

6. Coal

6.1 Introduction

- 6.1.1 In this chapter we report scenarios that have been developed for future demand for coal in the UK, drawn from a variety of sources. As the majority of demand is from the power sector, future levels of coal fired generating capacity and output from it are the key determinants of coal demand. The development and deployment of technologies such as Carbon Capture and Storage (CCS) are likely to have a significant impact on both in years to come. Linked to EU legislative proposals, the Government consulted on the regulation of storage of CO₂ as a preparation for Carbon Capture and Storage and on its preliminary stage Carbon Capture Readiness (CCR)⁶³ during 2008; the outcomes are expected shortly.
- 6.1.2 Here we also set out scenarios for future indigenous production of coal. As indigenous production is unlikely to be able to meet demand, we also present scenarios for import requirements, and examine the prospects for the global coal market, and issues affecting import of coal into the UK.
- 6.1.3 This chapter draws on inputs from the UK Coal Forum, the Confederation of UK Coal Producers, and the Association of UK Coal Importers, Coallmp. We also draw on the Government's Updated Emissions Projections⁶⁴ and analysis carried out by Redpoint⁶⁵ to underpin the Government's consultation on meeting the Renewable Energy Target.

6.2 UK Demand

- 6.2.1 A significant proportion of demand for coal in Great Britain (around 83% in 2007) comes from the electricity sector and so is closely linked to the level of generation by coal-fired power stations. Of the remaining 17% of demand, the majority is from the iron and steel sector and is met mainly by imported coking coal from Australia, Canada and the USA. This chapter concentrates mainly on steam coal for

63 <http://www.berr.gov.uk/files/file46810.pdf>

64 <http://www.berr.gov.uk/files/file26377.pdf>

65 http://renewableconsultation.berr.gov.uk/related_documents

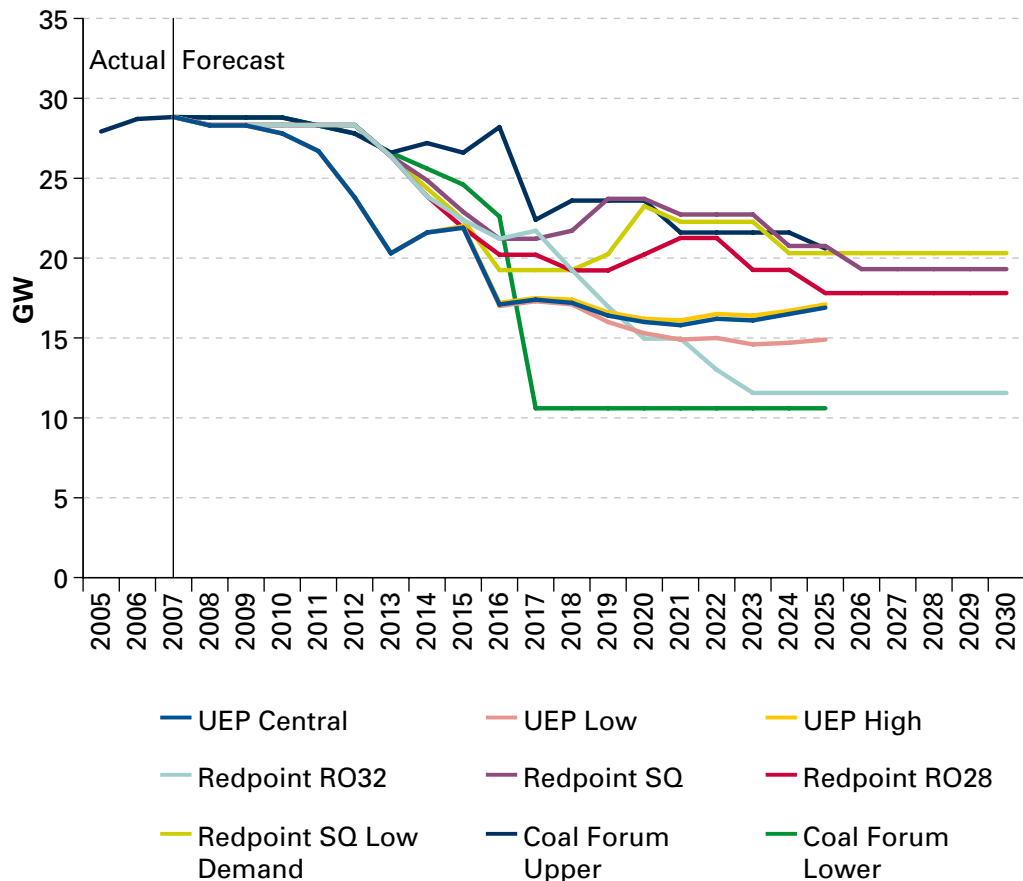
power generation, but also includes estimates of total coal demand, and implications for import requirements.

6.2.2 The level of coal-fired generation capacity in the mix will depend on the timing of any closure of existing plant, and investment in new plant. Decisions by companies on closures and on investment in new plant would be expected to depend on factors such as the environmental and regulatory regimes, technological developments (e.g. Carbon Capture and Storage, and clean coal development) and the expected relative price of gas, coal and carbon allowances. They may also be influenced by the evolving profile of the mix, i.e. the expected levels of gas, nuclear and renewables, and the need for baseload and peaking plant. For example, an increased level of intermittent capacity in the electricity generating mix is likely to increase the importance of generating plant whose output can readily be adjusted to compensate for fluctuations in the supply-demand balance. One purpose of the UK's planned demonstration project is to check how this capability is affected by CCS.

