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NATURAL ENVIRONMENT RESEARCH COUNCIL

Department for  
**Communities and  
Local Government**

# Summary of information on coal for land-use planning purposes

Commissioned Report CR/06/114N





BRITISH GEOLOGICAL SURVEY

COMMISSIONED REPORT CR/06/114N

# Summary of information on coal for land-use planning purposes

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## *Photograph*

*Orgreave opencast coal site near  
Sheffield, 2004*

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# 1 Preface

The British Geological Survey has produced this report for the Department for Communities and Local Government (formerly the Office of the Deputy Prime Minister). It is one of a number of reports, leaflets and factsheets prepared under the Joint DCLG–BGS Minerals Information Programme which, amongst a number of objectives, seeks to present factual and authoritative data on the extent, availability, production, trade and use of minerals that are of economic importance to the UK. Much of this information is made available on the BGS minerals website, [www.mineralsUK.com](http://www.mineralsUK.com).

# 2 Acknowledgements

The report brings together information that was previously scattered and the authors would like to acknowledge the considerable assistance of the Coal Authority and the Department of Trade and Industry for providing statistical information and constructive advice. They would also like to thank the Department for Communities and Local Government for their support and guidance.

### 3 Executive Summary

The UK has had a long history of coal production and coal was the UK's most important primary fuel until 1971, when it was overtaken by petroleum. Although the importance of coal as an energy source has declined, it continues to provide around 17 per cent of the nation's primary energy consumption and about one third of its electricity. In 2003 the UK became a net importer of coal and in 2005, of a total demand for coal of about 63 Mt, only 20 Mt was produced domestically. In the same year production of coal by surface mining exceeded deep-mine production for the first time.

There will be a continuing market for coal in the medium term as part of a balanced and varied UK energy supply. The operators of almost 75 per cent of UK coal-fired electricity generating capacity have opted to fit flue gas desulphurisation equipment to enable their power stations to operate to at least 2015 in compliance with the EU Revised Large Combustion Plants Directive. In addition, several operators have announced their interest in building new and more efficient coal-fired plant. However, the extent that indigenous coal will continue to contribute to UK supply will depend on the competitiveness of deep-mined coal relative to imported coal and the extent that new deep mine and opencast reserves can be accessed. The recent significant decline in opencast coal production in England reflects the fact that new permissions have failed to replenish the reserves being worked.

The report brings together data on coal production, trade, consumption and uses, and provides information on licensing and reserves. It also summarises information on opencast coal sites granted and refused planning permissions and recommends that a system of safeguarding shallow coal resources be put in place. Coal exploitation by methods other than conventional deep and shallow mining are also summarised.



## 4 Introduction

Coal was the UK's most important primary fuel until 1971, when consumption of petroleum exceeded it for the first time. It continues to account for around 17 per cent of primary energy consumption, and during 2000–05 supplied on average 33 per cent of the UK's electricity (Appendices 1 and 2).

In 2000 total coal demand was 58.862 million tonnes (Mt) of which 31.197 Mt (53 per cent) was home-produced. In 2003 the UK became a net importer of coal. In 2005, total demand for coal was in excess of 63 Mt, but UK production had fallen to 20 Mt (32 per cent). The balance was imported, mainly from Russia (about 17.584 Mt) and South Africa (13.054 Mt).

The UK became a net importer of natural gas in 2004 and is expected to become a net importer of oil by 2010. By 2020, the UK is likely to be importing three-quarters of its energy supplies. The Government has said that it does not propose to set targets for the share of total energy or electricity supply to be met by different fuels; it believes that this is a matter for the markets, reinforced by long-term policy measures. However, the Government announced in November 2005 a review of Energy Policy to report in mid-2006. This may revisit aspects of its policy on access to indigenous fuel supplies, including coal resources.

This report brings together information on coal usage and supply previously published by The Coal Authority, the Department of Trade and Industry (DTI) and the British Geological Survey (BGS). It is hoped that presenting the information in a convenient form will provide a reference source that will be of use to Regional Planning Bodies in preparing Regional Spatial Strategies, Mineral Planning Authorities (MPAs) in preparing mineral development documents, and industry and MPAs when preparing and considering planning applications.

## 5 Coal production

### 5.1 HISTORY

Coal production in the UK reached a peak of 287 Mt in 1913. Thereafter, output declined, due in part to loss of export markets during and subsequent to the First World War and in part to competition from oil and other fuels. However, the UK remained a net exporter of coal until the early 1980s. By 1980, annual output was 130 Mt, of which 112.4 Mt was from deep mines and 15.78 Mt from opencast or surface mines. This latter method of working was introduced as an emergency measure in 1942 to help maintain supplies of coal during the Second World War. It is, as a rule, more profitable than deep mining owing to its low capital costs, its ability to recover almost all of the coal in a given site, however thin the seams, and its high productivity per employee.

During the miners' strike of 1984–85, deep mine output was 35.24 Mt and 75.29 Mt respectively, recovering to 90.35 Mt in 1986, but declining steadily thereafter as uneconomic pits continued to be closed, even though loss-making operations tended to be cross-subsidised by profitable mines (Figure 1). Annual output from surface mines stood at 14.3 Mt in 1984 and 15.57 Mt in 1985 (i.e. not significantly different from 1980 production), and peaked at over 18 Mt during 1989–92 (Appendix 3).

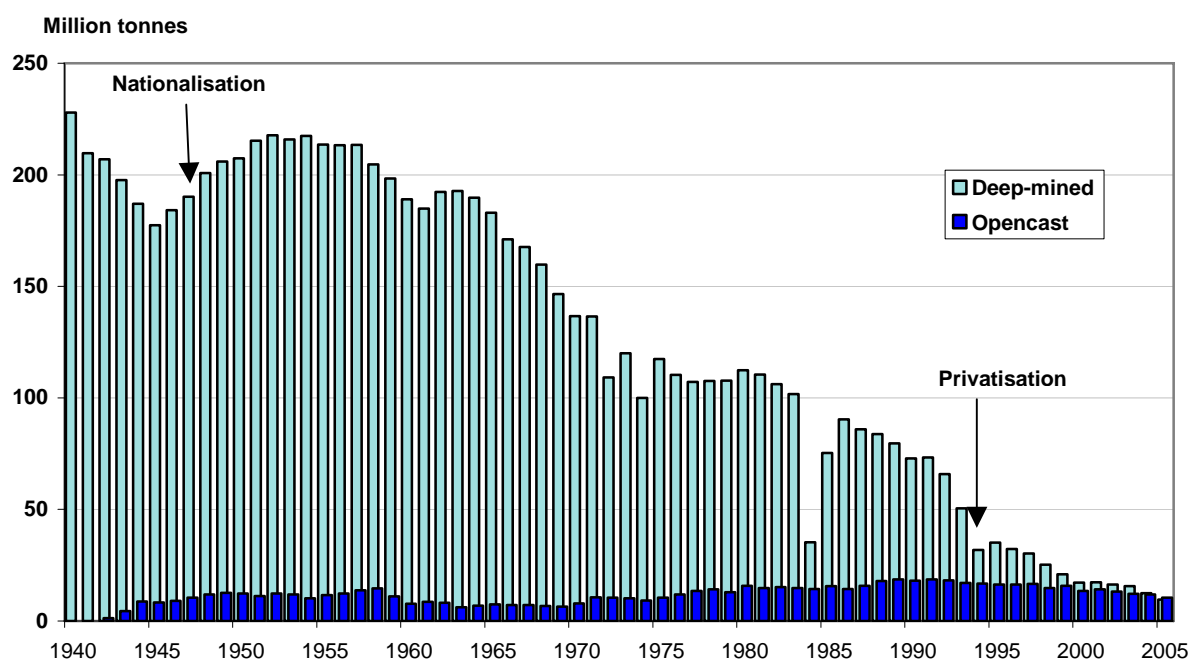
In 1994, the nationally-owned British Coal Corporation (formerly the National Coal Board) was privatised. In that year 60 deep mines produced a total of 31.5 Mt of coal while 100 surface mines produced 16.8 Mt. Since then, deep mine closures have continued for a range of reasons,

including lack of commercially viable reserves, geological problems, underground flooding and company failure. Surface output has also declined, particularly in England (Figure 3). Total UK coal production in 2005 was 20.0 Mt. Of this 9.56 Mt was deep mined at 13 mines, 10 in England and 3 in Wales. The other 10.44 Mt was from opencast at 34 working sites, including 21 in Scotland, which contributed 7.75 Mt; 8 in South Wales, contributing 1.23 Mt; and 5 in England, contributing 1.45 Mt.

These 2005 tonnages brought total cumulative production of coal since 1780 to over 26,000 Mt, of which surface mines contributed 773 Mt.

For the 60 years that preceded privatisation, continuing coal production was regarded as a national strategic necessity, since coal provided all but a small fraction of the total energy consumed by UK industry and the commercial sector. After the country had weathered the miners' strike of the early 1980s, it became accepted that the industry no longer needed to be protected for strategic reasons, especially as coal's share of national energy supply was overtaken by petroleum and natural gas. However, in more recent years, it has been recognised that coal can have a role to play as part of a balanced and varied energy supply, provided that its potential environmental impacts can be managed.

As evidence of the continuing role of coal in the generating mix, the operators of almost 75 per cent of UK coal-fired capacity have opted to fit flue gas desulphurisation (FGD) equipment to enable their power stations to continue to operate to at least 2015 in compliance with the EU Revised Large Combustion Plants Directive, a significant increase on the total originally anticipated. There will, therefore, be a continuing market for coal. Several operators have also recently announced their interest in building new coal-fired plant, not only with state-of-the-art cleaner burn technology from the outset but also designated to retrofit future enhancements as they come to market.



**Figure 1. UK coal production, 1940 - 2005**

## 5.2 BY-PRODUCTS

Methane gas released by coal mining (referred to as coal mine methane – CMM) is recovered and used as a process fuel on site. Methane extracted from some abandoned coal mines (known as abandoned mine methane - AMM) can be used in electricity generation but is not used to its

full potential because of logistics. An important by-product of opencast coal mining is fireclay – a type of mudstone that underlies most coal seams and which is used primarily in the production of buff-coloured facing brick and pavers. Fireclay production is crucially dependent on opencast coal mining, although only a small proportion of sites produce fireclay, either because they do not contain fireclay of suitable quality or because of planning restrictions. The brick industry has particular concerns about the future availability of fireclay in England, where most fireclays are consumed, because of the decline in opencast coal mining resulting from the difficulty in obtaining planning permissions for new sites. Mudstones occurring in coal-bearing strata may be of potential for use as brick clay from some opencast coal sites. Sandstone has also been recovered from some sites for use as aggregate and as a source of dimension stone.

Colliery spoil is produced at all deep-mine operations and consists mainly of mudstone and siltstone. It may be used as a low-grade aggregate, for example as bulk engineering fill. In 2001 783 000 tonnes was used for fill in England and Wales out of total arisings of 8 Mt. Old colliery spoil is also used on a small scale in brickmaking, and at one site in North Wales it is used as the clay feedstock for cement manufacture. Some coal tips may be reworked to recover any remaining coal present.

### 5.3 QUALITY

Almost all coal produced in the UK at present is categorised as *steam coal*, chiefly for use in power station boilers. The product from England and Scotland is almost entirely *bituminous coal* but producers in Wales invariably describe their product as *anthracite*, the north-west part of the South Wales coalfield having long been known as an anthracite district. Coal from deep mines contains varying amounts of deleterious elements, in particular, sulphur and chlorine. Coal from opencast operations contains, as a rule, lower amounts of these elements and a certain amount of blending is undertaken in order to minimise the sulphur and chlorine content of coal delivered to power stations. Imported coal has naturally lower sulphur contents (<1 per cent) than coal produced in the UK, and notably in England. This is a desirable step towards minimising sulphur dioxide emissions from coal-fired power stations.

