SUSTAINABLE ENERGY AUTHORITY OF IRELAND

# COMBINED HEAT AND POWER IN IRELAND

## 2020 Update

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## 2020 Report

December 2020

SUSTAINABLE ENERGY AUTHORITY OF IRELAND

# Sustainable Energy Authority of Ireland

SEAI is Ireland's national energy authority investing in, and delivering, appropriate, effective and sustainable solutions to help Ireland's transition to a clean energy future. We work with Government, homeowners, businesses and communities to achieve this, through expertise, funding, educational programmes, policy advice, research and the development of new technologies. SEAI is part-financed by Ireland's EU Structural Funds Programme co-funded by the Irish Government and the European Union.

# Energy Policy Statistical Support Unit (EPSSU)

SEAI 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 in meeting international reporting obligations, for advising policymakers and informing investment decisions. Based in Cork, EPSSU is SEAI'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.

# Acknowledgements

SEAI gratefully acknowledges the cooperation of the all the organisations, agencies, energy suppliers and distributors that provided data and responded to questionnaires throughout the year.

# Overview

## Capacity

- The operational capacity of CHP in Ireland at the end of 2019 was 322 MWe (319 units), an increase of 3.1 MWe (1.0%) in operating capacity from 2018.

## CHP by Fuel

- Natural gas was the fuel of choice for 274 operational CHP units in 2019. Biogas and oil products made up the next most significant share with 21 and 20 units respectively. The remainder was biomass and solid fuel with 4 units.
- Natural gas fuelled 300 MWe (93.2%) of the operational capacity in 2019. Biogas fuelled 11.9 MWe (3.7%), biomass 6.6 MWe (2.0%), solid fuel 1.6 MWe (0.8%) and oil products were used by the remaining 1.0 MWe (0.3%).
- Biomass and bioenergy CHP, as renewable energy sources are counted towards Ireland's renewable energy targets. Renewable CHP contributed 0.2% to both RES-E and RES-H in 2019.

## CHP by Sector and Sub-Sectors

- There are a large number of relatively small units in the services sector. The services sector accounted for 83% of the units and 13% of the operational capacity in 2019.
- Within the services sector, hotels account for the majority (24%) of units while the leisure sub-sector (which includes swimming pools, leisure centres, gyms, etc.) is the second largest at 18% in 2019.
- The industry sector accounted for 17% of the units and 87% of the operational capacity.
- The food sub-sector of industry contains the largest number of units with 47% of units and 24% of industrial operational capacity, while non-ferrous metals accounts for 2% of units but 57% of industrial operational capacity.

## CHP Electricity Generation

- In 2019, 6.6% of Ireland's electricity was from CHP installations, compared with 7.0% in 2018.
- In 2019, there were 17 units exporting electricity to the grid. These units exported 1,337 GWh of electricity in 2019, a decrease of 4.1% on 2018.

## CHP Heat Output

- In 2019, the useful heat produced from CHP met 5.7% of Ireland's total thermal energy demand.
- The useful heat output was estimated at 99% of the total heat generated by CHP plants in 2019[1].

## CHP Fuel Input and Thermal/Electrical Outputs

- In 2019, electricity output decreased by 3.0%, estimated useful heat output decreased by 3.6% with fuel input decreasing by 4.7%.
- The overall stock of CHP installations has become more efficient, increasing from 76% in 2001 to an efficiency of 83.5% in 2019.

## Avoided $CO_2$ Emissions

- The use of CHP in 2019 avoided 499 kt CO2 emissions when compared with separate electricity and heat production.

## EU Emissions Trading Scheme (ETS)

- CHP units that are part of the EU Emissions Trading Scheme made up 9% of the units but 80% of operational capacity in 2019.

## Primary Energy Savings

- There was a primary energy saving of 20% or 1,531 GWh from CHP plants in 2019 compared to separate heat and electricity production.

1 The survey responses for useful heat are not always reliable as a significant portion do not distinguish between the total CHP heat output and the useful heat resulting in an overestimation of useful heat.

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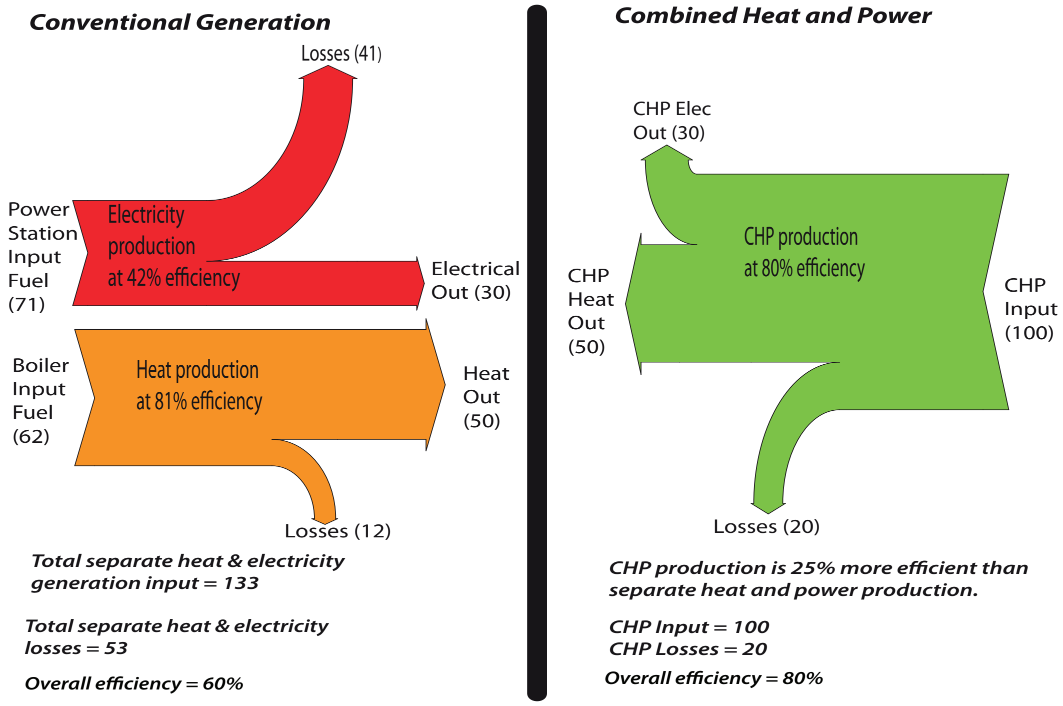
# 1 Introduction

In conventional electricity generation much of the input energy is lost to the atmosphere as waste heat. In Ireland over half of the input energy to electricity generation is lost with the other half being transformed into electricity. Combined Heat and Power (CHP) systems channel this lost heat to useful purposes so that usable heat and electricity are generated in a single process. CHP plants are also referred to as cogenerating plants. Where there is cooling energy created in the same process, the plants are referred to as trigeneration plants.

The efficiency of a CHP plant can typically be 20% to 25% higher than the combined efficiency of heat-only boilers and conventional power stations. *Figure 1* illustrates how a 25% energy saving can be achieved using CHP compared to the separate production of heat and centralised electricity. The heat efficiency component of the CHP units is calculated from the amount of heat usefully employed as opposed to heat generated. There may also be additional efficiency due to eliminating electricity transmission and distribution losses.

**Figure 1: Comparing Conventional Heat and Electricity Generation to CHP**




*Source : SEAI*

In the right circumstances, where there is a significant heating or cooling demand in addition to an electricity demand, CHP can be an economic means of improving the efficiency of energy supply and achieving environmental targets for emissions reduction. CHP usually involves the burning of fossil fuels but can also use biomass (including solid biomass, biogas and waste).

This report examines the contribution made by CHP to Ireland's energy requirements for the period 1991 to 2019, with a particular focus on the years 2018 and 2019. This is SEAI's fourteenth report on the topic. The data are gathered by surveying site operators and CHP unit suppliers. A list of survey questions is included in Appendix A of this report.

