Electricity Policy Research Group

UNIVERSITY OF CAMBRIDGE

Climate change policy and its effect on market power in the gas market

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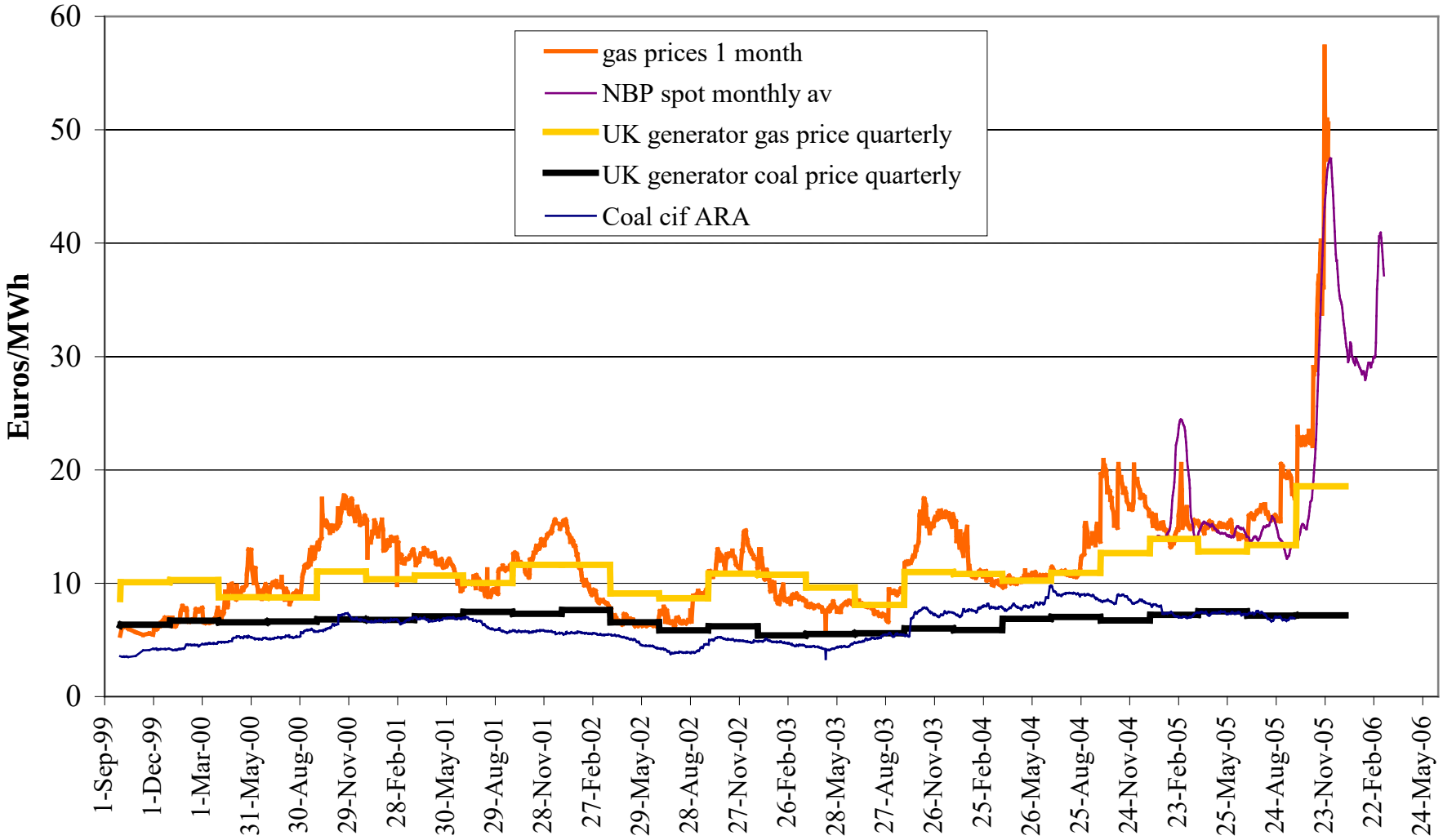
http://www.electricitypolicy.org.uk

Electricity prices

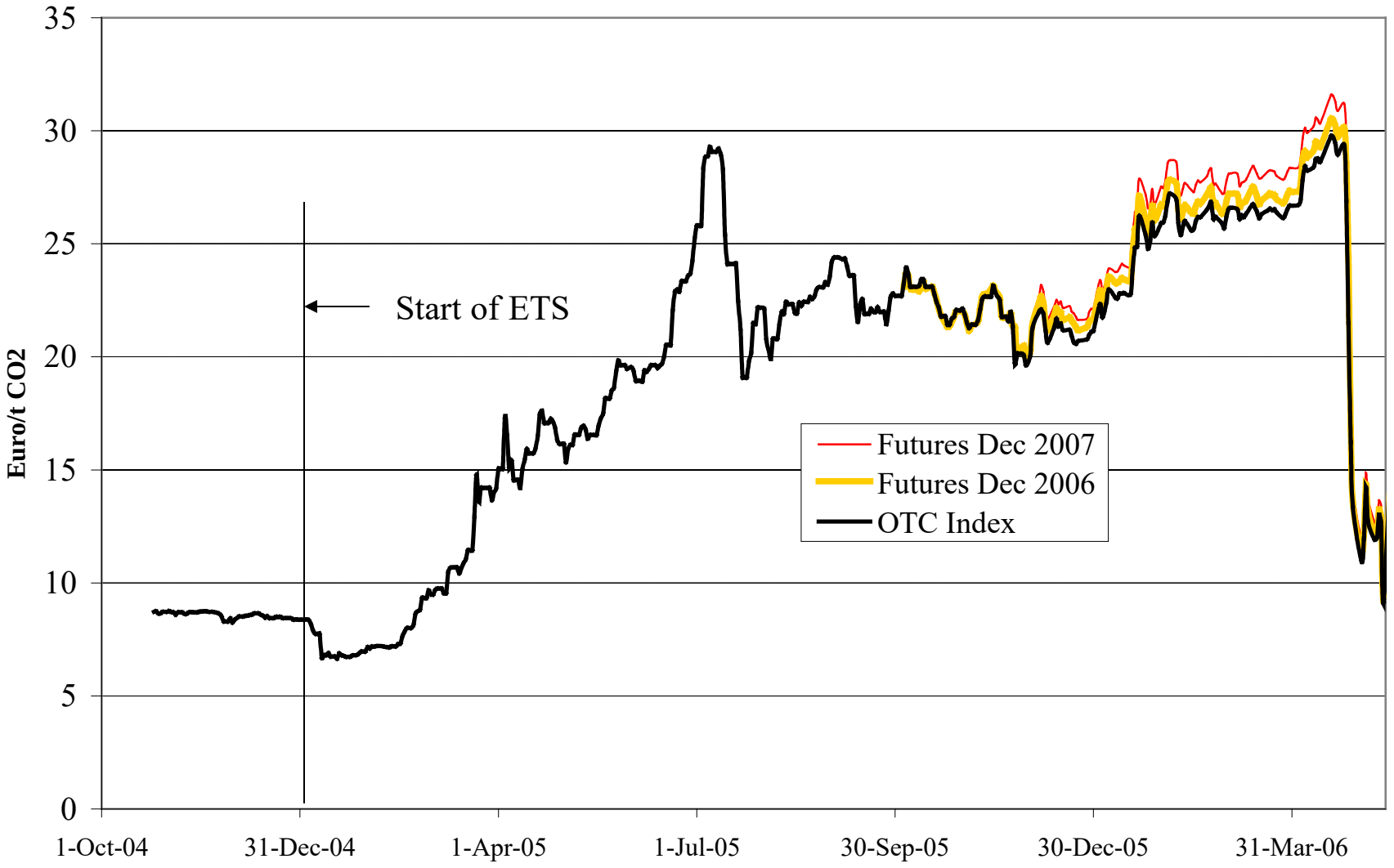
- Electricity spot prices have moved sharply up
  - EU baseload prices €35 => €70+/MWh 12/04-3/05
- so have gas prices
  - UK gas prices from < €15=>50/MWh mid-end 05
  - UK yr-ahd pk el €50=>90+/MWh 12/04-7/05
- and EUAs are now reflected in prices
  - wholly unsurprising to economists if not lawyers
- Value of EUAs = €60 billion at €20/EUA