*Lignite*, a relatively low-rank coal with high volatile content, has been produced in small quantities, in association with ball clay, in SW England. In Northern Ireland there are large resources of lignite that have been evaluated for power generation but have not been worked.

### 5.4 LOCATION

Coalfields, defined as areas where coal seams or coal-bearing strata occur at or within technical reach of the land surface, exist in all four countries of the UK. Both Scotland and Wales were important producers at one time - South Wales dominated world exports at the industry's peak in 1913 - but by 1980 England was responsible for 85 per cent of UK production. (Figure 2). The bulk of this output was from the East Pennines Coalfield where production from long-established mines had been augmented by several new deep mines developed in the 1960s. Deep-mine production in Scotland ceased in 2002 and by the end of 2005 only one major deep mine remained in Wales, and seven in England - six in the East Pennines Coalfield and one in Warwickshire. Two of the East Pennines mines (Rossington and Harworth) are scheduled to be mothballed in 2006. In addition to these large mines there were four small underground mines in operation, two in the East Pennines field and two in South Wales. There has been no significant production of coal in Northern Ireland.

There were 34 opencast sites producing at the end of 2005, of which 5 were in England, 21 in Scotland and 8 in Wales. In 1985/86 (financial year) two thirds of opencast production was from England but by 2004/05 English production had fallen to 23 per cent of total GB output and Scottish production had risen to 65 per cent (Figure 3). Welsh output has remained level at about 12 per cent of the total. Appendices 4 and 5 provide details of opencast and deep-mine coal production by MPA respectively.

The reason for the decline in opencast production in England is primarily the increasing difficulty in obtaining planning permission for opencast coal sites because of the interpretation of Mineral Planning Guidance 3: *Coal Mining and Colliery Spoil Disposal* (1999), which relates to England only. In Scotland the policy framework for opencast coal is provided in Scottish Planning Policy (SPP) 16: *Opencast Coal* (2005). In Wales comparable guidance is give in *Mineral Planning Policy Wales 2000*. The Welsh Assembly Government has published *Mineral Technical Advice Note 2: Coal* for consultation.

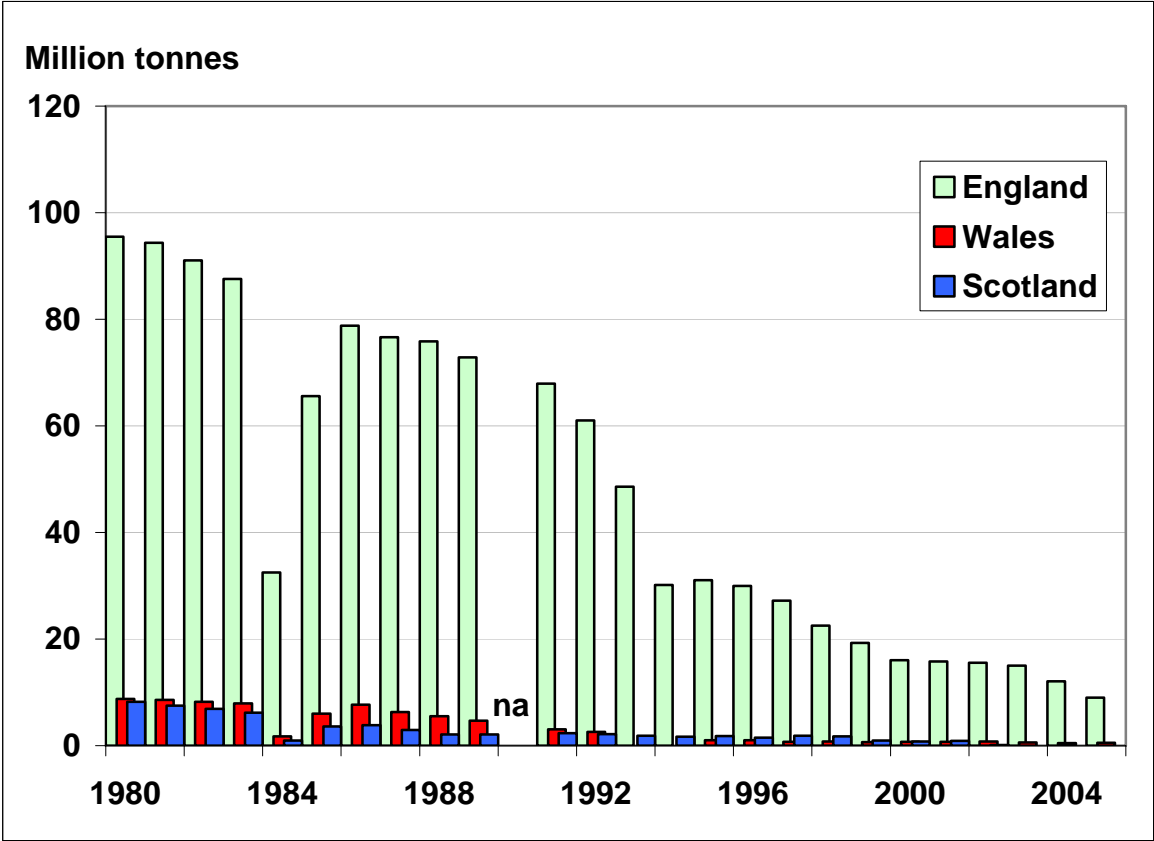


Figure 2. Underground coal production in England, Wales and Scotland, 1980 - 2005

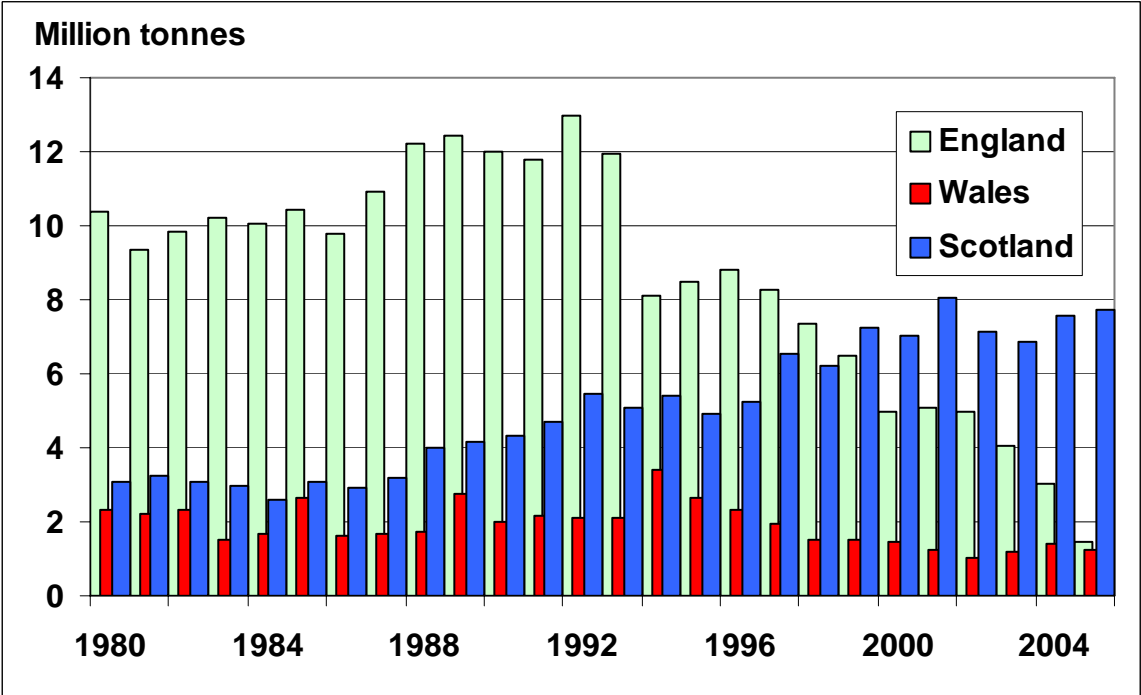
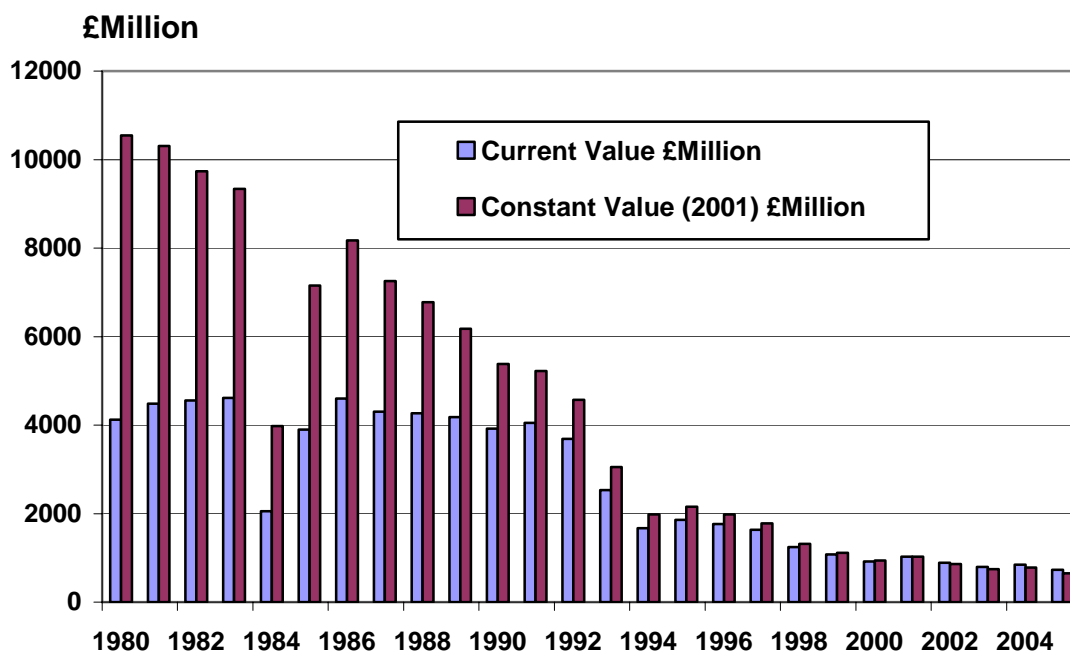


Figure 3. Opencast coal production in England, Wales and Scotland, 1980 - 2005

## 6 Value of production

The BGS has published estimates for the value of UK coal output since 1970. These are shown in both current and real (constant) terms in Figure 4; the decline in the value of production principally reflects the decline in coal output. The total value of coal production in 2005 is estimated at £727 million. The values have been calculated by multiplying total UK coal output by an average unit value for coal sales. Originally the latter was derived from the value of coal sales by the National Coal Board/British Coal Corporation but since privatisation the figure used has been the average price of coal purchased by the electricity generating industry. This figure includes imported coal and also an element for transport costs. However, it is believed to be a reasonable proxy for the value of coal output for comparison purposes with other minerals that are of economic importance to the UK. Values in real (constant) terms have been derived by using the UK GDP deflator.



Source: *United Kingdom Minerals Yearbook*, BGS

**Figure 4. Value of UK coal production, 1980 – 2005**

## 7 Number of active sites

At nationalisation in 1947 the National Coal Board operated 960 collieries but by 1980 underground NCB mines totalled 230. By 1995 this number (all operators) had declined to 73 and the number declined further to 12 at the end of 2005. Underground production is confined to six deep mines in the East Pennine Coalfield, one in Warwickshire and one in South Wales. At the end of 2005 there were also four small underground mines, two in the East Pennine Coalfield and two in South Wales. At the end of 2005 there were 34 opencast sites in operation, of which 5 were in England, 21 in Scotland and 8 in Wales.

## 8 Coal trade

### 8.1 CLASSIFICATION OF OFFICIAL UK TRADE

UK external trade (imports and exports) in coal is recorded by HM Revenue & Customs. The principal heading under which anthracite and bituminous coal is recorded is:

**Combined Nomenclature (CN) Code 27.01** [anthracite, bituminous coal & solid fuels based on coal].

Total UK trade under this overall heading in 2004 was:

- |           |                   |               |
|-----------|-------------------|---------------|
| • Imports | 34 661 000 tonnes | £1280 million |
| • Exports | 652 000 tonnes    | £41.2 million |

The UK is, therefore, a very significant net importer of coal.

