

***Energy Policy:
How much it costs you and what
you get for your money***

Michael Pollitt
Judge Business School

*U3A, Cambridge
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Outline

- What is energy policy?
- UK energy prices
- Key technologies behind energy policy
- What constitutes a sensible set of policies?
- Policies and their costs
- Prospects for prices
- Conclusions

What is UK energy policy?

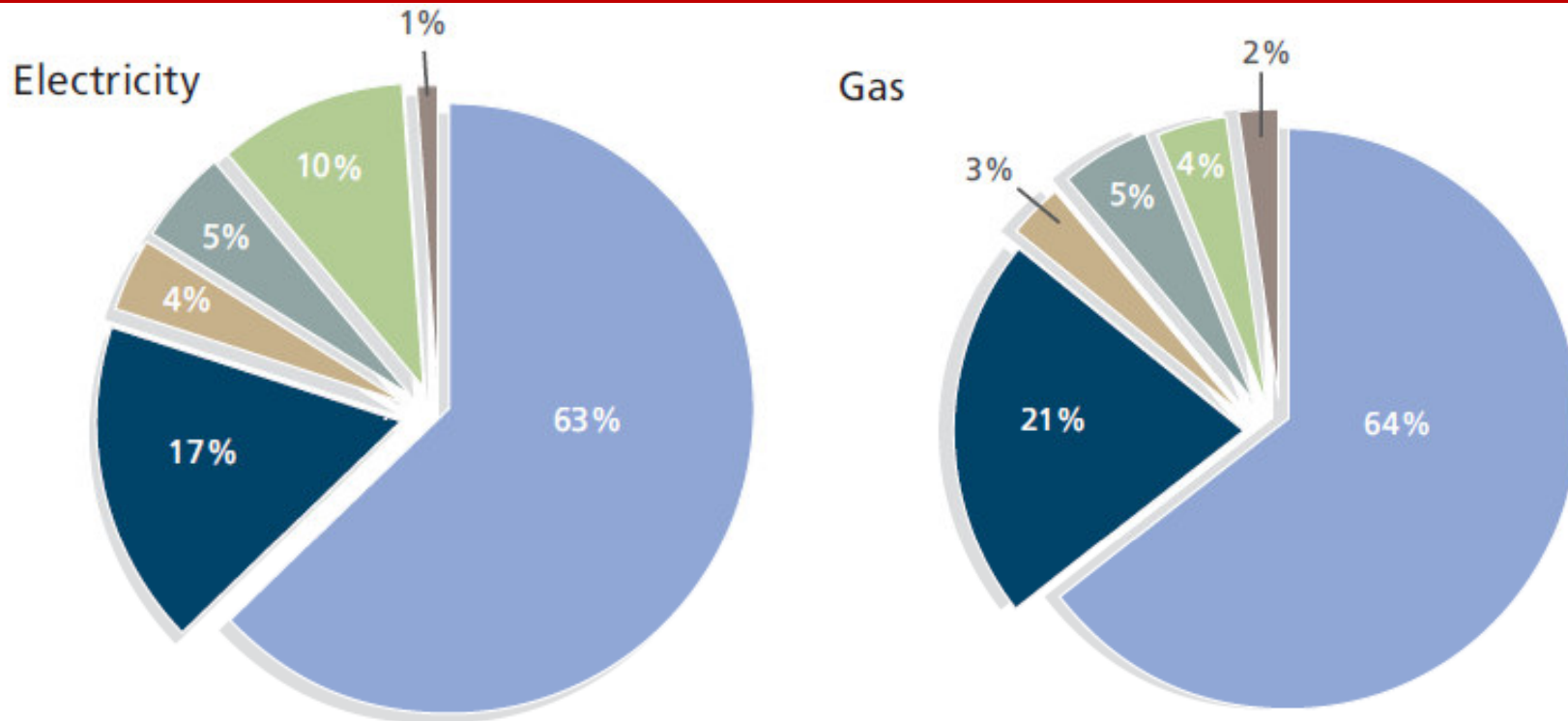
- *Secure*
- *Affordable*
- *Low Carbon*
- Energy

Macro context

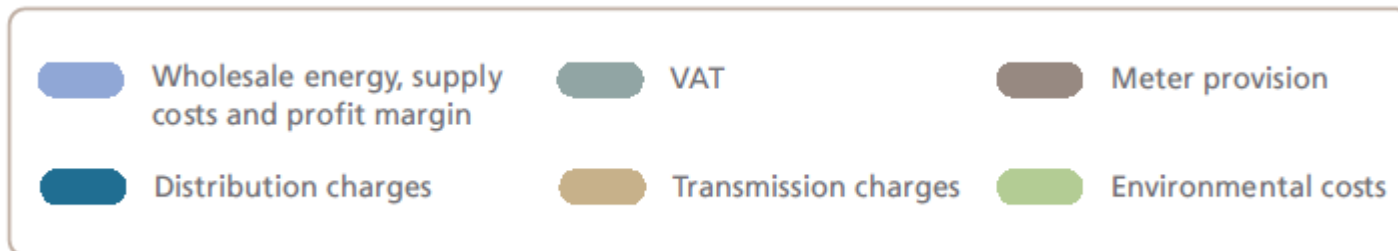
- Total sales to final customers 2010: £124.2 bn.
- Total sales by sector (all customers):
 - £ 24.4bn Gas;
 - £ 30.5bn Electricity;
 - £ 75.7bn petroleum (£67.7bn road transport)
- Energy Taxes in 2010: oil duties + VAT receipts + CC Levy (say £41bn in total).

