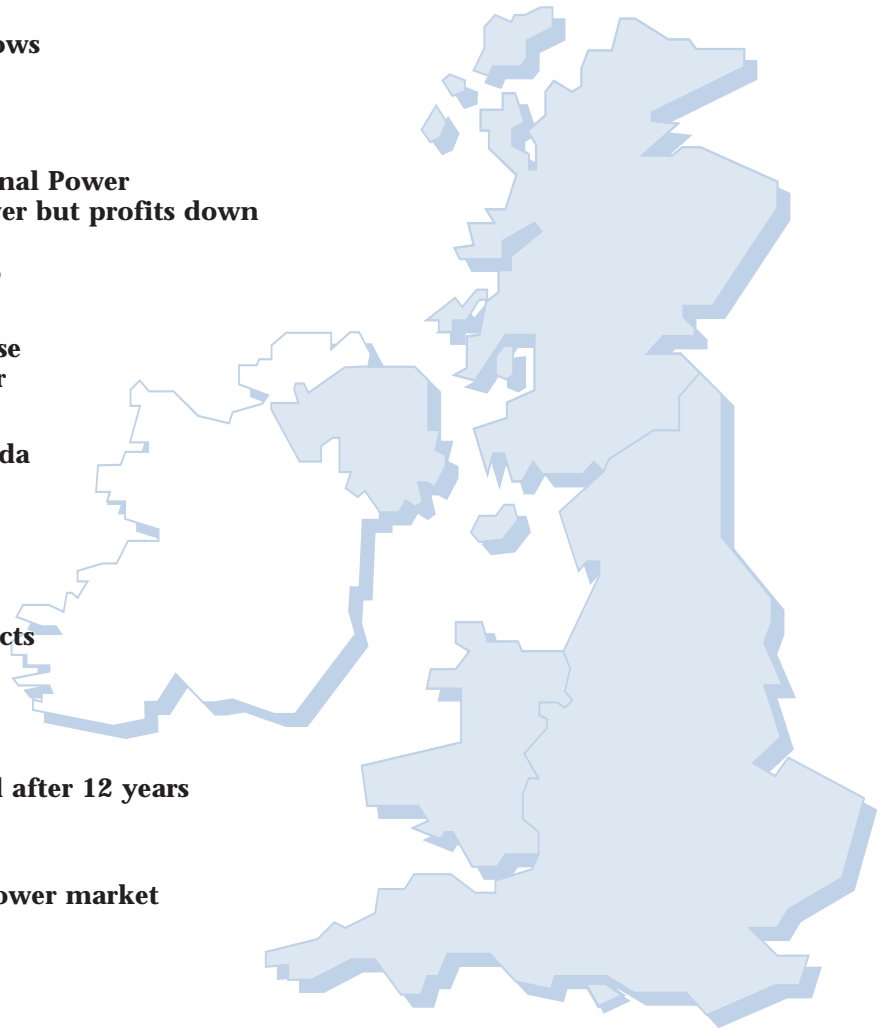


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Coal's renaissance

Coal capacity and coal running reduced steadily over the period from 1994 to 2002, as combined cycle gas turbine (CCGT) plant began to begin to dominate the UK plant mix. However, the growth of CCGTs has been halted in recent years and it seems that press reports of coal's death have been greatly exaggerated. Coal plant running is now at a ten year high, and significant investment is being poured into updating old plant. **Michael Wagner, Vanja Munerati and Sulven Weatherhead*** investigate what has caused such a radical shift in the fortunes of coal generation and ask what next for the coal fleet.

Coal, as a power station fuel, has enjoyed a renaissance over the last few years (as can be seen in Figure 1). Last winter was no exception with coal plant being run particularly hard.

The increase in coal running is particularly counter-intuitive given that coal prices have doubled over the last few years, environmental constraints have limited plant running, (particularly through the tightening of sulphur bubbles) and the introduction of carbon trading has reduced coal's competitiveness.

The reason for the resurgence of coal is simple; the cost of gas to fire CCGTs, its main competitor for the spot of marginal technology, has increased significantly. This has enabled coal generation to compete with gas generation (as can be seen in Figure 2).

