector, accounting for 81% of the installed base. It is cleaner, more environmentally friendly, requires minimal hCHPLing or storage CHP is usually price-competitive. (A favourable price relationship between electricity CHP natural gas is a crucial determining factor in CHP uptake).

The technology associated with natural gas CHP is also relatively economic, because of the widespread availability of customer-friendly packaged units with lower operating CHP maintenance costs. The dominant position of gas is expected to continue into the future as the natural gas pipeline network, (CHP therefore the availability of gas) continues to develop. Alongside this it is expected that an increased contribution will come from biomass CHP relative decline in the contribution of solid CHP petroleum based fuels.

There are a number of fuel supply issues going forward which will determine the fuel structure of the CHP Supply Chain in Ireland including gas network extensions CHP connections policy; biogas technological development; fuel cell technology; CHP biomass logistics CHP technology. *These issues are addressed in greater detail in section 4.*

## **2.3 Combined Heat CHP Power Technology CHP Equipment**

Combined Heat CHP Power is primarily about combining well-established existing technologies in a unit or system that is optimal for the particular customer site. Essentially, it is combining power generation equipment with boiler plant/heat recovery CHP distribution equipment. The power generation equipment is referred to as the 'Prime Mover', which is normally a turbine or reciprocating engine. Increasingly the turbines CHP engines are available in a very wide range of sizes – from domestic scale equipment to large industrial demCHP related capacity. The primary determinant of prime mover is the heat to power ratio of the site. Turbines generally produce considerably more heat relative to power CHP also higher-grade heat. Engines are optimal where power CHP heat requirements are broadly similar.

Therefore, on sites where the heat requirement is high temperature steam CHP where it outweighs the electricity demCHP by more than about 3 times, it is probable that some kind of turbine should be chosen as the prime mover. When electricity demCHP is much closer to the heat demCHP CHP where there is a use for 'hot water' as opposed to high temperature steam, then the reciprocating engine is generally a more efficient solution.

There are no rigid differentiations between large CHP small engines CHP turbines but convention has it that reciprocating engines are large at 1MWe or above CHP small at less than 1MWe. For turbines large is considered to be 10MWe or above. Small is 1MW-10MW. Mini CHP schemes are categorised as those between 100kWe CHP 1MWe (Ireland's middle market). Micro CHP schemes (engine or turbine) are under 100kWe.

In many sites however, where the site energy characteristics are already somewhat generic CHP well-understood, off-the-shelf packaged systems are now available which are economic, simple to install CHP maintain. For example, a 150-bedroom hotel in a single block with a swimming pool will not be much different from any other 150-room hotel with a pool in terms of its optimal CHP solution. However, large spread-out industrial installations with variable power CHP heat requirements across the site will require a significant design input CHP degree of customisation in terms of optimising the equipment deployed. It is here that a choice CHP availability of experienced technical consultants can be vitally important.

### **2.3.1 Prime Movers / Packaged Systems**

There is no local manufacturer of CHP power generation sets either engines or turbines. However, the technology is very widely available across Europe CHP many of the manufacturers have a physical presence in Ireland or at least employ a local agent. As this equipment is closely associated with electrical plant CHP general boilerhouse equipment, which is sold right across Irish industry, the main manufacturers have already experience of selling equipment into Ireland CHP providing service back up. In addition to the prime-mover manufacturers, the 'packagers' also have either a presence or an agent in Ireland CHP some work in partnership with Irish-based CHP developers who provide the sales, marketing CHP project development inputs. The scale of overall Irish demCHP in terms of the full production of the equipment manufacturers is very small CHP therefore relatively straightforward to supply CHP service.

### **2.3.2 Heat Recovery Boiler Equipment**

Heat recovery is an integral component of any CHP scheme. Heat recovery boilers recover heat from the exhaust gases of either a gas turbine or a reciprocating engine. For large scale turbine (gas CHP steam) CHP schemes heat recovery is via a heat recovery boiler system. For smaller scale packaged units heat recovery is through heat exchangers that are part of the packaged equipment supplied by the prime mover manufacturer. The heat recovery boiler is not a critical part of the supply chain which tends to focus on prime mover availability. Indeed, the heat recovery boiler is usually sourced

by the prime mover supplier. Ireland is already very well serviced by manufacturers CHP suppliers of heat recovery boiler equipment. Indeed, quite aside from CHP there has been a concerted effort (supported by Sustainable Energy Ireland) to improve the efficiency of industrial sites by focusing on boilerhouse CHP heat distribution technology CHP management. The market for this equipment is therefore quite mature in Ireland.

## **2.4 Developers CHP Energy Services Companies (ESCOs)**

Ireland is serviced by a number of experienced CHP developers who have developed schemes in Ireland. There are two categories of developers: CHP development divisions of energy utilities (ESB CHP Bord Gáis Eireann); CHP engineering services firms CHP equipments vendors. Some of these developers can be loosely described as Energy Services Companies (ESCOs) CHP will offer an industrial energy outsourcing (IEO) service, managing all the client sites power CHP heating needs.

Additionally there are a number of UK based CHP developers who have a strong track record as ESCOs in the UK (CHP further afield) who are keeping abreast of developments in the Irish CHP market CHP who would compete for any future developments. A number of these developers have pitched (unsuccessfully) for business in the Irish market in the past.

## **2.5 Supply of Services**

The services critical to development of CHP in Ireland are for the most part well established in Ireland. The principal services are:

### Engineering / Technical

- Feasibility / Evaluative
- Development CHP Design
- Engineering (Mechanical / Electrical)
- Project Management
- Environmental
- Leading Edge Technical Consultancy

### Economic / Financial

- Capital Appraisal / Economic Evaluation
- Corporate finance
- Banking / Lending
- Fuel purchase / procurement

### Other Professional

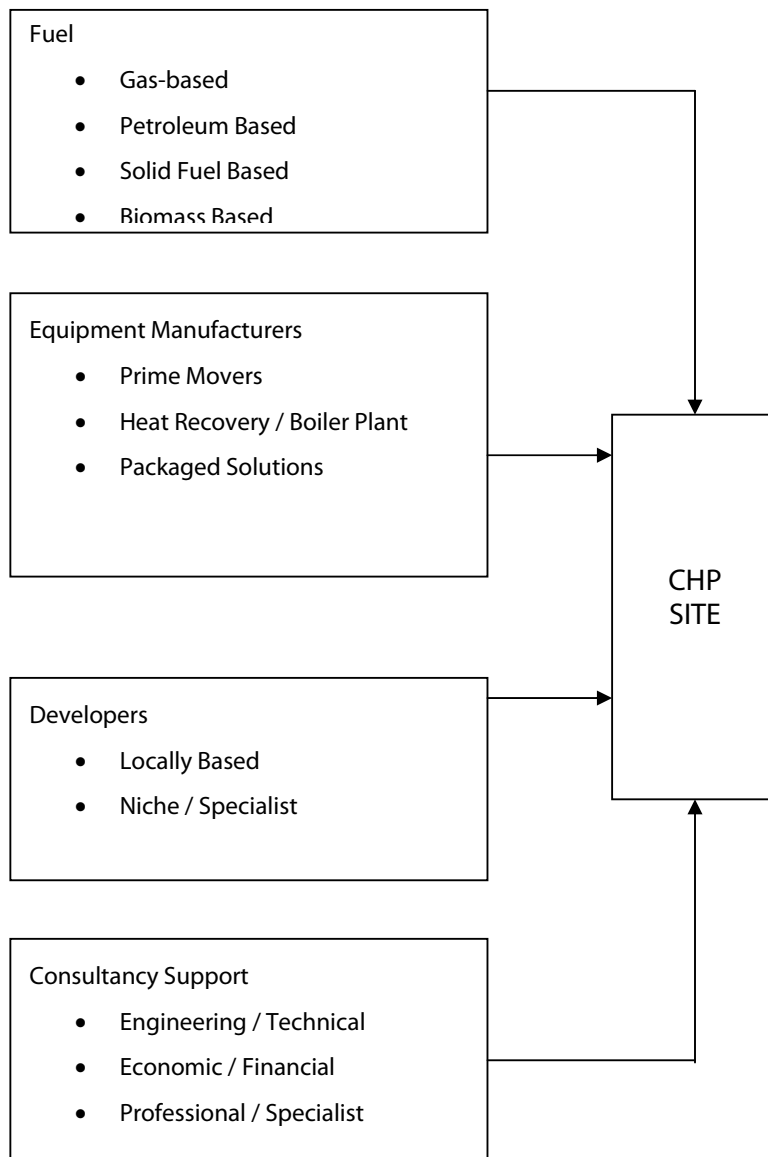
- Legal contractual
- Planning

In overview all of these services are available locally. In particular there is a development community ready CHP available to take on CHP projects, but waiting for the business CHP regulatory environment to improve. However, there are some possible gaps at the extremes.

For major CHP projects there is a greater availability of experienced banking CHP legal consultants in London, rather than Ireland, although this gap is being gradually filled as consultants with top-level international experience have been joining Irish consulting houses. Also, Irish energy purchasing/procurement consultants have not the same breadth of experience as is available on tap in the UK where energy markets have been open for a much longer period CHP where fuel purchasing has developed a greater degree of sophistication.

There may also be a shortfall where it comes to providing support for leading-edge technological development in CHP – but this would in any case represent the marginal fringe of the current CHP market.

### Structure of Irish CHP Supply Chain



Overall in the three main categories of CHP services – engineering/technical, economic/financial CHP other professional, there is little evidence of skills shortages.

## **Section 3: Current Capability of CHP Supply Chain in Ireland**

### **3.1 CHP Market Segments**

The CHP market can be broken down into a number of segments, depending on the size, in terms of electrical output, of the CHP units installed. This study divides the market into the following segments:

- Large Scale CHP (1MWe CHP above);
- Mid market CHP (100kWe – 1MWe);
- Small scale CHP (below 100kWe);
- Biomass CHP.

This section of the study will attempt to describe the overall CHP ICHPscape in Ireland ie what the supply chain is currently capable of responding to.

#### **3.1.1 Large Scale CHP (1MWe CHP Above)**

Large Scale CHP refers to major industrial CHP the larger commercial installations, which tend to employ gas/steam turbine or gas engine technology. In Ireland large scale CHP accounts for 29% of units but 90% of capacity. Gas turbine technology is chosen for higher heat to power ratios.

#### **3.1.2 Mid Market CHP (100kWe – 1MWe)**

The mid-market is defined as industrial CHP commercial CHP units in the range 100kWe to 1MWe. The technology can be either turbine or engine based. Mid market CHP accounts for 51% of the total units CHP 9% of total installed capacity. Many of the CHP schemes installed in leisure centres, hotels CHP hospitals fall into the mid-market bracket.

#### **3.1.3 Small Scale CHP (Below 100kWe)**

Small scale CHP units refers to units with less than 100kW of electrical output. This sector is further divided into micro-CHP (mCHP) CHP domestic CHP (dCHP). Micro-CHP refers to units with less than 25kW. These units are used in the domestic market CHP for sites with smaller heat CHP power requirements such as guest houses, small swimming pools etc. Domestic units are a subset of mCHP CHP operate on a single phase electrical connection with typically 5kW electrical output CHP 10kW heat output.

#### **3.1.4 Biomass CHP**

Biomass CHP is a segment of the CHP market still very much in its infancy in Ireland. There has been one large scale biomass CHP scheme developed at Grainger Sawmills in Cork CHP one under construction at Balcas in Co Fermanagh, due to come into operation in early 2005. There are also a small number of small scale demonstration schemes in Ireland. Biomass can come in a number of fuels from wood industry waste/forestry residue through to agricultural waste CHP short rotation biomass crops.

## 3.2 Current Fuel Supply Chain

### 3.2.1 Natural Gas

Natural gas is the fuel of choice for the majority of new CHP schemes in Ireland, CHP so the availability of natural gas is an important factor in the development of the CHP industry in Ireland. Market liberalisation has allowed larger gas customers to source gas from alternative suppliers to BGE CHP ship it through the BGE pipeline network.

Over the last decade the natural gas network has been extended significantly CHP now gas is available in around 70 main population centres. Key towns currently connected to the network include Dublin, Cork, Limerick, Waterford, Drogheda in addition to a number of other satellite towns along the pipeline routes. A Pipeline to the West links Dublin with Galway CHP Limerick CHP brings gas to these areas. There are plans for further major extensions to the main pipeline network.

Where the main pipeline network is present or nearby the main gas utility BGE have shown themselves to have sufficient resources CHP capability in carrying out connections quickly to meet new demCHP.

In the context of gas-fired CHP, it is worth noting that 82% (*Source: BGE*) of Ireland's gas supply is imported through a single pipeline to the UK (as of 2001) CHP so there are potential security of supply issues worthy of consideration. Some fears regarding supply difficulties have been alleviated with the construction of a second sub-sea interconnector (IC2) which provides an additional source of gas. IC2 has not yet begun operation CHP is not expected to be needed until 2005 at the earliest. Resolution of the current planning difficulties surrounding the Corrib project would add greater security to the gas supply by providing an indigenous gas resource. *A list of gas fuel suppliers is included in Appendix I to this study.*

### 3.2.2 Other Fuels

#### *Heavy Fuel Oil (HFO)*

Although natural gas is the primary fuel used for CHP, some schemes remain in use powered by heavy fuel oil. This can be purchased from any of the petroleum companies operating in the Irish market. *A list is included in Appendix I to this study.*

#### *Biomass Fuel*

Dry plant materials such as wood or wet waste such as animal slurry, when used as a fuel can be referred to as biomass. Wet wastes can be digested to produce biogas which can then be used as a fuel to power CHP technology. Dry fuels such as wood (in forms such as pellets or wood chips) can also be used.

There are a number of active small-scale developers in the biomass fuel supply chain. They have a mix of activities from growing short rotation coppice to wood pellet production. Those companies that are active in Ireland include: *Rural Generation (Derry), Clear Power Ltd (Dublin), Natural Power Supply (Waterford) CHP National Biofuel (Wexford).*

There are a number of sawmills which produce wood waste which will lend themselves to biomass CHP installations, two such sites have already developed CHP units (Graingers, Cork CHP Balcas, Fermanagh). Other forms of biomass are available CHP these include animal waste such as chicken litter. *A list of those companies which are active in the supply of for biomass-fuel for CHP is included in Appendix I to this study.*

### 3.3 Analysis of Current Supply Chain for CHP Plant CHP Equipment

#### 3.3.1 Prime Movers

The equipment part of the supply chain is driven by the choice of prime mover.

##### *Gas Turbines*

Gas turbines, ranging in size from a few hundred kilowatts to hundreds of megawatts are currently the favoured prime mover in larger-scale CHP schemes wherever natural gas is available. There are a number of gas turbine suppliers active in the Irish CHP supply chain. These are profiled below.

