Chapter 7
Combined heat and power

Key Points

- The Good Quality CHP capacity fell by 159 MWe between 2015 and 2016 from 5,730 MWe to 5,571 MWe. (Table 7A)
- The amount of good quality electricity produced in 2016 was 20.1 TWh (Table 7.4), which is 2.6 per cent higher than in 2015. The good quality electricity generated by CHP in 2016 corresponds to 6.3 per cent of all electricity supplied in the UK.
- Seventy-one percent of the fuel used in CHP schemes was natural gas. This is 1.1 percentage points higher than in 2015. In 2016, the share of total fuel that was renewable was 12 per cent, a 0.7 percentage point increase between 2015 and 2016.
- The Oil and Gas sector has the largest Good Quality CHP capacity (40 per cent), followed by the Chemicals sector (20 per cent), the Transport Commerce and Administration sector (9 per cent) and then the Food and Drink sector (8 per cent). The Paper sector is now only the sixth largest sector in terms of installed capacity. As recently as 2014 the Paper sector was the third largest sector.
- The absolute CO_2 savings delivered by CHP in 2016 were lower than in 2015. This is due to the provisional values for CO_2 intensity of electricity displaced by CHP electricity being substantially lower in 2016 than in 2015, rather than falls in the outputs of CHP or efficiency of operation.

Introduction

7.1 This chapter sets out the contribution made by Combined Heat and Power (CHP) to the United Kingdom's energy requirements. The data presented in this chapter have been derived from information submitted to the CHP Quality Assurance programme (CHPQA) or by following the CHPQA methodology in respect of data obtained from other sources. The CHPQA programme was introduced by the Government to provide the methods and procedures to assess and certify the quality of the full range of CHP schemes. It is a rigorous system for the Government to ensure that the incentives on offer are targeted fairly and benefit schemes in relation to their environmental performance.

7.2 CHP is the simultaneous generation of usable heat and power (usually electricity) in a single process. The term CHP is synonymous with cogeneration, which is commonly used in other Member States of the European Community and the United States. CHP uses a variety of fuels and technologies across a wide range of sizes and applications. The basic elements of a CHP plant comprise one or more prime movers (a reciprocating engine, gas turbine or Rankine cycle turbine using steam or organic fluids) driving electrical generators, with the heat generated in the process captured and put to further productive use, such as for industrial processes, hot water and space heating or cooling.

7.3 CHP is typically sized to make use of the available heat[1], and connected to the lower voltage distribution system (i.e. embedded). This means that unlike conventional power stations, CHP can provide efficiency gains by avoiding significant transmission and distribution losses. These gains are reflected in the calculation of CO_2 savings delivered by CHP (see 7.27-7.28). CHP can also provide important network services such as black start[2], improvements to power quality, and some have the ability to operate in island mode if the grid goes down. There are five principal types of CHP system: steam turbine, gas turbine, combined cycle systems, reciprocating engines and Organic Rankine Cycle (ORC) systems. Each of these is defined in paragraph 7.35 later in this chapter.

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[1] *But not always, see paragraph 7.4. In such cases there is an impact upon the electrical capacity and electrical output classified as CHP.*

[2] *Black start is the capability to operate in island mode if the grid goes down.*

UK energy markets, and their effect on CHP

7.4 Two major factors affecting the economics of CHP are the relative cost of fuel (principally natural gas) and the value that can be realised for electricity both for own use and export. This is known as the spark gap (i.e. the difference between the price of electricity and the price of the gas required to generate that electricity). Energy price trends that are applicable to CHP schemes differ depending upon the size and sector of the scheme. At the start of 2013 the spark gap started to increase and has done so each quarter since. While longer term, sustained improvements in the spark gap would be necessary to encourage investment in new CHP capacity, there is evidence that the improvements to date have encouraged some large schemes to generate more electricity. This evidence is a sharp increase in the Load Factor (actual) compared to a modest increase in the Load Factor (CHPQA), as shown in Table 7A. The Load Factor (actual) in 2016 was at its highest level since 2008, while the Load Factor (CHPQA) in 2016 was at its highest level since 2012.

Use of CHPQA in producing CHP statistics

7.5 The CHPQA programme is the major source for CHP statistics. The following factors need to be considered when using the statistics produced:

- Through CHPQA, scheme operators have been given guidance on how to determine the boundary of a CHP scheme (what is regarded as part of the CHP installation and what is not). A scheme can include multiple CHP prime movers[3], along with supplementary boilers and generating plant, subject to appropriate metering being installed to support the CHP scheme boundaries proposed, and subject to appropriate metering and threshold criteria. (See CHPQA Guidance Note 11 available at www.gov.uk/chpqa-guidance-notes). This point is relevant when considering the figures in Table 7D, where the power efficiencies, heat efficiencies and heat to power ratios stated in that table for 2016 are those of the scheme, which may not be just the prime mover.
- The output of a scheme is based on gross power output. This means that power consumed by parasitic plant such as pumps and fans is included in the power output of the scheme.
- The main purpose of a number of CHP schemes is the generation of electricity including export to other businesses and to the grid. Such schemes may not be sized to use all of the available heat. In such cases, the schemes' total electrical capacity and electrical output have been scaled back using the methodologies outlined in CHPQA (see www.gov.uk/chpqa-guidance-notes). Only the output from highly-efficient or "Good Quality" schemes is counted in this chapter. Chapter 5 includes all CHP capacity, fuel inputs and power outputs, for both highly-efficient or "Good Quality" and less efficient, under the categories "Other generators".
- For year of operation 2011 onwards, new scale back criteria came into force in order to be consistent with the EU Cogeneration Directive. This results in a more severe scale back than was previously the case. This has contributed to some of the decrease in Good Quality electricity output and associated fuel consumption seen after 2010.
- There are two load factors presented in Table 7A. Load Factor (CHPQA) is based on the Good Quality Power Output and Good Quality Power Capacity reported in this Chapter. Load Factor (Actual) is based on the Total Power Capacity and the Total Power Output. The Load Factor (CHPQA) is lower than the Load Factor (Actual) for schemes that have been scaled back on the power outputs. The load factor gives an indication of the degree to which the power generating capacity is utilized. Between 2007 and 2013 Load Factor (CHPQA) steadily declined, but has modestly improved over the last couple of years. This decline was confined to the industrial sectors, and was especially pronounced in the chemical and oil refinery sectors. As discussed above, there was an appreciable upturn in the Load Factor (Actual) in 2016, explained by a number of large CHP generators increasing their production of electricity.

3 The CHP prime mover is the heart of a CHP system and is a mechanical machine which drives the electricity generator or develops mechanical power for direct use

Table 7A: A summary of the recent development of CHP(1)

	Unit	2012	2013	2014	2015	2016
Number of schemes		1,942	2,029	2,076	2,139	2,182
Net No. of schemes added during year (2)		156	87	47	63	43
Electrical capacity (CHP_{QPC})	MWe	5,965	5,924	5,892	5,730	5,571
Net capacity added during year		204	-41	-32	-162	-159
Capacity added in percentage terms	Per cent	3.5	-0.7	-0.5	-2.8	-2.8
Heat capacity	MWth	22,545	22,167	22,228	20,123	19,673
Heat to power ratio *(3)*		2.1	2.26	2.13	2.06	2.01
Fuel input *(4)*	GWh	95,701	88,430	86,207	82,669	84,125
Electricity generation (CHP_{QPO})	GWh	22,226	19,592	19,695	19,558	20,070
Heat generation (CHP_{QHO})	GWh	46,690	44,350	41,957	40,261	40,423
Overall efficiency *(5)*	Per cent	72	72.3	71.5	72.4	71.9
Load factor (CHPQA) *(4)*	Per cent	42.5	37.8	38.2	39	41.1
Load factor (Actual) *(6)*	Per cent	53.2	51.7	52.3	50.9	60

(1) Data in this table for 2012 and 2015 have been revised since last year's Digest (see text for explanation).
(2) Net number of schemes added = New schemes – Decommissioned existing schemes
(3) Heat to power ratios are calculated from the qualifying heat output (QHO) and the qualifying power output (QPO).
(4) The load factor (CHPQA) is based on the qualifying power generation and capacity and does not correspond exactly to the number of hours run by the prime movers in a year
(5) Overall efficiencies are calculated using gross calorific values. Net efficiencies will be higher.
(6) The load factor (Actual) is based on the total power generated and total capacity

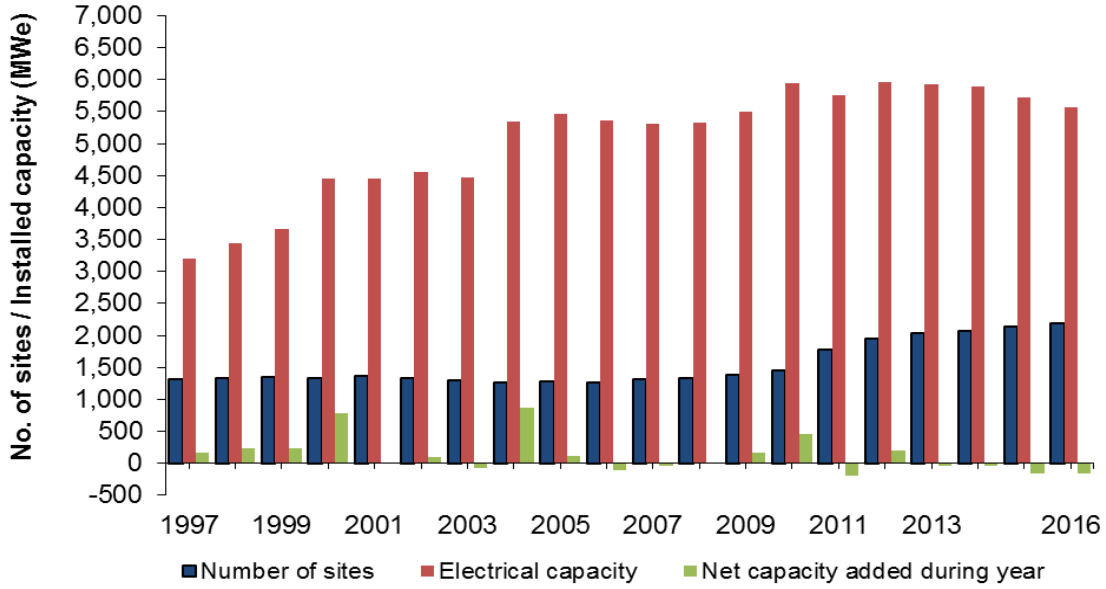
Efficiency of CHP schemes

7.6 Good Quality CHP denotes schemes that have been certified as being highly efficient through the UK's CHP Quality Assurance (CHPQA) programme. The criteria used are in line with the requirements for high efficiency CHP set down in the Energy Efficiency Directive (2012/27/EU). A Good Quality CHP scheme, with installed capacity >1 MWe, must achieve 10 per cent primary energy savings compared with the EU reference values for separate generation of heat and power i.e. via a boiler and power station.

Changes in CHP capacity

7.7 Chart 7.1 shows the change in installed CHP capacity since 2001, when the CHPQA programme began. Installed capacity at the end of 2016 stood at 5,571 MWe, a decrease of 159 MWe (2.8 per cent) compared to 2015. In spite of this capacity decrease, there was a net increase of 43 (2.0 per cent) schemes between 2015 and 2016. Overall, between 2015 and 2016, there were 62 new schemes included in the database and a removal of 19 schemes. There have been revisions to the capacity figures for 2012 to 2015 shown in the previous edition of the Digest, as recent information on the operational status of some schemes has come to light.

Chart 7.1: Operating CHP capacity by year



7.8 Table 7A gives a summary of the overall CHP market. CHP schemes generated 20,070 GWh in 2016 of Good Quality electricity, 2.6 per cent higher than in 2015. This generated electricity represents 5.9 per cent of the total electricity generated in the UK. Good Quality electricity generated in industry was 2.6 per cent higher in 2016 than in 2015, despite a 3.9 per cent decrease in Good Quality power generating capacity. This was substantially due to an increase in Good Quality power output in the Oil and Gas sector. There were also increases in Good Quality electricity generated of 0.5 per cent and 9.1 per cent in the Transport, Commercial and Administration and Other sectors, respectively.