6.2.3 Chart 6.1 below shows a range of scenarios for coal-fired generation capacity. These scenarios are based on:

- BERR Updated Emissions Projection (a high, central and low case for coal fired generation in the mix);
- scenarios developed as part of the Redpoint analysis carried out to underpin the BERR consultation on meeting the Renewable Energy Target. (Three scenarios are shown – Status Quo, RO 28 and RO32 in which the Government targets different levels of renewable electricity through extension of the Renewables Obligation);
- upper and lower scenarios developed by the Coal Forum Generation Sub-Group.

Chart 6.1: Generation Capacity, GW (Existing + New)



6.2.4 It should be noted that these three sets of scenarios have been developed for distinct purposes, and reflect different sets of assumptions, as set out below. Most significantly:

- the BERR Updated Emissions Projections provide a set of estimates of future carbon emissions and reflect only measures that are already in place. They do not take into account the impact of the Renewables Target;
- the Redpoint scenarios model the impact on the generation mix of a range of incentives to encourage the market to deliver renewable generation to meet the Renewables Target;
- the Coal Forum has presented high and low-case scenarios for delivery of coal generation.

6.2.5 It will be seen that most scenarios show a reduction in coal fired generation around 2015-2016, due to the closure of opted out plant under the Large Combustion Plants Directive. Thereafter, there are a range of scenarios, showing capacity of between 10 and 20 GW, with the current level being about 30GW.

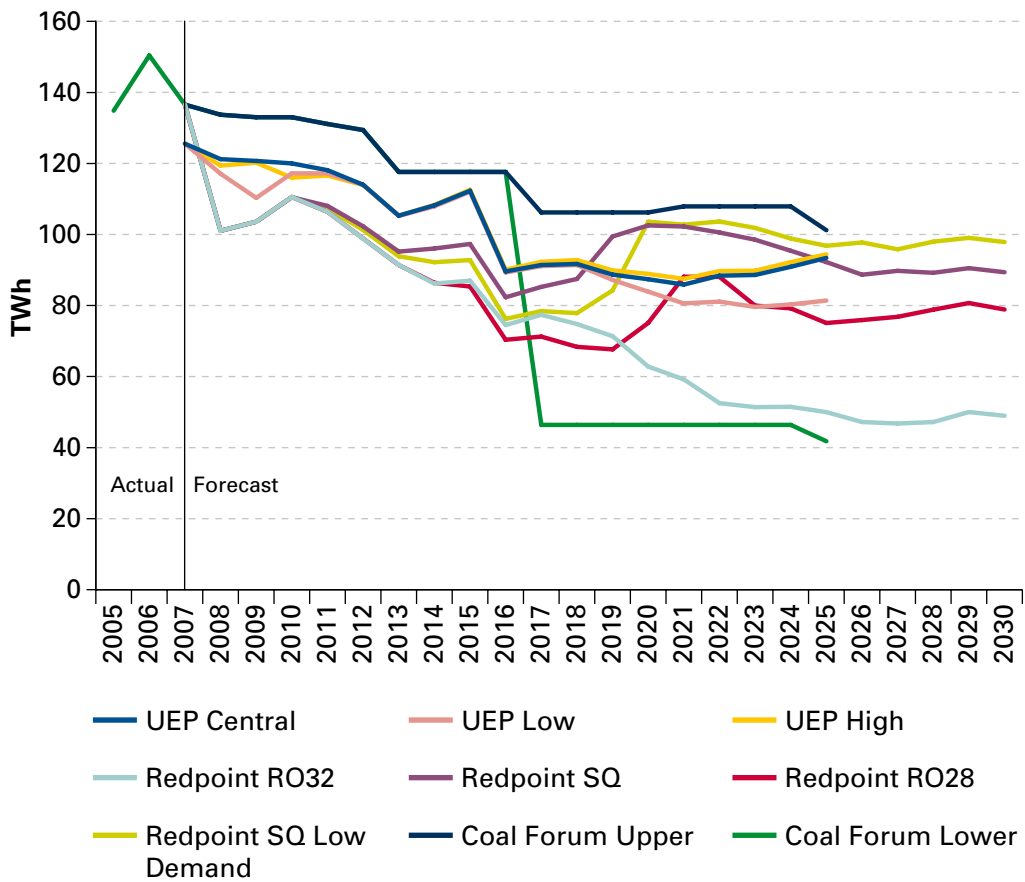
- 6.2.6 The following general points may be noted regarding the impact of Carbon Capture and Storage (CCS) and other clean coal technologies. The development and successful deployment of CCS will provide an option for coal fired generation to continue as an important part of the mix, while significantly reducing emissions. A consultation on some regulatory aspects of CCS as well as on the preliminary stage of Carbon Capture Readiness (CCR) was undertaken by BERR over summer 2008. This consultation was intended to help to ensure that the UK has a regulatory regime for CCS storage which is safe, effective and enables investment in this important technology. It should be noted that the individual components of CCS (capture, transport, and storage) have all been successfully demonstrated individually but the full chain of technologies has yet to be demonstrated and then upscaled to commercial scale. It is this lack of first generation demonstration that has been identified as a barrier for CCS deployment, and in turn, a potential barrier to the longer term delivery of new coal fired generation. The Government last year launched a competition to support one of the world's first commercial scale demonstration projects on a coal plant.
- 6.2.7 There is also potential for further long term improvements in other cleaner coal technologies, as well as improvements in the thermal efficiency of coal power stations through development of advanced supercritical boilers and improved turbines and gasifiers. These advances are expected to lead to emission reductions of about 20%, even before the introduction of CCS technology, and thus reduce coal's environmental impact. With CCS, this may lead to coal fired generation having an enhanced role in the energy mix.