So will the fortunes of coal continue to ride as high? Much will depend upon the relative movements in the coal, gas and carbon markets. The gas forward market is currently in backwardation (ie where future prices a couple of years out are lower than prices in the immediate future), reflecting significant planned growth in gas supply over the next few years through investment in liquified natural gas (LNG) and pipeline projects.

But gas markets have got to fall further than the markets are currently indicating before the fortunes of coal will begin to slide, especially given recent

reductions in carbon prices. Despite the commodity markets painting a rosy picture for coal, the prospects of ever tightening sulphur bubbles could still ruin the party.

The sulphur limit

Over the last eight years there have been reducing sulphur bubbles placed on coal stations, serving to limit plant running (as can be seen in Figure 3). However, by switching from typically high sulphur domestic coals to lower sulphur imported coals stations have been able to significantly extend the amount of running that they can achieve under their sulphur bubbles, effectively extending the reign of coal.

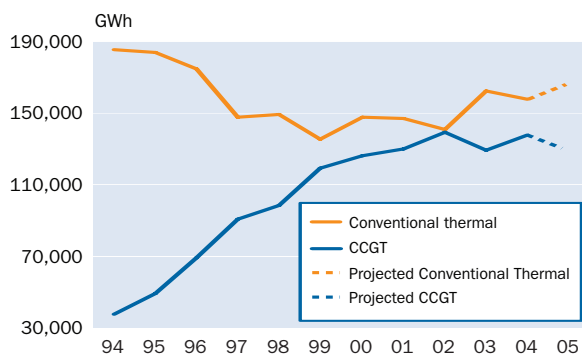
The switch from burning domestic coal to imported coal from the international markets has been significant (as can be seen in Figure 4), putting increasing pressure on the port and rail infrastructure, which now presents a significant constraint on coal movements.

The future will see increasing environmental restrictions as coal plant are regulated under the Large Combustion Plants Directive (LCPD, 2001/80/EC) and the Integrated Pollution Prevention and Control (IPPC 96/61/EC). The controls define limits on emissions of SO₂, NO_x and particulates, through rate and mass limits as well as cap and trade arrangements. Coal plant had a choice of how they would be regulated under the LCPD (the different options and the impact on coal running is summarised in Table 1).

The rate limits for plant Opted-In under LCPD or NERP are low enough to effectively exclude non-flue gas desulphurization (FGD) plant, theoretically plant could use very low sulphur coal but this is not widely available and is unlikely to be compatible for burning in existing boilers. However, the alternative is for plant to "opt-out" of the LCPD, with the number of hours of station running being limited to 20,000 hours to 2015, and plant then being forced to close.

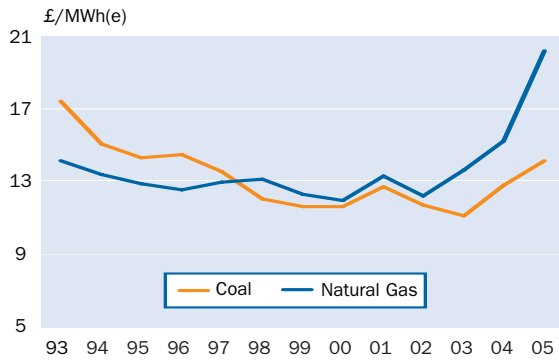
The clarification of the rules that will govern coal plant operation has led to a spate of investment decisions, with six coal stations announcing that they will retro-fit FGD. (The status of the UK coal and oil

Gas and conventional thermal generation over the last 10 years



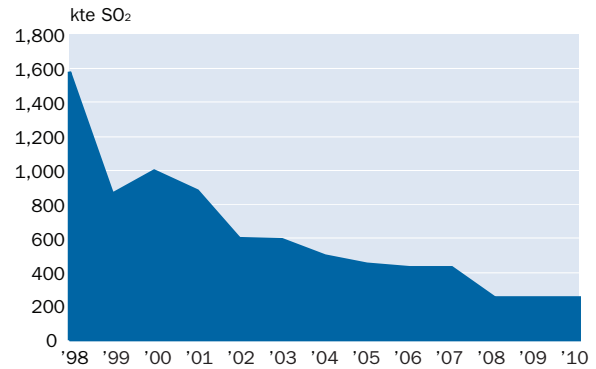
Source: DUKES 2005, Table 5.1.3. Conventional thermal includes coal, oil, gas turbine and thermal renewable plants – but the data is dominated by coal running.

