Chapter 7
Combined heat and power

Key Points

- The Good Quality CHP capacity increased by 210 MWe between 2016 and 2017 from 5,625 MWe to 5,835 MWe. (Table 7A)
- The amount of good quality electricity produced in 2017 was 21.6 TWh (Table 7.4), which is 6.1 per cent higher than in 2016. The good quality electricity generated by CHP in 2017 corresponds to 6.4 per cent of all electricity generated in the UK.
- Sixty-nine percent of the fuel used in CHP schemes in 2017 was natural gas. This is 2.4 percentage points lower than in 2016. In 2017, the share of total fuel that was renewable was 16.5 per cent, a 3.3 percentage point increase between 2016 and 2017.
- The Oil and Gas sector has the largest Good Quality CHP capacity (38 per cent), followed by the Chemicals sector (19 per cent), Other sector (12 per cent) and then the Transport Commerce and Administration sector (9.1 per cent).
- The absolute CO_2 savings delivered by CHP in 2017 were lower than in 2016. This is due to the provisional values for CO_2 intensity of electricity displaced by CHP electricity being lower in 2017 than in 2016, 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, Rankine cycle turbine using steam or organic fluids and, more recently, steam screw expanders) 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 (via absorption chillers).

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, which currently represent about 7.5 per cent of electricity demand in the UK. These gains are reflected in the calculation of CO_2 savings delivered by CHP (see paragraphs 7.29-7.30). CHP can also provide important network services such improvements to power quality, and some have the ability to operate in island mode if the grid goes down. There are six principal types of CHP system: steam turbine, gas turbine, combined cycle systems, reciprocating engines, Organic Rankine Cycle (ORC) and steam expander systems. Each of these is defined in paragraph 7.37 later in this chapter.

[1] *But not always, see paragraph 7.6. In such cases there is an impact upon the electrical capacity and electrical output classified as CHP.*

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 spread (i.e. the difference between the price of electricity and the price of the gas required to generate that electricity). The larger the spark spread the more favourable are the economics of CHP operation. At the start of 2013 the spark spread started to increase and did so each quarter until the middle of 2016. Since that time, the spark gap has fluctuated in magnitude up and down. Over the last 10 years the spark spread peaked at 5.2 (Q3 of 2016) and was at a minimum of 3.0 (Q1 2013). In Q4 2017 it stood at 4.6.

7.5 The effect of the introduction of a specific solid biomass CHP Renewable Heat Incentive (RHI) tariff for installations commissioned after May 2014 has encouraged the commissioning of a growing number of units based on Organic Rankine Cycle (ORC) and steam screw expander technologies. Statistics tables 7.3 to 7.7 now include a specific entry for schemes based on ORC technology, reflecting this development. These technologies are described in paragraph 7.37.

Use of CHPQA in producing CHP statistics

7.6 The CHPQA programme is the major source for CHP statistics. CHPQA schemes accounted for 92 per cent of the capacity reported in this chapter for 2017. 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[2], 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 2017 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. There may not be demand for all of the available heat from such schemes. 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 schemes, 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 undergone a modest increase since then. In 2016 there was an appreciable upturn in Load Factor (Actual), which was due to a number of large CHP generators in the Chemicals and Oil Refineries sectors increasing their production of electricity. Load Factor (Actual) in 2017 was lower than in 2016 but is still higher than at any time since 2011.

2 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	2013	2014	2015	2016	2017
Number of schemes		2,024	2,071	2,130	2,224	2,386
Net No. of schemes added during year (2)		84	47	59	94	162
Electrical capacity (CHP_{QPC})	MWe	5,919	5,888	5,708	5,625	5,835
Net capacity added during year		-45	-32	-179	-83	209
Capacity added in percentage terms	Per cent	-0.8	-0.5	-3.0	-1.5	3.7
Heat capacity	MWth	22,161	22,223	20,091	19,795	20,191
Heat to power ratio *(3)*		2.27	2.13	2.06	1.99	1.95
Fuel input *(4)*	GWh	88,403	86,184	82,576	85,123	90,279
Electricity generation (CHP_{QPO})	GWh	19,515	19,690	19,534	20,405	21,648
Heat generation (CHP_{QHO})	GWh	44,342	41,950	40,234	40,670	42,238
Overall efficiency *(5)*	Per cent	72.2	71.5	72.4	71.7	70.8
Load factor (CHPQA) *(6)*	Per cent	37.6	38.2	39.1	41.4	42.4
Load factor (Actual) *(7)*	Per cent	51.7	52.3	51.0	60.0	56.4

(1) Data in this table for 2013 and 2016 have been revised since last year's Digest as more up to date information on the performance and status of some CHP schemes has become available.
(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) Fuel input is the fuel deemed to have generated the qualifying power output (QPO) and qualifying heat output (QHO).
(5) Overall efficiencies are calculated using qualifying power output (QPO), qualifying heat output (QHO) and fuel input. Fuel input is expressed in Gross Calorific Value (GCV) terms. When fuel input is expressed in Net Calorific Value (NCV) terms, efficiencies will be higher.
(6) The load factor (CHPQA) is based on the qualifying power output (QPO) and qualifying power capacity (QPC) and does not correspond exactly to the number of hours run by the prime movers in a year.
(7) The load factor (Actual) is based on the total power generated and total capacity.

Efficiency of CHP schemes

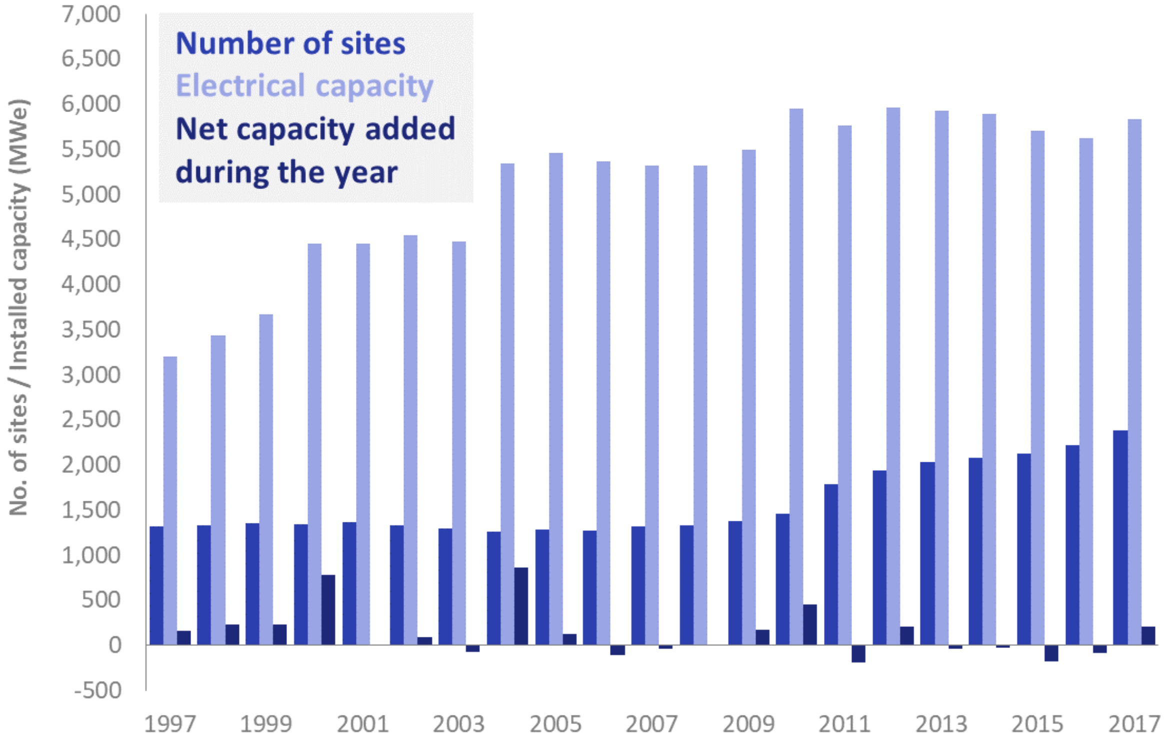
7.7 Good Quality CHP denotes schemes that have been certified as being highly efficient through the UK's CHP Quality Assurance (CHPQA) programme. The criteria used are in line with the requirements for high efficiency CHP set down in the Energy Efficiency Directive (2012/27/EU). A Good Quality CHP scheme, 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. Good Quality CHP schemes with installed capacity <1 MWe must achieve primary energy savings greater than zero per cent.

Changes in CHP capacity

7.8 Chart 7.1 shows the change in installed CHP capacity since 2001, when the CHPQA programme began. Installed capacity at the end of 2017 stood at 5,835 MWe, an increase of 209 MWe (3.7 per cent) compared to 2016. There was also a net increase of 162 (7.3 per cent) in the number of schemes between 2016 and 2017. Overall, between 2016 and 2017, there were 194 new schemes included in the database and a removal of 32 schemes. There have been revisions to the capacity figures for 2013 to 2016 shown in the previous edition of the Digest, as more up to date information on the performance and operational status of some schemes has become available.

7.9 For the first time it has been possible to include in the statistics a number of CHP schemes fuelled by biogas generated by anaerobic digesters which do not submit to CHPQA. These particular schemes are included on the basis that food waste makes up part of the composition of the feedstock and that, therefore, pasteurisation of the feedstock, or digestate, is required. As stated in paragraph 7.1, where data from sources other than CHPQA are used, the CHPQA methodology is nevertheless used to determine the qualifying capacities, fuel inputs, power and heat outputs, which are reported in this chapter. Under CHPQA, heat is only counted if it is deemed "useful heat". Useful heat from CHP is heat that is demonstrably utilised to displace heat that would otherwise be supplied from other sources. In the absence of CHP heat, heat to carry out the necessary pasteurisation of the feedstock or digestate, where the feedstock includes food waste, would have to come from another source. As such, at least some of the heat output from these particular CHP schemes is deemed useful heat, and so these schemes are included in the statistics. It is possible to include these schemes now because robust information has become available about the composition of the feedstock to the digesters. These schemes are included in the statistics just for year of operation 2017 and have not been added retrospectively.