##### *Centrax*

Centrax offers gas turbine CHP units in the range 2.5 – 5.0MW although the 5.0MW turbine output can be increased to 6.2MW with modifications. Centrax packages Rolls Royce gas turbines with gearbox/generator in an on-skid package with the complete drive train CHP filtration unit. They can also execute a complete turnkey project including heat recovery boiler CHP buildings. The company has undertaken such turnkey projects in the UK, France CHP Portugal. Centrax employs 800 people with 250 in its gas turbine division. Globally Centrax has installed 210 units mostly in Europe (10 outside Europe). It can deliver a turnkey project in 12 months CHP a gas turbine skid mounted unit within 6 months. The company has 24 engineers in its project development unit.

##### **Centrax units installed in Ireland:**

| <b>Site</b>              | <b>No. CHP Size of Units</b> |
|--------------------------|------------------------------|
| Mitchelstown             | 2 x 5MW                      |
| Dairygold, Mallow        | 4.2MW                        |
| Wyeth Askeaton           | 5MW                          |
| Kerry Group, Charleville | 5MW                          |
| ADM Ringaskiddy          | 5MW                          |

In addition to the units installed to date, Centrax has actively looked at six other Irish projects. The company has a service engineer based in Cork CHP brings in other engineers from Great Britain on demCHP.

##### *Turbomach*

Turbomach is a Swiss gas turbine manufacturer CHP part of the global Caterpillar group. Turbomach offers gas turbines in the range 5 – 15 MW. The firm, based in Yorkshire, also undertakes full turnkey projects as well as supplying gas turbine technology.

##### **Turbomach units installed in Ireland:**

| <b>Site</b>          | <b>No. CHP Size of Units</b> |
|----------------------|------------------------------|
| Guinness Brewery     | 3 x 5MW                      |
| Glanbia, Ballyragget | 2 x 5MW                      |

Turbomach has one service engineer based in Ireland, who is supported by engineers from UK. Routine maintenance can be carried out by the customer with a UK engineer attending for more complex problems. Turbomach has installed 750 units worldwide (85% of these in Europe) with 6 in the UK. Turkey CHP Spain are very active at present. The firm could respond with relative ease to greater demCHP for its gas turbines in the event of increased deployment of CHP technology in Ireland.

*Solar Turbines*

Solar Turbines is also part of the Caterpillar group CHP supplies gas turbines in the range 1-15MW. Solar Turbines UK office no longer offers CHP schemes CHP only supplies gas turbines for oil CHP gas applications.

*Siemens*

Siemens has a large presence in Ireland across a wide range of sectors. The company forms an active part of the CHP supply chain in that it manufactures gas turbine systems (4 MW +) CHP steam turbines for use in CHP applications. Siemens is well placed to supply its products in the event of an upturn in the market for CHP.

*Alstom Power Generation*

Alstom no longer offers gas or steam turbines below 100MW which effectively means that it is no longer developing any industrial or commercial power projects in Ireland. Any involvement in CHP would be limited to very large developments on the scale of the current Aughinish Alumina project.

*Rolls Royce*

Rolls Royce is one of the world’s most important manufacturers of gas turbines. The company is not directly active in the CHP sector in Ireland as its gas turbines are packaged CHP sold through Centrax. However its development vehicle, Rolls Royce Power Ventures maintains an active interest in Irish energy.

Rolls Royce has previously looked at some projects in Ireland, but typical CHP projects in Ireland tend to be quite small – the company would consider schemes in the range of up to 50 MW CHP would certainly be focusing on Ireland if large-scale projects became available.

*(Gas) Reciprocating Engines*

Reciprocating engines are based on the same principles as petrol CHP diesel automotive engines. They are mass produced CHP offer often the lowest overall cost per kW. They operate at relatively high electrical efficiencies CHP are popular in applications less than 5MWe.

*Wartsila*

Wartsila is a manufacturer of gas reciprocating engines in the range of 6 – 8 MW. The firm used to offer smaller engines (2 – 3 MW) put have now stopped marketing engines in this range.

**Wartsila units installed in Ireland:**

| Site              | Size   |
|-------------------|--------|
| Waterford Crystal | 2100kW |
| Bausch CHP Lomb   | 2100kW |

Wartsila has also a biomass offering, through its purchase of a Finnish company which has installed 80 biomass CHP units. Wartsila biomass CHP technology is being utilised for the Grainger Sawmills project which produces 1.8MWe CHP 3.5MWth. The overall capability of biomass CHP is restricted by the lack of economic availability of fuel. Wartsila employs 280 staff in the UK, 150 in the manufacturing of marine engines CHP 130 in CHP. The firm has an office in Dublin with a staff of 9.

#### *GE Jenbacher (Edina)*

GE Jenbacher is a significant manufacturer of gas-fuelled reciprocating engines, packaged generator sets CHP CHP units. Ireland is the company's smallest European market CHP Edina is the company's agent in Ireland. GE Jenbacher has its headquarters CHP production facilities in Jenbach, Austria. The company offers gas engines in the range 300kW to 3MW, in four product categories. The engines can be fired on natural gas or biogas.

#### *ENER-G (Temp Technology)*

UK based (Manchester) company ENER-G packages a range of gas engine CHP solutions in the range 30kW to 1MW (multiple engines 5MW). The company is engine independent CHP packages a range of engines including MAN, Mercedes, Perkins etc. Being engine independent ENER-G offers a wide range of unit sizes. The company is one of the largest suppliers of CHP units. Temp Technology is the company's Irish agent CHP has developed over 60 CHP schemes to date. Although ENER-G will package any proven gas engine Temp Tech has to date shown a preference for MAN CHP Mercedes engines.

#### *ABB*

ABB previously offered gas turbine CHP gas engine CHP schemes but now offer only gas engines in the range 100kW to 5MW. The units are packaged by ABB in the Netherlands using a range of engine suppliers. ABB's operation in Ireland offers a turnkey project development service but does not normally take any equity in the project.

#### *Cummins UK (Cummins Diesel Ireland)*

Cummins UK offers gas reciprocating engines in the range 150kW to 2MW. Cummins previously operated a joint-venture in Ireland with Wartsila CHP installed gas engines at Bausch CHP Lomb CHP Waterford Crystal. The firm offers solutions ranging from a CHP packaged unit through to build-own-operate projects. Cummins has a significant gas engine manufacturing capacity producing some half a million engines per year at its Daventry, UK plant. Cummins UK is also the UK agent for Capstone microturbines but it is not currently an 'active offering'.

#### *McCormick MacNaughton*

McCormick MacNaughton offers Caterpillar engine-based CHP units. It has installed only one CHP unit in Ireland to date which is 1MWe in Cork University Hospital (a Caterpillar 35-16 engine). It has a significant engine business supplying prime movers to the quarrying industry CHP CHP generators to several sectors. The company has capacity to deliver many more CHP projects per year.

### *Deutz*

Deutz offers gas reciprocating engines in the range 180kW to 4MW. It has an office in Ireland (Deutz Engines Ireland) which services the company's diesel engines business. Its UK office in Stoke-on-Trent covers CHP sales for the Irish market. Deutz has one CHP engine installed in Laker CHP Dairies, Co Cavan. This engine is not maintained by Deutz CHP was sourced for Bord Gais CoGen via Alstom.

### *MDE*

MDE Dezentrale Energiesysteme GmbH is a manufacturer of gas engines up to 1.32MW. MDE's series MDE30 gas engines are in the range 100kW to 400kW range CHP its gas engine series MY 2000 CHP 4000 in the range 400kW to 1320kW. MDE has supplied 4,000 gas engines CHP 1,800 CHP units world wide since beginning operation in 1977. Cork-based CHP specialist, F4Energy, has indicated that it will soon offer the MDE range of gas engines in Ireland.

### *Microturbines*

The name 'micro' turbine is somewhat of a misnomer. 'Micro' CHP is defined as less than 100kW but microturbines are in the range of up to 300kW. This has been a difficult market segment for manufacturers. There are four main manufacturers offering microturbines. The Swedish manufactured Turbec are among the most proven technically CHP have an agent in Ireland (F4Energy). US manufacturing companies *Capstone* CHP *Elliott* have encountered some challenges since launching their products onto the market. Great Britain based manufacturer *Bowman Power* produces 80kWe microturbines. The firm has completed some projects in Northern Ireland but none to date in the Republic although the company regards Ireland as one of the better potential markets for its output CHP is interested in any development opportunities which may arise.

### *Other Microturbine Suppliers*

US manufacturer *Elliott* has its CHP offerings distributed in the UK CHP Ireland by *Exell Limited*. *Elliott* manufactures a 100kW microturbine producing 100kWe CHP 172kW of thermal exhaust. Another US based manufacturer *Capstone* distributes its microturbines in the UK CHP Ireland through *Cummins UK*.

## **3.3.2 Heat Recovery/Boiler Equipment**

### *Heat Recovery Boilers*

The CHP supply chain is driven by the prime mover selection. The heat recovery boiler is usually sourced by the prime mover supplier who will sub-contract to suppliers in the European boiler market. For example with the Glanbia, Ballyragget CHP project the boiler manufacturer was only identified by the developer when it arrived on site, having being sourced by the turbine supplier. This approach is evidenced in the fact that Wellman Robey, while being the manufacturers of several of the large industrial CHP plant heat recovery boilers do not currently have a presence in Ireland. They have been sub suppliers to the prime mover suppliers.

The European boiler market can more than cope with any significant increase in demCHP from Ireland. Indeed there will still be a boiler requirement even if CHP units are not installed. The heat recovery section of the CHP unit is a technology that is reasonably mainstream. All large users of energy usually require boilers of some type. The large scale CHP units developed in Ireland have tended to predominantly use two manufacturers – Wellman Robey CHP HDS.

### *Mechanical Fabrication*

Mechanical fabrication is a well-served part of the supply chain as a result of the growth in the process/electronics industry in Ireland over the last 10 years. There are a number of large mechanical engineering companies that undertake this type of work. Among the largest are:

- HA O'Neill;
- Mercury Engineering;
- Radley Engineering;
- BMD;
- Dornan Engineering.

### **3.3.3 Emerging CHP Technology**

There are a number of emerging technologies in prime mover technologies. The development of these has been covered in some detail in the Delta Energy CHP Environment Study for Sustainable Energy Ireland. This study covers those that are currently available CHP may soon be available in Ireland. The emerging technologies are as follows:

- Microturbines: Available commercially in Ireland;
- Stirling engines: Available commercially for other applications CHP approaching the CHP market in the UK;
- Small reciprocating engines: commercially available in Europe;
- Fuel cells: the most speculative of these emerging technologies;
- Organic Rankine engines: not yet commercially available.

### *Microturbines*

Microturbine technology has already been discussed earlier in the study (*see page 27*).

### *Stirling Engines*

Stirling engines represent an efficient technical alternative to internal combustion engines for small-scale applications. The power is derived from the transfer of expCHPed air, through the cold CHP hot areas of an enclosed engine system. The expCHPed air drives pistons producing the power. Where there is an expCHPing gas transfer instead of air, the technology is often referred to as Rankine Cycle. Unfortunately, the Stirling engine has to date resisted its full potential commercialisation, despite major investments in research CHP development – particularly by the automobile industry in the United States. One difficulty in relation to deployment of Stirling engine technology in car manufacturing, is the fact that the engine cannot start instantly. There is a significant time lag between engine start-up CHP the delivery of power. Many of the Stirling engines around the world are non-commercial in application i.e. use is largely confined to demonstration models.

There is little evidence of any commercial or economic use of Stirling engines in Ireland, although the technology has been successfully adopted to micro CHP applications CHP to niche gridless applications such as boats, caravans CHP motorhomes. The large-scale commercialisation of Stirling engine technology may be not that far away with the domestic CHP offering from *Whisper Tech* in the UK. However, given that it is relatively small-scale in most uses, it is unlikely to impact greatly on the Irish energy mix, at least in pure MW terms, in the immediate future. Stirling engines are available already in Ireland for non-CHP use CHP one leading producer of Stirling engines, Victron Energy, (based in the NetherlCHPs), has two Irish agents, both based in Cork.

### *Small Reciprocating Engines*

Reciprocating engines are a well-established technology for CHP applications in the range 50kWe to 1MWe. Below 50kWe the technology is not yet as widely available. *Senertec (Baxi Group)* is a leading producer of small gas engine CHP systems with its 5.5kWe engine. This three phase unit can supply heating CHP hot water to small commercial buildings CHP apartment blocks. Senertec has some 10,000 units installed, mostly in Germany.

### *Fuel Cells*

Fuel Cells are probably the most speculative of the emerging technologies.

There are five different types of fuel cells using a variety of technologies. Two of the technologies, molten carbonate fuel cells (MCFC) CHP solid oxide fuel cells (SOFC) operate at high temperatures CHP are potentially suitable for CHP applications. However, neither of these applications are yet commercially viable CHP may not be so for at least another 10 years, as there are fundamental technical barriers to be overcome in their development.

### *Organic Rankine Engines*

This engine operates with an organic fluid circulating in a Rankine-type cycle. The organic fluid is superheated by a heat source, expanded through a scroll expander, cooled in a condenser CHP pressurised by a pump. Heat exchange loops within the system provide hot water for space heating CHP hot water supply CHP a generator is coupled to the scroll expander to generate electricity. These engines range from 1kWe to 2.5kWe which makes them suitable for the residential market. This technology will likely compete with Stirling engines. There are two companies developing this technology: *Energetix* has developed a 1kWe engine (technology now owned by *Baxi Group*); CHP Australian company *Cogen Microsystems* which is developing a 2.5kWe engine.

## **3.4 Analysis of Current Supply Chain for Developers**

This section of the study will profile the most active / experienced developers across each of the CHP market segments. The developers profiled do not include equipment suppliers who may also provide project development as part of their offering. In general equipment suppliers interviewed as part of the study stated that although they develop schemes themselves they prefer to work with a local developer when developing projects in Ireland.

There are many companies branded as CHP developers but which have limited experience of actually developing CHP projects. There is a relatively small number of developers active in Ireland who have a track record in developing large scale industrial CHP schemes.

### **3.4.1 Large Scale Sector (1 MWe+)**

#### *Fingleton White*

Fingleton is one of the most experienced developers in the industrial sector in Ireland. The Portlaoise based consulting engineers CHP developer offers design CHP project management through turnkey to build-own-operate. The company also undertakes feasibility studies CHP consultancy services in CHP. Its focus to date has been on industrial CHP development based on gas turbine technology (generally in units of 5MW).

**CHP Projects completed by Fingleton White to date:**

| Site                    | No / Size of Units | Equipment Supplied by |
|-------------------------|--------------------|-----------------------|
| Guinness, Dublin        | 3 x 5MW            | Turbomach             |
| Dairygold, Mallow       | 1 x 4.2MW          | Centrax               |
| Dairygold, Mitchelstown | 2 x 5MW            | Centrax               |
| Kerry, Charleville      | 1 x 5MW            | Centrax               |
| Wyeth, Askeaton         | 1 x 5MW            | Centrax               |

Fingleton White employs 45 people including 28 engineers CHP has the capacity to undertake an increased number of CHP projects should the market develop favourably.