# 2 CHP in Ireland 2019

## 2.1 Operational Capacity

The estimated capacity[1] of CHP in Ireland at the end of 2019 was 322 MWe (319 units). This reflects an increase of 3.1 MWe (1.0%) in operating capacity from 2018 to 2019.

The Aughinish Alumina plant which accounts for 160 MWe has been operational since 2006 and is the single largest CHP installation.

There were 6 new operational units (4.5 MWe) reported in 2019 which were mostly in the services sector.

## 2.2 CHP by Fuel

It is useful to examine the fuel type associated with CHP plants from the perspectives of both security of supply and environmental impact. 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 level of emissions reduction that may be achieved.

*Table 1* illustrates the operational capacity and number of units by fuel in 2019. Natural gas was the fuel of choice for 300 .3 MWe (274 units) in 2019. It is worth noting that there is a single 160 MWe gas plant which dominates. Biogas made up the next most significant share with 11.9 MWe (21 units) followed by biomass with 6.6 MWe (3 units) and solid fuels accounted for 2.6 MWe (1 unit). The remainder was oil fuels with 1.0 MWe (20 units).

**Table 1: Number of Units and Operational Capacity by Fuel in 2019**

| | No. of Units | Operational Capacity MWe | No. of Units | Operational Capacity |
|---|---|---|---|---|
| Natural Gas | 274 | 300.3 | 85.9% | 93.2% |
| Solid Fuels | 1 | 2.6 | 0.3% | 0.8% |
| Biomass | 3 | 6.6 | 0.9% | 2.0% |
| Oil Fuels | 20 | 1.0 | 6.3% | 0.3% |
| Biogas | 21 | 11.9 | 6.6% | 3.7% |
| **Total** | **319** | **322.3** | **100%** | **100%** |

*Source: SEAI*

## 2.3 CHP by Sector and Sub-Sector

CHP is more suited to some applications and sectors of the economy than others, depending on how the energy is used, the amount of energy consumption and the split between electrical and heat requirements. Traditionally, CHP was more suited to large industrial but the availability of small scale, reliable gas units since the 1990s (and more recently micro-turbines) meant that the services sector could avail of the technology.

*Table 2* presents the number of units and operational capacity for CHP in Ireland in 2019. The majority of units are in the services sector while the bulk of operational capacity is in industry, indicating that there are a large number of relatively small units in the services sector. The services sector accounted for 264 (83%) of the 319 units and 41 MWe of the 322 MWe operational capacity (13%) in 2019.

**Table 2: CHP Number of Units and Operational Capacity by Sector in 2019**

| | No. of Units | Operational Capacity MWe | No. of Units | Operational Capacity |
|---|---|---|---|---|
| Services | 264 | 41 | 82.8% | 12.8% |
| Industry | 55 | 281 | 17.2% | 87.2% |
| **Total** | **319** | **322** | **100%** | **100%** |

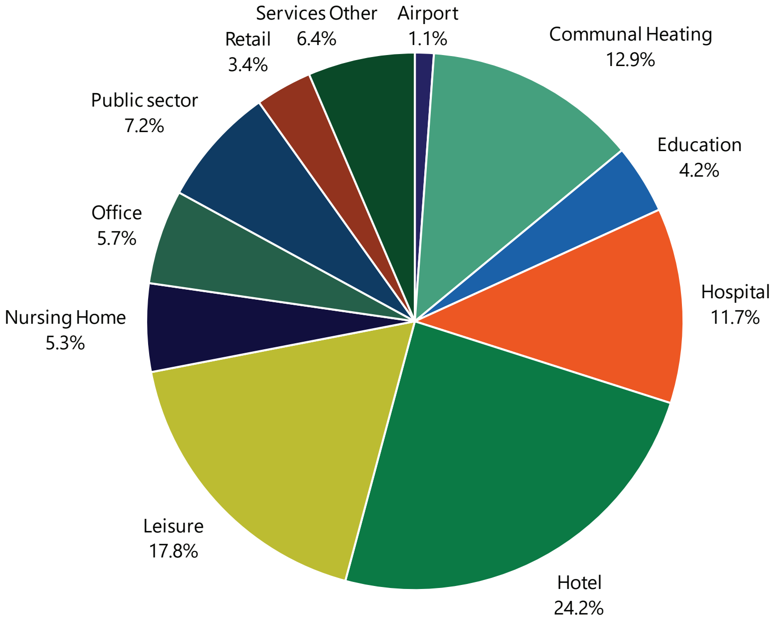
*Source: SEAI*

Examining the breakdown of the services sector further in *Figure 2* shows that hotels and leisure (which includes swimming

1 Megawatt electrical or MWe is the unit by which the installed electricity generating capacity or size of a CHP plant is quantified, representing the maximum electrical power output of the plant.

pools, leisure centres, gyms, etc.) account for 42% (111 units) of units in the sector while the hospital sub-sector accounts for another 12% (31 units). These sub-sectors, in particular, benefit from having close to relatively consistent demand for heat and electricity. The technology may also be suited to any site that has a sufficient simultaneous demand for both heat and electricity.

**Figure 2: Number of Units by Services Sub-Sectors in 2019**




It is interesting to note that certain sub-sectors have a small number of CHP units but represent a considerable proportion of the installed capacity, notably airports and the public sector (which includes waste water treatment plants). This is illustrated in *Table 3* where the combined Airport/Public Sector sub-sectors have 8.3% of the number of units in the services sector and 35% of the operational capacity.

Also, as we can see from *Table 3* that there are many small CHP units operating in communal heating where it has a 13% share (34 units) of units while it only represents 0.5% share of operational capacity in the services sector.

**Table 3: Number of Units and Operational Capacity by Services Sub-Sectors in 2019**

| | No. of Units | Operational Capacity MWe | No. of Units | Operational Capacity | Total CHP No. of Units | Total CHP Operational Capacity |
|---|---|---|---|---|---|---|
| Airport | 3 | 6.7 | 1.1% | 16.1% | 0.9% | 2.1% |
| Communal Heating | 34 | 0.2 | 12.9% | 0.5% | 10.7% | 0.1% |
| Education | 11 | 3.9 | 4.2% | 9.5% | 3.4% | 1.2% |
| Hospital | 31 | 5.0 | 11.7% | 12.0% | 9.7% | 1.5% |
| Hotel | 64 | 8.3 | 24.2% | 20.1% | 20.1% | 2.6% |
| Leisure | 47 | 3.7 | 17.8% | 8.8% | 14.7% | 1.1% |
| Nursing Home | 14 | 0.3 | 5.3% | 0.6% | 4.4% | 0.1% |
| Office | 15 | 2.2 | 5.7% | 5.3% | 4.7% | 0.7% |
| Public sector | 19 | 7.6 | 7.2% | 18.4% | 6.0% | 2.4% |
| Retail | 9 | 1.2 | 3.4% | 3.0% | 2.8% | 0.4% |
| Services Other | 17 | 2.3 | 6.4% | 5.6% | 5.3% | 0.7% |
| **Total** | **264** | **41.4** | **100%** | **100%** | **82.8%** | **12.8%** |

*Source: SEAI*

*Table 4* presents the sub-sectoral breakdown of operational capacity and number of units in industry. The 160 MWe installation at Aughinish Alumina dominates capacity with that single site accounting for 57% of the total operational capacity in the industrial sector. It can be seen that the food sector has the largest number of units with 47% (26 units), accounting for 28% (77.4 MWe) of industrial operational capacity in 2019. The sub-sector 'Other' refers to enterprises in the energy and the sawmills sub-sectors.