Platts fuel prices Euros/MWh

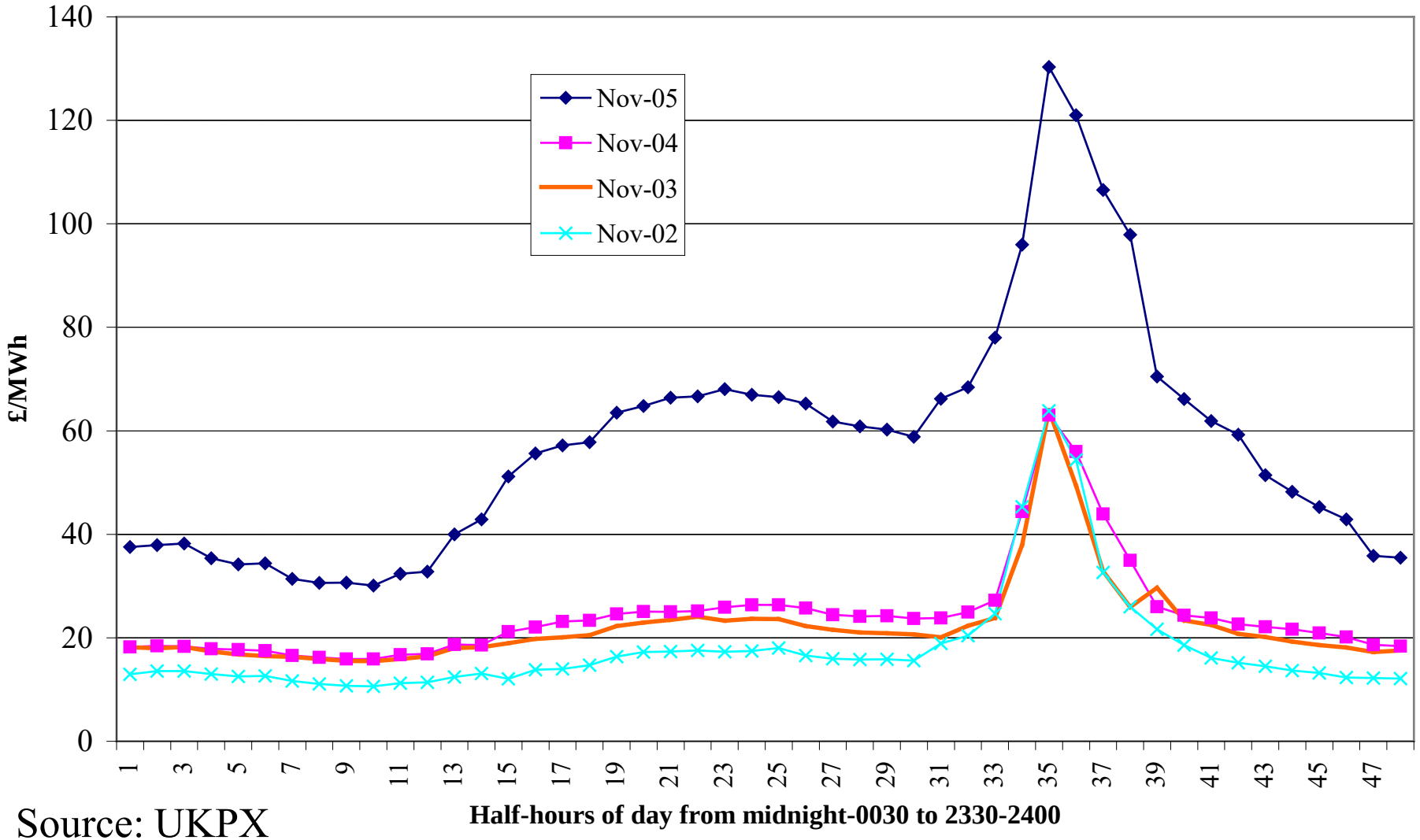


Source: Platts; DTI

EUA price 25 October 2004-15 May 2006

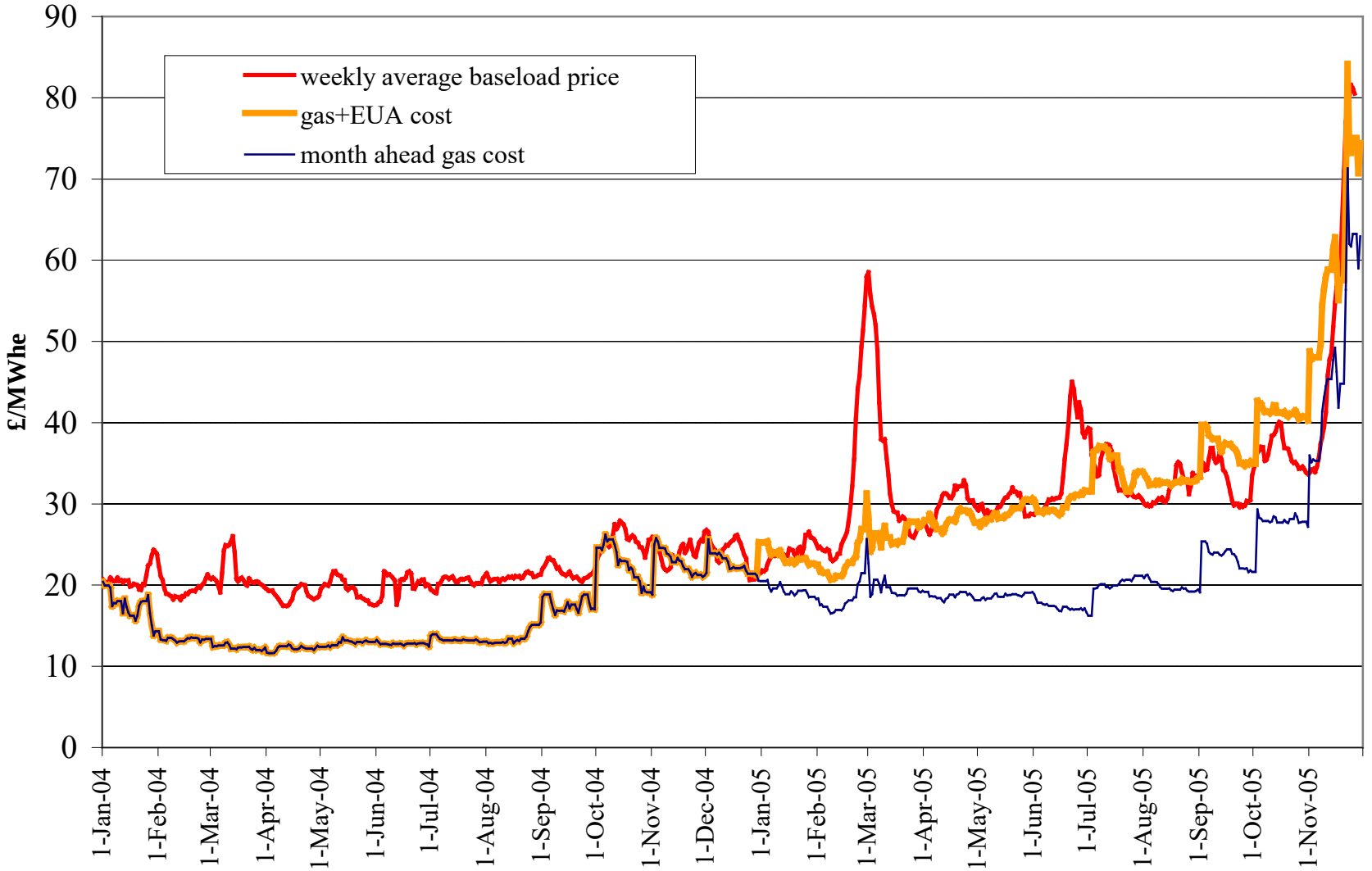


Monthly averages by half-hour for November UKPX



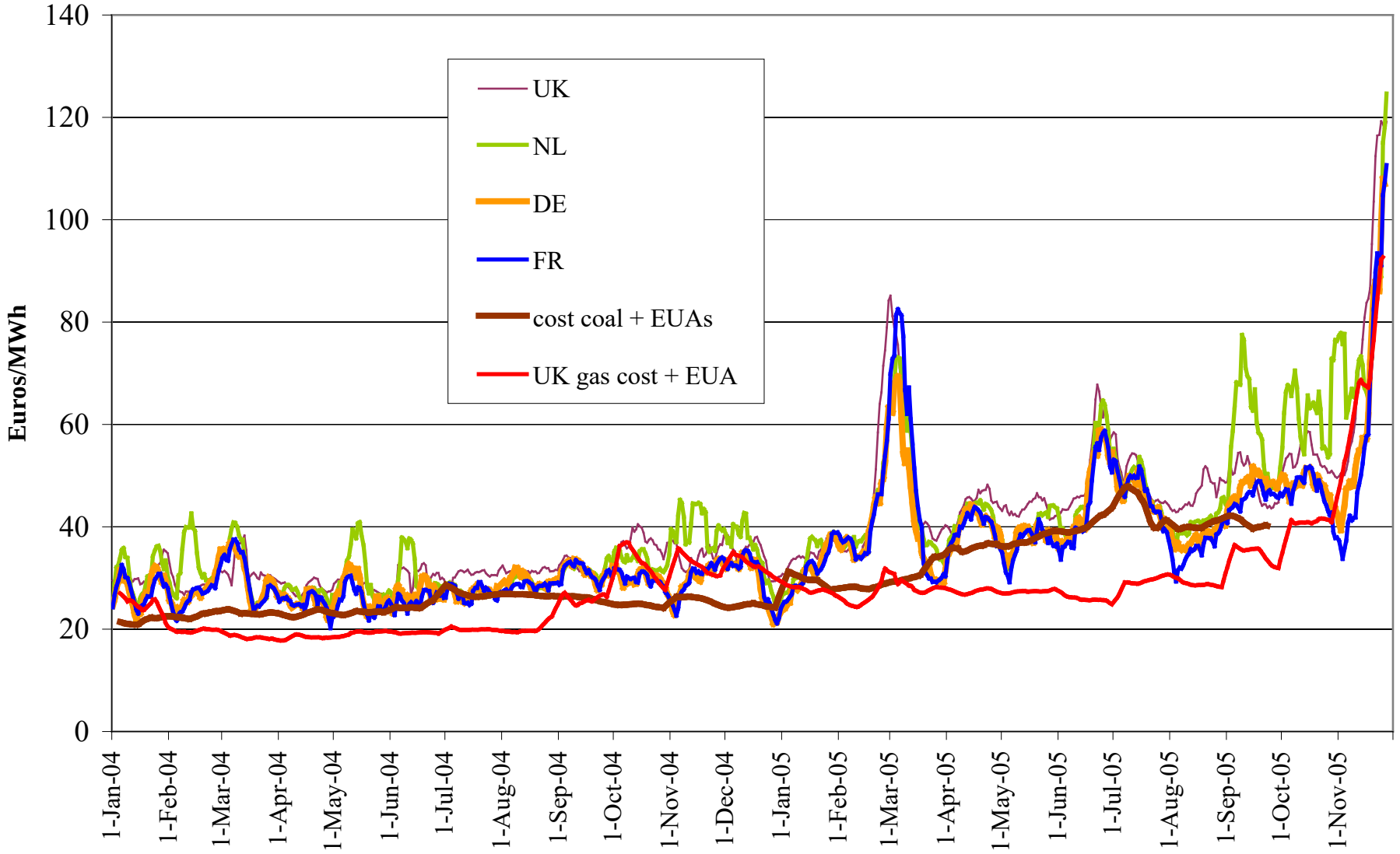