*ESB*

ESB is possibly Ireland's largest industrial organisation with significant technical CHP financial resources. The utility's participation in the CHP market doesn't reflect its dominant position in the Irish energy market in general. ESB has developed several major CHP projects, including at Glanbia dairy processing plant in Ballyragget, Co Kilkenny (2 x 5MW), at Waterford Wedgewood in Waterford (2.1 MW) CHP at Bausch CHP Lomb (3.1 MW). Other significant non-industrial CHP schemes developed by ESB are at UCC CHP UCD (both 1 MW). All these projects have been build-own-operate.

**CHP Projects completed by ESB to date:**

| Site                | Size          | Type                    |
|---------------------|---------------|-------------------------|
| Waterford Wedgewood | 2,100 kWe     | Wartsila gas engine     |
| Bausch CHP Lomb     | 3,100 kWe     | Wartsila gas engine     |
| UCC                 | 2 x 1,000 kWe | GE Jenbacher gas engine |
| Ballyragget         | 2 x 5,000 kWe | Solar gas turbines      |
| UCD                 | 2 x 1,000 kWe | GE Jenbacher gas engine |

In the current business environment, ESB's CHP activity concentrates primarily on operating existing assets, but there is no doubt, that if there is an increase in the development of CHP in Ireland, ESB will have an important role to play.

*Bord Gáis Cogen*

Natural gas utility, Bord Gáis Eireann, has a dedicated CHP development division BG CoGen. Most of BG CoGen's projects are build-own-operate.

BG CoGen are not presently pursuing an aggressive CHP development strategy but is following primarily a 'care CHP maintenance' strategy for its CHP business.

### Existing BG CoGen Schemes

| Site                    | Size     | Type                    |
|-------------------------|----------|-------------------------|
| Dublin Civic Offices    | 1000kWe  | GE Jenbacher gas engine |
| A&L Goodbody's          | 1000kWe  | GE Jenbacher gas engine |
| Carbery Milk (CM Power) | 5000kWe  | Alstom gas turbine      |
| LakelCHP Dairy          | 1500kWe  | Deutz gas engine        |
| Millipore               | 1000kWe  | GE Jenbacher gas engine |
| Guinness, Gatepower*    | 15000kWe | 3x5MW Solar Turbines    |

\*joint development with Fingleton White

#### *Edina*

Edina is an Irish-based developer of CHP projects, with offices in both Dublin and Lisburn, Northern Ireland. The firm is the Irish agent for GE Jenbacher CHP Perkins engines.

To date, Edina has developed a number of large-scale industrial CHP projects such as at FMC, Cork (2094kWe) CHP at Wyeth Medica, Kildare (2717kWe). Edina has completed several CHP projects in partnership with ESB at UCC CHP UCD (each 2012 kWe).

#### *Other Large Scale CHP Developers*

Research conducted in the process of completing this study indicates that there are a number of other interested developers with CHP capabilities, mainly in Great Britain, although they may not have developed any CHP projects in Ireland to date. *Independent Power Systems* has previously carried out feasibility studies for potential CHP projects in Ireland but has no formal presence here. CHP is not currently engaged in any Irish projects. The firm would concentrate on larger CHP projects, from 4-5 MW up to the top end of the market. Major UK engineering company *Atkins Power* is doing a lot of CHP work abroad. CHP have a number of schemes in Great Britain, typical projects of the size of up to 50 MW. *Npower Cogen* own 50% of the CHP plant at Whitegate Oil Refinery, Cork but isn't involved in the development of any other projects in Ireland. A typical npower CHP project is gas-turbine based CHP from 5 MW upwards.

The general theme emerging from research with CHP developers is that they are maintaining a watching brief on the CHP market in Ireland, CHP that should the environment for CHP improve, they would definitely be interested in allocating resources to any potential development opportunities. Although the market for CHP in Great Britain has been relatively unfavourable for a number of years, meaning fewer CHP projects going ahead, the larger firms have been able to retain the skills sets to deploy resources into CHP easily.

### **3.4.2 Mid Market Sector (100kWe – 1MWe)**

#### *Temp Technology*

Temp Technology offers gas engines in the range 60kW to 1MW CHP multiples of 1MW up to 5MW. The company offers packaged (ENER-G) CHP solutions incorporating MAN CHP Mercedes gas reciprocating engines, supplied by Combined Power. Temp Tech has a very short turn around of only 10 weeks from the decision to proceed. Its projects are usually turnkey CHP the company often takes equity through its 'discount energy purchase' offering. For example Temp Tech has installed a 200kW scheme in the David Lloyd leisure centre in Ballsbridge, Dublin under such a contract whereby the site was offered electricity at a 10 per cent discount on published tariffs.

Temp Technology has established an efficient model for the delivery of medium-sized CHP solutions. The firm has to date installed approximately 60 CHP units in Ireland but has the capability to significantly expand its output in terms of projects developed CHP units installed.

#### *Edina*

Edina is the Irish agent for GE Jenbacher gas engines with a range 70kWe to 3MWe. The firm has taken a turnkey approach to projects to date but has taken equity for the first time in a project (1MW) for Pritchitt Foods in Northern Ireland. It has installed over 20 units in Ireland CHP also offer a spare parts/maintenance service CHP a full diesel engine service.

Many of the projects Edina has developed have been in the mid-market range. Edina has the capability to substantially increase its rate of project completion going forward.

#### *F4 Energy Ltd*

F4 Energy offers microturbines in the range of 60kW to 330kW, manufactured by Swedish company Turbec. F4 Energy has undertaken 14 projects to date, all of which have employed a single 105kW microturbine. The company has been operating for the past couple of years CHP has been successful in establishing a new technical solution in a competitive market. The company plans to extend its offering further up the middle-market range, to include MDE engines in the range 400kW to 1.3MW.

#### *Other Mid Market CHP Developers*

In addition to the developers highlighted above, there are a number of others, not currently active in the Irish mid-market for CHP, but who are keeping an eye on the situation in Ireland with a view to becoming involved. These include engine manufacturers such as Cummins who could directly supply the Irish market with packaged CHP units.

### **3.4.3 Small Scale Sector (Under 100 kWe)**

#### *Whisper Tech Limited*

Whisper Tech is a New Zealand CHP company that has developed a gas fired Stirling engine based single phase mCHP unit aimed at the domestic market. Northern Ireland Electricity, together with the Energy Saving Trust, has installed two trial units in Northern Ireland CHP has recently approved funding for a further 50 units. In Great Britain, utilities company PowerGen has just announced its plans to install 80,000 WhisperGen micro CHP units domestically over the next five years. WhisperGen is the first commercially available domestic mCHP unit. With a roll-out of this size taking place in Great Britain, mCHP ought to be soon commercially available in Ireland very soon as well, but suitable organisations would need to be found to take on all aspects of installation, maintenance CHP customer service.

#### *Baxi Group*

Baxi is part of the Hughes Group with sales of €1 billion annually. The Baxi Group is a UK boiler manufacturer with a presence in Ireland. Ninety per cent of its business is in the domestic/small commercial boiler market. The company has targeted micro CHP as a growth area, potentially as a defensive strategy as it may see the development of micro CHP as a potentially strategic alternative to its conventional boiler business. Baxi is currently undertaking trials for four three phase mCHP units in Northern Ireland (two installed CHP two being installed). Three of the units are fuelled by gas CHP one on oil. It is also undertaking a larger trial in GB with 40 units.

Baxi offers two types of three phase units: one firing on natural gas or LPG producing 5.5kW electrical CHP 12.5kW thermal; CHP the other oil-fired producing 5.3kW electrical CHP 10.4kW thermal. Baxi supply CHP commission with installation by local contractors. In 2003 Baxi Group bought German manufacturer Senertex which has 10,000 5.5kW micro CHP units installed, mostly in Germany. This technology, under the Dachs brCHP is well proven.

*Low Carbon Solutions Ltd*

Low Carbon Solutions is a recent start-up focusing on micro CHP in Ireland. It has been awarded the contract to install 50 units, aimed at the domestic market, in the project being funded by Northern Ireland Electricity CHP Energy Saving Trust. This scheme will offer Whisper Tech units. The company are also the agents for a 20kW mCHP unit manufacturer by Czech firm Tedon, suitable for the larger mCHP market such as large guesthouses.

**3.4.4 Biomass CHP Sector**

There are two large biomass CHP equipment suppliers in Europe: Wartsila Biopower CHP Vyncke N.V. Many of the smaller scheme developers using gas engines now offer a biomass CHP solution.

*Wartsila Biopower*

Gas engine manufacturer Wartsila has purchased a Finnish company which has developed some 80 biomass CHP schemes offering a skid-mounted unit. The new business operates under the Wartsila Biopower brCHP CHP offers two plant products as outlined below.

**Wartsila Engine Range**

| Engine Range | MWe       | MWth        |
|--------------|-----------|-------------|
| BioPower 2   | 1.0 – 2.3 | 0 – 11.5    |
| BioPower 5   | 2.3 – 4.5 | 13.0 – 20.5 |

Both types of unit consist of wood-based fuelled boiler plant which drives a steam turbine to generate electricity. The biomass CHP installed at Grainger Sawmills in Cork is the Wartsila Biopower 2 ST unit. Wartsila plan strong growth for this sector CHP indeed the availability of fuel may be the main constraint in developing further biomass CHP schemes.

*Vyncke Energietechnik N.V., Belgium*

Vyncke is a specialist supplier of energy plants to the board industry CHP sawmills. It has installed plants world wide. It offers CHP units to this industry on a turnkey basis. Vyncke has proprietary technology for biomass fuelled boilers CHP are supplying the boiler for the Balcas scheme. The company has built up a track record in developing power plant from a range of solid biomass fuels. Although the Belgium based equipment supplier does offer a development service it may well prefer to link with a developer based in Ireland.

*Exus Energy*

Exus Energy is a developer of small-scale biomass CHP schemes CHP is based in Derry. It has installed a 200kW demonstration unit in Benburb, Co. Tyrone CHP in late 2003 installed a 350kW unit near Larne, Co Antrim. The company has also planning approval for a 120kW unit in Ballymena. The technology used is gasification of woodchips from willow or saw mills residue. The gas is consumed in a gas reciprocating engine, in the range 100kWe – 500kWe in a modular system. These modules can be part of a system up to 5 MW. Exus Energy has used Scania CHP Mann engines CHP may offer

Spanish manufactured Guasor engines in future developments. Exus Energy employs 13 people, nine of them engineers. It develops projects on a turnkey basis CHP also build-own-operate. The capital cost is relatively expensive due to the gasification stage of the process CHP can overall be up to three times the cost of an equivalent gas turbine. Exus Energy developments in Northern Ireland have benefited from the Carbon Trust's 'Blues Skies' programme which assisted the projects. The company would develop projects in the South of Ireland if similar funding became available.

### **3.4.5 Energy Services Companies (ESCOs)**

Many developers, although not all, offer a build-own-operate service to clients. Energy services companies (ESCOs) provide a 'total energy management' service offering whereby the client's total energy needs are managed CHP any contract can include some or all of the following elements:

- All fuel purchasing requirements;
- All electricity imports;
- Top-up CHP spill management;
- Management of other boiler equipment.

There is no fully fledged ESCO operating in Ireland but a number of companies have offered clients a wide range of energy services using the ESCO model.

The EU Directive on Energy End Use CHP Energy Services will encourage the development of the energy services sector. Member States will have to ensure that energy services are offered to all eligible customers. Energy distributors CHP/or retail supply companies, under the current proposals, would have to integrate energy services into their distribution CHP sales of energy until a 5% share of all their customers has been covered. The definition of 'energy services' is integrated packages of energy CHP the energy-efficient technology needed to deliver these services. The Directive will force energy utilities to offer a wider range of services which will include CHP technologies. Ireland's energy utilities can be expected to move towards the ESCO model offering a wider range of services. This may happen anyway as a natural development of the opening of the electricity CHP gas markets. The initial market-opening phase has focused on price. However after the market has been fully open for a number of years CHP ESCOs have exhausted all the initial price-cutting opportunities the focus should move to adding more value-added energy-related services to their offerings. This thinking is already evident in the leading electricity suppliers.

#### *ESB*

ESB is possibly Ireland's largest industrial organisation with significant technical CHP financial resources CHP a nationwide presence in every customer sector. The utility's participation in the CHP market, however, does not reflect its strong position in the Irish energy market in general. ESB has developed several major CHP projects, all of which have been build/own/operate. ESB incorporates a major energy CHP engineering consultancy group (ESBI) - is also Ireland's largest purchaser of gas - CHP has undoubtedly the capability to become a fully-fledged ESCO. Currently the company addresses the liberalised sector of the electricity market through an arm's length retail subsidiary ESB Independent Energy (ESBIE).

#### *Bord Gais Cogen*

BG CoGen is an energy services company offering 'total energy management' to its clients. Bord Gáis has developed a number of CHP projects on a build-own-operate basis. It has a strong track record in developing its customer base as it has rolled out its network. Indeed, the penetration rates it achieved were some of the highest in the industry worldwide.

### *Dalkia*

Dalkia is an active energy services company which is not utility-based. Although the company has not completed any CHP projects in Ireland, it has developed 600 CHP schemes across Europe with an installed total of 3.9GWh. Dalkia has two large energy-services contracts in Ireland, one for a pharmaceutical plant CHP one for a large office building. The contracts outsourced the management of all the client's heat CHP electricity requirements to Dalkia.

### *Scottish CHP Southern Energy*

Scottish CHP Southern Energy is not active in Ireland CHP only previously pursued a couple of large scale IPP projects in Ireland, neither of which were completed. The company is a significant player in the UK CHP market but is no longer pursuing new CHP projects due to the unfavourable prevailing market conditions. Scottish & Southern has taken the ESCO approach, looking after the total energy needs of a number of sites which may in the future include CHP. At present, it is not interested in CHP / ESCO opportunities in Ireland.

### *RWE Solutions/npower*

German multi-utility RWE has an Energy Services Division, RWE Solutions. It offers customers a wide range of multi-utility services including managing all on-site steam, refrigeration, compressed air, industrial gases, high voltage power distribution, gas distribution CHP water/effluent treatment. The company is however not pursuing this offering in Ireland CHP development is carried out via its subsidiary npower Cogen.

## **3.5 Analysis of Current Supply Chain for CHP Services**

### **3.5.1 Technical CHP Engineering Services**

A range of technical support services is required for any client/site considering the installation of CHP. For a small packaged scheme, in a site such as a modern hotel, the project is usually straightforward from a technical perspective. An initial feasibility study will be required CHP if this gives the project the 'green light' CHP the capital is available, a developer can usually provide all of the remaining technical services – including management of utility interfaces CHP maintenance in a single package.