**Table 4: Number of Units and Operational Capacity by Industry Sub-Sectors in 2019**

| | No. of Units | Operational Capacity MWe | No. of Units | Operational Capacity | Total CHP No. of Units | Total CHP Operational Capacity |
|---|---|---|---|---|---|---|
| Food | 26 | 77.4 | 47.3% | 27.6% | 8.2% | 24.0% |
| Manufacturing | 8 | 12.2 | 14.5% | 4.3% | 2.5% | 3.8% |
| Pharmaceutical | 15 | 25.8 | 27.3% | 9.2% | 4.7% | 8.0% |
| Non Ferrous Metals | 1 | 160.0 | 1.8% | 57.0% | 0.3% | 49.6% |
| Other Industry | 5 | 5.4 | 9.1% | 1.9% | 1.6% | 1.7% |
| **Total** | **55** | **280.9** | **100%** | **100%** | **17.2%** | **87.2%** |

*Source: SEAI*

Many of the larger capacity CHP units are part of the EU emissions trading scheme (ETS). ETS companies are subject to an annually declining emissions cap which reduces by 21% in 2020 compared to 2005. The breakdown is illustrated in *Table 5* where although the ETS sector has only 9% of operational units it has 80% of operational capacity. Of the 30 units in ETS, 25 (248 MWe) are in the industry sector, with the remaining five (8 MWe) in the services sector.

**Table 5: Number of Units and Operational Capacity by ETS Sector in 2019**

| | No. of Units | Operational Capacity MWe | No. of Units | Operational Capacity |
|---|---|---|---|---|
| ETS | 30 | 255.8 | 9.4% | 79.4% |
| non-ETS | 289 | 66.5 | 90.6% | 20.6% |
| **Total** | **319** | **322.3** | **100%** | **100%** |

*Source: SEAI*

# 3 Policy

The European Union CHP Directive[2], approved in February 2004, sought to create a favourable environment for CHP installations. The Directive contained definitions for micro, small and large scale CHP. *Table 6* lists Ireland's operational capacity in 2019 according to this classification. It can be seen that units in the over 1 MWe category account for most of the operational capacity (91%) while most units are between 50 kWe and 1 MWe (52%).

**Table 6: Number of Units and Operational Capacity by Capacity Size Range in 2019**

| Electrical Capacity Size Range | No. of Units | No. of Units | Operational Capacity MWe | Operational Capacity |
|---|---|---|---|---|
| Micro <50 kWe | 97 | 30.4% | 0.7 | 0.2% |
| 50 kWe ≤ Small < 1MWe | 166 | 52.0% | 27.4 | 8.5% |
| Large ≥ 1 MWe | 56 | 17.6% | 294.2 | 91.3% |
| **Total** | **319** | **100%** | **319.2** | **100%** |

*Source: SEAI*

The Energy (Miscellaneous Provisions) Act of 2006[3] is the transposition of the EU CHP Directive into Irish law. The European Commission published Decision 2007/74/EC[4] establishing harmonised efficiency reference values for separate production of electricity and heat in December 2006. The Commission also established detailed guidelines for the implementation and application of Annex II to Directive 2004/8/EC in Decision 2008/952/EC[5].

In 2009 three statutory instruments[6] SI 298, SI 299 and SI 499 relating to CHP were published. SI 298 brought into law section 6 of the 2006 act which relates to CHP. SI 299 gives the Commission for Regulation of Utilities (CRU) the responsibility of calculating Power to Heat Ratios for CHP units in Ireland. Under SI 499 the CRU is required to certify high efficiency HE (CHP) and the electricity system operator is required to give such generation priority when dispatching to the system.

The CRU's 2009 *Decision Paper: Treatment of Small, Renewable and Low Carbon Generators outside the Group Processing Approach* sets out the approach for securing grid connections for different scales of high efficiency CHP.

On 25 October 2012, the CHP Directive was repealed by Directive 2012/27/EU[7] of the European Parliament and of the Council on energy efficiency[8]. The new Directive places energy efficiency at the core of the EU Energy 2020 strategy, requires Member States to further decouple energy use from economic growth and sets out a common framework of measures for the achievement of the EU's headline 20% energy efficiency target (by 2020).

It recognises that high efficiency CHP, together with district heating and cooling, has significant potential for achieving primary energy savings. It sets out a number of obligations on Member States, including that they establish mechanisms for guaranteeing the origin of electricity from cogeneration and provide priority access or dispatch for electricity generated from high efficiency cogeneration. The Directive also requires that Member States:

- Assess the potential for the application of high efficiency cogeneration and district heating and cooling, implement policies at a local and regional level to encourage the consideration of using efficient heating and cooling systems, and assess the potential for local and regional heat markets;
- Ensure that a cost benefit analysis on the use of high efficiency cogeneration is carried out for new and refurbished electricity generating stations, industrial installations that generate waste heat at a useful temperature, and new and refurbished district heating and cooling systems, where the development has a total thermal input greater than 20 MW;
- Ensure that electricity generated from high efficiency cogeneration is guaranteed access to the grid and is provided with priority dispatch.

Transposition of the Directive in Ireland was completed in 2014 by two statutory instruments, SI 131 and SI 426. SI 426 transposes the majority of the Directive into law, including Article 14 which relates to the promotion of efficiency in heating

2 European Union, 2004. *Directive 2004/8/EC on the promotion of cogeneration based on a useful heat demand in the internal energy market*. Available at: http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:02004L0008-20090420&qid=1409052593848&from=EN

3 Acts of the Oireachtas are available at: http://www.irishstatutebook.ie/

4 European Union, 2007. *Commission Decision of 21 December 2006 establishing harmonised efficiency reference values for separate production of electricity and heat in application of Directive 2004/8/EC*. Available at: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2007:032:0183:0188:EN:PDF

5 European Union, 2008. *Commission Decision of 19 November 2008 establishing detailed guidelines for the implementation and application of Annex II to Directive 2004/8/EC for the European Parliament and of the Council*. Available at: https://publications.europa.eu/en/publication-detail/-/publication/6048f5e3-3649-4cf3-98af-31346a57a6bf/language-en

6 Statutory Instruments are available at: http://www.irishstatutebook.ie/

7 Full details are available at http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2012:315:0001:0056:EN:PDF

8 *Directive 2012/27/EU* also repealed *Directive 2004/8/EC (cogeneration)* and amended Directives *2009/125/EC (eco-design of energy-related products)* and *2010/30/EU (labelling of energy-related products)*.

and cooling. It also allows for exemptions for certain installations from the cost benefit analysis mentioned above.

## 3.1 High Efficiency CHP Certification

The Commission for Regulation of Utilities was appointed to certify high efficiency CHP (HE CHP) under SI 299 of 2009. A decision paper (CER/12/125)[9] on the certification process was published in March 2012. This decision paper put in place a process for applications from generators which would allow them to be assessed for certification as high-efficiency CHP as set out in Directive 2004/8/EC. The CRU has since published a number of clarification notes on matters relating to HE CHP assessment and certifications.

The certification is based on available data and applicants are required to:

- demonstrate that the heat load is useful heat;
- complete and submit relevant application forms and provide required data;
- maintain operational records and install metering and measurement systems where necessary;
- provide full access to operational data, and
- provide access and facilitate inspection of the plant and records by auditors appointed by the CRU.

The calculation methodology is based on that laid out in Directive 2004/8/EC with results provided as follows:

- power to heat ratio;
- primary energy savings (PES);
- determination of HE CHP electricity;
- electrical efficiency;
- heat efficiency;
- overall efficiency.

It is the calculation of the PES, rather than the overall energy efficiency, that ultimately determines whether a CHP plant qualifies as high efficiency. The specific requirements with respect to PES for high efficiency CHP certification are:

- PES ≥10% for plants with capacity greater than or equal to 1 MWe;
- PES >0% for plants below this capacity threshold, i.e. plants less than 1 MWe.

All certified HE CHP plants are required to report annually to the CRU detailing whether the high efficiency standards have been met and include key defined parameters which are based on twelve months' operational data. Audits must be carried out and certification may be revoked at any time.

## 3.2 Renewable Energy Feed-In Tariff

Further support for biomass CHP and anaerobic digestion CHP was provided through a Government renewable energy feed-in-tariff (REFIT). REFIT in general is a support mechanism to help meet the national renewable electricity target of 40% by 2020. Specifically REFIT 3[10] (biomass technologies) opened in February 2012 having received state aid clearance from the European Commission in October 2011.