7.9 Table 7A shows that in 2016 CHP schemes supplied a total of 40,423 GWh of heat. This was a small increase of 0.4 per cent compared to 2015. Over the long term, the trend in heat supplied by CHP has been a decreasing one as the heat supplied by industrial CHP schemes has fallen. However, between 2015 and 2016 the heat output in industry overall was steady, with large increases (6.4 per cent) in the Oil and Gas sector balancing large falls in Mineral Products (9.6 per cent), Food and Drink (6.1 per cent), and Paper (1.2 per cent). The heat output from schemes in the TCA and Other sectors were higher in 2016 than in 2015.

7.10 In terms of electrical capacity by size of scheme, schemes larger than 10 MWe represent 75 per cent of the total electrical capacity of CHP schemes as shown in Table 7B. However, schemes less than 1 MWe constitute the majority (82 per cent) in terms of the number of schemes and 6.1 per cent of the capacity. Table 7.5 provides data on electrical capacity for each type of CHP installation.

Table 7B: CHP schemes by capacity size ranges in 2016

Electrical capacity size range	Number of schemes	Share of total	Total electricity capacity (MWe)	Share of total
Less then100 kWe	627	29	40	0.7
100 kWe - 1 MWe	1,158	53	303	5.4
1 MWe - 2 MWe	151	6.9	218	3.9
2 MWe - 10 MWe	180	8.2	824	15
> 10 MWe +	66	3	4,185	75
Total	**2,182**	**100**	**5,571**	**100**

7.11 Table 7.5 shows nearly 62 per cent of total electrical capacity is in combined cycle gas turbine (CCGT) mode, followed by reciprocating engines at 22 per cent. Over the years there has been a gradual decrease in the total capacity taken up by CCGT schemes and a gradual increase in the total capacity taken up by reciprocating engines. This is mirrored in the results for Table 7B where, over the years, there has been a gradual fall in the proportion of capacity >10 MWe and a gradual increase in the proportion of capacity falling under the other capacity ranges, where reciprocating engines are deployed. Over the long term there has been a significant fall in the proportion of overall capacity that is back pressure steam turbine, as this relatively inefficient and inflexible technology is phased out. The pass out condensing steam turbine also went through a decline in its proportion of total capacity. However, in recent years its share has increased as more biomass and waste fuelled CHP schemes have been brought on line.

7.12 Excluded from the statistics tables presented in this chapter are a number of very small CHP schemes (micro-CHP) installed since 2010 in response to the Feed-in Tariff (FiT) scheme. The overwhelming majority of these schemes are domestic. At the end of 2016 there were 511 such schemes registered with Ofgem for FiTs with a total installed capacity of 538 kWe. There are no data on electricity generation or fuel consumption for these schemes and, consequently, they have been left out of the statistics tables. However, if included, there would have a negligible impact upon the capacity and generation figures presented in the statistics tables.

7.13 Table 7.7 provides data on heat capacity for each type of CHP installation. Starting in the 2013 edition of the Digest, there has been a change implemented in how the heat capacity has been derived. Prior to this, for a number of schemes, the data held on heat capacity were either not complete or were not a true reflection of the capacity of the scheme to generate heat in CHP operating mode. To allow for this, a standard methodology was developed and applied for the first time in the 2013 edition of the Digest for the determination of the heat capacity. This is applied to new schemes and schemes undergoing a change in plant. Details of this methodology may be found in the CHP methodology note which is available at:
www.gov.uk/government/publications/combined-heat-and-power-statistics-data-sources-and-methodologies

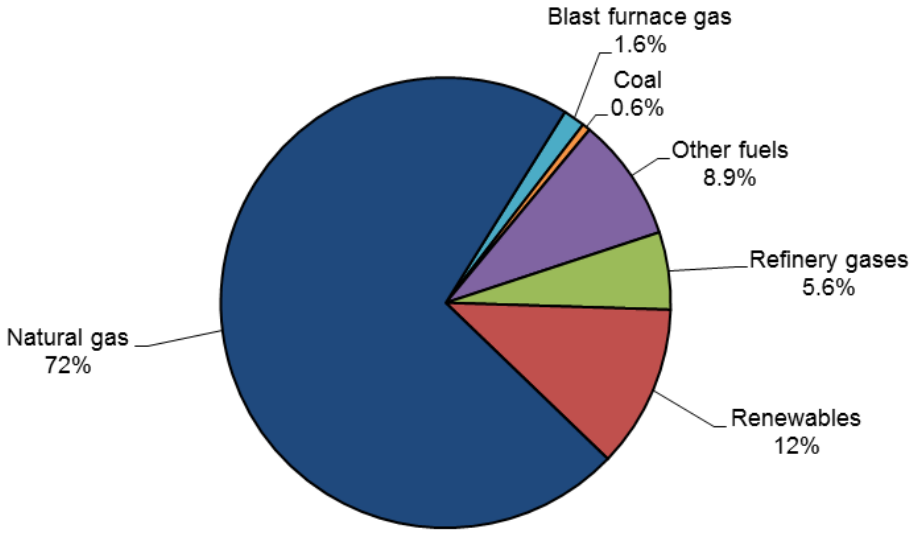
Fuel used by types of CHP installation

7.14 Table 7.2 shows the fuel used to generate electricity and heat in CHP schemes (see paragraphs 7.36 to 7.38, below for an explanation of the convention for dividing fuel between electricity and heat production). Table 7.3 gives the overall fuel used by types of CHP installation (which are explained in paragraph 7.35). Total fuel use is summarised in Chart 7.2. In 2016, 71 per cent of the total fuel use was natural gas. This is an increase of 1.1 percentage points compared with 2015. CHP schemes accounted for 7.2 per cent of UK gas demand in 2016 (see Table 4.3). The use of coal and fuel oil is now at extremely low levels, together taking up less than 1 per cent of overall fuel use in 2016.

7.15 The proportion of total fuel consumption that was renewable increased slightly between 2015 and 2016 from 11 per cent to 12 percent of the total. Gaseous renewable fuels constitute the single largest type of renewable fuel (47 per cent), followed by waste fuels (28 per cent) and biomass (24 per cent), with the balance being liquid renewable fuels.

7.16 Fuels which are liquids, solids or gases that are by-products or waste products from industrial processes, or are renewable fuels, accounted for 27 per cent of all fuel used in CHP in 2016. This proportion is substantially unchanged from 2015. Some of these by-product fuels are not commonly used by the mainstream electricity generating industry, and some would otherwise be flared or disposed of by some means. These fuels, with the exception of some waste gases, will generally be utilised in steam turbines being fed by boilers. In almost all cases, the technical nature of the combustion process, and the lower fuel quality (lower calorific value of the fuel, high moisture content of the fuel and the need to maintain certain combustion conditions to ensure complete disposal) will generally result in a lower efficiency. However, given that the use of such fuels avoids the use of fossil fuels, and since they need to be disposed of in some way, the use of these fuels in CHP provides environmental benefits.

Chart 7.2: Types of fuel used by CHP schemes in 2016



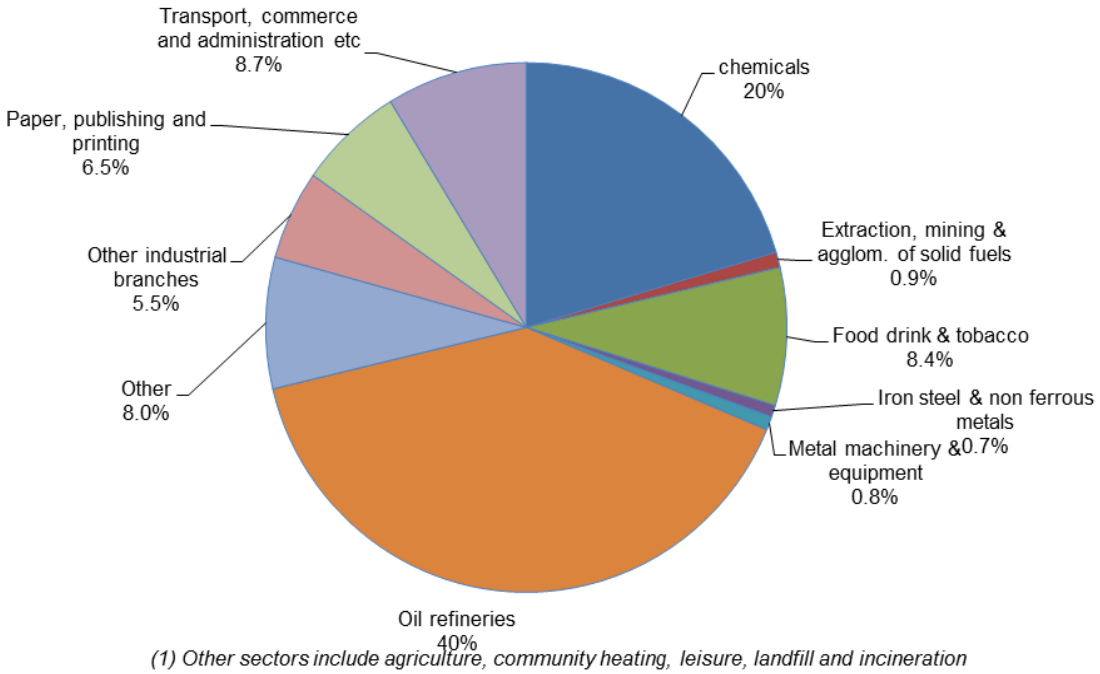
CHP capacity, output and fuel use by sector

7.17 In this chapter of the Digest, CHP is analysed by the sector using the heat or, where the heat is used by more than one sector, by the sector using the majority of the heat. This method of assigning a CHP scheme to a sector was rigorously applied for the first time in the 2008 edition of the digest and resulted in the movement of CHP schemes between sectors. One consequence of this was the removal of all schemes once allocated to the "electricity supply" sector and their distribution to other sectors. Full details of this reassignment are provided in paragraph 6.33 and Table 6J of the 2008 edition of the digest.

7.18 Table 7.8 gives data on all operational schemes by economic sector. A definition of the sectors used in this table can be found in Chapter 1, paragraph 1.60 and Table 1H:

- 399 schemes (83 per cent of electrical capacity) are in the industrial sector and 1,783 schemes (17 per cent of capacity) are in the agricultural, commercial, public administration, residential and transport sectors. The share of capacity taken up by industrial schemes is slightly lower than in 2015 and this continues a longer term trend for a greater share of total CHP capacity to be installed at non-industrial sites. This trend is the result of both a loss in industrial capacity, which has occurred every year since 2012, while the capacity in the non-industrial sectors has increased.
- The share of total installed Good Quality capacity taken up by each sector is shown in Chart 7.3. The oil refineries sector, which has been the largest sector since 2009, continues to have the largest share of total installed capacity, accounting for 40 per cent of all capacity. The chemicals sector has the second highest share of total installed capacity (20 per cent) followed by transport, commerce and administration (8.8 per cent) and the food and drink sector (8.4 per cent). The most significant development since the last edition of the digest has been the fall in capacity in the paper sector, which has led to it becoming the sixth largest sector in terms of installed capacity. As recently as 2014 it was the third largest. This is substantially explained by the closure of one significant paper manufacturing site. Over the last year the installed capacity fell in all of the following industrial sectors: Iron and steel and non-ferrous, chemicals, oil refineries and paper. It was unchanged in all other industrial sectors with the exception of sewage treatment, where there was a modest increase.