Source: UKPX

cost and prices in British electricity market



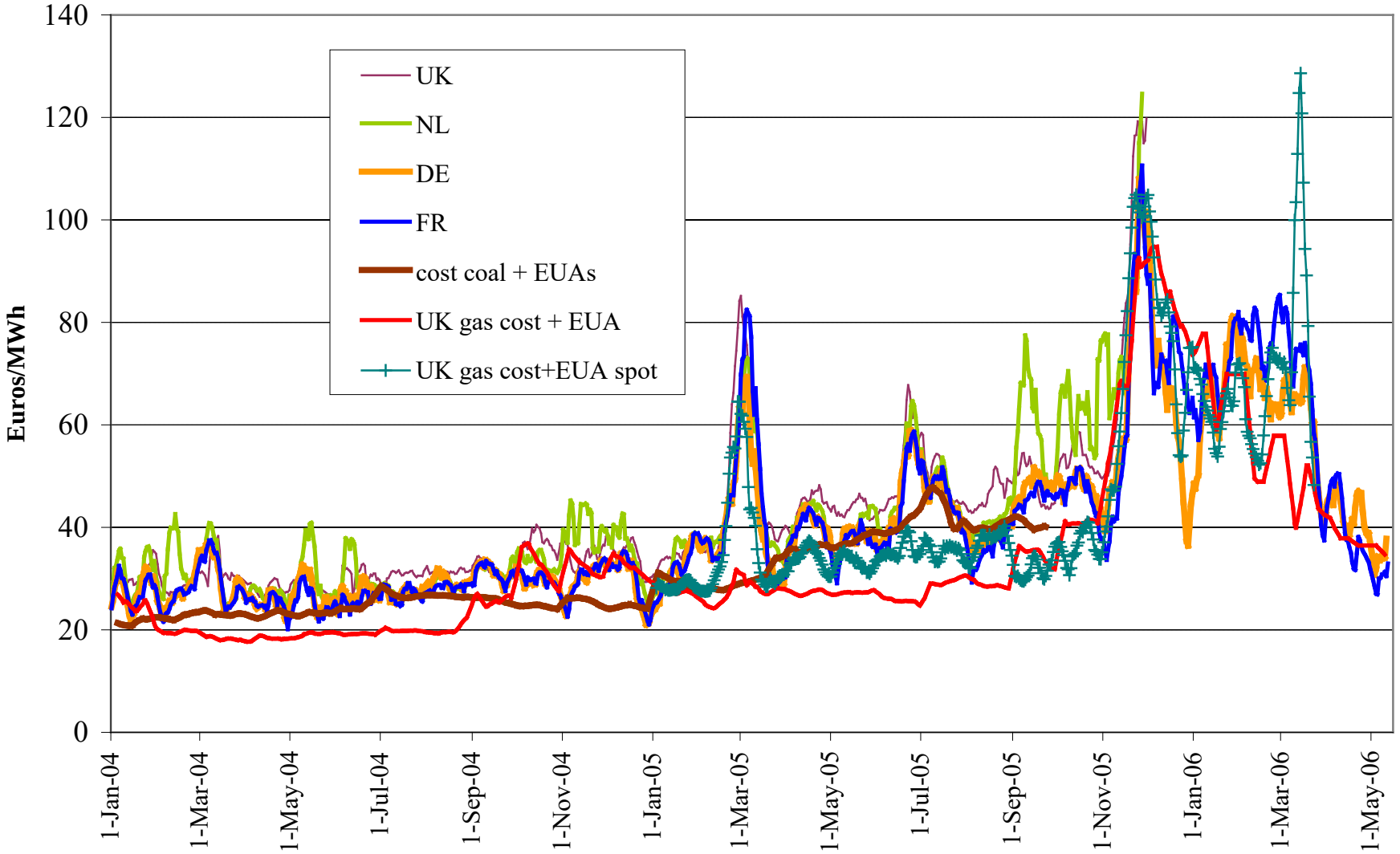
Source: Platts and UKPX

Weekly average baseload spot prices 2004-5



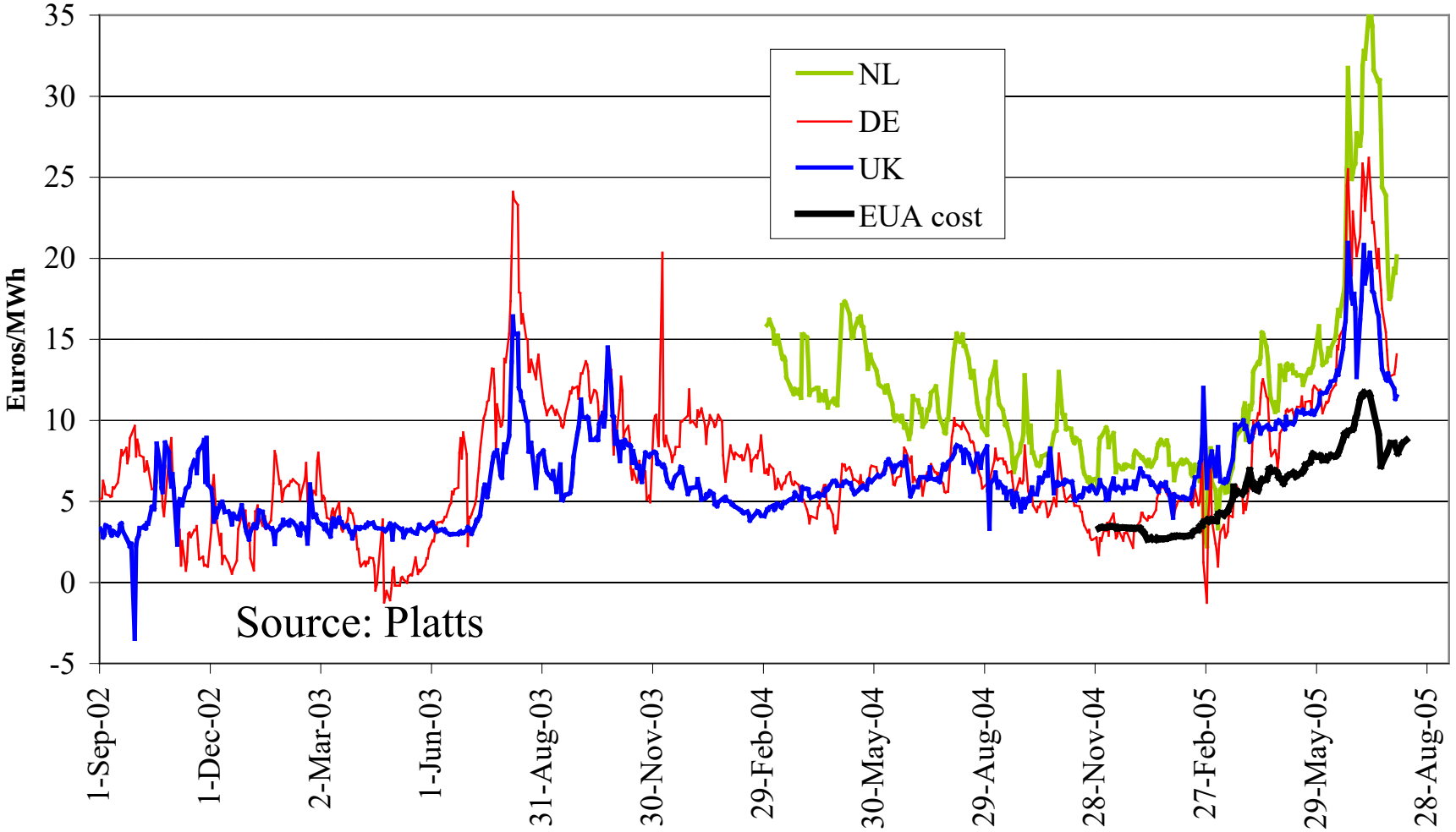
Source: Platts, UKPX, EEX, zfk