6.3 Generation Output

- 6.3.1 Once a particular level of coal capacity is available, the extent to which it will run will also depend on a range of factors, including demand, the availability of other sources of generation in the mix, any environmental constraints on running time (e.g. on plant which has opted out of the higher standards imposed by the Large Combustion Plants Directive – paragraphs 4.4.2 – 4.4.7 refer) and fuel price relativities, particularly the price of coal and gas relative to each other and to the electricity price.

6.3.2 Chart 6.2 shows scenarios of output based on the assumptions that underpin Chart 6.1.

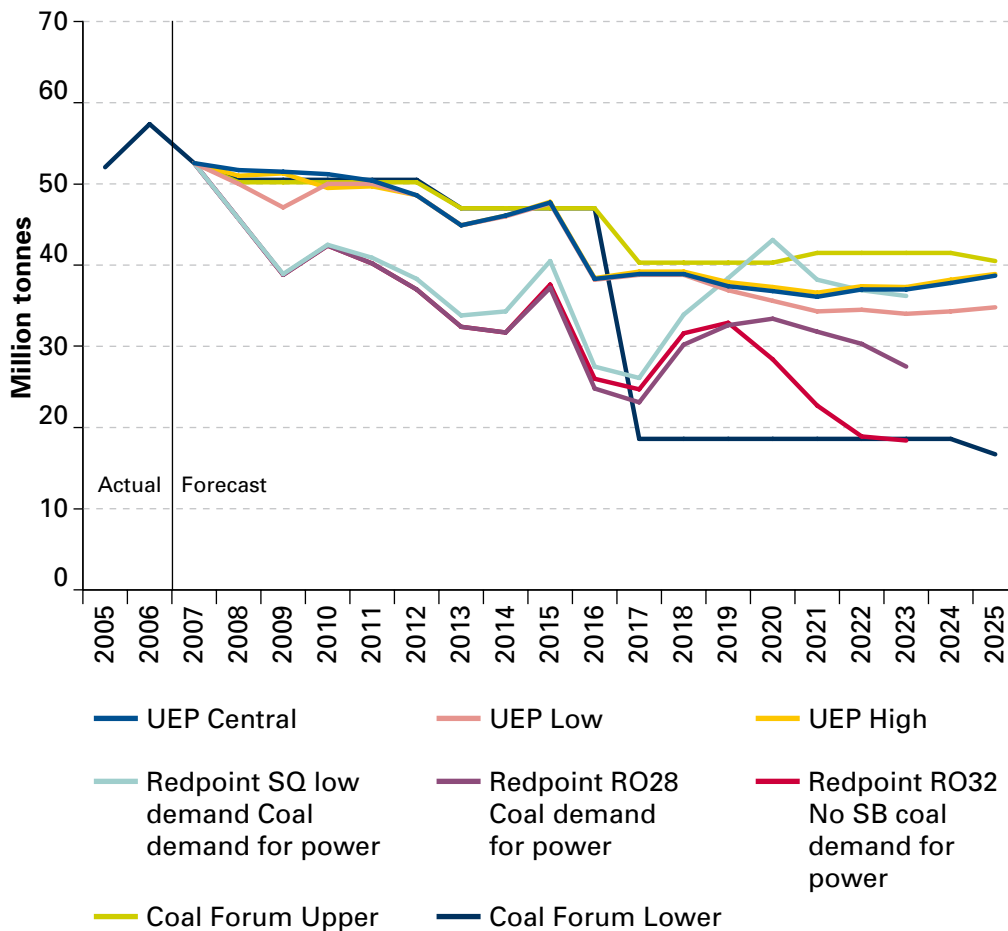
Chart 6.2: Generation output from coal



6.4 Coal demand for power generation

6.4.1 Coal demand for power generation can be estimated from output figures by applying appropriate conversion factors. Different conversion factors are applied to new and existing plant (reflecting different thermal efficiencies); over time, older, less efficient plant would be expected to close first, increasing the average efficiency of the remainder of plant.