Chart 7.3: CHP electrical capacity by sector in 2016



(1) Other sectors include agriculture, community heating, leisure, landfill and incineration
(2) Other industry includes textiles, clothing and footware and sewage treatment

7.19 Table 7C gives a summary of the 1,580 schemes installed in the commercial sector, public sector and residential buildings. These schemes form a major part of the "Transport, commerce and administration" and "Other" sectors in Tables 7.8 and 7.9. The vast majority of these schemes are based on spark ignition reciprocating engines fuelled with natural gas, though the larger schemes use compression ignition reciprocating engines or gas turbines. The largest proportion of the capacity is in the health sector (33 per cent), mainly hospitals. The leisure and hotel sectors remain the two sectors with the largest number of installed schemes. This is a reflection of the suitability of CHP for meeting the demand profiles for heating and hot water in these types of building. Of note is the large ratio of heat to power generating capacity in the health sector. This is a reflection of the especially acute need for security of heat supply required at hospitals, provided by back-up boilers, rather than the heat to power capacity ratios inherent in the prime mover used for power generation (see Definitions of schemes under Technical notes and definitions).

Table 7C: Number and capacity of CHP schemes installed in buildings by sector in 2016

	Number of schemes	Electrical capacity (MWe)	Heat capacity (MWth)
Leisure	508	66	113
Hotels	278	40	66
Health	224	183	1020
Residential Group Heating	111	89	410
Universities	96	93	489
Offices	40	14	18
Education	60	15	50
Government Estate	31	14	48
Retail	229	46	74
Other *(1)*	3	1	1
Total	**1,580**	**561**	**2,288**

(1) All schemes under Other are at airports

7.20 District heating and cooling, according to the Energy Performance in Buildings Directive, is the distribution of thermal energy in the form of steam, hot water or chilled products from a centralised place of production through a network to multiple buildings or sites for space or process heating or cooling. Observing this definition, research has been undertaken to identify the number, capacity and outputs of CHP schemes serving district heating and cooling. In 2016 there were considered to be 93 CHP schemes serving district heating and cooling, with a Good Quality CHP capacity of 2,091 MWe and Good Quality power outputs and heat outputs of 5,779 GWh and 11,549 MWh, respectively. CHP serving communal heating and cooling schemes are not included in this figure, where 'communal' is taken to mean serving a number of customers in the same building. These data were gathered as part of a district heating and cooling survey carried out for the ten Department of Energy and Climate Change.

CHP performance by main prime mover

7.21 Table 7D gives a summary of the performance of schemes in 2016 by main prime mover type. In 2016 the prime mover type with the highest average operating hours was gas turbines followed by back pressure steam turbines.

7.22 In 2016, the average operating hours were 3,603 hours. The average operating hours in 2015 was 3,413 hours, indicating a slight increase in the utilisation of good quality capacity between the two years. The revision to 2015 figures was the result of the submission of data for this year of operation too late to be incorporated in 2016 edition of the Digest. These are the highest average operating hours since 2012.

7.23 In 2015, the average electrical efficiency was 24 per cent and the heat efficiency 48 per cent, giving an overall average of 72 per cent, which is the same as the revised figure for 2015. Overall efficiency is simply the sum of the individual electrical and heat efficiencies.

Table 7D: A summary of scheme performance in 2016

Main prime mover in CHP plant	Average operating hours per annum (Full load equivalent)	Average electrical efficiency (% GCV)	Average heat efficiency (% GCV)	Average overall efficiency (% GCV)	Average heat to power ratio
Back pressure steam turbine	4,047	13	60	74	4.5
Pass out condensing steam turbine	2,342	11	55	65	5.2
Gas turbine	5,057	22	51	73	2.3
Combined cycle	3,574	26	48	74	1.9
Reciprocating engine	3,586	29	40	69	1.4
All schemes	**3,603**	**24**	**48**	**72**	**2**

CHP schemes which export and schemes with mechanical power output

7.24 Table 7E shows the electrical exports from CHP schemes between 2014 and 2016. In the 2015 edition of the Digest, for the first time we presented rigorous values for both total power exported and the Qualifying Power Output (QPO) exported. In previous editions of the Digest, power export figures have been based upon information voluntarily supplied by scheme operators. From the 2015 edition of the Digest, power export figures are based upon export meter data. The total power exported given below is therefore the value registered on the power export meter, with one adjustment made for some schemes. Where the value registered on a scheme's power export meter is greater than the Total Power Output (TPO) for the scheme, the total power exported is capped at the TPO of the scheme. This adjustment is necessary in some situations where schemes import power from another place and onward supply this power, with the onward supplied power passing through the power export meter. Mathematically, this is shown as:

TPO Exported = Value registered on power export meter

If Value registered on power export meter > TPO, then TPO Exported is set to equal TPO.

The QPO exported is the TPO exported that is deemed good quality. This is calculated by assuming that any power consumed by the scheme is good quality power (QPO). This means that only if the scheme's consumption of power is less than the QPO will QPO become available for export. Mathematically, the QPO exported is:

QPO Exported = QPO for the scheme – Electricity consumed by the scheme, where

Electricity consumed by the scheme = Total Power Output – TPO Exported

If QPO for the scheme < Electricity consumed by the scheme, then QPO Exported is set to zero.

Table 7E also sets out the recipients of exported power. In the 2015 edition of the Digest for the first time we rigorously followed up with Schemes to obtain data on recipients of exported power. This means that this follow-up was possible for years of operation 2014, 2015 and 2016.

Table 7E: Electrical exports from CHP (TPO)

GWh

	2014	**2015**	**2016**
To part of same qualifying group *(1)*	237	582r	775
To a firm NOT part of same qualifying group	14,424	9,365r	10,045
To an electricity supplier	9,321r	12,370r	17,662
Total	**23,982r**	**22,317r**	**28,483**

(1) A qualifying group is a group of two or more corporate consumers that are connected or related to each other, for example, as a subsidiary, or via a parent or holding company, or in terms of share capital.

Table 7F: Electrical exports from CHP (QPO)

GWh

	2014	**2015**	**2016**
To part of same qualifying group *(1)*	232	343r	267
To a firm NOT part of same qualifying group	4,807	3,908r	4,554
To an electricity supplier	2,325r	3,482r	3,820
Total	**7,364r**	**7,733r**	**8,641**

There has been a significant increase in the power exports in 2016 relative to 2015, and this is the case for both total power exports (TPO) and the power exports that can be considered Good Quality (QPO). This is consistent with the much higher Load Factor (Actual) and Load Factor (CHPQA) discussed above, where some large power exporting CHP schemes have generated more power than previously.

7.25 In 2016, 54 large schemes exported heat, with some exporting to more than one customer. In 2015 there were 52 schemes exporting heat. As Table 7G shows, together these schemes supplied 9,301 GWh of heat in 2016, which is an 8.7 per cent increase on the revised 2015 figure.

Table 7G: Heat exports from CHP

	2014	2015	2016
To part of same qualifying group *(1)*	511	760r	961
To a firm NOT part of same qualifying group	8,086	7,570r	8,099
To an electricity supplier	32	231r	242
Total	**8,629**	**8,560r**	**9,301**

(1) A qualifying group is a group of two or more corporate consumers that are connected or related to each other, for example, as a subsidiary, or via a parent or holding company, or in terms of share capital.

7.26 There are an estimated 10 schemes with mechanical power output. For those schemes, mechanical power accounts for 9 per cent of their total power capacity (Table 7H). These schemes are predominantly on petro-chemicals or steel sites, using by-product fuels in boilers to drive steam turbines. The steam turbine is used to provide mechanical rather than electrical power, driving compressors, blowers or fans, rather than an alternator. The number of operating schemes with mechanical power is one less than in 2015 due to the closure of the integrated steel operations at Redcar, which relied heavily on by-product fuel gases from the blast furnace and coke ovens.

Table 7H: CHP schemes with mechanical power output in 2016

	Unit	
Number of schemes		10
Total Power Capacity of these schemes (CHP_{TPC})	MWe	2,141
Mechanical power capacity of these schemes	MWe	203

Emissions savings

7.27 The calculation of carbon emissions savings from CHP is complex because CHP displaces a variety of fuels, technologies and sizes of plant. The methodology and assumptions used for calculating carbon emission savings are outlined in Energy Trends June 2003[4]. The figures compare CHP with the UK fossil fuel basket carbon intensity and the UK total basket carbon intensity, which includes nuclear and renewable generation. The carbon emission savings from CHP in 2016 as compared to the fossil fuel basket were 9.53 $MtCO_2$, which equates to 1.71 Mt CO_2 per 1,000 MWe installed capacity. Against the total basket, CHP saved 4.70 Mt CO_2 which equates to 0.84 Mt CO_2 per 1,000 MWe installed capacity.

7.28 Corresponding figures for 2014 and 2015 are shown in Table 7I. The 2014 and 2015 CO_2 savings are revised based on revisions to the relevant data for these years in Tables 7.1, 7.4, 7.6 and 7.9 and revisions to the CO_2 intensity of grid electricity. Absolute savings ($MtCO_2$) are sensitive to both the levels of CHP heat and power output and the CO_2 factor attributed to grid electricity that CHP electricity displaces. In spite of the fact that CHP outputs of heat and power, fuel consumption and fuel mix were broadly similar between 2015 and 2016, the absolute savings in 2016 were significantly lower than in 2015. This is explained by the provisional 2016 values for CO_2 intensity attributed to grid electricity being significantly lower in than in 2015, which was mainly due to a dramatic fall in the proportion of total electrity generation coming from coal. The relative savings ($MtCO_2$/MWe) in 2016 was also lower than in 2015 and this can be also attributed to the lower CO_2 intensities of grid electricity in 2016 compared to 2015, since the CHP load factor on CHPQA basis in 2016 was actually higher than in 2015.

4 http://webarchive.nationalarchives.gov.uk/20060213234600/http:/www.dti.gov.uk/energy/inform/energy_trends/index.shtml

Table 7I: Carbon dioxide savings due to CHP, absolute and per 1,000 MWe of installed good quality CHP capacity

	2014		2015		2016	
	$MtCO_2$	$MtCO_2$/1000 MWe	$MtCO_2$	$MtCO_2$/1000 MWe	$MtCO_2$	$MtCO_2$/1000 MWe
Carbon savings against all fossil fuels	13.18	2.24	12.57	2.19	9.53	1.71
Carbon savings against all fuels (including nuclear and renewables)	7.81	1.33	6.46	1.13	4.7	0.84

Note: (1) The CO_2 savings in Table 7I assume that CHP generated electricity avoids the transmission and distribution losses associated with its conventionally generated equivalent. These losses are assumed to be 1.5% in the case of transmission losses and 6.0% in the case of distribution losses.

(2) The CO_2 savings quoted above for 2016 are based on preliminary CO_2 intensities, for that year, for the fossil fuel basket and the total fuel basket of conventional electricity generation. As such, they are subject to revision at a later date. The CO_2 savings quoted above for 2014 and 2015 have also been revised in response to changes in the CO_2 intensity factors for electricity for these years since reporting in DUKES 2016.The figures have also been revised to reflect revisions to CHP electricity and heat output and fuel consumption.