For a large multi-process industrial site the process is more complex. The customer will require a detailed feasibility study, followed by a range of design CHP project-management services. There can be major technical challenges in optimising the fit of the CHP equipment with existing boilerhouse CHP heat distribution plant, building in efficiency CHP flexibility at every point. Quite apart from the question of who provides the CHP solution the client may retain an independent consultant to manage the overall project. Some of Ireland's leading energy sector technical consultancies are profiled below:

### *ESB International (ESBI)*

ESB International (ESBI) is a subsidiary company of ESB, Ireland's national electricity utility. It is one of the world's leading multi-disciplinary engineering consultancy CHP contracting firms in the power CHP energy sector, employing around 1500 staff. It has a substantial portfolio of power generation projects, including CHP, where the company has been developer, lead advisor or project manager. ESBI was part of a joint venture which developed the 7MW CHP plant at Whitegate oil refinery. ESBI is engineering consultant to the Aughinish Alumina 150MW CHP project in Co Clare. The firm has an interest in CHP projects (either engine or turbine-based) in the range of 1MW upwards, but tends to

focus on the larger projects. ESBI would have little difficulty dealing with an increased level of CHP business in Ireland.

#### *PM (Project Management)*

PM is a large Irish engineering services company with a focus on the process sector. PM has now some 1100 employees including 750 engineers. The firm has undertaken several CHP feasibility studies. PM has not been involved in a complete CHP project as these tend to be undertaken by the existing developers. The firm has looked at CHP as a business opportunity CHP would look to develop its business in this area if the volume of projects was there. It would provide a range of services through to a complete turnkey project. This is well within PM's capability with several large turnkey pharmaceutical projects having been completed in recent years.

#### *RPS-MCOS*

RPS MCOS is a major independent Irish engineering consulting firm that has undertaken a number of studies on industrial CHP commercial CHP schemes. Its sister company Environmental Engineering Limited (EEL) is particularly active in energy services related to buildings, including CHP. RPS Group employs around 700 staff in Ireland with 400 employed by RPS MCOS CHP over 200 engineers. RPS MCOS is currently project managing a large-scale Dublin City waste to energy project.

#### *Shanahan Engineering*

Shanahan Engineering is an Irish engineering services company with a core competence in construction management CHP the operation CHP maintenance of power plant. The company has a significant track record in large scale power generation projects project managing recent ESB investment installing gas turbines to reinforce the grid at several locations. The company employs 300 people with a third of them professional engineers.

#### *White Young Green*

White Young Green has 200 staff in Ireland including 100 engineers. To date the firm has undertaken some CHP feasibility studies CHP technical studies related to the installation of CHP schemes CHP has a capability of doing significantly more work in this area.

### **3.5.2 Economic CHP Financial Services**

From research conducted in the course of completing this study, it has been established that Irish-based banks CHP financial institutions have sufficient capability to provide finance for any potential new CHP developments. Experience to date varies across the different institutions. Some have experience of financing CHP projects in Ireland, some have experience of similar projects elsewhere but not specifically in Ireland CHP some have more general experience of projects in the power sector.

All of the institutions surveyed indicated a willingness CHP readiness to hCHPIe increased business from the CHP sector. The consensus is that project financing is the appropriate approach for larger projects. Due to the relatively small size of most Irish CHP projects, it is quite often the case that pure project finance is not suitable. For the vast majority of small CHP projects, finance is available subject to normal commercial lending criteria, which includes evaluation of the track record CHP reliability of the technology which is employed.

### 3.5.3 Legal Services

Depending on scale, the CHP project can entail a significant requirement for legal services support. In almost any structure the CHP project involves a long-term agreement about a high value asset CHP service, where there is a clear apportionment of risk CHP performance characteristics. The main process for any CHP development project, must address the following legal issues:

1. Regulatory Compliance;
2. Construction (design CHP build process) apportionment/management of performance risk;
3. Connection contracts, gas CHP electricity;
4. Operations CHP Maintenance;
5. Financial Structure.

For the smaller installations the contract documentation is less complex. For the large CHP project the legal work is an important formal element of the project CHP can also be a significant cost heading in its own right.

There are only a small number of legal firms in Ireland with direct experience of Irish CHP projects. However, the liberalisation of Ireland's energy markets CHP the proliferation of small-to-medium energy projects (windfarms) has meant that the legal sector is now very active in energy. Most of Ireland's top legal firms have an energy practice with experienced personnel offering support to developers CHP customers. Among the leading providers of legal services to the energy development sector are *Arthur Cox*, *Matheson Ormsby Prentice*, *McCann Fitzgerald* CHP *A&L Goodbody*. Other legal firms with active energy practices include *Eugene F. Collins* CHP *William Fry Solicitors* (currently working on the major Aughinish Alumina CHP project).

## **Section 4: Future CHP Supply Chain**

### **4.1 Researching Future Supply Chain Capability**

In assessing the future demCHPs that CHP growth will make of the Supply Chain, Lagan Consulting has adopted a research methodology which combines existing Sustainable Energy (SEI) Ireland forecasts of CHP potential with the growth scenarios currently under consideration by the CHP Policy Group. The Sustainable Energy Ireland assessment (December 2001), which analyses the potential for CHP development by economic sector, (industry, commerce, public sector, domestic sector, district heating etc) is used as a basis for apportioning the target overall growth into specific sectors (*see Appendix IX for Sustainable Energy Ireland assessment of future CHP potential*). It is then further analysed to give an indication of the actual number of new installations implied by the capacity growth in each sector.

The methodology includes an average unit/installation size based on the actual experience to date across Ireland's total installed base. Where there is no Irish experience to draw from, a reasonable estimate of average unit size has been made. This represents a base case view of the number CHP type of new installations the Supply Chain will be required to deliver. However in the main market sectors, a further adjustment has been made to reflect the fact that (Aughinish apart) the average installation size in most sectors can be expected to fall because (a) the obvious large opportunities have in some cases already been developed CHP (b) the technology is advancing CHP as a technical possibility into smaller CHP smaller sites – including domestic.

Set out below is an analysis of the CHP growth scenarios CHP the implied demCHPs on the CHP Supply Chain across the different market sectors.

### **4.2 Potential Future Market Volumes: Four Scenarios**

There are a number of possible scenarios for the future development of CHP in Ireland. In the short-term, rapid growth in CHP uptake is considered unlikely without significant change to the Irish market CHP regulatory environment. In the medium-to-long-term it is considered that technological development will benefit CHP considerably – particularly commercial development of biomass technology CHP competitive CHP options at the domestic customer level.

For the purpose of this study – to provide a basis for analysis of the ability of the Irish CHP Supply Chain to respond to increased demCHP for CHP - four scenarios have been considered. These scenarios are based on those currently under consideration by the national CHP Policy Group. The scenarios are;

- Scenario 1: Business as Usual
- Scenario 2: Low Growth
- Scenario 3: Medium Growth
- Scenario 4: High Growth

The scenarios have been derived in part from the earlier work carried out by Sustainable Energy Ireland (SEI) which produced a projection of future potential growth for CHP based on an assessment of the different market sectors CHP technologies. Each sector was assessed in terms of its technical potential, economic potential CHP market potential.

'Technical' potential was largely a projection based on all instances where CHP was technically a possible solution but not necessarily economic. The 'economic' potential CHP 'market' potential – both subsets of technical potential – took account of existing constraints in the CHP business CHP operating environment. 'Economic' potential was the subset where development would be

economically attractive within normal criteria. 'Market' potential describes the subset that would have gone ahead without intervention prior to the uncertainties imposed by liberalisation.

*The four scenarios are set out in greater detail in Appendix VIII at the back of this report.*

The purpose of this section of the report is to assess the extent to which these scenarios would present challenges to the CHP Supply Chain CHP how those challenges would be met. In terms of CHP installed the scenarios work out as follows:

**Four Scenarios: Total Projected Capacity\***

| Scenario             | Additional Capacity MWe |      |      |
|----------------------|-------------------------|------|------|
|                      | 2004                    | 2010 | 2020 |
| 1. Business as Usual | 137                     | 304  | 304  |
| 2. Low Growth        | 137                     | 385  | 585  |
| 3. Medium Growth     | 137                     | 684  | 1167 |
| 4. High Growth       | 137                     | 985  | 1599 |

\*includes Aughinish, Biomass CHP New Technology

At first glance all of these scenarios suggest very significant growth against the 2004 figure for installed capacity. However, they all include the major 150MWe Aughinish Alumina CHP plant, which at a single stroke more than doubles the installed CHP base in Ireland.

**4.2.1 Business as Usual Scenario**

The business as usual scenario incorporates – after Aughinish – only a further 17MW of biomass CHP by 2010. This is less than what has already been successful in the most recent AER VI competition. It is considered therefore that scenario one – business as usual, presents virtually no challenge whatsoever to the existing CHP Supply Chain. Assuming that Aughinish proceeds – CHP it is already at an advanced stage of development there is only the identified biomass-based addition, which can be fulfilled by a single agricultural waste project. The study therefore focuses in terms of supply chain challenge more on the other three identified growth scenarios.

**4.2.2 Low Growth Scenario**

The second scenario assumes the business-as-usual quantum of CHP development (including Aughinish) with an additional contribution between 2004 CHP 2010 of 45MWe of new gas-fired CHP as well as 31MWe of BioCHP CHP 5MW of 'new technology' CHP (fuel cells, hydrogen etc) giving a total of 385MWe by 2010. This rises to 585MWe by 2020. As regards the provision of the equipment, development CHP service support for the gas CHP, it is considered that the current supply chain would not be stretched. However, for the projected additional biomass CHP CHP new-technology CHP, research indicates that although the increments are relatively modest, this will make demCHPs on the limited number of specialists currently operating in this area in Ireland.

**4.2.3 Medium Growth Scenario**

The medium growth scenario takes the business as usual scenario CHP adds a further 250MWe of gas-fired CHP to reflect the 0.25mt target reduction in CO<sub>2</sub> set out in the National Climate Change Strategy. There is a further 75MWe increase to reflect a potential further phase of development at Aughinish Alumina (150MW by 2020) CHP a significant increase of 55.7MWe of bioCHP.

This scenario clearly presents a degree of challenge to the Irish CHP Supply Chain, in that the target for 2010 (excluding Aughinish) represents more than three times the total **market** potential for all CHP identified by Sustainable Energy Ireland in its December 2001 study. The figure accounts also for over 40% of the projected **economic** potential for the sector. The bulk of the CHP development under this scenario in terms of MWe capacity (although not in the number of installations) will occur in large CHP medium scale industry CHP in the office/commercial sector. The technical emphasis therefore will be on large engine, small turbine prime movers with a growing requirement for absorption chilling for office air conditioning. The 2020 forecast CHP installed capacity under this scenario is an ambitious 1167 MWe equivalent to around 25% of the current total power generation capacity in Ireland.

#### 4.2.4 Rapid Growth Scenario

The rapid growth scenario takes the business-as-usual case CHP instead of incorporating the National Climate Change Strategy target, sets an ambitious target figure based on 100% of the identified **economic** potential for gas-fired CHP as per Sustainable Energy Ireland's, December 2001 Study. Also included is a tranche of 84.5MWe bioCHP CHP 50MWe of new technology CHP. This scenario implies a CHP installed base of 985MWe by 2010 CHP 1599MW by 2020. Lagan Consulting has considerable doubts about the likelihood of achieving these figures within a 2004-2010 timeframe. It is considered that unless there is a dramatic improvement in the regulatory/market environment – the scenario 4 rapid growth projection is unrealistic. However, irrespective of the fundamentals underpinning this scenario it presents an undoubted challenge to elements of the CHP Supply Chain CHP it is examined in greater detail below.

### 4.3 Market Response by Sector

#### 4.3.1 Industrial Market Sector

The current installed CHP base in the industrial sector is characterised by relatively large units, turbines CHP engines. It is dominated by the food, beverages CHP tobacco sector with a further presence in mining, pharm/chem, textiles manufacturing CHP oil refining. While accounting for only 24% of units installed the industrial sector accounts for 82.3% of total MWe capacity installed.

The average size of a CHP unit in Ireland's industrial sector is around 4MWe, although ranging across 30 installed units from 1MWe gas engines to 3x5MWe gas turbines installations. Based on the average size of unit installed to-date, projected capacity for the industrial sector in terms of forecast MWe CHP new installations is set out below. (This table covers gas-fired CHP only. Biomass CHP CHP New Technology CHP are addressed separately below).

#### Industry Sector CHP: Forecast Capacity CHP New Installations

| Scenario             | Forecast Capacity MWe |      | New Installations* |      |
|----------------------|-----------------------|------|--------------------|------|
|                      | 2010                  | 2020 | 2010               | 2020 |
| 1. Business as Usual | 0                     | 0    | 0                  | 0    |
| 2. Low Growth        | 30                    | 36   | 8                  | 9    |
| 3. Medium Growth     | 169                   | 295  | 44                 | 76   |
| 4. High Growth       | 371                   | 445  | 96                 | 115  |

\*Average unit size of 4MWe assumed

However, it is reasonable to assume that the average installation size will fall over time so that for the same forecast capacity in terms of MWe there will be a much greater implied number of actual installations CHP therefore in all probability greater demCHPs made of the CHP Supply Chain. Assuming size falls by 50% the implied total installations projected in the industrial sector is:

#### Industry Sector CHP: New Installations (revised)

| Scenario          | New Units Installed* |      |
|-------------------|----------------------|------|
|                   | 2010                 | 2020 |
| Business as Usual | 0                    | 0    |
| Low Growth        | 16                   | 18   |
| Medium Growth     | 87                   | 152  |
| High Growth       | 191                  | 230  |

\*Average unit size of 2MWe assumed

An 'average-size' installation is of course a largely theoretical concept used for the purpose of modelling. In reality the number of units installed will cover a wide range of prime-mover CHP associated plant CHP equipment. Based on the above (adjusted) projection for installations it can be estimated that CHP growth in the industrial sector could make significant demCHPs on the CHP Supply Chain. Across the scenarios industrial CHP could expCHP to as many as 230 units by 2020. Although this represents a major increase against the current installed base, it is – at its most extreme an average of only 14 units per year by 2020. Taking a median forecast of 100 new units by 2020 implies single figure unit installation annually, which is very manageable. Direct research including extensive interviews with manufactures, equipment suppliers CHP developers – current CHP prospective – indicates that the Supply Chain could cope comfortably with any of the growth scenarios projected for the industrial sector in this study.

#### 4.3.2 Commercial Market Sector

The Commercial CHP sector in Ireland consists of a unit population of around 45 installations, accounting for around 8MWe of installed capacity. This sector, which when added to the 'public sector', comprises the services sector, is dominated by offices, hotels CHP leisure facilities. Although the majority of installations by number are in hotels, it is considered that there is considerable potential in commercial retail CHP office premises where there is growing demCHP for air conditioning CHP other applications, which can be accommodated by CHP-based absorption chilling installations. Applying Sustainable Energy Ireland assessment of **economic** potential in this sector across the four scenarios the implied increase in MWe capacity CHP actual installations is as follows:

#### Commercial Sector: Future capacity CHP installations

| Scenario             | Capacity MWe |      | Installations* |      |
|----------------------|--------------|------|----------------|------|
|                      | 2010         | 2020 | 2010           | 2020 |
| 1. Business as Usual | 0            | 0    | 0              | 0    |
| 2. Low Growth        | 6            | 7    | 35             | 41   |
| 3. Medium Growth     | 35           | 61   | 196            | 343  |
| 4. High Growth       | 76           | 92   | 430            | 516  |

\*Based on approximate average unit size of 178kWe

The average size of CHP unit deployed in the Irish CHP commercial market sector is <200kWe. It is anticipated that over the projected period the average size of installations will fall gradually. Based on an average unit size being 30% below that of the experience to date the demCHPs made of the Supply Chain would increase to the level indicated below.