Source: DUKES, 2011 4

Breakdown of Household Energy Bills



Typical Electricity bill: £424; Typical Gas Bill: £608. Source: Ofgem, Jan 2011



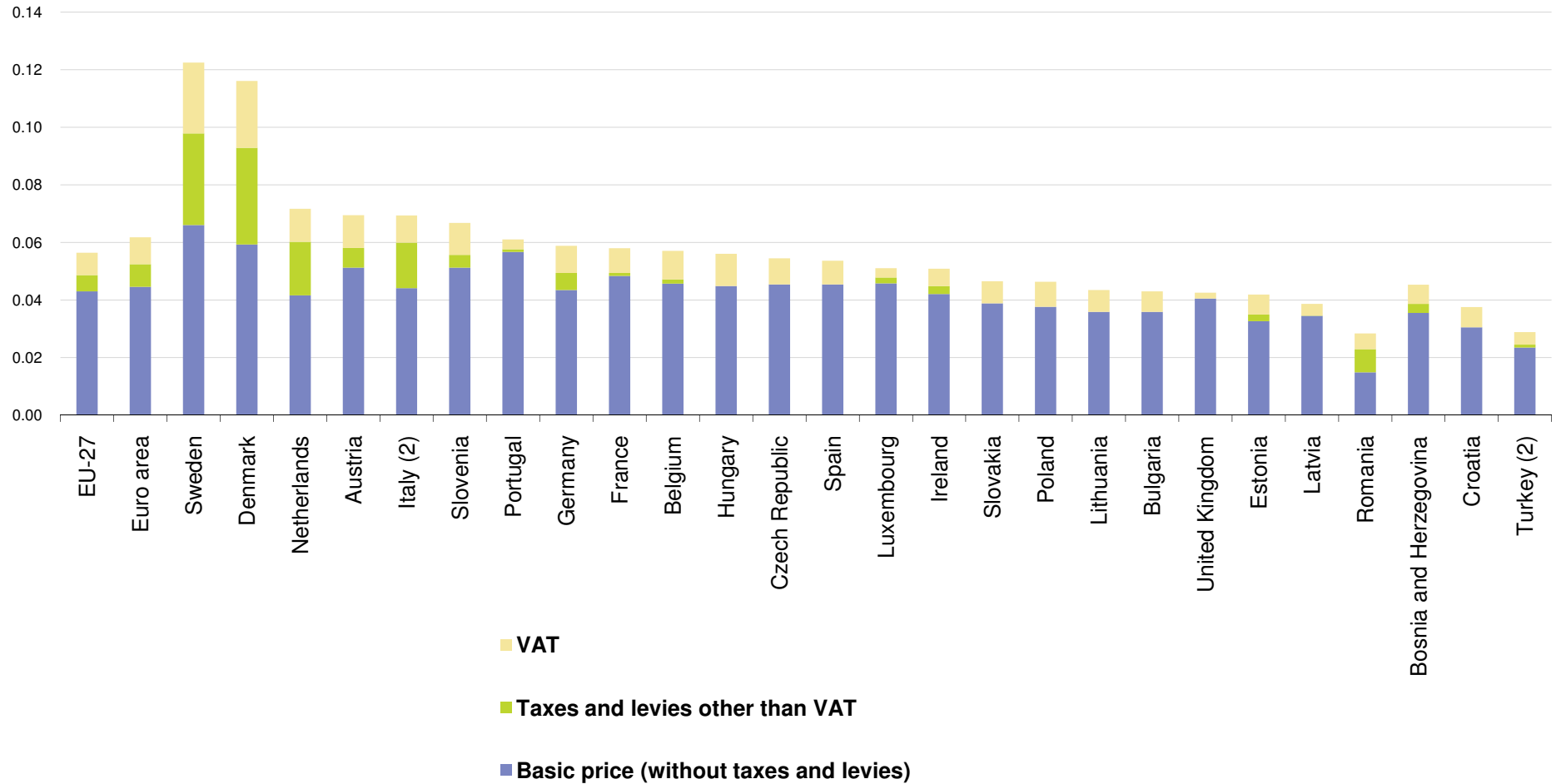
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Electricity Prices for Household Consumers, Eur/kWh, first half 2011

Source: Eurostat (online data codes: nrg_pc_204, nrg_pc_205, nrg_pc_202 and nrg_pc_203) Electricity Policy
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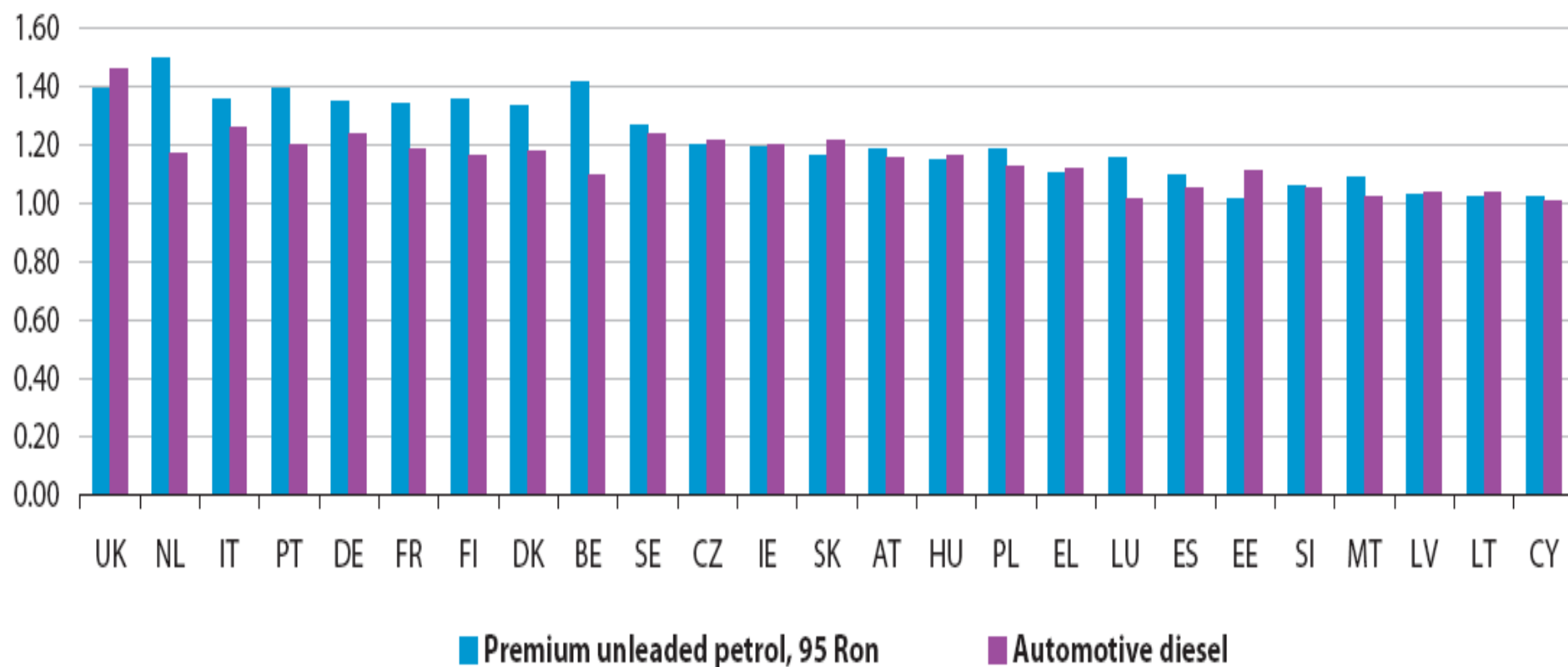
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Natural Gas Prices for Household Consumers, Eur/kWh, first half 2011



Source: Eurostat (online data codes: nrg_pc_204, nrg_pc_205, nrg_pc_202 and nrg_pc_203)

Retail price of automotive fuel (2008 EUR/litre)



(1) Countries ranked on average price.

Source: Eurostat (Energy)

European Energy Policy Context

- 20-20-20 Targets for 2020:
 - 20% reduction in CO₂e (hard target)
 - 20% renewable energy (indicative target)
 - 20% reduction in energy intensity (aspirational target)
- Completion of Electricity and Gas markets (3rd Energy Package)
- Energy Security Directive, Energy Services Directive etc...
- Reality of patchy implementation

UK Decarbonisation targets

- UK in 2010 GHGs: -23% relative to 1990
- Kyoto Target: -12.5% by 2020
- 2008 Climate Change Act
 - 80% reduction by 2050
 - Climate Change Committee
 - Five Year Carbon budgeting
 - First report: complete decarbonisation of electricity by 2030
 - Latest target: -49% relative to 1990 by 2023-27.

UK Renewables Targets

- UK committed to 15% target for renewables contribution to total final energy consumption in 2020 (2009/28/EC) (3.0% in 2009)
- Currently support regime only envisages 15.4% renewables in electricity by 2015-16. (7.3% in 2010)
- 2010 target of 10% for electricity from renewables (2001/77/EC)
- Now have Renewable Heat Incentive (RHI)

Technology 1: Nuclear?