Coal and gas prices over the last 10 years



Source: DTI Quarterly Energy Prices, March 2006, Table 3.2.1 Average prices of fuels purchased by the major UK power producers and of gas at UK delivery points. The cost of commodities has been converted to a cost of electricity using standard generation efficiencies.

Total power sulphur bubble over last 10 years and next 5 years



Source: Environment Agency Data, SEPA Data and IPA Analysis

stations under the LCPD and in terms of FGD is summarised in Table 2).

Although the new rules on sulphur emissions are restrictive for non-FGD plant, it is perhaps surprising that in a world that should be increasingly incentivizing low carbon generation, so many companies are making significant capital investments to ageing coal plant, many of which are approaching the end of their design lives.

A major reason for this may be the fillip announced for FGD coal generation under the UK Phase 2 Draft National Allocation Plant (NAP).

The carbon giveaway

The draft UK NAP for Phase 2 of the EU ETS has been published. The power sector allocation methodology is to be based upon a benchmarking approach for different generation technologies, with each technology assigned a load factor, efficiency and associated emissions factor. Coal allocations will reflect the higher carbon intensity of the fuel and the lower efficiency of the plant. Critically the benchmarking distinguishes FGD and non-FGD coal

(despite the fact that FGD does not reduce carbon intensity), representing a significant shift of approach since the Phase 1 NAP.

The draft NAP will allocate approaching twice as many free carbon allocations to FGD coal than non-FGD coal, reflecting the fact that FGD plant are likely to generate at higher load factors, providing a significant financial incentive for operators to retro-fit FGD to plant.

The Phase 2 power sector allocation could be around 107 million tons of CO₂ per annum, which will result in a 500MW FGD coal unit receiving in the order of 0.64 million tons of CO₂ more free carbon allowance per year over Phase 2, than non FGD plant. These extra carbon allowances have a market value of £6.6million each year over Phase 2 assuming a carbon price of around ~15/t CO₂.

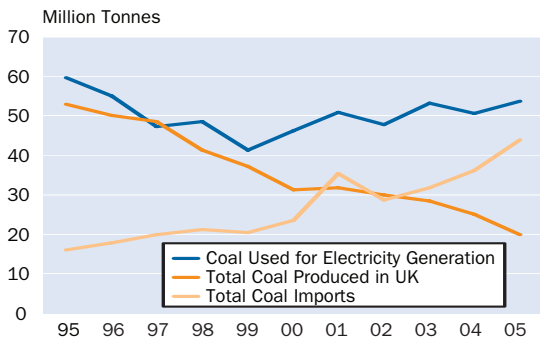
The value of the additional carbon allocations are likely to be sufficient to cover the £30-40million cost of FGD installation, especially as the work also provides the plant with additional running flexibility and a life extension. This has clearly provided sufficient incentive to send the industry scurrying to install FGD on a number of coal plant.

Coal Plant Sulphur Emission Limits

	LCPD Rate Limit	IPPC Mass Limit
Opted in ELV	400mgSO ₂ /m ³ Based on load weighted average over 48 hours over all boilers. Excludes start up and shut down.	9kt/year per GWe capacity Excludes start up and shut down. Transferable 'B' limits Limits FGD plant to 58% LF @ 1.75% sulphur coal with 90% sulphur removal.
Opted in NERP	1.8tSO ₂ /GWh Equivalent to 400mgSO ₂ /m ³ , but this is an annual limit. Excludes start up and shut down.	Operator NERP Limits not yet set Transferable NERP Limits
Opted Out 20,000 hours operation over station between 2008-2015. Plant must then close. Limit plant to average 28% LF over period	7.5tSO ₂ /GWh Equivalent to 2000mgSO ₂ /m ³ , but this is an annual average. Excludes start up and shut down.	9kt/year per GWe capacity Excludes start up and shut down Transferable B limits Limits non-FGD plant to 22% LF @ 0.6% sulphur coal

Source: IPA Consulting

Domestic and imported coal burnt over last 10 years



Source: DTI and the Coal Authority

What next for coal?

Coal has seen a renaissance, and is currently enjoying high levels of running and investment. This goes deeper than the planned FGD installations. For instance new turbines are planned at Aberthaw, Cottam and West Burton and NO_x reduction work is planned at Cottam, Drax and Didcot.

