

Combined Heat and Power in Scotland, Wales, Northern Ireland and the regions of England in 2014

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 2015. This article updates statistics published in the September 2014 edition of Energy Trends and provides a breakdown of CHP in the Devolved Administrations and English regions in 2014¹.

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 Association for Decentralised Energy (ADE). Data from CHP schemes not covered by the above sources are extrapolated from historic data. There is an ongoing data quality assurance exercise in respect of these schemes.

Between 2013 and 2014 there was a net increase of 12 in the number of CHP schemes in the database (54 new schemes and the removal of 42 schemes), but a net decrease of 72 MWe in capacity. Good Quality CHP² capacity in the UK fell from 6,190 MWe (revised 2013 figure) to 6,118 MWe in 2014.

Regional Trends³

Tables 1 and 1B show a comparison of the number of schemes, electrical capacity, electricity generated and heat generated in the regions⁴ for the period 2012 to 2014. During this time, the total number of schemes increased from 1,955 to 2,066, however the capacity decreased from 6,175 MWe to 6,118 MWe. With the exception of the South East region, the number of schemes increased in all regions over the period 2012 to 2014. Over this period, the electrical capacity increased in all regions except in the East Midlands, North East, North West and Wales regions. The largest falls in capacity in the period 2012-2014 were in East Midlands and North East regions. In the East Midlands there was a significant decrease in capacity due largely to the closure of one scheme serving the Chemicals sector. In the North East one scheme ceased to operate as CHP in the period 2012-2014 and so is no longer counted in the statistics.

¹ Similar articles on CHP have appeared in previous Energy Trends publications from 2001 to 2014. 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.

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

³ 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.

⁴ These regions are the Government Office Regions of England and Devolved Administrations of Scotland, Wales and Northern Ireland.

Table 1: Trend in number of CHP schemes and their electrical capacity over the period 2012-2014

	Number of Schemes			Electrical Capacity (MWe)		
	2012	2013	2014	2012	2013	2014
England	1,658	1,733	1,743	5,405	5,405	5,312
East Midlands	102	110	112	209	138	144
Eastern	158	170	164	299	291	302
London	273	279	291	172	179	195
North East	108	113	111	852	844	745
North West	266	271	276	787	797	768
South East	283	297	293	940	969	969
South West	129	139	142	82	86	82
West Midlands	163	170	171	100	107	110
Yorkshire/Humberside	176	184	183	1,965	1,995	1,998
Scotland	119	130	132	496	512	538
Wales	117	122	119	219	214	208
Northern Ireland	61	69	72	55	59	60
UK Total	1,955	2,054	2,066	6,175	6,190	6,118

Table 1B: Trend in CHP electricity and heat generated over the period 2012-2014

	Electricity Generated (GWh)			Heat Generated (GWh)		
	2012	2013	2014	2012	2013	2014
England	19,584	16,951	16,831	39,023	37,194	34,618
East Midlands	946	579	571	1,949	1,391	1,347
Eastern	1,222	1,227	1,323	1,848	1,983	2,005
London	476	494	533	1,184	1,190	1,201
North East	2,450	1,800	2,001	7,130	6,594	6,265
North West	3,440	3,227	2,663	9,671	9,020	7,772
South East	4,007	3,403	3,239	7,711	7,409	6,839
South West	358	365	364	620	638	449
West Midlands	403	414	433	714	731	753
Yorkshire/Humberside	6,283	5,442	5,703	8,197	8,239	7,988
Scotland	2,274	2,357	2,487	6,000	5,802	5,811
Wales	873	882	747	2,720	2,571	2,366
Northern Ireland	220	210	216	500	508	512
UK Total	22,950	20,400	20,281	48,244	46,076	43,306

The region with the highest proportion of the UK's electrical capacity was the Yorkshire and Humberside region with a 33 per cent share. The average capacity of CHP schemes in this region was higher than in any other region.

Chart 1 shows the distribution of electricity and heat generation from CHP in 2014 across the English regions and the Devolved Administrations. The largest contribution to electricity generation comes from the Yorkshire and the Humber region (28 per cent), followed by the South East (16 per cent), the North West (13 per cent), Scotland (12 per cent) and the North East (9.9 per cent). This ranking is the same as in 2013. However, while there was an increase in the proportion of total electricity generated in the North West in the years to 2013, this proportion declined in 2014.