REFIT 3 was designed to incentivise the addition of 310 MW of renewable electricity capacity to the Irish grid. Of this, 150 MW was intended to be high efficiency CHP (HE CHP), using anaerobic digestion (50 MW) or the thermo-chemical conversion of solid biomass (100 MW), while 160 MW was reserved for biomass combustion and biomass co-firing. Demand for the biomass CHP category exceeded the original allocation of 100 MW and was significantly lower for the other categories. In August 2014 the Government approved the reallocation of 70MW capacity from these categories (35MW anaerobic digestion and 35MW biomass combustion), to biomass CHP. This was done to reflect demand and increase the number of projects without significantly increasing the modelled costs of the scheme.

REFIT 3 closed for new applications on December 31st 2015.

9 Commission for Energy Regulation (Mar. 2012), *Certification Process for High Efficiency CHP Decision Paper*, https://mk0cruiefjep6wj7niq.kinstacdn.com/wp-content/uploads/2012/07/cer12125.pdf

10 REFIT 3 Terms and Conditions available from https://www.dccae.gov.ie/en-ie/energy/topics/Renewable-Energy/electricity/renewable-electricity-supports/refit/Pages/REFIT-3.aspx

## 3.3 Support Scheme for Renewable Heat

In December 2017 the Minister for Communications, Climate Action and Environment introduced a national Support Scheme for Renewable Heat[11] after securing Government approval. The Scheme is designed to financially support the replacement of fossil fuel heating systems with renewable energy for large heat demand non-domestic users. This covers commercial, industrial, agricultural, district heating, public sector and other non-domestic businesses and sectors (in the non-emissions trading sector).

The Scheme aims to

- Bridge the gap between the installation and operating costs of renewable heating systems and the conventional fossil fuel alternatives; and
- Incentivise the development and supply of renewable heat.

The Scheme is currently open to applicants and offers ongoing operational support (a tariff) based on useable heat output in renewable heating systems, in new installations or installations that currently use a fossil fuel heating system and convert to using the following technologies:

- Biomass boiler or biomass HE CHP heating systems
- Biogas (anaerobic digestion) boiler or biogas HE CHP heating systems

SEAI has been appointed as the administrator for the SSRH. The planned tariffs support up to 5.66 cent per kilowatt hour of energy produced from biomass heating systems and 2.95 cent per kilowatt hour of energy produced from anaerobic digestion heating systems. The tariffs paid will reduce with increasing output reflecting the economy of scale associated with larger systems. Payments will be made to participants on the basis of eligible heat use and the relevant tariff for a period of up to 15 years, provided they continue to satisfy eligibility criteria and ongoing obligations.

High efficiency combined heat and power (HECHP) heating systems that use a technology that is eligible for an operational support may receive this support for the useable heat output from a HECHP process. However, if such projects are eligible for receipt of a support payment for the electricity output (such as under the proposed Renewable Electricity Support Scheme) they may be subject to a reduction in the operational support under this scheme.

Projects that are in receipt of supports under the REFIT scheme will not be eligible for operational support under this scheme.

## 3.4 Tax Relief

Provision for a partial relief from carbon tax for mineral oil, natural gas or solid fuel, and a full relief in the case of peat, used for environmentally friendly heat and power cogeneration, was made in Finance Act 2012[12]. The partial relief for natural gas and solid fuel was changed to a full relief in Finance Act 2016[13]. These new reliefs apply from 1 January 2017 where fuel is used in HE CHP to generate high efficiency electricity and where the quantity of fuel so used has been set out in a certificate issued by the CRU in the course of performing their function of certifying that a unit qualifies as HE CHP. The relief is given by means of repayment to the consumer of the fuel for CHP, therefore the consumer must make the application to their local Revenue District office. Please see the Revenue website[14] for more details.

These certified CHP plants may also be eligible for relief from electricity tax for electricity produced from high-efficiency environmentally friendly heat and power generation. This tax relief will normally be claimed by the supplier when making the tax return. There is a further relief from electricity tax for electricity used for combined heat and power generation. Please see the Electricity Tax Guide[15] for more details.

11 Support Scheme for Renewable Heat Guideline available from https://www.seai.ie/resources/publications/SSRH-Grant-Scheme-Operating-Rules-and-Guidelines.pdf

12 *Finance Act 2012* available from http://www.irishstatutebook.ie/eli/2012/act/9/enacted/en/pdf

13 *Finance Act 2016* available from http://www.irishstatutebook.ie/eli/2016/act/18/enacted/en/pdf

14 Revenue website available from http://www.revenue.ie/en/companies-and-charities/excise-and-licences/energy-taxes/he-chp/index.aspx

15 Electricity Tax Guide available from https://www.revenue.ie/en/companies-and-charities/excise-and-licences/energy-taxes/electricity-tax/index.aspx

## 3.5 Energy Efficiency Obligation Scheme

The Energy Efficiency Obligation Scheme (EEOS) is an obligation scheme for energy suppliers in Ireland established by Statutory Instrument No. 131, 2014. The Scheme aims to assist in the delivery of Ireland's legal obligation to achieve new savings each year from 1 January 2014 to 31 December 2020 of 1.5% of the annual energy sales to final customers of all energy distributors and retail energy sales companies by volume.

Obligated parties under the EEOS are energy distributors and retail energy sales companies that have market sales in Ireland of greater than 600 GWh final sales in any relevant year, regardless of the sector they supply. Obligated parties' targets are allocated according to their proportion of energy market sales volume in Ireland. The positions against targets for each year are to be achieved, audited and finalised by 31 March of the following year. The target allocated to obligated parties is 550 GWh PPE, which is sub-sectionalised as 75% non-residential, 20% residential and 5% fuel poverty residential.

Obligated parties can choose to achieve energy savings independently or through partnerships with service providers in the market. The scheme permits the exchange of validated savings between obligated parties in certain circumstances. Obligated parties can buyout up to a maximum of 30% of their total cumulative target, whether or not they have achieved their minimum cumulative target. For any portion of the minimum annual target not achieved, exchanged or bought out, a penalty will be imposed. The price of buyout and penalty will be set and published by the Minister and reviewed as appropriate.

For every unit of energy saved by an obligated party, energy credits are achieved towards their target. The Primary Energy Savings (PES) from CHP are eligible for energy credits for the purposes of the EEOS so long as:

- the CHP plant meets its 'own use' heat and electricity demand;
- the CHP plant has no net export of electricity;
- the CHP plant meets PES standard as described in Annex II of Energy Efficiency Directive 2012, and
- the heat generated from CHP plant is used and not 'dumped'.

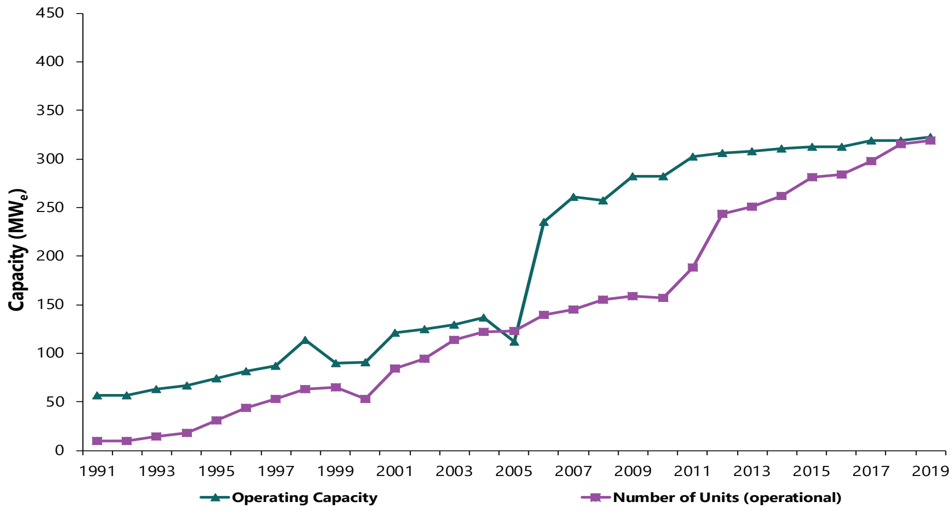
A Combined Heat and Power Primary Energy Savings Calculator is available on the SEAI website[16]. This calculator should be used to calculate energy credits for the purposes of the EEOS. SEAI will only accept savings from CHP projects that have been calculated using this tool.

