SUSTAINABLE ENERGY IRELAND

Energy Policy Statistical Support Unit

Combined Heat and Power in Ireland

Trends and Issues 1991-2002

February 2004

Sustainable Energy Ireland

Sustainable Energy Ireland (SEI) is Ireland's national energy authority. Established on May 1st 2002 under the Sustainable Energy Act 2002, SEI has a mission to promote and assist the development of sustainable energy. This encompasses environmentally and economically sustainable production, supply and use of energy, in support of Government policy, across all sectors of the economy. Its remit relates mainly to improving energy efficiency, advancing the development and competitive deployment of renewable sources of energy and combined heat and power, and reducing the environmental impact of energy production and use, particularly in respect of greenhouse gas emissions.

SEI is charged with implementing significant aspects of the Green Paper on Sustainable Energy and the National Climate Change Strategy as provided for in the National Development Plan.

SEI manages programmes aimed at:

- assisting deployment of superior energy technologies in each sector as required;
- raising awareness and providing information, advice and publicity on best practice;
- stimulating research, development and demonstration;
- stimulating preparation of necessary standards and codes;
- publishing statistics and projections on sustainable energy and achievement of targets.

SEI is responsible for advising Government on policies and measures on sustainable energy; implementing programmes agreed by Government and stimulating sustainable energy policies and actions by public bodies, the business sector, local communities and individual consumers.

Energy Policy Statistical Support Unit

Sustainable Energy Ireland has a lead role in developing and maintaining comprehensive national and sectoral statistics for energy production, transformation and end use. This data is a vital input to meeting international reporting obligations, for advising policy makers, and informing investment decisions. Based in Cork, the Energy Policy Statistical Support Unit is SEI's specialist statistics team. Its core functions are to:

- collect, process and publish energy statistics to support policy analysis and development in line with national needs and international obligations;
- conduct statistical and economic analyses of energy services sectors and sustainable energy options;
- contribute to the development and promulgation of appropriate sustainability indicators.

Report prepared by
Fergal O' Leary, Dr. Brian Ó Gallachóir and Martin Howley

Highlights

The purpose of this report is to document and assess the contribution made by CHP to Ireland's energy requirements by presenting the results of the most recent survey conducted for the years 2001 and 2002. These results are compared with previous surveys to identify and track trends.

Installed Capacity

- The total installed capacity of CHP in Ireland at the end of 2002 was 131.5 MW_e[1] an increase of 2.2 % (2.8 MW_e) over 2001. This figure includes operational and non-operational units.
- The installed capacity of operational CHP units increased from 56.8 MW_e in 1991 to 125.3 MW_e in 2002. This represents an overall increase of 121% and an average annual growth rate of 7.5%.
- In 2002 the bulk of installed capacity (82% or 108 MW_e) was in the industrial sector.
- Over the period 1994 to 2002 (the period where a sub-sectoral breakdown is available) there was growth across all sectors and industrial sub-sectors[2], with the exception of the mining and textile sub –sectors which recorded respective declines of 36% and 3%.
- The largest absolute increase (24.7 MW_e) over the same period occurred in the food, beverages and tobacco sub-sector.

Number of Units

- There was a total of 105 CHP units in 2002, an increase of 7 units on 2001. This figure includes operational and non-operational units.
- The number of operational units in 1991 was 10; this increased to 95 by the end of 2002. This represents an average annual growth rate of 22.7%.
- In 2002, the services sector, comprising private services (hotels, leisure centres, etc.) and public services (hospitals, universities etc.), accounted for 77 (73%) of the 105 units.
- In 2002 food, beverages and tobacco was the most populated industrial sub-sector with a total of 13 units (12%).
- Over the period 1994-2002 most of the growth in the number of CHP units can be attributed to the services sector. In 2002, the services sector accounted for 73% (69 units) of the total number compared with 18% (3 units) in 1994.

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[1] Megawatt electrical or MW_e is the unit which represents the installed electricity generating capacity or size of a CHP plant.

[2] The sectors and industrial sub-sectors used in this report are per Eurostat methodology and are detailed in Annex 2.

Fuel Inputs / Electrical and Thermal Outputs

- In 2002 81% of installed capacity (106.1 MW_e) was fuelled by natural gas.
- The electrical output from CHP plants increased from 259 GWh in 1994 to 629 GWh in 2002, representing an annual average growth rate of 12%. Over the same period, the thermal output increased from 1092 GWh to 1639 GWh, representing an average annual growth rate of 5%.
- Average electrical and thermal efficiencies rose from 11% to 22.2% and from 46.3% to 57.8% respectively over the period 1994-2002, which combined gives an increase in overall efficiency of 22.7% and a total efficiency of 79.98%. The figures for thermal and overall efficiencies are inflated due to heat produced being used in this report, rather than heat usefully employed.
- Electricity exported to the grid[3] increased significantly by 106% in 2002 to a total of 99 GWh. This growth is attributable to a large increase in exports to the grid by a small number of units. In 2002 the largest five exporters to the grid accounted for 69 GWh.

International Comparison

- The installed electrical capacity of CHP in EU countries increased by 20%, in the period 1994-2000 from 64 to 76 GW_e. During the same period Ireland's growth was 76% (from 66.8 MW_e to 118 MW_e).
- Belgium, Spain Greece and the UK showed extremely strong growth (in the range 108% to 224%) while Germany, Austria and Portugal exhibited a decrease in installed capacity (in the range –7% to –28%). Growth in Ireland over the period was 76%.
- The share of gross electricity consumption[4] accounted for by CHP varies greatly across the EU from (in 2000) 2.1% in Greece to 52.2% in Denmark. Ireland's share was 2.4% (576 GWh) in 2000 and 2.6% (629 GWh) in 2002.

Future Growth

- It is anticipated that CHP growth in Ireland for 2003 will not be greater than 4 or 5 MW_e. The growth in installed capacity is expected to be dominated by a small number of large units in the industrial sector. There are also a number of smaller capacity units that are planned for the services sector.

[3] As opposed to electricity generated and consumed onsite.
[4] Defined as electricity generated (excluding generation from pumped storage) plus electricity imported minus electricity exported.

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1 Introduction

Combined Heat and Power (CHP) is the simultaneous generation of usable heat and electricity[5] in a single process. In the right circumstances, CHP can be an economic means of improving the efficiency of energy use and achieving environmental targets for emissions reduction.

This report examines the contribution made by CHP to Ireland's energy requirements since 1991, the first year in which data on CHP is available.

The purpose of the report is to document and assess this contribution by presenting the results of the most recent survey conducted in Ireland for the years 2001 and 2002. These results are subsequently compared with those from previous surveys and with surveys undertaken in other EU Member States. The objective of this analysis is to identify salient characteristics and to track trends associated with CHP deployment in Ireland.

CHP installations are profiled by size, fuel, sector and sub-sector. This document updates and builds upon a report prepared by the Irish Energy Centre[6] (now Sustainable Energy Ireland, SEI), which was published in December 2001.

This report was produced by Sustainable Energy Ireland's Energy Policy Statistical Support Unit (EPSSU), based in Cork. This unit underpins the work of SEI through the collation and publication of energy statistics and economic analyses of energy trends.

The remainder of the report is structured as follows:

- Section 2 presents the general context behind the drive for energy efficiency, as well as an introduction to the energy and environmental aspects of CHP.
- Section 3 identifies some of the major policy developments with regard to CHP at international, European and national level.
- Section 4 focuses on the results of the most recent survey.
- Section 5 compares the results of section 4 with those of previous surveys.
- Section 6 contrasts the situation in Ireland with other EU Member States and with the national target for CHP.
- Section 7 presents conclusions.

[5] In a small number of cases internationally, mechanical rather than electrical power is produced, in addition to heat.
[6] Irish Energy Centre (2001) An Examination of the Future Potential of CHP in Ireland- A Report for Public Consultation.

2 Energy, Environmental and Economic Aspects of CHP

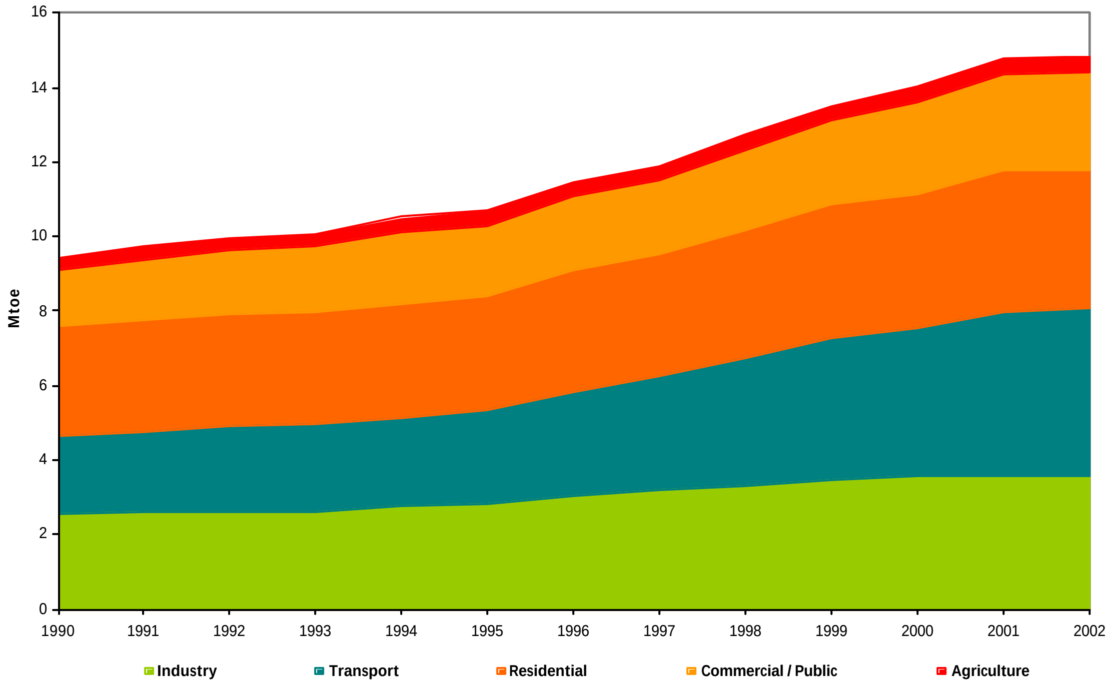
2.1 Energy and Environmental Context

This section gives a brief overview of energy trends in Ireland, covering the period 1990 – 2002. The purpose of this section is to provide a context for the increasing importance placed upon energy efficient technologies such as CHP. A full discussion for the period 1990-2001 is contained in "Energy in Ireland 2002 trends, issues and indicators 1990-2001", also published by SEI's Energy Policy Statistical Support Unit. Figures 1-3 are from a draft, updated edition of the report.

Ireland's energy supply is discussed in terms of changes to the total primary energy requirement (TPER, also known as gross inland consumption). TPER is defined as the total amount of energy consumed within Ireland in any given year. This represents the consumption of energy by all five sectors of the Irish economy, namely industry, transport, services (public and private), residential and agriculture. TPER includes the energy consumed in conversion processes such as electricity generation and oil refining.

Figure 1 illustrates the trend in energy supply over the period 1990-2002, indicating the overall growth pattern and sectoral share of gross energy consumption.

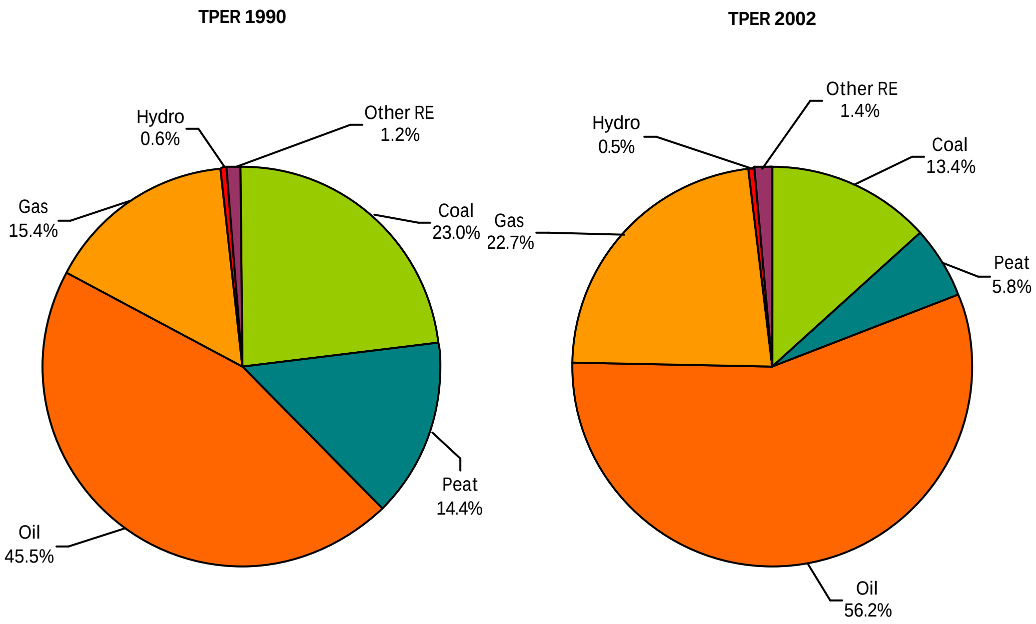
Figure 1: Total Primary Energy Requirement by Sector 1990-2002



Source: SEI

Figure 2 contrasts 1990 with 2002, showing the share each fuel contributes to energy supply.