The regions of Yorkshire and Humberside and the North West each represented 18 per cent of the heat generated, followed by the South East (16 per cent) and the North East (14 per cent). In 2013 the North West had the greatest share of heat generation, consequently there has been a greater fall in power and heat generation in the North West compared to the other regions. The overwhelming majority of this decrease has been within the Chemical sector.

Chart 1: CHP generation by area in 2014

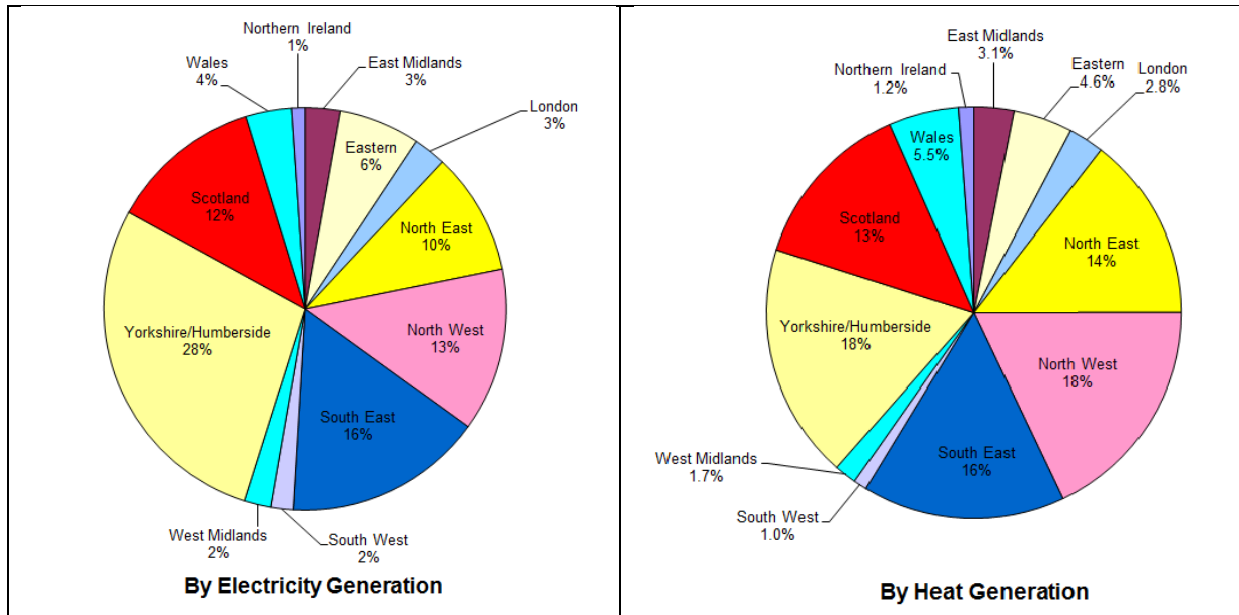


Table 2 shows an overview of CHP plant data broken down between the English regions and devolved administrations. CHP capacity utilisation can be expressed by the Load Factor (LF). LF is the actual generation as a proportion of the theoretical maximum power that can be generated for a given total installed capacity (TPC). The power output that is actually generated is the total power output (TPO). For 2014, the TPC was 8,906 MWe and the TPO was 40,213 GWh, giving a LF of 52 per cent, which is one percentage point lower than in 2013 (revised).

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 2014

	Number of Schemes	Electrical Capacity (QPC)* MWe	Electrical Capacity (TPC) MWe	Heat Capacity MWth	Fuel Used* GWh	Electricity Generated (QPO)* GWh	Electricity Generated (TPO) GWh	Heat Generated GWh	Load Factor** (%)
England	1,743	5,312	7,855	18,608	73,430	16,831	34,789	34,618	50.6%
East Midlands	112	144	175	495	2,821	571	614	1,347	40.1%
Eastern	164	302	302	860	5,779	1,323	1,355	2,005	51.2%
London	291	195	196	850	2,407	533	621	1,201	36.2%
North East	111	745	839	1,876	12,261	2,001	3,076	6,265	41.9%
North West	276	768	872	4,049	13,463	2,663	3,555	7,772	46.6%
South East	293	969	2,197	5,219	14,059	3,239	9,381	6,839	48.7%
South West	142	82	82	186	1,212	364	384	449	53.6%
West Midlands	171	110	177	585	1,859	433	576	753	37.2%
Yorkshire/Humberside	183	1,998	3,016	4,488	19,569	5,703	15,227	7,988	57.6%
Scotland	132	538	692	2,859	11,597	2,487	3,502	5,811	57.8%
Wales	119	208	300	917	4,650	747	1,695	2,366	64.6%
Northern Ireland	72	60	60	154	1,030	216	227	512	43.5%
UK Total	2,066	6,118	8,906	22,539	90,707	20,281	40,213	43,306	51.5%

*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 shows the CHP outputs of each region and is derived from the data contained in Table 1B. It portrays only a limited picture as it does not account for the varying size of each region's economy. 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.