16 https://www.seai.ie/tools/

# 4 CHP Trends 1991 to 2019

*Figure 3* presents the number and operational capacity of CHP units in Ireland over the period 1991 to 2019[17]. The increase in operational capacity over the period was 467% (6.4% per annum) from a low base.

### Figure 3: Number of Units and Operational Capacity, 1991 – 2019




*Source: SEAI*

The operational capacity increased by 3.1% in 2019. Growth in 2006 was 127%, largely due to the addition of the Aughinish Alumina plant. The average annual growth rate of operational capacity was 5% prior to the addition of the Aughinish Alumina plant (1991 – 2005) and 2.4% after the addition (2006 – 2019).

*Figure 3* also presents data for the growth in the number of operational units over the period, representing an average incremental growth of 13.2% per annum, again from a low base.

*Table 7* tabulates the operational capacity growth rates from 1991 to 2019. In 2019, there was a 1.3% increase in the number of operational units representing an increase of 1.0% in operational capacity.

### Table 7: Growth Rates and Quantities of Operational Capacity

| | Growth (%) | Average annual growth rates (%) | | | | | | Capacity (MWe) | |
|---|---|---|---|---|---|---|---|---|---|
| | 1991 – 2019 | '91 – '19 | '00 – '05 | '05 – '10 | '10 – '15 | '15 – '19 | 2019 | 1991 | 2019 |
| Operational Capacity | 467 | 6.4 | 4.2 | 20.4 | 2.1 | 0.8 | 1.0 | 56.8 | 322.3 |

*Source: SEAI*

The data compiled in the CHP survey quantifies electricity and heat generated by all operational CHP plants in Ireland. Data on useful heat is also requested. *Table 8* shows that the useful heat output has increased by 257% since 2000 (6.9% per annum). However, it should be noted that the survey responses for useful heat are not always reliable and the overall useful heat values are likely to be overestimating the amount of useful heat. It is anticipated, once results are available from the CRU on the new reporting requirements for high efficiency CHP certification,[18] that data quality on useful heat will improve. However, it will not be possible to update historical values.

It is estimated that the CHP useful heat output met 5.7% of Ireland's total thermal demand[19] in 2019.

### Table 8: Useful Heat as a Percentage of Heat Generated

| | 2000 | 2005 | 2010 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
|---|---|---|---|---|---|---|---|---|---|
| Heat usefully employed (GWh) | 742 | 1,140 | 3,262 | 3,157 | 3,516 | 3,302 | 3,290 | 3,229 | 3,112 |
| Percentage of total heat generated | 84% | 92% | 98% | 98% | 99% | 98% | 99% | 99% | 99% |

17 Data for this report originates from surveys conducted by SEAI in 1996 to 1998, 2000 and 2002 that were part funded by Eurostat. SEAI conducted similar surveys for 1999, 2001 and 2002. The ESB undertook the surveys in 1994 and 1996. A survey was not carried out for 1995. An annual survey has been carried out by SEAI since 2003.

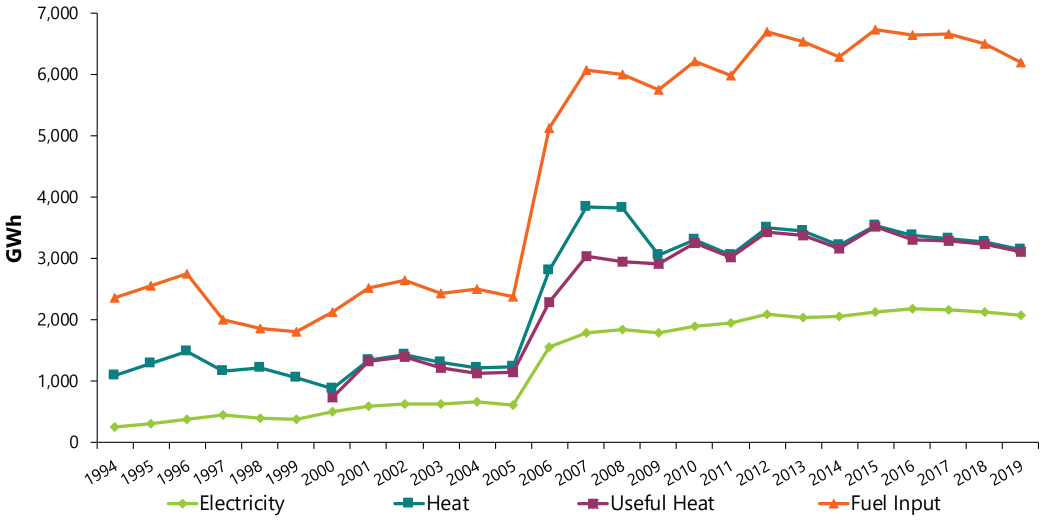
18 High efficiency CHP certification was introduced as a result of SI 499 of 2009 which is discussed in section 4.

19 Thermal energy is defined here as energy used for space, process and water heating, cooking, etc. The total thermal demand is calculated as the residual energy requirement when energy use from transport and electricity generation is subtracted from the total primary energy supply.

*Source: SEAI*

*Figure 4* illustrates the trends relating to fuel inputs and electricity and thermal outputs for all operational plants over the period 1994 to 2019. Fuel inputs have increased by 163% (3.6% per annum) while the thermal and electrical outputs have increased by 188% (4.3% per annum) and 699% (8.7% per annum) respectively over the period. This suggests that the overall stock of CHP installations has become more efficient over the period. In 2019 fuel input decreased by 4.7%, while thermal output decreased by 3.6% and electricity decreased by 3.0%.

**Figure 4: CHP Fuel Input and Thermal/Electricity Output, 1994 – 2019**




*Source: SEAI*

*Table 9* tabulates the growth rates and quantities of fuel inputs and thermal/electricity output from 2000 to 2019.

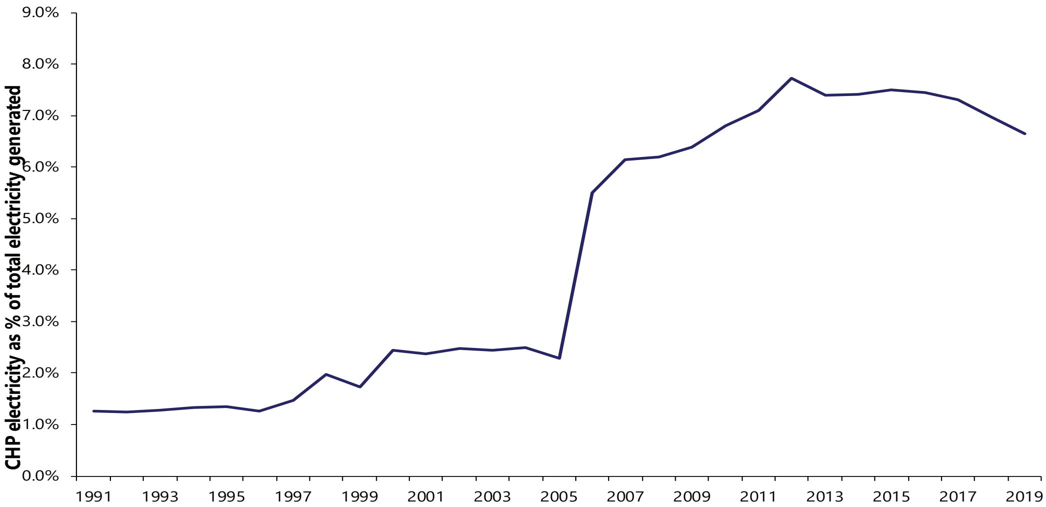
**Table 9: Growth Rates and Quantities of CHP Fuel Input and Thermal/Electricity Output**

| | Growth (%) | Average annual growth rates (%) | | | | | | Quantities (GWh) | |
|---|---|---|---|---|---|---|---|---|---|
| | 2000 – 2019 | '00 – '19 | '00 – '05 | '05 – '10 | '10 – '15 | '15 – '19 | 2019 | 2000 | 2019 |
| Fuel Input | 191 | 5.8% | 2.2% | 21.3% | 1.6% | -2.0% | -4.7% | 2,131 | 6,199 |
| Electricity Output | 312 | 7.7% | 4.1% | 25.4% | 2.3% | -0.8% | -3.0% | 502 | 2,067 |
| Heat Output | 257 | 6.9% | 7.0% | 21.8% | 1.3% | -2.9% | -3.6% | 882 | 3,147 |
| Useful Heat Output | 320 | 7.8% | 9.0% | 23.4% | 1.5% | -3.0% | -3.6% | 742 | 3,112 |