Chart 7.1: Operating CHP capacity by year



7.10 Table 7A gives a summary of the overall CHP market. In 2017, CHP schemes generated 21,648 GWh of Good Quality electricity, 6.1 per cent higher than in 2016. This generated electricity represents 6.4 per cent of the total electricity generated in the UK. Virtually all of this increase in Good Quality outputs may be attributed to the inclusion in the statistics for the first time of a number of CHP schemes running on biogas generated by anaerobic digestion plant, as explained in paragraph 7.9. The quantity of Good Quality electricity generated in industry was more or less unchanged between 2016 and 2017. However, at the individual industrial sector level, there were more notable changes. For example, there was a 9.6 per cent increase in Good Quality power outputs in the Food and Drink sector, but a 5.2 per cent and 26 per cent decrease in the Iron and Steel and Non-ferrous sector. The Transport, Commerce and Administration (TCA) sector continued its more or less uninterrupted, gradual rise in Good Quality power outputs. In the Other sector, the output of Good Quality power outputs increased significantly between 2016 and 2017, and this is due to the inclusion of a number of CHP schemes based on food waste fed anaerobic digestion (see paragraph 7.9 for further information).

7.11 Table 7A shows that CHP schemes supplied a total of 42,238 GWh of heat in 2017. This was an increase of 3.9 per cent (1,568 GWh) compared to 2016. There were two notable components to this increase, one is the inclusion in the statistics for the first time of some CHP schemes fuelled by biogas from anaerobic digestion plant (contributing 421 GWh to the increase – see paragraph 7.9 for further information) and the other was a 777 GWh increase from industrial CHP. This increase in heat output from industrial CHP breaks a ten-year downward trend in industrial heat output from CHP. There were modest relative increases in the heat output from the Chemicals, Oil Refineries and Paper sectors, with a more significant increase (6.2 per cent) increase from the Food and Drink sector. The heat output from CHP in the Transport, Commerce and Administration (TCA) sector continued its long term upward trend, with an increase of 2.8 per cent between 2016 and 2017.

7.12 In terms of electrical capacity by size of scheme, schemes larger than 10 MWe represent 72 per cent of the total electrical capacity of CHP schemes as shown in Table 7B. Schemes less than 1 MWe constitute the majority of scheme numbers (79 per cent), but just 6.3 per cent of the total capacity. Table 7.5 provides data on electrical capacity for each type of CHP installation.

Table 7B: CHP schemes by capacity size ranges in 2017

Electrical capacity size range	Number of schemes	Share of total (per cent)	Total electricity capacity (MWe)	Share of total (per cent)
Less then100 kWe	605	25	36	0.6
100 kWe - 1 MWe	1,291	54	331	5.7
1 MWe - 2 MWe	183	7.7	259	4.4
2 MWe - 10 MWe	240	10	1,027	18
> 10 MWe +	67	2.8	4,181	72
Total	**2,386**	**100**	**5,835**	**100**

7.13 Table 7.5 shows that 58 per cent of total electrical capacity is in combined cycle gas turbine (CCGT) mode and 26 per cent is from reciprocating engines. In 2007 these proportions were 74 per cent and 12 per cent, respectively. These changes are explained by an absolute fall in the CCGT capacity and an absolute increase in reciprocating engine capacity. There were significant falls in CCGT capacity in the Chemicals and Paper sectors, while there was an increase in reciprocating engine capacity across all but one sector during this period. These changes in technology over time also explain changes in the distribution of capacity within capacity ranges, as shown in Table 7B across different editions of the Digest. As CCGT capacity has been lost, the proportion of total capacity in the size range >10 MWe has decreased from 82 percent in 2007 to 72 per cent in 2017. Over the long term there has been a fall in the proportion of overall capacity that is back pressure steam turbine, as this relatively inefficient and inflexible technology is phased out. In recent years there has been an increase in pass out condensing steam turbine capacity, as more biomass and waste fuelled CHP schemes have been brought on line.

7.14 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 2017 there were 517 such schemes registered with Ofgem for FiTs with a total installed capacity of 545 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.

7.15 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 from the following link:
www.gov.uk/government/publications/combined-heat-and-power-statistics-data-sources-and-methodologies

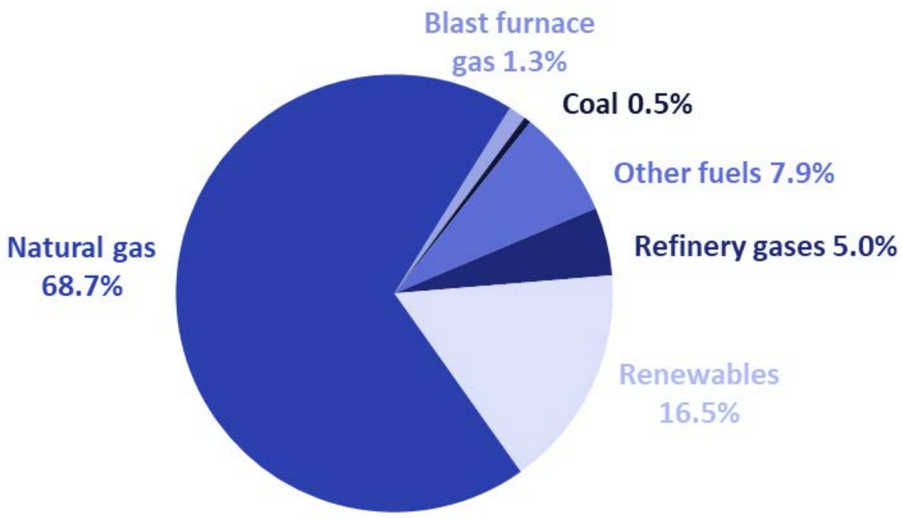
Fuel used by types of CHP installation

7.16 Table 7.2 shows the fuel used to generate electricity and heat in CHP schemes (see paragraphs 7.38 to 7.40 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 7.37). Total fuel use is summarised in Chart 7.2. In 2017, 69 per cent of the total fuel use was natural gas. This is a decrease of 2.4 percentage points compared with 2016. CHP schemes accounted for 7.1 per cent of UK gas demand in 2017 (see Table 4.1). The use of coal and fuel oil is now less than 1 per cent of overall fuel use.

7.17 The proportion of total fuel consumption that was renewable increased between 2016 and 2017 from 13 per cent to 16 percent of the total. This increase is substantially due to the inclusion of a number of CHP schemes fuelled by biogas generated by anaerobic digestion fed with food waste (see paragraph 7.9 for detailed explanation). Gaseous renewable fuels constitute the single largest type of renewable fuel (45 per cent), followed by biomass fuels (34 per cent) and waste fuels (20 per cent), with the balance being liquid renewable fuels.

7.18 Fuels which are liquids, solids or gases that are by-products or waste products from industrial processes, or are renewable fuels, accounted for 30 per cent of all fuel used in CHP in 2017. This is 2.5 percentage points higher than in 2016, and this is mainly due to the increase in the consumption of renewable fuel included in this chapter, as discussed in paragraphs 7.9 and 7.17.

Chart 7.2: Types of fuel used by CHP schemes in 2017



CHP capacity, output and fuel use by sector

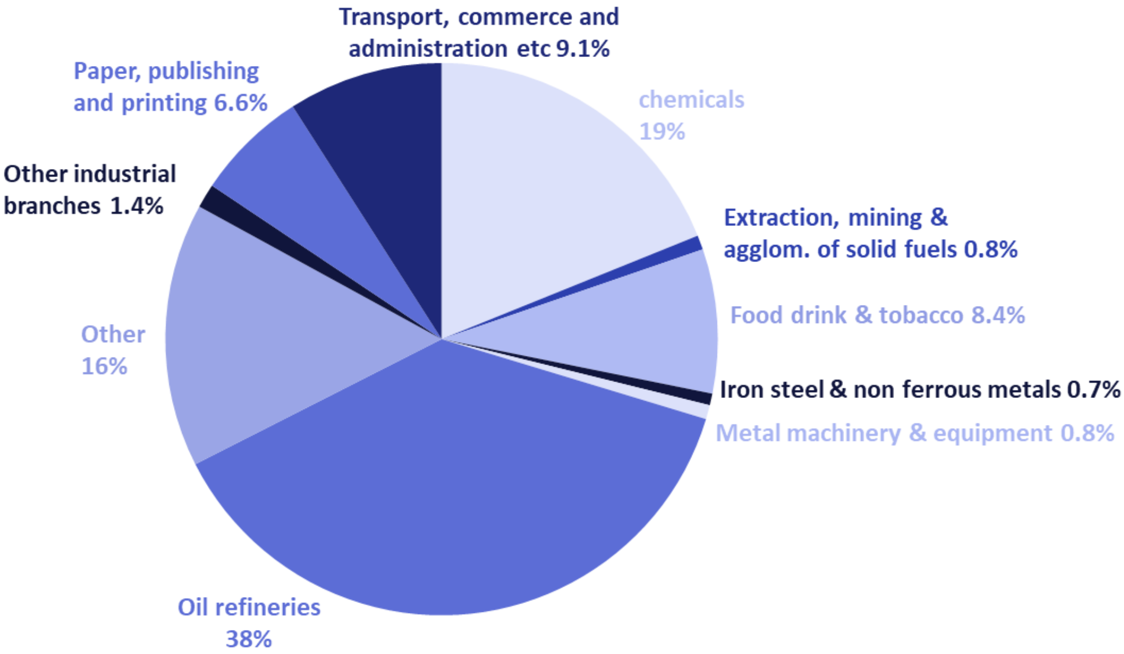
7.19 In this chapter of the Digest, CHP is analysed by the sector using the heat or, where the heat is used by more than one sector, by the sector using the majority of the heat. This method of assigning a CHP scheme to a sector was rigorously applied for the first time in the 2008 edition of the digest 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.