CN code 27.01 is further broken down into a number of other detailed (eight digit) codes.

In Table 1, and in the *United Kingdom Minerals Yearbook*, ‘bituminous coal’ comprises the following codes:

- 2701 12 10 : Bituminous coal, not agglomerated: Bituminous coal - coking coal.
- 2701 12 90: Bituminous coal, not agglomerated: Bituminous coal o/t (other than) coking coal.
- 2701 19 00: Coal, not agglomerated, other than anthracite or bituminous: Other coal o/t those specified in 2701 11 and 2701 12 .

In terms of tonnage and value the most important of these codes are ‘Bituminous coal other than coking coal’, i.e. steam coal chiefly for power generation, imports of which were 15.3 Mt in 2004, and ‘Coal ... other than anthracite or bituminous’, imports of which were 12.9 Mt in 2004. In spite of the description of this latter code it is clear that these imports are also chiefly of bituminous coal other than coking coal, i.e. steam coal. It is designated as a separate code since its use (coking or non-coking) is not specified. Total value of imports of these two codes was £1000 million at an approximate unit value of £35 per tonne in 2004.

Imports of ‘Bituminous coal – coking coal’ were 6.34 Mt in 2004 with a value of £269 million. Coking coal commands a significantly higher price than steam coal and approximate unit value of coking coal imports in 2004 was £42 per tonne.

‘Anthracite’ consists of the following two codes:

- 2701 11 10: Anthracite, whether or not pulverized, but not agglomerated: Anthracite coal with a volatile matter limit (on a dry, mineral-matter-free basis) not exceeding 10 per cent.
- 2701 11 90: Anthracite, whether or not pulverized, but not agglomerated: Anthracite with a volatile matter limit (on a dry, mineral-matter-free basis) exceeding 10 per cent.

Imports of anthracite were 173 000 tonnes in 2004 with a value of £10.7 million and exports totalled 172 000 tonnes.

‘Briquettes of coal’ comprises:

- 2701 20 00: Briquettes, ovoids and similar solid fuels manufactured from coal: Briquettes, ovoids and similar solid fuels manufactured from coal (ecsc).

Imports of briquettes manufactured from coal were 7697 tonnes with a value of £0.84 million in 2004.

‘Lignite’, a high-volatile relatively low-rank coal, is classified under CN code 2702, with two sub-codes:

- 2702 10 00 Lignite, non-agglomerated
- 2702 20 00 Lignite, agglomerated

Imports of lignite in 2004 were 5255 tonnes with a value of £0.68 million

<b>Coal</b>	<b>Thousand tonnes</b>							
<b>EXPORTS</b>	<b>1998</b>	<b>1999</b>	<b>2000</b>	<b>2001</b>	<b>2002</b>	<b>2003</b>	<b>2004</b>	<b>2005(p)</b>
Bituminous coal	688	439	616	310	342	353	440	377
Anthracite	282	336	304	273	187	180	172	172
Briquettes of coal	57	53	77	76	63	59	40	15
Lignite (inc. agglomerated)	3	5	2	3	4	4	3	3
<b>Total Exports</b>	<b>1 030</b>	<b>833</b>	<b>999</b>	<b>662</b>	<b>596</b>	<b>607</b>	<b>655</b>	<b>567</b>
<b>IMPORTS</b>								
Bituminous coal	20 743	20 167	22 397	32 773	27 110	31 539	34 480	43 620
Anthracite	502	602	1 058	2 757	1 551	335	173	343
Briquettes of coal	11	8	18	11	17	7	8	6
Lignite (inc. agglomerated)	3	1	1	3	1	3	5	2
<b>Total Imports</b>	<b>21 258</b>	<b>20 779</b>	<b>23 473</b>	<b>35 544</b>	<b>28 680</b>	<b>31 884</b>	<b>34 666</b>	<b>43 971</b>

*Source: HM Revenue & Customs*

(p) provisional

**Table 1. UK: imports and exports of coal, 1998 – 2005**

The UK is a large importer of coal. Provisional data for 2005 (Table 1) show that net imports rose to an all-time high of 43.6 Mt. Bituminous coal accounted for 99 per cent of the total imports and for 66 per cent of total exports. Of total bituminous coal imports, coal other than for coking (steam coal) amounted to 37.1 Mt (85 per cent) and coking coal to 6.52 Mt (15 per cent). Bituminous coal imports are on a rising trend and exceeded annual domestic production for the first time in 2001.

In addition to coking coal imported for the domestic production of coke, chiefly by, and for the use of, the steel industry, the UK has recently been a significant net importer of coke, under the following codes:

- 2704 00 19: Coke and semi-coke (including char) of coal other than for electrodes
- 2704 00 90: Coke and semi-coke (including char) of lignite.

Net imports of coke under these two codes were 748 493 tonnes in 2003 and 833 750 tonnes in 2004. These tonnages represent approximately 16 per cent of annual UK coke consumption of about 5 Mt.

## **8.2 IMPORTS OF COAL AND COKE BY COUNTRY OF ORIGIN**

The country of origin of UK imports of coal and coke can also be determined from trade accounts. Imports of bituminous coal, anthracite and coke are shown in Table 2 by the principal countries of origin.

Coal	2003		2004		2005 (p)	
IMPORTS	kt	£000	kt	£000	kt	£000
<b>Bituminous coal - Total</b>	<b>31 539</b>	<b>907 426</b>	<b>34 480</b>	<b>1 268 000</b>	<b>43 620</b>	<b>1 853 850</b>
Of which from:						
S. Africa	12 082	322 023	10 270	356 000	12 983	494 149
Russia	3 386	90 619	8 556	320 796	17 008	671 778
Australia	5 336	174 350	6 240	244 151	4 333	284 500
Colombia	3 163	93 448	3 298	121 082	3 289	126 132
Indonesia	-	-	1 458	40 066	1 616	47 850
<b>Anthracite - Total</b>	<b>335</b>	<b>15 897</b>	<b>173</b>	<b>10 739</b>	<b>343</b>	<b>19 359</b>
Of which from:						
S. Africa	109	4 439	45	2 644	40	2 881
Russia*	-	-	19	1 296	76	3 563
China	40	2 410	37	2 613	24	2 912
Vietnam	45	1 641	23	1 634	-	-
EU**	56	3 164	47	2 443	37	2 870
<b>Coke - Total</b>	<b>981</b>	<b>69 931</b>	<b>1 029</b>	<b>149 430</b>	<b>722</b>	<b>84 941</b>
Of which from:						
China	470	38 821	432	91 079	367	54 321
Ukraine	128	9 119	152	21 579	-	-
Russia	181	6 689	142	7 628	152	10 721
Colombia	-	-	53	4 251	-	-
EU	157	11 957	124	19 558	202	19 900

\*Imports from Russia, Estonia and Latvia. \*\*Chiefly re-exports, not of EU origin

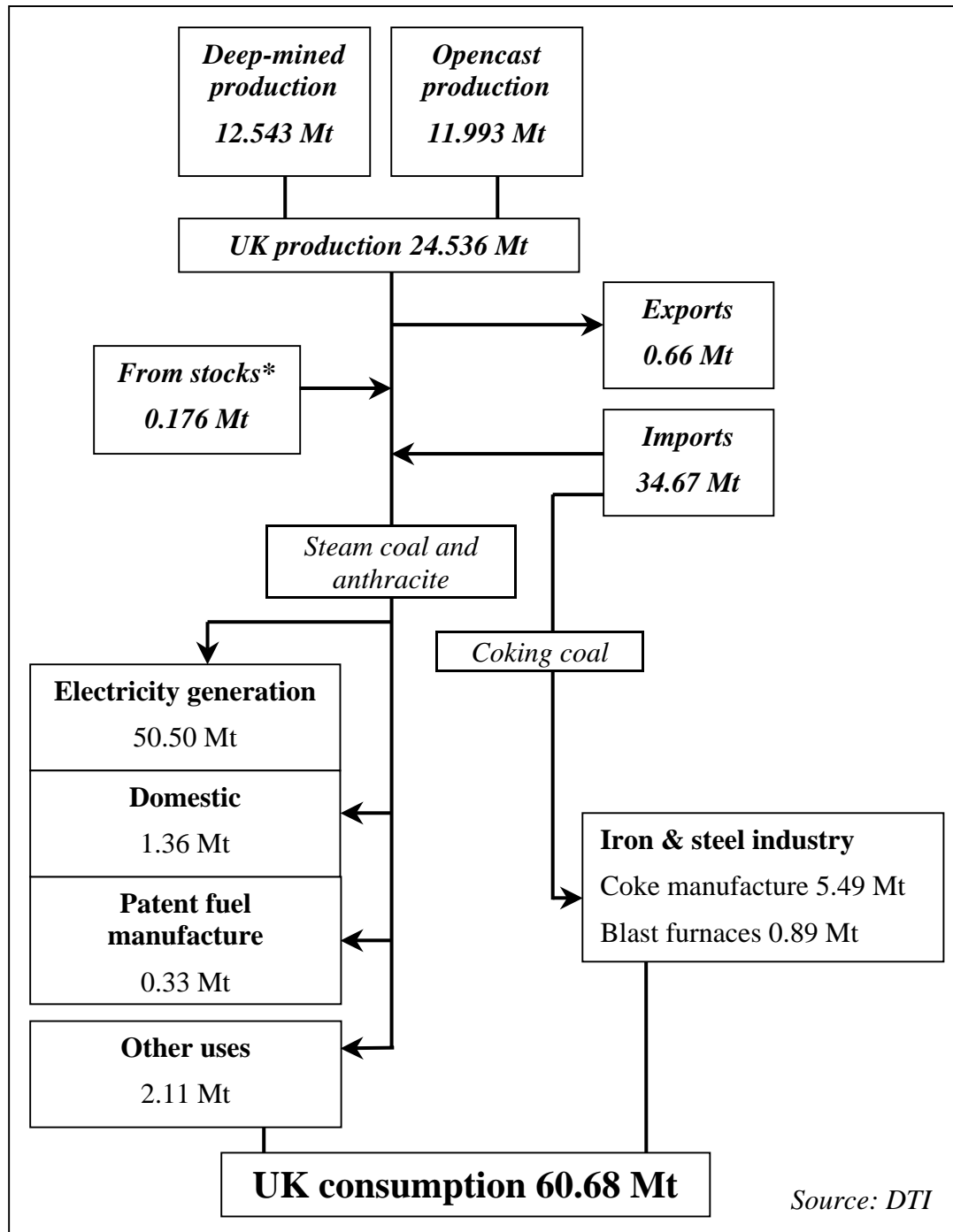
(p) provisional

Source: HM Revenue & Customs

**Table 2. Imports of coal and coke by country of origin, tonnage and value, 2003 – 2005**

Table 2 illustrates the rapid increase in imports of bituminous coal from Russia (25 per cent of the total in 2004). The bulk of the tonnages of **bituminous coal** shown are of steam coal but the imports from Australia are almost entirely of coking coal. Imports of **anthracite** from Latvia and Estonia are of Russian origin. Imports of **anthracite** from the EU are chiefly from countries that have no coal production of any kind and must, therefore, originate as exports to the EU from other countries. The table shows the recent increase in imports of **coke** from China, Ukraine and Russia although the value figure for imports from China in 2004 appears to be anomalously high in relation to the tonnage. Imports of **coke** from the EU are chiefly from countries that have no coal production and which are therefore dependent on coal imports for coke production. The UK coal supply chain is shown diagrammatically in Figure 5.





\* Domestic and imported.

**Figure 5. UK coal supply chain, 2004.**

Table 3 shows imports of coal in 2004, by tonnage and country of origin, broken down to the three categories: bituminous (steam coal), bituminous (coking coal) and anthracite.