The recent announcement of a review of the rules governing co-firing with biomass under the energy review could further incentivize the development of co-firing, which has provided plant access to a renewable energy fuel source and the revenue from Renewables Obligation Certificates (ROCs). Investment in co-firing equipment has already been announced with investment in direct injection at Drax, Fiddlers Ferry and Ferrybridge. In addition, considerable effort has been put into developing energy crops, with potential planned cultivation leaping from 1,000 hectares to 60,000 hectares over the next 3 years.

Phase 2 Allocation Methodology

	Load Factor	Efficiency	tCO ₂ /MWh(e)
LCPD Opt-In Coal	51.57%	35.50%	0.89
LCPD Opt-Out Coal	28.54%	36.20%	0.88
Gas	58.92%	46.80%	0.42
Non GQCHP	70.59%	35%	0.56
Other	1.11%	38%	0.7

Source: http://www.dti.gov.uk/energy/sepn/euets_pub_spreadsheet.xls

There have also been a number of announcements regarding clean coal developments, with possible developments at Tilbury (RWE), Killingholme (Eon) and Hatfield, with EdF having an objective to bring clean coal technologies into commercial operation within five years.

The potential to redevelop non-FGD coal plant, retrofitting plant, for instance, with advanced super-critical boilers, dedicated biomass feed systems and burners, and potentially developing carbon capture and storage systems could yet see coal stations with a new lease of life and re-licensed to operate beyond 2015.

Coal is likely to have its challenges in the future, tightening carbon markets and volatile commodity markets could yet undermine coals competitiveness. However, coal plant appears to have managed to withstand a twin regulatory assault from both the LCPD and EU ETS, and current investment plans suggest that it will take a lot more to kill off coal plant; indeed it seems that coal is thriving!

** Michael Wagner is an associate director and Vanja Munerati and Suiiven Weatherhead are consultants at IPA Energy Consulting*

UK Coal and Oil Stations

Installation	Operator	Fuel	Installed Capacity (MWe)	# of boilers	# of plant (Common Stack Definition)	Capacity Opted In (MW)	Capacity Opted In NERP (MW)	Capacity Opted In ELV (MW)	Capacity Opted out (MW)	FGD
Drax	Drax Power	Coal	3,960	6	1	3,960	3,960	0	0	Fitted
Eggborough	BE	Coal	2,000	4	1	2,000	2,000	0	0	Half units fitted
Cottam	EDF Energy	Coal	2,000	4	1	2,000	0	2,000	0	Will fit by 2007
Ferrybridge	SSE	Coal	2,000	4	2	1,000	0	1,000	1,000	Half units will fit
Fiddlers Ferry	SSE	Coal	2,000	4	1	2,000	0	2,000	0	Will fit
Didcot A	RWE npower	Coal	2,000	4	1	0	0	0	2,000	No
Tilbury	RWE npower	Coal	1,520	4	2	0	0	0	1,520	No
Kingsnorth	E.ON UK	Coal	2,000	4	1	0	0	0	2,000	No
Ratcliffe	E.ON UK	Coal	2,000	4	1	2,000	0	2,000	0	Fitted
Ironbridge	E.ON UK	Coal	1,000	2	1	0	0	0	1,000	No
Rugeley	IP	Coal	1,000	2	1	1,000	0	1,000	0	Will fit
West Burton	EDF Energy	Coal	2,000	4	2	2,000	0	2,000	0	Fitted
Peterhead	SSE	CCGT	1,320	2	1	1,320	1,320	0	0	No decision
Longannet	SP	Coal	2,304	4	1	2,304	2,304	0	0	Will Fit
Cockenzie	SP	Coal	1,152	4	2	0	0	0	1,152	No
Aberthaw	RWE npower	Coal	1,500	3	1	1,500	0	1,500	0	Will fit by 2008
Kilroot	AES	Coal/Oil	520	2	1	520	0	520	0	Will fit by 2007
Uskmouth	Uskmouth Power	Coal	393	3	1	393	0	393	0	Fitted
Littlebrook	RWE npower	Oil	2,000	3	1	0	0	0	2,000	No
Fawley	RWE npower	Oil	1,000	2	1	0	0	0	1,000	No
Total			33,669	69	24	21,997	9,584	12,413	11,672	

Source: IPA Consulting