7.20 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:

- 400 schemes (79 per cent of electrical capacity) are in the industrial sector and 1,986 schemes (21 per cent of capacity) are in the agricultural, commercial, public administration, residential and transport sectors. The share of capacity in the industrial sector was 3.8 percentage points lower in 2017 than in 2016. This continues a long-standing trend of a shrinking proportion of total CHP capacity being installed at industrial sites.
- The share of total installed Good Quality capacity taken up by each sector is shown in Chart 7.3. The Oil and gas terminals sector, which has been the largest sector since 2009, continues to have the largest share of total installed capacity, accounting for 38 per cent of all capacity. The Chemicals sector has the second highest share of total installed capacity (19 per cent) followed by the "Other" sector (12 per cent) and Transport, commerce and administration (TCA) at 9.1 per cent. The "Other" sector has overtaken TCA to occupy third position due to the inclusion for a number of anaerobic digestion CHP schemes (see paragraph 7.9 for detailed explanation).

Between 2016 and 2017 the following sectors saw a decrease in installed Good Quality capacity: Chemicals, Oil and gas terminals, Mineral products and Sewage treatment works. There were modest increases in the Paper, Food and drink and Metal products sectors.

Chart 7.3: CHP electrical capacity by sector in 2017



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

7.21 Table 7C gives a summary of the 1,649 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 (32 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 2017

	Number of schemes	Electrical capacity (MWe)	Heat capacity (MWth)
Leisure	545	71	121
Hotels	282	41	67
Health	231	188	1050
Residential Group Heating	122	96	420
Universities	99	102	521
Offices	43	17	29
Education	61	15	50
Government Estate	32	14	48
Retail	230	46	74
Other *(1)*	4	2.6	19
Total	**1,649**	**593**	**2,399**

(1) All schemes under Other are at airports

7.22 According to the Energy Performance in Buildings Directive, District Heating and Cooling (DHC) 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. For statistical purposes, EUROSTAT further stipulates that, as well as more than one building or site having to be supplied, there must also be more than one customer for the heating or cooling supplied. Comprehensive data on Community Heating (CH) and District Heating (DH) schemes in the United Kingdom became available for the first time in 2017 when data submissions, made to the Office of Public Safety and Standards, as required under Article 3 of The Heat Network (Metering and Billing) Regulations 2014, were processed. Using these data and adopting the EUROSTAT definition of DH, in 2015 there were approximately 246 DH schemes using CHP in the UK, with a heat capacity of 5,619 MWth and supplying 7,099 GWh of heat to their associated DH networks[3].

CHP performance by main prime mover

7.23 Table 7D gives a summary of the performance of schemes in 2017 by main prime mover type. In 2017 the prime mover type with the highest average operating hours was gas turbines followed by reciprocating engines.

7.24 In 2017, the average operating hours were 3,710 hours. The average operating hours in 2016 (revised) was 3,627 hours, indicating a slight increase in the utilisation of good quality capacity between the two years. These are the highest average operating hours since 2012.

7.25 In 2017, the average electrical efficiency was 24 per cent and the heat efficiency 47 per cent, giving an overall average of 71 per cent. This is 1.0 percentage points lower than the revised figure for 2016. Overall efficiency is simply the sum of the individual electrical and heat efficiencies.

Table 7D: A summary of scheme performance in 2017

	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
Main prime mover in CHP plant					
Back pressure steam turbine	2,141	8.5	75	84	8.9
Pass out condensing steam turbine	3,682	15	38	53	2.5
Gas turbine	5,210	23	50	72	2.2
Combined cycle	3,545	25	49	74	2.0
Reciprocating engine	3,870	31	37	67	1.2
Organic Rankine Cycle	3,213	9.0	55	64	6.1
All schemes	**3,710**	**24**	**47**	**71**	**2.0**

CHP schemes which export and schemes with mechanical power output

7.26 Table 7E shows the electrical exports from CHP schemes between 2015 and 2017. 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

[3] When comparing these statistics with other sources, care is required to ensure that the same definition of District Heating (DH) is being used.

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 2015, 2016 and 2017, as shown below.

Table 7E: Electrical exports from CHP (TPO)

GWh

	2015	2016	2017
To part of same qualifying group *(1)*	582	775	1,129
To a firm NOT part of same qualifying group	9,365	10,040(r)	9,675
To an electricity supplier	12,596(r)	17,931(r)	15,725
Total	**22,544(r)**	**28,747(r)**	**26,528**

(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

	2015	2016	2017
To part of same qualifying group *(1)*	343	267	262
To a firm NOT part of same qualifying group	3,908	4,536(r)	4,446
To an electricity supplier	3,482	3,900(r)	3,918
Total	**7,733**	**8,703(r)**	**8,626**

There was a significant increase in the power exports in 2016 relative to 2015, both for total power exports (TPO) and Good Quality (QPO) power exports. Although there was a drop off in 2017, both the TPO and QPO exported is appreciably higher in 2017 than it was in 2015. This is consistent with the step up in Load Factor (Actual) and Load Factor (CHPQA) between 2015 and 2016, which has only dropped off slightly in 2017, caused by some large power exporting CHP schemes generating more power post 2015.

7.27 In 2017, 54 large schemes exported heat, with some exporting to more than one customer. In 2016 there were 52 schemes exporting heat. As Table 7G shows, these schemes supplied 9,802 GWh of heat in 2017, which is a 6.6 per cent increase on the revised 2016 figure.

Table 7G: Heat exports from CHP

GWh

	2015	2016	2017
To part of same qualifying group *(1)*	760	961	949
To a firm NOT part of same qualifying group	7,670(r)	8,207(r)	8,783
To an electricity supplier	4(r)	25(r)	70
Total	**8,333(r)**	**9,193(r)**	**9,802**

(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.

7.28 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 statistics on schemes with mechanical power are substantially unchanged from those for 2016, published in the previous edition of the Digest.

Table 7H: CHP schemes with mechanical power output in 2017

	Unit	
Number of schemes		10
Total Power Capacity of these schemes (CHP_{TPC})	MWe	2,157
Mechanical power capacity of these schemes	MWe	203

7.29 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] (www.decc.gov.uk/en/content/cms/statistics/publications/trends/trends.aspx). 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 2017 as compared to the fossil fuel basket were 10.70 $MtCO_2$, which equates to 1.83 Mt CO_2 per 1,000 MWe installed capacity. Against the total basket, CHP saved 4.91 Mt CO_2 which equates to 0.84 Mt CO_2 per 1,000 MWe installed capacity.

7.30 Corresponding figures for 2015 and 2016 are shown in Table 7I. The 2015 and 2016 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. When measured against the total basket of grid electricity (i.e. including nuclear

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

and renewables) both the absolute and relative CO_2 savings delivered by CHP fell each year between 2015-2017. This is in spite of an increase in CHP power and heat outputs over this period and is explained by a 30 per cent decrease in the carbon intensity of all grid electricity over this relatively short period. Over the longer term, this downward trend in absolute and relative savings (when measured against the total basket) has been unbroken since 2012, when the CO_2 intensity of the total basket was more than double what it was in 2017. There has been a similar downward (though not unbroken) trend in savings since 2012 (when measured against the fossil fuel basket) when the CO_2 intensity of fossil fuel generated electricity was 45 per cent higher than it was in 2017, owing to an increasing proportion of fossil fuel generated electricity coming from natural gas.

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

	2015		2016		2017	
	$MtCO_2$	$MtCO_2$/1000 MWe	$MtCO_2$	$MtCO_2$/1000 MWe	$MtCO_2$	$MtCO_2$/1000 MWe
Carbon savings against all fossil fuels	12.59	2.21	10.20	1.81	10.70	1.83
Carbon savings against all fuels (including nuclear and renewables)	6.47	1.13	5.09	0.90	4.91	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 2017 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 2015 and 2016 have also been revised in response to changes in the CO_2 intensity factors for electricity for these years since reporting in DUKES 2017.The figures have also been revised to reflect revisions to CHP electricity and heat output and fuel consumption.