	Thousand tonnes				
	Steam coal	Coking coal	Anthracite	Other solid fuel	Total
<b>European Union <sup>(1)</sup></b>	1 500	-	80	199	<b>1 779</b>
<b>Australia</b>	2 035	4 140	-	25	<b>6 200</b>
<b>Canada</b>	25	715	-	18	<b>758</b>
<b>Colombia</b>	3 630	-	-	53	<b>3 683</b>
<b>Indonesia</b>	1 458	-	-	-	<b>1 458</b>
<b>Norway</b>	138	-	-	2	<b>140</b>
<b>People's Republic of China</b>	190	-	43	432	<b>665</b>
<b>Republic of South Africa</b>	10 105	-	39	-	<b>10 144</b>
<b>Russia</b>	9 776	148	8	142	<b>10 074</b>
<b>United States of America</b>	717	1 342	2	-	<b>2 061</b>
<b>Venezuela</b>	39	-	-	-	<b>39</b>
<b>Other countries</b>	-	-	-	179	<b>179</b>
<b>Total all countries</b>	<b>29 614</b>	<b>6 345</b>	<b>194</b>	<b>1 051</b>	<b>37 203</b>

*Source: DTI/HM Revenue & Customs*

<sup>(1)</sup> Includes extra-EU coal routed through the Netherlands

**Table 3. Imports of coal and other solid fuel in 2004**

## 9 Uses and consumption

The property of coal that makes it of economic interest is that it is combustible. It oxidises and releases heat when burnt, which in turn can be used for power generation, its most important use, but also for industrial processes, such as iron smelting, and domestic heating.

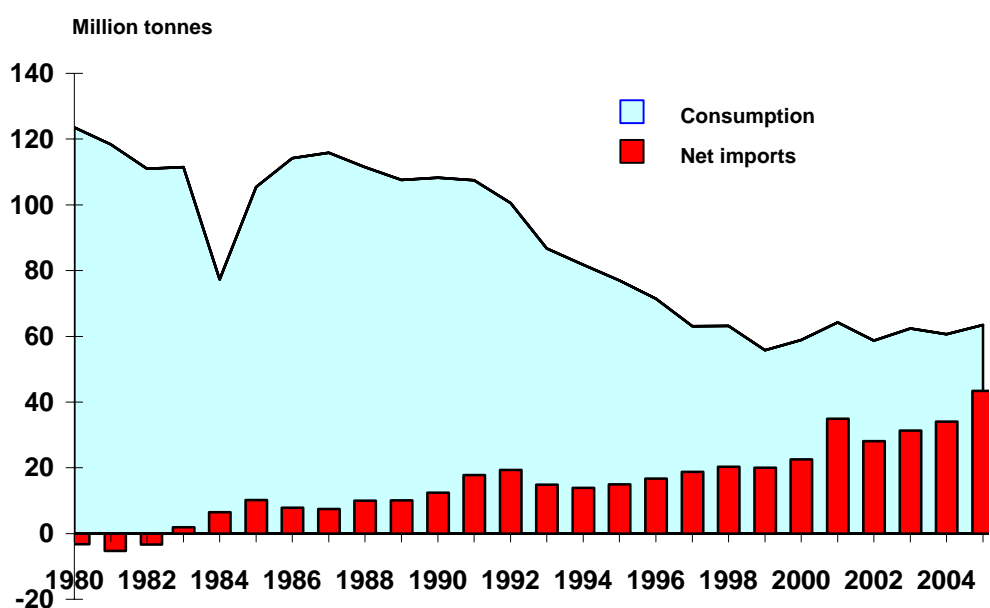
UK coal consumption has been on a declining trend for many years although there has been a small increase in recent years. (Details of coal supply and consumption for the period 1980 – 2005 are shown in Appendix 3). In 2004 coal consumption was 60.68 Mt of which 36.15 Mt (59 per cent) was supplied by imports (Figure 6). Per capita consumption was 1018 kg in 2004. Of total consumption 50.5 Mt or 83 per cent of the total was used for electricity generation. At the time of coal industry privatisation in 1994 about three-quarters of the nation's electricity was generated from coal. Subsequently its use declined as it was replaced by natural gas and, to a lesser extent, by nuclear power (Figure 7). Due to its higher sulphur content, indigenous coal will in future have to be used exclusively in power stations fitted with flue-gas desulphurisation (FGD) equipment, which can remove about 90 per cent of sulphur dioxide emissions. Sulphur is

recovered by these plants as synthetic gypsum which is used mainly in plasterboard manufacture. Other uses for *steam coal* and *anthracite* (Table 4) are in heat generation, patent fuel manufacture, industry and domestic use. *Coking coal*, which is entirely supplied by imports, is used in coke manufacture, for the steel industry and directly in blast furnaces.

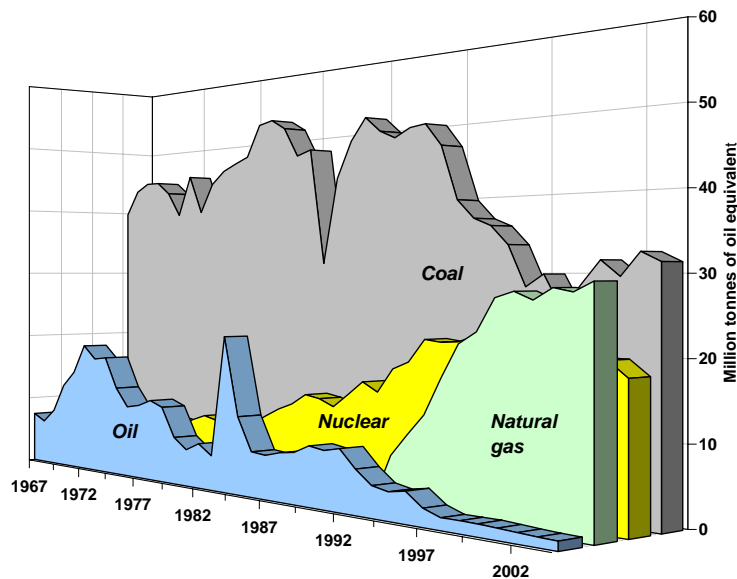
	Thousand tonnes			
	Steam coal	Coking coal	Anthracite	Total
Electricity generation	49 520	-	983	50 503
Heat generation	543	-	-	543
Coke manufacture	-	5 487	-	5 487
Blast furnaces	-	895	-	895
Patent fuel manufacture	-	-	327	327
Industry	1 449	-	33	1 482
Domestic	793	-	566	1 359
Other	82	-	1	83
<b>TOTAL</b>	<b>52 387</b>	<b>6 382</b>	<b>1 910</b>	<b>60 679</b>

Source: DTI

**Table 4. Use of coal by type and sector in 2004**



**Figure 6. UK coal consumption and net imports, 1980 – 2005**



Source: DTI

**Figure 7. Fuel used in electricity generation, 1965 – 2004**

## 10 Licensing

Ownership of almost all coal in Britain (but not lignite) now resides with the Coal Authority on behalf of the state. The Coal Authority is a non-departmental public body, established by the Coal Industry Act 1994. On 31st October 1994 it assumed responsibility for all the interests previously vested in British Coal in respect of unworked coal and coal mines and for the liabilities associated with past coal mining and unworked coal. The main functions of the Authority are to manage the coal resources under its control, encourage economically viable operations to work these resources, grant licences for coal exploration and extraction, provide effective management of subsidence damage claims, and provide information on past, present and proposed future coal mining activities. The Coal Authority issues licences for exploration for and extraction of underground and opencast coal and the development of coalbed methane.

The Petroleum Act 1998 (the “1998 Act”) vests all rights and ownership of the petroleum resources (oil and gas) of Great Britain and the United Kingdom territorial waters to the Crown. For onshore gas in Great Britain, including coalbed methane, the Secretary of State for Trade and Industry grants licences to persons that confer exclusive rights to ‘search and bore for and get’ these gas resources. The rights granted by landward licences do not include any rights of access, and the onus is upon the licensee to obtain all the relevant planning permissions from the respective authorities. Licensees wishing to enter or drill through coal seams for coalbed methane must also seek the permission of the Coal Authority.

## 11 Reserves

Debate on the size, and hence the life expectancy, of Britain’s coal ‘reserves’, began in the 19<sup>th</sup> century. During the era of the nationalised industry, coal reserves were claimed to be extremely large. However, the statistical data presented on coal reserves were not subject to economic rigour and tended to indicate the tonnages of coal that were deemed to be *technically* recoverable

(over a certain seam thickness and above a certain depth). However, only a very small proportion of the total coal resource is currently *economically* viable.

The economic potential of any mineral deposit can only be proved by detailed evaluation involving borehole drilling and associated test work to prove that mineral of sufficient quantity and quality is present to justify commercial development. That part of a mineral resource that has been fully evaluated and proved commercially viable to work is often called a 'mineral reserve'. International practice now further limits the term reserve to mineral that can be *legally* extracted. In the context of mineral planning in the UK the term reserve, thus refers to mineral with legal access and for which a valid planning permission for extraction exists (i.e. 'permitted reserve').

The ultimate fate of a permitted reserve is to be either physically worked out or to be made non-viable by changing economic circumstances. In the case of deep mine coal in the UK, large tonnages of coal have been removed from the reserve category because of mine closures caused by deteriorating economic factors, which made operations non-viable. In some cases geological problems, including flooding, have also contributed to premature mine closure because the costs of remediation could not be financially justified. In contrast, the current improved outlook for coal prices may extend the life of an operation and allow mothballed mines to be reopened. In the case of opencast coal sites with relatively high overburden (waste rock) to coal ratios higher prices may allow working of deeper seams.

Permitted reserves of opencast coal by Mineral Planning Authority in operational sites and in those with planning permission but not yet worked is shown in Table 5.

MPA	2003	2004	2005	No. producing sites
<b>Derbyshire</b>	485 554	116 496	466 577	0
<b>Leicestershire</b>	505 611	47 092	61 823	1
<b>East Midlands Total</b>	<b>991 165</b>	<b>163 588</b>	<b>528 400</b>	<b>2</b>
<b>Durham</b>	387 311	117 169	257 000	0
<b>Northumberland</b>	2 864 271	2 614 498	2 492 246	2
<b>Newcastle</b>	200 000	229 929	185 984	1
<b>North East Total</b>	<b>3 451 582</b>	<b>2 961 596</b>	<b>2 935 230</b>	<b>3</b>
<b>Bolton</b>	964 000	964 000	964 000	0
<b>St Helens</b>	3 797	-	10 950	0
<b>Lancashire</b>			15 000	0
<b>North West Total</b>	<b>967 797</b>	<b>964 000</b>	<b>989 950</b>	<b>0</b>
<b>Shropshire</b>	-	349 318	344 976	0
<b>West Midlands Total</b>	<b>-</b>	<b>349 318</b>	<b>344 976</b>	<b>0</b>
<b>Barnsley</b>	185 562	34 031	-	0
<b>Leeds</b>	451 740	122 601	-	0
<b>Rotherham</b>	540 240	148 937	60 329	1
<b>Wakefield</b>	50 307	-	-	0
<b>Yorkshire &amp; the Humber Total</b>	<b>1 227 849</b>	<b>305 569</b>	<b>60 329</b>	<b>1</b>
<b>ENGLAND TOTAL</b>	<b>6 638 393</b>	<b>4 744 071</b>	<b>4 858 885</b>	<b>5</b>
<b>Carmarthenshire</b>	188 839	159 119	157 080	0
<b>Neath Port Talbot</b>	1 911 934	3 563 421	3 622 048	7
<b>Merthyr Tydfil</b>	-	5 500 000	10 800 000	0
<b>Powys</b>	3 134 166	2 753 569	2 435 552	1
<b>Wrexham</b>	117 421	38 558	-	0
<b>WALES TOTAL</b>	<b>5 352 360</b>	<b>12 014 667</b>	<b>17 014 680</b>	<b>8</b>
<b>Borders</b>	450 000	-	-	0
<b>Clackmannanshire</b>	191 406	82 456	-	0
<b>Dumfries and Galloway</b>	1 878 045	1 878 045	-	0
<b>East Ayrshire</b>	11 601 204	17 780 204	15 835 443	8
<b>Falkirk</b>	284 000	405 875	441 925	1
<b>Fife</b>	3 381 099	2 929 774	1 608 018	5
<b>Midlothian</b>	-	392 875	181 353	1
<b>North Lanarkshire</b>	1 103 212	902 347	580 000	1
<b>South Lanarkshire</b>	11 918 137	10 922 312	10 080 893	4
<b>West Lothian</b>	1 000 000	1 262 647	754 082	1
<b>SCOTLAND TOTAL</b>	<b>31 807 103</b>	<b>36 556 535</b>	<b>29 481 714</b>	<b>21</b>
<b>GREAT BRITAIN TOTAL</b>	<b>43 797 856</b>	<b>53 315 273</b>	<b>51 355 279</b>	<b>34</b>

*Source: The Coal Authority*

**Table 5. Permitted reserves of coal in working opencast sites and those not yet worked at 31st December in year stated.**

The approximate tonnage of coal in underground and opencast sites licensed by the Coal Authority is shown in Table 6. This includes ‘reserves’ of coal in sites with planning permission (operating and not yet worked) and coal within licence at closed sites. The Coal Authority states that underground mining usually extracts just above 50 per cent of the total volume of available coal whilst opencast often achieves near 100 per cent recovery. This means that the recoverable deep-mine coal is likely to be half of that shown. Appendices 6 and 7 provide a breakdown of licensed tonnages by country (England, Wales and Scotland).