Figure 2: Total Primary Energy Requirement by Fuel 1990 and 2002



Total 9.4 Mtoe **Total 14.8 Mtoe**

Source: SEI

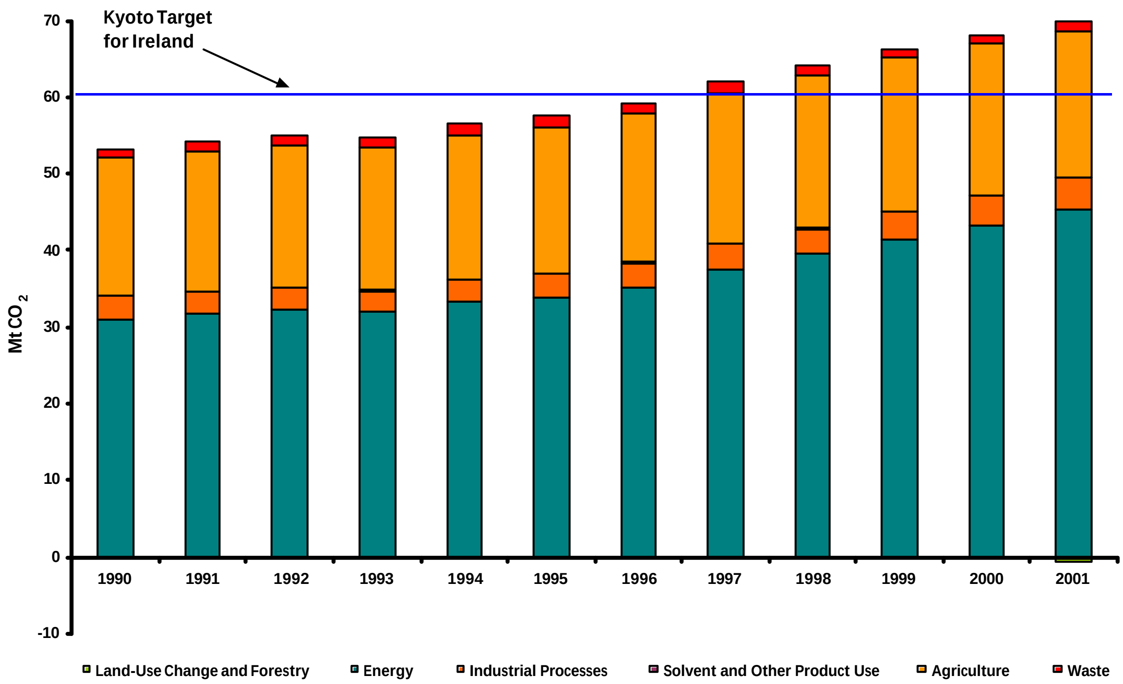
Figures 1 and 2 illustrate that Ireland's demand for energy has increased significantly in recent years. Over the period 1990 – 2002 Ireland's total primary energy requirement grew in absolute terms by 57.9%. The average annual growth rate was 3.9%.

The energy supply fuel mix has changed considerably over the period 1990-2002, with significant decreases in the share of peat (-24%) and coal (-8%) while natural gas, (+129%) and oil, (+92%) have shown substantial increases.

The large increase in energy consumption has resulted in a consequent increase in energy related CO_2 (carbon dioxide) emissions. This is clear from figure 3, which illustrates that energy is the principal source of greenhouse gas emission growth since 1990. Greenhouse gas emissions in Ireland reached 31% above 1990 levels in 2001. This growth is set against the context of Ireland's target under the Kyoto Protocol to limit emissions growth to 13% above 1990 levels by the period 2008-2012.

It is against the background of increased energy consumption and related emissions that the potential for energy saving and emission avoidance arising from CHP deployment are discussed in this report.

Figure 3: Greenhouse Gas Emissions 1990-2001–Ireland



Source: EPA[7]

[7] EPA (2003) Ireland National Greenhouse Gas Inventory Report.

2.2 Definition of and rationale for using CHP

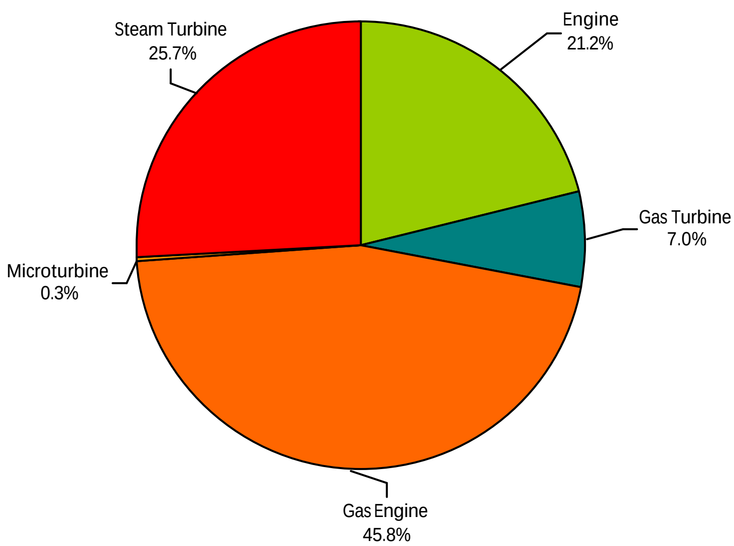
CHP is the simultaneous generation of usable heat and electricity[8] in a single process. The term CHP is synonymous with cogeneration, a term often used in other Member States of the European Community and in the United States.

CHP usually involves the burning of fossil fuels, but it can also be produced from biomass (including biogas and waste). As will be seen in subsequent sections, the recent trend is to use natural gas for CHP.

CHP has been in use for more than 100 years and can be based on a variety of fuels and technologies across a wide selection of sites and scheme sizes. There are however, a number of common characteristics. The basic elements of a CHP plant comprise one or more prime movers (a reciprocating engine, gas turbine, steam turbine etc.) driving electrical generators, where the exhaust or residual heat is recovered via suitable heat recovery equipment for use either in industrial processes or heating.

Figure 4 shows the percentage breakdown of Ireland's installed CHP capacity in 2002 by prime mover.

Figure 4: Percentage of Installed Capacity 2002 by Prime Mover



Total 131.5 MW_e

Source: SEI

[8] In a small number of cases internationally mechanical rather than electrical power is produced, in addition to heat.

CHP in effect utilises the heat produced in electricity generation instead of releasing it into the atmosphere. In simple terms, CHP makes more efficient use of fuel and, as a result, has a less detrimental effect on the environment than if heat and power are produced independently.

A range of different definitions or criteria exists for CHP. They generally differ in terms of the overall energy efficiency achieved by the unit. For example the Electricity Regulation Act, 1999[9] defines CHP as:

"the simultaneous production of utilisable heat and electricity from an integrated thermo-dynamic process where the overall process operating efficiency, based on the gross calorific value of the fuel used and defined as the ratio of energy output usefully employed to the energy input, is greater than 70%".

Throughout Europe, a range of CHP definitions exist, the majority of which approximate towards a variant of the following formula:

"Total electricity output plus 2/3rd of the useful heat should be greater than 60% of the total fuel input"[10].

In order to harmonise the many different definitions, a formal methodology for calculating the efficiency of CHP, as well as the calculation of electricity from CHP, is included in the European Commission Directive on CHP (see section 3.2).

Conventional, centralised power generation is normally only 30-40% energy efficient i.e. only 30-40% of the fuel input is transformed into electricity. In Ireland, for example, the overall efficiency of national electricity generation, including renewables, was 41.6% (this figure does not take into account own use or losses) in 2002. The recent introduction of combined cycle gas turbine (CCGT) plants with efficiency levels of up to 55% is improving the overall efficiency of electricity generation.

By utilising the heat that is produced in electricity generation, the efficiency of a CHP plant can typically be 20-25% more efficient than the combined efficiency of heat-only boilers and conventional power stations. Also, if embedded in the network close to the point of electrical consumption, CHP avoids some of the transmission losses incurred by centralised generation.

Consequently CHP can bring environmental benefits in the form of CO_2 savings.

The precise amount of CO_2 avoided by employing a CHP unit is difficult to determine and is widely debated. One perspective suggests that CHP displaces the marginal fuel of electricity generation, as less marginal plant electricity is required if additional electricity is generated from CHP. For example, if additional CHP electricity is produced, less open cycle natural gas electricity will be generated.

An alternative perspective is that new CHP plant will change investment decisions regarding other new generation options, i.e. the CHP plant will avoid the need for

[9] Government of Ireland (1999) Electricity Regulation Act 1999.
[10] See Footnote 6 (page 7).

new capacity and thus CHP will displace *best new entrant* plant electricity. The starting point has a key bearing on the projected amount of CO_2 savings, which will be significantly higher if CHP displaces marginal fuel rather than best new entrant fuel.

This debate is explored in more detail in a CHP consultation paper published by SEI (then the Irish Energy Centre) in December 2001[11]. The paper proposes that every kWh produced from CHP results in approximately 200 g CO_2, being avoided. This is equivalent to a figure of 1000 tonnes of CO_2 per MW_e of CHP installed. Applying this to the National Climate Change Strategy[12] target (of a per annum saving of 0.25 Mt CO_2) means that an additional 250 MW_e of CHP plant will need to be installed by the end of this decade, in order to achieve this target.

2.3 Benefits of CHP

The benefits of CHP are outlined in a European Commission memorandum[13], under three headings:

a) Potential Energy Savings.

If the share of CHP in electricity generation could be increased from 9% in 1994 to 18% of total electricity generation by 2010, it is estimated that total EU CO_2 emissions could be reduced by 4%[14].

b) Security of Supply.

A key objective of European energy policy, as outlined in the Commission's Green Paper, published in November 2000[15] is security of supply.

CHP can contribute to this objective in two ways. Firstly, due to the contribution CHP can make to increased diversification of the fuel mix and secondly arising from the increased physical security and regional self-sufficiency when generation is embedded close to the point of consumption. This may mean that a country's overall energy supplies are less vulnerable to supply shortages.

c) Cost –effectiveness.

New high-efficiency CHP installations, in certain circumstances, have the benefit of being cost-effective energy solutions.

In addition:

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[11] See Footnote 6 (page 7).
[12] Government of Ireland (2000) National Climate Change Strategy.
[13] Commission of the European Communities (2002) Memorandum on the Promotion of Combined Heat and Power-A New Proposal for a Directive.
[14] Commission of the European Communities (1997) A Community Strategy to Promote Combined Heat and Power and to Dismantle Barriers to its Development.
[15] European Commission (2000) Green Paper Towards a European Strategy for the Security of Energy Supply.

- Since CHP plants are usually close to the consumption point, there are fewer losses on the electrical grid;
- CHP increases competition among energy producers by increasing the number of firms capable of supplying energy. Customers therefore have more choice.

A CHP plant may not be appropriate in every case. In general for a CHP plant to be economical the project will require:

- Fuel costs to the developer to be competitive with the alternative, for example low natural gas prices compared to electricity prices,
- Medium or high demand for thermal energy (steam, hot water, hot gases, cooling etc.) over prolonged periods of time,
- Heat and electricity requirements to be balanced in volume and timing and or
- Sales of heat and/or electricity to other parties on assured contract terms and equitable/competitive prices.

3 International, European and National Policies

The significant growth in energy consumption in Ireland in recent years was demonstrated in section 2. This has led to an increase in environmentally harmful emissions such as CO_2 resulting from the burning of fossil fuels (98% of our energy supply is fossil fuel based).