*Source: SEAI*

*Figure 5* focuses on CHP generated electricity in Ireland as a proportion of gross electricity consumption (i.e. electricity generation plus net imports) in the period 1990 to 2019. In 2019, 6.6% of total electricity generation was from CHP installations compared with 7.0% in 2018.

**Figure 5: CHP Electricity as a Percentage of Gross Electricity Consumption, 1990 – 2019**




*Source: SEAI*

*Table 10* tabulates the growth rates and share of CHP electricity of gross electricity consumption from 1991 to 2019.

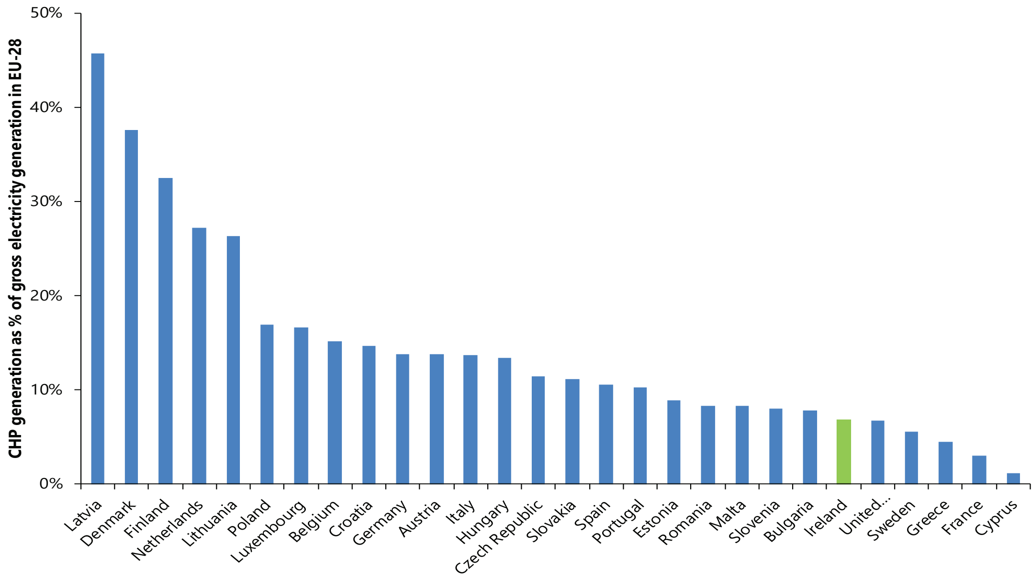
**Table 10: Growth Rates of CHP Electricity as a Percentage of Gross Electricity Consumption**

| | Growth (%) | Average annual growth rates (%) | | | | | | Share (%) | |
|---|---|---|---|---|---|---|---|---|---|
| | 1991 – 2019 | '91 – '19 | '00 – '05 | '05 – '10 | '10 – '15 | '15 – '19 | 2019 | 1991 | 2019 |
| CHP Electricity as a Percentage of Gross Electricity Consumption | 430 | 6.1 | -1.3 | 24.4 | 2.0 | -2.9 | -4.7 | 2.4 | 6.6 |

*Source: SEAI*

The proportion of total electrical output that was generated from CHP was 11.2% for EU-28 in 2018. Data is not yet available for 2019. *Figure 6* shows Ireland's position in relation to the EU-28 in 2018. In Latvia, 45.7% of total electricity was generated from CHP compared to 1.1% in Cyprus.

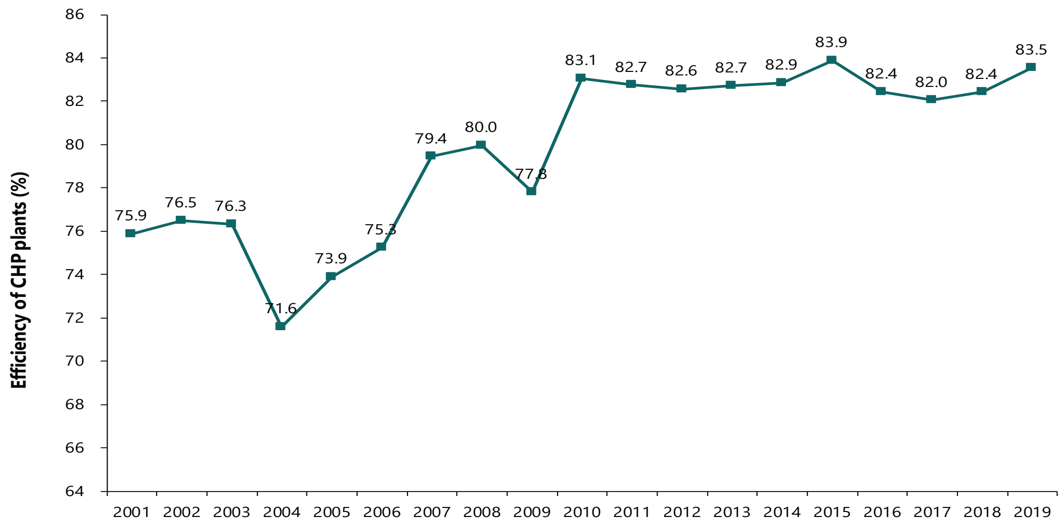
**Figure 6: CHP Electricity as a Percentage of Gross Electricity Consumption in EU-28 in 2018**




Some CHP units export electricity to the national grid. In 2019, there were 17 units exporting electricity to the grid. These units exported 1,337 GWh of electricity in 2019, a decrease of 4.1% on 2018.

The overall efficiency of the CHP plants since 2001 is shown in *Figure 7*. The overall efficiency of the CHP plants in 2019 was calculated as 83.5%. This figure is strongly influenced by the likely overestimation of the useful heat responses to the CHP survey. Many of the responses have the same figure for heat generated and useful heat. Although CHP installations are typically sized to the required heat demand, it is unlikely that all of the heat generated is being used.

### Figure 7: Efficiency of CHP Plants




*Source: SEAI*

*Table 11* tabulates the growth rates of efficiency of CHP plants from 2001 to 2019.