	<b>UNDERGROUND</b>		<b>OPENCAST</b>	
	<b>Mt</b>		<b>Mt</b>	
<b>YEAR ENDING</b>	<b>Operating</b>	<b>Closed*</b>	<b>Operating</b>	<b>Closed*</b>
<b>March 1995</b>	803	1	44	2
<b>March 1996</b>	776	7	32	2
<b>March 1997</b>	637	52	38	3
<b>March 1998</b>	535	114	47	3
<b>March 1999</b>	447	190	51	4
<b>March 2000</b>	426	191	43	4
<b>March 2001</b>	415	192	37	4
<b>March 2002</b>	328	311	48	5
<b>March 2003</b>	122	27	46	4
<b>March 2004</b>	106	226	51	3
<b>March 2005</b>	112	79	46	1

\*Closed underground mines and opencast sites are those where coaling operations have ceased but the licence remains valid

*Source: The Coal Authority*

**Table 6. Estimated tonnage remaining in licence in the UK, 1995 – 2005**

## 12 Planning permissions

In order to evaluate the extent that applications to work opencast coal were being granted or refused, a survey questionnaire was sent out by the BGS in February 2005 to 50 MPAs. Most of these MPAs replied within first four months, although four MPAs had yet to respond. The survey requested that each MPA should provide information on the sites in their area that were operational at any time during 2004, together with any planning applications that had been either been granted or refused during 2004. A similar survey is currently being undertaken for 2005.

### 12.1 SITES GRANTED PLANNING PERMISSIONS IN 2004

From the 46 MPAs that provided information there were a total of 9 planning permissions for opencast coal working approved in 2004 (Table 7). Of these, five of the applications were for new workings and the other four applications were for extensions to previous sites.

An estimated total reserve of 5 381 000 tonnes of coal was permitted in all 9 sites, with 2 364 000 tonnes from new sites (Table 8). The estimated reserve for each site varied greatly

with the largest tonnage from a single site (an extension to an existing site) being 2 100 000 tonnes, and the smallest tonnage (also from an extension) of 7000 tonnes. This compares with an estimated total reserve for opencast coal in operational sites in Great Britain of 37 246 066 tonnes on 31 December 2004.

	<b>Active sites during 2004</b>	<b>Planning permissions granted</b>	<b>Planning permissions refused</b>
<b>England</b>	16	5	3
<b>Scotland</b>	14	3	1
<b>Wales</b>	12	1	0
<b>Total</b>	<b>42</b>	<b>9</b>	<b>4</b>

**Table 7. Summary statistics for opencast coal site information received from MPAs (survey covers the period 1 January 2004 to 31 December 2004).**

	<b>Permitted reserves in operational sites at end 2004</b>	<b>Permitted reserves in sites not worked at end 2004*</b>	<b>Reserves in sites granted planning permissions in 2004</b>	<b>Tonnage in sites refused planning permission in 2004</b>
<b>England</b>	2 760 142	1 983 929	1 181 000	2 210 000
<b>Scotland</b>	30 453 490	6 103 045	2 100 000	900 000
<b>Wales</b>	4 032 434	7 982 233	2 100 000	0
<b>Total</b>	<b>37 246 066</b>	<b>16 069 207</b>	<b>5 381 000</b>	<b>3 110 000</b>

\* includes reserves granted planning permission in 2004

**Table 8. Tonnage of opencast coal sites granted and refused planning permission in 2004 and reserves remaining at year end.**

## **12.2 SITES REFUSED PLANNING PERMISSIONS IN 2004**

Of the four sites refused planning permission in 2004, two of the applications were for new sites and two were for extensions to existing operations. The total tonnage in these four sites was 3 110 000 tonnes. The tonnage per site varied from 140 000 to 1 070 000 tonnes.

Refusals of planning permissions usually reflect local opposition to opencast coal mining. This may be because neighbours – residential, industrial or commercial – are concerned about noise, dust, traffic movements and risk to environmentally sensitive sites, and cannot be persuaded that planning conditions attached to any consent can be effective in mitigating the risks of disturbance, or that the potential impact can be offset by other planning gain. There also may be local resistance explained by sensitivity to the socio-political status of underground mining, especially in areas where deep mines have closed and perceptions about the role of opencast output during the 1984 strike (but see paragraph 2.1 above for details of output in that period). A preference for avoiding unnecessarily sterilising farming land may also be a factor, but the Coal Measures do not, as a rule, support high-quality agricultural land. Most surface mining operations are relatively short-lived and restoration standards are now much higher than they were at some times in the past. Surface mining can, in particular, be an effective way to remediate areas with a history of shallow mining or with colliery spoil in order to restore them as open land or for other development.



## 13 Safeguarding coal resources

Coal-bearing strata occur at the surface in a number of discrete ‘exposed coalfields’ but also dip beneath younger rocks to form ‘concealed coalfields’. Figures 8 and 9 show the distribution of exposed and concealed coal-bearing strata in Britain and the location of operational underground and opencast mines in early 2006.

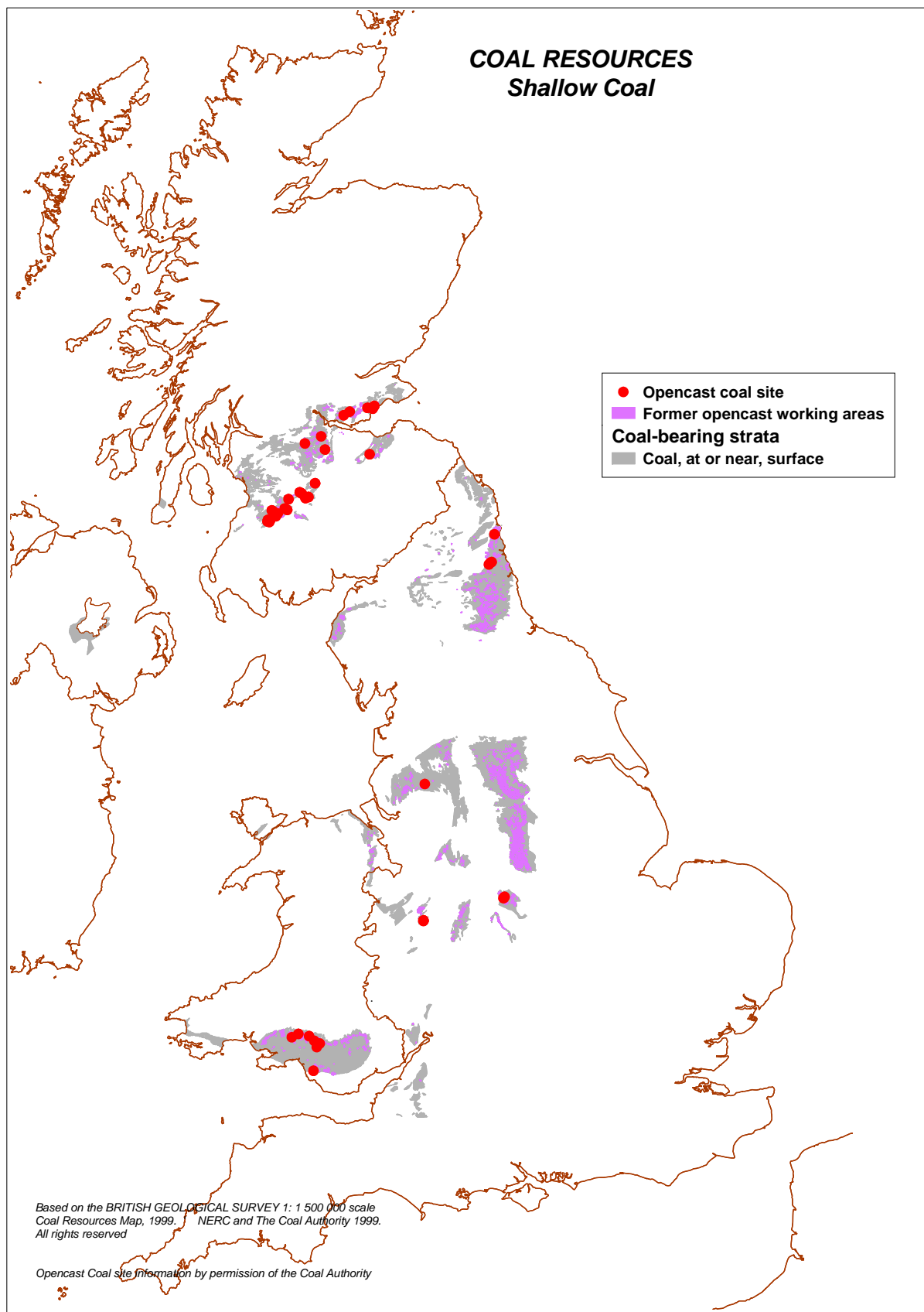
Since coal has been mined intensively in Great Britain for the past 160 years the resources readily accessible to conventional underground mining have been heavily depleted. Investigations have concluded that it is unlikely that any new deep mines for working virgin resources would be economically viable in the foreseeable future, although access to such resources from existing mines is an option. However, the possibility of accessing coal by drift mining remains. Thus, future interest in coal extraction is likely to be mainly confined to shallow coal resources that can be worked by surface mining methods. This method also has the advantage of extracting coals that were either too thin to be extracted by earlier underground methods, or were only partially extracted due to the need to leave supporting pillars in the workings. Opencast coal mining can thus be used to remove and stabilise old underground working prior to redevelopment of an area for other uses.

Shallow coal resources are easily sterilised by other forms of non-mineral development. *Mineral Planning Guidance 3* (revised 1999) states that it is desirable to secure coal extraction prior to new permanent development above coal ‘reserves’ (*sic*). However, the consultation draft of *Mineral Policy Statement 1* for England only recommended safeguarding of non-energy minerals. Opencast coal in particular is a valuable and readily accessible energy resource that could be worked relatively rapidly. It is desirable, therefore, that shallow coal resources that could be worked by surface mining be identified and safeguarded against future sterilisation by non-mineral development. Since coal is a national resource it would be desirable if safeguarding were undertaken on a national basis throughout Great Britain. Safeguarding policies have been proposed in the Coal Technical Advice Note for Wales. Representations have also been made in respect of safeguarding energy minerals in England by consultees responding to the draft MPS1.