This, coupled with concerns regarding climate change has prompted Governments and policy-makers to respond by promoting renewable energy, energy efficiency and energy saving technologies such as CHP.

The following sections discuss a number of key policies underpinning or relating directly to CHP deployment.

3.1 The Kyoto Protocol

Ireland's target under the Kyoto Protocol is to limit annual greenhouse gas (GHG) emissions to 13% above 1990 levels by the period 2008 – 2012. This is part of an EU Burden Sharing Agreement whereby the overall EU target reduction of 8% in emissions is to be achieved through the combined efforts of the Member States.

Ireland's national target reflects a number of factors, including the relatively underdeveloped state of the economy in the base year (1990). As shown in figure 3, in 2001 Ireland was already 31% above 1990 levels, mainly as a result of high economic growth. Ireland's policy response to the Kyoto protocol is articulated in the National Climate Change Strategy, discussed below.

3.2 European Policy

The EU has a long history of promoting energy efficient policies and practices. It has formally promoted CHP since 1977[16], when a Council recommendation set as an objective the elimination of non-technical obstacles to the development of CHP.

Some of the more recent EU communications and Directives with regard to CHP are detailed below.

A Directive of the European Parliament and of the Council of 19 December 1996[17], concerning common rules for the internal market in electricity, provides that a

" …*system operator, when dispatching generating installations, is to give priority to generating installations using renewable energy sources or waste or producing combined heat and power*."

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[16] Council Recommendation (1977) on the creation in the Member States of advisory bodies or committees to promote combined heat and power production and the exploitation of residual heat.

[17] Directive (1996) of the European Parliament and of the Council concerning common rules for the internal market in electricity.

The Commission's strategy document on CHP has as its aim the doubling of 1994 CHP penetration by 2010[18] (from 9% to 18%). In 2000 the proportion of total electrical output in the EU that was generated from CHP was 10% (see section 6.1).

The strategy, which was endorsed by a Council resolution in December 1997, states that:

" …optimised CHP is an environmentally friendly method of energy production, reducing fuel need and increasing competition in generation; for this reason it could be considered as a vehicle for promoting liberalisation in energy markets."

The Commission's communication on energy efficiency in 1998[19] set out a strategy for the rational use of energy and CHP was seen as critical for achieving increased energy efficiency.

The final stage in the approval of a Cogeneration Directive[20] was completed on the 11th February 2004, and the Directive will take effect once it has been published in the Official Journal of the European Communities (publication imminent at time of going to print). Member States are required to implement the Directive within two years.

The objective of the Directive is to create a favourable environment for CHP installations.

The Directive includes the following provisions:

- A commitment for Member States to analyse national potentials for CHP; the analysis will identify all potential for heating and cooling demands as well as a separate analysis of barriers which may prevent the realisation of the national potential for CHP.

- The evaluation of support schemes until a harmonised community framework is put into place. The Commission will monitor the situation in Member Sates and report on experiences across the EU. Member States will ensure that support for cogeneration is based on useful heat demand.

- In addition, there is a requirement for Member States to collect statistics on electricity and heat generated (as per definitions set out in the position) from CHP on an annual basis from 2003.

- The methodology for determining the efficiency of CHP as well as the calculation of electricity from CHP is detailed in Annex 2.

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[18] Commission of the European Communities (1997) A Community Strategy to Promote Combined Heat and Power and to Dismantle Barriers to its Development.
[19] Commission of the European Communities (1998) Energy Efficiency in the European Community – Towards A Strategy for the Rational Use of Energy.
[20] Directive, 2004, of the European Parliament and of the Council on the promotion of cogeneration based on useful heat demand in the internal energy market.

An additional EU policy instrument that impacts CHP is a Directive[21] published on 13 October 2003, which has the aim of establishing a scheme for greenhouse gas emission allowance trading within the Community. The Directive

"will encourage the use of more energy efficient technologies, including combined heat and power technology….".

As a result of the political impetus, a growing interest has developed in gathering appropriate statistics on CHP in order to assess the level of penetration of CHP into energy markets and to enable monitoring of progress towards existing and future Community targets.

Eurostat recognised in the early 1990s that the existing energy statistics system did not adequately cover this technology. It was decided therefore, in collaboration with the Directorate General for Energy and Transport (DG TREN), to undertake a long-term action in the compilation of CHP statistics. One of the outcomes of this process was that Member States adopted a new methodology for collecting and reporting CHP statistics in a Eurostat Working Group meeting on CHP statistics in April 2001. This addresses the fact that in certain cases a portion of the electricity produced in CHP units may not be considered cogeneration.

Eurostat and DG TREN have provided financial assistance to Member States to carry out surveys for the years 1994, 1996-1998 and 2000. These surveys provide much of the data for this report and are discussed in further detail in sections 4 and 5.

3.3 Irish Policy

3.3.1 Green Paper on Sustainable Energy

The 1999 Green Paper on Sustainable Energy[22] made a number of proposals for further consideration including; a report on the future potential of CHP, a high efficiency CHP project with clear and environmental benefits, and that small scale CHP suitable for commercial and other buildings should be encouraged under future support mechanisms. As a consequence, the Irish Energy Centre (now SEI) published a report [24]on future potential in December 2001 and SEI launched a CHP RD&D Programme Strategy in July 2002. This strategy included work on district heating potential, feasibility studies/pilot plants for innovative CHP projects, an awareness programme, consideration of the formation of a CHP Association, the regulatory and legislative treatment of CHP, and appraisal of future support mechanisms for CHP/DH, in preparation for assisting the Government in developing a CHP/DH Strategy.

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[21] Directive (2003) of the European Parliament and of the Council establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC.
[22] Government of Ireland (1999) Green Paper on Sustainable Energy.
[22] See Footnote 6 (page 7).

3.3.2 National Climate Change Strategy

In October 2000, the Department of Environment and Local Government published its National Climate Change Strategy[23] (NCCS). This strategy provides a framework for achieving greenhouse gas emissions reductions in the most efficient and equitable manner while continuing to support economic growth.

The NCCS specifies our response to the Kyoto Protocol and the subsequent EU Burden Sharing Agreement. The strategy sets out a ten-year framework to ensure Ireland meets its Kyoto target and prepares for the post Kyoto context of further emissions reductions. The NCCS projects that in the absence of the measures in the strategy, Ireland is likely to overshoot the Kyoto target by approx 13 Mt CO_2 The cumulative effect by 2010 of NCCS measures would be a reduction annually of 15.4 Mt CO_2 compared with the business as usual projections.

The NCCS specifically advocates the use of CHP. As mentioned in section 2.2, the strategy targets a saving of 0.25 Mt CO_2 per year up to 2010 from CHP. This has been estimated to mean that an additional 250 MW_e of CHP plant will need to be installed by the end of this decade if the Government target is to be achieved[24].

3.3.3 Government Legislation

Under the Electricity Regulation Act[25], 1999, the Commission for Energy Regulation (CER) licences new players to enter the electricity generation and supply market. Anyone wishing to construct an electricity generating plant (including CHP) requires a licence to do so. An additional licence is required in order to supply electricity.

Government legislation has promoted the use of CHP by expanding the market for the electricity produced from CHP. Section 9 of the Electricity (Supply) (Amendment) Act 2001[26] amends the Electricity Regulation Act, 1999[27] in relation to the treatment of CHP. Specifically, section 14 is amended to allow for the electricity produced from CHP to be sold to any final customer. Therefore any electricity consumer may now purchase electricity from a licensed CHP electricity supplier. This essentially puts CHP electricity on a similar footing to electricity produced from renewable sources and should increase the demand for the electricity produced from CHP.

3.3.4 Alternative Energy Requirement (AER) Programme

The AER programme was launched in 1995 to encourage renewable energy and CHP technologies (collectively termed "alternative energy" in this programme) to enter the market. The AER offers guaranteed demand contacts awarded in a competitive bidding process. These contracts oblige the ESB to purchase all the output from selected renewable energy and CHP based electricity generation for

[23] See Footnote 12 (page 13).
[24] See Footnote 6 (page 7).
[25] See Footnote 9 (page 12).
[26] Government of Ireland (2001) Electricity (Supply) (Amendment) Act 2001.
[27] See Footnote 9 (page 12).

up to fifteen years at each applicants bid price, with provisions for increases in line with inflation.

There have been six AER competitions since 1995, three of which have included CHP.

- AER I, the results of which were announced in April 1996 included 10.72 MW_e of CHP
- AER IV in August 1998 was exclusively for gas-fired CHP plants and 57.977 MW_e of contracts were awarded.
- AER VI in July 2003 resulted in 26.83 MW_e of Biomass CHP being awarded.

Not all of the winners proceeded with developing plants, even with a guaranteed source of income; AER IV resulted in only 18.3 MW_e being developed. The reasons for not going ahead with the developments included inability to get planning permission or finance for the proposed projects.

3.3.5 CHP Strategy Group

DCMNR is establishing a CHP Strategy Group to analyse and make recommendations on possible options for future national CHP policy. Such a policy is intended to be based on staged and achievable targets. This group will produce a Strategy Report for publication.

The Strategy Group will consult with suppliers, industry, local authorities and other agencies as appropriate in the development of its work. Further it will take particular account of the EU Directive on Cogeneration. The timeframe for reporting will be six months from establishment, which is expected in the first quarter of this year.

4 CHP In Ireland 2002

This section presents the results of a survey carried out by EPSSU in 2003. The survey was carried out by first contacting all known suppliers of CHP units in Ireland in order to get a list of all installed units. Where the company that supplied the unit still maintains the unit, a questionnaire was sent to the supplier. Where the supplier had no further contact after installation, the questionnaire was sent directly to the plant.

The format of the questionnaire covered some general information such as type of prime mover, year of installation, fuel used etc. and then year specific information was requested on inputs and outputs during 2001 and 2002. A copy of the questionnaire is attached in Annex 1.

Based on the survey results, the total installed electricity-generating capacity of CHP in Ireland at the end of 2002 was 131.5 MW_e, an increase of 2.2% over 2001. This installed capacity was spread across a total of 105 CHP units, an increase of 7 units on 2001.

The reason for using units, in addition to installed capacity, as a measure is twofold. Firstly, this is the method used by Eurostat and it therefore facilitates comparison across years and EU Member States. Secondly, each CHP unit is a separate, self-contained unit with distinct inputs / outputs and as such it is reasonable to treat each unit as a separate entity. It is important to note that units are distinct from CHP plants or schemes and that there may be more than one CHP unit at a site.

It should also be noted that the figure of 131.5 MW_e includes 5.2 MW_e (6 units), which were not operational in 2002, (due to mechanical problems), and a further 1MW_e (4 units) the status of which is currently unknown. These are not, for the purposes of this report, considered to be operational. Therefore, operational capacity in 2002 was 125.3 MW_e. It is this operational capacity will be used in section 5 for comparison purposes.

A final point to note relates to statistics for thermal outputs in this report. The figures used in this report refer to heat produced rather than heat usefully employed. The reason for this is that the majority of respondents were unable to supply accurate figures for heat usefully employed. This is consistent with previous surveys in Ireland and does limit the capacity to discuss efficiency in detail.

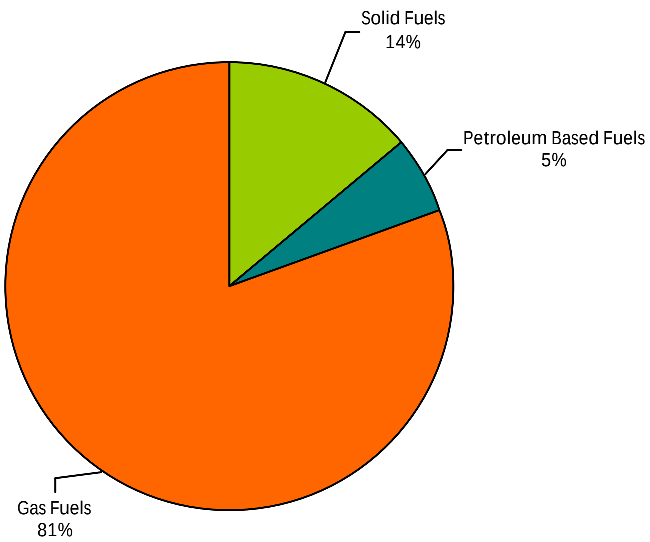
The following sections present the results of the 2003 survey and provide a profile of CHP in Ireland.

