

## Combined Heat and Power in Scotland, Wales, Northern Ireland and the regions of England in 2013

### Background

Combined Heat and Power (CHP) is the simultaneous generation of usable heat and power (usually electricity) in a single process. CHP data for the UK as a whole are updated annually and published in the Digest of United Kingdom Energy Statistics (DUKES), the latest edition of which was published in July 2014. This article updates statistics published in the September 2013 edition of Energy Trends and provides a breakdown of total UK CHP data for the Devolved Administrations and English regions in 2013<sup>1</sup>.

The data presented originates from a CHP database maintained by Ricardo-AEA on behalf of DECC. Data relating to the overwhelming majority of CHP electrical capacity (about 99 per cent of total capacity) is received annually from the reliable sources of the Combined Heat and Power Quality Assurance (CHPQA) programme, the Iron and Steel Statistics Bureau (ISSB) and from Ofgem's Renewable Obligations Certificates (ROCs) returns. Another source of data is the sales databases of the Combined Heat and Power association (CHPA). Data from CHP schemes not covered by the above sources are extrapolated from historic data. There is an ongoing data proving exercise in respect of these schemes.

Between 2012 and 2013 there was a net increase of 59 in the number of CHP schemes in the database (68 new schemes and the removal of 9 schemes), but a net decrease of 5 MWe in capacity. Good Quality CHP<sup>2</sup> capacity in the UK fell from 6,175 MWe (revised 2012 figure) to 6,170 MWe in 2013.

### Regional Trends<sup>3</sup>

Tables 1 and 1B show a comparison of the number of schemes, electrical capacity, electricity generated and heat generated in the Devolved Administrations and English regions for the period 2011 to 2013. During this time, the total number of schemes increased from 1,791 to 2,014, while capacity increased from 5,969 MWe to 6,170 MWe. The number of schemes increased in all regions over the period 2011 to 2013. Over this period, the electrical capacity increased in all regions except in the Eastern, East Midlands and Wales regions. There was a significant decrease in the capacity between 2012 and 2013 in the East Midlands region due largely to the closure of one scheme serving the Chemicals sector.

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<sup>1</sup> Similar articles on CHP have appeared in previous Energy Trends publications from 2001 to 2013. The figures within any one article are a snapshot of the position as seen at the time and therefore figures between articles do not constitute a time series.

<sup>2</sup> Good Quality CHP denotes schemes that have been certified as being highly efficient through the UK's CHP Quality Assurance (CHPQA) programme.

<sup>3</sup> Note: The figures for previous years are revised on an annual basis to account for late information submitted after the publication date of the article. This is to ensure that the true trends are captured in the data. The figures herein therefore supersede the previous articles published.

**Table 1: Number and electrical capacity of CHP schemes, 2011 to 2013**

	Number of Schemes			Electrical Capacity (MWe)		
	2011	2012	2013	2011	2012	2013
<b>England</b>	<b>1,513</b>	<b>1,658</b>	<b>1,699</b>	<b>5,206</b>	<b>5,405</b>	<b>5,392</b>
East Midlands	97	102	104	211	209	130
Eastern	153	158	165	296	299	290
London	213	273	275	149	172	180
North East	97	108	109	828	852	843
North West	251	266	271	743	787	839
South East	268	283	295	852	940	963
South West	116	129	135	73	82	83
West Midlands	154	163	166	98	100	102
Yorkshire/Humberside	164	176	179	1,957	1,965	1,961
<b>Scotland</b>	<b>113</b>	<b>119</b>	<b>127</b>	<b>494</b>	<b>496</b>	<b>510</b>
<b>Wales</b>	<b>108</b>	<b>117</b>	<b>121</b>	<b>216</b>	<b>219</b>	<b>210</b>
<b>Northern Ireland</b>	<b>57</b>	<b>61</b>	<b>67</b>	<b>53</b>	<b>55</b>	<b>59</b>
<b>UK Total</b>	<b>1,791</b>	<b>1,955</b>	<b>2,014</b>	<b>5,969</b>	<b>6,175</b>	<b>6,170</b>