Chart 6.3: Coal demand for power generation

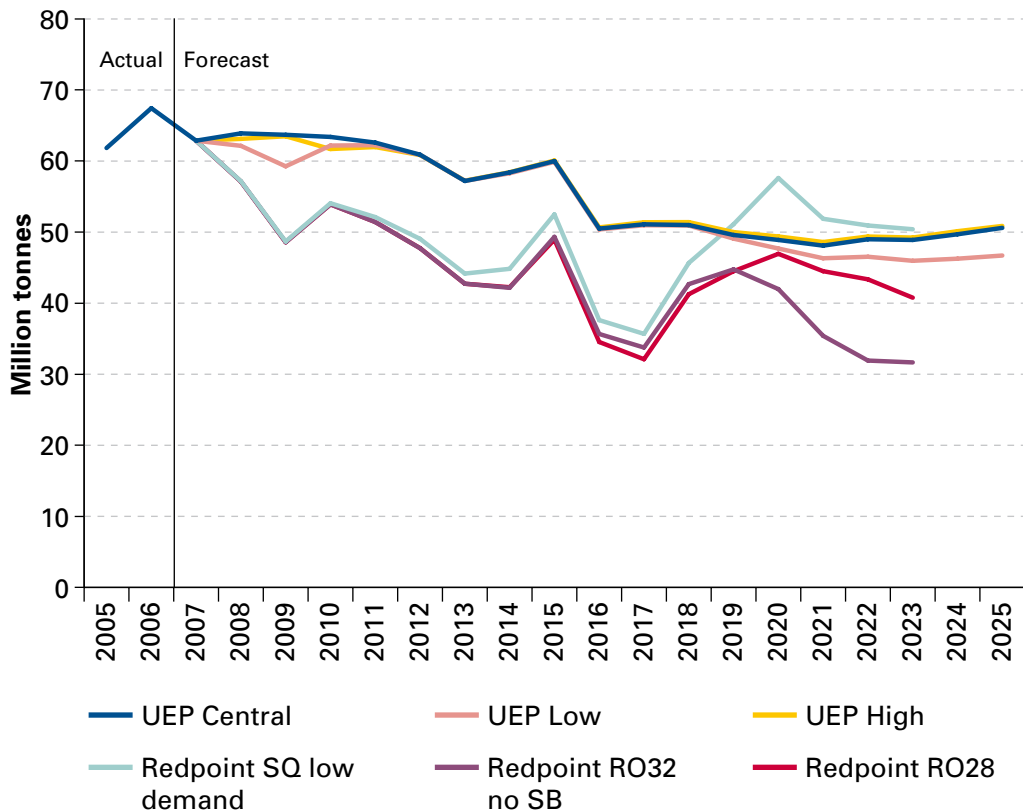


6.4.2 The analysis presented here considers aggregate demand for coal. In practice, account would also need to be taken of requirements for particular types of coal, for example in terms of sulphur content and NOx profile, which affect emissions of sulphur oxides (SOx) and nitrogen oxides (NOx) respectively. Typically, low sulphur coal would be needed for the opted out fleet (8.2 GW of capacity, for which the Coal Forum has estimated coal usage of 6 – 12 mtpa for the period 2008 to 2015). For all plant (opted in and opted out), coal with a particular NOx profile may be needed depending on whether NOx reduction equipment had been fitted (e.g. low-NOx burners.)

6.5 Total demand for coal

6.5.1 Coal is also required for non-power uses, including coking and smelting. Chart 6.4 below incorporates data from the BERR Updated Emissions Estimate to provide scenarios for total UK coal demand.

Chart 6.4: Total demand for coal



6.6 UK Supply: Indigenous production

6.6.1 A number of factors affect levels of production of coal in the UK, of which just over half still comes from deep mines and the remainder from surface (opencast) mines.

Deep mines

6.6.2 Production from deep mines may be considered in terms of:

- output from existing mines;
- potential for reopening of closed or mothballed deep mines (e.g. Hatfield, Harworth);
- potential for investment in new deep mines.

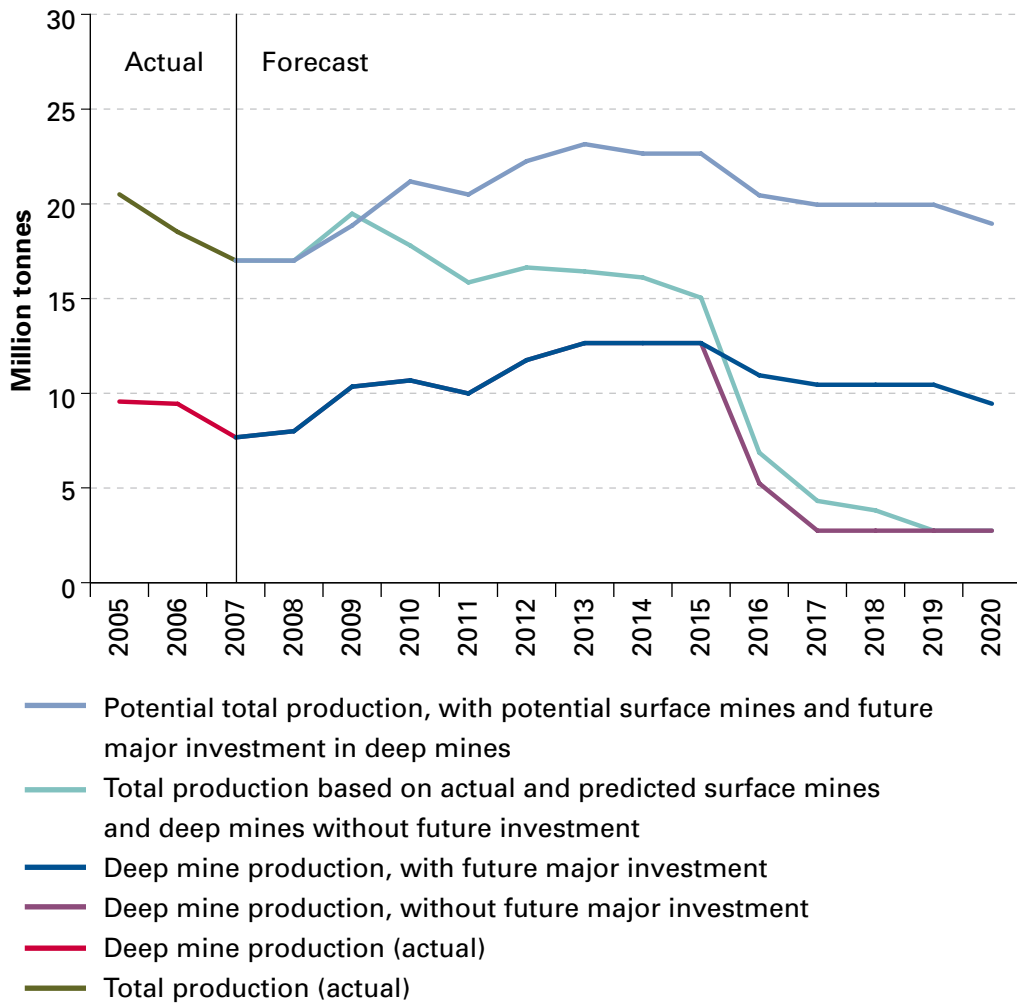
6.6.3 Most of the UK's existing deep mines have investment programmes in place which should allow them to maintain current production levels until at least 2015. Thereafter, further tranches of investment would be needed if production levels were to be maintained at these mines. Recent increases in the coal price have made the economics of re-opening closed or mothballed mines more attractive. Greater certainty around continuing demand for