4.1 CHP by Fuel

It is useful to examine the fuel type associated with CHP plants from the perspectives of security of supply and emissions. CHP is promoted due to the improved efficiencies and reduced emissions that may be achieved relative to the alternatives. In this context, the choice of fuel has a direct impact on the levels of emissions reductions that may be achieved.

Figure 5[28] illustrates the installed capacity of CHP by fuel in 2002. Solid fuels are peat and coal, petroleum based fuels are LPG, heavy fuel oil and refinery gas while gas has natural gas and biogas as its constituent parts. The majority of installed capacity (106.1 MW_e) was fuelled by gas. The vast majority of the 106.1 MW_e was accounted for by natural gas. Solid fuels made up a significant share with 18.2 MW_e while petroleum based fuels accounted for the remainder with 7.2 MW_e.

Figure 5: Percentage Share of Installed Capacity by Fuel 2002



131.5 MW_e

Source: SEI

The main reasons why natural gas has become the "fuel of choice" for CHP are as follows:

- The price of natural gas relative to electricity, which is key in the decision making process for developing CHP, was quite low for most of the 1990s in Ireland. This, coupled with the expansion of the gas grid, contributed to the increasing penetration of small capacity natural gas fuelled CHP units (see section 5.2).

[28] It was necessary to group some of the fuels in order to maintain confidentiality.

- Natural gas releases a smaller amount of CO_2 into the atmosphere than comparable amounts of other fossil fuels. It can therefore be more attractive from an environmental perspective.
- The technology associated with natural gas CHP is relatively cheap compared to CHP fuelled by other fossil fuels, partly because natural gas CHP is available in packaged units.
- Construction costs are reduced because natural gas CHP installations have a relatively small footprint when compared to, for example, coal and peat CHP units.
- Because natural gas arrives on demand through a pipeline there is no need to stockpile fuel, as is the case with other fossil fuels. This will also reduce costs.
- There is virtually no ash with natural gas, which again lowers costs.
- Natural gas CHP units may be more suitable for businesses with smaller heat and electricity demands than was the case with fuels such as coal or oil. Previously only companies with very large requirements of heat and electricity would have found it economical to invest in CHP. Due to developments in technology and the increased availability of natural gas, CHP can be attractive across many different sectors and capacity size ranges from hotels to large manufacturing industries.
- There is a more flexible turn-down ratio with natural gas than with other fossil fuels (i.e. natural gas units can be adjusted relatively quickly to changes in demand for heat and/or electricity).

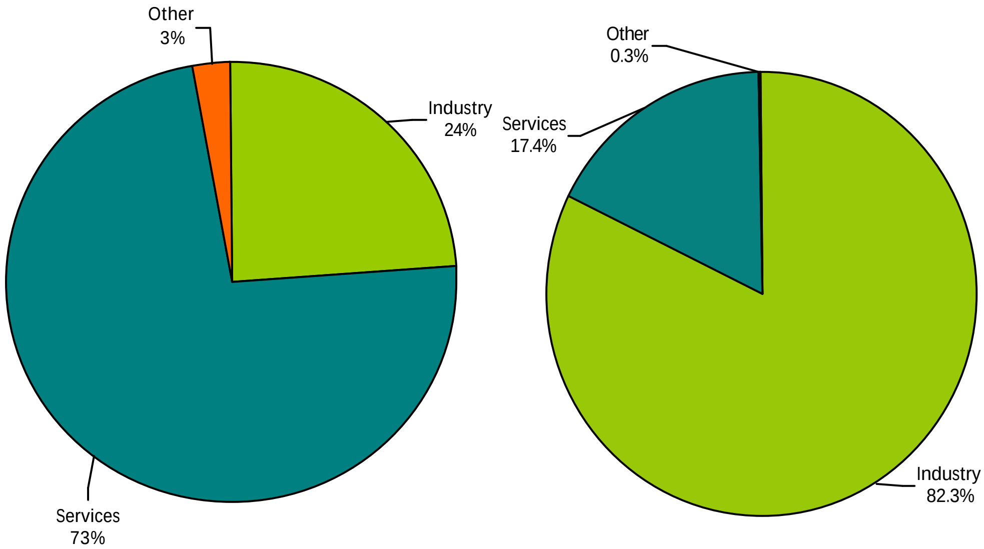
The increasing importance of natural gas in CHP is analysed further in section 5.

4.2 CHP by Sector and Sub-sector[29]

CHP is more suited to some sectors of the economy than others, depending on what it is used for, the amount of energy consumption and the split between electrical and heat requirements.

Figure 6 shows the split between the services sector (which includes hotels, leisure centres and the public sector) and the industrial sector (which consists of mining, textile, chemical, refinery and food industries). The other category consists of units, which cannot currently be classified. It can be seen that the bulk (73%) of CHP units were in the services sector.

Figure 6: Number of CHP Units and Installed Capacity by Sector 2002



Total 105 Units **Total 131.5 MW_e**

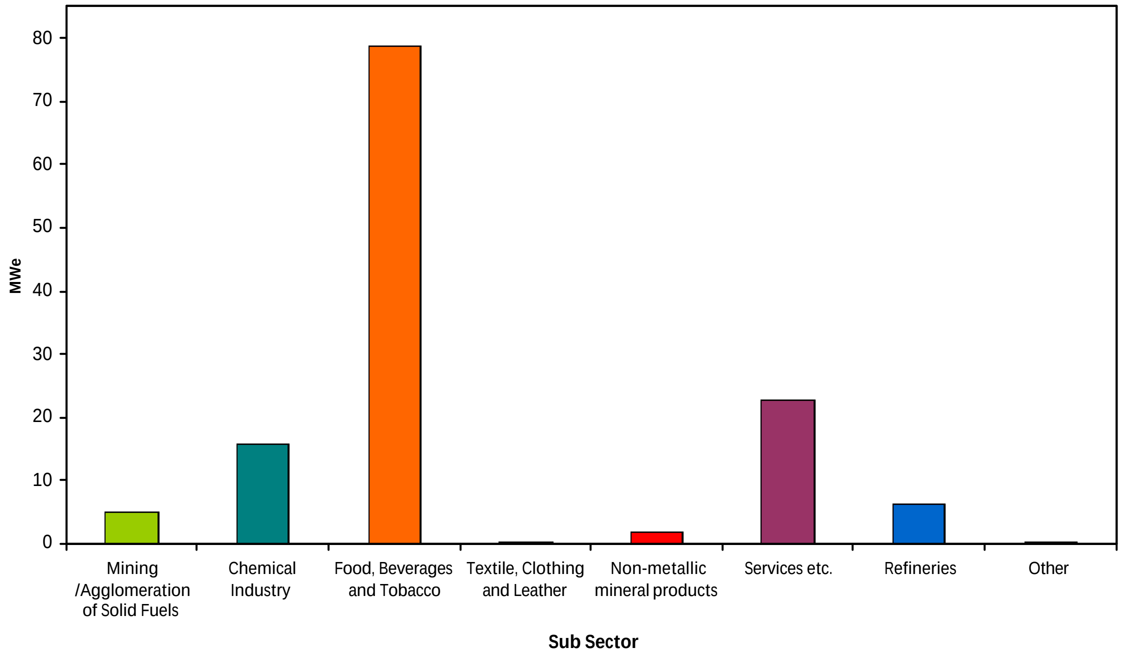
Source: SEI

If we examine the split between services and industry in terms of installed capacity, also shown in figure 7, we can see that the bulk of installed capacity was in the industrial sector.

Data is also available at a sub-sectoral level. Figure 7 indicates that the majority of installed capacity was in the food, beverages and tobacco sub-sector. In 2002 60% of installed capacity (79 MW_e of the 131.5 MW_e) was contained in this sub-sector. The second largest grouping was the services sector with 17% (22.9 MW_e).

[29] The sub-sectors that are used in this report are per Eurostat methodology. The sub-sectors and accompanying NACE classification codes are presented in Appendix 2.

Figure 7: CHP Installed Capacity by Sub- Sector 2002



Source: SEI

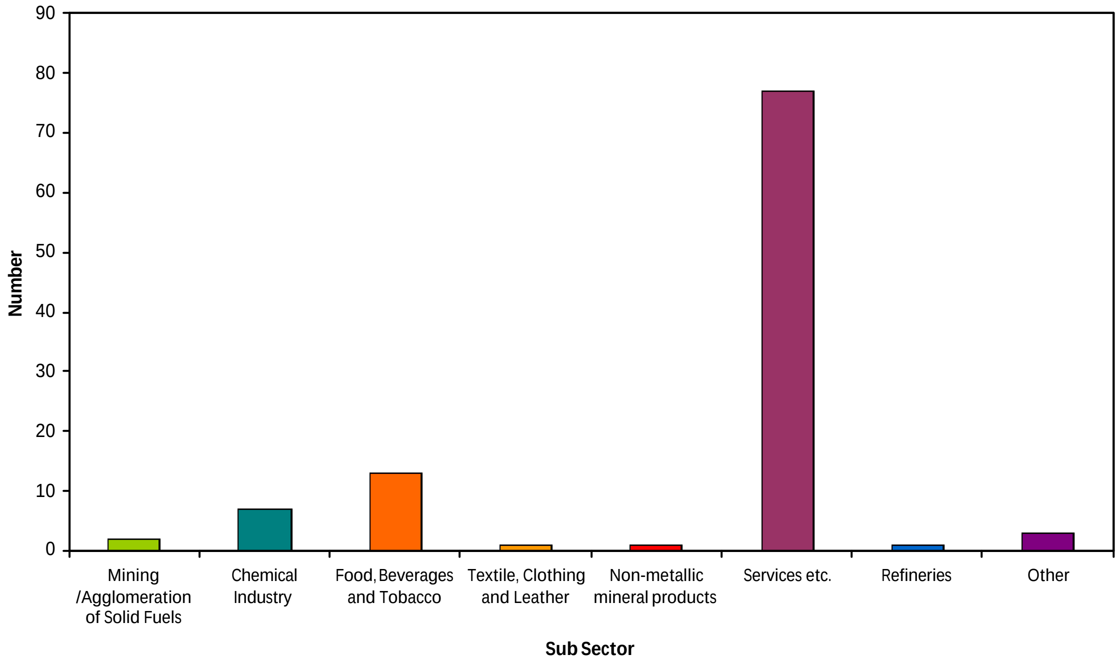
The number of units[30] by sector and industrial sub-sector is examined in figure 8. It can be seen that the services sector accounted for 77 (73%) of the 105 units.

Food, beverages and tobacco was the most populated sub-sector with a total of 13 units (12%).

In addition to the Eurostat sub-sectors, we can also examine the sub-sectoral breakdown of services, shown in Figure 9. The largest category in terms of installed capacity (4.9 MW_e) was the hospital sub-sector. The number of units by services sub-sector is presented in figure 10. The hotel sub-sector was the largest category here with 77 units.

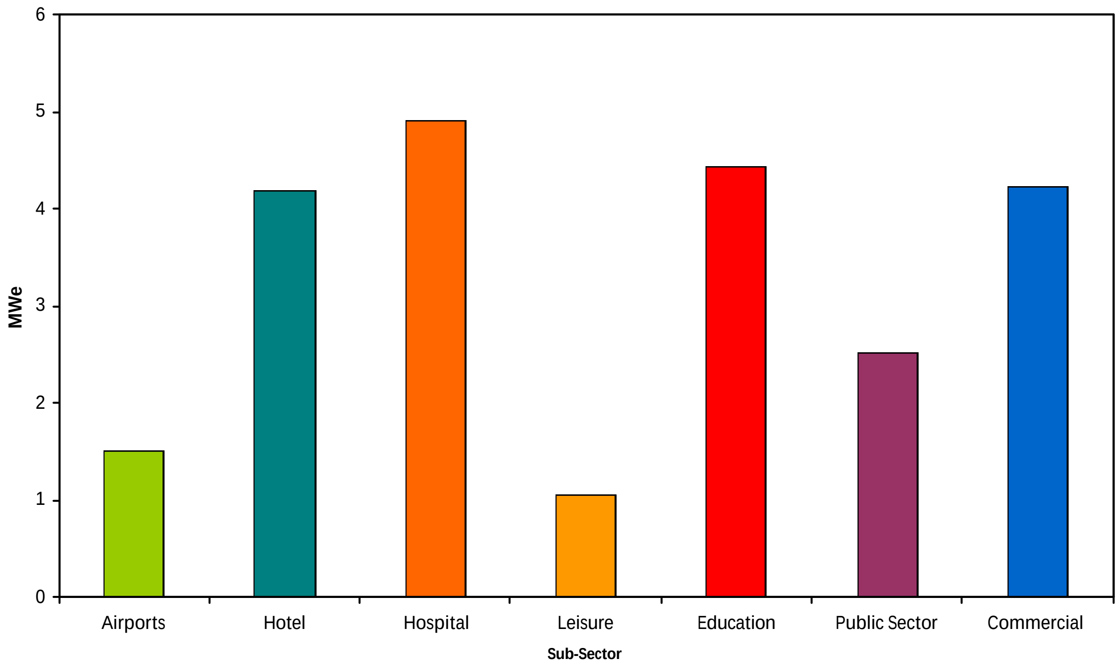
[30] Note that units are dstinct from CHP plants or schemes and that there may be more than one CHP unit at a site.