**Table 1B: Electrical and heat generated, 2011 to 2013**

	Electricity Generated (GWh)			Heat Generated (GWh)		
	2011	2012	2013	2011	2012	2013
<b>England</b>	<b>18,995</b>	<b>19,584</b>	<b>17,532</b>	<b>38,206</b>	<b>39,023</b>	<b>37,940</b>
East Midlands	982	946	546	2,030	1,949	1,296
Eastern	1,254	1,222	1,226	1,852	1,848	1,958
London	438	476	496	1,080	1,184	1,195
North East	2,208	2,450	1,889	6,268	7,130	6,590
North West	3,151	3,440	3,734	9,584	9,671	10,101
South East	3,821	4,007	3,783	8,175	7,711	7,373
South West	310	358	363	596	620	633
West Midlands	389	403	417	706	714	720
Yorkshire/Humberside	6,442	6,283	5,078	7,916	8,197	8,075
<b>Scotland</b>	<b>2,653</b>	<b>2,274</b>	<b>2,338</b>	<b>6,649</b>	<b>6,000</b>	<b>5,713</b>
<b>Wales</b>	<b>945</b>	<b>873</b>	<b>812</b>	<b>2,876</b>	<b>2,720</b>	<b>2,544</b>
<b>Northern Ireland</b>	<b>174</b>	<b>220</b>	<b>210</b>	<b>453</b>	<b>500</b>	<b>503</b>
<b>UK Total</b>	<b>22,767</b>	<b>22,950</b>	<b>20,891</b>	<b>48,184</b>	<b>48,244</b>	<b>46,701</b>

The region with the highest proportion of the UK's electrical capacity was the Yorkshire and Humberside region with a 39 per cent share, but only 9 per cent of the total number of schemes, due to the large capacity schemes in this region.

Chart 1 shows the distribution of electricity and heat generation from CHP in 2013 across the English regions and the Devolved Administrations. The largest contribution to electricity generation comes from the Yorkshire and the Humber region (24 per cent), followed by the South East (18 per cent), the North West (18 per cent), Scotland (11 per cent) and the North East (9 per cent). With the exception of Scotland and the North East, this ranking is the same as in 2012. However, there has been noticeable growth in electricity generation in the North West region between 2011 and 2013. This is substantially due to new capacity in the Paper sector in this region. In the

### Special feature - CHP

Yorkshire/Humber and North East regions, against a background of more or less steady generating capacity, there have been appreciable falls in electricity generated between 2012 and 2013. These falls reflect lower generation in the Oil Refineries and Oil and Gas terminals sector in the Yorkshire/Humber region and the in the Chemicals sector in the North East Region.

The region with the greatest share of heat generation in 2013 was the North West (22 per cent), followed by Yorkshire and Humberside (17 per cent.) the South East (16 per cent) and then the North East (14 per cent).