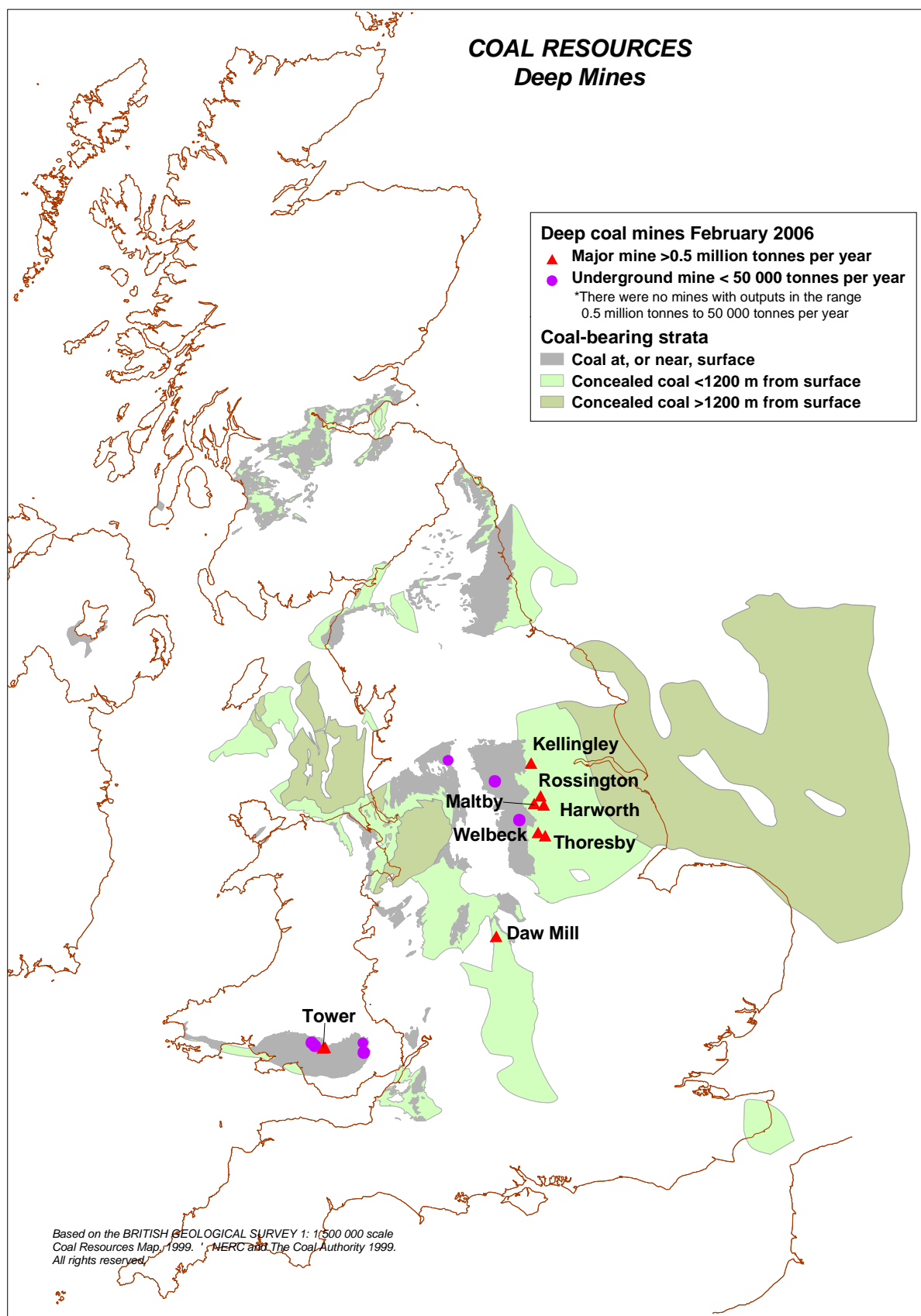
Against this background and the possible need to define ‘mineral safeguarding areas’ for opencast coal, sections 13.1–13.4 discuss the types of information that should be considered.

### 13.1 EXTENT OF SHALLOW COAL RESOURCES

The broad extent of shallow coal resources are defined on the *Coal Resources Map of Britain*, which was produced by the BGS on behalf of the Coal Authority in 1999 (Figure 8). The resources were originally defined at a scale of 1:50 000. Shallow coal resources (coalfield with less than 50 m overburden) are the areas that are technically amenable to opencast coal working and contain all such workings. The coal seams occur from the surface to 200 m depth from the surface, which is the usual maximum depth for opencast working in Britain. There are normally numerous old underground mines in these areas, which may represent a continuing hazard for construction work and other activities, as well as a small number of operational drift mines. Shallow coal is defined by the outcrop of the lowest normally workable coal seam and the highest normally workable seam. In practice, the usual younger boundary is defined by projecting to land surface the intersection of the –50 m level (from surface) with the base of the overburden. In this context ‘overburden’ means any barren rocks or superficial deposits that overlie the coal-bearing strata. In practice these resource areas may overstate what is practically workable by surface mining as most opencast sites do not go deeper than 100 m.



**Figure 8. Coal resources, showing location of opencast coal sites, February 2006**



**Figure 9. Coal resources, showing location of deep mines, February 2006.**

### **13.2 OPENCAST COAL PROSPECTING AREAS**

The BGS holds data on 'Opencast coal prospecting areas' supplied by the Coal Authority. This index includes outlines for over 8000 opencast coal prospecting sites from the 1940s to date. The index leads to information on the records of approximately 1 million boreholes (additional to those shown in the BGS Borehole Records layer) drilled during site exploration and also the accompanying plans and other data, all filed in 3618 boxes. The sites include those that have been drilled and not worked and also those that have been exploited. The extent of these areas are shown on the BGS GeoData Index and are visible at 1:50 000 and larger scales.

### **13.3 AREAS OF WORKED SHALLOW COAL**

Areas of extracted opencast coal are shown on the 'county' mineral resource maps and the online Regional minerals GIS (see [www.mineralsUK.com](http://www.mineralsUK.com)) that have been produced by BGS on behalf of the former ODPM, although these data may not be completely up-to-date. The data has been obtained from the Coal Authority's Mining Reports database which contains information on past opencast coal mining activity, which is an aggregate of information derived from a number of sources. The areas mainly reflect the limits of coal extraction. However, the recent entries into the mining reports database principally reflect site boundaries.

### **13.4 AREAS OF FORMER 'CONDITIONAL LICENCES' FOR OPENCAST COAL**

Prior to privatisation, British Coal 'proved' a significant number of sites that were intended to be in their future working programme. Those sites that had not, or were not, being worked at privatisation in 1994 were included in the portfolio of assets that were transferred to the private sector. Where these sites did not have planning permission they were issued 'Conditional Licences'. However, as the sites identified by British Coal were often very large and for which obtaining a planning permission would now be difficult, or the whole of the site might not now be viable, only parts of the licences were worked. Consequently many Conditional Licences were not worked and at March 2004 the estimated total tonnage of coal remaining in Conditional Licences was about 154 Mt (Table 9). However, all Conditional Licences expired at the end of 2004. Nevertheless the areas of former Conditional Licences represent the highest level of 'proved' opencast coal resources outside sites currently being considered by the industry. They might provide the primary targets for future safeguarding. However, many other areas that have been explored may also warrant safeguarding.

<b>YEAR ENDING</b>	<b>OPENCAST Mt</b>
	<b>Conditional Licences</b>
<b>March 1995</b>	245
<b>March 1996</b>	245
<b>March 1997</b>	230
<b>March 1998</b>	214
<b>March 1999</b>	203
<b>March 2000</b>	205
<b>March 2001</b>	202
<b>March 2002</b>	118
<b>March 2003</b>	256
<b>March 2004</b>	154
<b>March 2005</b>	7

Source: The Coal Authority

**Table 9. Estimated tonnage in conditional opencast licences.**

## 14 Coal exploitation other than by mining

### 14.1 COALBED METHANE

During the process of coal formation through the conversion of plant matter into coal, gases are produced which are either adsorbed onto the coal or dispersed into pore spaces around the coal seam. The generic term for this gas is coalbed methane (CBM), although it may also contain ethane, carbon dioxide, nitrogen, helium and hydrogen.

The majority of the gas is attached to the coal surface in micropores. However, during mining the coal is destressed or fractured which releases significant quantities of CBM. Further gas is released during the life of the mine and after mining has ceased. This gas is an environmental hazard but it is also a potential source of energy. This potential depends on the gas content, permeability and total thickness of the coal present.

CBM can be exploited in various ways:

- Extraction from operational mines for safety reasons prior to it entering the mine air stream (coal mine methane - CMM).
- Coal extracted from abandoned mines (abandoned mine methane - AMM).
- Extraction from virgin or unmined coal from surface boreholes (virgin coalbed methane - VCBM)

Only coal operators can extract methane under licence from operating mines. The extraction of other coalbed methane requires a Petroleum and Exploration Licence from the DTI. Licensees wishing to enter or drill through coal seams for coalbed methane must also seek the permission of the Coal Authority.

## **14.2 COAL MINE METHANE**

The term 'coal mine methane' is often used to include abandoned mine methane. However, a distinction is made here, and coal mine methane is gas collected at operating mines and used as an energy source.

## **14.3 ABANDONED MINE METHANE**

Abandoned mine methane (AMM) is the term used for the recovery of methane from the artificial voids left in abandoned coal mines. It includes the methane-rich gas that occurs in the zone of enhanced permeability that occurs approximately 40 m below and 150 m above the worked coal seam. The extraction of methane in this way for use in electricity generation or in industrial processes is an established industry in the UK. Prospects exist wherever former deep mining was carried out in coals with sufficient methane contents, providing that the workings remain unflooded and air ingress does not cause problems.

## **14.4 VIRGIN COALBED METHANE**

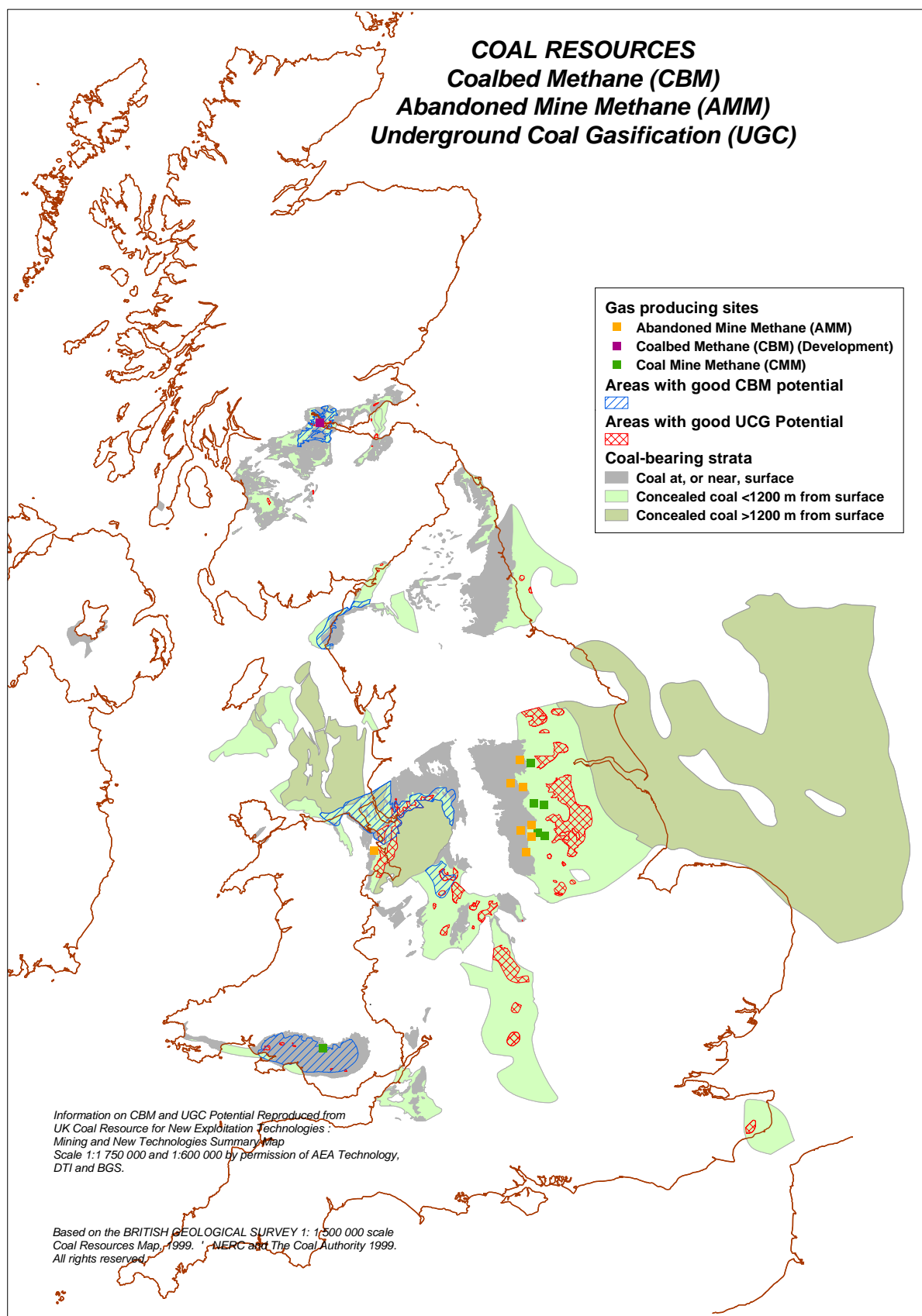
This is the methane resource present in undisturbed coal seams. The prime requirements for coalbed methane prospects are unworked coal seams thicker than 0.4 m at depths of between 200 and 1 200 m (low permeability and high drilling costs currently make deeper targets unattractive). Good prospects should have adequate levels of methane ( $> 7 \text{ m}^3/\text{tonne coal}$ ), which generally increases with coal rank (degree of alteration, the greater the alteration the higher the rank). However, permeability rather than seam gas content is the most critical factor. In general, UK coals exhibit low natural permeabilities, which make them less attractive VCBM targets than elsewhere in the world.