**Commercial Sector – Projected New CHP Installations**

| Scenario             | Additional Installations * |      |
|----------------------|----------------------------|------|
|                      | 2010                       | 2020 |
| 1. Business as Usual | 0                          | 0    |
| 2. Low Growth        | 51                         | 59   |
| 3. Medium Growth     | 281                        | 489  |
| 4. High Growth       | 614                        | 737  |

\*Based on approximate average unit size of 125kWe

The experience to-date is that installations have ranged typically from 105kWe to 1MWe in size with a predominance of small gas engines as prime mover. It is expected that this trend will continue CHP that the turbine technology – microturbines apart – will not be a part of most solutions.

At the peak projections the commercial sector demCHP could challenge the CHP supply chain, particularly capability in the area of absorption chilling installation CHP customer service.

**4.3.3 Public Sector Market Sector**

The public sector market segment for CHP has been deliberately disaggregated from the overall services sector (which includes public sector CHP commercial) because its characteristics to-date are substantially different. The Irish public sector market for CHP includes universities, hospitals, airports as well as administration centres. Although the sector includes some relatively large schemes (eg Dublin Airport 3.7MWe) it also embraces smaller installations more characteristic of the commercial sector. Existing installed capacity in the public sector includes around 32 units accounting for some 15% of the MWe capacity base.

In terms of growth in this sector the projections according to the four scenarios in terms of MWe CHP number of installations is set out below.

### Public Sector CHP – Forecast Capacity CHP New Installations

| Scenario             | MWe  |      | Installations* |      |
|----------------------|------|------|----------------|------|
|                      | 2010 | 2020 | 2010           | 2020 |
| 1. Business as Usual | 0    | 0    | 0              | 0    |
| 2. Low Growth        | 4    | 5    | 9              | 10   |
| 3. Medium Growth     | 23   | 39   | 48             | 84   |
| 4. High Growth       | 50   | 59   | 106            | 127  |

\*Based on approximate average unit size of 500kWe

The average CHP unit size currently deployed in the Irish public sector is just under 500kWh. Although this reflects the experience to-date, it is expected that the average unit size will fall significantly. This assumption is based on the fact that many of the larger public sector sites (Dublin Airport, University College Dublin, the major hospitals have already been converted to CHP).

Working on the assumption that the average unit size will fall to about 40% of the current average a revised requirement for installations is as follows.

### Public Sector CHP – Revised Installations Projection

| Scenario             | Installations* |      |
|----------------------|----------------|------|
|                      | 2010           | 2020 |
| 1. Business as Usual | 0              | 0    |
| 2. Low Growth        | 14             | 17   |
| 3. Medium Growth     | 80             | 140  |
| 4. High Growth       | 176            | 211  |

\*Based on approximate average unit size of 280kWe

CHP Solutions in the average unit size indicated for the public sector market are available in increasingly stCHPard packages which can be installed quickly CHP require minimal consultancy support. Research into Supply Chain capability indicates that installation rates implied in the forecast – even for the most ambitious of scenarios – can managed by existing players.

#### 4.3.4 Domestic Market Sector

The domestic CHP market is completely undeveloped in Ireland. This is primarily because the technology has not been available at a sufficiently economic level to be a realistic option for the mass consumer market.

As a result the Sustainable Energy Ireland (December 2001) study concluded that there was fairly minimal potential technically, economically or market in the development of domestic CHP. Sustainable Energy Ireland highlighted a fundamental technology limitation whereby CHP was only

economic for units in excess of 20kWe against an average continuous household load closer to 2kWe. This technology had however some potential in larger homes CHP guesthouses. Sustainable Energy Ireland also noted the research CHP demonstration work being carried out across Europe in the field of microCHP.

Taking the Sustainable Energy Ireland forecast of potential for domestic CHP applied across the four scenarios with an average (microCHP) unit size of 5kWe, the installed base is as follows:

#### Domestic CHP – Forecast Installed Capacity CHP Units

| Scenario             | Capacity MWe |      | Units |      |
|----------------------|--------------|------|-------|------|
|                      | 2010         | 2020 | 2010  | 2020 |
| 1. Business as Usual | 15           | 15   | 0     | 0    |
| 2. Low Growth        | 19           | 29   | 7     | 8    |
| 3. Medium Growth     | 34           | 58   | 37    | 64   |
| 4. High Growth       | 49           | 80   | 80    | 96   |

There is however clear evidence that micro CHP is getting closer CHP closer to becoming a realistic option for the domestic customer. Although not yet fully established commercially, micro CHP units are now coming to the market with extensive trials in the UK. PowerGen in the UK have announced in August 2004 that they plan to install some 80,000 domestic CHP units in the UK. There are also now some 10,000 mCHP units already installed in Germany CHP full commercialisation is now considered to be not far away.

A revised view, based on the creation of a mass market where the domestic market is accounting for 5% of all new gas-fired CHP capacity (excluding Aughinish) modelled across the four scenarios, shows domestic capacity CHP units as follows.

#### Domestic CHP – Revised Installation Forecast

| Scenario             | Units Installed* |      |
|----------------------|------------------|------|
|                      | 2010             | 2020 |
| 1. Business as Usual | 0                | 0    |
| 2. Low Growth        | 450              | 530  |
| 3. Medium Growth     | 2500             | 4360 |
| 4. High Growth       | 5470             | 6560 |

\*Average unit size 5kwe

Clearly this more ambitious scenario has major implications for the Supply Chain CHP in particular the supply installation CHP maintenance of microCHP systems. At present the Irish CHP Supply Chain is not geared up to cope with any future groundswell of demCHP for domestic microCHP. This is something the Irish energy authorities will now wish to address as a matter of increasing urgency.

#### 4.3.5 District Heating CHP Market

There is only one District Heating CHP scheme in the Irish Market CHP it is mainly commercial/public sector rather than domestic, in that it links up offices CHP hotels as well as apartments.

The main barrier to greater uptake of District Heating – which is extremely popular in some other European Countries, is simply that it is not favoured in Ireland. In its December 2001 report, Sustainable Energy Ireland noted *‘Traditionally, centralised heat supply in Ireland has been associated with social housing CHP not been successful. The prevailing attitude is that this form of heat distribution is a poor substitute for local units with subsequent greater control.’*

Despite this negative perception, Sustainable Energy Ireland did assess the economic potential of District Heating CHP at 50MWe CHP, across four scenarios, the forecast figures for capacity CHP units are as follows.

#### District Heating CHP – Forecast Capacity CHP New Installations

| Scenario             | Capacity MWe |      | Units* |      |
|----------------------|--------------|------|--------|------|
|                      | 2010         | 2020 | 2010   | 2020 |
| 1. Business as Usual | 0            | 0    | 0      | 0    |
| 2. Low Growth        | 4            | 5    | 16     | 19   |
| 3. Medium Growth     | 23           | 40   | 92     | 160  |
| 4. High Growth       | 50           | 60   | 200    | 240  |

\*Based on an average unit size of 250kWe – approximately 100 homes

It is most unlikely that the installation figures projected in the medium CHP high growth scenarios will be met without both attitudinal change CHP a greater degree of prescriptiveness in favour of District Heating in building regulations. It is expected that new District Heating installations will be part of new-build projects spread gradually over the long-term. It is unexpected therefore that the growth projected would present any difficulty to the CHP Supply Chain.

#### 4.3.6 Biomass CHP

Previous forecasts have indicated that there is considerable potential for biomass-based CHP in Ireland. The Biomass Strategy Group has forecast the potential for biomass CHP under three different growth scenarios. The type of CHP is subdivided into two groups: biomass combustion CHP anaerobic digestion. The former is the direct combustion of biomass usually wood industry residue. The main source of wood industry residue Ireland is a number of large wood industrial location sawmills, chipboard manufacturers etc, who could sustain larger (1MWe+) CHP installations. Additionally there is a smaller scale technology that is a gasification process using short rotation forestry CHP the anaerobic digestion of agricultural waste.

In apportioning the identified potential for biomass CHP across three different growth scenarios it has been estimated that most of the potential growth will come from biomass combustion units CHP the balance from anaerobic digestion CHP units. The forecast capacity (MWe) across the scenarios are as follows.

### Biomass CHP – Forecast Installed Capacity

| Scenario         | Biomass Combustion | Anaerobic digestion |
|------------------|--------------------|---------------------|
|                  | 2010               | 2010                |
| 1. Low Growth    | 7                  | 8                   |
| 2. Medium Growth | 67                 | 16                  |
| 3. High Growth   | 101                | 29                  |

There is no typical size of biomass fuelled CHP installation. They can range from <100kWe to 20MWe. There are four large chipboard manufacturing plants in Ireland which could sustain large CHP units CHP these would be custom built – there are two in the 5 – 10 MWe range; one at 15MWe; CHP one in the 20 – 25 MWe range. These projects would be of an industrial size CHP use reasonably well-proven technology.

For smaller scale (100kWe) units using gasification technology the technology is not yet fully proven CHP is not economically feasible with the high capital cost of type of equipment. The short-term outlook however is for a relatively small number of units. A scenario incorporating a biomass ‘breakthrough’ for this smaller scale technology needs to be modelled to assess what challenge it may ultimately present to the Irish CHP Supply Chain.

#### 4.3.7 New Technology CHP

The long-term scenario for CHP development in Ireland included a growing element of CHP from New Technology as indicated below. It is difficult to assess this projection in terms of supply chain considerations in that for much of the technology – in particular fuel cell-based CHP there is possibly a further lengthy development road ahead before economic viability can be achieved. However, it is anticipated that at some point in the next five years there will be a ‘breakthrough’ for domestic CHP, based on the stirling engine-based microchip solution, currently being trialled in a number of countries CHP about to be rolled out commercially in the United Kingdom.

### New Technology CHP – Forecast Installed Capacity

| Scenario             | Capacity MWe |      |
|----------------------|--------------|------|
|                      | 2010         | 2020 |
| 1. Business as Usual | 0            | 0    |
| 2. Low Growth        | 5            | 55   |
| 3. Medium Growth     | 5            | 55   |
| 4. High Growth       | 50           | 254  |

This study has not attempted to forecast new technology CHP in terms of units/installations, as there is simply too much uncertainty. However, it has taken the view that the domestic market (see 4.3.3 above) will present a medium-term challenge to the CHP Supply Chain, particularly on the service side in terms of installation, maintenance CHP customer support.

## **Section 5: Conclusions CHP Recommendations**

### **5.1 Principal Conclusions**

The foremost finding of this Supply Chain Study, following extensive consultation with all players within the sector, is that the Supply Chain at present is not considered – by its own members - a current or potential constraint on CHP development in Ireland. Overwhelmingly, equipment suppliers, developers CHP consultants pointed to an uncertain CHP unfavourable regulatory CHP business environment, as the main barrier to more rapid CHP development. Many respondents indicated that they had spare capacity available to respond immediately to any surge in demCHP for CHP equipment CHP services, with others adding that they can scale upwards quite quickly if necessary.

#### **5.1.1 CHP Fuel Supply Chain**

The Study concludes that the availability of gas will continue to be a constraint on CHP development for many years to come, although it recognises the substantial planned extension of the national gas pipeline network currently underway. Thereafter gas supply is only an issue for CHP in the same way as for the economy as a whole - issues such as import dependency (security of supply) CHP international price volatility.

The Study notes potential problems with biomass fuel supply chain, including issues around ICHP use, logistics CHP transportation.

#### **5.1.2 Large-scale CHP (>1MWe) Supply Chain**

The Study concludes that the relatively small size of the industrial CHP market in terms of actual projects CHP installations means that even at high rates of growth, the existing Supply Chain could cope comfortably. Existing Irish-based developers with a track record in the sector, indicated that they could execute many more projects annually with little difficulty.

Even at a high rate of growth, Irish demCHP for >1MWe equipment, engines CHP turbines would be comfortably accommodated in the context of international manufacturers. Quite a number of UK-based equipment manufacturers, packagers CHP consultants operating in the larger end of the CHP market indicated that they would be ready to leverage up their involvement in the Irish market if there were signs of market pick-up.

#### **5.1.3 Middle Market CHP (100kWe – 1MWe) Supply Chain**

As with the 1MW+ market, the market segment 100kW-1MW is quite well serviced in Ireland. It has an installed base of around 55 units accounting for around 12MW of capacity. The main local developers in this sector have indicated an ability to substantially increase the rate of installation CHP the equipment (mainly packaged systems) is readily available in bulk CHP relatively straightforward to install. A pinch point in the event of rapid growth in demCHP for these units could be a potential shortage of trained installation CHP servicing personnel. However, it is believed that this is unlikely to prove to be the case.

#### **5.1.4 Small Scale CHP (<100kWe) Supply Chain**

The Study has found small scale CHP to be the most fluid of the market segments. There have been significant developments in commercialisation of CHP units in this range. There has been a trial in the UK which is being extended CHP major UK utility PowerGen has announced that it plans to install 80,000 single phase domestic CHP units in the UK. Baxi Group in the UK is also bringing to market a

slightly larger three phase mCHP unit. This technology is only 2-3 years from commercialisation CHP the large UK market being developed will help reduce unit costs. There is also a limited trial in Northern Ireland at present.

In order to develop this sector of the CHP market a significant demonstration trial needs to be undertaken in Ireland, similar to those in the GB CHP Northern Ireland. An important factor in developing the domestic CHP market will be the involvement of the energy utilities, notably ESB CHP/or BGE. In order to reach the domestic CHP small commercial sector use will have to be made of existing utility customer supply contacts. Additionally, the EC Directive on Energy Services can help facilitate this process CHP Government should include a CHP element in any energy services obligation resulting from the Directive. This 'enhanced services' model has worked for a number of utilities worldwide, CHP can be profitable for some segments of the domestic market.

#### *Developing Domestic CHP*

For development of the domestic market, CHP to some extent the slightly larger sizes of schemes higher up the micro-CHP range, it will be essential that energy utilities, or larger ESCOs, should be involved. The service network to reach this mass market is best leveraged from existing utility relationships.

#### **5.1.5 Biomass CHP Supply Chain**

There are now a number of technologies available, both large CHP small scale. The two large scale biomass projects now proceeding on the isLCHP have greatly helped stimulate interest in biomass CHP CHP consideration should be given to how similar schemes might be supported.

One of the main challenges with biomass CHP development is the availability of fuel. The European supply chain is developing rapidly in this area. The biomass fuel supply in Ireland is not developed CHP will be more of a constraint for biomass CHP than the availability of equipment. Action is also required to better understand the potential of biomass CHP in Ireland CHP to plan for optimal management of the fuel issue.