**Chart 1: CHP generation by area in 2013**

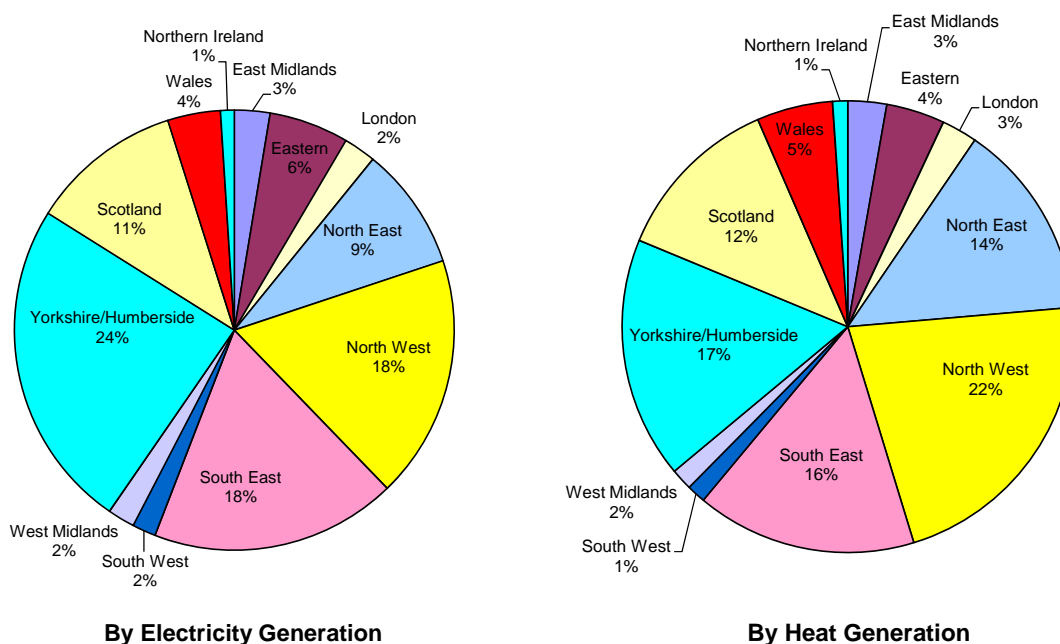


Table 2 shows an overview of CHP plant data broken down between the English regions and Devolved Administrations. CHP capacity utilisation can be expressed by the Load Factor (LF), the actual generation of electricity as a proportion of the theoretical maximum power that can be generated for a given total installed capacity (TPC). The power output that is actually generated is called the total power output (TPO). For 2013, the TPC was 8,977 MWe and the TPO was 41,439 GWh, giving a LF of 53 per cent, consistent with 2012 figures.

Higher LF values tend to be found in industrial uses where the demand for heat extends over a greater proportion of the year than for space heating applications (where the heat demanded from the CHP is mostly confined to the heating season).

**Table 2: Overview of CHP schemes in 2013**

	Number of Schemes	Electrical Capacity (QPC)* MWe	Electrical Capacity (TPC) MWe	Heat Capacity MWth	Fuel Used* GWh	Electricity Generated (QPO)* GWh	Total Electricity Generated (TPO) GWh	Heat Generated GWh	Load Factor** (%)
<b>England</b>	<b>1,699</b>	<b>5,392</b>	<b>7,968</b>	<b>18,447</b>	<b>78,732</b>	<b>17,532</b>	<b>36,249</b>	<b>37,940</b>	51.9%
East Midlands	104	130	161	426	2,693	546	570	1,296	40.4%
Eastern	165	290	290	821	5,270	1,226	1,255	1,958	49.3%
London	275	180	180	741	2,388	496	541	1,195	34.2%
North East	109	843	937	2,175	12,303	1,889	3,096	6,590	37.7%
North West	271	839	943	3,926	18,034	3,734	4,639	10,101	56.2%
South East	295	963	2,197	5,140	15,930	3,783	9,130	7,373	47.4%
South West	135	83	82	214	1,174	363	378	633	52.3%
West Midlands	166	102	168	533	1,810	417	574	720	38.9%
Yorkshire/Humberside	179	1,961	3,009	4,472	19,131	5,078	16,066	8,075	61.0%
Scotland	127	510	650	2,708	11,424	2,338	3,176	5,713	55.8%
Wales	121	210	301	921	4,899	812	1,791	2,544	67.9%
Northern Ireland	67	59	59	148	1,000	210	224	503	43.6%
<b>UK Total</b>	<b>2,014</b>	<b>6,170</b>	<b>8,977</b>	<b>22,225</b>	<b>96,056</b>	<b>20,891</b>	<b>41,439</b>	<b>46,701</b>	<b>52.7%</b>

\*This represents Good Quality CHP capacity, Good Quality CHP power output and the fuel associated with the Good Quality CHP outputs.

\*\* These load factors are based on the total power output (TPO) and total power capacity (TPC) of the CHP (for partially and fully qualified schemes). This gives the true utilisation of the power generating plant.

## Importance of CHP in the Regional Economies

Chart 1 is derived from Table 1 and portrays only a limited picture as it does not account for the varying size of each region. To allow for this, CHP heat capacity and electrical capacity have been compared with the level of economic activity in each region as measured by Gross Value Added (in £ million) in Table 3. Chart 2 maps the heat capacity per unit of GVA for the different regions.

When comparing the heat capacities presented in Table 3 with versions of this table before 2012, it should be noted that these figures are based on a revision to the way in which heat capacities are worked out for each CHP scheme<sup>4</sup>. This has produced a reordering of the regions in terms of Heat Capacity per unit of GVA. CHP continues to be a very important part of the economies of the North East, Yorkshire/Humber and North West regions, as evidenced by the large heat capacities per unit of GVA in these regions. This is due to the prominence of the chemicals and oil refining sectors in these regions, which are heat intensive sectors.