coal beyond 2020 could also help the case for such projects, as could significantly higher confidence in continuing demand and forward price levels.

Surface mines

- 6.6.4 The surface mining industry aims to maintain production through a five-year rolling site replacement programme which requires a sufficient flow of planning consents for new mines. Few sites in production now have sufficient reserves to be active beyond 2012, but there are extensive unworked shallow coal reserves suitable for surface mining, subject to approvals within relevant minerals planning guidance.
- 6.6.5 The Confederation of UK Coal Producers (CoalPro) estimates that surface mining could potentially provide production of 8,500 to 10,500 mtpa to at least 2015. The chart below, which has been provided by CoalPro, shows a central forecast for UK deep mine steam coal production, both with and without additional investment for 2016 onwards. It also shows potential production with a contribution from surface mines.

Chart 6.5: Coal production forecasts



6.7 UK Supply: Stocks

6.7.1 Generators collectively held about 11.5 million tonnes of coal stocks at the end of 2007⁶⁶. Assuming that the average production rate is 2.55 GWh per kilo-tonne of coal burn, then this amount is equivalent to 29.3TWh of electricity generation – or approx 7% of total electricity supplied in 2007⁶⁷. Based on National Grid data⁶⁸, there is 29 GW of (transmission-connected) coal-fired generating capacity in Great Britain, so it follows that the fleet could run on stocks alone for about 42 days continuously. This is for illustrative purposes only; in reality coal-fired power stations would be very unlikely to operate non-stop for this length of time.

66 DUKES table 2.7 at <http://www.berr.gov.uk/whatwedo/energy/statistics/source/coal/page18529.html>

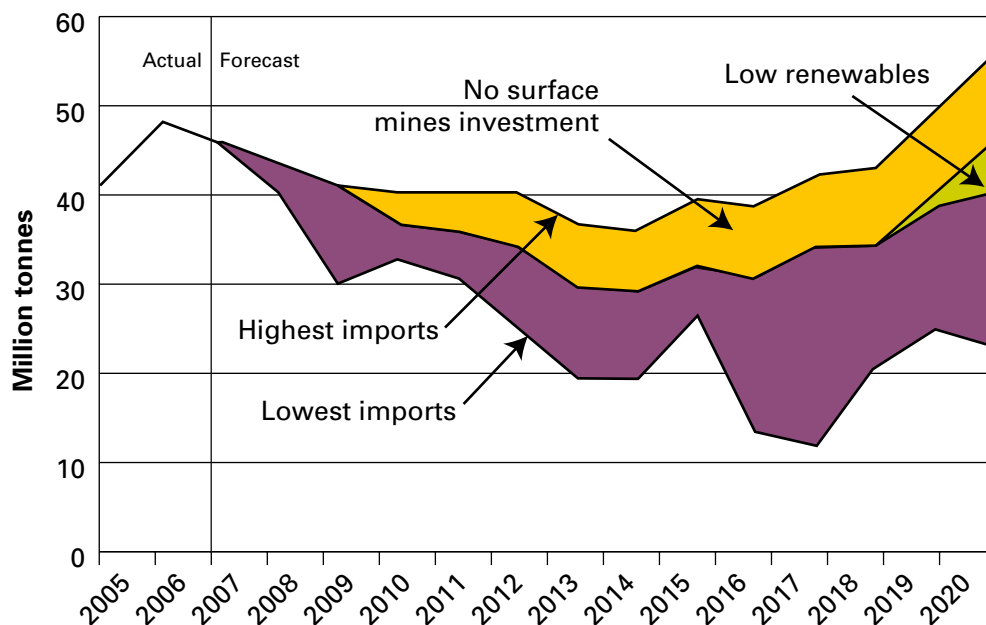
67 <http://www.berr.gov.uk/whatwedo/energy/statistics/publications/dukes/page45537.html>

68 Table 3.5 http://www.nationalgrid.com/uk/sys_08/print.asp?chap=3

6.8 UK supply: imports

- 6.8.1 There follows from the above scenarios for demand and indigenous production, a range of scenarios for future import requirements. This is shown in Chart 6.6, which shows the upper and lower boundaries of the ranges for these scenarios.
- 6.8.2 The trend for volumes of imported coal to fall from 2005 to 2010 is due to increasing UK domestic production and declining demand from power stations. From 2010, there are scenarios where domestic production of coal starts to fall, and depending on assumptions about demand, import requirements can be expected to increase or to decrease. The potential for indigenous surface mined coal has a significant influence on overall import requirements.
- 6.8.3 Plans for the ports and rail network would need to take into account likely patterns in the future transport of coal, in particular if there were to be a significant increase in import requirements.