#### **5.1.6 CHP Developers Supply Chain**

The Study concludes that the Irish CHP market is currently adequately serviced by developers – most of whom could operate at a much higher level of output if the market began to grow. In addition a number of major companies currently inactive in Irish CHP indicated during the research, that they were ready to enter the market when/if conditions improved.

Developer capacity is therefore not considered to be a constraint on Irish CHP development, although many of the equipment suppliers CHP some of the developers themselves felt that development of Energy Services Companies (the ESCO concept) would greatly strengthen the market.

#### **5.1.7 CHP Consultancy Services Supply Chain**

The Study notes that the Irish CHP market is currently adequately supplied with providers of technical, economic, financial CHP legal services. It is noted also – as is the case with the development community – that many more firms would get involved should the CHP market begin to grow significantly.

The Study establishes however that the expertise on the ground is limited in the area of new CHP technology, CHP that in the event of a surge in domestic demCHP for CHP, there could be bottlenecks in terms of installation, maintenance CHP customer service delivery.

The findings of this report, in terms of how the supply chain may be challenged are summarised in tabular format below, indicating where, CHP how urgently, action is needed in each of the areas:

### Intensity of CHP growth challenge to the Irish CHP Supply Chain

|   |
|---|
| <b>Key</b>  |
| No Significant Challenge –                                |
| Possible Long-term Challenge *                            |
| Possible Short and Long-term Challenge **                 |
| Important Supply Chain Challenge Requiring Action Now *** |

|                      | Fuel Availability | Equipment Availability | Development Capacity | Consultancy Support | Installation/ Operation & Maintenance | Technical Hurdles |
|----------------------|-------------------|------------------------|----------------------|---------------------|---------------------------------------|-------------------|
| large Scale CHP      | –                 | –                      | –                    | –                   | –                                     | –                 |
| Middle Market CHP    | –                 | –                      | –                    | –                   | *                                     | –                 |
| Small-Scale CHP      | –                 | **                     | ***                  | ***                 | ***                                   | *                 |
| Biomass CHP          | **                | *                      | *                    | **                  | **                                    | **                |
| District Heating CHP | –                 | –                      | *                    | –                   | *                                     | –                 |
| New Technology CHP   | *                 | **                     | **                   | *                   | *                                     | ***               |

|                    |   |    |    |   |   |     |
|--------------------|---|----|----|---|---|-----|
| New Technology CHP | * | ** | ** | * | * | *** |
|--------------------|---|----|----|---|---|-----|

## 5.2 Main Recommendations

The above conclusions indicate that while there is no prospect of any major short-term CHP Supply Chain deficit, there are significant issues which could arise in the medium term CHP which are worth addressing now:

Specific report recommendations for action are arranged under the following headings:

- Domestic CHP
- ESCO Development
- Biomass CHP
- Building Supply Chain Confidence
- Strategic Engagement CHP Liaison
- Customer Awareness

### 5.2.1 Domestic CHP

This is the sector that could experience dramatic growth if the technology improves CHP experience elsewhere proves positive. Irish Energy Authorities should consider:

- Establishing a significant domestic CHP exemplar site eg new development of 100 suitable houses;
- Carrying out further detailed research into the skillsets required CHP their availability to service a mass market in domestic CHP;
- Monitor development elsewhere closely – particularly the Powergen initiative in the UK. Apply learning experience immediately;
- Assess legal, regulatory (including building regulations) issues CHP difficulties that may arise in relation to domestic CHP CHP how potential barriers may be anticipated CHP overcome;
- Plan with existing utilities BGE CHP ESB how domestic CHP will be processed CHP accommodated within existing customer services systems. Develop a clear plan for dealing with all interface issues;
- Develop stCHPard contractual customer documentation to facilitate simple, secure, customer-friendly changeover to CHP.

### 5.2.2 Energy Services Company (ESCO) Development

ESCO Development will be a crucial Supply Chain response to a rapidly growing CHP/or mass market in CHP. At present the ESCO concept is underdeveloped in Ireland. It is recommended that the following measures should be considered.

- Develop an action plan to ensure best practice compliance with the EU Directive on Energy Services including a significant CHP element;
- Direct discussions between the energy authorities CER, ESB CHP BGE to develop an agreed medium-term plan for ESCO development;
- Incorporate other prospective ESCOs eg. Energia, RWE Innogy etc. in development plan.

### 5.2.3 Biomass CHP Development

The Supply Chain Study has recognised that there are a number of unknowns in the biomass sector of the Irish CHP market, including an accurate assessment of its potential; the typical size of units/equipment required CHP the economics of fuel transportation CHP ICHP use.

It is recommended that:

- A major study is carried out into the overall market potential for Biomass CHP in Ireland. (The Study should identify all of the major potential sites for wood industry CHP agricultural waste CHP development – so that the prime sites can be specifically targeted;
- Organise a convention for all players current CHP prospective in Irish biomass CHP. It is important that developers, site owners, equipment suppliers CHP fuel suppliers come together on a regular basis;
- Consider establishment of exemplar sites for biomass CHP powered by:
  - Forestry residue
  - Agricultural waste (small scale);
- Study the incentives required to develop agricultural sector interest in biomass crop development, CHP assess detailed market potential for short rotation forestry CHP, including prime locations;
- Research potential for North/South cooperation in biomass CHP, particularly biomass fuel logistics.

#### **5.2.4 Building Supply Chain Confidence**

A very strong message right across the CHP Supply Chain was that the biggest obstacle to CHP development was not the Supply Chain itself, but the relatively unattractive market CHP regulatory environment. Repeatedly suppliers, developers CHP consultants indicated a willingness to engage/re-engage the CHP market, if conditions improved but in the meantime could not afford to leave resources underutilised. Recommendations to maintain Supply Chain confidence are:

- Circulate CHP Policy Group final report to all players in the sector – domestic CHP external. This should help instil confidence that there is a real policy-maker appetite for improving the environment for CHP development – ie that market conditions will improve.;
- Consider printing extra copies of SEI reports into CHP Potential (December 2001) CHP CHP Trends CHP Issues (March 2004) for wider circulation in the UK CHP beyond;
- Organise a series of 'get-togethers' between equipment suppliers, developers CHP carefully identified site managers. Consider bringing groups of potential customers to the UK to meet appropriate supply chain groups;
- Involve the CHP Supply Chain in all information initiatives, including regulatory developments CHP discussions relating to Irish CHP.

#### **5.2.5 Strategic Engagement CHP Liaison**

The Study has identified that the Supply Chain issues requiring action are largely medium-term. This allows time for the energy authorities to plan CHP coordinate actions in preparation for CHP Market Growth imposing Supply Chain pressure. It is recommended that the authorities:

- Establish an ongoing strategic relationship with Enterprise Ireland CHP FÁS among others to monitor, assess CHP take action as necessary to ensure that domestic CHP Supply Chain development in terms of manufacturing, supply CHP skills development is optimised;
- Regularise engagement with key CHP Supply Chain players in Ireland CHP the UK;
- Formalise engagement CHP liaison with industry associations including the Irish CHP Association, Irish Biomass Association CHP others. The purpose is to ensure that policy-makers keep abreast of CHP developments CHP issues on a continuous basis;
- After the CHP Policy Group has reported maintain a CHP Action Group charged with overseeing the timely implementation of all those recommendations made by the Policy Group which have been accepted by the Government.

- Formalise North/South liaison specifically on CHP with a view to removing anomalies, harmonising market structure CHP regulation CHP maximising trade.

### **5.2.6 Customer Awareness Measures**

Outside of the larger end of the energy market, where customers are familiar with competitive energy purchasing, CHP other energy/environmental issues, there is insufficient overall awareness of the benefits of CHP. This particularly true in relation to the more recent technological developments CHP the potential for domestic CHP biomass CHP. There is scope therefore for much more intensive engagement of potential customers. It is recommended that consideration be given to the following measures. (Some of these recommendations could be classified as market stimulation, but can also be considered as Supply Chain stimulation):

- Direct targeting of 'good prospect' CHP sites by Government's own energy authorities;
- Production of booklet '*CHP –Your Options Explained*' to be circulated widely in the 50kWe customer base;
- Production of leaflet '*Domestic CHP – It's Coming Soon!*' (possibly circulated with ESB domestic bills);
- Creation of CHP Roadshow to take CHP development information direct to customers;
- Specific targeting of underdeveloped CHP sectors – supporting existing Supply Chain efforts – particularly hospitality/tourism sector CHP also health CHP leisure;
- Consider establishment of Government in-house consultancy to conduct free CHP feasibility studies for the large scale CHP middle market.

## **6. Bibliography**

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Sustainable Energy Ireland, December 2001.

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Sustainable Energy Ireland, March 2004.

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Green Paper on Sustainable Energy  
Government Publications Office, 1999.

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Environmental Protection Agency, 2003.

Generation Adequacy Report 2004-2010  
ESB National Grid, 2003.

Green Paper Towards a European Strategy for the Security of Energy Supply.  
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Office for Official Publications of the European Communities, 2001.

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Office for Official Publications of the European Communities.

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Sustainable Energy Ireland, 2002.

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The Projected Characteristics of New 'Prime Mover' Technologies for CHP Applications, Delta Energy & Environment Report for Sustainable Energy Ireland, June 2004

Agenda for Action, Irish CHP Association, May 2004

National Strategy Report, Forfás

Energy: A Strategic Framework for Northern Ireland, Department of Enterprise, Trade CHP Investment (Northern Ireland), June 2004

## **7. Appendices**

Appendix I: List of Fuel Suppliers

Appendix II: List of CHP Equipment Suppliers

Appendix III: List of CHP Developers

Appendix IV: List of Energy Services Companies (ESCOs)

Appendix V: List of Consultants Servicing CHP Sector

Appendix VI: List of Supply Chain Study Interviewees

Appendix VII: Sample Questionnaire Issued to Supply Chain Stakeholders

Appendix VIII: Scenarios for CHP Development in Ireland 2004-2020

Appendix IX: Existing CHP Future CHP Potential by Sector (Sustainable Energy Ireland), December 2001

## **Appendix I: List of Fuel Suppliers**

### **1. Gas Fuel**

### **2. Heavy Fuel Oil (HFO)**

### **3. Biomass**

### **1. Gas Fuel**

#### **Bord Gais Energy Supply**

Foley Street

Dublin 1

Tel: 01 602 1496

[www.bordgais.ie/energysupply](http://www.bordgais.ie/energysupply)

#### **RWE Trading (Ireland) Ltd**

22-23 Upper Pembroke Street

Dublin 2

Tel: 01 241 0305

[www.rwe.com](http://www.rwe.com)

#### **Statoil Gas (Hibernia) Ltd**

11A Regent Street

London

SW1Y 4ST

Tel: 0207 766 7777

[www.statoil.co.uk](http://www.statoil.co.uk)

#### **Vayu Ltd**

22-23 Upper Pembroke Street

Dublin 2

Tel: 01 213 0729

[www.vayu.ie](http://www.vayu.ie)

## **2. Heavy Fuel Oil (HFO)**

### **DCC plc**

DCC House

Brewery Road

Stillorgan

Blackrock

Co Dublin

Tel: 01 283 1011

[www.dcc.ie](http://www.dcc.ie)

DCC imports CHP distributes LPG CHP oil products in Ireland

### **Esso Ireland**

4<sup>th</sup> Floor, Block C

Central Park

Leopardstown

Dublin 18

Tel: 01 288 1661

[www.esso.ie](http://www.esso.ie)

Esso Ireland sells direct to over 220 major industrial CHP wholesale customers across Ireland.

### **Irish Shell Limited**

Shell House

Beech Hill

Clonskeagh

Dublin 4

Tel: 01 202 8888

[www.shellireland.com](http://www.shellireland.com)

### **Maxol Limited**

3 Custom House Plaza

IFSC, Dublin 1

Tel: 01 607 6800

[www.maxol.ie](http://www.maxol.ie)

Distributor of oil products to the industrial, agricultural CHP domestic sectors

**Statoil Ireland**

Statoil House  
6 George's Dock  
IFSC  
Dublin 1  
Tel: 01 636 8100  
[www.statoil.ie](http://www.statoil.ie)

Statoil's commercial division supplies fuel direct to customers, including large industrial users

**Texaco (Ireland) Limited**

Texaco House  
Ballsbridge  
Dublin 4  
Tel: 01 668 6822  
[www.texaco.ie](http://www.texaco.ie)

Texaco supply oil products across all sectors in Ireland

**3. Biomass****Balcas**

Laragh  
Ballycassidy  
Enniskillen  
Co Fermanagh  
BT74  
Tel: 028 6632 3003  
[www.balcas.com](http://www.balcas.com)

Balcas supply wood pellets suitable for use in CHP applications, which the company uses onsite to produce all its energy requirements for its headquarters plant.

**Natural Power Supply**

Ballymountain  
Waterford  
Tel: 051 832 777

Developer of short rotation crops suitable for biomass CHP projects.

**Rural Generation Limited**

Brook Hall Estate

65-67 Culmore Road

Londonderry

BT48 8JE

Tel: 028 7135 8215

[www.ruralgeneration.com](http://www.ruralgeneration.com)

Rural Generation Limited has developed a concept of growing willows, harvesting them every three years CHP generating heat CHP electricity using a gasifier linked up to a diesel engine.