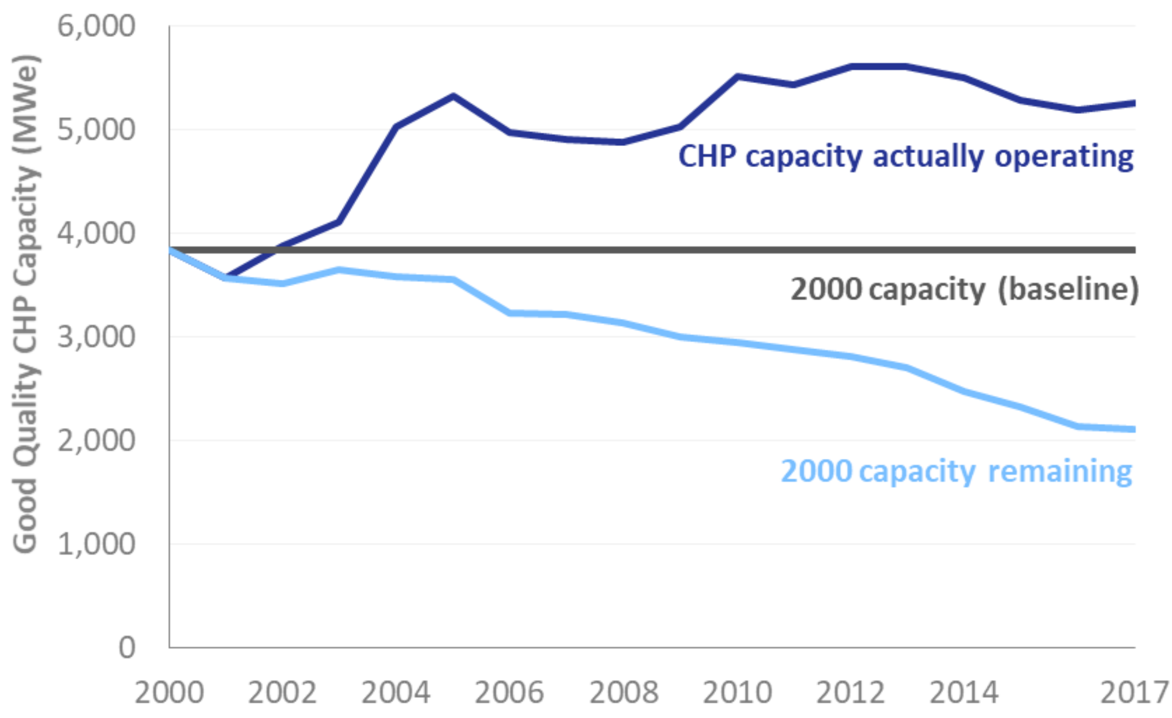
Government policy towards CHP

7.31 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.

7.32 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 2017 there had been just over 3.1 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

7.33 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 a preliminary free allocation which is 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 a preliminary free allocation which is 100% of the allocation determined using the benchmark for the duration of Phase III of EU ETS[5]. 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[6].

5 In determining the final free allocation received by the installation, the preliminary free allocation is multiplied by a factor known as the cross-sectoral correction factor. The cross-sectoral correction factor is applied to ensure that the total amount of free allocation does not exceed a certain cap. For EU ETS Phase III, the cross-sectoral correction factor is a factor that is less than 1 and declines linearly from 0.94 to 0.82 between 2013 and 2020. This means that the final free allocation is always less than the preliminary free allocation.

6 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

7.34 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 1.64.

Data for 2017

7.35 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.

7.36 Data for 2017 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-two 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 and FITs information from Ofgem returns. The data from these sources accounts for approximately 6.0 per cent of total electrical capacity. The contribution from this source to the overall CHP statistics is higher than in previous years. The reason for this is explained in paragraph 7.9. 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

7.37 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 pass out 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.

- **Steam screw expander systems** are based upon rotary screw expanders, rather than the turbine blades used in conventional steam turbine systems (see above). This allows power to be generated from wet steam, rather than the superheated dry steam that must be utilised in conventional steam turbines if turbine blade damage is to be avoided. Such systems can, for example, be installed in the place of pressure reduction valves in steam distribution systems, allowing the recovery of energy in the form of mechanical power and the onward supply of steam at the conditions desired downstream.

Determining fuel consumption for heat and electricity

7.38 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.

7.39 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.

7.40 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

7.41 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 419 schemes were scaled back for year of operation 2017. For information, in 2016, 380 schemes (revised) were scaled back.

7.42 In 2017, the power output from these schemes was scaled back from a total of 33,120 GWh to 12,181 GWh. The total fuel input to these schemes was 111,568 GWh of which 55,328 GWh was regarded as being for power only. For 2016, the total power output was scaled back from 35,822 GWh to 12,189 GWh. The scale back of power was greater in 2016 than in 2017 as a number of large schemes generated more power for export in 2016 than in 2017, without a corresponding increase in the useful consumption of heat. This is consistent with the peak in Load Factor (Actual) in 2016 (60.0 per cent).

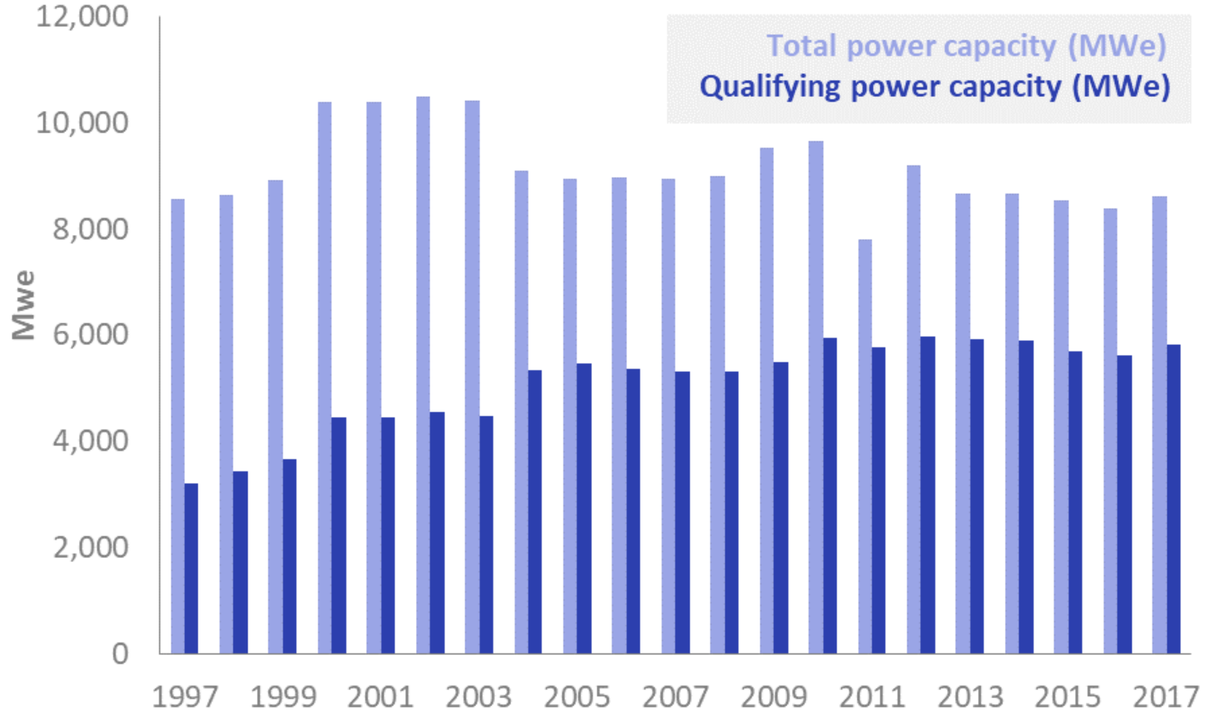
Table 7J: CHP capacity, output and fuel use which has been scaled back in 2017

	Units	
Number of schemes requiring scaling back		419
Total Power Capacity of these schemes (CHP_{TPC})	MWe	6,599
Qualifying Power Capacity of these schemes (CHP_{QPC})	MWe	3,818
Total power output of these schemes (CHP_{TPO})	GWh	33,120
Qualifying Power Output of these schemes (CHP_{QPO})	GWh	12,181
Electricity regarded as "Power only" not from CHP (CHP_{TPO} - CHP_{QPO})	GWh	20,939
Total Fuel Input of these schemes (CHP_{TFI})	GWh	111,568
Fuel input regarded as being for "Power only" use i.e. not for CHP	GWh	55,328

**This figure includes generation from major power producers*

7.43 The evolution of Total Power Capacity (TPC) and Qualifying Power Capacity (QPC) over time is shown in Chart 7.5.

Chart 7.5: Installed CHP capacity by year



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

7.44 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.

Contacts:
Richard Hodges
Ricardo Energy & Environment
Richard.Hodges@ricardo.com
01235 753 047

Liz Waters
BEIS Energy Statistics Team
elizabeth.waters@beis.gov.uk
0300 068 5735

7.1 CHP installations by capacity and size range

	2013	2014	2015	2016	2017
Number of Schemes	**2,029**	**2,076**	**2,130r**	**2,224r**	**2,386**
<= 100 kWe	602	608	615r	642r	669
> 100 kWe to 1 MWe	1,083	1,102	1,129r	1,183r	1,239
>1 MWe to 2 MWe	114	132	141r	151	183
> 2 MWe to 10 MWe	165	169	179r	180	228
> 10 MWe +	65	65	66r	68r	67
Total Capacity	**5,924**	**5,892**	**5,708r**	**5,625r**	**5,835**
<= 100 kWe	39	39	40r	41r	43
> 100 kWe to 1 MWe	273	280	296r	309r	337
>1 MWe to 2 MWe	164	190	206r	218r	271
> 2 MWe to 10 MWe	759	781	818r	824r	1,003
> 10 MWe +	4,689	4,601	4,348r	4,232r	4,181

(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 2017 515 such schemes were registered on Ofgems Central FIT Register totalling 0.54MWe