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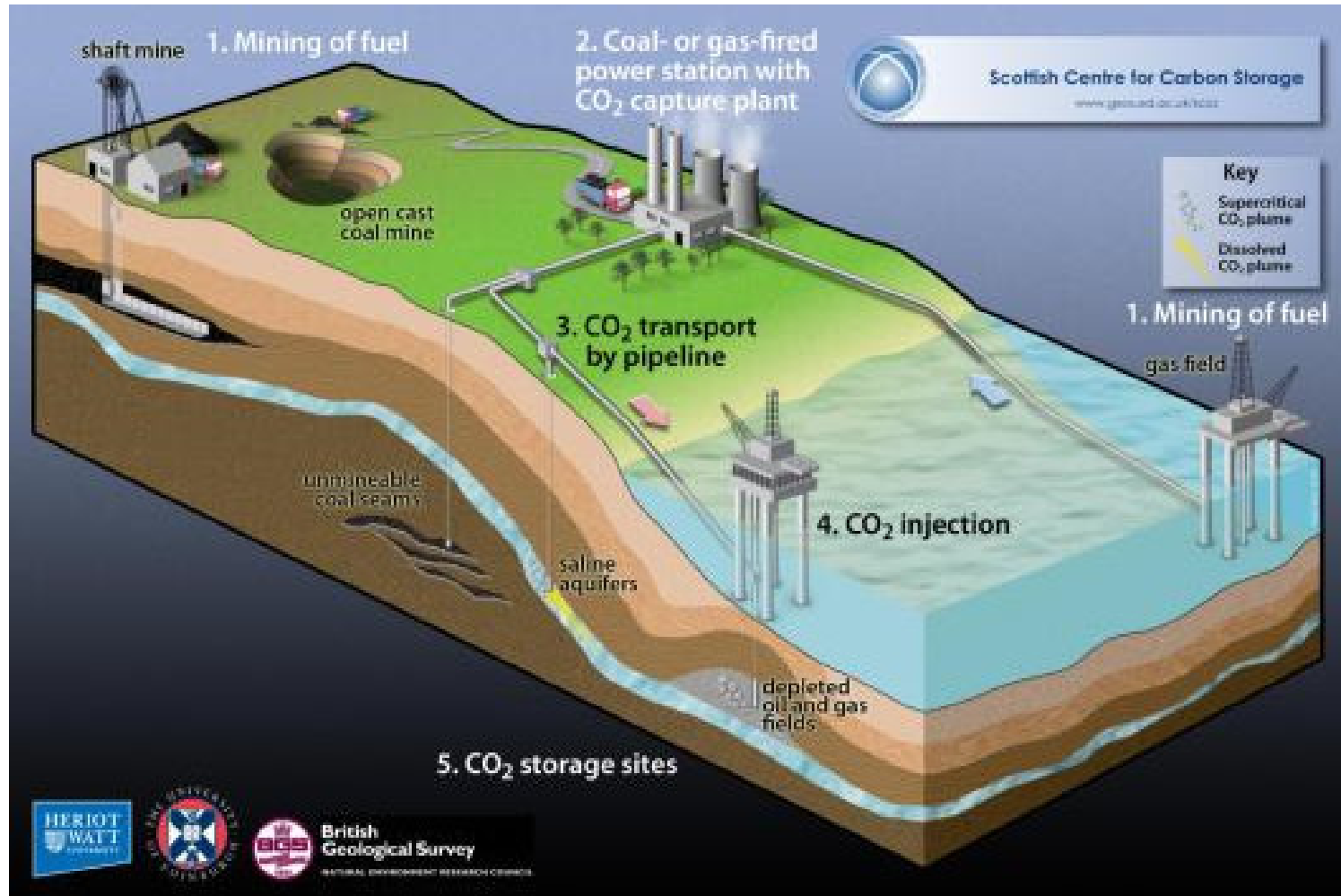
Nuclear: Pros

- Delivers large blocks of decarbonisation
- Only historically proven (France and Sweden, though UK gas experience does get close)
- Build and forget

Nuclear: Cons

- Public / protestor anxiety
- Nuclear proliferation issue
- High upfront cost (£3bn+ per plant)
- New builds in France/Finland at c.100% over budget
- Liabilities large (UK: £80bn; £2.8bn p.a.)
- Costs vary significantly on:
 - Upfront cost
 - Build time
 - Discount rate
 - Operation efficiency

Technology 2: Carbon Capture and Storage?



CCS: Pros

- Delivers substantial decarbonisation
- Oil, gas and coal going to be substantially used
- A bridging technology
- Applicable in US, China and India

CCS: Cons

- Energy inefficient (10-40% energy penalty)
- Capture inefficiency (only 80-90%)
- Untried at scale
- Public acceptability issues
- Cost substantial (adds 1.5p / kWh +)
- Does not address energy security issues
- Only a stop-gap
- CCS demonstration projects abandoned

Technology 3: Renewables?



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Renewables: Pros

- Clean, green and sustainable
- High potential in the UK
- Strategic deployment leads to learning
- Some technologies now well developed

Potential for Renewables in UK

Technology Category	Technology Detail	Annual Potential
<i>Wind power</i>	Onshore	50 TWh
	Offshore	100 TWh
<i>Bioenergy</i>	Biomass	41 TWh
<i>Geothermal</i>	Ground source heat pumps	8 TWh
<i>Hydro</i>	Large scale	5 TWh
	Small scale	10 TWh
<i>PV</i>	Retro fitted and Building integrated	>1 TWh
<i>Marine</i>	Wave energy	33 TWh
	Tidal barrage	50 TWh
	Tidal stream	18 TWh
<i>Total</i>		~316 TWh

Renewables: Cons

- Issues of scalability
- Intermittency and blackout risks
- Costs of some technologies prohibitive
- Grid enforcement and backup expensive
- Costs of support high and rising

Costs of different renewables

- Onshore wind: 6.6-9.3 p / kWh
- Offshore wind: 11-19.7 p / kWh
- Tidal Stream: 16.6-39.5 p / kWh
- Severn Barrage: 10.4 - 31.7p / kWh
- Wave: 22.5-50.5 p / kWh
- Domestic PV 38p / kWh

- Memo: CCGT c.5.5p / kWh (inc. CO₂ price)

Sources: Costs of Low Carbon Generation Technologies 2011, Renewable Energy Review-
Technical Appendix, Solar Century, Jamasb and Pollitt, 2008

Technology 4: Demand Reduction?