Chart 6.6: Possible range of coal imports



6.9 Global supply and demand; supply to the UK

- 6.9.1 The remainder of this chapter focuses on the availability of imported coal (both steam and coking coal, together termed "hard coal"). Coal is a globally traded commodity so that availability will depend on global supply and demand

conditions. In addition, there are a number of issues specific to the UK.

World coal reserves

6.9.2 Coal is the most abundant fossil fuel in terms of reserves. Global coal reserves at the end of 2005 are given as 847.5 billion tonnes, estimated to be sufficient for almost 150 years at current rates of production⁶⁹. These reserves are geographically well-dispersed, with economically recoverable reserves of coal available in more than 70 countries worldwide, and in each major world region. It should be noted, however, that accessing new reserves could be associated with higher mining and/or infrastructure costs in the medium term. Coal and lignite resources were reported in 2007 as totalling 8,710 billion tonnes coal equivalent⁷⁰, suggesting that proven, recoverable, reserves are around 10% of total resources.

6.10 Supply and Demand: international hard coal trade

6.10.1 In 2007, coal was the fastest growing fuel in the world for the fifth consecutive year.⁷¹ Global consumption rose by 4.5%, to around 3,400 mtoe (million tonnes of oil equivalent). Two thirds of this increase was accounted for by Chinese coal consumption, growing by 7.9%. Indian consumption rose by 6.6% and OECD consumption rose by 1.3%.

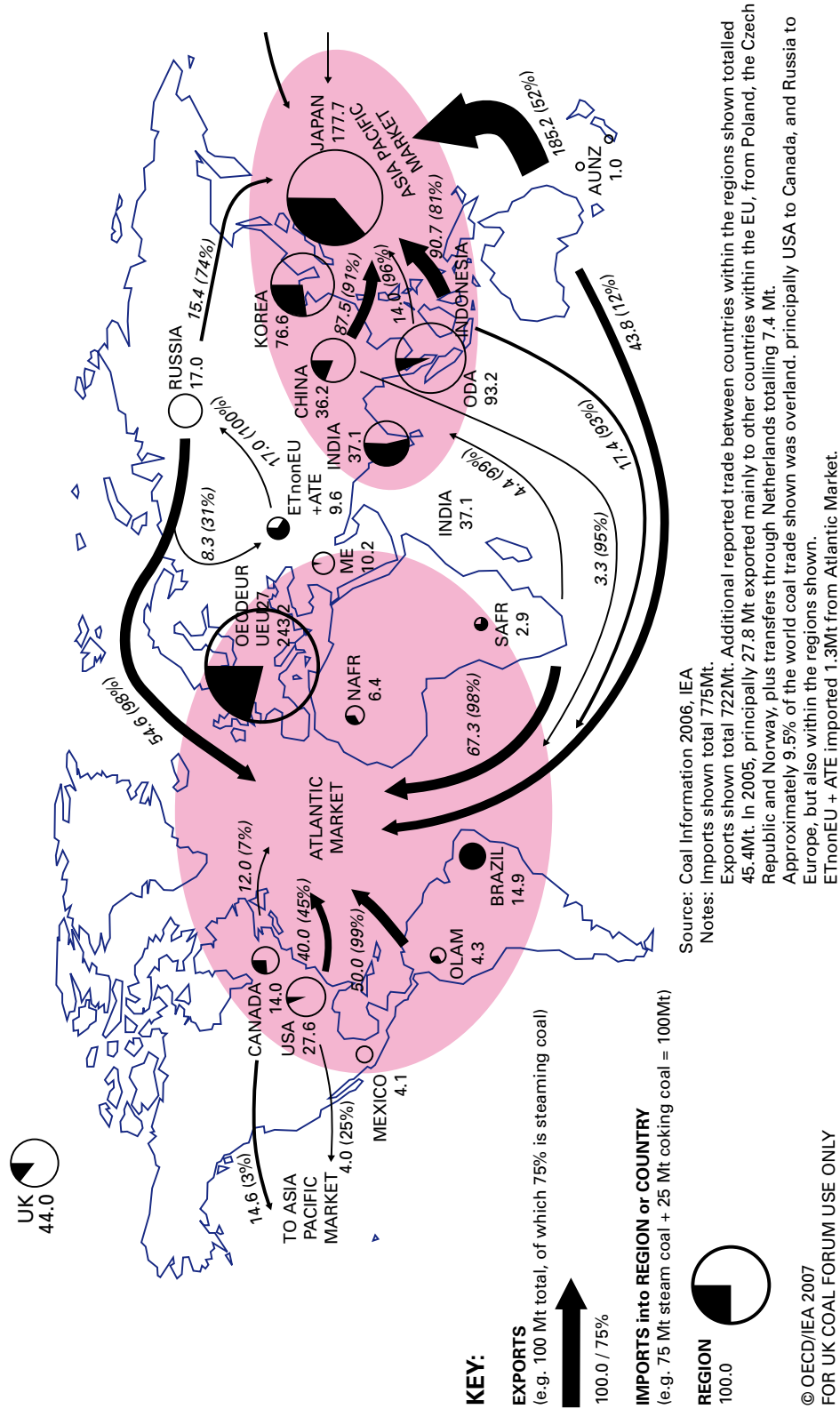
6.10.2 Most of the world's coal demand continues to be met by indigenous production with around 15% of production being traded internationally. Forecasting of future global supply and demand is beyond the scope of this document. However, the charts below, as published by the IEA in 2006, show hard coal trade in 2005, and a projection for 2030. These show that, over this period, exports from Australia, Russia and South Africa are expected to increase.