**Table 3: Density of CHP in different areas, ordered by heat capacity**

	Heat capacity kWt/GVA (£million)*	Electrical capacity kWe/GVA (£million)*
North East	51.94	20.14
<b>Scotland</b>	<b>25.47</b>	<b>4.80</b>
Yorkshire/Humberside	47.91	21.01
North West	30.06	6.43
South East	25.37	4.75
<b>Wales</b>	<b>19.45</b>	<b>4.43</b>
<b>England</b>	<b>15.72</b>	<b>4.59</b>
East Midlands	5.35	1.63
<b>Northern Ireland</b>	<b>5.02</b>	<b>1.99</b>
Eastern	7.07	2.50
London	2.39	0.58
West Midlands	5.42	1.04
South West	2.10	0.81
<b>UK total</b>	<b>16.07</b>	<b>4.46</b>

\*GVA is provisional gross value added in 2012 (workplace based)<sup>5</sup>

The distribution of CHP capacity across the regions and economic sectors is summarised in Table 4, which shows the proportion of total CHP capacity in a particular economic sector in each region. More than half of all CHP capacity in the oil refineries and oil and gas terminals sector can be found in the Yorkshire and Humber region and about 85 per cent of capacity in the chemicals sector is to be found in three regions: North East, Yorkshire/Humber and the North West. Almost half of the capacity in the Paper, Publishing and Printing sector is located in the South East region. The Eastern region is the single largest region for CHP capacity in the Food, Beverages and Tobacco sector (43 per cent), which is substantially explained by the heavy concentration of the heat intensive sugar beet industry in this region.

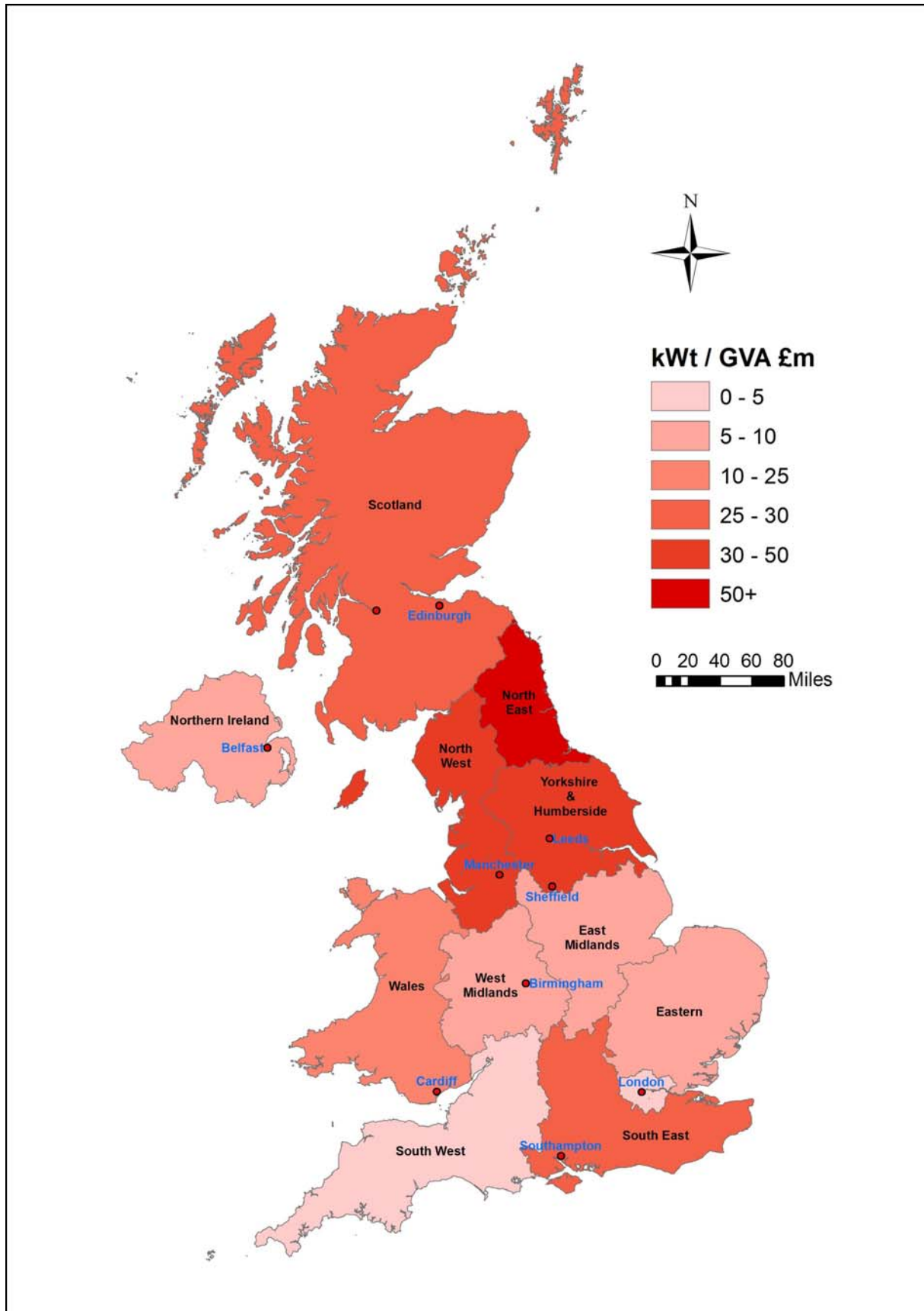
<sup>4</sup> See Chapter 7 para 7.44, Digest of United Kingdom Energy Statistics, 2013