Weekly average baseload spot prices 2004-May 2006

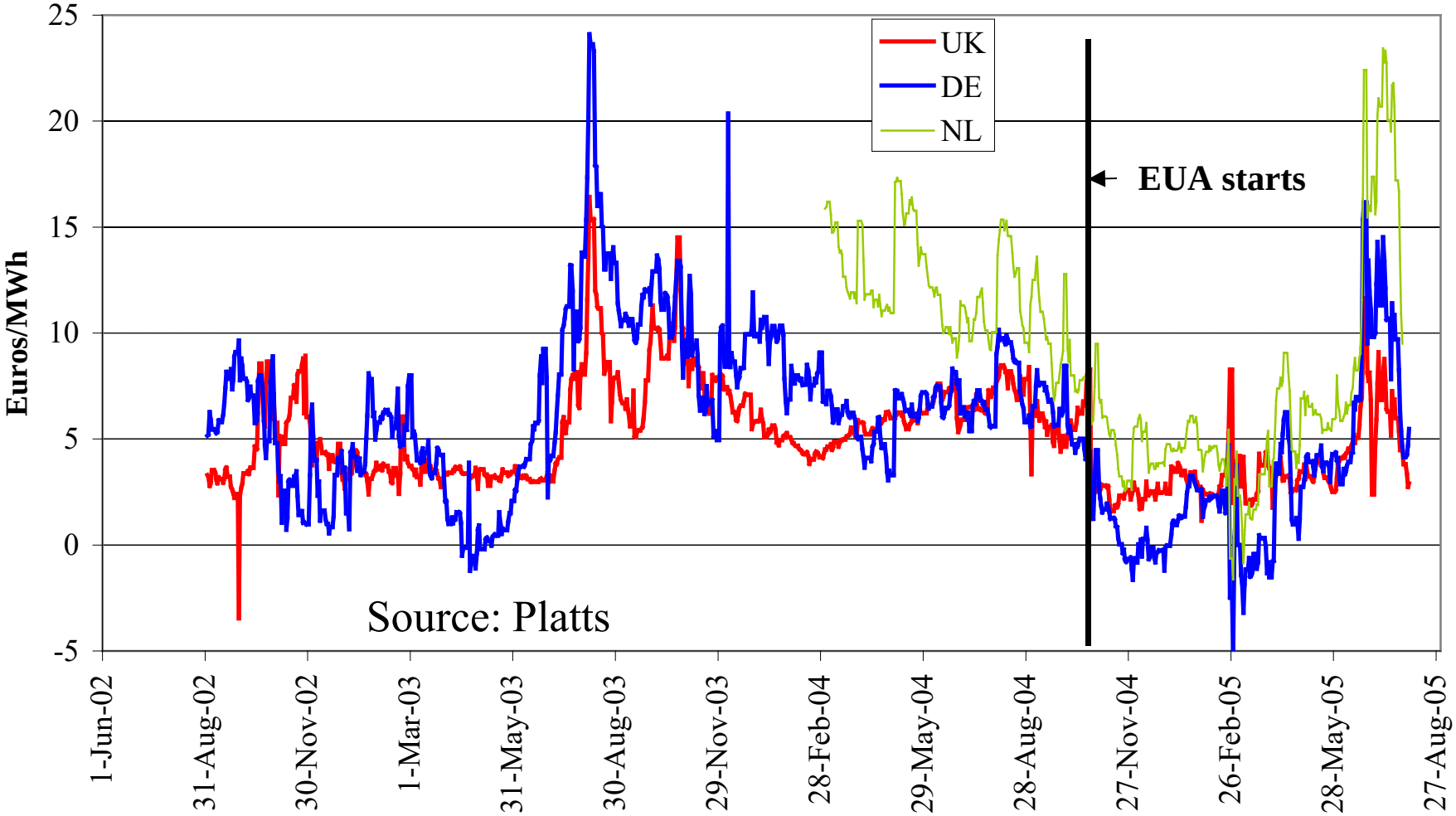


Source: Platts, UKPX, EEX, zfk

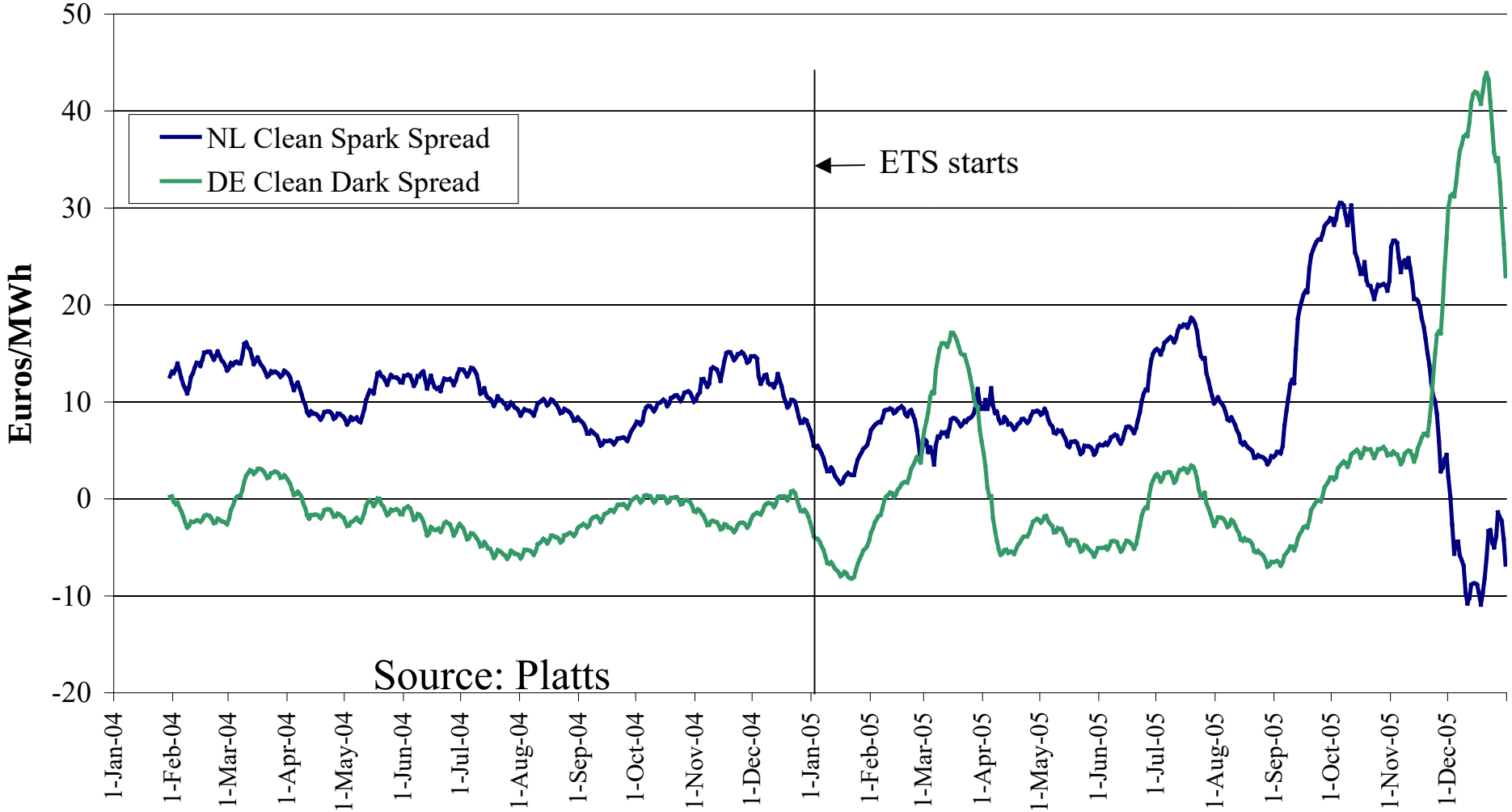
Spark spread month ahead 50% efficiency



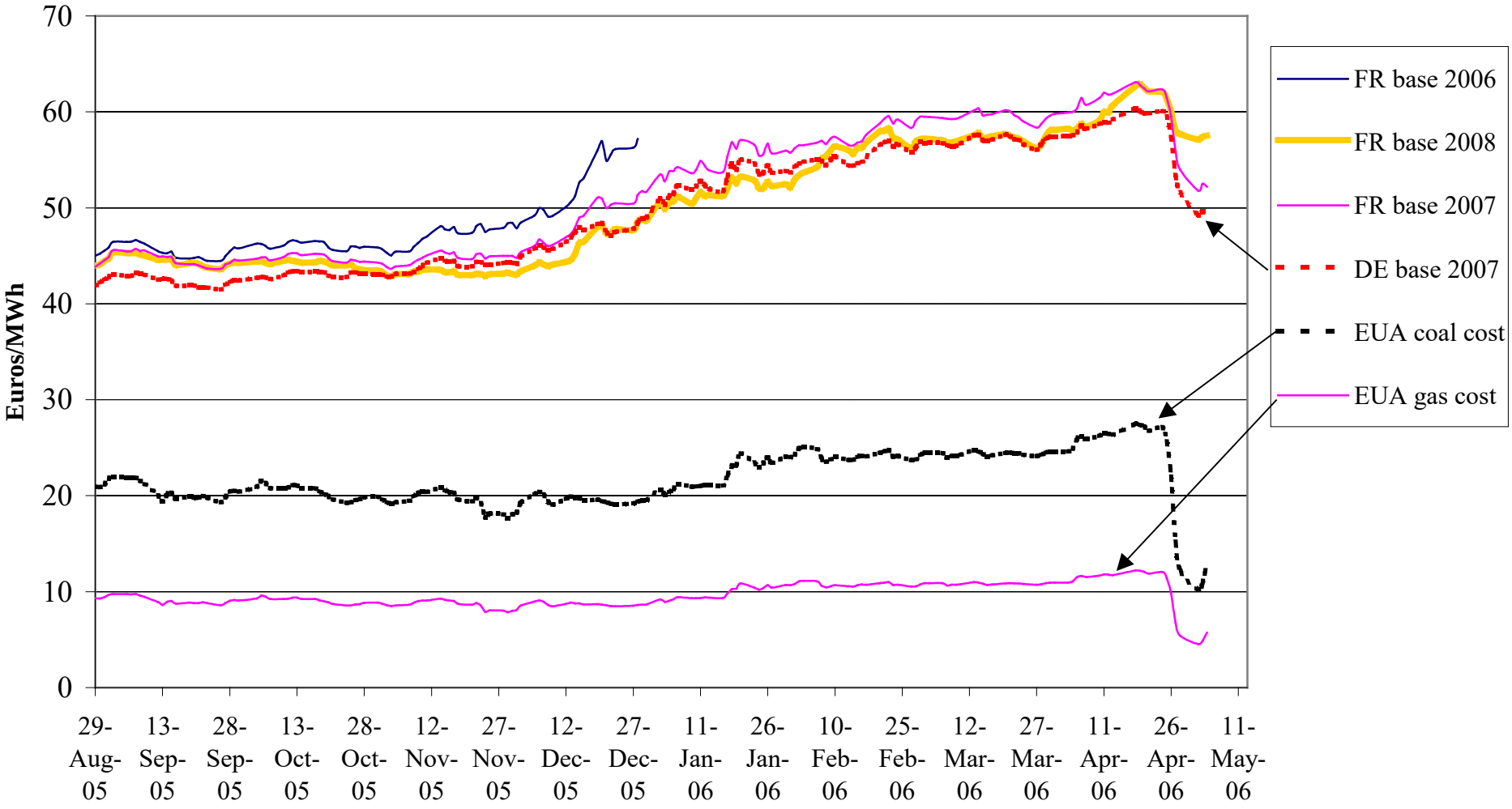