69 The World Energy Council's 2007 Survey of Energy Resources http://www.worldenergy.org/documents/ser2007_final_online_version_1.pdf

70 The German Federal Institute for Geosciences and Natural Resources (BGR). This figure relates to coal of 7,000 kcal/kg calorific value

71 BP Statistical Review of World Energy – June 2008 http://www.bp.com/liveassets/bp_internet/globalbp/globalbp_uk_english/reports_and_publications/statistical_energy_review_2008/STAGING/local_assets/downloads/pdf/statistical_review_of_world_energy_full_review_2008.pdf

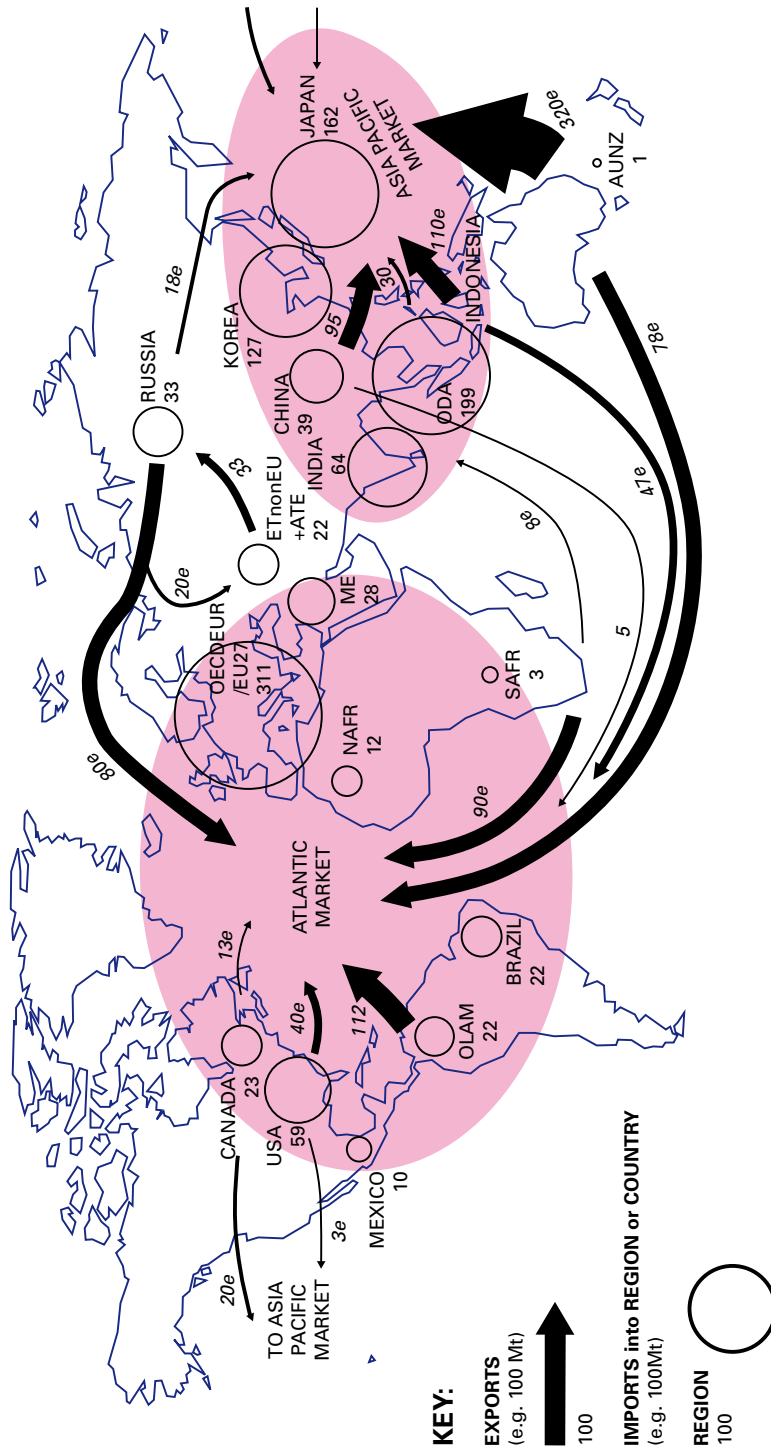
Chart 6.7: International hard coal trade, 2005 (million tonnes)



Source: Coal Information 2006, IEA
 Notes: Imports shown total 775Mt.
 Exports shown total 722Mt. Additional reported trade between countries within the regions shown totalled 45.4Mt. In 2005, principally 27.8 Mt exported mainly to other countries within the EU, from Poland, the Czech Republic and Norway, plus transfers through Netherlands totalling 7.4 Mt.
 Approximately 9.5% of the world coal trade shown was overlaid, principally USA to Canada, and Russia to Europe, but also within the regions shown.
 ETnonEU + ATE imported 1.3Mt from Atlantic Market.