Figure 8: Number of CHP Units by Sub-Sector 2002



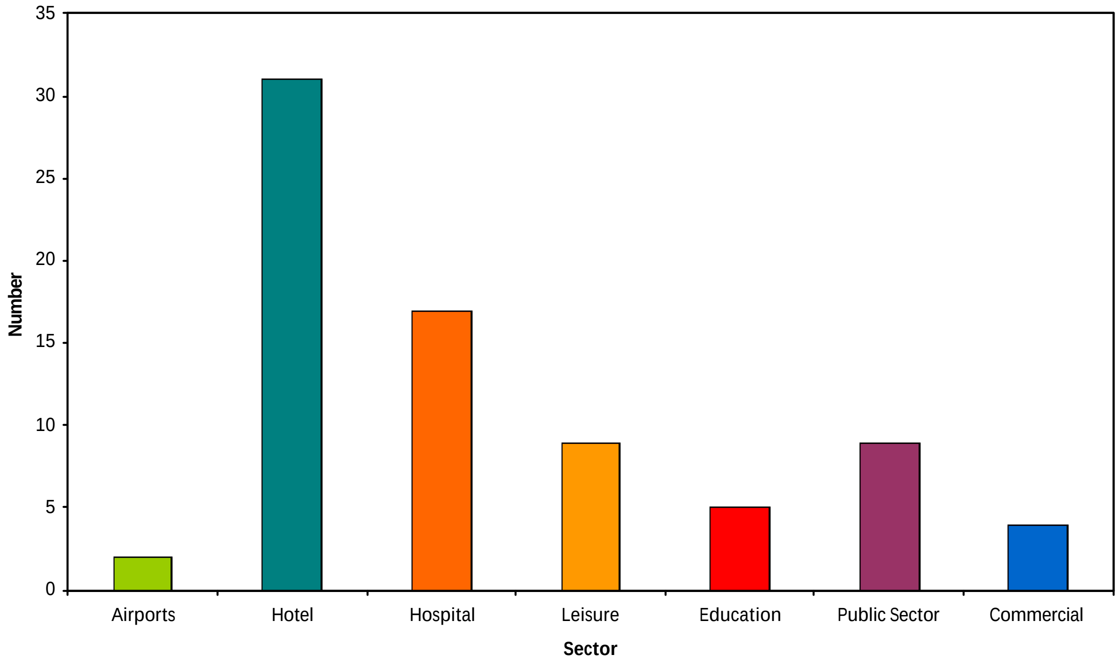
Source: SEI

Figure 9: Installed Capacity by Services Sub-Sector 2002



Source: SEI

Figure 10: Number of Units By Services Sub-Sector 2002



Source: SEI

In 2002 there were a large number of small capacity, gas-fired CHP units in the services sector (especially hotels and hospitals) while the larger capacity units, fuelled for the most part by gas but also by significant amounts of other fossil fuels, were found in the industrial sector. Further evidence of this is presented in the next section.

The following can be observed by examining the relationship between installed capacity and number of units for the other industrial sub-sectors in 2002:

- Mining and agglomeration of solid fuels represented 4% of installed capacity and 2% of units.
- The chemical sub-sector was responsible for 11% of installed capacity and 7% of units.
- Textile, clothing and leather accounted for 0.14% of installed capacity and 1% of CHP units.
- Non-metallic mineral products represented 2% of installed capacity and 1% of units.
- The refineries sub-sector was responsible for 5% of installed capacity and 1% of units.

4.3 CHP by Capacity Size Range 2002

Figures 6-10 point to differences in plant sizes that warrant closer examination.

Table 1 and figure 11 profile CHP units by capacity size ranges in 2002. Most of units were in the 100 to 999 kW_e range, while the largest share of capacity was in the larger 1000 to 9999 kW_e category. It is interesting to note that 3 units accounted for 29% of installed capacity while 54 units accounted for just 9% of installed capacity.

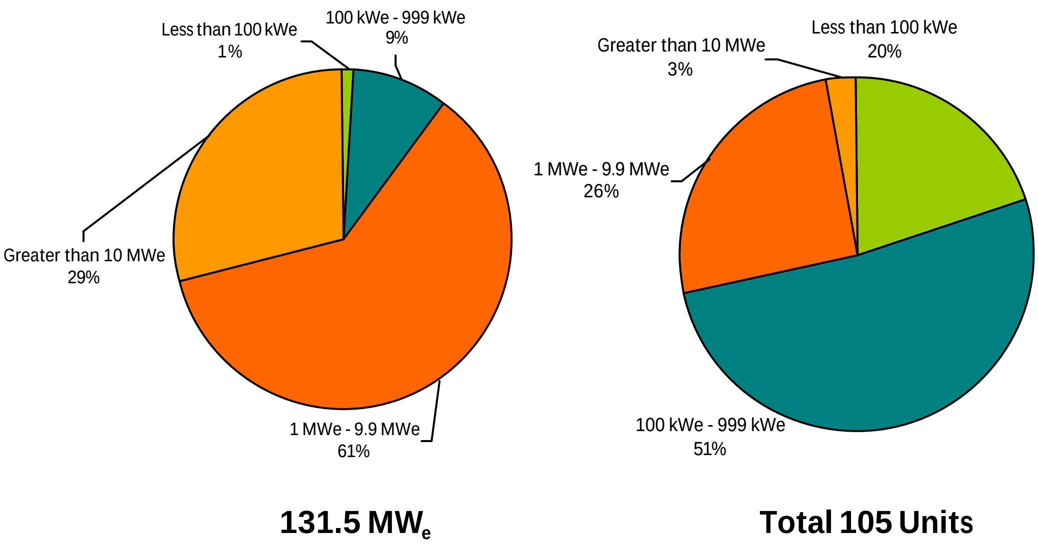
Table 1: Units by Capacity Size Range 2002

Electrical Capacity Size Range	Number of Units	Share of total (%)	Total Electrical Capacity kW_e	Share of total (%)
Less than 100 kW_e	21	20	1574	1
100 kWe - 999 kW_e	54	51	11781	9
1000 kWe - 9999 kW_e	27	26	80166	61
Greater than 10000 kW_e	3	3	38000	29
Total	105	100	131521	100

Source: SEI

The greater than 10000 kW_e units were found in the food, beverages and tobacco sub-sector while the less than 100 kW_e units were in the services sector. No general statement can be made about the middle categories, as they are a mixture of all sectors/sub-sectors.

Figure 11: CHP by Overall Capacity Size Ranges 2002



Source: SEI

4.4 CHP Inputs and Outputs

Table 2: Summary of Recent Developments

Year	2001	2002	% +/-
Number of Units	98	105	7.1
Installed Capacity MW_e	128.7	131.5	2.2
Installed Capacity MW_t	553.9	557.6	0.7
Fuel Input GWh	2,719	2,836	4.3
Electrical Output GWh	603	629	4.4
Thermal Output GWh	1,563	1,639	4.9
Electricity Exported to the Grid GWh	48303	99360	105.7
Total Run Hours[31]	408178	428290	4.9

Source: SEI

Table 3: Summary of Recent Developments –Efficiencies [32]

Year	2001	2002	Absolute +/-
Electrical Efficiency %	22.16	22.18	0.02
Thermal Efficiency %*	57.5	57.8	0.3
Overall Efficiency %*	79.66	79.98	0.32

** It should be noted that thermal and overall efficiency would, in reality, be significantly smaller than 57.8% and 79.98% respectively. The figures are inflated due to data for heat produced rather than heat usefully employed being used. Clearly, some of the heat produced will be lost before it is used and therefore the figure for overall efficiency with heat usefully employed will be lower than that for heat produced. As mentioned previously, this it is consistent with previous surveys in Ireland and does limit the capacity to discuss efficiency in detail.*

Source: SEI

Tables 2 and 3 provide a summary of recent developments in CHP by comparing data from 2001 and 2002. The evolution of CHP over a longer time period is assessed in more detail in the next section.

[31] This refers to the total run hours of all CHP units.

[32] Calculated by dividing the (electrical / thermal) output by the (fuel) input and multiplying this by 100 to get a percentage. The overall efficiency is calculated by adding them together.

Fuel input and electrical / thermal output have increased. The outputs increased slightly more than the fuel input, which suggests that the stock of CHP units was being used more efficiently.

The thermal and electrical efficiencies support this assertion (table 3). The increase in efficiency, while small, may be attributable to fuel switching to more energy efficient fuels such as natural gas as well as the installation of more efficient units such as gas turbines.

Finally in table 2, it can be seen that electricity exported to the grid more than doubled between 2001 and 2002. This growth is attributable to a large increase in the amount of electricity exported to the grid by a small number of units and may be a result of more favourable selling conditions in the liberalised electricity market. In future, the amount of electricity generated from CHP and exported to the grid will clearly depend on the new electricity market structure due to take effect in 2005.

5 CHP In Ireland 1991-2002

In extending the analysis retrospectively, it is important to comment on the data set and any data anomalies that were encountered, as well as the approach adopted to address them.

The data originates from surveys conducted by SEI in 1996-1998 and 2000 that were part funded by EUROSTAT. SEI conducted similar surveys for 1999, 2001 and 2002. The ESB undertook the surveys in 1994 and 1996. There was no CHP survey carried out for 1995.

There is also a limited amount of data available for 1991-1993, which is contained in the 1994 ESB survey. Therefore the period covered is from 1991 where possible and later where there are data constraints.

With regard to the data used, it is important to note the following:

- Only operational units are included in the Eurostat funded surveys and thus only operational units are considered in the comparisons made in this section. Therefore installed capacity in 2002 was 125.3 MW_e (95 units) and in 1991 it was 56.8 MW_e (10 units).

- There was a change in methodology, which meant that the Eurostat survey in 2000 did not include units under 100 kW_e. For comparison purposes across all years, the results for units under 100 kW_e that were operational before 2000, which were surveyed in 2001, were added to the 2000 Eurostat figures.

- CHP is again profiled by installed capacity, number of units, by fuel and by sub-sector. The sector and sub-sectors are the same as those used in the previous section.

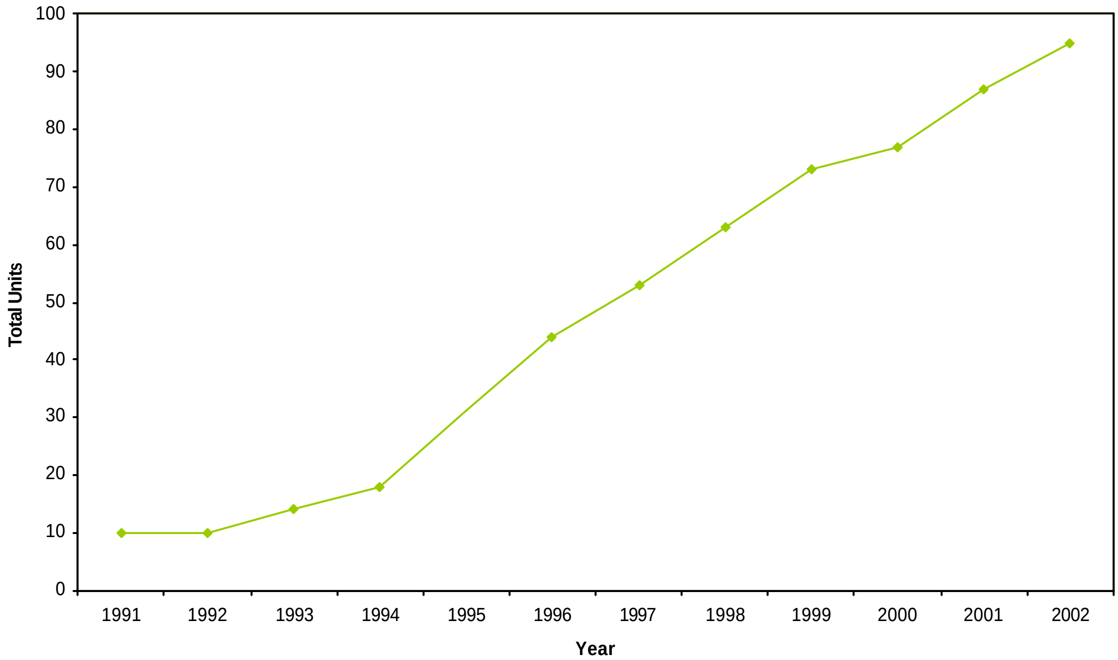
- There may be some inconsistencies with the results of previously published Eurostat surveys and the results presented here. This is due to a small number of units, which were reclassified.