Spark spread net of EUA



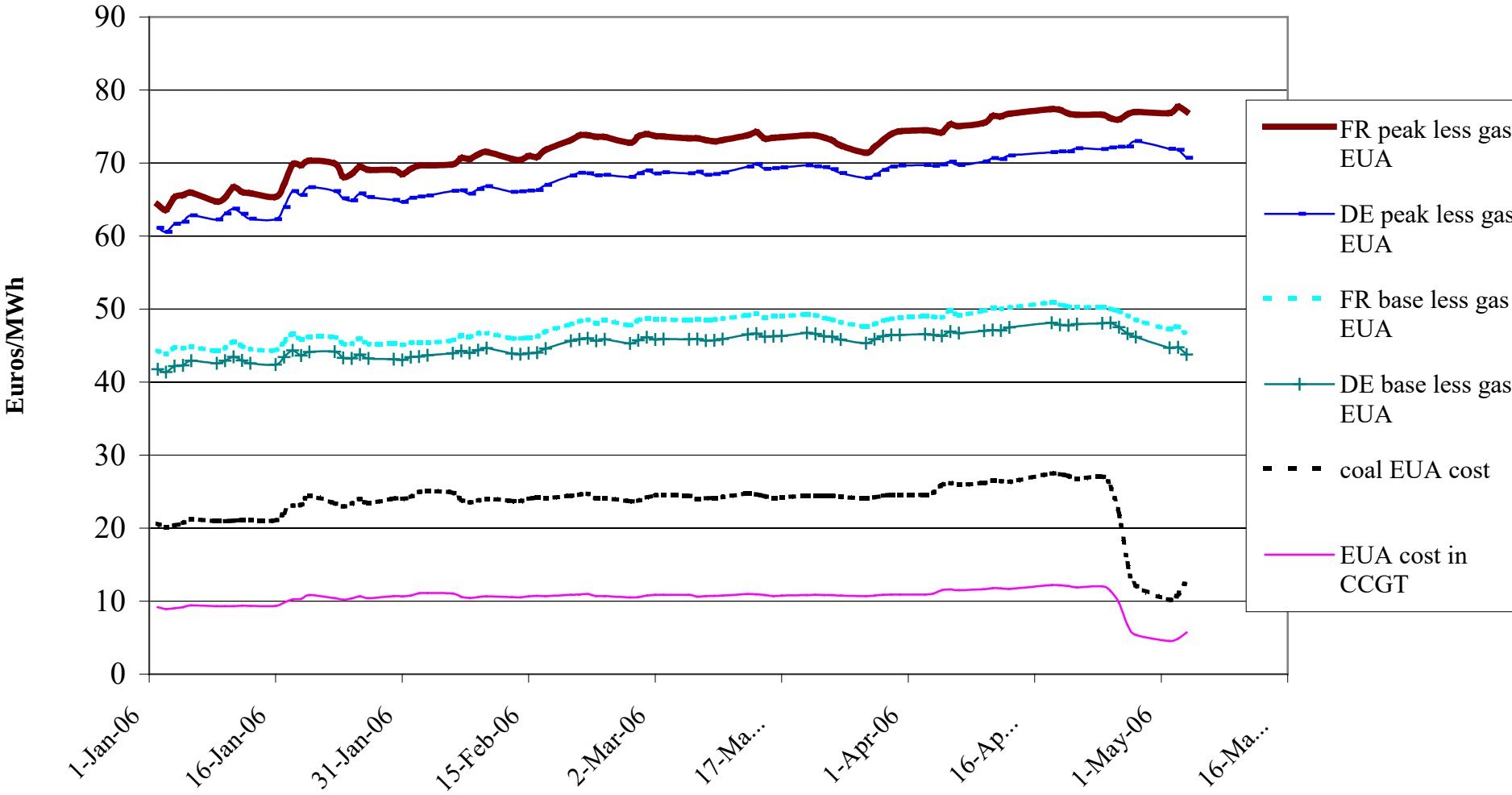
30-Day Moving Average Clean Spark and Dark Spreads: NL, DE



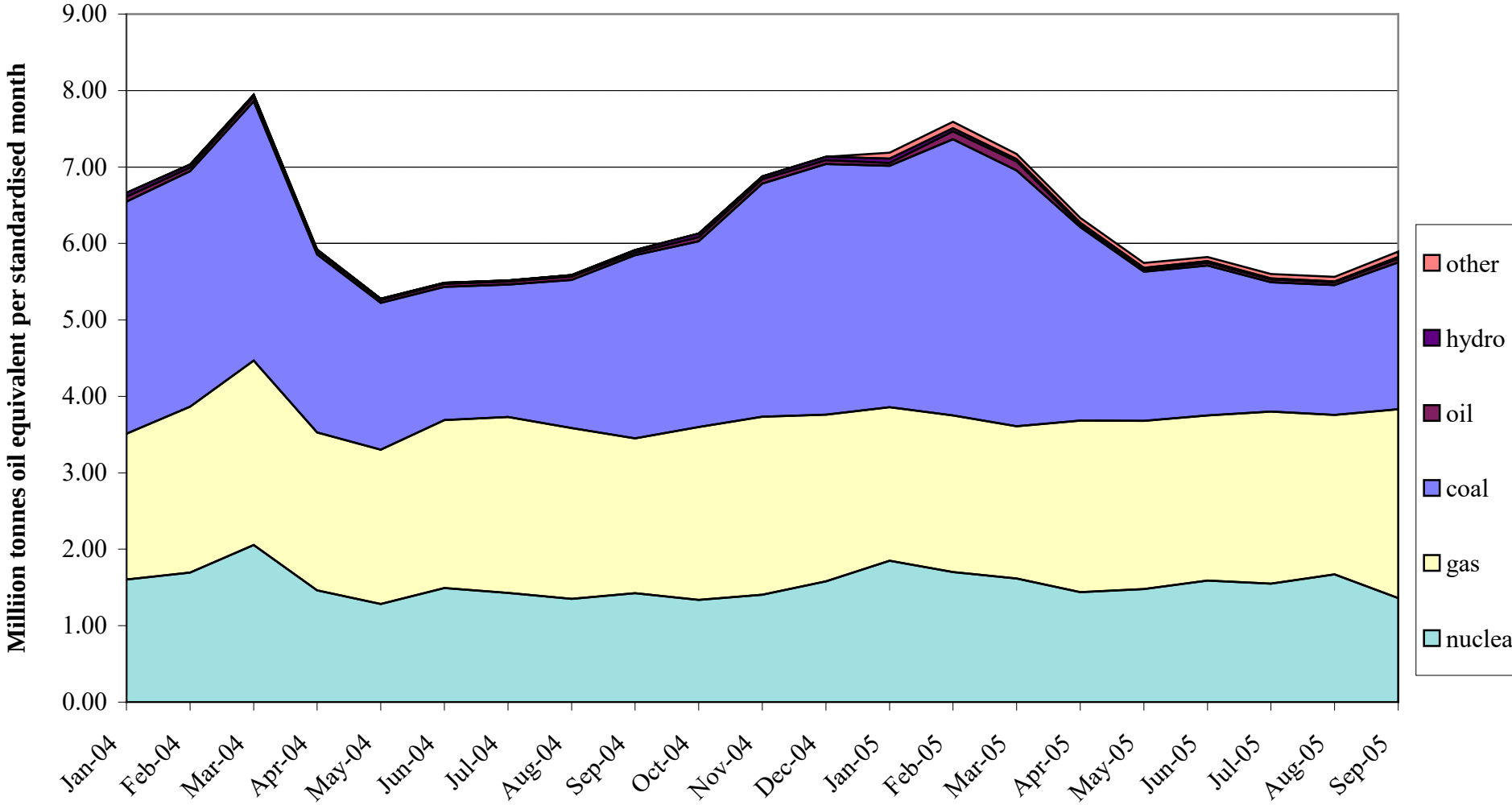
Forward base year contracts - France and Germany Aug 2005-May 2006