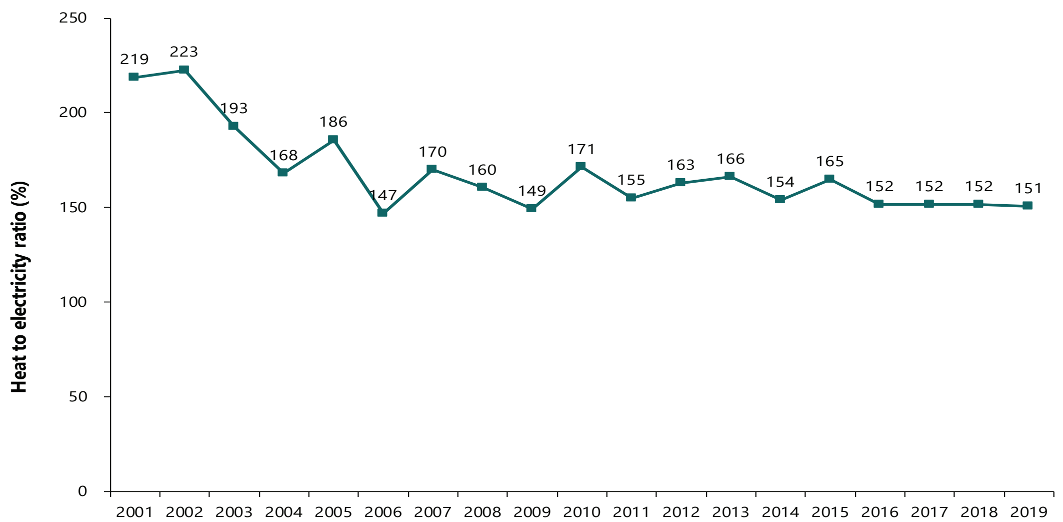
### Table 11: Growth Rates of CHP Plant Efficiency

| | Growth (%) | Average annual growth rates (%) | | | | | | Efficiency (%) | |
|---|---|---|---|---|---|---|---|---|---|
| | 2001 – 2019 | '01–'19 | '01 – '05 | '05 – '10 | '10 – '15 | '15 – '19 | 2019 | 2001 | 2019 |
| Efficiency of CHP Plants | 10.1 | 0.5 | -0.7 | 2.4 | 0.2 | -0.1 | 1.4 | 75.9 | 83.5 |

*Source: SEAI*

The heat to power ratio is plotted in *Figure 8*. The variation in the ratio can be attributed to unreliable responses to the CHP survey for the useful heat values in those years. As mentioned previously, it is anticipated that the data quality on useful heat will improve once the data reported to the CRU in accordance with the high efficiency CHP requirements becomes available. In 2019 there was 51% more heat produced from CHP than electricity in energy terms.

### Figure 8: Heat to Power Ratio of CHP Plants




*Source: SEAI*

*Table 12* tabulates the growth rates of the heat to power ratio of CHP plants from 2001 to 2019.

**Table 12: Heat to Power Ratio of CHP Plants**

| | Growth (%) | Average annual growth rates (%) | | | | | | Ratio (%) | |
|---|---|---|---|---|---|---|---|---|---|
| | 2001 – 2019 | '01 – '19 | '01 – '05 | '05 – '10 | '10 – '15 | '15 – '19 | 2019 | 2001 | 2019 |
| Heat to Power Ratio of CHP Plants | -31.2 | -2.1 | -4.0 | -1.6 | -0.8 | -2.2 | -0.6 | 215.1 | 150.5 |

*Source: SEAI*

## 4.1 Progress towards Renewable Targets

The target for Ireland in the Directive 2009/28/EC[20] is a 16% share of renewable energy in GFC by 2020. The Directive requires each Member State to adopt a national renewable energy action plan (NREAP) to set out Member States' national targets for the share of energy from renewable sources consumed in transport, electricity and heating in 2020 that will ensure delivery of the overall renewable energy target. Biomass and biogas CHP, as renewable energy sources, can be counted towards Ireland's renewable electricity and heat targets. These renewable energy sources made up 3.7% of total fuel inputs to CHP in 2019 compared with 3.2% in 2018.

Ireland's NREAP specified a target of 40% electricity consumption from renewable sources by 2020 and a target of 12% from renewable heat. The total contribution from renewable energy to gross electricity consumption in 2019 was 36.5% (normalised) with 0.2 percentage points coming from CHP. The renewable share of thermal energy was 6.3% in 2019, also with 0.2 percentage points coming from useful heat generated by CHP.

20 http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32009L0028&from=en

# 5 Avoided $CO_2$ from CHP

CHP can be used to achieve environmental targets for emissions reduction. The amount of $CO_2$ avoided by employing a CHP unit requires assumptions relating to the electricity generation in the absence of CHP plants, i.e. relative to a specific baseline. One option is assume that CHP displaces the marginal fuel of electricity generation, as less marginal plant generation is required if additional electricity is generated from CHP. This is typically referred to as the *operating margin approach*[21,22]. For example, if additional CHP electricity is produced, less open cycle[23] (mainly natural gas in Ireland) electricity will be generated. The operating margin approach is the approach adopted in this report for calculating the historical emissions avoided by CHP plants.

The assumptions regarding displacement of heat depend on the fuel used and are detailed in *Table 13*.

**Table 13: Displacement of Heat – Assumptions**

| Fuel | Displacement fuel | Efficiency |
|---|---|---|
| Natural Gas | Natural gas | 80% |
| Biogas | Fuel oil | 80% |
| Biomass | Fuel oil | 80% |
| Peat | Milled peat | 70% |
| LPG | Gas oil | 80% |
| Coal | Fuel oil | 80% |
| Refinery Gas | Fuel oil | 80% |
| Biodiesel | Gas oil | 80% |

*Source: SEAI*

A number of factors influence the quantity of avoided emissions in using the operating margin approach. These include the carbon intensity of the operating margin fuel mix, the overall efficiency of the installed CHP plants and the absolute CHP capacity. The assumption underpinning this approach is that the CHP plant is displacing the last plant to be dispatched to meet electricity demand – i.e. the marginal gas plants. CHP plants are not generally displacing electricity from either 'must-run' plants (peat) or baseload plants (coal fired station at Moneypoint). The carbon intensity of the marginal generation mix will have a significant impact on the quantity of avoided $CO_2$. Detailed in *Table 14*, this varies annually depending on the composition of the marginal generation in any particular year.

**Table 14: Carbon Intensity of the Marginal Generation**

| | 2001 | 2005 | 2010 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
|---|---|---|---|---|---|---|---|---|---|
| Intensity $CO_2$ g/kWh (Operating Margin Mix) | 611 | 520 | 448 | 407 | 400 | 402 | 409 | 414 | 442 |
| Annual Change | | 2.2% | -1.8% | -1.1% | -1.7% | 0.5% | 1.7% | 1.2% | 6.3% |

*Source: SEAI*

The results from the operating margin approach are illustrated in *Figure 9* and *Table 15*[24].

**Table 15: Avoided $CO_2$ Operating Margin Approach**

| | 2001 | 2005 | 2010 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Avoided $CO_2$ (kt) | 199 | 113 | 425 | 410 | 403 | 399 | 408 | 398 | 425 | 438 | 499 |

*Source: SEAI*

The cumulative avoided $CO_2$ emissions by CHP plants since 2001 is 6,396 kt $CO_2$.

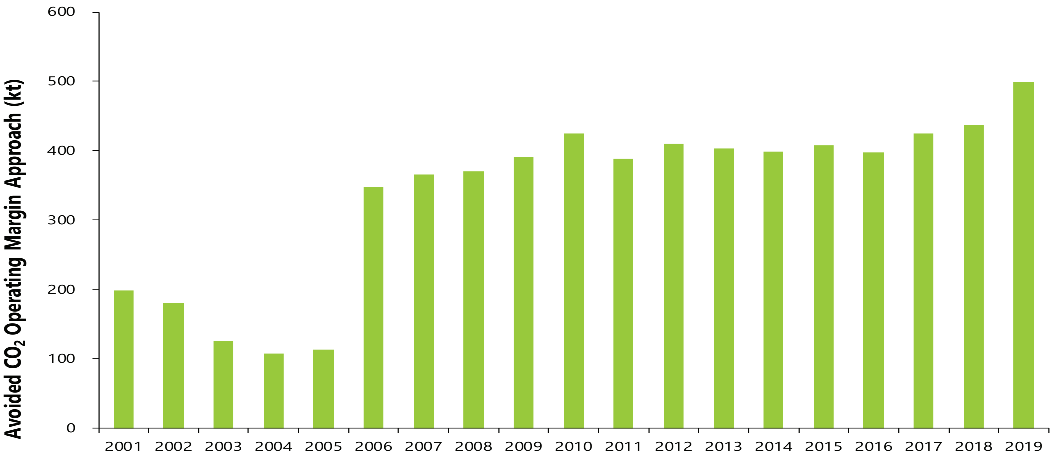
21 Kartha S., Lazarus M. and Bosi M. Baseline recommendations for greenhouse gas mitigation projects in the electric power sector. *Energy Policy* 2004, 32, 545-566.