5.1 CHP 1991-2002

Figure 12: Installed Capacity 1991-2002

Source: Eurostat and SEI

Figure 13: Number of CHP Units 1991-2002



Source: Eurostat and SEI

CHP is not a new technology in Ireland. Most CHP units in use before 1993 were steam-cycle based and fuelled by coal, peat or heavy fuel oil. In nearly all cases they were installed on sites where the steam demand was high, and where requirements for electricity were large in relation to grid capacity, for example:

- Large scale brewing – Guinness
- Sugar Extraction – Irish Sugar Company
- Peat Briquette Manufacture – Bord na Móna

Figures 12 and 13 illustrate that while there was a substantial increase in the amount of installed capacity during the period 1991-2002, (121% or 68.5 MW_e) there was a greater percentage increase in the number of units installed (850% or 85 units). This represents an average annual growth rate of 22.7% compared with a per annum increase of 7.5% for installed capacity.

A major exception is 1998, which saw a small number of large units being added. Some of these were plants that were successful in AER competitions.

The increasing availability and market penetration of small capacity, reliable natural gas engine CHP units during the 1990's help to explain the greater increase in numbers over installed capacity. Hotels and hospitals in particular, have employed these smaller units.

It is important to note that large industrial units have also contributed significantly to the recent growth in CHP. These large units, while few in number, have had a considerable impact on overall installed capacity and generation. These observations will be illustrated further in subsequent sections.

A number of important incentive schemes such the various Alternative Energy Requirement competitions (as described section 3.3.2) as well as the EU THERMIE Programme and the Energy Efficiency Investment Support Scheme have contributed to the spread of CHP since the early 1990's.

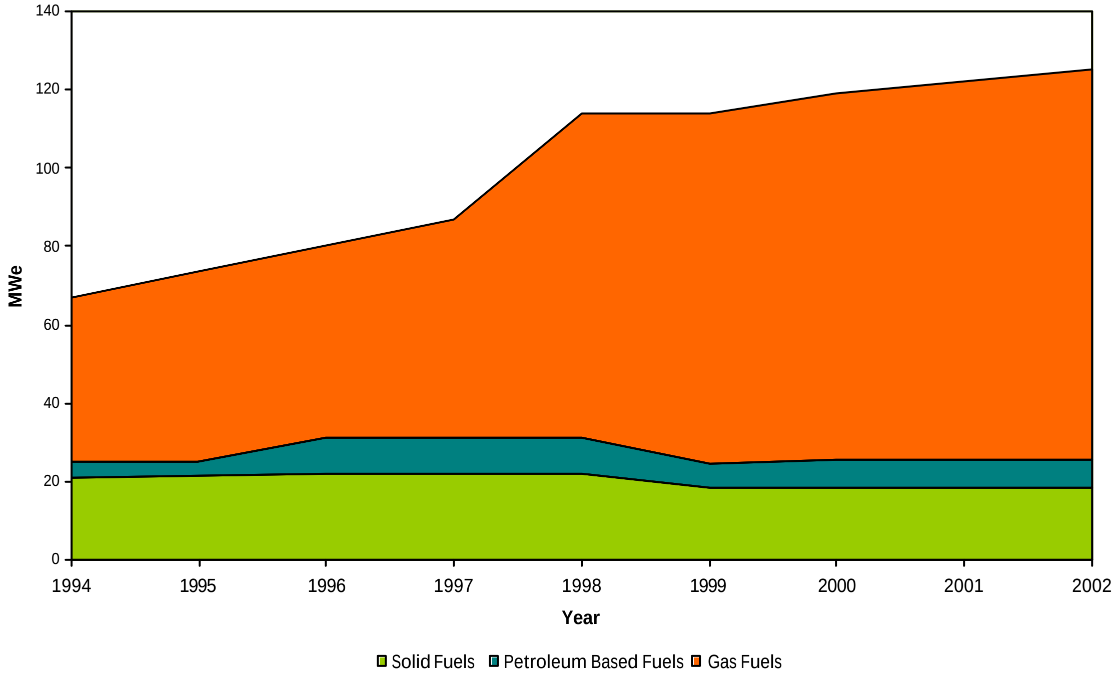
The THERMIE programme was the energy demonstration component of the Non-Nuclear RTD Programme managed by the European Commission Directorate-General for Energy (DG XVII). Under this programme 14 Irish sites received financial assistance for the installation of CHP.

The Energy Efficiency Investment Support Scheme of the Irish Energy Centre (now SEI) provided financial assistance for technologies such as CHP. In October 1995, the small end (hotels and hospitals in particular) of the CHP market was targeted for funding under this scheme and €380,000 was made available for schemes up to 300kWe. This resulted in approximately 1.2 MW_e of new capacity. In July 1998 large industry was targeted for funding. Up to €635,000 per project was available and this resulted in a further 18MW_e of installed capacity[33].

[33] See Footnote 6 (page 7).

5.2 CHP 1994-2002 by Fuel

Figure 14: CHP Installed Capacity by Fuel Type 1994-2002



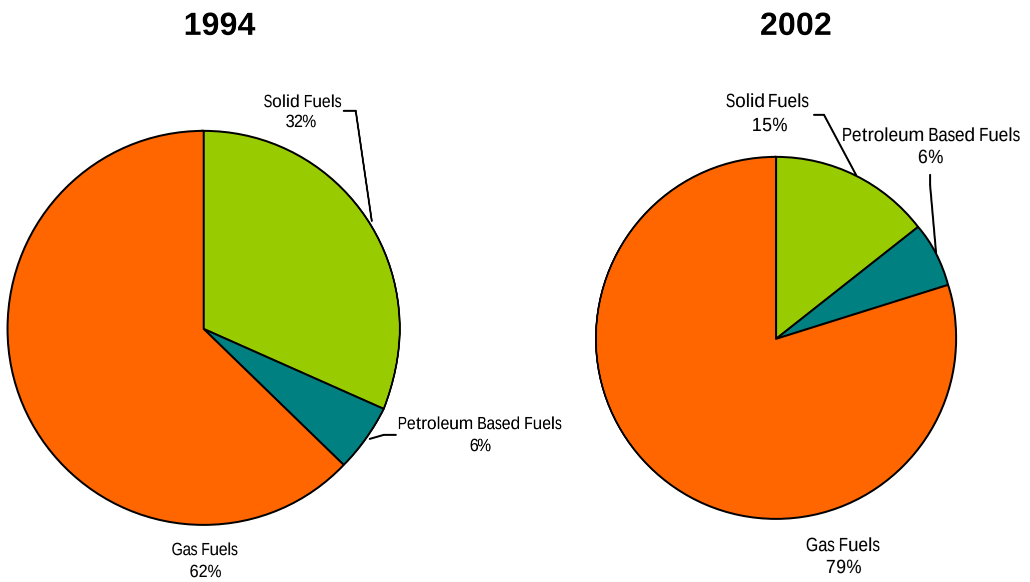
Source: Eurostat and SEI

A full breakdown by fuel is not available for the entire 1994-2002 period but installed capacity by one of the following fuels types is available: solid fuels, petroleum based fuels and gas fuels. Solid fuels are peat and coal, petroleum based fuels are LPG, heavy fuel oil and refinery gas while gas has natural gas and biogas as its constituent parts.

Gas fuels rose in absolute terms by 139% (58 MW_e) over the period 1994-2002, as illustrated in figure 14. This category makes up the bulk of installed capacity. It should be noted that natural gas is by far the dominant fuel in this grouping.

During the same period solid fuels declined by 14% (3 MW_e) while petroleum products increased by 90% (3 MW_e). The share of total installed capacity by fuel type for 1994 and 2002 are shown in figure 15.

Figure 15: Installed Capacity by Fuel Type 1994 and 2002

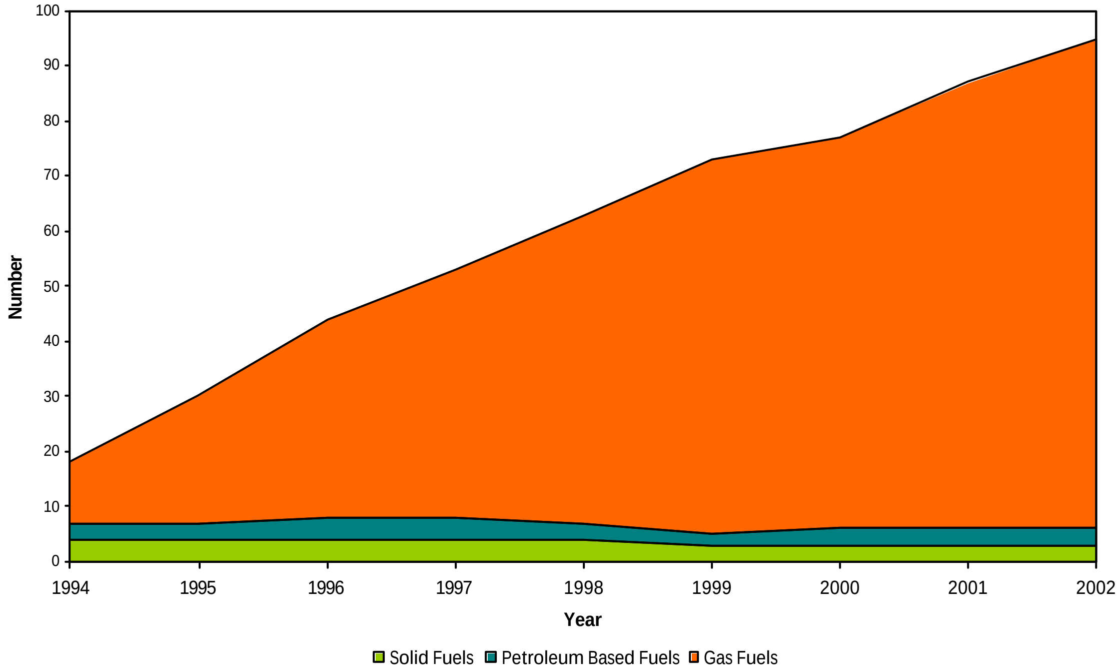


Total 66.8 MW_e **Total 125.3 MW_e**

Source: Eurostat SEI

Figure 16 illustrates the number of units per fuel type. Gas fuel was again the principal category and became increasingly dominant over the period.

Figure 16: Number of Units by Fuel Type 1994-2002



Source: Eurostat and SEI

Figures 5, 14-16 and section 4.1 have shown the importance of natural gas to CHP in Ireland. The price of gas is therefore a significant factor when discussing the development of CHP. More correctly, the price of natural gas relative to the price of electricity is key in the decision making process for choosing CHP as an option. High electricity prices and low gas prices make CHP much more favourable.

Figure 17 compares the price of electricity and natural gas to industry during the period 1990-2001. Natural gas prices are not available for Ireland after 1990 so the EU average is presented as a proxy for prices in Ireland. This is considered reasonable as over 85% of Ireland's natural gas is now imported.