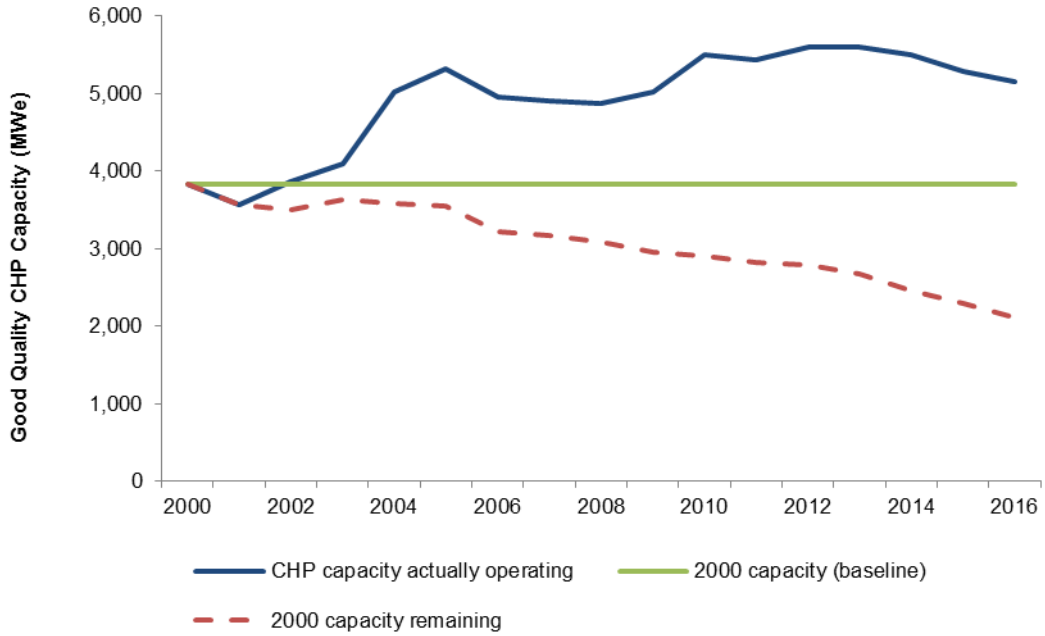
Government policy towards CHP

7.29 There are a range of support measures to incentivise the growth of Good Quality CHP in the UK. These include:

- Exemption from the Climate Change Levy (CCL) of all fuel inputs to, and electricity outputs from, Good Quality CHP. This exemption has been in place since the introduction of the CCL in 2001.
- From April 2013, exemption from Carbon Price Support (CPS) on fuel to CHP consumed for the generation of heat
- From April 2015, exemption from Carbon Price Support (CPS) on fuel to CHP consumed for the generation of Good Quality CHP electricity which is consumed on site
- Eligibility to Enhanced Capital Allowances for Good Quality CHP plant and machinery.
- Business Rates exemption for CHP power generation plant and machinery.
- Reduction of VAT (from 20 to 5 per cent) on domestic micro-CHP installations.
- Extension of the eligibility for Renewable Obligation Certificates (ROCs) to energy from waste plants that utilise CHP.
- Specific Renewable Heat Incentive (RHI) for biomass fuelled Good Quality CHP certified under CHPQA.
- Contract for Difference (CFD) for biomass fuelled CHP
- The zero-rating of heat under the Carbon Reduction Commitment Energy Efficiency Scheme (CRC), this means that allowances do not have to be purchased by a site covered by CRC for heat that it imports. This incentivises the use of CHP heat outputs.

7.30 Table 7.1 shows the installed Good Quality CHP capacity in each year. However, this table hides the underlying market activity that replaces older capacity as it is taken out of service over time. Chart 7.4 gives an idea of the scale of this activity since 2000 for CHP schemes certified under CHPQA. The dotted line shows how much of the Good Quality CHPQA capacity that was in place in 2000 remained in place in subsequent years, while the upper line shows the actual Good Quality CHPQA capacity in place in each year. For any year since 2000, the gap between these two lines represents the new Good Quality CHPQA capacity installed between 2000 and that year. By 2016 there had been just over 3.0 GWe of new Good Quality CHPQA capacity installed since 2000.

Chart 7.4: Underlying market activity – operating Good Quality CHP versus retained Good Quality CHP



International context

7.31 Phase III of EU ETS runs from 2013 until 2020. Under this phase there is no allocation made in respect of CO_2 emissions associated with the generation of electricity, including electricity generated by CHP. However, there is an allocation made in respect of EU ETS CO_2 emissions associated with measurable CHP heat consumption. The allocation is based upon harmonised benchmarks for heat production. In 2013 an EU ETS installation consuming CHP generated heat (not deemed at risk of carbon leakage) will have received 80% of the allocation determined using this benchmark, declining linearly to 30% by 2020. Where the installation consuming the heat is deemed at significant risk of carbon leakage, then it will receive 100% of the allocation determined using the benchmark for the duration of Phase III of EU ETS. If the consumer of the heat is not an EU ETS installation, then the allocation is given to the heat producer. The benchmark for heat adopted by the European Commission is based on the use of natural gas with a conversion efficiency of 90% (N.C.V.). This means that the benchmark allocation made for each MWh of heat generated by a CHP scheme which is subsequently is 0.224 tCO2[5].

5 Where the CHP supplies heat to an EU ETS Phase III sub-installation or installation and the sub-installation or installation produces a product that is product benchmarked, then an allocation is not made in respect of the heat supplied but in respect of the product produced.

Technical notes and definitions

7.32 These notes and definitions are in addition to the technical notes and definitions covering all fuels and energy as a whole in Chapter 1, paragraphs 1.28 to 1.61.

Data for 2016

7.33 The data are summarised from the results of a long-term project undertaken by Ricardo Energy & Environment on behalf of the Department of Business, Energy and Industrial Strategy (BEIS). Data are included for CHP schemes installed in all sectors of the UK economy.

7.34 Data for 2016 were based on data supplied to the CHPQA programme, information from the Iron and Steel Statistics Bureau (ISSB), information from Ofgem in respect of "Renewables Obligation Certificates" (ROCs), information from the CHP Sales database maintained by the CHPA and from a survey of anaerobic digestion (AD) sites. Ninety-five per cent of the total capacity is from schemes that have been certified under the CHPQA programme. Sewage Treatment Works and other AD schemes that do not provide returns to CHPQA have been included based on ROCs information from Ofgem returns. The data from these sources accounts for approximately 3.1 per cent of total electrical capacity. The balance of the capacity is for schemes covered by ISSB sources (<1 per cent), CHPA Sales Database (<1 per cent) and for schemes not covered by the above sources which were interpolated from historical data (<1 per cent).

Definitions of schemes

7.35 There are four principal types of CHP system:

- **Steam turbine,** where steam at high pressure is generated in a boiler. In **back pressure steam turbine systems**, the steam is wholly or partly used in a turbine before being exhausted from the turbine at the required pressure for the site. In **pass-out condensing steam turbine systems**, a proportion of the steam used by the turbine is extracted at an intermediate pressure from the turbine with the remainder being fully condensed before it is exhausted at the exit. (Condensing steam turbines without passout and which do not utilise steam are not included in these statistics as they are not CHP). The boilers used in such schemes can burn a wide variety of fuels including coal, gas, oil, and waste-derived fuels. With the exception of waste-fired schemes, a steam turbine plant has often been in service for several decades. Steam turbine schemes capable of supplying useful steam have electrical efficiencies of between 10 and 20 per cent, depending on size, and thus between 70 per cent and 30 per cent of the fuel input is available as useful heat. Steam turbines used in CHP applications typically range in size from a few MWe to over 100 MWe.

- **Gas turbine systems**, often aero-engine derivatives, where fuel (gas or gas-oil) is combusted in the gas turbine and the exhaust gases are normally used in a waste heat boiler to produce usable steam, though the exhaust gases may be used directly in some process applications. Gas turbines range from 30 kWe upwards, achieving electrical efficiency of 23 to 30 per cent (depending on size) and with the potential to recover up to 50 per cent of the fuel input as useful heat. They have been common in CHP since the mid 1980s. The waste heat boiler can include supplementary or auxiliary firing using a wide range of fuels, and thus the heat to power ratio of the scheme can vary.

- **Combined cycle systems**, where the plant comprises more than one prime mover. These are usually gas turbines where the exhaust gases are utilised in a steam generator, the steam from which is passed wholly or in part into one or more steam turbines. In rare cases reciprocating engines may be linked with steam turbines. Combined cycle is suited to larger installations of 7 MWe and over. They achieve higher electrical efficiency and a lower heat to power ratio than steam turbines or gas turbines. Recently installed combined cycle gas turbine (CCGT) schemes have achieved an electrical efficiency approaching 50 per cent, with 20 per cent heat recovery, and a heat to power ratio of less than 1:1.

- **Reciprocating engine systems** range from less than 100 kWe up to around 5 MWe, and are found in applications where production of hot water (rather than steam) is the main requirement, for example, on smaller industrial sites as well as in buildings. They are based on auto engine or

marine engine derivatives converted to run on gas. Both compression ignition and spark ignition firing is used. Reciprocating engines operate at around 28 to 33 per cent electrical efficiency with around 50 per cent to 33 per cent of the fuel input available as useful heat. Reciprocating engines produce two grades of waste heat: high grade heat from the engine exhaust and low grade heat from the engine cooling circuits.

- **Organic Rankine Cycle systems** operate on the same principle as steam turbines but, instead of using water steam as the working fluid, use organic substances with a lower boiling point and higher vapour pressure than water. This allows heat of a lower temperature to be converted into power via evaporation of the organic working fluid and expansion through a turbine. Low and medium temperature heat sources in the temperature range 80 to 350°C are exploited by ORC systems. The accessibility of low grade heat means that geothermal, industrial waste heat, biomass and solar heat sources can be exploited by ORC systems for the generation of power.

Determining fuel consumption for heat and electricity

7.36 In order to provide a comprehensive picture of electricity generation in the United Kingdom and the fuels used to generate that electricity, the energy input to CHP schemes has to be allocated between heat and electricity production. This allocation is notional and is not determinate.

7.37 The convention used to allocate the fuels to heat and electricity relates the split of fuels to the relative efficiency of heat and electricity supply. The efficiency of utility plant varies widely: electricity generation from as little as 25 per cent to more than 50 per cent and boilers from 50 per cent to more than 90 per cent. Thus it is around twice as hard to generate a unit of electricity as it is to generate a unit of heat. Accordingly, a simple convention can be implemented whereby twice as many units of fuel are allocated to each unit of electricity generated, as to each unit of heat supplied. This approach is consistent with the Defra Guidelines for Company Reporting on greenhouse gas emissions and for Negotiated Agreements on energy efficiency agreed between Government and industry as part of the Climate Change Levy (CCL) package. It recognises that, in developing a CHP scheme, both the heat customer(s) and the electricity generator share in the savings.

7.38 The assumption in this convention that it is twice as hard to generate a unit of electricity as heat, is appropriate for the majority of CHP schemes. However, for some types of scheme (for example in the iron and steel sector) this allocation is less appropriate and can result in very high apparent heat efficiencies. These, however, are only notional efficiencies.

The effects on the statistics of using CHPQA

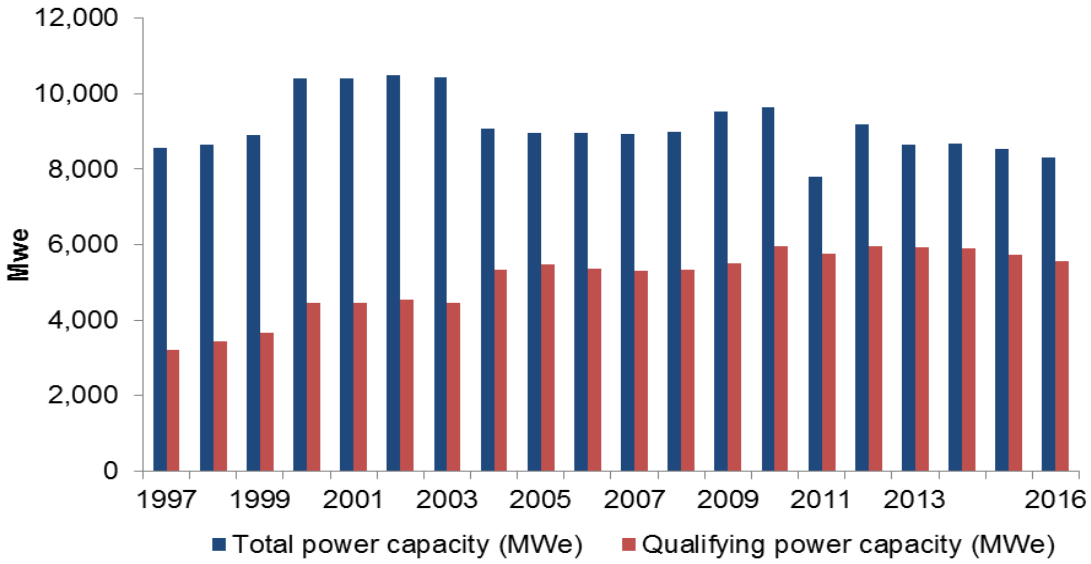
7.39 Paragraph 7.5 described how schemes were scaled back so that only CHP_{QPC} and CHP_{QPO} are included in the CHP statistics presented in this Chapter. This is illustrated in Table 7J where it is seen that 370 schemes were scaled back. For information, in 2015, 358 schemes were scaled back.