## **14.5 UNDERGROUND COAL GASIFICATION**

Underground coal gasification (UCG) is a technology that is being assessed in the UK. It involves the *in situ* conversion of coal in seams into a combustible gas by reacting it with air (or oxygen) pumped from the surface and the removal of the product gas via another borehole. The coal is accessed by accurate and controlled directional drilling and is then subject to a controlled burn that proceeds towards the recovery borehole. The gas can be treated to remove carbon dioxide thus providing a clean source of energy with minimal greenhouse gas emissions. The gas product may be used for electricity generation, as well as hydrogen production, or conversion into liquid fuel or chemical feedstock. The method is capable of accessing coal resources that would be uneconomic to work by traditional mining methods. UCG is seen as a longer-term option for energy supply and the DTI and industry have embarked on a study to establish its commercial feasibility in the UK. This includes identifying onshore resources of coal suitable for UCG (Figure 10) and, as the process depends on the ability to intercept and follow a coal seam and to establish a link between injection and production wells, advances in directional drilling technology.

Criteria for the UCG include a minimum coal seam thickness of 2 m, depths of between 600 m and 1200 m and seam dips typically from 10 to 30°. Prospective areas would also need to have stand offs (500 m) from operational and abandoned mine workings, urban areas, dense faulting and major aquifers.

Interest in UCG has increased significantly since the mid-1990s and trials have been carried out in a number of countries including China, Australia, Belgium and Spain. However, most of these have been in shallow coal. There are considerable environmental issues associated with UCG. Public concerns are likely to be focussed on uncontrolled combustion, groundwater contamination and subsidence. UCG developments in shallow offshore areas are likely to be the best early options.



**Figure 10. The distribution of prospective areas for CBM, CMM, AMM and UGC in the UK**

## 15 Conclusions

Coal will continue to play a significant role in the UK energy supply mix for the medium future. The extent to which indigenous coal contributes to UK supply depends on:

- (a) the competitiveness of deep-mined coal relative to imported coal. The recent increase in the world price of coal has helped in this respect, but deep mining operations are subject to geological risks that can rapidly affect mining costs; and
- (b) the availability of reserves with planning permission, both for surface and deep mining.

There are substantial resources that could be profitably worked if planning permissions were forthcoming, especially with respect to shallow coal for surface mining. The decline in opencast production in England reflects the fact that new planning permissions have failed to replenish the reserves being worked. In Scotland, permitted reserves of coal of 29.5 Mt at the end of 2005 represented about 4 years output at current rates; in contrast reserves of 4.9 Mt in England were less than total English output in 2002.

Britain's shallow coal resources represent an important mineral asset that could be brought into production comparatively quickly provided that the necessary permissions are forthcoming. Consideration should be given to identifying and protecting these resources in development plans to prevent their unnecessary sterilisation or to ensure their prior extraction before surface development takes place. It is recommended that a system of safeguarding shallow coal resources be put in place.

The current level of the world price of coal, together with a revised appreciation of the future role of coal in meeting UK energy needs, may encourage new investment in deep mines. This may be for extensions to existing mines, which may require the development of peripheral surface infrastructure, or for new drift mines. Consideration should also be given to identifying and safeguarding potential locations for these developments.



# 16 Appendices

## APPENDIX 1. UK PRODUCTION OF PRIMARY ENERGY, 1978 – 2005

Year	Mt of oil or oil equivalent (a)					Total (d)
	Coal	Petroleum	Natural gas (b)	Nuclear electricity	Hydro electricity (c)	
1978	75.5	58.2	36.2	10.0	0.3	180.2
1979	74.0	84.0	36.6	10.2	0.4	205.2
1980	78.5	86.9	34.8	9.9	0.3	210.5
1981	78.0	96.9	34.7	10.2	0.4	220.2
1982	76.1	112.5	35.3	11.9	0.4	236.1
1983	72.7	125.5	36.4	13.5	0.4	248.4
1984	30.7	137.6	35.6	14.5	0.3	218.8
1985	56.6	139.4	39.7	16.5	0.4	252.5
1986	65.6	139.1	41.7	15.4	0.4	262.2
1987	63.2	135.1	43.7	14.4	0.4	256.7
1988	63.3	125.5	42.1	16.6	0.4	248.5
1989	60.9	100.4	41.2	17.7	0.4	221.3
1990	56.4	100.1	45.5	16.3	0.4	219.4
1991	57.6	99.9	50.6	17.4	0.4	226.7
1992	51.5	103.7	51.5	18.5	0.5	226.5
1993	41.6	109.6	60.5	21.6	0.5	234.9
1994	29.7	138.9	64.6	21.2	0.4	256.6
1995	32.8	142.7	70.8	21.3	0.5	269.7
1996	31.1	142.1	84.2	22.1	0.3	281.6
1997	30.3	140.4	85.9	23.1	0.4	282.1
1998	25.8	145.3	90.2	23.4	0.5	287.2
1999	23.2	150.2	99.1	22.4	0.5	297.7
2000	19.6	138.3	108.4	19.6	0.5	288.7
2001	20.0	127.8	105.8	20.8	0.4	277.4
2002	18.8	127.0	103.6	20.1	0.5	272.9
2003	17.6	116.2	102.9	20.0	0.4	260.4
2004	15.7	104.5	96.0	18.3	0.5	238.4
2005	14.7	92.8	89.5	18.53	0.5	216.1

Source: Department of Trade and Industry.

1978 – 2004: *Digest of Energy Statistics 2005*, Office for National Statistics.

2005: *Energy Trends*, March 2006, Office for National Statistics.

(a) Based on a standard ‘tonne of oil equivalent’ equal to 397 therms.

(b) Including colliery methane.

(c) Including, from 1988, other renewable primary electricity sources (wind, etc.).

(d) Including, from 1988, small amounts of primary heat sources (solar, geothermal, etc.), solid renewable sources (wood, waste, etc.) and gaseous renewable sources (landfill gas, sewage gas, etc.).

## APPENDIX 2. UK CONSUMPTION OF PRIMARY ENERGY, 1978 – 2005

Year	Mt of oil or oil equivalent (a)						Total (d)
	Coal	Petroleum	Natural gas (b)	Nuclear electricity	Hydro electricity (c)	Net imports of electricity	
1978	73.3	87.2	41.0	10.0	0.3	—	211.8
1979	78.8	87.7	44.9	10.2	0.4	—	222.0
1980	73.3	76.2	44.8	9.9	0.3	—	204.5
1981	72.9	69.5	45.4	10.2	0.4	—	198.4
1982	68.0	70.7	45.2	11.9	0.4	—	196.1
1983	68.6	67.2	47.1	13.5	0.4	—	196.8
1984	48.7	84.7	48.2	14.5	0.3	—	196.4
1985	64.8	72.2	51.8	16.5	0.4	—	205.7
1986	70.0	71.1	52.7	15.4	0.4	0.4	210.0
1987	71.7	69.4	54.1	14.4	0.4	1.0	211.0
1988	69.6	74.0	51.4	16.6	0.4	1.1	213.1
1989	67.0	75.4	49.1	17.7	0.4	1.1	211.4
1990	67.0	77.2	51.2	16.3	0.4	1.0	213.7
1991	67.1	77.1	55.4	17.4	0.4	1.4	219.5
1992	63.1	77.5	55.1	18.5	0.5	1.4	216.8
1993	54.9	78.1	62.9	21.6	0.5	1.4	220.6
1994	51.3	76.7	64.9	21.2	0.4	1.5	217.5
1995	48.9	75.4	69.2	21.3	0.5	1.4	218.4
1996	45.7	77.8	81.0	22.1	0.3	1.4	230.0
1997	40.8	75.5	83.5	23.1	0.4	1.4	226.8
1998	40.9	76.1	86.9	23.4	0.5	1.1	230.8
1999	36.7	76.0	91.4	22.4	0.5	1.2	230.4
2000	38.1	75.9	95.6	19.6	0.5	1.2	233.2
2001	41.2	75.6	95.3	20.8	0.4	0.9	236.8
2002	37.7	74.4	94.2	20.1	0.5	0.7	230.3
2003	40.0	74.3	94.5	20.0	0.4	0.2	232.5
2004	39.3	76.5	96.1	18.3	0.6	0.6	234.9
2005	42.2	78.3	95.5	18.5	0.5	0.72	235.7

Source: Department of Trade and Industry.

1978 – 2004: *Digest of Energy Statistics 2005*, Office for National Statistics.

2005: *Energy Trends*, March 2006, Office for National Statistics.

(a) Based on a standard 'tonne of oil equivalent' equal to 397 therms.

(b) Including colliery methane.

(c) Including, from 1988, other renewable primary electricity sources (wind, etc.).

(d) Including, from 1988, small amounts of primary heat sources (solar, geothermal, etc.), solid renewable sources (wood, waste, etc.) and gaseous renewable sources (landfill gas, sewage gas, etc.).