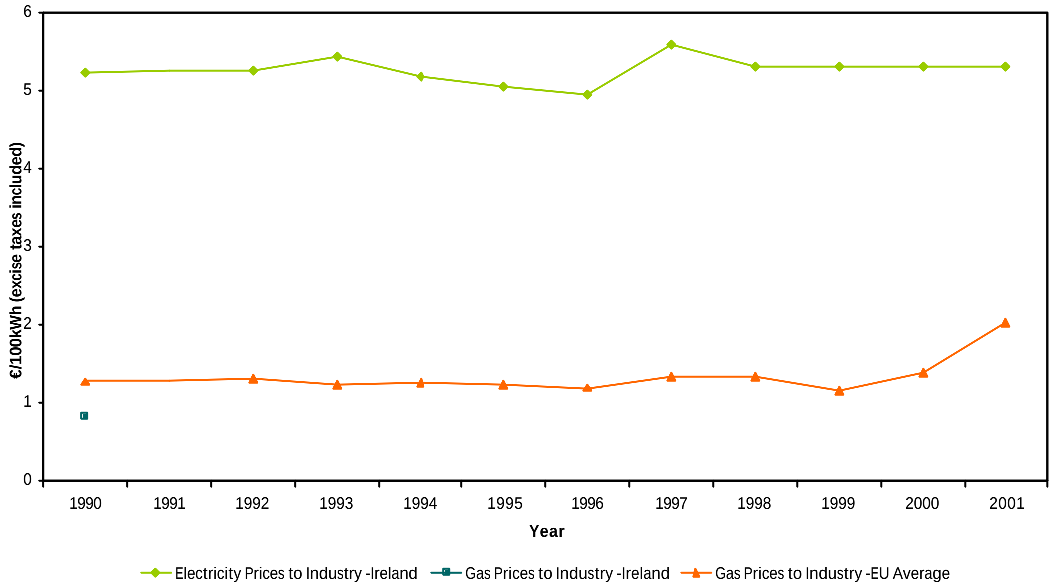
It is important to note in these comparisons that not all CHP units are located in the industrial sector. It is, however, reasonable to assume that large-scale commercial users would be subject to similar prices. In any event the prices to industry would be the lowest available so the differential between natural gas and electricity prices in other sectors would be even greater.

It can be seen from figure 17 that for most the 1990's gas prices to industry were low compared to those for electricity. Data is unavailable after 2001 but it is known[34] that average price rises for natural gas of over 40% have been experienced in the UK over the period 1999-2002. It has also been observed[35] that sizeable price increases have taken place on contract renewal by certain large customers in Ireland over the same period.

[34] SEI (2003) Profiling Energy Consumption and CO2 Emissions – Sensitivity to Carbon Taxation and Emissions Trading.
[35] Ibid.

A previous SEI report has shown that electricity prices to industry have increased by up to 15% since mid 2001[36]. While the increase in electricity prices will partially offset the increase in the price of natural gas, the overriding factor is that the relative difference between the two has declined since 1999. It is reasonable to assume that this has contributed to the levelling off in the growth rate of installed capacity in recent years.

Figure 17: Gas and Electricity Prices to Industry 1990-2001



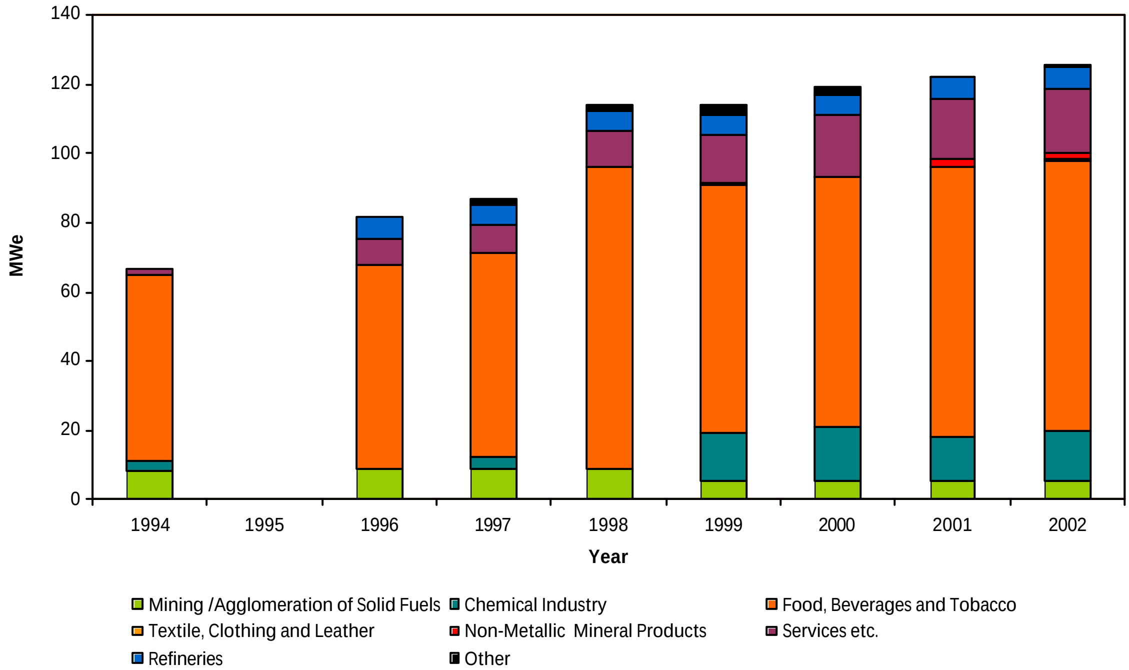
Source: Eurostat

[36] Ibid.

5.3 CHP by Sub-Sector 1994-2002

From the trend in installed capacity over the period 1994-2002 (figure 18) it can be seen that the services sector and all industrial sub-sectors with the exception of the mining and textile sub-sectors recorded growth. The largest absolute increase (24.7 MW_e) occurred in the food, beverages and tobacco sub-sector while the largest relative increase occurred in the services sector (980%).

Figure 18: Evolution of Installed Capacity by Sector 1994-2002

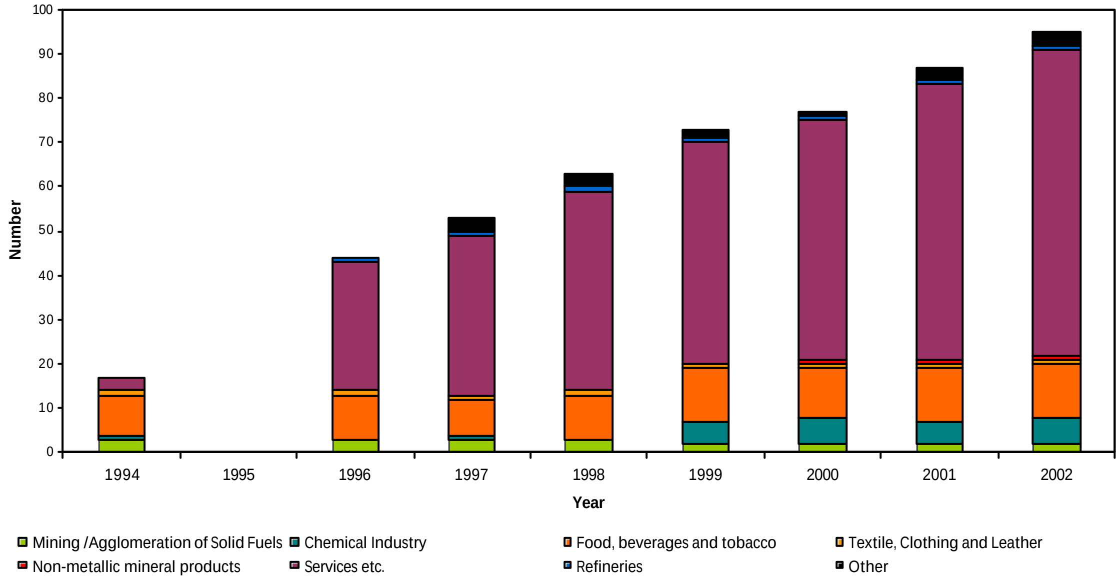


Source: Eurostat and SEI

Figure 19 shows that the growth in the number of CHP units over the same period can be primarily attributed to the services sector. Services in 1994 accounted for 18% (3 units) of the total. This had increased to 73% (69 units) by 2002.

Even though the largest increase in the number of units has occurred in the services sector (66 units and 16.8 MW_e) the small number of new units (3 units and 24.7 MW_e) in the food sector had a greater overall impact on installed capacity.

Figure 19: Evolution of CHP Units by Sector 1994-2002



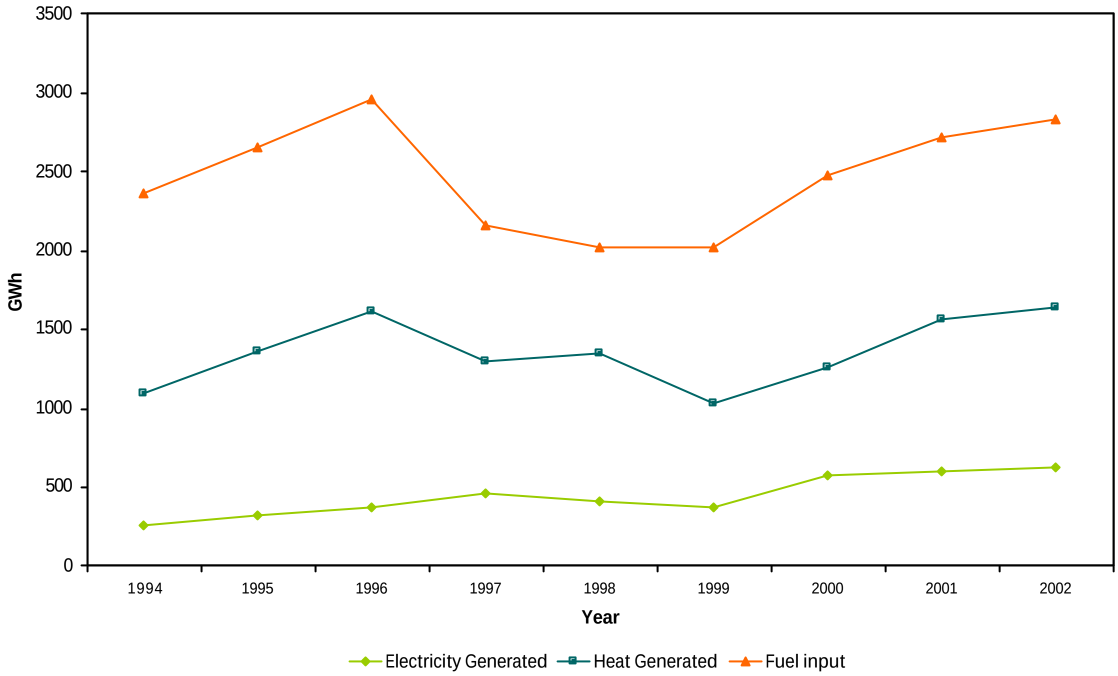
Source: Eurostat and SEI

5.4 CHP Energy Production and Efficiency 1994-2002

The trend in fuel input, electricity and thermal outputs over the period 1994-2002 is presented in figure 20. Fuel input increased by 20% while the thermal and electrical outputs increased by 50% and 143 % respectively over the period.

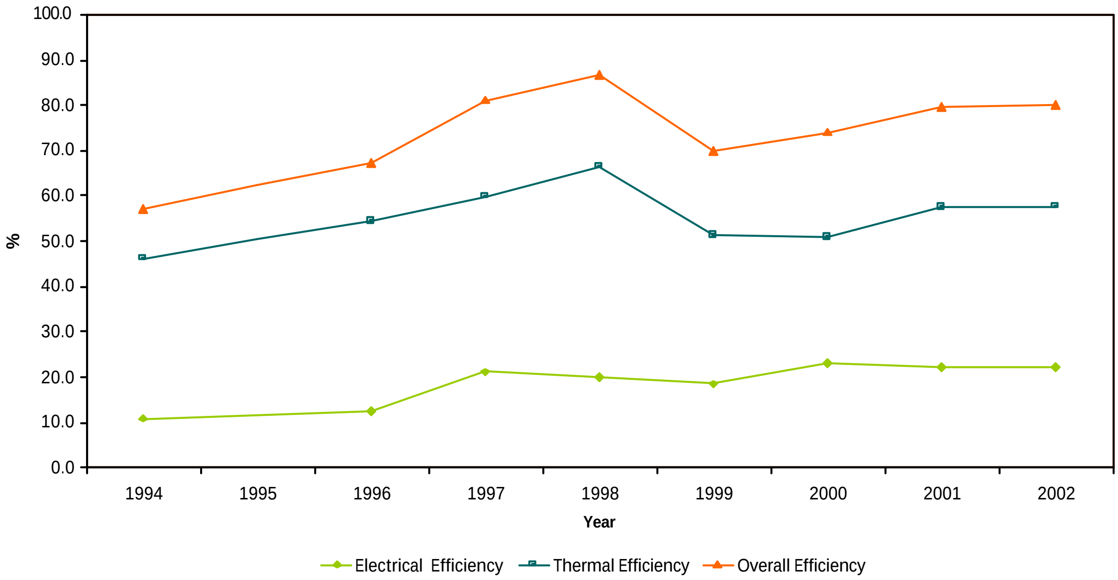
This suggests that the efficiencies of CHP installations increased over the period.