7.40 In 2016, the power output from these schemes was scaled back from a total of 35,880 GWh to 12,179 GWh. The total fuel input to these schemes was 114,919 GWh of which 61,089 GWh was regarded as being for power only. For 2015, the total power output was scaled back from 30,356 GWh to 11,760 GWh. The increase in power output from these schemes in 2016 relative to 2015 is consistent with the increase in the Load Factor (Actual) and TPO exports discussed above for 2016, where number of large schemes (whose Good Quality power outputs are also scaled back) generated more power in 2016 than in 2015.

Table 7J: CHP capacity, output and fuel use which has been scaled back in 2016

	Units	
Number of schemes requiring scaling back		370
Total Power Capacity of these schemes (CHP_{TPC})	MWe	6,554
Qualifying Power Capacity of these schemes (CHP_{QPC})	MWe	3,803
Total power output of these schemes (CHP_{TPO})	GWh	35,880
Qualifying Power Output of these schemes (CHP_{QPO})	GWh	12,179
Electricity regarded as "Power only" not from CHP (CHP_{TPO} - CHP_{QPO})	GWh	23,701
Total Fuel Input of these schemes (CHP_{TFI})	GWh	114,919
Fuel input regarded as being for "Power only" use i.e. not for CHP	GWh	61,089

Chart 7.5: Installed CHP capacity by year



Exports of heat

7.41 The figures quoted in Table 7G for exports of heat for 2014 are based on voluntary returns from schemes. As such, there is the potential for these figures to underestimate the true situation. More robust follow up with schemes on heat exports was implemented for year of operation 2015 onwards.

Typical Power and Heat Efficiencies and Heat to Power Ratios of Prime Movers

7.42 The figures quoted above in Table 6D are for CHP schemes. These schemes may contain supplementary boilers, supplementary firing and auxiliary firing. The figures are, therefore, not reflective of the power and heat efficiencies and the heat to power ratios of the prime mover when it is considered in isolation.

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7.1 CHP installations by capacity and size range

	2012	2013	2014	2015	2016
Number of Schemes	**1,942r**	**2,029r**	**2,076r**	**2,139r**	**2,182**
<= 100 kWe	571	602	608r	617r	627
> 100 kWe to 1 MWe	1,045r	1,083r	1,102r	1,132r	1,158
>1 MWe to 2 MWe	105	114	132	142r	151
> 2 MWe to 10 MWe	154	165	169	181r	180
> 10 MWe +	67	65	65	67r	66
Total Capacity	**5,965r**	**5,924r**	**5,892r**	**5,730**	**5,571**
<= 100 kWe	37	39	39	40	40
> 100 kWe to 1 MWe	260r	273r	280r	297	303
>1 MWe to 2 MWe	149	164	190	208	218
> 2 MWe to 10 MWe	723	759	781	826	824
> 10 MWe +	4,797	4,689	4,601	4,360	4,185

(1) A site may contain more than one CHP scheme; the capacity categories have changed since publication in the 2013 Digest.
(2) MicroCHP schemes installed under FIT are not included in these figures (or any subsequent figures in chapter 7). At the end of 2016 517 such schemes were registered on Ofgems Central FIT Register totalling 0.55MWe

7.2 Fuel used to generate electricity and heat in CHP installations

GWh

	2012	2013	2014	2015	2016
Fuel used to generate electricity *(1)*					
Coal *(2)*	543	420	386	137	113
Fuel oil	525	145	120	124r	133
Natural gas	36,203r	31,314r	30,615r	30,439r	31,294
Renewable fuels *(3)*	3,966	4,428	5,374	4,881r	5,414
Other fuels *(4)*	5,083	4,735	4,773	4,180r	4,194
Total all fuels	**46,321r**	**41,042r**	**41,268r**	**39,763r**	**41,148**
Fuel used to generate heat					
Coal *(2)*	1,491	1,592	863	439	371
Fuel oil	723	205	140	166r	147
Natural gas	33,642r	32,038r	29,781r	27,746r	28,820
Renewable fuels *(3)*	3,301	3,429	3,924	4,216r	4,395
Other fuels *(4)*	10,223	10,124	10,230	10,339r	9,244
Total all fuels	**49,380r**	**47,388r**	**44,939r**	**42,906r**	**42,978**
Overall fuel use					
Coal *(2)*	2,035	2,012	1,249	577	484
Fuel oil	1,248	350	260	291r	280
Natural gas	69,844r	63,352r	60,397r	58,186r	60,114
Renewable Fuel o/w;	7,268	7,856	9,298	9,097r	9,809
Bioliquid	*63*	*70*	*62*	*66*	*82*
Biomass	*3,112*	*3,363*	*4,042*	*3,179*	*3,727*
Waste	*1,307*	*1,205*	*1,691*	*2,011*	*2,223*
Biogas/Syngas	*2,785*	*3,218*	*3,504*	*3,842*	*3,778*
Other Fuels (3)	15,306	14,859	15,003	14,519r	13,439
Total all fuels	**95,701r**	**88,430r**	**86,207r**	**82,669r**	**84,125**

(1) See paragraphs 7.36 to 7.37 and the CHP methodology note on the BEIS website for an explanation of the method used to allocate fuel use between heat generation and electricity generation.
(2) Includes coke.
(3) Other fuels include: process by-products, coke oven gas, blast furnace gas, gas oil and refinery gas.

7.3 Fuel used by types of CHP installation

GWh

	2012	2013	2014	2015	2016
Coal					
Back pressure steam turbine	518	550	572	577	484
Gas turbine	-	-	-	-	-
Combined cycle	1,371	1,358	674	-	-
Reciprocating engine	6	1	1	-	-
Pass out condensing steam turbine	139	102	2	-	-
Organic Rankine Cycle[1]	-	-	-	-	-
	2,035	**2,012**	**1,249**	**577**	**484**
Fuel Oil					
Back pressure steam turbine	117	145	100	95	77
Gas turbine	0	5	3	1r	3
Combined cycle	987	56	16	25	65
Reciprocating engine	122	123	122	118r	119
Pass out condensing steam turbine	22	21	20	52r	16
Organic Rankine Cycle[1]	-	-	-	-	-
	1,248	**350**	**260**	**291r**	**280**
Natural Gas					
Back pressure steam turbine	1,305	2,544	2,079	832r	731
Gas turbine	9,411	8,683	8,492	8,555r	9,230
Combined cycle	49,365	42,164	39,617	36,956r	38,199
Reciprocating engine	9,390r	9,574r	9,988r	10,904r	11,326
Pass out condensing steam turbine	374	388	221	939r	629
Organic Rankine Cycle[1]	-	-	-	-	-
	69,844r	**63,352r**	**60,397r**	**58,186r**	**60,114**
Renewable Fuels *(2)*					
Back pressure steam turbine	1,527	1,484	1,081	894r	888
Gas turbine	6	12	12	12	12
Combined cycle	344	87	60	67	61
Reciprocating engine	2,815	3,226	3,492	3,828r	3,785
Pass out condensing steam turbine	2,576	3,049	4,654	4,153r	4,920
Organic Rankine Cycle[1]	-	-	-	....	....
	7,268	**7,856**	**9,298**	**7,773r**	**8,016**
Other Fuels *(3)*					
Back pressure steam turbine	3,175	1,581	1,634	0r	0
Gas turbine	209	155	153	212	245
Combined cycle	9,241	10,306	9,915	9,782r	9,534
Reciprocating engine	69	47	68	91r	106
Pass out condensing steam turbine	2,613	2,771	3,234	4,435r	3,509
Organic Rankine Cycle[1]	-	-	-	....	....
	15,306	**14,859**	**15,003**	**15,843**	**15,232**
Total - all fuels					
Back pressure steam turbine	6,642	6,303	5,466	2,398r	2,180
Gas turbine	9,626	8,854	8,659	8,779r	9,490
Combined cycle	61,309	53,972	50,281	46,830r	47,858
Reciprocating engine	12,401r	12,971r	13,670r	14,941r	15,335
Pass out condensing steam turbine	5,724	6,331	8,131	9,578r	9,073
Organic Rankine Cycle[1]	-	-	-	....	....
	95,701r	**88,430r**	**86,207r**	**82,669r**	**84,125**

(1) From 2015, Organic Rankine Cycle CHP schemes are included in the statistics
For 2015 and 2016, where there is a "...." entered against this category, the data are merged with the back pressure steam turbine technology category, in order to avoid disclosure
(2) Renewable fuels include: Biomass, sewage gas, other biogases, municipal solid waste and refuse derived fuels
(3) Other fuels include: process by-products, coke oven gas, blast furnace gas, gas oil and refinery gas

7.4 CHP - electricity generated by fuel and type of installation

GWh

	2012	2013	2014	2015	2016
Coal					
Back pressure steam turbine	62	63	67	66	56
Gas turbine	-	-	-	-	-
Combined cycle gas turbine	165	101	113	-	-
Reciprocating engine	1	0	0	-	-
Pass-out condensing steam turbine	1	9	0	-	-
Organic Rankine Cycle[1]	-	-	-	-	-
	228	**173**	**179**	**66**	**56**
Fuel oil					
Back pressure steam turbine	14	17	13	12	10
Gas turbine	0	1	0	0	1
Combined cycle gas turbine	200	12	3	6	14
Reciprocating engine	41	42	42	41r	41
Pass-out condensing steam turbine	1	1	1	2	1
Organic Rankine Cycle[1]	-	-	-	-	-
	257	**72**	**59**	**61r**	**66**
Natural gas					
Back pressure steam turbine	126	168	172	83r	71
Gas turbine	2,262	2,034	1,953	1,966r	2,045
Combined cycle gas turbine	12,779	10,467	10,097	10,210r	10,428
Reciprocating engine	2,556r	2,628r	2,795r	3,087r	3,204
Pass-out condensing steam turbine	8	34	27	69r	34
Organic Rankine Cycle[1]	-	-	-	-	-
	17,731r	**15,331r**	**15,045r**	**15,415r**	**15,781**
Renewable Fuel					
Back pressure steam turbine	214	213	168	155r	154
Gas turbine	1	2	2	2	2
Combined cycle gas turbine	10	15	16	18	17
Reciprocating engine	839	971	1,056	1,153r	1,166
Pass-out condensing steam turbine	441	599	885	608r	780
Organic Rankine Cycle[1]	-	-	-	15	17
	1,506	**1,801**	**2,128**	**1,950r**	**2,136**
Other Fuels					
Back pressure steam turbine	214	82	106	0r	0
Gas turbine	38	29	21	35	38
Combined cycle gas turbine	2,060	1,967	1,935	1,785r	1,819
Reciprocating engine	18	11	16	19	28
Pass-out condensing steam turbine	174	127	206	227r	139
Organic Rankine Cycle[1]	-	-	-	-	5
	2,505	**2,215**	**2,284**	**2,066r**	**2,030**
Total - All Fuels					
Back pressure steam turbine	630	543	526	317r	291
Gas turbine	2,301	2,066	1,977	2,003r	2,086
Combined cycle gas turbine	15,214	12,561	12,164	12,019r	12,278
Reciprocating engine	3,455r	3,652r	3,909r	4,299r	4,439
Pass-out condensing steam turbine	626	770	1,119	906r	954
Organic Rankine Cycle[1]	-	-	-	-	22
Total	**22,226r**	**19,592r**	**19,695r**	**19,558r**	**20,070**