7.2 Fuel used to generate electricity and heat in CHP installations

GWh

	2013	2014	2015	2016	2017
Fuel used to generate electricity *(1)*					
Coal *(2)*	420	386	137	113	102
Fuel oil	145	120	122r	133r	93
Natural gas	31,314	30,615	30,435r	31,496r	31,797
Renewable fuels *(3)*	4,428	5,374	4,829r	6,393r	9,222
Other fuels *(4)*	4,735	4,773	4,180	3,877r	4,078
Total all fuels	**41,042**	**41,268**	**39,704r**	**42,011r**	**45,291**
Fuel used to generate heat					
Coal *(2)*	1,592	863	439	371	379
Fuel oil	205	140	164r	147r	69
Natural gas	32,038	29,781	27,743r	28,960r	30,127
Renewable fuels *(3)*	3,429	3,924	4,187r	4,799r	5,636
Other fuels *(4)*	10,124	10,230	10,339	8,835r	8,777
Total all fuels	**47,388**	**44,939**	**42,872r**	**43,111r**	**44,988**
Overall fuel use					
Coal *(2)*	2,012	1,249	577	484	480
Fuel oil	350	260	287r	279r	161
Natural gas	63,352	60,397	58,178r	60,456r	61,924
Renewable Fuel o/w;	7,856	9,298	9,016r	11,192r	14,858
Bioliquid	*70*	*62*	*60r*	*82r*	*103*
Biomass	*3,363*	*4,042*	*3,179*	*4,233r*	*5,103*
Waste	*1,205*	*1,691*	*2,011*	*3,039r*	*3,027*
Biogas/Syngas	*3,218*	*3,504*	*3,766r*	*3,837r*	*6,625*
Other Fuels (3)	14,859	15,003	14,519	12,712r	12,855
Total all fuels	**88,430**	**86,207**	**82,576r**	**85,123r**	**90,279**

(1) See paragraphs 7.38 to 7.39 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

	2013	2014	2015	2016	2017
Coal					
Back pressure steam turbine	550	572	577	484	480
Gas turbine	-	-	-	-	-
Combined cycle	1,358	674	-	-	-
Reciprocating engine	1	1	-	-	-
Pass out condensing steam turbine	102	2	-	-	-
Organic Rankine Cycle[1]	-	-	-	-	-
	2,012	**1,249**	**577**	**484**	**480**
Fuel Oil					
Back pressure steam turbine	145	100	95	77	17
Gas turbine	5	3	1	3	1
Combined cycle	56	16	25	65	14
Reciprocating engine	123	122	113r	116r	113
Pass out condensing steam turbine	21	20	52	18r	16
Organic Rankine Cycle[1]	-	-	-	-	-
	350	**260**	**287r**	**279r**	**161**
Natural Gas					
Back pressure steam turbine	2,544	2,079	1,466r	1,118r	1,340
Gas turbine	8,683	8,492	8,555	9,145r	9,468
Combined cycle	42,164	39,617	36,956	37,963r	38,671
Reciprocating engine	9,574	9,988	10,897r	11,986r	12,243
Pass out condensing steam turbine	388	221	305r	245r	201
Organic Rankine Cycle[1]	-	-	-	-	-
	63,352	**60,397**	**58,178r**	**60,456r**	**61,924**
Renewable Fuels *(2)*					
Back pressure steam turbine	1,484	1,081	1,037r	852r	1,099
Gas turbine	12	12	12	12	13
Combined cycle	87	60	67	191r	213
Reciprocating engine	3,226	3,492	3,747r	3,846r	6,657
Pass out condensing steam turbine	3,049	4,654	4,153	6,051r	6,469
Organic Rankine Cycle[1]	-	-	....	241r	407
	7,856	**9,298**	**9,016r**	**11,192r**	**14,858**
Other Fuels *(3)*					
Back pressure steam turbine	1,581	1,634	1,737r	1,678r	1,795
Gas turbine	155	153	212	245	152
Combined cycle	10,306	9,915	9,782	9,153r	9,452
Reciprocating engine	47	68	91	96r	47
Pass out condensing steam turbine	2,771	3,234	2,697r	1,540r	1,410
Organic Rankine Cycle[1]	-	-	-	-	0
	14,859	**15,003**	**14,519r**	**12,712r**	**12,855**
Total - all fuels					
Back pressure steam turbine	6,303	5,466	4,913r	4,209r	4,732
Gas turbine	8,854	8,659	8,779	9,405r	9,634
Combined cycle	53,972	50,281	46,830	47,372r	48,350
Reciprocating engine	12,971	13,670	14,848r	16,043r	19,060
Pass out condensing steam turbine	6,331	8,131	7,207r	7,854r	8,096
Organic Rankine Cycle[1]	-	-	....	241r	407
	88,430	**86,207**	**82,576r**	**85,123r**	**90,279**

(1) From 2015, Organic Rankine Cycle CHP schemes are included in the statistics
For 2015, 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. In 2017's publication, 2016 was also disclosive but since publication, sufficient data have been received to enable splitting out for that year.

(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

	2013	2014	2015	2016	2017
Coal					
Back pressure steam turbine	63	67	66	56	49
Gas turbine	-	-	-	-	-
Combined cycle gas turbine	101	113	-	-	-
Reciprocating engine	0	0	-	-	-
Pass-out condensing steam turbine	9	0	-	-	-
Organic Rankine Cycle[1]	-	-	-	-	-
	173	**179**	**66**	**56**	**49**
Fuel oil					
Back pressure steam turbine	17	13	12	10	2
Gas turbine	1	0	0	1	0
Combined cycle gas turbine	12	3	6	14	3
Reciprocating engine	42	42	40r	40r	40
Pass-out condensing steam turbine	1	1	2	1r	0
Organic Rankine Cycle[1]	-	-	-	-	-
	72	**59**	**60r**	**65r**	**46**
Natural gas					
Back pressure steam turbine	168	172	118r	85r	97
Gas turbine	2,034	1,953	1,966	2,034r	2,146
Combined cycle gas turbine	10,467	10,097	10,210	10,357r	10,084
Reciprocating engine	2,628	2,795	3,084r	3,447r	3,549
Pass-out condensing steam turbine	34	27	35r	21r	20
Organic Rankine Cycle[1]	-	-	-	-	-
	15,331	**15,045**	**15,412r**	**15,945r**	**15,895**
Renewable Fuel					
Back pressure steam turbine	213	168	170r	161r	206
Gas turbine	2	2	2	2	3
Combined cycle gas turbine	15	16	18	53r	61
Reciprocating engine	971	1,056	1,132r	1,177r	2,241
Pass-out condensing steam turbine	599	885	608	1,018r	1,138
Organic Rankine Cycle[1]	-	-	….	25r	37
	1,801	**2,128**	**1,930r**	**2,437r**	**3,685**
Other Fuels					
Back pressure steam turbine	82	106	95r	59r	47
Gas turbine	29	21	35	38r	21
Combined cycle gas turbine	1,967	1,935	1,785	1,722r	1,836
Reciprocating engine	11	16	19	25r	13
Pass-out condensing steam turbine	127	206	132r	59r	56
Organic Rankine Cycle[1]	-	-	-	-r	-
	2,215	**2,284**	**2,066**	**1,903r**	**1,973**
Total - All Fuels					
Back pressure steam turbine	543	526	461r	371r	401
Gas turbine	2,066	1,977	2,003	2,075r	2,169
Combined cycle gas turbine	12,561	12,164	12,019	12,146r	11,984
Reciprocating engine	3,652	3,909	4,276r	4,689r	5,842
Pass-out condensing steam turbine	770	1,119	776r	1,099r	1,214
Organic Rankine Cycle[1]	-	-	….	25r	37
Total	**19,592**	**19,695**	**19,534r**	**20,405r**	**21,648**

(1) From 2015, Organic Rankine Cycle CHP schemes are included in the statistics
For 2015, 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. In 2017's publication,
(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

	2013	2014	2015	2016	2017
Coal					
Back pressure steam turbine	20	21	22	22	22
Gas turbine	-	-	-	-	-
Combined cycle gas turbine	197	128	-	-	-
Reciprocating engine	0	0	-	-	-
Pass-out condensing steam turbine	2	0	-	-	-
Organic Rankine Cycle[1]	-	-	-	-	-
	220	**150**	**22**	**22**	**22**
Fuel oil					
Back pressure steam turbine	6	5	4	5	1
Gas turbine	0	0	0	0	0
Combined cycle gas turbine	3	1	1	3	1
Reciprocating engine	7	6	6r	6r	6
Pass-out condensing steam turbine	1	1	2	2r	0
Organic Rankine Cycle[1]	-	-	-	-	-
	17	**13**	**13r**	**16r**	**8**
Natural gas					
Back pressure steam turbine	79	71	50r	42r	48
Gas turbine	422	360	401	401r	412
Combined cycle gas turbine	3,114	3,220	3,005	2,885r	2,806
Reciprocating engine	763	825	857r	933r	987
Pass-out condensing steam turbine	9	9	13r	7r	7
Organic Rankine Cycle[1]	-	-	-	-	-
	4,387	**4,485**	**4,325r**	**4,269r**	**4,260**
Renewable Fuel *(2)*					
Back pressure steam turbine	37	28	28r	28r	30
Gas turbine	1	1	1	1	1
Combined cycle gas turbine	2	3	3	8r	8
Reciprocating engine	230	236	299r	315r	502
Pass-out condensing steam turbine	162	180	226	274r	293
Organic Rankine Cycle[1]	-	-	....	8r	11
	432	**447**	**556r**	**634r**	**845**
Other Fuels *(3)*					
Back pressure steam turbine	67	67	80r	89r	86
Gas turbine	9	4	10	6r	4
Combined cycle gas turbine	700	602	583	540r	565
Reciprocating engine	15	18	19	20r	15
Pass-out condensing steam turbine	77	107	100r	29r	30
Organic Rankine Cycle[1]	-	-	-r	-r	-
	868	**798**	**792**	**685r**	**699**
Total - All Fuels					
Back pressure steam turbine	210	192	184r	185r	187
Gas turbine	431	364	411	409r	416
Combined cycle gas turbine	4,018	3,954	3,592	3,437r	3,380
Reciprocating engine	1,014	1,085	1,181r	1,275r	1,510
Pass-out condensing steam turbine	251	297	340r	312r	330
Organic Rankine Cycle[1]	-	-	....	8r	11
Total	**5,924**	**5,892**	**5,708r**	**5,625r**	**5,835**

(1) From 2015, Organic Rankine Cycle CHP schemes are included in the statistics
For 2015, 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. In 2017's publication, 2016 was also disclosive. However, since publication, sufficient data have been received to enable splitting out for that year.
(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