Demand reduction: Pros

- Potential is large for energy saving
- Increased focus on energy services
- Micro-gen included reducing grid costs
- Potential relative to trend important
- Engages consumer and innovation
- Improves energy security
- Reduces energy poverty
- Interacts with heat and transport

Some Home Energy Economics

	Capital Cost £	Lifetime energy cost £	Total cost	Energy cost %
<i>Lightbulb 100W</i>	0.35	18.98	19.33	98.2%
<i>Lightbulb low energy 100W</i>	1	15.53	16.53	94.0%
<i>Gas Boiler</i>	1000	7629.05	8629.05	88.4%
<i>TV</i>	700	540.01	1240.01	43.5%
<i>Fridge</i>	300	159.56	459.56	34.7%
<i>Car (annual)</i>	2500		3500.00	28.6%
<i>Computer</i>	1000	48.84	1048.84	4.7%
<i>Mobile phone (annual)</i>	360	1.42	361.42	0.4%

Demand reduction: Cons

- Transaction cost issues
 - ‘Behavioural’ barriers
 - Can negatively impact vulnerable
 - Requires decentralisation of policy
 - Standard setting opaque
-
- Higher unit prices must accompany measures

A sensible UK electricity policy

- Some combination of nuclear, CCS, renewables and demand reduction is necessary to meet targets.
- The problem is deciding which combination is best?
- Here is where economic principles are important.

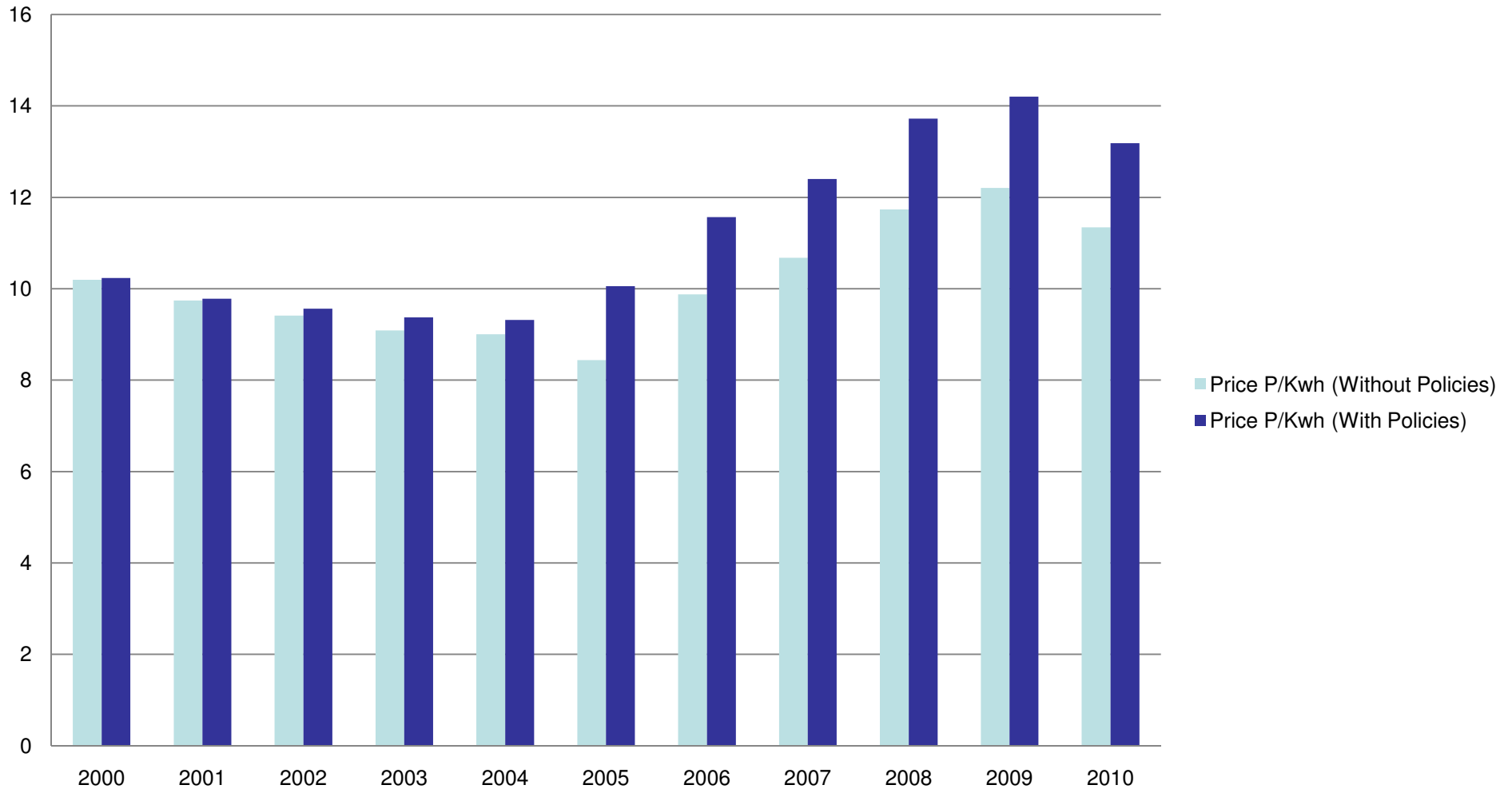
Four economic principles

- Carbon externality needs to be priced.
- Production subsidies where exists learning effect.
- Net *and* gross cost effects significant,
- Supplement income rather than interfere with efficient pricing of energy.

Current policy costs: £4.88bn + £4.23bn

Scheme	Description	Cost	Paid by
Environmental Policy			
1. CERT/CERT Extension	This requires energy suppliers to make savings in the amount of CO2 emitted by householders. Suppliers meet this target by promoting (for example, through subsidies) the uptake of energy efficiency measures; predominantly loft insulation, cavity wall insulation and historically low energy lighting.	Total cost for the scheme over the entire period (April 08- Dec 12) is estimated to be £5.5 billion	Gas and Electricity consumers
2. CESP	CESP targets households in Great Britain, in areas of low income, to improve energy efficiency standards.	Total cost for the scheme over the entire period (Oct 09- Dec 12) is estimated to be £350 million	Gas and Electricity consumers
3. EU ETS	Renewable generators indirectly benefit from the increase in electricity prices as other companies pass the cost of emissions permits into the price of power	156.4mt emitted by power sector at 14.3 Euro per tonne EUA = £1.94 bn - in 2010.	Electricity consumers
4. FIT	Introduced in April 2010, small-scale FITs are designed to incentivise small-scale, low-carbon electricity generation by households, communities and businesses.	The value of the FIT scheme is calculated at £14.4 million for 2010/11	Electricity consumers
5. RO	Introduced in April 2002, It requires retail electricity suppliers to source an increasing proportion of their electricity from renewable sources by purchasing Renewables Obligation Certificates (ROCs) issued to generators of renewable electricity by Ofgem.	The value of the RO scheme is calculated at £1.487 billion for 2011/12	Electricity consumers
6. Warm Front Scheme (WFS)	Introduced with an aim to reduce carbon dioxide emissions, WFS helps eligible households with the take-up of heating and insulation measures, making them more energy efficient	The value of the WFS scheme is calculated at £143 million for 2011/12	WFS in totality is funded through HM Treasury
Income Supplement			
1. Warm Home Discounts	The powers to introduce the WHD scheme were taken in the Energy Act 2010 and the scheme was launched in April 2011 following consultation.	Total cost for the scheme over the entire period (April 11- March 12) is estimated to be £1.1 billion	Electricity and Gas customers
2. Winter Fuel Payments	The Winter Fuel Payment is a tax free payment to help older people keep warm during winter. For winter 2010-11, the WFP are worth £250 and £400 for aged 60 and 80 years, resp.	Total cost for 2010-11 is estimated to be £2.7 billion	Funded through HM Treasury
3. Cold Weather Payments	CWP provides additional monetary help to the fuel poor during periods of severe winters. A period of severe winter is defined as seven consecutive days (observed or forecasted) in which the average mean daily temperature is zero degree Celsius or lower	The value of the CWP scheme is calculated at £130.8 million for 2011/12	the Scheme was integrated into the Social Fund and was administered by the Department for Work and Pensions