(1) From 2015, Organic Rankine Cycle CHP schemes are included in the statistics
For 2015 and 2016, where there is a "…." entered against this category, the data are merged with the back pressure steam turbine technology category, in order to avoid disclosure
(2) Renewable fuels include: Biomass, sewage gas, other biogases, municipal solid waste and refuse derived fuels
(3) Other fuels include: process by-products, coke oven gas, blast furnace gas, gas oil and refinery gas

7.5 CHP - electrical capacity by fuel and type of installation

MWe

	2012	2013	2014	2015	2016
Coal					
Back pressure steam turbine	20	20	21	22	22
Gas turbine	-	-	-	-	-
Combined cycle gas turbine	175	197	128	-	-
Reciprocating engine	1	0	0	-	-
Pass-out condensing steam turbine	3	2	0	-	-
Organic Rankine Cycle[1]	-	-	-	-	-
	199	**220**	**150**	**22**	**22**
Fuel oil					
Back pressure steam turbine	6	6	5	4	5
Gas turbine	0	0	0	0	0
Combined cycle gas turbine	45	3	1	1	3
Reciprocating engine	6	7	6	6	7
Pass-out condensing steam turbine	1	1	1	2	0
Organic Rankine Cycle[1]	-	-	-	-	-
	58	**17**	**13**	**13r**	**15**
Natural gas					
Back pressure steam turbine	39	79	71	21r	21
Gas turbine	412	422	360	401	401
Combined cycle gas turbine	3,395	3,114	3,220	3,005r	2,881
Reciprocating engine	717r	763	825r	857r	886
Pass-out condensing steam turbine	7	9	9	42r	28
Organic Rankine Cycle[1]	-	-	-	-	-
	4,571	**4,387**	**4,485r**	**4,326r**	**4,217**
Renewable Fuel *(2)*					
Back pressure steam turbine	39	37	28	24r	24
Gas turbine	0	1	1	1	1
Combined cycle gas turbine	4	2	3	3	3
Reciprocating engine	195	230	236	320r	325
Pass-out condensing steam turbine	105	162	180	226r	230
Organic Rankine Cycle[1]	-	-	-	….	….
	344	**432**	**447**	**577r**	**587**
Other Fuels *(3)*					
Back pressure steam turbine	107	67	67	-r	0
Gas turbine	12	9	4	10	11
Combined cycle gas turbine	576	700	602	583r	549
Reciprocating engine	21	15r	18r	19	20
Pass-out condensing steam turbine	77	77	107	180r	149
Organic Rankine Cycle[1]	-	-	-	….	….
	793	**868r**	**798r**	**792r**	**731**
Total - All Fuels					
Back pressure steam turbine	211	210	192	72r	72
Gas turbine	425	431	364r	411	412
Combined cycle gas turbine	4,196	4,018	3,954	3,592r	3,436
Reciprocating engine	941	1,014r	1,085r	1,202r	1,238
Pass-out condensing steam turbine	193	251	297	449r	407
Organic Rankine Cycle[1]	-	-	-	….	5
Total	**5,965r**	**5,924r**	**5,892r**	**5,730r**	**5,571**

(1) From 2015, Organic Rankine Cycle CHP schemes are included in the statistics
For 2015 and 2016, where there is a "…." entered against this category, the data are merged with the back pressure steam turbine technology category, in order to avoid disclosure
(2) Renewable fuels include: Biomass, sewage gas, other biogases, municipal solid waste and refuse derived fuels
(3) Other fuels include: process by-products, coke oven gas, blast furnace gas, gas oil and refinery gas

7.6 CHP - heat generated by fuel and type of installation

GWh

	2012	2013	2014	2015	2016
Coal					
Back pressure steam turbine	405	434	432	423	366
Gas turbine	-	-	-	-	-
Combined cycle gas turbine	745	776	381	-	-
Reciprocating engine	3	1	0	-	-
Pass-out condensing steam turbine	111	92	1	-	-
Organic Rankine Cycle[1]	-	-	-	-	-
	1,263	**1,302**	**813**	**423**	**366**
Fuel oil					
Back pressure steam turbine	98	121	78	71	60
Gas turbine	0	3	2	1	2
Combined cycle gas turbine	562	31	8	13	37
Reciprocating engine	35	36	35	34r	36
Pass-out condensing steam turbine	14	13	13	32	10
Organic Rankine Cycle[1]	-	-	-	-	-
	708	**204**	**136**	**151r**	**144**
Natural gas					
Back pressure steam turbine	1,183	2,082	1,716	635r	549
Gas turbine	4,689	4,506	4,365	4,265r	4,689
Combined cycle gas turbine	22,526	19,961	18,540	17,200r	17,784
Reciprocating engine	4,243r	4,443r	4,424r	4,868r	5,065
Pass-out condensing steam turbine	268	291	121	760r	496
Organic Rankine Cycle[1]	-	-	-	-	-
	32,909r	**31,283r**	**29,164r**	**27,728r**	**28,581**
Renewable Fuel *(2)*					
Back pressure steam turbine	712	758	554	344r	341
Gas turbine	3	2	2	2	2
Combined cycle gas turbine	70	34	30	34	31
Reciprocating engine	779	873	961	1,013r	1,013
Pass-out condensing steam turbine	757	1,113	1,423	1,634r	1,794
Organic Rankine Cycle[1]	-	-	-	....	....
	2,321	**2,780**	**2,970**	**3,090r**	**3,256**
Other Fuels *(3)*					
Back pressure steam turbine	2,820	1,458	1,519	0r	0
Gas turbine	108	83	62	91	115
Combined cycle gas turbine	4,839	5,564	5,243	5,528r	5,220
Reciprocating engine	17	15	20	26	36
Pass-out condensing steam turbine	1,704	1,660	2,030	3,225r	2,681
Organic Rankine Cycle[1]	-	-	-	....	....
	9,488	**8,781**	**8,874**	**8,870r**	**8,075**
Total - All Fuels					
Back pressure steam turbine	5,218	4,853	4,298	1,472r	1,316
Gas turbine	4,800	4,595	4,430	4,359r	4,807
Combined cycle gas turbine	28,741	26,366	24,201	22,775r	23,070
Reciprocating engine	5,077r	5,369r	5,441r	5,940r	6,149
Pass-out condensing steam turbine	2,854	3,168	3,587	5,651r	4,982
Organic Rankine Cycle[1]	-	-	-	....	99
Total	**46,690r**	**44,350r**	**41,957r**	**40,261r**	**40,423**

(1) From 2015, Organic Rankine Cycle CHP schemes are included in the statistics
For 2015 and 2016, where there is a "...." entered against this category, the data are merged with the back pressure steam turbine technology category, in order to avoid disclosure
(2) Renewable fuels include: Biomass, sewage gas, other biogases, municipal solid waste and refuse derived fuels
(3) Other fuels include: process by-products, coke oven gas, blast furnace gas, gas oil and refinery gas

7.7 CHP - heat capacity by fuel and type of installation

MWth

	2012	2013	2014	2015	2016
Coal					
Back pressure steam turbine	125	124	134	137	134
Gas turbine	-	-	-	-	-
Combined cycle gas turbine	283	301	169	-	-
Reciprocating engine	5	2	1	-	-
Pass-out condensing steam turbine	57	48	20	-	-
Organic Rankine Cycle[1]	-	-	-	-	-
	470	**474**	**324**	**137**	**134**
Fuel oil					
Back pressure steam turbine	40	42	32	31	34
Gas turbine	0	1	1	1	2
Combined cycle gas turbine	179	14	6	5	12
Reciprocating engine	12	8	7	6	8
Pass-out condensing steam turbine	5	5	5	15	6
Organic Rankine Cycle[1]	-	-	-	-	-
	236	**70**	**51**	**57**	**61**
Natural gas					
Back pressure steam turbine	465	829	751	212r	212
Gas turbine	1,763	1,781	1,662r	1,785	1,807
Combined cycle gas turbine	10,761	9,750	9,836	8,946r	8,667
Reciprocating engine	2,595r	2,758	2,991r	3,153r	3,257
Pass-out condensing steam turbine	133	145	241	330r	230
Organic Rankine Cycle[1]	-	-	-	-	-
	15,717r	**15,263**	**15,481r**	**14,426r**	**14,172**
Renewable Fuel *(2)*					
Back pressure steam turbine	161	155	129	107r	106
Gas turbine	2	4	4	4	4
Combined cycle gas turbine	1,627	258	12	14	12
Reciprocating engine	230	303	313	450r	447
Pass-out condensing steam turbine	546	737	905	1,232r	1,247
Organic Rankine Cycle[1]	-	-	-	....	....
	2,566	**1,456**	**1,363**	**1,828r**	**1,841**
Other Fuels *(3)*					
Back pressure steam turbine	944	586	593	0r	0
Gas turbine	48	32	7	20	23
Combined cycle gas turbine	1,856	3,578	1,991	1,946r	1,858
Reciprocating engine	17	15	18r	20r	21
Pass-out condensing steam turbine	691	694	2,401	1,689r	1,544
Organic Rankine Cycle[1]	-	-	-	....	....
	3,555	**4,904r**	**5,010r**	**3,675r**	**3,464**
Total - All Fuels					
Back pressure steam turbine	1,735	1,735	1,638	486r	486
Gas turbine	1,813	1,818	1,674	1,810	1,835
Combined cycle gas turbine	14,707	13,900	12,014	10,911	10,549
Reciprocating engine	2,857r	3,085r	3,330r	3,629r	3,733
Pass-out condensing steam turbine	1,432	1,628	3,573	3,267r	3,027
Organic Rankine Cycle[1]	-	-	-	....	43
Total	**22,545**	**22,167r**	**22,228r**	**20,123r**	**19,673**

(1) From 2015, Organic Rankine Cycle CHP schemes are included in the statistics
For 2015 and 2016, where there is a "...." entered against this category, the data are merged with the back pressure steam turbine technology category, in order to avoid disclosure

(2) Renewable fuels include: Biomass, sewage gas, other biogases, municipal solid waste and refuse derived fuels
(3) Other fuels include: process by-products, coke oven gas, blast furnace gas, gas oil and refinery gas

7.8 CHP capacity, output and total fuel use[(1)] by sector

	2012	2013	2014	2015	2016
Iron and steel and non ferrous metals					
Number of sites	6	6	6	6	5
Electrical capacity	81	81	81	81	40
Heat capacity	674	674	674	674	435
Electrical output	212	163	158	118	103
Heat output	1,764	1,701	1,776	1,506	1,026
Fuel use	2,766	2,885	2,743	2,720	1,798
of which : for electricity	484	435	395	316	269
for heat	2,282	2,450	2,348	2,404	1,529
Chemicals					
Number of sites	53	52	52	52r	52
Electrical capacity	1,539	1,461	1,437	1,183r	1,137
Heat capacity	5,139	4,828	4,878	4,458r	4,363
Electrical output	5,783	5,212	4,574	4,977r	4,802
Heat output	13,334	12,282	11,010	10,487r	10,421
Fuel use	27,646	25,189	22,685	22,110r	22,197
of which : for electricity	12,960	11,543	10,214	10,458r	10,505
for heat	14,686	13,646	12,470	11,652r	11,693
Oil and gas terminals and oil refineries					
Number of sites	11	11	10	9	9
Electrical capacity	2,380	2,380	2,278	2,235	2,226
Heat capacity	7,600	7,600	7,255	6,825	6,825
Electrical output	8,105	6,184	6,391	6,151r	6,722
Heat output	16,211	14,446	13,615	13,060r	13,904
Fuel use	31,340	26,634	25,759	24,164r	25,833
of which : for electricity	15,486	12,218	12,362	11,533r	12,350
for heat	15,854	14,416	13,397	12,631r	13,483
Paper, publishing and printing					
Number of sites	23	22	21	21	20
Electrical capacity	453	451	477	463r	364
Heat capacity	2,060	1,776	1,764	1,771	1,537
Electrical output	2,170	1,948	2,025	1,639r	1,670
Heat output	4,875	4,849	4,389	3,844r	3,799
Fuel use	9,448	9,221	8,831	7,349r	7,730
of which : for electricity	4,553	4,138	4,295	3,410r	3,676
for heat	4,895	5,082	4,536	3,939r	4,053
Food, beverages and tobacco					
Number of sites	49	54	59	61r	61
Electrical capacity	439	436	455	469r	469
Heat capacity	1,712	1,743	1,787	1,808r	1,808
Electrical output	2,146	2,117	2,266	2,257r	2,132
Heat output	4,046	4,277	4,291	4,119r	3,866
Fuel use	8,129	8,362	8,717	8,563r	8,081
of which : for electricity	4,177	4,172	4,487	4,471r	4,232
for heat	3,952	4,190	4,230	4,092r	3,849
Metal products, machinery and equipment					
Number of sites	19	19	20	21	21
Electrical capacity	68	43	43	46	46
Heat capacity	288	254	254	257	257
Electrical output	106	119	139	153r	159
Heat output	159	193	190	192r	214
Fuel use	603	462	625	654r	711
of which : for electricity	270	250	301	329r	336
for heat	332	212	324	325r	375