<sup>5</sup> [www.ons.gov.uk/ons/dcp171778\\_345191.pdf](http://www.ons.gov.uk/ons/dcp171778_345191.pdf) (Regional Gross Value Added (Income Approach), December 2013)

**Table 4: Distribution of CHP capacity across the regions and economic sectors**

Region	Sector									
	Iron and steel and non-ferrous metals	Chemicals	Oil Refineries and Gas Terminals	Paper, Publishing and Printing	Food, Beverages and Tobacco	Metal Products, Machinery and Equipment	Mineral Products	Other Industrial Branches	Transport, Commerce and Administration	Other
<b>England</b>	<b>80.2%</b>	<b>92.4%</b>	<b>85.0%</b>	<b>84.7%</b>	<b>88.2%</b>	<b>88.2%</b>	<b>100.0%</b>	<b>76.2%</b>	<b>83.8%</b>	<b>92.5%</b>
East Midlands	0.0%	0.9%	0.0%	0.0%	7.0%	42.3%	6.5%	3.8%	5.1%	5.6%
Eastern	7.2%	0.7%	0.0%	0.0%	43.4%	0.0%	0.0%	11.6%	6.0%	9.2%
London	3.6%	0.7%	0.0%	0.0%	7.2%	8.9%	0.0%	9.7%	16.5%	10.4%
North East	50.5%	38.3%	4.1%	0.0%	0.0%	0.0%	23.6%	5.6%	8.9%	2.6%
North West	0.0%	23.2%	4.6%	31.8%	18.7%	3.5%	46.2%	9.8%	10.5%	4.0%
South East	0.0%	4.5%	18.1%	48.3%	5.2%	4.0%	0.0%	13.1%	14.6%	27.9%
South West	0.0%	0.5%	0.0%	1.2%	1.9%	4.1%	13.5%	5.1%	4.4%	5.5%
West Midlands	0.0%	0.0%	0.0%	1.9%	0.1%	25.4%	0.0%	13.6%	8.0%	3.2%
Yorkshire and Humber	18.9%	23.6%	58.2%	1.4%	4.7%	0.0%	10.1%	3.8%	9.8%	24.1%
<b>Scotland</b>	<b>0.0%</b>	<b>4.7%</b>	<b>12.0%</b>	<b>9.2%</b>	<b>4.9%</b>	<b>0.3%</b>	<b>0.0%</b>	<b>11.8%</b>	<b>9.5%</b>	<b>4.1%</b>
<b>Wales</b>	<b>18.0%</b>	<b>2.1%</b>	<b>3.0%</b>	<b>6.1%</b>	<b>1.4%</b>	<b>5.7%</b>	<b>0.0%</b>	<b>11.9%</b>	<b>4.5%</b>	<b>1.3%</b>
<b>Northern Ireland</b>	<b>1.7%</b>	<b>0.7%</b>	<b>0.0%</b>	<b>0.0%</b>	<b>5.5%</b>	<b>5.8%</b>	<b>0.0%</b>	<b>0.1%</b>	<b>2.2%</b>	<b>2.1%</b>
<b>UK Total</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>