	2013	2014	2015	2016	2017
Coal					
Back pressure steam turbine	434	432	423	366	366
Gas turbine	-	-	-	-	-
Combined cycle gas turbine	776	381	-	-	-
Reciprocating engine	1	0	-	-	-
Pass-out condensing steam turbine	92	1	-	-	-
Organic Rankine Cycle[1]	-	-	-	-	-
	1,302	**813**	**423**	**366**	**366**
Fuel oil					
Back pressure steam turbine	121	78	71	60	13
Gas turbine	3	2	1	2	1
Combined cycle gas turbine	31	8	13	37	8
Reciprocating engine	36	35	32r	34r	32
Pass-out condensing steam turbine	13	13	32	11r	10
Organic Rankine Cycle[1]	-	-	-	-	-
	204	**136**	**149r**	**143r**	**63**
Natural gas					
Back pressure steam turbine	2,082	1,716	1,242r	931r	1,116
Gas turbine	4,506	4,365	4,265	4,634r	4,737
Combined cycle gas turbine	19,961	18,540	17,200	17,791r	18,378
Reciprocating engine	4,443	4,424	4,864r	5,358r	5,467
Pass-out condensing steam turbine	291	121	153r	119r	101
Organic Rankine Cycle[1]	-	-	-	-	-
	31,283	**29,164**	**27,724r**	**28,833r**	**29,800**
Renewable Fuel *(2)*					
Back pressure steam turbine	758	554	408r	300r	349
Gas turbine	2	2	2	2	3
Combined cycle gas turbine	34	30	34	95r	110
Reciprocating engine	873	961	991r	1,013r	1,509
Pass-out condensing steam turbine	1,113	1,423	1,634	1,944r	2,028
Organic Rankine Cycle[1]	-	-	....	120r	223
	2,780	**2,970**	**3,068**	**3,474**	**4,222**
Other Fuels *(3)*					
Back pressure steam turbine	1,458	1,519	1,665r	1,659r	1,724
Gas turbine	83	62	91	115	61
Combined cycle gas turbine	5,564	5,243	5,528	5,110r	5,090
Reciprocating engine	15	20	26	33r	14
Pass-out condensing steam turbine	1,660	2,030	1,560r	938r	900
Organic Rankine Cycle[1]	-	-	-r	-r	-
	8,781	**8,874**	**8,870**	**7,855r**	**7,788**
Total - All Fuels					
Back pressure steam turbine	4,853	4,298	3,809r	3,316r	3,568
Gas turbine	4,595	4,430	4,359	4,753r	4,801
Combined cycle gas turbine	26,366	24,201	22,775	23,033r	23,585
Reciprocating engine	5,369	5,441	5,913r	6,438r	7,022
Pass-out condensing steam turbine	3,168	3,587	3,379r	3,011r	3,038
Organic Rankine Cycle[1]	-	-	....	120r	223
Total	**44,350**	**41,957**	**40,234r**	**40,670r**	**42,238**

(1) From 2015, Organic Rankine Cycle CHP schemes are included in the statistics
For 2015, 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. In 2017's publication, 2016 was also disclosive, however, since publication, sufficient data have been received to enable splitting out for that year.
(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

	2013	2014	2015	2016	2017
Coal					
Back pressure steam turbine	124	134	137	134	141
Gas turbine	-	-	-	-	-
Combined cycle gas turbine	301	169	-	-	-
Reciprocating engine	2	1	-	-	-
Pass-out condensing steam turbine	48	20	-	-	-
Organic Rankine Cycle[1]	-	-	-	-	-
	474	**324**	**137**	**134**	**141**
Fuel oil					
Back pressure steam turbine	42	32	31	34	7
Gas turbine	1	1	1	2	0
Combined cycle gas turbine	14	6	5	12	3
Reciprocating engine	8	7	5r	7r	5
Pass-out condensing steam turbine	5	5	15	9r	7
Organic Rankine Cycle[1]	-	-	-	-	-
	70	**51**	**56r**	**64r**	**22**
Natural gas					
Back pressure steam turbine	829	751	470r	393r	439
Gas turbine	1,781	1,662	1,785	1,807r	1,833
Combined cycle gas turbine	9,750	9,836	8,946	8,680r	8,566
Reciprocating engine	2,758	2,991	3,153r	3,312r	3,495
Pass-out condensing steam turbine	145	241	72r	51r	44
Organic Rankine Cycle[1]	-	-	-	-	-
	15,263	**15,481**	**14,426r**	**14,243r**	**14,377**
Renewable Fuel *(2)*					
Back pressure steam turbine	155	129	128r	111r	118
Gas turbine	4	4	4	4	4
Combined cycle gas turbine	258	12	14	39r	41
Reciprocating engine	303	313	420r	433r	673
Pass-out condensing steam turbine	737	905	1,232	1,644r	1,690
Organic Rankine Cycle[1]	-	-	....	78r	111
	1,456	**1,363**	**1,797r**	**2,310r**	**2,637**
Other Fuels *(3)*					
Back pressure steam turbine	586	593	706r	784r	758
Gas turbine	32	7	20	18r	7
Combined cycle gas turbine	3,578	1,991	1,946	1,818r	1,828
Reciprocating engine	15	18	20	21r	13
Pass-out condensing steam turbine	694	2,401	983r	404r	410
Organic Rankine Cycle[1]	-	-	-	-	-
	4,904	**5,010**	**3,675**	**3,045**	**3,015**
Total - All Fuels					
Back pressure steam turbine	1,735	1,638	1,471r	1,456r	1,462
Gas turbine	1,818	1,674	1,810	1,830r	1,843
Combined cycle gas turbine	13,900	12,014	10,911	10,549	10,438
Reciprocating engine	3,085	3,330	3,597r	3,773r	4,186
Pass-out condensing steam turbine	1,628	3,573	2,303r	2,109r	2,151
Organic Rankine Cycle[1]	-	-	....	78r	111
Total	**22,167**	**22,228**	**20,091r**	**19,795r**	**20,191**

(1) From 2015, Organic Rankine Cycle CHP schemes are included in the statistics
For 2015, 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. In 2017's publication, 2016 was also disclosive; however, since publication, sufficient data have been received so that 2016 is no longer disclosive.

(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

	Unit	2013	2014	2015	2016	2017
Iron and steel and non ferrous metals						
Number of sites		6	6	6	5	5
Electrical capacity	MWe	81	81	81	40	40
Heat capacity	MWth	674	674	674	435	435
Electrical output	GWh	163	158	118	98r	73
Heat output	GWh	1,701	1,776	1,506	1,024r	949
Fuel use	GWh	2,885	2,743	2,720	1,739r	1,503
of which : for electricity	GWh	435	395	316	255r	188
for heat	GWh	2,450	2,348	2,404	1,484r	1,315
Chemicals						
Number of sites		52	52	52	52	51
Electrical capacity	MWe	1,461	1,437	1,183	1,137	1,102
Heat capacity	MWth	4,828	4,878	4,458	4,363	4,252
Electrical output	GWh	5,212	4,574	4,977	4,792r	4,542
Heat output	GWh	12,282	11,010	10,487	10,396r	10,554
Fuel use	GWh	25,189	22,685	22,110	22,156r	21,970
of which : for electricity	GWh	11,543	10,214	10,458	10,487r	10,034
for heat	GWh	13,646	12,470	11,652	11,668r	11,936
Oil and gas terminals and oil refineries						
Number of sites		11	10	9	9	9
Electrical capacity	MWe	2,380	2,278	2,235	2,226r	2,208
Heat capacity	MWth	7,600	7,255	6,825	6,825	6,825
Electrical output	GWh	6,184	6,391	6,151	6,590r	6,576
Heat output	GWh	14,446	13,615	13,060	13,864r	14,222
Fuel use	GWh	26,634	25,759	24,164	25,346r	26,501
of which : for electricity	GWh	12,218	12,362	11,533	12,006r	12,479
for heat	GWh	14,416	13,397	12,631	13,340r	14,022
Paper, publishing and printing						
Number of sites		22	21	21	20	22
Electrical capacity	MWe	451	477	463	367r	383
Heat capacity	MWth	1,776	1,764	1,771	1,537	1,582
Electrical output	GWh	1,948	2,025	1,639	1,689r	1,751
Heat output	GWh	4,849	4,389	3,844	3,768r	3,863
Fuel use	GWh	9,221	8,831	7,349	7,723r	8,091
of which : for electricity	GWh	4,138	4,295	3,410	3,718r	3,925
for heat	GWh	5,082	4,536	3,939	4,005r	4,165
Food, beverages and tobacco						
Number of sites		54	59	61	63r	67
Electrical capacity	MWe	436	455	469	485r	492
Heat capacity	MWth	1,743	1,787	1,808	1,880r	1,895
Electrical output	GWh	2,117	2,266	2,257	2,149r	2,356
Heat output	GWh	4,277	4,291	4,119	3,896r	4,137
Fuel use	GWh	8,362	8,717	8,563	8,187r	8,900
of which : for electricity	GWh	4,172	4,487	4,471	4,277r	4,758
for heat	GWh	4,190	4,230	4,092	3,909r	4,142
Metal products, machinery and equipment						
Number of sites		19	20	21	21	22
Electrical capacity	MWe	43	43	46	46	48
Heat capacity	MWth	254	254	257	257	259
Electrical output	GWh	119	139	153	164r	166
Heat output	GWh	193	190	192	232r	225
Fuel use	GWh	462	625	654	729r	738
of which : for electricity	GWh	250	301	329	342r	357
for heat	GWh	212	324	325	387r	381