For footnotes see page 217

7.8 CHP capacity, output and total fuel use[(1)] by sector (continued)

	2012	2013	2014	2015	2016
Mineral products, extraction, mining and agglomeration of solid fuels					
Number of sites	8	8	8	8r	8
Electrical capacity	54	54	54	52r	52
Heat capacity	183	183	183	165r	165
Electrical output	102	104	109	131r	120
Heat output	494	526	530	550r	498
Fuel use	816	836	881	889r	827
of which : for electricity	236	230	253	289r	269
for heat	580	605	628	600r	558
Sewage treatment					
Number of sites	199	197	200	204r	208
Electrical capacity	173	164	165	222r	228
Heat capacity	241	240	245	372r	378
Electrical output	688	657	719	763r	788
Heat output	740	740	822	872r	891
Fuel use	2,458	2,391	2,601	2,832r	2,804
of which : for electricity	1,605	1,540	1,660	1,791r	1,804
for heat	853	851	941	1,041r	1,001
Other industrial branches *(2)*					
Number of sites	11	12	12	14r	15
Electrical capacity	46	50	50	76r	77
Heat capacity	254	274	274	229r	233
Electrical output	213	225	243	265r	345
Heat output	374	409	422	410r	390
Fuel use	1,182	812	845	920r	1,221
of which : for electricity	621	423	452	535r	841
for heat	562	389	393	385r	380
Total industry					
Number of sites	379	381	388	396r	399
Electrical capacity	5,234	5,119	5,039	4,827r	4,638
Heat capacity	18,151	17,571	17,312	16,559r	16,000
Electrical output	19,524	16,729	16,625	16,455r	16,841
Heat output	41,998	39,423	37,046	35,040r	35,009
Fuel use	84,388	76,792	73,685	70,201r	71,202
of which : for electricity	40,392	34,950	34,419	33,133r	34,283
for heat	43,996	41,842	39,266	37,069r	36,920
Transport, commerce and administration					
Number of sites	930r	956r	974r	1,003r	1,020
Electrical capacity	398r	419r	445r	480r	486
Heat capacity	1,674	1,729r	1,823r	1,945r	1,988
Electrical output	1,695r	1,742r	1,867r	1,830r	1,840
Heat output	2,982r	3,134r	3,028r	3,258r	3,277
Fuel use	6,925r	6,956r	7,377r	7,331r	7,397
of which : for electricity	3,691r	3,567r	4,106r	3,811r	3,839
for heat	3,234r	3,389r	3,272r	3,520r	3,558
Other *(3)*					
Number of sites	633r	692	714	740r	763
Electrical capacity	333	386	408	423r	447
Heat capacity	2,720	2,866	3,093	1,619r	1,685
Electrical output	1,007r	1,121	1,203	1,273r	1,389
Heat output	1,710r	1,793	1,884	1,964r	2,137
Fuel use	4,389r	4,683	5,144	5,137r	5,526
of which : for electricity	2,238r	2,525	2,744	2,820r	3,025
for heat	2,150r	2,158	2,401	2,317r	2,501
Total CHP usage by all sectors					
Number of sites	1,942r	2,029r	2,076r	2,139r	2,182
Electrical capacity	5,965r	5,924r	5,892r	5,730r	5,571
Heat capacity	22,545	22,167r	22,228r	20,123r	19,673
Electrical output	22,226r	19,592r	19,695r	19,558r	20,070
Heat output	46,690r	44,350r	41,957r	40,261r	40,423
Fuel use	95,701r	88,430r	86,207r	82,669r	84,125
of which : for electricity	46,321r	41,042r	41,268r	39,763r	41,148
for heat	49,380r	47,388r	44,939r	42,906r	42,978

(1) The allocation of fuel use between electricity and heat is largely notional and the methodology is outlined in the methodology note

(2) Other industry includes Textiles, clothing and footwear sector.

(3) Sectors included under Other are agriculture, community heating, leisure, landfill and incineration.

7.9 CHP - use of fuels by sector

GWh

	2012	2013	2014	2015	2016
Iron and steel and non ferrous metals					
Coal	-	-	-	-	-
Fuel oil	22	21	20	51	15
Natural gas	225	204	169	237	232
Blast furnace gas	1,892	2,169	2,114	2,001	1,317
Coke oven gas	599	489	440	431	220
Other fuels *(1)*	29	2	-	-	14
Total iron and steel and non ferrous metals	**2,766**	**2,885**	**2,743**	**2,720**	**1,798**
Chemicals					
Coal	1,699	1,697	1,033	359	331
Fuel oil	6	10	12	3r	4
Gas oil	5	4	6	4r	5
Natural gas	22,748	20,118	18,169	17,444r	17,829
Refinery gas	556	646	653	648	614
Renewable fuels *(2)*	52	90	92	663r	846
Other fuels *(1)*	2,579	2,623	2,720	2,990r	2,568
Total chemicals	**27,646**	**25,189**	**22,685**	**22,110r**	**22,197**
Oil and gas terminals and oil refineries					
Fuel oil	983	48	7	25	65
Gas oil	52	763	906	798r	687
Natural gas	21,260	18,484	17,847	16,380r	17,786
Refinery gas	3,774	3,872	3,996	4,264r	4,051
Other fuels *(1)*	5,272	3,466	3,003	2,698r	3,244
Total oil and gas terminals and oil refineries	**31,340**	**26,634**	**25,759**	**24,164r**	**25,833**
Paper, publishing and printing					
Coal	139	102	-	-	-
Fuel oil	-	-	-	-	-
Gas oil	6	7	2	1r	1
Natural gas	7,455	6,298	5,402	4,917r	5,161
Renewable fuels *(2)*	1,643	2,516	2,786	2,189r	2,381
Other fuels *(1)*	204	298	641	241r	187
Total paper, publishing and printing	**9,448**	**9,221**	**8,831**	**7,349r**	**7,730**
Food, beverages and tobacco					
Coal	181	205	214	218	152
Fuel oil	116	148	100	94r	77
Gas oil	19	3	4	3r	15
Natural gas	7,642	7,653	7,885	7,812r	7,423
Renewable fuels *(2)*	171	354	515	436r	414
Other fuels *(1)*	-	-	-	-r	0
Total food, beverages and tobacco	**8,129**	**8,362**	**8,717**	**8,563r**	**8,081**
Metal products, machinery and equipment					
Coal	-	-	-	-	-
Fuel oil	89	89	89	89	89
Gas oil	0	0	0	0	0
Natural gas	439	332	364	399r	422
Renewable fuels *(2)*	75	41	172	166r	199
Other fuels *(1)*	-	-	-	-	-
Total metal products, machinery and equipment	**603**	**462**	**625**	**654r**	**711**

For footnotes see page 219

7.9 CHP - use of fuels by sector (continued)

GWh

	2012	2013	2014	2015	2016
Mineral products, extraction, mining and agglomeration of solid fuels					
Coal	-	-	-	-	-
Fuel oil	-	-	-	-	-
Gas oil	-	-	-	-	-
Natural gas	586	606	651	739r	677
Coke oven gas	230	230	230	150	150
Total mineral products, extraction, mining and agglomeration of solid fuels	**816**	**836**	**881**	**889r**	**827**
Sewage treatment					
Fuel oil	33	32	33	29r	28
Gas oil	32	17	26	37r	26
Natural gas	181	36	50	71r	121
Renewable fuels *(2)*	2,213	2,305	2,491	2,696r	2,630
Total sewage treatment	**2,458**	**2,391**	**2,601**	**2,832r**	**2,804**
Other industrial branches					
Fuel oil	-	-	-	-	-
Gas oil	14	0	0	2	3
Natural gas	762	803	837	821	730
Renewable fuels *(2)*	406	9	7	94r	475
Total other industrial branches	**1,182**	**812**	**845**	**918r**	**1,207**
Transport, commerce and administration					
Coal	-	-	-	-	-
Fuel oil	-	-	-	-	0
Gas oil	17	12	34	39r	52
Natural gas	6,019r	6,287r	6,255r	6,572r	6,613
Refinery gas	-	-	-	-	-
Renewable fuels *(2)*	884	657	1,088	719r	732
Other fuels *(1)*	5	-	0	0r	0
Total transport, commerce and administration	**6,925r**	**6,956r**	**7,377r**	**7,331r**	**7,397**
Other *(3)*					
Coal	16	7	3	-	-
Fuel oil	0	2	-	0	2
Gas oil	10	14	13	10r	13
Natural gas	2,528r	2,530	2,768	2,793r	3,119
Renewable fuels *(2)*	1,824	1,886	2,148	2,134r	2,133
Other fuels *(1)*	10	244	213	201r	273
Total other	**4,389r**	**4,683**	**5,144**	**5,139r**	**5,540**
Total - all sectors					
Coal	**2,035**	**2,012**	**1,249**	**577**	**484**
Fuel oil	**1,248**	**350**	**260**	**291r**	**280**
Gas oil	**156**	**820**	**992**	**895r**	**802**
Natural gas	**69,844r**	**63,352r**	**60,397r**	**58,186r**	**60,114**
Blast furnace gas	**1,892**	**2,169**	**2,114**	**2,001**	**1,317**
Coke oven gas	**829**	**719**	**670**	**581**	**370**
Refinery gas	**4,329**	**4,519**	**4,650**	**4,911r**	**4,665**
Renewable fuels *(2)*	**7,268**	**7,856**	**9,298**	**9,097r**	**9,809**
Other fuels *(1)*	**8,100**	**6,633**	**6,577**	**6,130r**	**6,285**
Total CHP fuel use	**95,701r**	**88,430r**	**86,207r**	**82,669r**	**84,125**

(1) Other fuels include: process by-products.
(2) Renewable fuels include: sewage gas, other biogases, municipal solid waste and refuse derived fuels.
(3) Sectors included under Other are agriculture, community heating, leisure, landfill and incineration.