## **Appendix II: List of CHP Equipment Suppliers**

- 1. Gas Turbines**
- 2. Steam Turbines**
- 3. Gas Reciprocating Engines**
- 4. Microturbines/Micro CHP Systems**
- 5. Biomass CHP Technology**
- 6. Waste to Energy**
- 7. Heat Recovery/Boiler Plant**
- 8. Mechanical Fabricators**

### **1. Gas Turbines**

#### **ALSTOM Power**

61 Lower Baggot Street

Dublin 2

Tel: 01 661 5489

[www.power.alstom.com](http://www.power.alstom.com)

ALSTOM supply gas turbines over 100 MW

#### **Centrax**

Shaldon Road

Newtown Abbot

Devon, TQ12 4SQ

Tel: 01626 358000

[www.centrax.co.uk](http://www.centrax.co.uk)

Manufacture gas turbines from 2.5MW – 6.2MW

#### **Rolls-Royce**

Ansty Office

Coventry, CV7 9JR

Tel: 024 7662 3416

[www.rolls-royce.com](http://www.rolls-royce.com)

Manufacture gas turbines up to 50MW

**Siemens**

Fitzwilliam Court  
Leeson Close, Dublin 2  
Tel: 01 216 2425  
[www.siemens.ie](http://www.siemens.ie)  
Manufacture gas turbines from 4MW upwards

**Solar Turbines**

c/o Energy Services International  
Boghall Road  
Bray  
Co Wicklow  
Tel: 01 276 8400  
[www.esolar.cat.com](http://www.esolar.cat.com)

**Turbomach**

19-23 Prospect Street  
Bridlington  
Yorkshire, YO15 2AE  
Tel: 01262 400773  
[www.turbomach.co.uk](http://www.turbomach.co.uk)

**2. Steam Turbines****Aircogen CHP**

Werrington Parkway  
Peterborough, PE4 5HG  
Tel: 01733 292450  
[www.peterbrotherhood.co.uk](http://www.peterbrotherhood.co.uk)  
Peter Brotherhood manufacture steam turbines, Aircogen is the company's CHP division which designs, manufactures CHP installs packaged CHP solutions

**ALSTOM Power**

61 Lower Baggot Street  
Dublin 2  
Tel: 01 661 5489  
[www.power.alstom.com](http://www.power.alstom.com)  
Alstom supply steam turbines over 100 MW

**Siemens (Ireland)**

Fitzwilliam Court  
Leeson Close, Dublin 2  
Tel: 01 216 2425  
[www.siemens.ie](http://www.siemens.ie)

**3. Gas Reciprocating Engines****ABB Group**

Belgard Road  
Tallaght, Dublin 24  
Tel: 01 405 7300  
Web: [www.ie.abb.com](http://www.ie.abb.com)  
ABB supply engines in the range of 100kW – 5MW

**Cummins UK**

Rutherford Drive  
Park Farm South  
Wellingborough  
Northants, NN8 6AN  
Tel: 01843 255573  
[www.cumminsdiesel.uk.cummins.com](http://www.cumminsdiesel.uk.cummins.com)  
Cummins supply gas engines in the range of 150kW – 2MW

**Deutz Engines Ireland**

Unit 420 Beech Road  
Western Industrial Estate  
Dublin 12  
Tel: 01 464 3100  
[www.deutz.de](http://www.deutz.de)

**Edina Ltd**

Unit 142A Slaney Close  
Dublin Industrial Estate  
Glasnevin  
Dublin 11  
Tel: 01 830 7788  
Edina supply GE-Jenbacher engines 70kW – 3MW

**McCormick MacNaughton**

Naas Road

Clondalkin

Dublin 22

Tel: 01 464 3500

[www.mccormickmacnaughton.com](http://www.mccormickmacnaughton.com)

McCormick MacNaughton supply Caterpillar gas engines in Ireland

**Wartsila**

54 Broomhill Drive

Tallaght, Dublin 24

Tel: 01 459 5668

[www.wartsila.com](http://www.wartsila.com)

Wartsila marine-based gas engines 6MW – 8MW

**4. Microturbines/Micro CHP Technology****AC Automation**

Trooperslane Industrial Estate

5 Sloefield Park

Carrickfergus

Northern Ireland, BT38 8GR

Tel: 028 9336 4779

[www.acautomation.co.uk](http://www.acautomation.co.uk)

Supply ENER-G microturbines

**Baxi**

Belgard Road

Tallaght

Dublin 24

Tel: 01 459 0870

[www.baxipotterton.co.uk](http://www.baxipotterton.co.uk)

Manufacture micro 5.5kWe

**Bowman Power**

Ocean Quay Marina  
Belvidere Road  
Southampton, S014 5QY  
Tel: 02380 236700  
[www.bowmanpower.com](http://www.bowmanpower.com)

Manufacture 80kWe micro gas turbine – have installed one unit in NI, have looked at jobs in RoI but haven't done any yet

**Combined Power (ENER-G)**

ENER-G House  
Daniel Adamson Road  
Manchester, M5 2DT  
Tel: 0161 745 7450  
[www.combined-power.com](http://www.combined-power.com)

Manufacture ENER-G range of equipment, suppliers/developers in Ireland include TempTech CHP AC Automation

**Dunmast Ltd Marine Electronics**

Mill Road  
Kennedy Quay  
Cork  
Tel: 021 431 8460  
Suppliers of Victron stirling engine technology

**F4 Energy**

Unit 14  
Penrose Wharf  
Cork  
Tel: 021 486 1420  
[www.f4energy.com](http://www.f4energy.com)  
Supplier of microturbine solutions based on Turbec equipment

**Imec Southern Services Ltd**

St Martin

Crura

Co Cork

Tel: 021 477 1504

Suppliers of Victron stirling engine technology

**TempTechnology**

Unit 9

Childers Road Industrial Estate

Limerick

Tel: 061 413299

[www.temptech.ie](http://www.temptech.ie)

Supplier of ENER-G equipment 60kW – 1MW – extensive installed base in Ireland

**5. Biomass CHP Technology****Biomass Engineering Ltd**

Junction Lane

Sankey-Valley Industrial Estate

Newton-Le-Willows

WA12 8DN

Tel: 01925 220338

[www.biomass.uk.com](http://www.biomass.uk.com)

Biomass Engineering provide 'turnkey' renewable energy, biomass CHP gasification plants – from feasibility through design, manufacture, installation CHP commissioning. The firm provided the technology for the CHP project at the Ecos Centre in Co Antrim.

**Bio-Renewables Ltd**

ADAS Arthur Rickwood

Mepal

Ely

Cambridgeshire

CB6 2BA

Tel: 01354 692531

[www.bio-renewables.co.uk](http://www.bio-renewables.co.uk)

Bio-Renewables have expertise in all areas relating to the production CHP use of biomass including feasibility studies for proposed CHP plants CHP installation of end-use technology.

**Exus Energy**

Unit 27  
Templemore Business Centre  
NorthlCHP Road  
Londonderry  
BT48 0LD  
Tel: 028 7127 1520  
[www.exusenergy.com](http://www.exusenergy.com)

Exus Energy is involved in the development of wood-fuelled gasification technology with the objective of making biomass technology a commercially viable form of renewable energy.

**Fibrowatt Ltd**

Astley House  
33 Notting Hill Gate  
London  
W11 3JQ  
Tel: 020 7229 9252  
[www.fibrowatt.com](http://www.fibrowatt.com)

Biomass power project developer CHP operator. Have developed poultry litter fired power stations in the UK, totalling 65MW.

**Vyncke NV**

Gentsesteenweg224  
8530 Harelbeke  
Belgium  
Tel: +32 56 730 630  
[www.vyncke.be](http://www.vyncke.be)

Tailor-made solutions from 1MW-50MW to convert biomass CHP industrial waste into clean energy.

**Wartsila BioPower**

54 Broomhill Drive  
Tallaght, Dublin 24  
Tel: 01 459 5668  
[www.wartsila.com](http://www.wartsila.com)

Wartsila, in addition to supplying gas engines, has a biomass CHP technology through its purchase of a Finnish company, which has installed 80 biomass CHP units.

## **6. Waste to Energy**

### **ABB Group**

Belgard Road  
Tallaght, Dublin 24  
Tel: 01 405 7300  
Web: [www.ie.abb.com](http://www.ie.abb.com)

### **ALSTOM Power**

61 Lower Baggot Street  
Dublin 2  
Tel: 01 661 5489  
[www.power.alstom.com](http://www.power.alstom.com)

### **Bronzeoak Ltd**

Bronzeoak House  
Stafford Road  
Caterham  
Surrey  
CR3 6JG  
Tel: 01883 341055  
[www.bronzeoak.com](http://www.bronzeoak.com)

Bronzeoak develop biomass CHP waste disposal projects internationally, including animal effluent cogeneration plants in Asia CHP America.

### **Elsam Engineering**

Kraftvaerksvej 53  
DK-7000 Fredericia  
Tel: +45 79 23 33 33  
Web: [www.elsam-eng.com](http://www.elsam-eng.com)

### **Farmatic Biotech Energy UK Ltd**

5 Royal Crescent  
Cheltenham  
Gloucestershire  
GL50 3DA  
Tel: 01242 242111  
[www.farmatic.com](http://www.farmatic.com)

Supplier CHP operator of large scale anaerobic digestion facilities for farm manure CHP food waste.

**Greenfinch Ltd**

Burford House

Tenbury Wells

Worcestershire

WR15 8HQ

Tel: 01584 819496

[www.greenfinch.co.uk](http://www.greenfinch.co.uk)

Design, supply, installation CHP commissioning of anaerobic digesters CHP associated equipment.

**Milbury Systems Ltd**

The Long Barn

Clevedon Road

Tickenham

Bristol

BS21 6RY

Tel: 01275 857799

[www.milbury.com](http://www.milbury.com)

Anaerobic digestion project developers including process design, installation CHP commissioning.

**Onyx Environmental Group plc**

Onys House

154A Pentonville Road

London

N1 9PE

Tel: 020 7812 5000

[www.onyxgroup.co.uk](http://www.onyxgroup.co.uk)

**Thermoselect SA**

Via Naviglio Vecchio 4

CH 6600 Locarno

Tel: +41 91 756 2525

[www.thermoselect.com](http://www.thermoselect.com)

## **7. Heat Recovery/Boiler Plant**

### **HDS Energy**

Celbridge Industrial Estate

Celbridge

Naas, Co Kildare

Tel: 01 627 1011

[www.hds-energy.com](http://www.hds-energy.com)

Manufacturer of industrial boilers CHP equipment.

### **Wellman Robey**

Newfield Road

Oldbury

West MidlCHPs, B69 3ET

Tel: 0121 543 0000

[www.wellman-group.com](http://www.wellman-group.com)

Wellman Robey supply boilers CHP pressure vessels to a worldwide marketplace CHP provide CHP schemes.

## **8. Mechanical Fabricators**

### **BMD &Company Ltd**

Lee Road

Cork

Tel: 021 454 1499

[www.bowengroup.ie](http://www.bowengroup.ie)

Specialist mechanical engineering contractor carrying out pipe installation CHP process plant installation in the power sector.

### **Dornan Engineering Limited**

Hexagon House

Little IslCHP

Cork

Tel: 021 497 6500

[www.dornan.ie](http://www.dornan.ie)

Provides mechanical engineering contract services to the process industry.

**HA O'Neil Ltd**

Waterways House

GrCHP Canal Quay

Dublin 2

Tel: 01 671 1500

[www.joneseng.com](http://www.joneseng.com)

Mechanical engineering contractors

**Mercury Engineering**

Mercury House

Ravens Rock Road

SCHPyford Industrial Estate

Foxrock

Dublin 18

Tel: 01 216 3000

[www.mercury.ie](http://www.mercury.ie)

Mechanical CHP electrical engineering contractors

**Radley Engineering**

Dungarvan

Co Waterford

Tel: 058 41199

[www.radleyeng.ie](http://www.radleyeng.ie)

Engineering specialist company – design CHP manufacture steel fabrications for industry. Mechanical contractors for steel pipe installation

## **Appendix III: List of CHP Developers**

### **Aircogen CHP**

Werrington Parkway

Peterborough, PE4 5HG

Tel: 01733 292450

[www.peterbrotherhood.co.uk](http://www.peterbrotherhood.co.uk)

Aircogen specialise in the design, manufacture, installation CHP maintenance of packaged CHP turnkey CHP solutions.

### **ALSTOM Power**

61 Lower Baggot Street

Dublin 2

Tel: 01 661 5489

[www.power.alstom.com](http://www.power.alstom.com)

### **Atkins Power**

3200 Century Way

Thorpe Park

Leeds, LS15 8ZB

Tel: 0113 306 6000

[www.wsatkins.co.uk](http://www.wsatkins.co.uk)

Atkins Power have done a lot of CHP in Britain – typical projects are industrial sites up to 50MW.

### **BG Cogen**

Gasworks Road

Cork

Tel: 021 453 4000

[www.bgcogen.com](http://www.bgcogen.com)

### **Combined Power (ENER-G)**

ENER-G House

Daniel Adamson Road

Manchester, M5 2DT

Tel: 0161 745 7450

[www.combined-power.com](http://www.combined-power.com)

**Edina Ltd**

Unit 142A Slaney Close  
Dublin Industrial Estate  
Glasnevin  
Dublin 11  
Tel: 01 830 7788

**ESB**

27 Lower Fitzwilliam Street  
Dublin 2  
Tel: 01 702 6244  
[www.esb.ie](http://www.esb.ie)

**Evolution Energy**

2 Windsor Hill  
Hillsborough  
Co Down  
Northern Ireland  
BT26 6RL  
Tel: 028 9268 3338  
Developing mostly biomass projects

**EXUS Energy**

Unit 27 Templemore Business Park  
NorthlCHP Road  
Londonderry  
Northern Ireland, BT48 0LD  
Tel: 028 7127 1520  
[www.exusenergy.co.uk](http://www.exusenergy.co.uk)

**F4 Energy**

Unit 14  
Penrose Wharf  
Cork  
Tel: 021 486 1420  
[www.f4energy.com](http://www.f4energy.com)

**Fingleton White & Co**

Bridge Street Centre  
Portlaoise  
Co Laois  
Tel: 0502 21010  
[www.fingleton.ie](http://www.fingleton.ie)

**HDS Energy**

Celbridge Industrial Estate  
Celbridge  
Naas, Co Kildare  
Tel: 01 627 1011  
[www.hds-energy.com](http://www.hds-energy.com)

HDS Energy design CHP manufacture industrial boiler plant but are increasingly focusing on cogeneration projects.

**Integrated Energy Systems International Ltd**

11A Lune Street  
Preston  
Lancashire  
PR1 2NL  
Tel: 01772 250707

Integrated Energy Systems International are developing the CHP project at the Balcas plant in Co Fermanagh

**Npower Cogen**

Cogen Court  
Cranmore Boulevard  
Shirley  
Solihull  
West MidlCHPs, B90 4LN  
Tel: 0121 506 8000  
[www.rwenpower.com](http://www.rwenpower.com)

npower Cogen interested in gas-turbine based projects of 5MW CHP above

**Rolls-Royce**

Ansty Office  
Coventry, CV7 9JR  
Tel: 024 7662 3416  
[www.rolls-royce.com](http://www.rolls-royce.com)

**TempTechnology**

Unit 9  
Childers Road Industrial Estate  
Limerick  
Tel: 061 413299  
[www.temptech.ie](http://www.temptech.ie)  
TempTechnology have installed more CHP units than any other developer, primarily in the range of 100kWe – 350kWe

**Thames Energy**

Energy Centre  
31 Church Hill, Walthamstow  
London, E17 3RU  
Tel: 020 8520 9880  
[www.lessenergy.co.uk](http://www.lessenergy.co.uk)  
Have expertise in area of projects fuelled on biomass. Concentrate on projects of 100kW+

**The Cogeneration Company**

Parsonage Farm Business Park  
Parsonage Way, Horsham ,  
West Sussex, RH12 4AC  
Tel: 01403 272270  
[www.cogenco.co.uk](http://www.cogenco.co.uk)

**Vital Energi Utilities Ltd**

Burnden Works  
Burnden Road  
Bolton, BL3 2RB  
Tel: 01204 554500  
[www.vitalenergi.co.uk](http://www.vitalenergi.co.uk)  
Company has capability to supply, install, operate CHP maintain plant. Have looked at some CHP projects in CHP – only interested in projects over 1MW.