Forward 2007 annual prices - France and Germany 2006

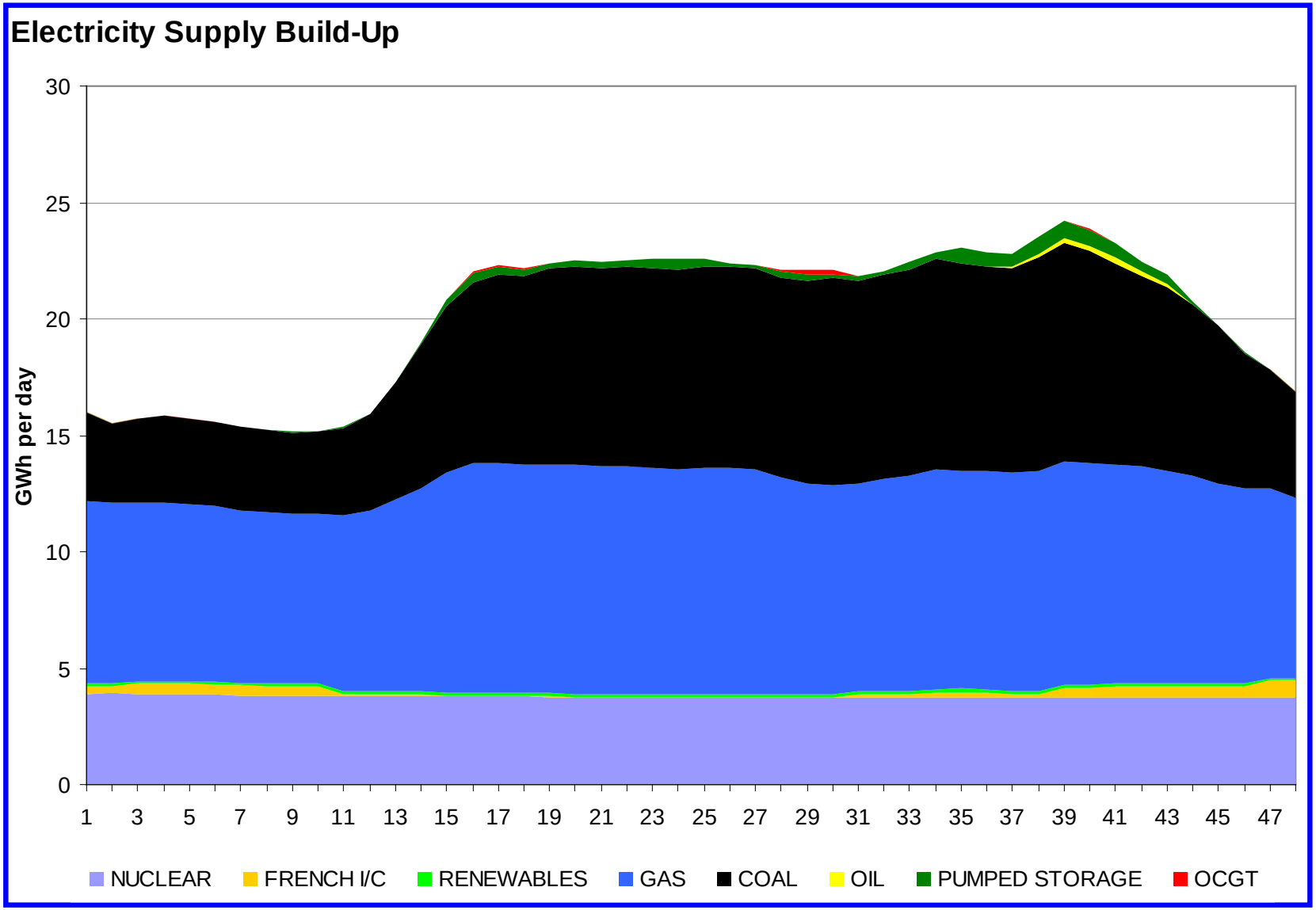


Fuel used in electricity generation by major producers

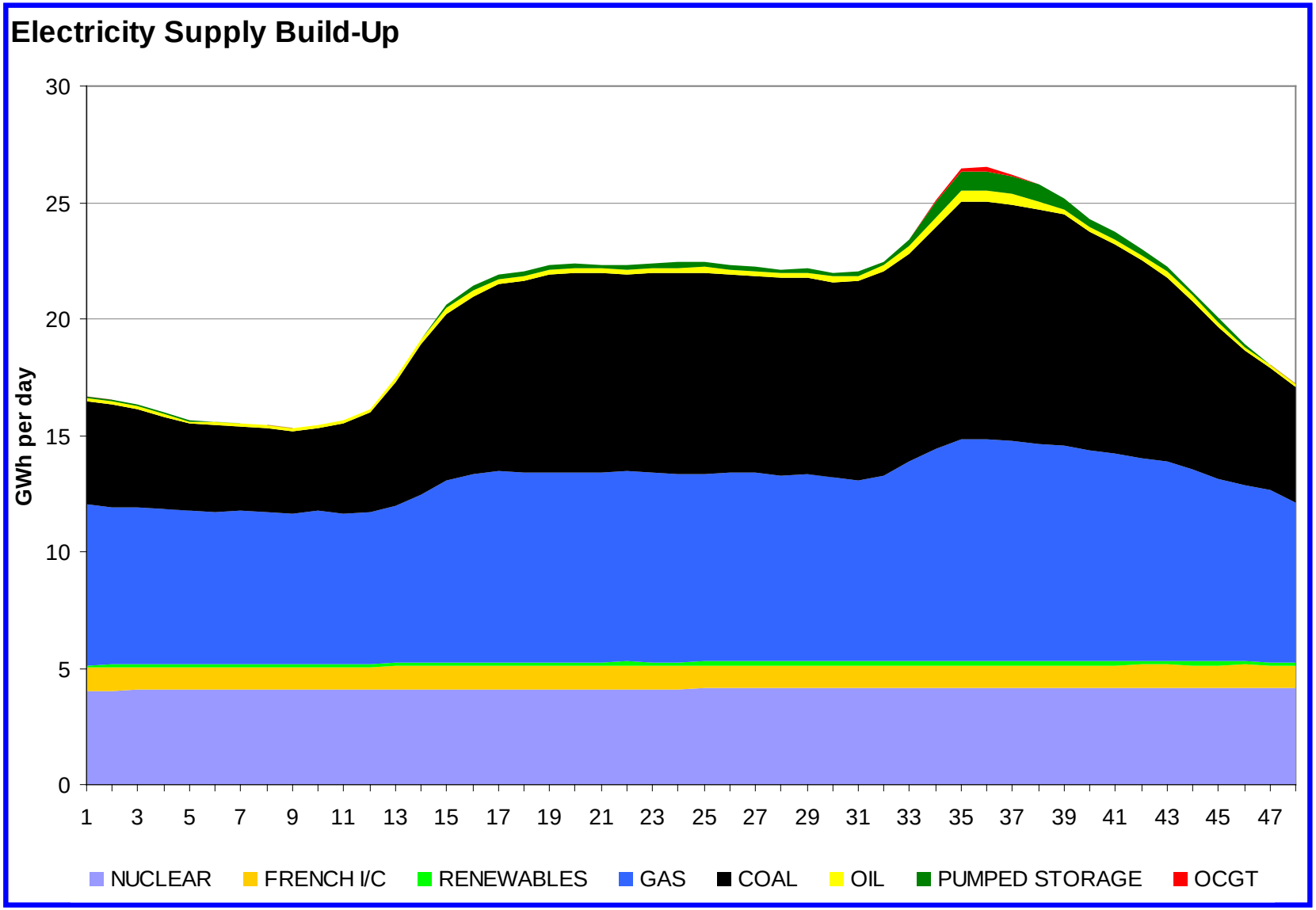


Source: DTI

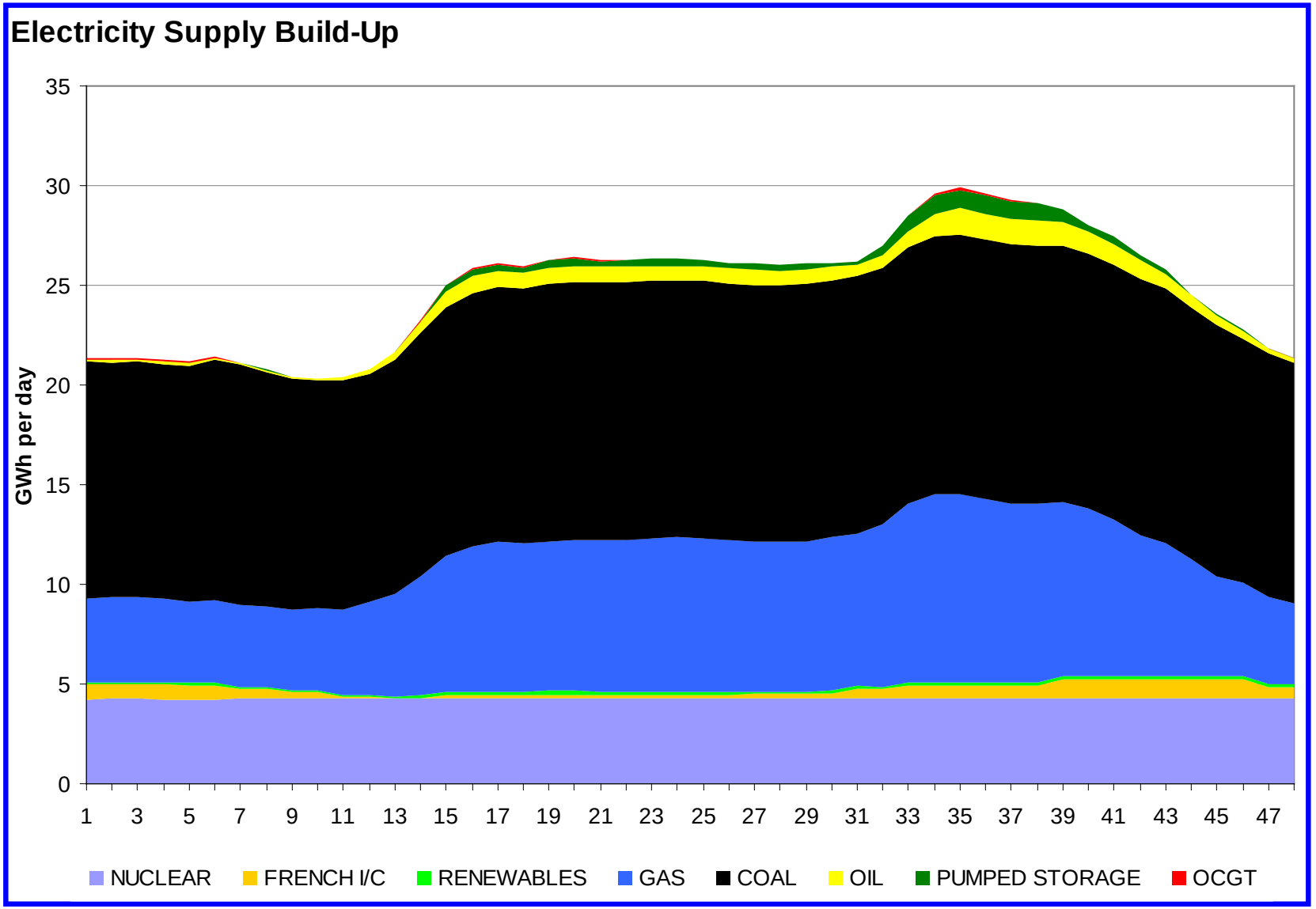
Load profile Tues 4 October 2006



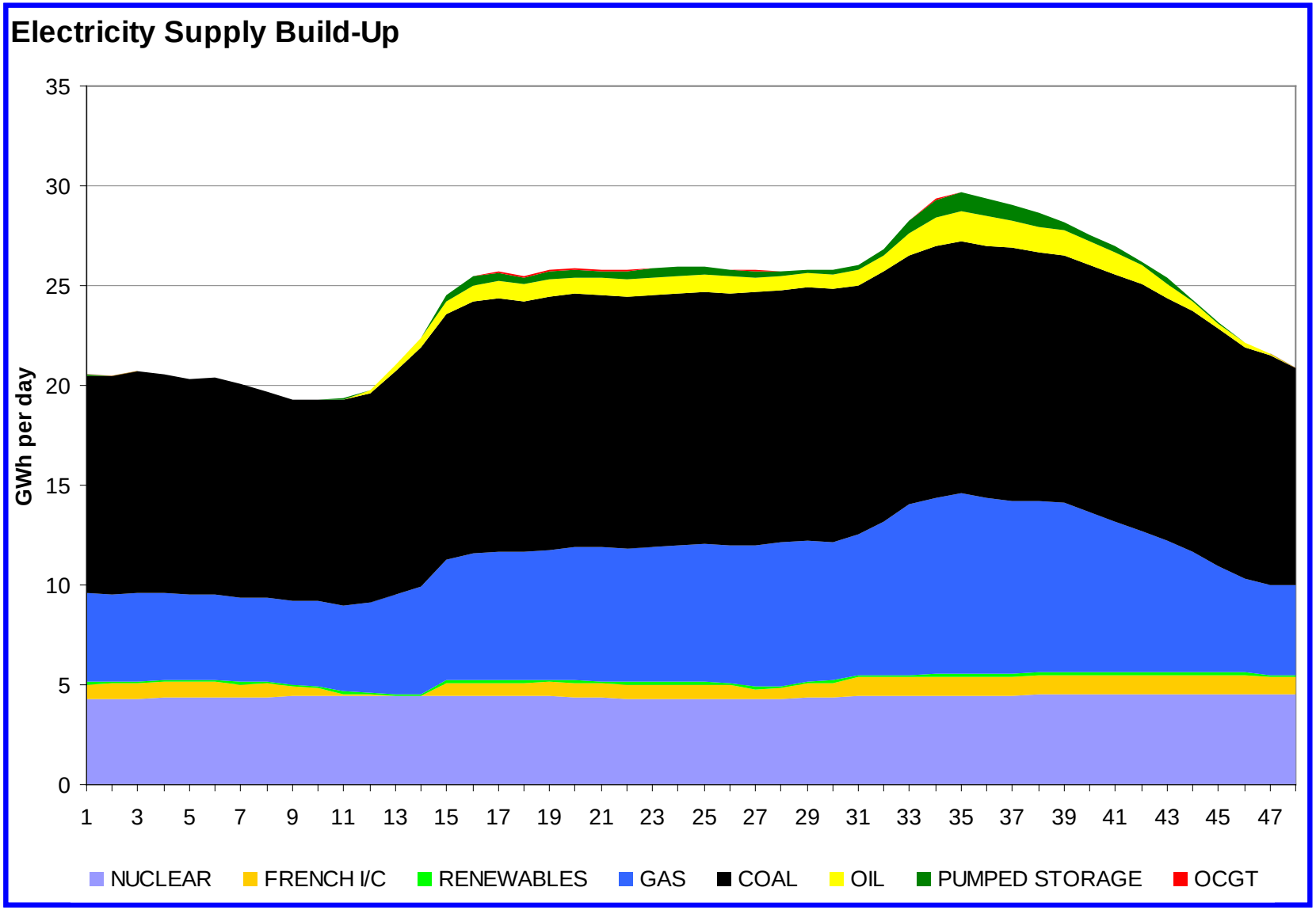
Load profile Tues 1 November 2006



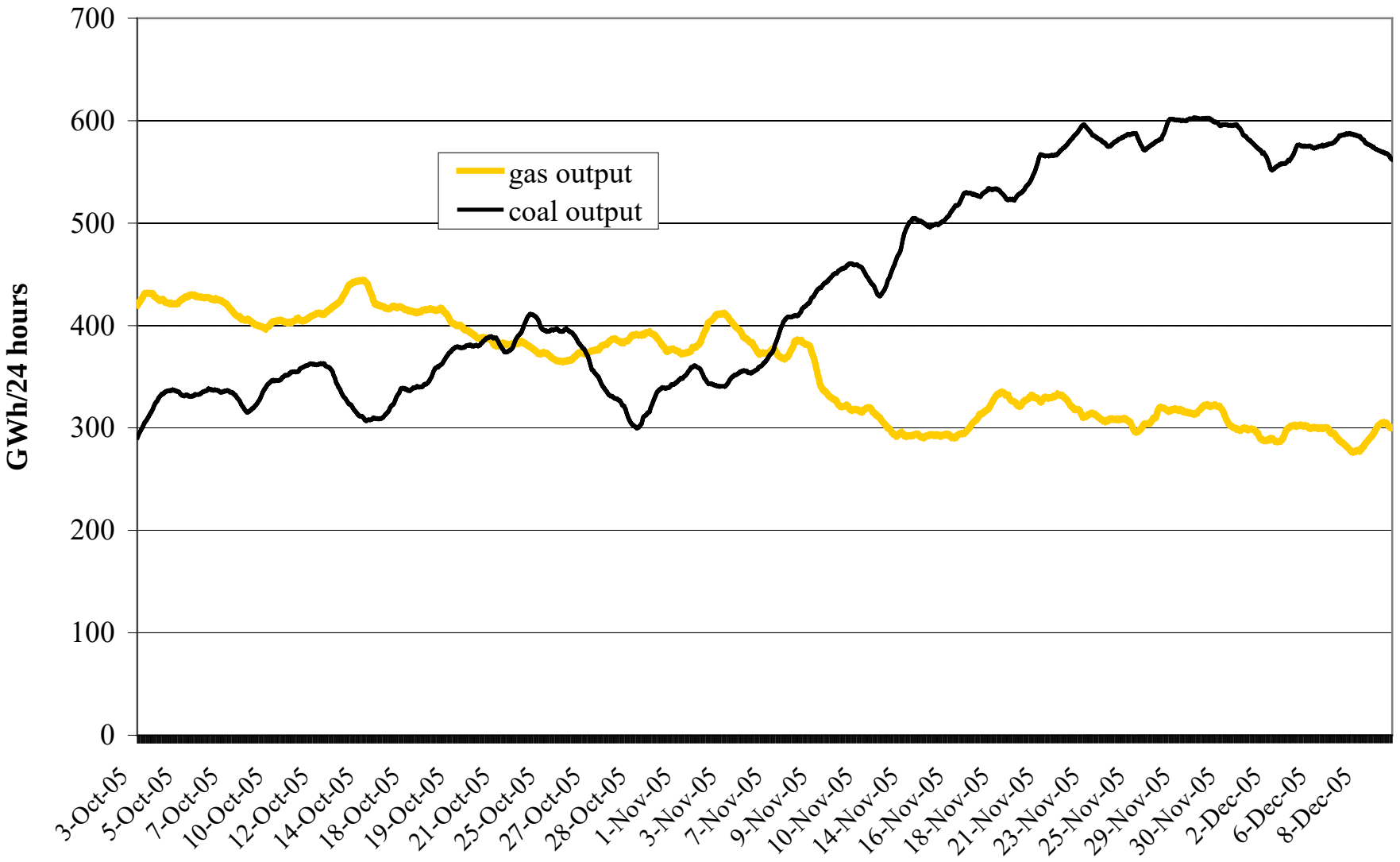
Load profile Tues 29 November 2006



Load profile Tues 6 December 2006