For footnotes see page 213

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

	Unit	2013	2014	2,015	2,016	2017
Mineral products, extraction, mining and agglomeration of solid fuels						
Number of sites		8	8	8	8	8
Electrical capacity	MWe	54	54	52	52	49
Heat capacity	MWth	183	183	165	165	165
Electrical output	GWh	104	109	131	120	125
Heat output	GWh	526	530	550	498	457
Fuel use	GWh	836	881	889	827	793
of which : for electricity	GWh	230	253	289	269	282
for heat	GWh	605	628	600	558	511
Sewage treatment						
Number of sites		197	200	200r	207r	204
Electrical capacity	MWe	164	165	202r	212r	197
Heat capacity	MWth	240	245	343r	353r	329
Electrical output	GWh	657	719	749r	769r	793
Heat output	GWh	740	822	851r	884r	934
Fuel use	GWh	2,391	2,601	2,766r	2,775r	2,901
of which : for electricity	GWh	1,540	1,660	1,753r	1,766r	1,825
for heat	GWh	851	941	1,013r	1,010r	1,077
Other industrial branches *(2)*						
Number of sites		12	12	11r	12r	12
Electrical capacity	MWe	50	50	53r	82r	82
Heat capacity	MWth	274	274	166r	198r	198
Electrical output	GWh	225	243	217r	313r	269
Heat output	GWh	409	422	369r	411r	409
Fuel use	GWh	812	845	748r	912r	902
of which : for electricity	GWh	423	452	409r	556r	529
for heat	GWh	389	393	340r	356r	373
Total industry						
Number of sites		381	388	389r	397r	400
Electrical capacity	MWe	5,119	5,039	4,784r	4,648r	4,602
Heat capacity	MWth	17,571	17,312	16,466r	16,013r	15,940
Electrical output	GWh	16,729	16,625	16,392r	16,686r	16,653
Heat output	GWh	39,423	37,046	34,979r	34,973r	35,749
Fuel use	GWh	76,792	73,685	69,965r	70,394r	72,300
of which : for electricity	GWh	34,950	34,419	32,969r	33,677r	34,377
for heat	GWh	41,842	39,266	36,996r	36,718r	37,922
Transport, commerce and administration						
Number of sites		956	974	1,002r	1,027r	1,048
Electrical capacity	MWe	419	445	499r	506r	529
Heat capacity	MWth	1,729	1,823	1,999r	2,049r	2,148
Electrical output	GWh	1,742	1,867	1,875r	2,212r	2,247
Heat output	GWh	3,134	3,028	3,288r	3,437r	3,534
Fuel use	GWh	6,956	7,377	7,476r	8,749r	8,903
of which : for electricity	GWh	3,567	4,106	3,927r	5,033r	5,084
for heat	GWh	3,389	3,272	3,549r	3,716r	3,819
Other *(3)*						
Number of sites		692	714	739r	800r	938
Electrical capacity	MWe	386	408	426r	471r	705
Heat capacity	MWth	2,866	3,093	1,626r	1,733r	2,103
Electrical output	GWh	1,121	1,203	1,268r	1,506r	2,748
Heat output	GWh	1,793	1,884	1,967r	2,260r	2,955
Fuel use	GWh	4,683	5,144	5,135r	5,980r	9,077
of which : for electricity	GWh	2,525	2,744	2,809r	3,302r	5,830
for heat	GWh	2,158	2,401	2,327r	2,678r	3,247
Total CHP usage by all sectors						
Number of sites		2,029	2,076	2,130r	2,224r	2,386
Electrical capacity	MWe	5,924	5,892	5,708r	5,625r	5,835
Heat capacity	MWth	22,167	22,228	20,091r	19,795r	20,191
Electrical output	GWh	19,592	19,695	19,534r	20,405r	21,648
Heat output	GWh	44,350	41,957	40,234r	40,670r	42,238
Fuel use	GWh	88,430	86,207	82,576r	85,123r	90,279
of which : for electricity	GWh	41,042	41,268	39,704r	42,011r	45,291
for heat	GWh	47,388	44,939	42,872r	43,111r	44,988

(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
	2013	**2014**	**2015**	**2016**	**2017**
Iron and steel and non ferrous metals					
Coal	-	-	-	-	-
Fuel oil	21	20	51	15r	16
Natural gas	204	169	237	218r	109
Blast furnace gas	2,169	2,114	2,001	1,291r	1,152
Coke oven gas	489	440	431	214r	227
Other fuels *(1)*	2	0	-	-r	0
Total iron and steel and non ferrous metals	**2,885**	**2,743**	**2,720**	**1,739r**	**1,503**
Chemicals					
Coal	1,697	1,033	359	331	306
Fuel oil	10	12	3	4	2
Gas oil	4	6	4	5r	15
Natural gas	20,118	18,169	17,444	17,788r	17,692
Refinery gas	646	653	648	614	630
Renewable fuels *(2)*	90	92	663	891r	910
Other fuels *(1)*	2,623	2,720	2,990	2,522r	2,415
Total chemicals	**25,189**	**22,685**	**22,110**	**22,156r**	**21,970**
Oil and gas terminals and oil refineries					
Fuel oil	48	7	25	65	14
Gas oil	763	906	798	766r	902
Natural gas	18,484	17,847	16,380	17,549r	18,360
Refinery gas	3,872	3,996	4,264	3,722r	3,912
Other fuels *(1)*	3,466	3,003	2,698	3,244	3,312
Total oil and gas terminals and oil refineries	**26,634**	**25,759**	**24,164**	**25,346r**	**26,501**
Paper, publishing and printing					
Coal	102	-	-	-	-
Fuel oil	-	-	-	-	-
Gas oil	7	2	1	0r	2
Natural gas	6,298	5,402	4,917	5,199r	5,238
Renewable fuels *(2)*	2,516	2,786	2,189	2,472r	2,800
Other fuels *(1)*	298	641	241	52r	52
Total paper, publishing and printing	**9,221**	**8,831**	**7,349**	**7,723r**	**8,091**
Food, beverages and tobacco					
Coal	205	214	218	152	174
Fuel oil	148	100	94	80r	17
Gas oil	3	4	3	15	12
Natural gas	7,653	7,885	7,812	7,441r	7,759
Renewable fuels *(2)*	354	515	436	499r	938
Other fuels *(1)*	-	-	-	-	-
Total food, beverages and tobacco	**8,362**	**8,717**	**8,563**	**8,187r**	**8,900**
Metal products, machinery and equipment					
Coal	-	-	-	-	-
Fuel oil	89	89	89	89	89
Gas oil	0.3	0.3	0	0	0.3
Natural gas	332	364	399	440r	442
Renewable fuels *(2)*	41	172	166	199	207
Other fuels *(1)*	-	-	-	-	-
Total metal products, machinery and equipment	**462**	**625**	**654**	**729r**	**738**

For footnotes see page 215

7.9 CHP - use of fuels by sector (continued)

GWh

	2013	2014	2,015	2,016	2017
Mineral products, extraction, mining and agglomeration of solid fuels					
Coal	-	-	-	-	-
Fuel oil	-	-	-	-	-
Gas oil	-	-	-	-	-
Natural gas	606	651	739	677	643
Coke oven gas	230	230	150	150	150
Total mineral products, extraction, mining and agglomeration of solid fuels	**836**	**881**	**889**	**827**	**793**
Sewage treatment			-	-	0
Fuel oil	32	33	24r	24r	24
Gas oil	17	26	37	22r	12
Natural gas	36	50	71	125r	140
Renewable fuels *(2)*	2,305	2,491	2,634r	2,604r	2,726
Total sewage treatment	**2,391**	**2,601**	**2,766r**	**2,775r**	**2,901**
Other industrial branches					
Fuel oil	-	-	-	-	-
Gas oil	0	0	-r	-r	-
Natural gas	803	837	733r	884r	852
Renewable fuels *(2)*	9	7	15r	28r	49
Total other industrial branches	**812**	**845**	**748r**	**912r**	**902**
Transport, commerce and administration					
Coal	-	-			
Fuel oil	-	-	-	0	1
Gas oil	12	34	41r	53r	24
Natural gas	6,287	6,255	6,652r	6,819r	6,939
Refinery gas	-	-	-	-	-
Renewable fuels *(2)*	657	1,088	782r	1,876r	1,940
Other fuels *(1)*	-	0	0	0r	0
Total transport, commerce and administration	**6,956**	**7,377**	**7,476r**	**8,749r**	**8,903**
Other *(3)*					
Coal	7	3	-	-	-
Fuel oil	2	-	0	2r	0.3
Gas oil	14	13	10	14r	10
Natural gas	2,530	2,768	2,794r	3,315r	3,751
Renewable fuels *(2)*	1,886	2,148	2,130r	2,622r	5,288
Other fuels *(1)*	244	213	201	27r	27
Total other	**4,683**	**5,144**	**5,135r**	**5,980r**	**9,077**
Total - all sectors					
Coal	**2,012**	**1,249**	**577**	**484**	**480**
Fuel oil	**350**	**287**	**287r**	**279r**	**161**
Gas oil	**820**	**992**	**895**	**874r**	**977**
Natural gas	**63,352**	**58,178**	**58,178r**	**60,456r**	**61,924**
Blast furnace gas	**2,169**	**2,114**	**2,001**	**1,291r**	**1,152**
Coke oven gas	**719**	**670**	**581**	**364r**	**377**
Refinery gas	**4,519**	**4,650**	**4,911**	**4,337r**	**4,542**
Renewable fuels *(2)*	**7,856**	**9,298**	**9,016r**	**11,192r**	**14,858**
Other fuels *(1)*	**6,633**	**6,577**	**6,130**	**5,845r**	**5,807**
Total CHP fuel use	**88,430**	**86,207**	**82,576r**	**85,123r**	**90,279**

(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 2017)(1)