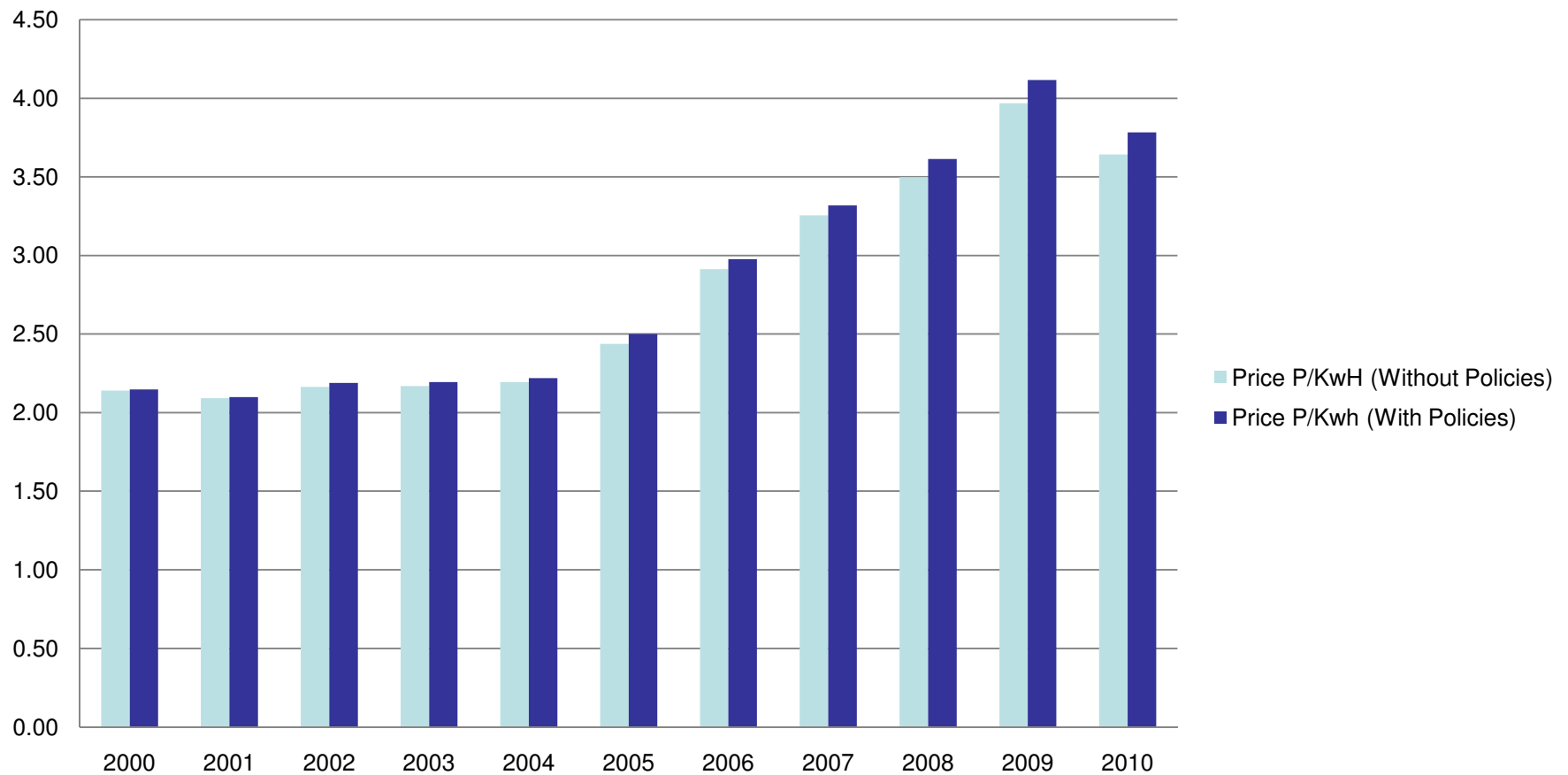
Electricity Price with and without policies 2000-2010 (real 2010)



Own calculations

Gas Price with and without policies 2000-2010 (real 2010)

Gas Price for Households, 2000-2010



Own calculations

Distributional Impact: Weighted Average of Standard Electricity and Econ 7 households, 2010

Income	1	2	3	4	5	6	7	8	9	10	Mean
GrossIncome	9,275	14,184	17,375	20,890	26,435	32,019	37,515	46,257	57,969	101,808	36,373
Direct Taxes	1,113	1,277	1,788	2,612	4,155	5,545	7,386	9,421	13,281	25,719	7,230
Total Indirect Taxes	2906	3024	3294	3638	4088	4830	5148	5623	6441	8442	4,743
Total Inkind Benefits	7570	7541	7387	7117	6940	7237	6168	6156	4958	5287	6,636
Final Income	12,826	17,424	19,680	21,757	25,132	28,881	31,149	37,369	43,205	72,934	31,036
CERT et al	23	23	23	23	23	23	23	23	23	23	23
RO	10	11	12	13	14	15	16	16	18	21	15
EUETS	16	19	20	22	23	24	26	27	29	34	24
CESP	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2
FIT	0	0	0	0	0	0	0	0	0	0	-
VAT (Policies)	3.3	3.5	3.5	3.7	3.8	3.9	4	4	4.2	4.6	4
Bill with Policies	352	401	429	456	477	506	524	540	580	667	493
Electricity Policies	54	59	61	64	66	68	71	72	77	84	68
Share of Policies	15%	14%	14%	14%	14%	13%	14%	13%	13%	13%	

Source: Income and tax estimates are from ONS (2011a), table 14, page 61 (This table is reproduced on tab "Income")