Chart 2: Map of CHP density in terms of heat capacity and gross value added



## Technology type and size

Tables 5 and 6 show the regional split of installed electrical capacity (that qualifies as Good Quality CHP capacity) by prime mover type and by size range, respectively. In a number of regions, disaggregation of the data by prime mover type or size category could result in the disclosure of confidential information and so, for these areas, only totals are shown. The following conclusions can be drawn from the tables:

- Gas turbines, whether on their own or as part of Combined Cycle Gas Turbines (CCGT), continue to dominate the CHP market. In 2013, CCGT accounted for about 70 per cent of total CHP capacity but less than 3 per cent of the total number of CHP schemes.
- The North East and North West regions continue to be the regions with the most significant presence of steam turbine-based CHP plant. These regions have correspondingly high heat to power ratios (H:P > 2.7).
- As CCGT CHP plant has the lowest heat to power ratios of all the CHP technologies, the large proportion of total CCGT capacity in the Yorkshire/Humber region (40 per cent of the total) explains why that region has the lowest heat to power ratio of all regions. Yorkshire/Humber region generated over 24 per cent of all CHP power but only about 17 per cent of all of the heat.

**Table 5: CHP electrical capacity (MWe) by area and prime mover in 2013**

	Gas Turbines*	Steam Turbines	Reciprocating Engines	Total
<b>England</b>	<b>4,193</b>	<b>354</b>	<b>844</b>	<b>5,392</b>
East Midlands	85		44	130
Eastern	195		95	290
London	61		119	180
North East	713	67	63	843
North West	551	178	111	839
South East	772	0	191	963
South West	24		59	83
West Midlands	27		75	102
Yorkshire/Humberside	1,810	63	88	1,961
<b>Scotland</b>	<b>401</b>	<b>57</b>	<b>53</b>	<b>510</b>
<b>Wales</b>	<b>166</b>		<b>43</b>	<b>210</b>
<b>Northern Ireland</b>	<b>15</b>		<b>44</b>	<b>59</b>
<b>UK Total</b>	<b>4,725</b>	<b>461</b>	<b>984</b>	<b>6,170</b>

\*Includes combined cycle gas turbines

The CHP market is dominated by large-scale (>10MWe) plant, with about 80 per cent of all installed capacity in this size range. The regional distribution of CHP by capacity tranche is given in Table 6.



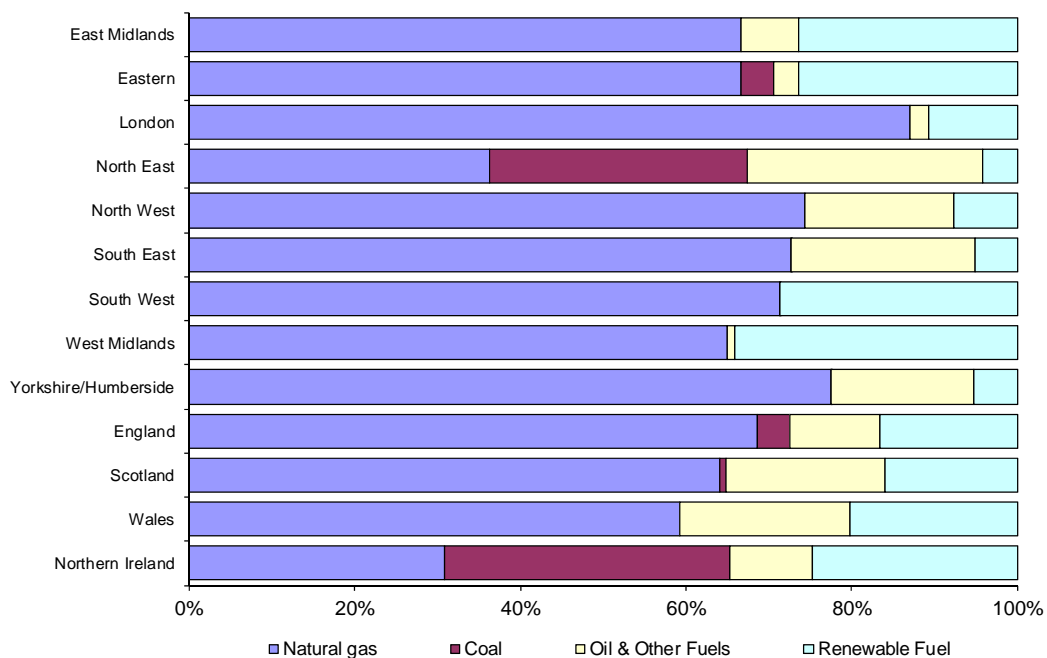
**Table 6: CHP electrical capacity (MWe) by area and size in 2013**