Weekday moving 24 hr av coal and gas generation Britain 1 Oct-9 Dec 05



Impact of ETS on gas pricing

- Suppose gas price increases
  - initially: demand falls (fuel switch gas => coal)
  - demand for EUAs rises => EUA price ⇑

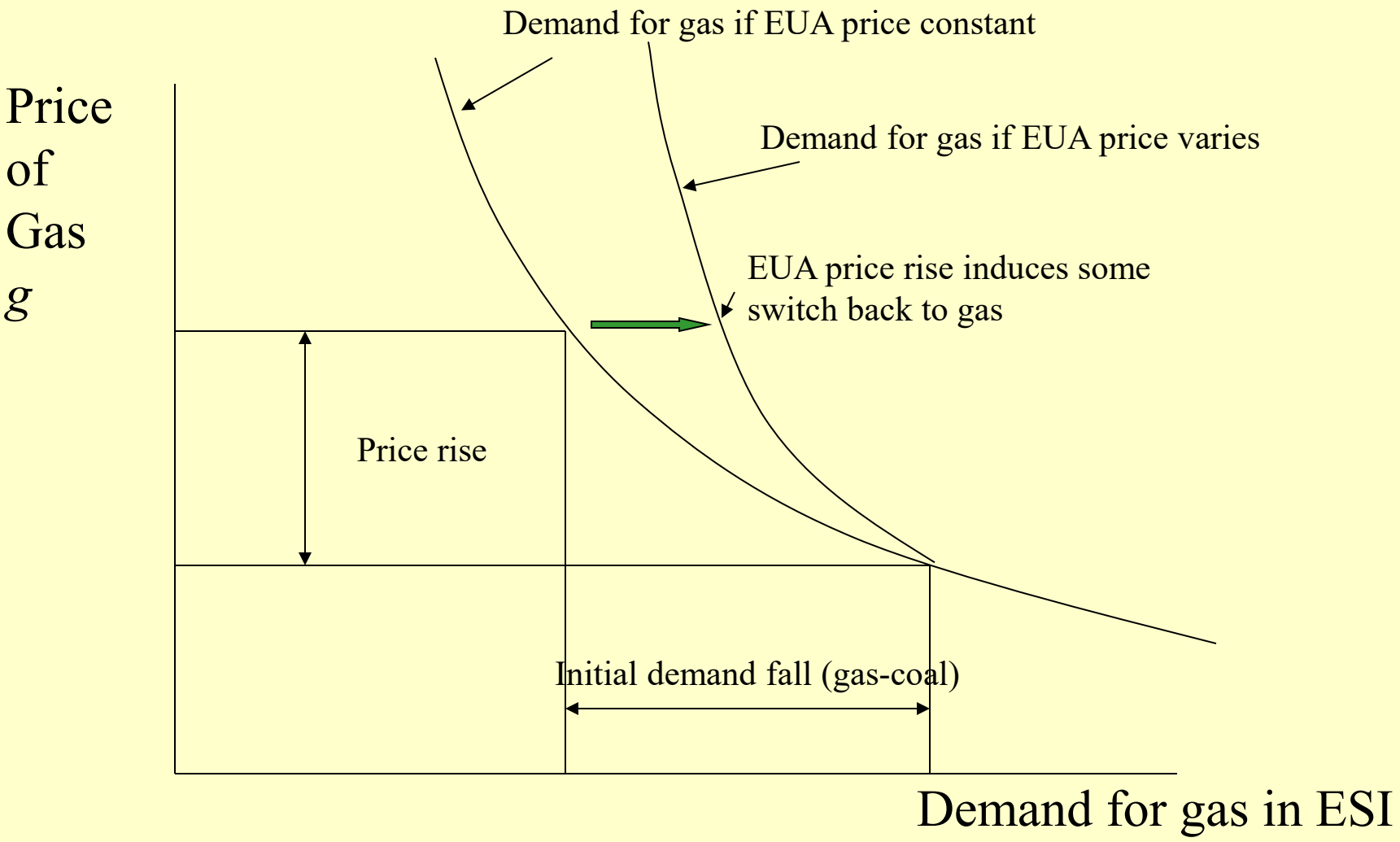
  => partially offsets advantage of coal

  => reduces demand reduction for gas

  => reduces elasticity of demand for gas

  => increases market power of gas suppliers
    - Gazprom, and suppliers with protected markets