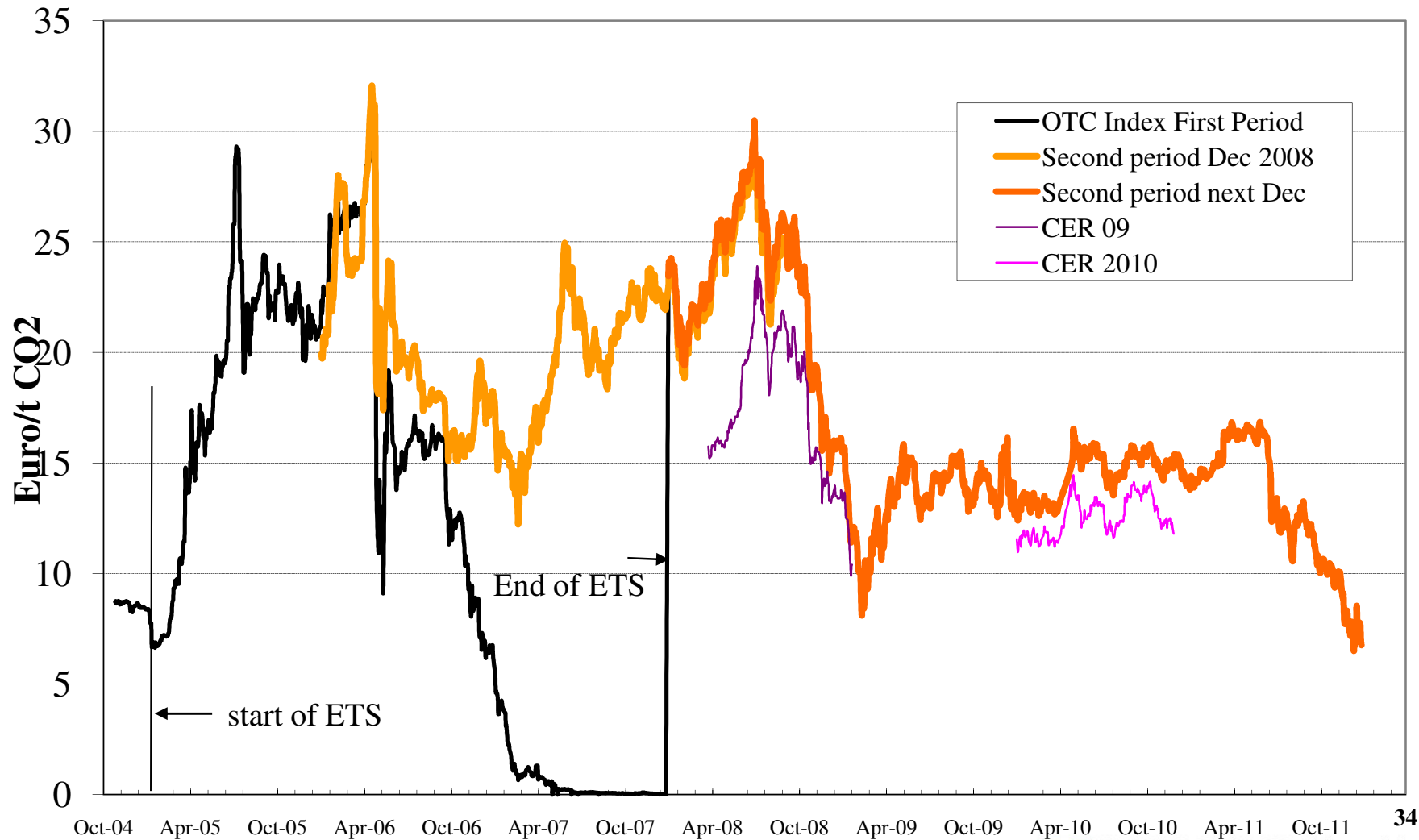
Distributional impact: Gas All Households, 2010

Income	1	2	3	4	5	6	7	8	9	10	Mean
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CERT et al.	23	23	23	23	23	23	23	23	23	23	23
CESP	1	1	1	1	1	1	1	1	1	1	1
VAT (Policies)	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1
Bill with Policies	376	437	473	505	554	561	595	626	668	761	556
Gas Policies	25	25	25	25	25	25	25	25	25	25	25
Share of Policies	7%	6%	5%	5%	5%	5%	4%	4%	4%	3%	

Source: Income and tax estimates are from ONS (2011a), table 14, page 61 (This table is reproduced on tab "Income")

Are main policies working?

Carbon Prices: EUA price October 2004-December 2011



Are policies working?

Renewables share: UK Renewables Obligation

	Target renewable share in GB	% Delivery in UK	Nominal Buyout Price £/MWh	Total Cost £m
2002-03	3.0	59%	30.00	282.0
2003-04	4.3	56%	30.51	415.8
2004-05	4.9	69%	31.59	497.9
2005-06	5.5	76%	32.33	583.0
2006-07	6.7	68%	33.24	719.0
2007-08	7.9	64%	34.30	876.4
2008-09	9.1	65%	35.36	1036.2
2009-10	9.7	71%	37.19	1108.6
2010-11	10.4	72%	36.99	1285.4
2011-12	11.4		+ inflation thereafter	
2012-13	12.4			
2013-14	13.4			
2014-15	14.4			
2015-16	15.4			Estimated: ~£1903m (2010-11 prices) assuming no demand growth

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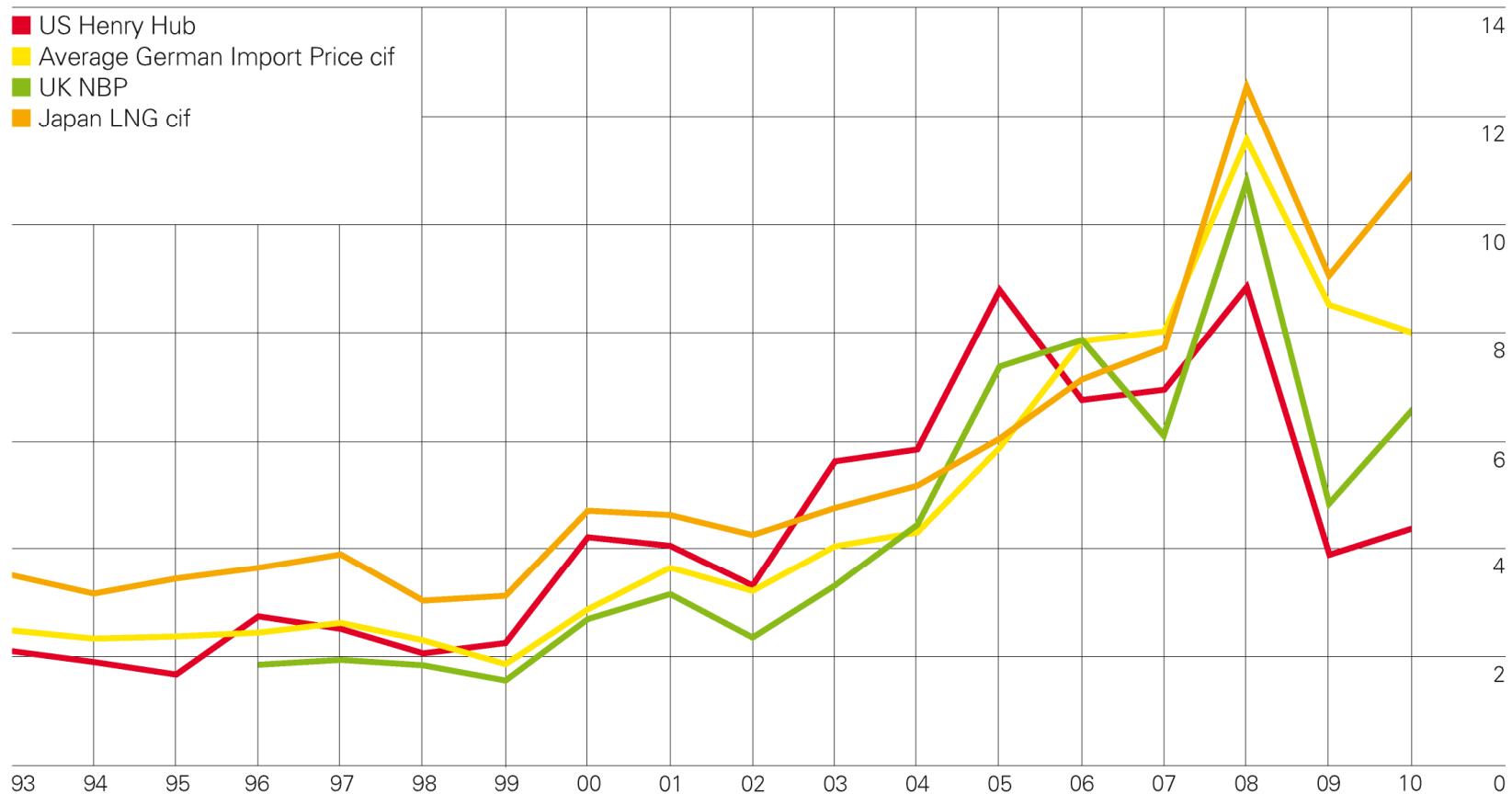
Are policies working?