22 Ó Gallachóir B. P., O'Leary F., Bazilian M., Howley M. & McKeogh E. J. 2005 Comparing Primary Energy Attributed to Renewable Energy with Primary Energy Equivalent to Determine Carbon Abatement in a National Context. *Journal of Environmental Science and Health*.

23 Open cycle plants normally operate as the marginal plant as they can respond to varying demand. They typically have efficiencies of approximately 35% and generate increased $CO_2$ and $NO_x$ emissions compared to combined cycle generators which have efficiencies in the range of 50% - 60%.

24 Historical figures were updated in 2020 resulting in different avoided $CO_2$ emissions than previously reported in the 2019 CHP update. Where a useful heat figure was not provided the useful heat was assumed to be equal to the actual heat output.

**Figure 9: Avoided $CO_2$ on the basis of the Operating Margin Approach, 2001 – 2019**




*Source: SEAI*

It can be seen in *Figure 9* that the avoided $CO_2$ from the operating margin approach decreased from 199 kt $CO_2$ in 2001 to 113 kt $CO_2$ in 2005[25], a decrease of 43% (13% per annum on average). During this time there was a 15% reduction in the $CO_2$ intensity (g $CO_2$/kWh) of the electricity generated from the marginal generation fuel mix, so the decrease in emissions avoided from CHP units was due to overall improvements in the efficiency of the electricity system.

In 2006 there was a sharp increase (207%) in the avoided emissions to 348 kt $CO_2$, mainly due to the additional capacity added that year. In 2019 avoided $CO_2$ was 499 kt, an increase of 151% since 2001. This increase in avoided emissions was due to the improvement in the estimated overall efficiency of the CHP plants, which is plotted in *Figure 7*, as well as the increase in the marginal generation $CO_2$ emissions.

25 Note that the historical figures for the avoided $CO_2$ emissions were revised for this update. The heat output used is the amount of heat usefully employed.

# 6 Primary Energy Savings

Primary energy savings are the savings achieved when CHP is used to provide the heat and electricity outputs, instead of separate production. The amount of primary energy savings (PES) provided by CHP is calculated according to the formula specified in EU Directive on the promotion of cogeneration[26]. Using this method the primary energy savings are calculated as a percentage of the overall primary energy use for separate heat and electricity generation.

The results are shown in *Table 16*. In order for CHP to qualify as high efficiency CHP under the directive, small and micro scale CHP must achieve positive primary energy savings compared to the separate production of heat and electricity. CHP at a scale greater than 1 MWe must achieve a PES of at least 10% in order to qualify as high efficiency CHP. This calculation is based on useful heat only, so the result is determined by the accuracy of the useful heat responses in the annual CHP survey.[27] Based upon the data provided by CHP plant operators, the total population of CHP plants has achieved positive primary energy savings in each year since 2000, with the average PES exceeding 20% since 2006[28].

**Table 16: Primary Energy Savings**

| | 2000 | 2005 | 2010 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| % PES | 9.7% | 19.5% | 25.8% | 24.8% | 22.6% | 22.8% | 23.1% | 23.7% | 22.1% | 20.4% | 19.8% |
| PES (GWh) | 229 | 575 | 2,163 | 2,212 | 1,906 | 1,856 | 2,025 | 2,066 | 1,892 | 1,671 | 1,531 |

*Source: SEAI*

26 European Union, 2004. Directive 2004/8/EC of the European Parliament and of the Council of 11 February 2004 on the promotion of cogeneration based on a useful heat demand in the internal energy market. Available from: http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32004L0008&from=EN

27 A significant portion of survey respondents do not distinguish between the total CHP heat output and the useful heat which results in overestimation of primary energy savings.

28 Historical figures were updated in 2020 resulting in different primary energy savings than previously reported in the 2019 CHP update. Where a useful heat figure was not provided the useful heat was assumed to be equal to the actual heat output.

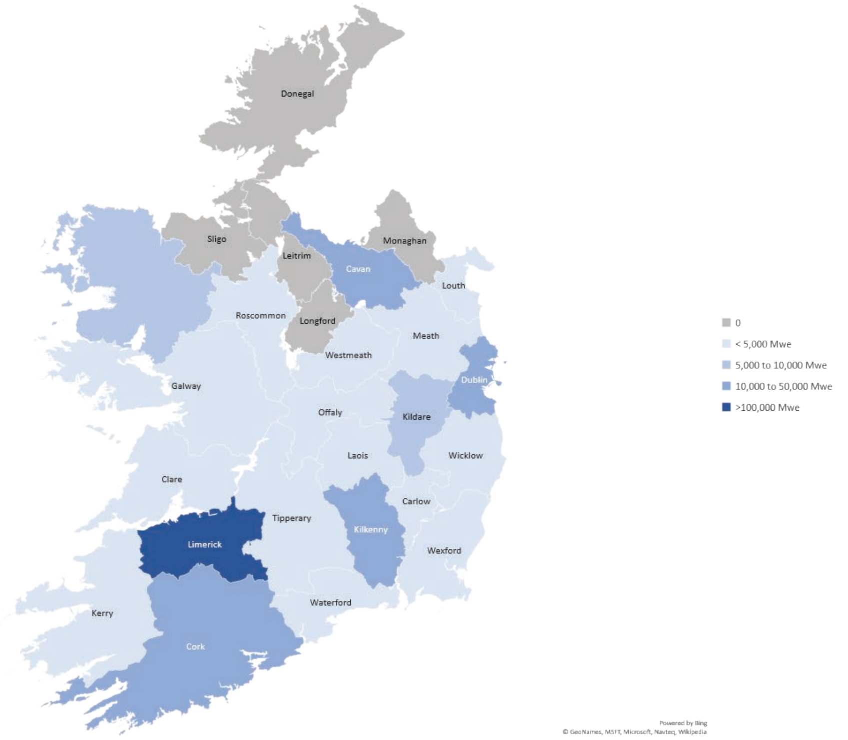
# Appendix A: Annual CHP Survey

| Installation Date[1] | Prime Mover[2] | Fuel Type[3] | Installed Electrical Capacity (kWe)[4] | Installed Thermal Capacity (kWt)[5] | Annual Operating Hours[6] | Fuel Input e.g. Tonnes, Litres[7] | Fuel Input MWh[8] | Total Electricity Generated MWh[9] | Total Heat Generated MWh[10] | Heat Usefully Employed MWhr[11] | Grid Connection to Export[12] | Electricity Exported to the Grid MWh[13] | Heat to Power Ratio[14] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |

Notes

1. Provide the date when the CHP unit came online.
2. Choose one from the following: Combined cycle, Steam: backpressure turbine, Steam: condensing turbine, Gas turbine with heat recovery, Internal combustion engine or Other. Please specify when choosing other.
3. Choose one from the following: Coal, Peat, Residual Fuel oil, Gasoil, Natural gas, Refinery gas, Biogas, Biomass or Other. Please specify when choosing Other.
4. The rated electrical capacity of the CHP unit.
5. The rated thermal capacity of the CHP unit.
6. The total amount of hours the unit was in operation during the year.
7. This is the total amount of fuel used by the CHP unit in the year, excluding fuel used for supplementary firing (i.e. firing to meet heat demand not met by CHP output).
8. Same as number 7 but converted to MWh
9. Total amount of electricity generated by the CHP unit in the year.
10. Total amount of heat generated by the CHP unit in the year. Do not include heat generated from other sources.
11. Useful heat is the total amount of CHP heat that was used during the year as distinct from the total heat produced.
12. Is the unit connected to the national grid to export electricity (yes or no) ?
13. Total amount of electricity sold on to the national grid in the year.
14. Power to heat ratio is the ratio between electricity from CHP and useful heat when operating in full CHP mode.

# Appendix B: CHP Installed Capacity by County



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