Figure 20: CHP Fuel Input and Thermal /Electricity Output 1994-2002



Source: Eurostat and SEI

Figure 21: Percentage CHP Efficiencies 1994-2002



Source: Eurostat and SEI

The assertion that CHP became more efficient is supported by figure 21, which presents electrical, thermal and overall efficiencies for the period 1994-2002.

Note that the efficiencies are calculated in same way as the previous section. Electrical and thermal efficiency rose by 11.2% and 11.5% respectively over the period, which combined, gave an overall increase in efficiency of 22.7%. As mentioned in section 4.4 the true efficiency figures are likely to be less than those presented above given that the measure used is heat produced rather than heat usefully employed.

It is reasonable to assert that some of this increase in efficiency is attributable to fuel switching to more energy efficient fuels such as natural gas as well as technological changes i.e. CHP units becoming more efficient over the period.

6 CHP in the EU and Irish Targets

This section examines the evolution of installed capacity in Ireland relative to other EU Member States over the period 1994-2000 as well as comparing the importance of CHP electricity generation across the EU. It also charts progress towards Government targets.

6.1 CHP in Europe

The installed capacities and accompanying percentage increases of CHP plants in the EU are presented for the Eurostat survey years in Table 4[37]. The installed electrical capacity in the EU countries has increased by 20%, in the period 1994-2000 from 64 to 76 GW.

Belgium, Spain, Greece and the UK showed extremely strong growth (in excess of 100%) while Germany, Austria and Portugal exhibited a decrease in installed capacity. The remainder, including Ireland were in between these two extremes.

Table 4: Installed Capacity Of CHP 1994-2000

Member State	1994	1996	1997	1998	2000	1994-2000 % +/-
Germany	26183	22542	20666	22160	18747	-28
Austria	3246	3134	3409	3416	2879	-11
Portugal	991	961	921	965	923	-7
Denmark	5214	5489	5946	7027	5885	13
Finland	4085	4265	5018	5097	5502	35
Sweden	2808	2837	3063	3205	3857	37
Netherlands	6148	6809	8358	8500	9092	48
France	2920	3170	3346	3485	4861	66
Ireland	67	82	87	114	118	76
Italy	6328	8034	9519	9802	11994	90
Belgium	728	630	721	797	1512	108
UK	3042	3525	3694	3842	6460	112
Spain	1533	2279	3016	3558	3457	126
Greece	218	218	218	257	706	224
Luxembourg	N/A	N/A	31	98	45	N/A
Total	63511	63975	68013	72323	76037	20

Source: Eurostat

It is also possible to examine the importance of CHP electrical production as a percentage of total electrical output in Europe. Data is presented in table 5[38] for 2000, the most recent year for which comparable data is available.

[37] EU Commission and Eurostat (2001) Combined Heat and Power Production (CHP) in the EU – Summary of statistics 1994-2000.
[38] Ibid

Total electrical production from CHP in the EU in 2000 was 259 TWh, which represented 10% of the gross electrical production in the EU. This figure is the result of very different situations from one country to another. Three distinct groups of countries can be identified.

- The first group is made up of Denmark, Finland and Netherlands in which CHP electrical production was over 35% of their total electricity production, District heating is an important factor in explaining this.
- The second group comprises Belgium, France, Greece, Ireland[39], Sweden, and the UK in which electrical production from CHP was low, at less than 7%.
- The third group comprises Austria, Germany, Italy, Luxembourg, Portugal, and Spain in which CHP electrical production was between 8% and 18% of their total electrical production.

Table 5: Importance of CHP Electricity in the EU 2000

Member State	CHP Electricity (GWh)	CHP Electricity as a % of Total Electrical Production
Greece	1137	2.1
Ireland	576	2.4
France	16280	3.0
United Kingdom	23053	6.1
Sweden	9075	6.2
Belgium	5445	6.5
Italy	23030	8.3
Spain	20706	9.2
Portugal	4375	10.0
Austria	6408	10.4
Germany	60836	10.6
Luxembourg	208	17.7
Finland	25510	36.4
Netherlands	43153	48.2
Denmark	18971	52.2
EU-15	**258763**	**10.0**

Source: Eurostat

[39] In Ireland in 2002 2.6% of total electrical output was generated by CHP.

6.2 Planned Growth and Targets

The 2003 survey found that there is a planned 20.8 MW_e of installed capacity. This proposed growth is dominated by a small number of large units in the industrial sector. There are also a number of smaller capacity units that are planned for the services sector.

It should be noted that this figure is made up of units that range from being in the early planning stages to those that became operational in 2003. In reality, the estimated growth for 2003 will be in the region of 4 to 5 MW_e. The growth from 2001 to 2002 was 2.8 MW_e (2.2%).

ESB National Grid, in its most recent Generation Adequacy Report 2004 –2010 predicts that 65 MW_e of installed capacity will be added by 2010, from a base of 132Mw_e at the end of 2003[40].

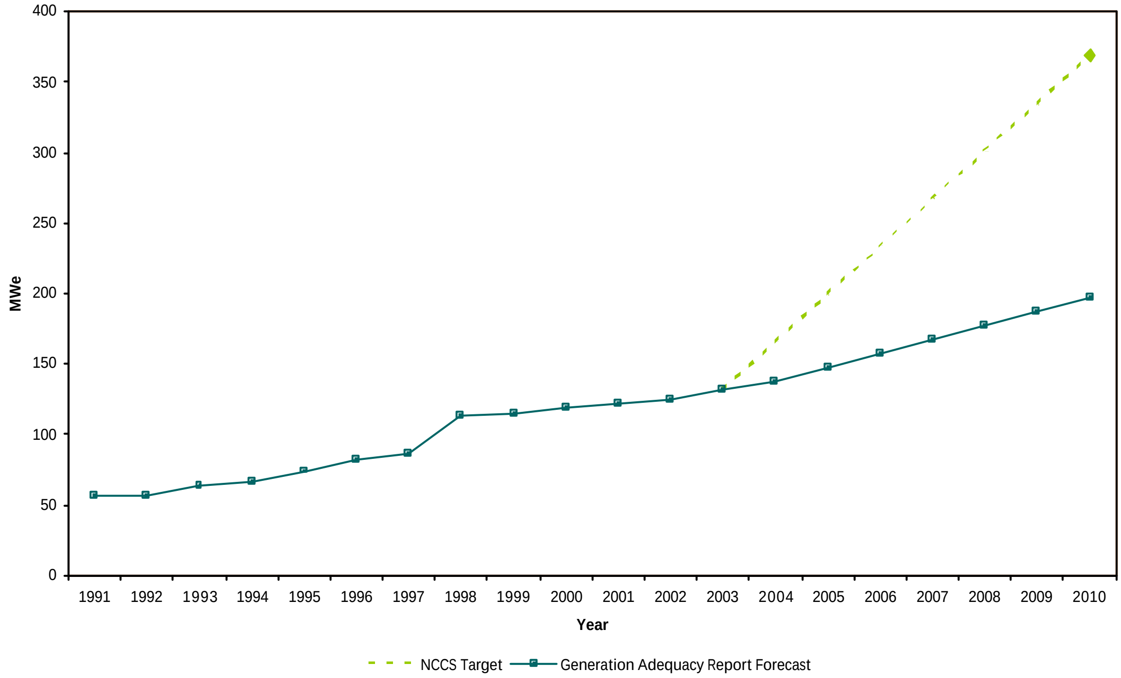
Figure 22 illustrates the Generation Adequacy Report forecast, which results in a total instated capacity of 197 MW_e in 2010.

As stated earlier, the National Climate Change Strategy sets a per annum target of 0.25 Mt reduction of CO_2 attributable to CHP, relative to business as usual, to be achieved by 2010. It has been estimated[41] that an additional 250 MW_e will need to be installed by the end of the decade, in order to achieve this target. The NCCS target is shown for comparison in figure 22.

If the Generation Adequacy Report forecast is realised, it is clear that the target of an additional 250MW_e will not be realised.

[40] ESB National Grid (2003) Generation Adequacy Report.
[41] See Footnote 6 (page 7).

Figure 22: Installed Capacity Future Scenario Versus NCCS Target



Source: NCCS, ESB National Grid

New technologies such as micro-turbines, the gas to electrically price ratio, and Government and EU policies will ultimately decide the future level of growth.

In December 2003, Aughinish Alumina, an alumina manufacturing company, was awarded a contract by CER to build a 150 MW_e CHP plant at its site in Co. Limerick. This installation does not contribute to the 250 MW_e NCCS target. A plant of over 300MW_e, which was the original proposal for the Aughinish site, was included under the business as usual scenario due to its large size and specific nature.

7 Conclusion

Total installed capacity of CHP in Ireland at the end of 2002 was 131.5 MW_e, comprising of 105 units. In 2002 the bulk of installed capacity was in the industrial sector (82% or 108.3 MW_e) while the majority of units (77 units or 73%) were found in the services sector.

The bulk of installed capacity in 2002 was fuelled by natural gas (81%). Over the period 1994-2002, the use in CHP units of fuels such as coal, peat, LPG, biogas, refinery gas and heavy fuel oil remained constant or declined while the use of natural gas rose sharply.

The electrical and thermal efficiency of CHP rose by 11.2% and 11.5% respectively over the period 1994-2002, which combined, gave an overall increase in efficiency of 22.7%. It is likely that some of this increase in efficiency is attributable to fuel switching to more energy efficient fuels such as natural gas as well as technological changes i.e. CHP units became more efficient over the period.

The annual growth in installed capacity of CHP in 2002 was 2.2 % (2.8 MW_e), an increase of 7 units on 2001. The average annual growth rate of operational CHP units over the period 1991-2002 was 22.7% compared with 7.5% for installed capacity. The estimated growth rate in 2003 is 4-5 MW_e. ESB National Grid[42] forecasts that total instated capacity in 2010 will be 197 MW_e. It is therefore unlikely that the NCCS target of an additional 250 MW_e to be installed by 2010 will be achieved.

A European wide analysis of CHP is currently being undertaken, similar to previous Eurostat surveys. This report will be updated to include the new European data when it becomes available. In addition the survey, which was undertaken in 2003, will be repeated in 2004. The planned survey will be expanded to include qualitative data such as views on the perceived barriers to CHP development.

[42] ESB National Grid (2003) Generation Adequacy Report.

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Annex 1 Questionnaire

System Details

Prime Mover (engine, gas turbine etc…)	
Fuel	
Supplier	
Installed Capacity (kWe) Electrical	
Installed Capacity (kWt) Thermal	
Date of Installation	

Year 2001 information *only*

Operating Hours	
Fuel Input (TJ)	
Total Electricity Generated (kWh)	
Total Heat Generated (MWh)	
Heat Usefully Employed (MWh)	
Electricity Exported to Grid (MWh)	
Electrical Efficiency (%)	
Thermal Efficiency (%)	

Year 2002 information *only*

Operating Hours	
Fuel Input (TJ)	
Total Electricity Generated (kWh)	
Total Heat Generated (MWh)	
Heat Usefully Employed (MWh)	
Electricity Exported to Grid (MWh)	
Electrical Efficiency (%)	
Thermal Efficiency (%)	

Annex 2 NACE Classification of Sectors and Sub-Sectors

Table A2:1: NACE Classification of Sub-Sectors

Mining and agglomeration of solid fuels	NACE 10
Extraction of crude oil and natural gas	NACE 11
Coke ovens	NACE 23.1
Refineries	NACE 23.2
Extraction and processing of nuclear fuels	NACE 12, 23.3
Iron and steel industry	NACE 27.1, 27.2, 27.3, 27.51, 27.52
Non-ferrous metals	NACE 27.4, 27.53, 27.54
Chemical industry	NACE 24
Non-metallic mineral products	NACE 26
Extraction	NACE 13, 14
Food, beverages and tobacco	NACE 15, 16
Textile, clothing, leather	NACE 17, 18, 19
Paper, publishing and printing	NACE 21, 22
Metal products, machinery, equipment	NACE 28, 29, 30, 31, 32, 34, 35
Other industrial branches	NACE 20, 25, 33, 36, 37, 45
Transport	NACE 60, 61, 62
Services etc.	NACE 40.2, 41, 50, 51, 52, 55, 63, 64, 65, 66, 67, 70, 71, 72, 73, 74, 75, 80, 85, 90, 91, 92, 93, 95, 99,
Agriculture	NACE 01,02, 05
Other (specify)	