- Lack of high and stable enough carbon price:
 - Inhibits demand response.
 - Has delayed nuclear investment (if truly efficient).
 - Has led to more coal and less gas being burnt (and more CO₂).
 - Has slowed development of bio-fuels (land fill gas and co-firing) and prolonged their subsidy.
- Renewables support scheme has performed poorly:
 - UK scheme overgenerous per kWh.
 - Interacts badly with EUETS.
 - Planning problems for onshore wind.
 - Offshore wind very expensive alternative.

Future Prospects: Shale Gas?

Prices

\$/Mmbtu



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Source: BP Statistical Review of World Energy, 2011

Future Prospects: UK Electricity Market Reform?

- Aims to support up to 29% renewable electricity by 2020 (35% by 2030):
 - Carbon Price Support (target price £70 per tonne 2030)
 - Capacity Markets
 - Emissions Performance Standard
 - Low Carbon Contracts for Differences (CCFs)
- Impacts from DECC:
 - Household bills: +33% by 2030
 - Business bills: +62% by 2030
 - Wholesale prices: +80% by 2024

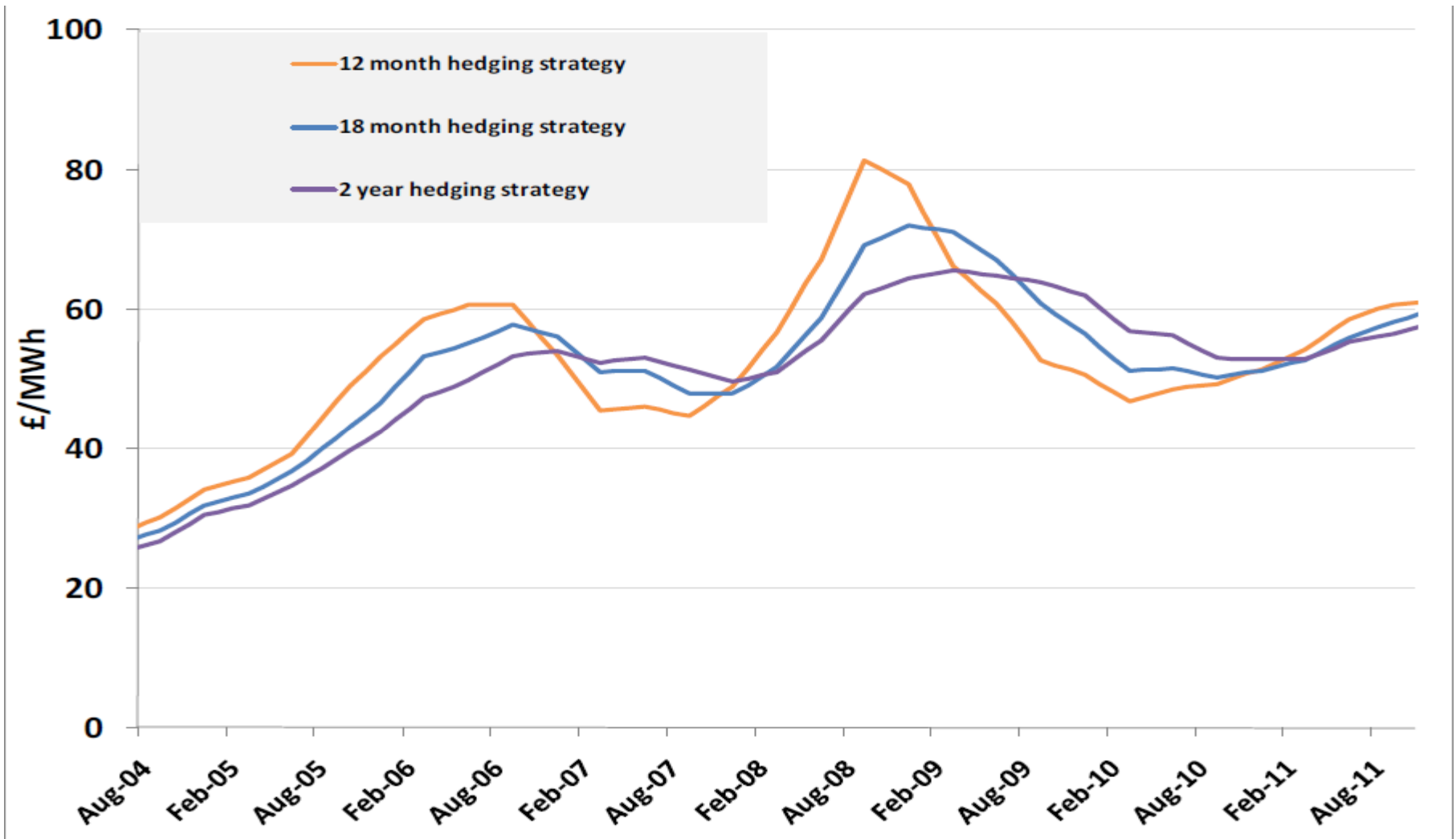
Conclusions

- The UK has had a set of energy policies which has kept electricity and gas prices relatively low.
- Energy taxes in the UK are unbalanced towards petrol and away from electricity and gas.
- Decarbonisation will be expensive due to the price impact of the four technologies available.
- The two key decarbonisation policies – EUETS and RO - are working poorly.
- Decarbonisation policy costs are around £90 p.a., but costs are rising and unevenly impacting consumers.