	<= 100 kWe	> 100 kWe to 1 MWe	>1 MWe to 2 MWe	> 2 MWe to 10 MWe	> 10 MWe +	Total
<b>England</b>	<b>33</b>	<b>225</b>	<b>143</b>	<b>612</b>	<b>4,378</b>	<b>5,392</b>
East Midlands	2	14	7	35	72	130
Eastern	3	26	17	59	185	290
London	6	38	10	67	60	180
North East	3	8	10	48	774	843
North West	4	36	31	91	677	839
South East	5	41	30	130	758	963
South West	3	21	6	53	0	83
West Midlands	3	21	16	62	0	102
Yorkshire/Humberside	4	20	16	67	1,853	1,961
Scotland	2	16	10	69	412	510
Wales	3	15	4	39	148	210
Northern Ireland	1	13	3	15	27	59
<b>Grand Total</b>	<b>39</b>	<b>270</b>	<b>160</b>	<b>736</b>	<b>4,965</b>	<b>6,170</b>

### The fuel mix

The proportion of coal, gas, renewable fuels and 'oil and other fuels' (comprising oil products, refinery gases, blast furnace gas and other industrial wastes) in the fuel mix for each region is shown in Chart 3.

**Chart 3: Proportion of different fuels in the fuel mix for CHP in 2013 for each region**



Natural gas represented about 67 per cent of all fuel burned in CHP in 2013, which is lower than in 2012 when the share was 71 per cent. Natural gas made up more than half of fuel burned in every region/country except Northern Ireland and the North East. The fall in the share of total fuel that was natural gas was substantially due to large absolute falls in natural gas consumption in the Yorkshire/Humberside and East Midland regions. The former was due mainly to a large fall at one large scheme and the latter due to the closure of one large scheme in 2012. Northern Ireland continues to be the region with the lowest share of total fuel consumed in the form of natural gas. Although the long term trend is for increasing proportions of natural gas to be used in Northern Ireland, the proportion in 2013 was slightly lower than in 2012. The share of total fuel that was natural gas in the North East is showing a trend of long term decline.

With the exception of Northern Ireland and the North East regions, where the share of total fuel that was coal was 35 per cent and 21 per cent, respectively, coal continues to play a minor overall role. Coal was not consumed at all in six regions (West Midlands, Wales, South West, North West, London and East Midlands).

The share of total renewable fuel use in CHP plant rose from 7 per cent in 2012 (revised) to about 10 per cent in 2013. An important part of this increase is due to the initiation in 2013 of a large, new renewable CHP scheme in the North West region. In 2013 the region with the largest absolute quantity of renewable fuel consumption was Scotland and the region with renewable fuel constituting the largest share of CHP fuel input was the West Midlands, where renewables accounted for 34 per cent of total fuel used in the region.

## **Summary**

The Yorkshire and the Humberside region continues to be the region of the UK with the greatest level of installed CHP capacity and electricity generation, accounting for 32 per cent of all capacity and 24 per cent of all electricity generated. Other regions with high levels of CHP capacity are the South East, North East and the North West regions where there is a significant presence of heat intensive industry, such as oil refining, chemicals production and paper and printing. About 88 per cent of all refinery CHP capacity is located in the regions of Yorkshire and the Humber, the South East and Scotland, while about 85 per cent of CHP capacity at chemical works is located in the three regions of the North East, the North West and Yorkshire and Humber. Over 80% of the paper and printing CHP capacity is to be found in just two regions: South East and North West and a large proportion of Food and Drink related capacity (43 per cent) is to be found in the Eastern region.

The continuing importance of the heat-intensive oil refining and the chemicals sectors in the Yorkshire and Humber, North East and North West regions explain the higher values of CHP heat and electrical capacities per unit of GVA in these regions than any of the other regions. However, there has been a significant decrease in CHP electricity generated in the Yorkshire and Humber and North East regions between 2012 and 2013 and a significant increase in the North West region in the period 2011-2013.

The region consuming the largest quantity of renewable fuel in 2013 was Scotland and the region with renewable fuel making up the largest proportion of CHP fuel input was the West Midlands.

*Special feature - CHP*

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