Source: IEA Coal Information 2006

Chart 6.8: International hard coal trade, 2030 (million tonnes)



NOTES: "e" after tonnage means an estimated split between Atlantic and Pacific markets since WEO model balances at the world market level

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Source: IEA Coal Information 2006

6.11 Factors that might affect international availability

6.11.1 A number of factors could increase demand or reduce availability of coal on the international market in the short, medium or longer term:

- economic growth rates of rapidly developing nations have been consistently under-estimated. This applies particularly to China, but is also relevant to India, Russia, Brazil and parts of South-East Asia;
- whilst China is expected to remain broadly self-sufficient in coal, small proportionate changes in the supply/demand balance can have a major impact on international trade;
- India is considered less likely to meet its own demand, and could become a major importer, competing with Europe for South African supplies;
- Russia is expected to increase generation from coal, which may increase domestic demand, and reduce quantities available for export.

6.11.2 Factors which could depress coal demand and prices include more robust and effective climate change policies (unless or until Carbon Capture and Storage can be deployed cost effectively at scale), such as considered in the IEA Alternative Policy Scenario⁷². A major fuel-switch to gas or other alternative forms of electricity generation would be likely to depress international prices.

72 <http://www.worldenergyoutlook.org/>

6.12 Issues affecting security of supply of coal imports to the UK

Constraints on use of types of coal for UK generators

- 6.12.1 Regulatory limits on sulphur (SO_x) and nitrogen oxide (NO_x) emissions place constraints on the relative volumes of different quality coals that can be used by UK coal-fired power stations. This is a particular constraint for plant that is opted out of the Large Combustion Plants Directive (LCPD) and has therefore accepted restricted running hours and closure by 2015 as an alternative to fitting flue gas desulphurisation (FGD) equipment to remove SO_x for longer term running. Such plant typically requires low sulphur coal to comply with other emissions regulations. For all plant that remains after 2016, or is newly built, the requirement for FGD removes the constraint on sulphur content of coal used. It is noted that the draft Industrial Emissions Directive (IED), which is currently under discussion within the EU, could result in revised emissions limits. This in turn could impact on the performance required from the FGD equipment fitted to power stations to allow opted in plant to run.
- 6.12.2 Limits on NO_x emissions are also a constraint on types of coal suitable for both opted in and opted out plant. Depending on the outcome of discussions on the draft Industrial Emissions Directive (IED), at least some plant is likely to fit NO_x abatement equipment such as Selective Catalytic Reduction (SCR). Once SCR is fitted, the NO_x constraint on types of coal that can be used is removed. Progressive fitting of NO_x abatement equipment up to 2016 may therefore open up the range of coals that can be used in the intervening period.
- 6.12.3 A significant issue for the sector will be the economics of fitting these abatement technologies, and how they will perform, and therefore the economic viability of a coal fleet. Along with the outcome of the development and deployment of Carbon Capture and Storage technology, this would be expected to have an influence on the resulting size of the coal fleet.

The role of Russian coal

- 6.12.4 Russian coal is generally well-suited for use in the UK, in terms of its low sulphur content and its volatile content (which allows it to be burnt with acceptable NO_x emissions). There has been a significant increase in the use of Russian coal in the last few years. High overall demand for coal imports into the UK has led to greater use of smaller ports, which are suited to Russian supply. In addition, the relatively short shipping times to the UK has meant that Russian coal has a particular market advantage.
- 6.12.5 Alternative sources of coal are available, principally from Colombia, Indonesia and Venezuela. However, these coals are currently more expensive than Russian coal. This is on account of higher freight rates for shipping (especially in the case of Indonesian coal) or because of competition from more natural geographical markets, such as North America for Colombian coal, and Japan for Indonesian coal. Production of Venezuelan coal is limited. South African coals are available but are currently less attractive in terms of NO_x emissions.
- 6.12.6 It was announced earlier this year that the state-owned Russian gas companies, Gazprom and SUEK (Russia's largest coal producer) were withdrawing from their proposed joint venture, but there would be strategic cooperation between the two companies. Such an arrangement would allow Russia to direct more coal towards domestic power generation. This could provide more gas for export markets, but in the absence of an increase in coal production, could reduce the amount of coal available for export.
- 6.12.7 The main Russian coalfields are a long way from port and supply interruptions have been caused over the past year as a result of congestion and shortage of rail cars. These are also risk factors which could affect supply or cause upward pressure on prices.

6.13 Conclusion

- 6.13.1 A range of scenarios can be postulated for demand for coal in the UK over the next decades. These are driven primarily by assumptions about levels of coal fired power generation, which in turn depend upon assumptions about the future regulatory framework. These demand scenarios provide an opportunity for indigenous production of coal, although issues such as planning consents in particular for surface mines would also need to be considered. In all scenarios described here, there is a requirement for imports. However, only under one scenario would import requirements be at 2006 levels of 50 mtpa and under all other scenarios they would be lower.
- 6.13.2 Given the abundance of proven reserves of coal globally, the future use of coal is unlikely to be limited by resource availability, but there are a number of international issues and risks that could affect future prices. A particular issue for the UK for the medium term could be availability of Russian low-sulphur coal if this coal is increasingly used for domestic power generation within Russia. This would not be expected to raise a security of supply issue, since alternative sources are available, but alternative sources are currently more expensive.