Company Name	Scheme Location	Installed Capacity (MWe) (2)
Aberdeen Heat & Power	Stockethill CHP2	1
Aberdeen Heat & Power	SEATON ENERGY CENTRE, ABERDEEN HEAT & POWER	2
Aberdeen Heat & Power	Tillydrone CHP	1
Adam Wilson & Sons Ltd	Glennon Brothers Troon Limited	2
ADM Erith Ltd	ERITH OIL WORKS	14
Agrivert Ltd	Wallingford AD	2
Agrivert Ltd	Cassington 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 Bradford	BASF PLC	16
Boortmalt	Boortmalt - Bury St Edmunds	5
Briar Chemicals Ltd	Briar Chemicals Ltd	4
BRITISH SUGAR PLC	CANTLEY SUGAR FACTORY	15
British Sugar plc	BURY ST EDMUNDS SUGAR FACTORY	77
British Sugar Plc	WISSINGTON SUGAR FACTORY, BRITISH SUGAR PLC (CHP 2)	93
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	10
COFELY LTD	Rampton Hospital	1
Cofely Ltd	TRAFFORD PARK, KELLOGG COMPANY OF GREAT BRITAIN	5
Cofely UK Energy Services Ltd (UK) LTD	SULLOM VOE POWER STATION	89
Community Energy	Citigen_2	9
ContourGlobal Solutions (Northern Ireland) Ltd	KNOCKMORE HILL CHP, CONTOURGLOBAL SOLUTIONS (NORTHERN iRELAND)	15
CYCLERVAL UK LTD	NEWLINCS EFW, NEWLINCS DEVELOPMENT LTD	3
Cynergin Projects Limited	VILLA NURSERY LIMITED	1
Cynergin Projects Limited	George Eliot NHS Trust Hospital	1
Dalkia	FREEMAN HOSPITAL	4
Dalkia	ROYAL VICTORIA INFIRMARY	4
DALKIA UTILITIES SERVICES	ELI LILLY & CO LTD	10
DS Smith Paper Limited	KEMSLEY CHP	81
DSM NUTRITIONAL PRODUCTS (UK) LTD	DSM DALRY	46
DWR Cymru Welsh Water	AFAN WWTW, DWR CYMRU WELSH WATER	3
DWR Cymru Welsh Water	FIVE FORD WWTW	1
E.ON	St James University Hospital	5
E.ON UK Cogeneration Ltd	Nufarm UK Limited	5
East Sussex Healthcare NHS TRUST	EASTBOURNE DISTRICT GENERAL HOSPITAL	1
Eco Sustainable Solutions Ltd	Eco Piddlehinton AD	1
ENGIE	ICC ENERGY CENTRE	3
ENGIE	LDEC-City Centre and Leicester East	3
ENGIE	LDEC-LEICESTER NORTH	2
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	ASTON UNIVERSITY ENERGY CENTRE, ASTON UNIVERSITY	3
ENGIE	BIRMINGHAM CHILDRENS HOSPITAL	2
Engie Group Energy Infrastructure	ENGIE HUMBER ENERGY	21
ENGIE Services Holding UK Ltd	Leeds GSC	19
Enviroenergy Ltd	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

For footnotes see page 218

7.10 Large scale CHP schemes in the United Kingdom
(operational at the end of December 2017)[1] *(continued)*

Company Name	Scheme Location	Installed Capacity (MWe) *(2)*
FEC Energy	BUCKLAND GARDEN NURSERIES	2
FEC Energy	Vitacress Herbs Ltd	4
Fine Organics Limited	FINE ORGANICS LIMITED	4
Frimley Park Hospital NHS Foundation Trust	Frimley Park Hospital	1
G4 Power Grid Ltd	Brookenby Power Station	2
Genzyme Ltd	GENZYME Ltd	1
GlaxoSmithKline	GLAXOSMITHKLINE (ULVERSTON)	2
GLAXOSMITHKLINE	GLAXOSMITHKLINE MONTROSE	1
GlaxoSmithKline	GLAXOSMITHKLINE, IRVINE	4
GlaxoSmithKline	WARE GMS	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	Barnard Castle	2
Guy's and St Thomas' Hospital NHS Foundation Trust	ST THOMAS' HOSPITAL	3
GUY'S AND ST THOMAS' HOSPITAL NHS FOUNDATION TRUST	GUYS HOSPITAL	3
Heathcoat Fabrics Ltd	HEATHCOAT FABRICS LIMITED	1
Helix Agencies Limited	BLACKPOOL VICTORIA HOSPITAL	1
Helix Agencies Limited	SOUTH KENSINGTON CAMPUS CHP PLANT	9
Helix Agencies Limited	NATURAL HISTORY MUSEUM	2
Iggesund Paperboard (Workington) Ltd	Iggesund Paperboard (Workington) Ltd	50
Imerys Minerals Ltd	PAR GRADE DRIER	4
Imerys Minerals Ltd	ROCKS DRIERS	4
INBEV UK LTD	MAGOR BREWERY, INBEV UK LTD	7
Inbev UK Ltd	SAMLESBURY BREWERY, INBEV UK LTD	7
INEOS RUNCORN (TPS) LIMITED	RUNCORN EFW FACILITY	37
Inovyn Chlorvinyls Ltd	Inovyn Chlorvinyls Ltd	10
Inovyn Chlorvinyls Ltd	Gas Engine CHP	2
INTEGRATED ENERGY UTILITIES LTD	CALLENDAR PARK ENERGY CENTRE, FALKIRK COUNCIL	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	6
Johnson Matthey	JOHNSON MATTHEY ENFIELD	3
Johnson Matthey	JOHNSON MATTHEY - ROYSTON	6
Kronospan Limited	KRONOSPAN LTD (CHIRK CHP B)	13
Lawrence Brown 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
Medway NHS Foundation Trust	MEDWAY HOSPITAL, MEDWAY MARITIME HOSPITAL	1
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 Partners	Woodhouse Nurseries	3
P3P Partners	Harvest Energy Centre	11
P3P Partners	Glasshouse Energy Centre	11
P3P Partners	Spark Steam Energy Centre	7
P3P Partners	Europa Nursery	15
Peel Utilities Holdings Limited	MEDIA CITY, UTILITIES (MEDIA CITY UK) LTD	2
Portals De La Rue Limited	Portals De La Rue Overton Mill	7
Powell Energy	ST. GEORGES HOSPITAL	4
PRESTON BOARD AND PACKAGING LTD	ROMILEY BOARD	1
Queen Elizabeth Hospital King's Lynn NHS Foundation Trust	Queen Elizabeth Hospital	1
Reckitt Benckister	KWE HULL	2
REG BIO POWER LTD	BENTWATERS CHP	6

For footnotes see page 218

7.10 Large scale CHP schemes in the United Kingdom

(operational at the end of December 2017)[(1)] *(continued)*

Company Name	Scheme Location	Installed Capacity
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
Shanks Waste Management Limited	Westcott Biogas Generating Plant	3
SLOUGH HEAT & POWER LTD	SLOUGH POWER STATION	21
Smurfit Kappa SSK	SMURFIT KAPPA SSK LIMITED	9
Solvay Solutions UK Ltd	Oldbury	2
SOUTHERN WATER SERVICES	BUDDS FARM WTW, SOUTHERN WATER	2
SOUTHERN WATER SERVICES	MILLBROOK WTW, SOUTHERN WATER	1
SOUTHERN WATER SERVICES	ASHFORD STC	2
SPRINGFIELDS FUELS LTD	SPRINGFIELDS	12
STAPLES BROTHERS LTD	Sibsey 1	2
Swansea University	Swansea University	2
T & L SUGARS LTD	Thames Refinery	28
Tata Chemicals Europe	Winnington CHP	103
THAMES WATER UTILITIES LTD	Swindon STW CHP 2015	1
THAMES WATER UTILITIES LTD	Mogden STW 2016	6
THAMES WATER UTILITIES LTD	Beddington STW	2
THAMES WATER UTILITIES LTD	Deephams STW 2016	3
THAMES WATER UTILITIES LTD	Rye Meads STW CHP 2015	2
THAMES WATER UTILITIES LTD	Slough STW CHP 2015	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
THAMES WATER UTILITIES LTD	MAPLE LODGE STW	4
THAMES WATER UTILITIES LTD	LONG REACH STW	3
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
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 Royal Marsden Hospital (NHS Foundation Trust)	Royal Marsden Hospital	2
The University of Birmigham	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	7
UNIVERSITY OF EDINBURGH UTILITIES SUPPLY COMPANY	KINGS BUILDINGS	3
UNIVERSITY OF EDINBURGH UTILITIES SUPPLY COMPANY	GEORGE SQUARE ENERGY CENTRE	2
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	Cryfield Energy Centre	4
University of Warwick	CHP BOILERHOUSE (CHP 2), UNIVERSITY OF WARWICK	4
UNIVERSITY OF YORK	University of York	3
Unversity of Edinburgh Utilities Supply Company	Holyrood Energy Centre	1
UPM-Kymmene (UK)	UPM Shotton	25
Veolia BioEnergy UK Limited	CHILTON BIOMASS PLANT, Veolia BioEnergy UK Limited	17
Veolia Environmental Services plc	SHEFFIELD ERF	21
Veolia Plc	LINCOLN COUNTY HOSPITAL	1
Vinnolit Hillhouse LTD	Hillhouse International Business Park	5
VPI Immingham LLP	VPI IMMINGHAM LLP	1,344
Weetabix	Weetabix Limited	6
WESSEX WATER SERVICES LTD	BRISTOL WASTE WATER TREATMENT WORKS SCHEME A	6
Total *(2)*		**3,496**
Electrical capacity of good quality CHP for these sites in total		**3,214**

(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.