CHP continues to be a very important part of the economies of the Yorkshire/Humber, North East, 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 industries in these regions, which are heat intensive sectors.

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

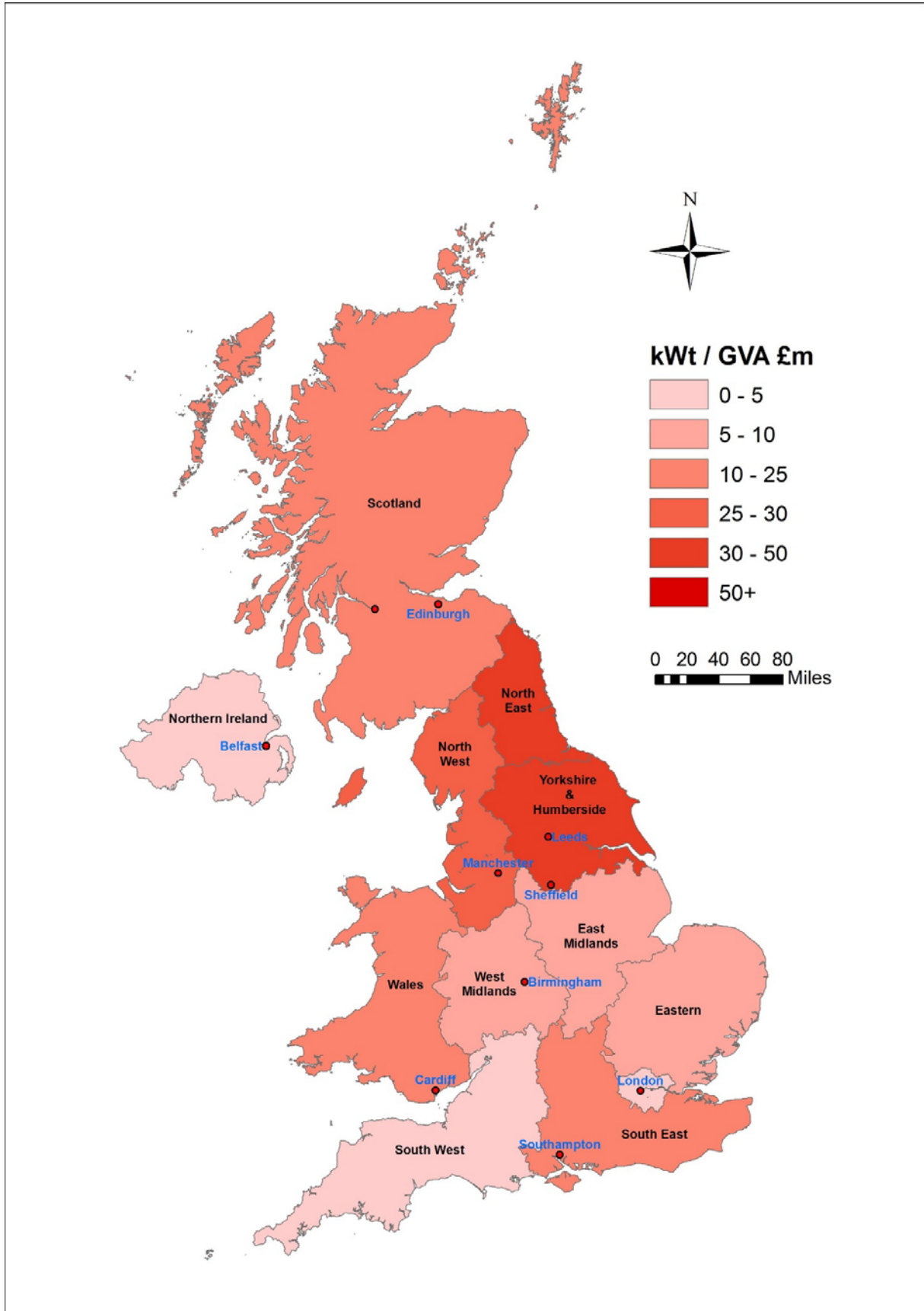
	Heat capacity per unit GVA kWt/ (£million)*	Electrical capacity per unit GVA kWe/ (£million)*
Yorkshire/Humberside	44.13	19.65
North East	41.34	16.43
North West	28.59	5.42
Scotland	24.41	4.59
South East	22.97	4.26
Wales	17.62	4.00
England	14.34	4.09
Eastern	6.59	2.32
East Midlands	5.57	1.62
West Midlands	5.31	1.00
Northern Ireland	4.70	1.81
London	2.51	0.58
South West	1.64	0.72
UK total	14.78	4.01