7.10 Large scale CHP schemes in the United Kingdom
(operational at the end of December 2016)(1)

Company Name	Scheme Location	Installed Capacity (MWe) (2)
Adm Erith Ltd	Erith Oil Works	14
Agrivert Ltd	Cassington Ad	2
Agrivert Ltd	Wallingford Ad	2
Atkins Power	Hedon Salads - Burstwick	7
Atkins Power	Hedon Salads - Newport	4
Balcas Limited	Laragh	3
Balcas Timber Ltd	Balcas Invergordon	9
Barkantine Heat & Power Company	Barkantine, Barkantine Heat & Power Company	1
Basf Performance Products	Water Treatments, Basf Plc	16
Birds Eye Limited	Birds Eye Limited, Lowestoft	3
Boortmalt	Boortmalt - Bury St Edmunds	5
Briar Chemicals Ltd	Briar Chemicals Ltd	4
British Sugar Plc	BURY ST EDMUNDS SUGAR FACTORY	77
British Sugar Plc	Cantley Sugar Factory	15
British Sugar Plc	Wissington Sugar Factory, British Sugar Plc (Chp 2)	93
Cambridge University Hospitals Foundation Trust	Addenbrookes Hospital	4
Cantelo Nurseries	Bradon Farm	10
Cargill Plc	Cargill Manchester Chp 2	28
Carillion Services Ltd, Ta Carillion Health	Queen Alexandra Hospital	3
Cereal Partners Uk	Cereal Partners Uk	5
Cereal Partners Uk	Cereal Partners Uk	5
Chichester Power Ltd	Chichester Power	8
City West Homes Limited	Pump House	3
Cleveland Potash Limited	Boulby Mine. Cleveland Potash Limited	13
Cofely IES	COFELY HUMBER ENERGY	46
Cofely Ltd	Trafford Park, Kellogg Company Of Great Britain	5
Cofely Ltd	Rampton Hospital	1
Community Energy	Citigen_2	9
Contourglobal Solutions (Northern Ireland) Ltd	KNOCKMORE HILL CHP, CONTOURGLOBAL SOLUTIONS (NORTH	15
Cyclerval Uk Ltd	Newlincs Efw, Newlincs Development Ltd	3
Cynergin Projects Limited	Villa Nursery Limited	1
Dalkia	FREEMAN HOSPITAL	4
Dalkia	ROYAL VICTORIA INFIRMARY	4
Dalkia Plc	Lincoln County Hospital	1
Dalkia Utilities Services	Eli Lilly & Co Ltd	10
De La Rue Overton	Overton Mill, De La Rue International Ltd	7
Ds Smith Paper Ltd	Kemsley Chp	81
Dsm Nutritional Products (Uk) Ltd	Dsm Dalry	46
Dwr Cymru Welsh Water	Cardiff Wwtw, Dwr Cymru Welsh Water	5
Dwr Cymru Welsh Water	Five Ford Wwtw	1
E.On	Nufarm Uk Limited	5
East Sussex Healthcare Trust	Eastbourne District General Hospital	1
Eco Sustainable Solutions Ltd	Eco Piddlehinton Ad	1
Engie	The Heat Station (Chp 2)	7
Engie	DOW CORNING CHP	27
Engie	Mod Main Building, Cofely Limited	5
Engie	Soas Chp, The Boiler House	1
Engie	Icc Energy Centre	3
Engie	Aston University Energy Centre, Aston University	3
Engie	Birmingham Childrens Hospital	2
Engie	Ldec-City Centre And Leicester East	3
Engie	Ldec-Leicester North	2
Enviroenergy	London Road Heat Station	11
Eon	Queens Medical Centre Nhs Trust	5
Eon Uk	Citigen Chp, Citigen (London) Limited	16
Esso Petroleum Company Limited	Fawley Cogen	316
Fine Organics Limited	Fine Organics Limited	4
Frimley Health Nhs Foundation Trust	Frimley Park Hospital	1
G4 Power Grid Ltd	Brookenby Power Station	2
Genzyme Ltd	Genzyme Ltd	1

For footnotes see page 222

7.10 Large scale CHP schemes in the United Kingdom
(operational at the end of December 2016)[1] *(continued)*

Company Name	Scheme Location	Installed Capacity (MWe) *(2)*
Glasshouse Generation Limited	Glasshouse Energy Centre	11
Glaxosmithkline	GLAXOSMITHKLINE (ULVERSTON)	2
Glaxosmithkline	Glaxosmithkline Montrose	1
Glaxosmithkline	GLAXOSMITHKLINE, IRVINE	4
Glaxosmithkline	Barnard Castle	2
Glaxosmithkline Research & Development Ltd	GSK R & D Ware	4
Glaxosmithkline Research & Development Ltd	Stevenage R&D	4
Great Ormond Street Hospital	Great Ormond Street Hospital	1
Gsk	Glaxosmithkline, Ware	2
Heathcoat Fabrics Ltd	Heathcoat Fabrics Limited	1
Helix Agencies Limited	Natural History Museum	2
Helix Agencies Limited	Blackpool Victoria Hospital	1
Iggesund Paperboard (Workington) Ltd	Iggesund Paperboard (Workington) Ltd	50
Inbev Uk Ltd	Samlesbury Brewery, Inbev Uk Ltd	7
Inbev Uk Ltd	Magor Brewery, Inbev Uk Ltd	7
Ineos Runcorn (Tps) Limited	Runcorn Energy From Waste Facility, Ineos Runcorn (Tps) Ltd	37
Inovyn Chlorvinyls Ltd	Inovyn Chlorvinyls Ltd	10
Inovyn Chlorvinyls Ltd	Gas Engine Chp	2
Integrated Energy Utilities Limited	Stockethill Chp2	1
Integrated Energy Utilities Limited	Seaton Energy Centre, Aberdeen Heat & Power	2
Integrated Energy Utilities Ltd	Callendar Park Energy Centre, Falkirk Council	1
Integrated Energy Utilities Ltd	Tillydrone Chp	1
Jacobs Douwe Egberts	Jde Banbury	8
Jaguar Land Rover Limited	Castle Bromwich, Jaguar Land Rover Ltd	6
Jaguar Landrover	Landrover Group - Solihull North Works	3
Jaguar Landrover	Landrover - Solihull Paint Shop 21	3
James Cropper Plc	James Cropper Plc	7
John Thompson And Son Ltd	John Thompson & Sons Limited	4
Johnson Matthey	Johnson Matthey Enfield	3
Johnson Matthey	Johnson Matthey - Royston	6
Kodak Alaris Limited	Harrow Site, Kodak Alaris Limited	12
Lawrence Automotive Interiors (Vmc) Ltd	Browns Lane, Lawrence Automotive Interiors (Vmc) Ltd	3
London Borough Of Islington	Bunhill Heat And Power	2
Loughborough University	Central Park	2
Lucozade Ribena Suntory Ltd	Coleford	5
Medway Nhs Foundation Trust	Medway Hospital, Medway Maritime Hospital	1
Mill Nurseries Ltd	Mill Chp, Mill Nurseries	14
Nestle Uk Ltd	Nestle York	10
Nhs Grampian	Aberdeen Royal Infirmary	5
North Tees & Hartlepool Nhs Foundation Trust	University Hospital Of North Tees	2
Northumbrian Water	Levenmouth Waste Water Treatment Works	3
Northumbrian Water Ltd	Bran Sands (Biogas)	5
Northumbrian Water Ltd	Howdon Stw	6
Northwood & Wepa Ltd	Bridgend Chp	9
Novartis Grimsby Ltd	Novartis Grimsby Limited	8
P3P Energy Management Ltd. On Behalf Of Brehon Proper	Europa Nursery - Ash	15
P3ppartners LLP	Woodhouse Nurseries	3
Peel Utilities Holdings Limited	Media City, Utilities (Media City Uk) Ltd	2
Powell Energy	St. Georges Hospital	4
Preston Board And Packaging Ltd	Romiley Board	1
Reckitt Benckister	Kwe Hull	2
Reg Bio Power Ltd	Bentwaters Chp	6
Rotherham General Hospital Nhs Trust	Rotherham District General Hospital	1
Royal Devon And Exeter Foundation Trust	ROYAL DEVON AND EXETER HOSPITAL WONFORD	1
Rwe Npower	Basf Chp	98
RWE Npower Cogen Ltd	Markinch CHP	65
Ryobi Aluminium Casting (Uk) Ltd	Ryobi	1
Saria Ltd	Re-Food Ad Plant Saria Ltd	5
Scottish And Southern Energy	Slough Nurseries, G & C Properties	2
Sellafield Ltd	Combined Heat And Power Plant F238	193
Slough Heat & Power Ltd	Slough Power Station	21
Smurfit Kappa Ssk	Smurfit Kappa Ssk Limited	9

For footnotes see page 222

7.10 Large scale CHP schemes in the United Kingdom
(operational at the end of December 2016)[1] *(continued)*

Company Name	Scheme Location	Installed Capacity
Solvay Solutions Uk Ltd	Oldbury	2
Southern Water Services	Ashford Stc	2
Southern Water Services	Millbrook Wtw, Southern Water	1
Southern Water Services	Budds Farm Wtw, Southern Water	2
Springfields Fuels Ltd	Springfields	12
Swansea University	Swansea University	2
Tata Chemicals Europe	Winnington Chp	103
Tate & Lyle Sugars Ltd	Thames Refinery, Tate And Lyle New Scheme	28
Thames Water Utilities Ltd	Maple Lodge Stw	4
Thames Water Utilities Ltd	Swindon Stw Chp 2015	1
Thames Water Utilities Ltd	Long Reach Stw	3
Thames Water Utilities Ltd	Mogden Stw	10
Thames Water Utilities Ltd	Beddington Stw	2
Thames Water Utilities Ltd	Deephams Stw 2016	3
Thames Water Utilities Ltd	Deephams Stw	3
Thames Water Utilities Ltd	Ryemeads Stw	1
Thames Water Utilities Ltd	Slough Stw Chp 2015	1
Thames Water Utilities Ltd	Oxford Stw	2
Thames Water Utilities Ltd	Crawley Stw	1
Thames Water Utilities Ltd	Reading (Island Road) Stw	1
Thames Water Utilities Ltd	Chertsey Stw	1
Thames Water Utilities Ltd	Riverside Stw	6
Thames Water Utilities Ltd	Beckton Stw Biogas Chp	6
Thames Water Utilities Ltd	Crossness Stw Biogas Chp	6
Thameswey Central Milton Keynes Ltd	Woking Town Centre Phase I	1
Thameswey Central Milton Keynes Ltd	Tcmk Phase 1 Chp No 2 Gas Engine	6
The University Of Birmingham	The University Of Birmingham Scheme Ref 740A	4
The University Of Bradford	Richmond Boiler House	2
Transport For London	PALESTRA, TRANSPORT FOR LONDON	1
University College London	University College London, Gower Street Heat And Power Ltd	3
University Of Aberdeen	OLD ABERDEEN CAMPUS	2
University Of Bristol	University Of Bristol Chp 2	1
University Of Dundee	University Of Dundee, Main Chp Boilerhouse	4
University Of East Anglia	University Of East Anglia	5
University Of Edinburgh Utilities Supply Company	Kings Buildings	3
University Of Edinburgh Utilities Supply Company	George Square Energy Centre	2
University Of Liverpool	University Of Liverpool Chp 2	7
University Of Reading	Whiteknights Energy Centre	1
University Of Southampton	UNIVERSITY OF SOUTHAMPTON	3
University Of Surrey	UNIVERSITY OF SURREY	1
University Of Sussex	UNIVERSITY OF SUSSEX	1
University Of Warwick	CHP BOILERHOUSE (CHP 2), UNIVERSITY OF WARWICK	4
University Of Warwick	Cryfield Energy Centre	4
University Of York	University Of York	3
Unversity Of Edinburgh Utilities Supply Company	Holyrood Energy Centre	1
Upm-Kymmene (Uk)	Upm Shotton	22
Veolia Environmental Services Plc	SHEFFIELD ERF	21
Vinnolit Hillhouse Ltd	Hillhouse International Business Park	5
Vital Energi	South Kensington Campus Chp Plant	9
Vital Energi	York Teaching Hospital	1
Vital Energi	Cheltenham General Hospital	1
Weetabix Ltd	Weetabix Limited	6
Wessex Water Services Ltd	Bristol Waste Water Treatment Works Scheme A	6
Total *(2)*		**2,036**
Electrical capacity of good quality CHP for these sites in total		**1,844**

(1) These are sites of 1 MW installed electrical capacity or more that either have agreed to be listed in the Ofgem register of CHP plants or whose details are publicly available elsewhere, or who have provided the information directly to BEIS It excludes CHP sites that have been listed as major power producers in Table 5.10.

(2) This is the total power capacity from these sites and includes all the capacity at that site, not just that classed as good quality CHP under CHPQA.