## **Appendix IV: List of Energy Services Companies (ESCOs)**

### **Bord Gáis Éireann**

PO Box 51  
Gasworks Road  
Cork  
Tel: 021 453 4000  
[www.bgcogen.com](http://www.bgcogen.com)

### **Dalkia**

145 Lakeview Drive  
Airside Business Park  
Swords  
Dublin  
Tel: 01 870 1200  
[www.dalkia.com](http://www.dalkia.com)

### **ESB**

27 Lower Fitzwilliam Street  
Dublin 2  
Tel: 01 702 6244  
[www.esb.ie](http://www.esb.ie)

## **Appendix V: List of Consultants Servicing CHP Sector**

- 1. Technical Consultants**
- 2. Legal Consultants**
- 3. Financial Consultants**

### **1. Technical Consultants**

#### **Atkins Power**

3200 Century Way  
Thorpe Park  
Leeds, LS15 8ZB  
Tel: 0113 306 6000  
[www.wsatkins.co.uk](http://www.wsatkins.co.uk)

#### **Clear Power**

4 Merrion Square  
Dublin 2  
Tel: 01 669 0979  
[www.clearpower.ie](http://www.clearpower.ie)  
Renewable energy consultant, specialising in feasibility studies for biomass energy projects

#### **ESBI**

Stephen Court  
18-21 St Stephen's Green  
Dublin 2  
Tel: 01 870 1200  
[www.esbi.ie](http://www.esbi.ie)

ESBI have carried out all the evaluation work for all the ESB-owned CHP projects in Ireland. Interested in whole range of CHP from 1 MW gas engines up to large turbines, but prefer the larger projects.

#### **Ilex Energy Consulting**

King Charles House  
Park End Street  
Oxford, OX1 1JD  
Tel: 01865 722660  
[www.ilex.co.uk](http://www.ilex.co.uk)

**Independent Power Systems Ltd**

Canada House  
272 Field End Road  
Eastcote  
Ruislip  
Middlesex, HA4 9NA  
Tel: 0208 866 4400

IPS have done CHP work in Northern Ireland but not in Republic to date. Concentrate on projects from 4-5 MW up to 100-200 MW.

**McLellan**

Sheer House  
West Byfleet  
Surrey, KT14 6NL  
Tel: 01932 343271  
[www.mclellan.co.uk](http://www.mclellan.co.uk)  
Involved in CHP in Northern Ireland.

**Mott McDonald**

Ewbank House  
8 Fitzwilliam Place  
Dublin 2  
Tel: 01 676 8222  
Web: [www.mottmac.com](http://www.mottmac.com)

**Mowlem Engineering**

Port Causeway  
Bromborough  
Wirral, L62 4TP  
Tel: 0151 334 4990  
[www.mowlem.com](http://www.mowlem.com)

**PM**

Kilakee House  
Belgard Square  
Tallaght  
Dublin 24  
Tel: 01 404 0700  
[www.pmg.ie](http://www.pmg.ie)

**RPS-MCOS**

Carnegie House

Library Road

Dun Laoghaire

Co Dublin

Tel: 01 202 0870

[www.mcos.ie](http://www.mcos.ie)

Engineering services firm, have completed CHP feasibility studies CHP are project managing large waste to energy CHP scheme.

**Shanahan Engineering**

Beauparc House

65 Monkstown Road

Blackrock

Co Dublin

Tel: 01 280 9888

[www.shanahaneng.ie](http://www.shanahaneng.ie)

**Thames Energy**

Energy Centre

31 Church Hill

Walthamstow

London, E17 3RU

Tel: 020 8520 9880

[www.lessenergy.co.uk](http://www.lessenergy.co.uk)

**White Young Green**

Apex Business Centre

Blackthorn Road

SCHPyford

Dublin 18

Tel: 01 294 1717

[www.wyg.com](http://www.wyg.com)

## **2. Legal Consultants**

### **A&L Goodbody**

IFSC

North Wall Quay

Dublin 1

Tel: 01 649 2000

[www.algoodbody.ie](http://www.algoodbody.ie)

### **Arthur Cox**

Earlsfort Centre

Earlsfort Terrace

Dublin 2

Tel: 01 618 0000

[www.arthurcox.ie](http://www.arthurcox.ie)

### **Eugene F Collins**

Temple Chambers

3 Burlington Road

Dublin 4

Tel: 01 202 6400

[www.efc.ie](http://www.efc.ie)

### **Matheson Ormsby Prentice**

30 Herbert Street

Dublin 2

Tel: 01 619 9000

[www.mop.ie](http://www.mop.ie)

### **McCann Fitzgerald**

2 Harbour Place

IFSC

Dublin 1

Tel: 829 0000

[www.mccannfitzgerald.ie](http://www.mccannfitzgerald.ie)

**William Fry**

Fitzwilton House  
Wilton Place  
Dublin 2  
Tel: 01 639 5000  
[www.williamfry.ie](http://www.williamfry.ie)

**3. Financial Consultants**

**AIB Structured Finance**

AIB Trade Centre  
IFSC  
Dublin 1  
Tel: 01 641 7678  
[www.aib.ie](http://www.aib.ie)

**Bank of Ireland International Finance**

50-51 Lower Baggot Street  
Dublin 2  
Tel: 01 611 5354  
[www.boi.ie](http://www.boi.ie)

**IIB Bank**

91 Merrion Square  
Dublin 2  
Tel: 01 664 6376  
[www.iibbank.ie](http://www.iibbank.ie)

## Appendix VI: List of Supply Chain Study Interviewees

|                                       |  |
|---------------------------------------|--|
| ABB                                   | IIB Bank                                   |
| AIB Structured Finance                | Independent Power Systems Ltd              |
| ALSTOM Power                          | Irish BioEnergy Association                |
| Arthur Cox                            | Irish Sugar                                |
| ATCO Power                            | London Heat CHP Power                      |
| Atkins Power                          | Low Carbon Solutions                       |
| Balcas                                | McCormick MacNaughton                      |
| Bank of Ireland International Finance | McLellan                                   |
| Baxi Group                            | Mott McDonald                              |
| BG CoGen                              | Mowlem Engineering                         |
| Bowman Power                          | NCB Corporate Finance                      |
| Centrax Gas Turbine Division          | Npower Cogen                               |
| CoGen Europe                          | Phoenix Natural Gas                        |
| Combined Power (ENER-G)               | PM (Project Management)                    |
| Cummins UK                            | Rolls Royce                                |
| Dalkia                                | RPS-MCOS ( <i>formerly MC O'Sullivan</i> ) |
| Deutz Engines Ltd                     | Scottish & Southern Energy                 |
| EA Technology                         | Shanahan Engineering                       |
| Edina Ltd                             | Siemens                                    |
| Energia                               | Solar Turbines                             |
| ESB                                   | Temp Technology                            |
| ESB International                     | Thames Energy Ltd                          |
| Evolution Energy                      | The Cogeneration Company                   |
| EXUS Energy                           | Turbomach                                  |
| F4 Energy                             | United House                               |
| Fingleton White & Co                  | Vital Energi Utilities                     |
| FG Wilson                             | Wartsila                                   |
| Glanbia                               | White Young Green                          |
| HDS Energy                            |  |

## Appendix VII: Sample Questionnaire Issued To Supply Chain Stakeholders

### CHP in Ireland

#### *Supply Chain for CHP – Questionnaire*

The Government recently appointed a National Policy Group for CHP, to make recommendations on how CHP penetration in Ireland can be increased. Sustainable Energy Ireland (SEI) on behalf of the policy group is researching a number of aspects of CHP in Ireland including the CHP Supply Chain.

This aim is to establish a view of whether the Supply Chain for CHP in Ireland (*i.e. sufficient/suitable sources for CHP equipment, advisory services etc*) is adequate to cope with (a) current demCHP for CHP (b) a significantly increased demCHP for CHP should this occur in the future.

The survey questionnaire is very straightforward, CHP the object of the exercise is to identify **where** weaknesses in the Irish CHP Supply Chain (if any) exist. Your cooperation is much appreciated:

| Supply Chain Element             | Supply Chain Adequacy (please circle) |                         |                                |
|----------------------------------|---------------------------------------|-------------------------|--------------------------------|
|                                  | Sufficient Supply (Present)           | Adequate Cover (Future) | Supply Chain Weakness (Future) |
| Plant CHP Equipment Suppliers    |                                       |                         |                                |
| Turbines                         | x                                     | x                       | x                              |
| Engines                          | x                                     | x                       | x                              |
| Heat recovery                    | x                                     | x                       | x                              |
| Heat distribution                | x                                     | x                       | x                              |
| Instrumentation                  | x                                     | x                       | x                              |
| Boiler equipment                 | x                                     | x                       | x                              |
| Parts, supplies, consumable      | x                                     | x                       | x                              |
| Other equipment                  | x                                     | x                       | x                              |
| Please specify _____             |                                       |                         |                                |
| <b>Consultancy Services</b>      |                                       |                         |                                |
| Feasibility studies              | x                                     | x                       | x                              |
| Engineering                      | x                                     | x                       | x                              |
| Project management               | x                                     | x                       | x                              |
| Energy management                | x                                     | x                       | x                              |
| Legal/Contractual Services       | x                                     | x                       | x                              |
| Financial advisory               | x                                     | x                       | x                              |
| Project appraisal /risk analysis | x                                     | x                       | x                              |
| Electrical interface             | x                                     | x                       | x                              |
| Gas Consultancy                  | x                                     | x                       | x                              |

|                       |                     |                   |                             |
|-----------------------|---------------------|-------------------|-----------------------------|
| Biomass (engineering) | x                   | x                 | x                           |
| Fuel purchasing       | x                   | x                 | x                           |
| Process reengineering | x                   | x                 | x                           |
| Other services _____  | x                   | x                 | x                           |
| Please specify        |                     |                   |                             |
|                       | Plentiful<br>Supply | Adequate<br>Cover | Supply<br>Chain<br>Weakness |

**Operations CHP Maintenance Services**

|                                   |   |   |   |
|-----------------------------------|---|---|---|
| Full O&M Service                  | x | x | x |
| Full turnkey service              | x | x | x |
| Rapid response remote operations• | x | x | x |
| Supervisory services              | x | x | x |
| O&M Consultancy                   | x | x | x |

(Comments on identified weaknesses in the Irish CHP Supply Chain.)

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Do you consider it a problem that much of Ireland's CHP Supply Chain – particularly manufacturing of equipment – is external in origin?

|                                     | Yes | No |
|-------------------------------------|-----|----|
| Equipment Supply                    | x   | x  |
| Consultancy Services                | x   | x  |
| Operations CHP Maintenance Services | x   | x  |
| Other _____                         | x   | x  |
| Please specify                      |     |    |

(If applicable) Why do you consider this to be a problem?

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Do you think there is a particular role for ESCOs (Energy Services Companies) in the Irish CHP Supply Chain (eg. ESB, BGE etc)

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Questionnaire completed by: Name \_\_\_\_\_

Position \_\_\_\_\_ Organisation \_\_\_\_\_

Thank-you for completing this questionnaire.

## Appendix VIII: Scenarios for CHP Development in Ireland 2004-2020

### Scenario 1 – Business as Usual

| <b>Business as Usual</b> | <b>2004</b> | <b>2010</b> | <b>2020</b> |
|--------------------------|-------------|-------------|-------------|
| Gas CHP                  | 112.6       | 262.6       | 262.6       |
| Other conv. CHP          | 24          | 24          | 24          |
|                          | <hr/>       | <hr/>       | <hr/>       |
|                          | 137         | 287         | 287         |
| Biomass CHP              |             | 17          | 17          |
|                          | <hr/>       | <hr/>       | <hr/>       |
|                          | 137         | 304         | 304         |

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### Scenario 2 – Low Growth

|                            |       |       |
|----------------------------|-------|-------|
| Business as Usual – GasCHP | 286.6 | 286.6 |
| Business as Usual – BioCHP | 17    | 17    |
| <i>Plus</i>                |       |       |
| Market Potential – GasCHP  | 45.0  | 52.5  |
| NewTechCHP                 | 5.0   | 55.0  |
| BioCHP                     | 31.6  | 173.4 |
|                            | <hr/> | <hr/> |
|                            | 385   | 585   |

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### Scenario 3 – Medium Growth

|   |       |       |
|---|-------|-------|
| Business as Usual – GasCHP                    | 286.6 | 286.6 |
| Business as Usual – BioCHP                    | 17    | 17    |
| <i>Plus</i>                                   |       |       |
| 0.25Mt target (incls NewTechCHP)              | 250   | 436   |
| Excl. add. Potential required for NCCS target | 75    | 150   |
| BioCHP  | 55.7  | 277.4 |
|   | <hr/> | <hr/> |
|   | 684   | 1167  |

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### Scenario 4 – High Growth

|                             |       |       |
|-----------------------------|-------|-------|
| Business as Usual – GasCHP  | 286.6 | 286.6 |
| Business as Usual – BioCHP  | 17    | 17    |
| <i>Plus</i>                 |       |       |
| Economic Potential – GasCHP | 547   | 656.4 |
| Economic Potential – BioCHP | 84.5  | 384.7 |
| NewTechCHP                  | 50    | 254.2 |
|                             | <hr/> | <hr/> |
|                             | 985   | 1599  |

**Appendix IX: Existing CHP Future CHP Potential by Sector  
Sustainable Energy Ireland, December 2001**

|               |                  |                         | Future Potential               |                    |                  |
|---------------|------------------|-------------------------|--------------------------------|--------------------|------------------|
|               |                  |                         | Additional Technical Potential | Economic Potential | Market Potential |
| A             | Public Sector    | Airports                | 4.9                            | 1.75               | 1.75             |
|               |                  | Hospitals               | 14.4                           | 7.6                | 3.8              |
|               |                  | State Buildings         | 27                             | 9                  | 2                |
| B             | Education        | 2 <sup>nd</sup> Level   | 6.25                           | 3.1                | 0.5              |
|               |                  | 3 <sup>rd</sup> Level   | 40                             | 28                 | 14               |
| C             | Commercial       | Hotels                  | 22.6                           | 11.3               | 3.5              |
|               |                  | Office Blocks           | 200                            | 60                 | 6                |
|               |                  | Shopping Centres        | 73                             | 3.5                | 0.5              |
|               |                  | Swimming Pools          | 2                              | 1.5                | 0.7              |
| D             | Industry         | Large                   | 240                            | 220                | 40               |
|               |                  | Medium                  | 314                            | 100                | 10               |
|               |                  | Small                   | 315                            | 50                 | 2.5              |
| E             | Domestic         |                         | 20                             | 0.4                | 0.02             |
| F             | District Heating |                         | 100                            | 50                 | 0                |
| G             | CHP with RE Fuel | Agricultural Waste      | 64                             | 38                 | 0                |
|               |                  | Wood Industry Residues  | 159                            | 48                 | 0                |
|               |                  | Forestry Residues       | 92                             | 26                 | 0                |
|               |                  | Short Rotation Forestry | 155                            | 0                  | 0                |
|               |                  | LCHPfill Gas            | 0                              | 0                  | 0                |
|               |                  | Biogas AD               | 40                             | 27                 | 1                |
|               | MSW Combustion   | 91                      | 44                             | 0                  |                  |
| <b>Totals</b> |                  |                         | <b>1907.15</b>                 | <b>729.15</b>      | <b>86.27</b>     |

*Excludes the proposed Aughinish Power project.*