### APPENDIX 3. GREAT BRITAIN: COAL SUPPLY AND CONSUMPTION, 1980 – 2005<sup>1</sup>

	Thousand tonnes									
	U/ground	Opencast	Recovered	Production	Imports	Exports	Stock change <sup>2</sup>	Consumption	Used in electricity generation <sup>3</sup>	per cent for electricity generation
<b>1980</b>	112,430	15,779	1,888	130,097	7,334	3,809	-9,779	123,460	89,569	72.5
<b>1981</b>	110,473	14,828	2,168	127,469	4,290	9,113	-4,566	118,386	87,226	73.7
<b>1982</b>	106,161	15,266	3,284	124,711	4,063	7,447	-10,124	110,998	80,228	72.3
<b>1983</b>	101,742	14,706	2,806	119,254	4,456	6,561	-5,583	111,475	81,565	73.2
<b>1984</b>	35,243	14,306	1,633	51,182	8,894	2,293	21,413	77,309	53,411	69.1
<b>1985</b>	75,289	15,569	3,253	94,111	12,732	2,432	1,567	105,386	73,940	70.2
<b>1986</b>	90,358	14,275	3,458	108,099	10,554	2,677	-3,500	114,234	82,652	72.4
<b>1987</b>	85,852	15,786	2,790	104,533	9,781	2,353	5,234	115,894	87,960	75.9
<b>1988</b>	83,461	17,899	2,405	104,066	11,685	1,822	-2,920	111,498	84,258	75.6
<b>1989</b>	79,628	18,657	1,535	99,820	12,137	2,049	-3,078	107,581	82,586	76.8
<b>1990</b>	72,899	18,134	1,729	92,762	14,783	2,307	1,484	108,256	84,547	78.1
<b>1991</b>	73,357	18,636	2,209	94,202	19,611	1,824	-5,560	107,513	83,542	77.7
<b>1992</b>	65,800	18,187	506	84,493	20,339	973	-3,887	100,580	78,509	78.1
<b>1993</b>	50,457	17,006	736	68,199	18,400	1,114	1,346	86,757	66,163	76.3
<b>1994</b>	31,854	16,804	1,127	49,785	15,088	1,236	19,289	81,767	62,406	76.3
<b>1995</b>	33,917	16,369	1,518	53,037	15,896	859	7,842	76,942	59,588	77.4
<b>1996</b>	32,480	16,315	1,659	50,197	17,799	988	3,825	71,400	54,893	76.9
<b>1997</b>	29,779	16,700	1,514	48,495	19,757	1,146	-3,683	63,080	47,333	75.0
<b>1998</b>	25,057	14,315	1,131	41,177	21,244	971	1,421	63,152	48,588	76.9
<b>1999</b>	20,926	15,275	914	37,077	20,293	761	-1,164	55,724	41,178	73.9
<b>2000</b>	17,511	13,412	598	31,197	23,446	661	4,680	58,862	46,198	78.5
<b>2001</b>	17,382	14,166	417	31,930	35,542	549	-2,886	64,202	50,932	79.3
<b>2002</b>	16,421	13,148	450	29,989	28,687	537	351	58,644	47,741	81.4
<b>2003</b>	15,633	12,125	501	28,258	31,891	542	2,613	62,369	53,086	85.1
<b>2004</b>	12,542	11,937	561	25,096	36,149	620	152	60,608	50,480	83.3
<b>2005</b>	9,563	10,445	616	20,624	43,813	621	-1,789	62,098	52,208	84.1

Source: DTI Digest of Energy Statistics. 2005 Energy Trends

1 There is no coal production in Northern Ireland. 2 In the stock change column a negative sign denotes a stock increase [or rise] and vice versa

3 Figures earlier than 1987 do not appear to include 'generation by other companies'.

**APPENDIX 4. OPENCAST COAL PRODUCTION BY MPA AND COUNTRY, 1997 – 2006<sup>a</sup>**

County/Unitary Authority	Thousand tonnes								
	1997/98	1998/99	1999/00	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06
<b>Barnsley</b>	295	241	177	67	261	398	352	201	11
<b>Leeds</b>	288	800	908	752	728	685	249	311	11
<b>Rotherham</b>	398	457	519	446	525	428	463	407	280
<b>Wakefield</b>	77	15	215	50	—	194	289	—	—
<b>Durham</b>	564	404	403	233	184	170	231	258	42
<b>Gateshead</b>	—	—	—	—	73	54	22	—	—
<b>Newcastle upon Tyne</b>	71	16	—	—	—	—	—	—	92
<b>Northumberland</b>	2,630	2,223	1,805	1,802	1,697	1,625	852	906	653
<b>Sunderland</b>	242	313	243	61	—	—	—	—	—
<b>Derbyshire</b>	2,475	1,510	861	600	706	699	567	255	9
<b>Leicestershire</b>	60	128	183	535	606	608	572	328	69
<b>Cumbria</b>	238	49	173	111	70	16	—	—	—
<b>St Helens</b>	15	19	54	50	41	76	76	48	11
<b>Wigan</b>	155	186	71	—	—	—	—	—	—
<b>Shropshire</b>	79	25	34	7	—	—	—	6	25
<b>Staffordshire</b>	477	420	372	—	—	—	—	—	—
<b>Stoke on Trent</b>	—	—	—	13	—	—	—	—	—
<b>Walsall</b>	—	143	123	6	—	—	—	—	—
<b>Warwickshire</b>	72	8	23	36	—	—	—	—	—
<b>ENGLAND</b>	<b>8,138</b>	<b>6,956</b>	<b>6,163</b>	<b>4,768</b>	<b>4,890</b>	<b>4,953</b>	<b>3,674</b>	<b>2,720</b>	<b>1,204</b>
<b>Blaenau Gwent</b>	—	—	—	—	10	7	—	—	—
<b>Merthyr Tydfil</b>	390	375	—	—	—	—	—	—	—
<b>Carmarthenshire</b>	273	21	—	—	0	0	7	29	7
<b>Neath Port Talbot</b>	474	725	925	1 133	955	423	377	977	870
<b>Powys</b>	617	375	186	268	214	331	424	354	327
<b>Flintshire</b>	—	12	—	—	—	—	—	—	—
<b>Bridgend</b>	—	—	429	—	—	309	355	—	—
<b>Wrexham</b>	—	—	—	—	—	—	14	66	7

<b>WALES</b>	<b>1,753</b>	<b>1,507</b>	<b>1,540</b>	<b>1,401</b>	<b>1,178</b>	<b>1,070</b>	<b>1,177</b>	<b>1,426</b>	<b>1,210</b>
<b>Clackmannanshire</b>	136	122	391	165	211	150	177	65	—
<b>East Lothian</b>	171	287	524	43	—	—	—	—	—
<b>Falkirk</b>	105	7	—	—	—	—	—	39	209
<b>Midlothian</b>	299	197	253	139	341	215	12	128	222
<b>Perth &amp; Kinross</b>	31	9	—	—	—	—	—	—	—
<b>West Lothian</b>	94	74	11	—	—	—	—	262	520
<b>East Ayrshire</b>	2,143	2,369	2,883	3,469	4,528	4,183	3,908	3,719	4,034
<b>Fife</b>	731	579	605	804	763	739	1 035	1 630	1,477
<b>North Lanarkshire</b>	614	559	716	756	651	425	188	203	130
<b>South Lanarkshire</b>	2,002	2,232	1,841	1,701	1,674	1,368	1,456	1,585	1,147
<b>SCOTLAND</b>	<b>6,326</b>	<b>6,434</b>	<b>7,224</b>	<b>7,078</b>	<b>8,170</b>	<b>7,080</b>	<b>6,776</b>	<b>7,632</b>	<b>7,737</b>
<b>UNITED KINGDOM</b>	<b>16,217</b>	<b>14,897</b>	<b>14,927</b>	<b>13,247</b>	<b>14,238</b>	<b>13,103</b>	<b>11,627</b>	<b>11,778</b>	<b>10,153</b>

*Source: The Coal Authority.*

a Financial years to March.

**APPENDIX 5. DEEP-MINE COAL PRODUCTION BY MPA AND COUNTRY, 1997 – 2006<sup>a</sup>**

County/Unitary Authority	Thousand tonnes								
	1997/98	1998/99	1999/00	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06
<b>Doncaster</b>	1,137	1,006	2,728	991	675	1,070	1,030	378	622
<b>Kirklees</b>	39	39	41	34	31	31	32	24	18
<b>North Yorkshire</b>	10,028	7,888	6,349	5,991	6,174	5,719	5,111	3,054	2,042
<b>Rotherham</b>	1,493	1,334	1,194	931	1,499	1,587	962	1,635	1,003
<b>Sheffield</b>	15	20	27	23	22	—	—	—	—
<b>Wakefield</b>	1,636	1,564	1,342	1,354	1,177	414	—	—	—
<b>Durham</b>	24	23	6	—	—	—	—	—	—
<b>Northumberland</b>	1,046	1,211	924	394	840	800	598	376 <sup>b</sup>	125 <sup>b</sup>
<b>Derbyshire</b>	0	—	—	—	—	22	25	21	24
<b>Leicestershire</b>	331	—	—	—	—	—	—	—	—
<b>Nottinghamshire</b>	7,083	6,257	4,192	4,272	4,650	4,733	4,083	2,617	3,579
<b>Cumbria</b>	1	1	1	1	0	—	—	—	—
<b>Lancashire</b>	1	1	—	—	1	—	—	—	—
<b>Staffordshire</b>	805	557	—	—	—	—	—	—	—
<b>Warwickshire</b>	1,780	1,494	1,150	1,951	1,582	663	2,252	2,977	2,346
<b>Gloucestershire</b>	—	—	—	—	—	1	1	—	—
<b>ENGLAND</b>	<b>25,420</b>	<b>21,397</b>	<b>17,954</b>	<b>15,942</b>	<b>16,652</b>	<b>15,039</b>	<b>14,094</b>	<b>11,082</b>	<b>9,759</b>
<b>Blaenau Gwent</b>	1	1	2	1	0	—	—	—	—
<b>Caerphilly</b>	2	—	—	—	—	—	—	—	—
<b>Merthyr Tydfil</b>	13	6	1	—	—	—	—	—	—
<b>Rhondda, Cynon Taff</b>	543	506	460	569	567	632	525	398	544
<b>Carmarthenshire</b>	82	102	80	40	51	84	20	—	—
<b>Neath Port Talbot</b>	96	76	43	39	50	43	18	26	11
<b>Torfaen</b>	18	19	18	17	6	7	9	8	3
<b>WALES</b>	<b>756</b>	<b>710</b>	<b>604</b>	<b>666</b>	<b>674</b>	<b>765</b>	<b>571</b>	<b>431</b>	
<b>Clackmannanshire</b>	1,892	1,600	996	728	756	—	—	—	—
<b>West Lothian</b>	25	10	—	—	—	—	—	—	—
<b>SCOTLAND</b>	<b>1,917</b>	<b>1,611</b>	<b>996</b>	<b>728</b>	<b>756</b>	—	—	—	
<b>UNITED KINGDOM</b>	<b>28,093</b>	<b>23,717</b>	<b>19,553</b>	<b>17,336</b>	<b>18,082</b>	<b>15,805</b>	<b>14,664</b>	<b>11,513</b>	

*Source: The Coal Authority.*

a Financial years to March. b From surface stocks at Ellington colliery.

## APPENDIX 6. GREAT BRITAIN: LICENSED UNDERGROUND RESERVES, 1995 – 2005

Financial year ending	Licensed reserves remaining (Mt)				Producing underground mines*
	England	Scotland	Wales	Great Britain	
March 1995	759	24	19	803	71
March 1996	736	21	19	776	74
March 1997	583	15	39	637	66
March 1998	489	10	36	535	55
March 1999	428	6	13	447	40
March 2000	410	4	13	426	35
March 2001	401	2	12	415	34
March 2002	319	0	9	328	32
March 2003	119	0	3	122	25
March 2004	104	0	2	106	21
March 2005	110	0	2	112	15

*Source: The Coal Authority*

\*Figures for mines include sites declaring manpower but not necessarily producing coal and relate to operations not licences as some mines have more than one licence.

## APPENDIX 7. GREAT BRITAIN: LICENSED OPENCAST RESERVES, 1995 – 2005

Financial year ending	Licensed reserves remaining (Mt)				Producing opencast sites*
	England	Scotland	Wales	Great Britain	
March 1995	22	16	5	44	100
March 1996	16	13	3	32	86
March 1997	17	17	14	38	90
March 1998	16	17	14	47	86
March 1999	14	25	12	51	73
March 2000	10	22	11	43	64
March 2001	8	20	10	37	49
March 2002	8	31	10	48	54
March 2003	6	27	12	46	49
March 2004	4	32	15	51	44
March 2005	3	28	14	46	42

*Source: The Coal Authority*

\*Figures for mines include sites declaring manpower but not necessarily producing coal and relate to operations not licences as some mines have more than one licence.