*GVA is provisional gross value added in 2014 (income approach)⁵

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. Over 60 per cent of all CHP capacity in the oil refineries and oil and gas terminals sector can be found in the Yorkshire and Humber region and 85 per cent of capacity in the chemicals sector is to be found in three regions: North East, Yorkshire/Humber and the North West. Over 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 (45 per cent), which is substantially explained by the heavy concentration of the heat intensive sugar beet industry in this region.

⁵www.ons.gov.uk/ons/rel/regional-accounts/regional-gross-value-added--income-approach-/december-2014/index.html

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, either on their own or as part of Combined Cycle Gas Turbines (CCGT), continue to dominate the CHP market. In 2014, CCGT accounted for about 70 per cent of total CHP capacity but only about 6 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.
- Reciprocating Engines constitute the vast majority of all CHP schemes (92 per cent). The region with the highest proportion of Reciprocating Engines is the West Midlands (nearly 98 per cent of all schemes in that region) and the region with the lowest proportion is Yorkshire/Humberside (87 per cent).

Table 5: CHP electrical capacity (MWe) by area and prime mover in 2014

	Gas Turbines*	Steam Turbines	Gas and Steam Turbines Subtotal	Reciprocating Engines	Total
England	3,776	609	4,385	927	5,312
East Midlands	-	-	90	54	144
East of England	-	-	195	107	302
London	-	-	51	144	195
North East	-	-	683	62	745
North West	466	178	644	123	768
South East	-	-	774	195	969
South West	18	0	18	64	82
West Midlands	-	-	27	83	110
Yorkshire and The Humber	1,840	63	1,903	95	1,998
Scotland	401	81	482	56	538
Wales	130	36	166	42	208
Northern Ireland	-	-	15	45	60
Grand Total	-	-	5,048	1,070	6,118

*Includes Combined Cycle Gas Turbines (CCGT)

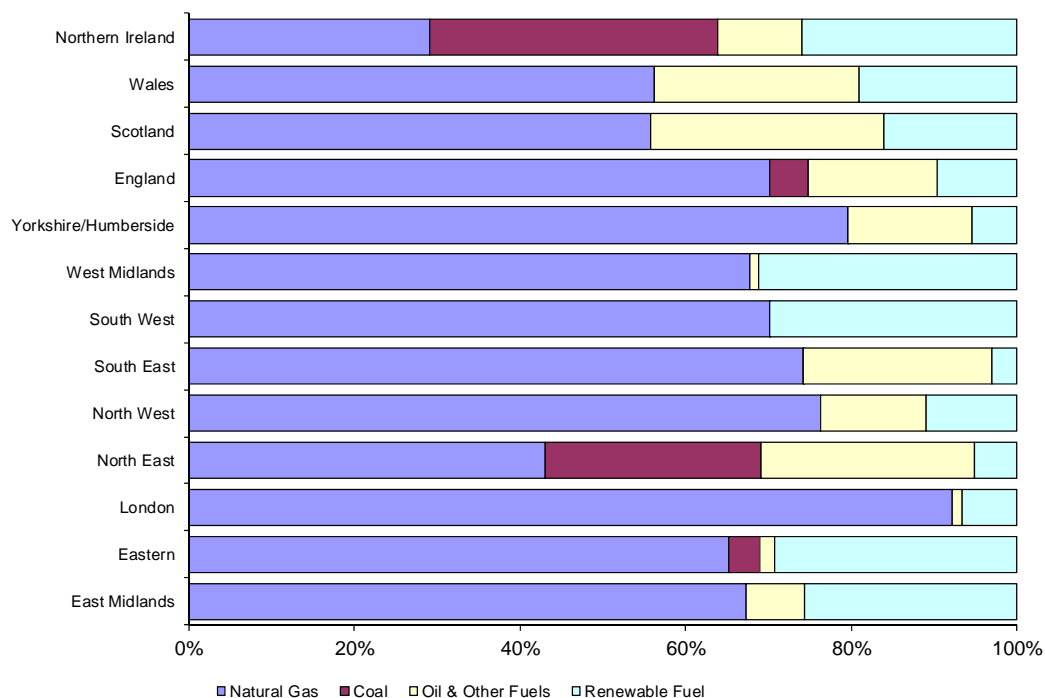
The CHP market continues to be dominated by large-scale (>10MWe) plant, with 79 per cent of all installed capacity being in this size range. The regional distribution of CHP by capacity tranche is given in Table 6.