Demand for gas

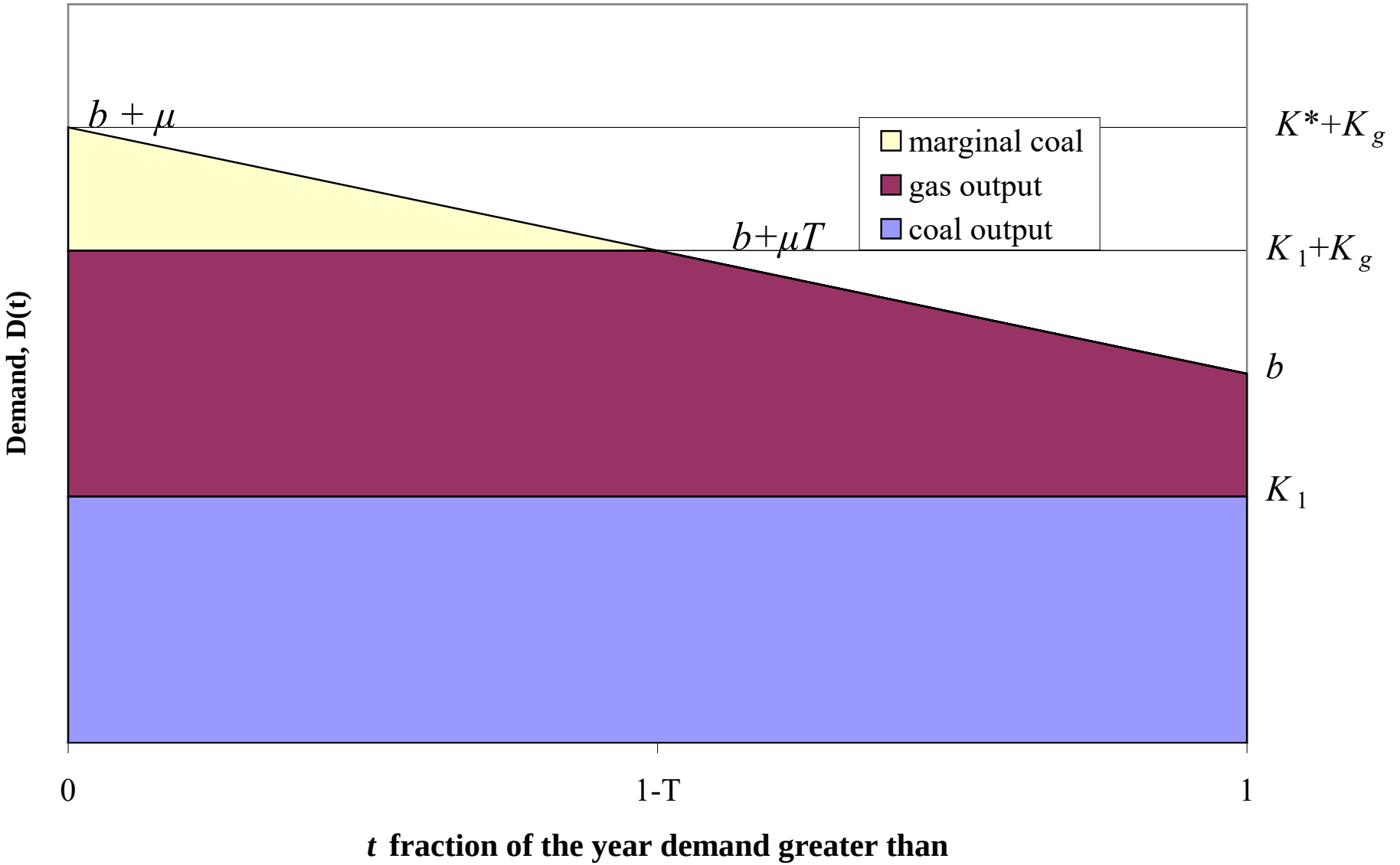


Carbon link amplifies partial impact of gas price change

$$\frac{dp}{dg} = \frac{h_g h_c e_c}{h_c e_c - h_g e_g} = h_g \left(\frac{1}{1 - h_g e_g / h_c e_c} \right) > h_g .$$

h_f = heat rate of fuel f (MWh/MWhe), e_f = tCO_2/MWh,
p = price of electricity, g = price of gas
e.g $h_g = 2$, $h_c = 2.65$, $e_g = 0.2$, $e_c = 0.34$, multiplier = 1.8

Load duration curve and shares of generation from each fuel



Effect of gas price on gas demand

Let η be elasticity of supply of EUAs to ESI

Ratio of elasticity of gas demand with (ε^*) and without (ε) ETS

$$\frac{\varepsilon^*}{\varepsilon} = \left(\frac{\eta}{\eta+\phi}\right), \quad \phi \equiv \left(\frac{K_1 \partial E}{E \partial K_1}\right)\left(\frac{-s \partial K_1}{K_1 \partial s}\right).$$

where K_1 is capacity of cheap coal, E is total ESI emissions, s is price of EUA

Note Lerner Index $(p\text{-}c)/p = 1/\varepsilon$

Table 1 Parameters for calibrating the model to Britain, 2005

gas heat rate	h_g	2	
coal base heat rate	h_0	2.5	
rate of change of HR	α	0.025	per GW
CO_2 per MW gas	e_g	0.2	tonnes/MWh
CO_2 per MW coal	e_c	0.34	tonnes/MWh
min demand	b	25	GW
Slope of load duration	μ	30	GW
gas capacity	K_g	20	GW
coal capacity	K_c	40	GW
Price of gas	g	16	€/MWh
Price of coal	c	6	€/MWh
EUA price	s	20	€/tonne CO_2

This gives a value of $\varphi = 0.55$. If $\eta = 0.1$, then gas demand elasticity falls to 2/3 and Lerner index increases by 50%.

Policy implications

- Imposing extra constraint on market reduces demand elasticities and amplifies market power
- If the price of EUAs is independent of gas demand then there is no multiplier effect
- There are other reasons for setting carbon price rather than quantity:

Prices vs Quantities (Weitzman, 1974)

Permits vs Taxes (or constant prices)

Weitzman: Taxes superior to permits unless MB of abatement more curved than MC

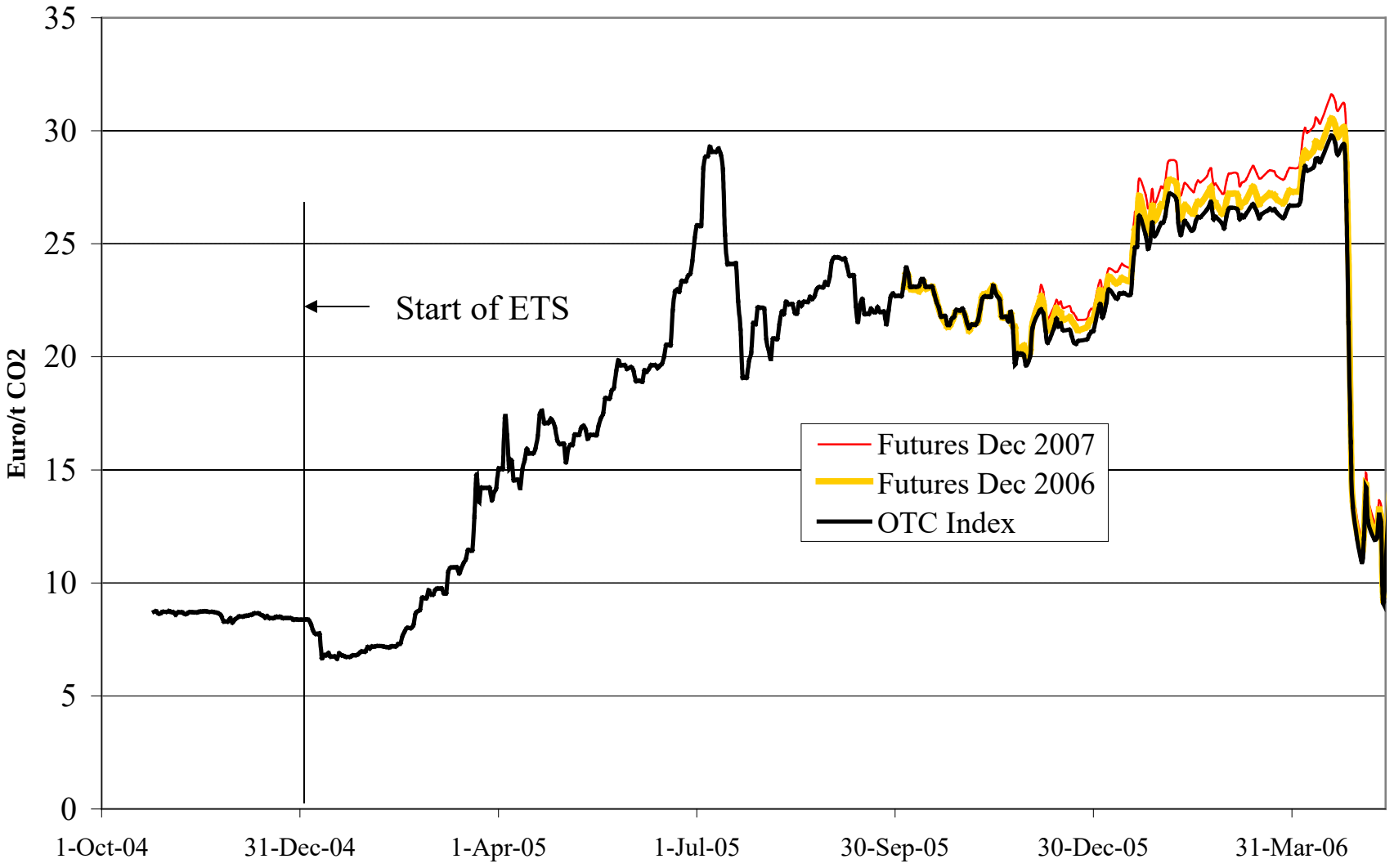
CO_2 is a stock pollutant

- CO_2 damage today effectively same as tomorrow

  => marginal benefit of abatement essentially flat
- marginal cost of abatement rises rapidly
- hazard of global warming very uncertain, as are the future abatement costs

Carbon tax superior to tradable permits

EUA price 25 October 2004-15 May 2006



Other estimates of C taxes

- EUA €20/t CO_2 = €73.3/tC
- Tax for global optimum ~ €10-220/tC
  - Karp and Zhang €8- 55/tC
- Old EU carbon tax = $5/bbl = €50/tC
- But political economy favours (and EU Directive requires) grand-fathered allocation of permits

So how to get to a fixed price from the ETS?

Stabilising the price of carbon

- banking over longer periods helps
- floors and ceilings: c.f. US NO_x
- NAPs continue with decreasing coverage
- CEC offers extra EUAs at fixed price
  - revenue raising, reduces budgetary problems
  - allows long-term carbon contracts
  - allows CfDs for low-carbon generators
  - basis for import tariff on embodied carbon?

Conclusion

- present ETS imposes a quantity constraint
  - this reduces demand elasticity for gas

  => enhances market power of gas producers
- fixing CO_2 price better than fixing quantity
  - stock pollutant whose damage insensitive to date

=> CEC fixes CO_2 price by selling EUAs
  - avoids enhancing market of gas producers
  - generates revenue, allows long-term CO_2 contracts

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