Table 6: CHP electrical capacity (MWe) by area and size in 2014

	<= 100 kWe	> 100 kWe to 1 MWe	>1 MWe to 2 MWe	> 2 MWe to 10 MWe	> 10 MWe +	Total
England	33	232	160	666	4,222	5,312
East Midlands	2	15	10	-	-	144
East of England	2	25	20	-	-	302
London	6	42	12	-	-	195
North East	3	9	8	49	677	745
North West	4	36	32	103	592	768
South East	5	41	32	134	758	969
South West	3	23	9	47	0	82
West Midlands	3	22	16	69	0	110
Yorkshire and The Humber	4	20	21	71	1,882	1,998
Scotland	2	16	14	62	444	538
Wales	3	15	-	-	148	208
Northern Ireland	1	14	-	-	-	60
Grand Total	39	277	179	783	4,841	6,118

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 2014 for each region

Special feature - CHP

Natural gas represented 67 per cent of all fuel burned in CHP in 2014, which is lower than in 2013 when the share was 69 per cent (revised). Natural gas continues to make up more than half of fuel burned in every sector except Northern Ireland and the North East. With the exception of Northern Ireland, natural gas was the fuel accounting for the largest proportion of overall fuel consumption in all regions. In Northern Ireland, coal accounted for the largest proportion of overall fuel consumption (35 per cent) followed by natural gas (29 per cent). Northern Ireland continues to be the region with the lowest share of total fuel consumed in the form of natural gas. This reflects the relatively low penetration of the natural gas network in Northern Ireland.

In 2014, coal consumption was absent in all but five regions, with two of the five consuming significantly less than 1 per cent. The largest users of coal were Northern Ireland (35 per cent) followed by the North East (26 per cent). The number of schemes burning coal in 2014 was very small (<10 schemes).

The share of total renewable fuel use in CHP plant rose from 9.5 per cent in 2012 (revised) to 11 per cent. In 2013 the region with the largest absolute quantity of renewable fuel consumption continued to be Scotland, followed by the Eastern and North West regions. The region with renewables making up the greatest share of fuel was the West Midlands (31 per cent), followed by the South West (30 per cent) and then the Eastern region (29 per cent).

Summary

The Yorkshire and the Humber region continues to be the region of the UK with the greatest level of installed CHP capacity and CHP electricity generation, accounting for 33 per cent of all capacity and 28 per cent of all electricity generated. Other regions with high levels of CHP capacity are the South East, North West and the North East regions. This is substantially explained by the significant presence of heat intensive industries, such as oil refining, chemicals production and paper and printing in these regions.

The largest share of CHP capacity in the UK (about 37 per cent) is found at oil refineries, oil terminals and gas terminals. Capacity in this sector occurs in just five of the twelve UK regions. About 92 per cent of all capacity in this sector is located in three regions: Yorkshire and Humber, South East and Scotland.

The second largest share of CHP capacity in the UK (about 27 per cent) is found in the chemicals sector and 85 per cent of this capacity is found in just three regions: North East, Yorkshire and the Humber and North West.

About 90% of the paper and printing CHP capacity is to be found in just three regions: South East, North West and Scotland. Forty-five per cent of capacity in the Food and Drink sector is in the Eastern region, which is substantially explained by a very high concentration of heat intensive sugar from sugar beet production in this 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.

The region consuming the largest quantity of renewable fuel for CHP generation in 2014 was Scotland and the region with renewable fuel making up the largest proportion of CHP fuel input was the West Midlands.

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