References

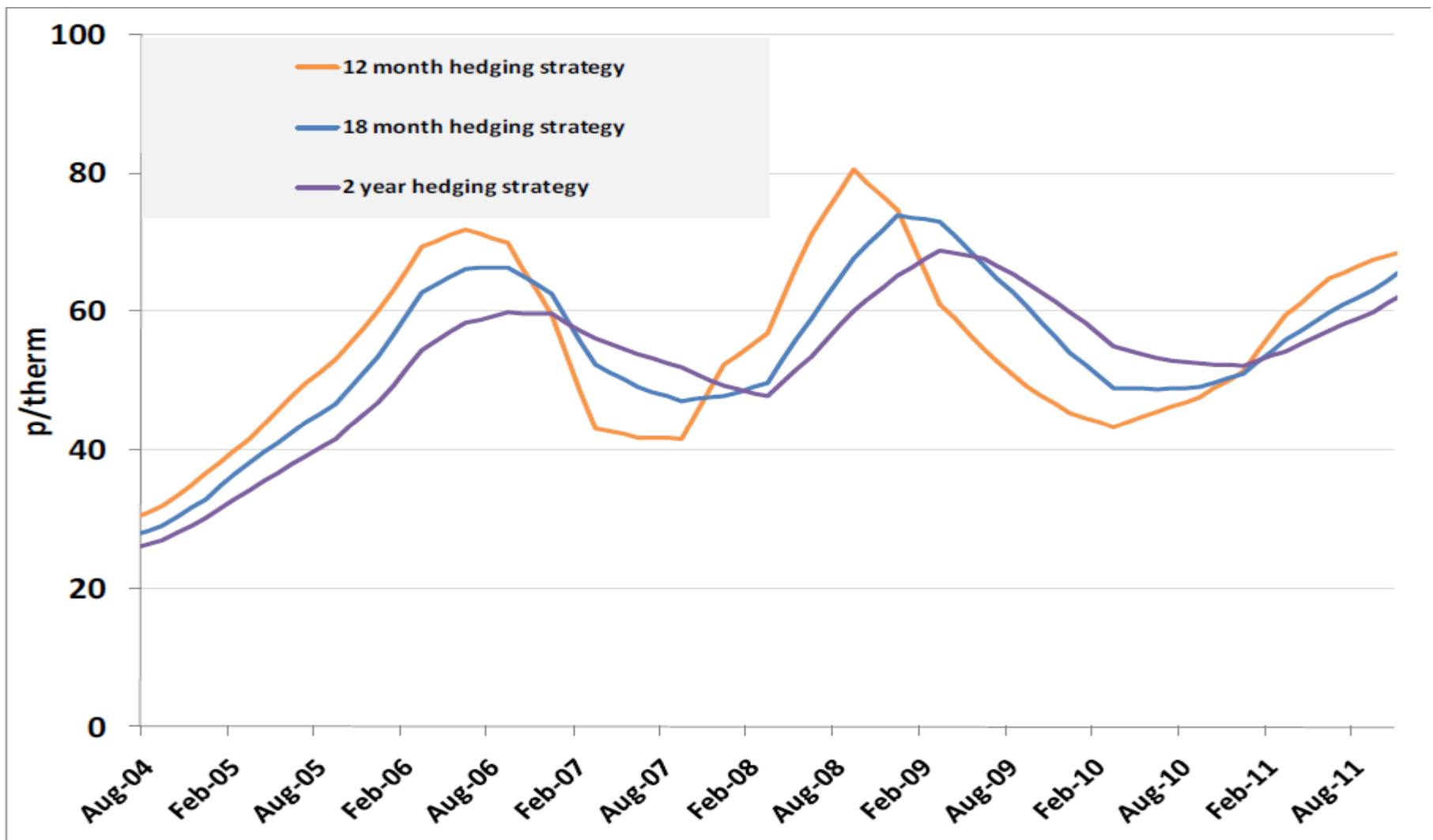
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Sticky prices: Electricity Hedging Strategies



Source: Ofgem, 2011.

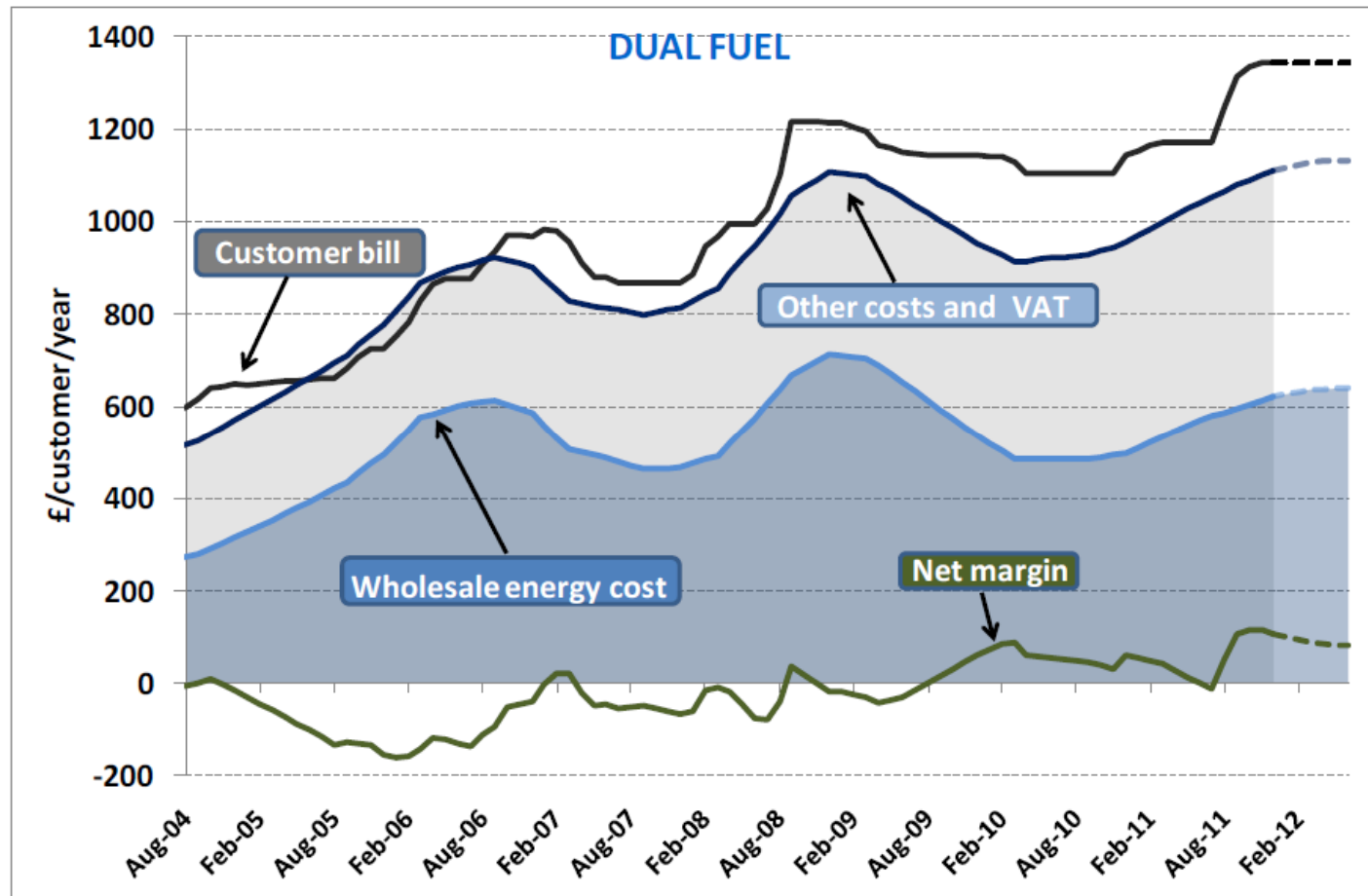
Sticky Prices: Gas Hedging Strategies



Source: Ofgem, 2011.

Net margin on retail energy

Figure 1.1: Typical dual fuel customer bill, costs and net margin



Source: Ofgem 2011, Electricity and Gas Supply Market Report, December, p.4. Typical bill: £1345.

2008 Memo Numbers

- 177mt CO₂ emissions from power stations
- 623mt CO₂e, UK economy
- 393g CO₂ per KWh, gas power stations
- 910g CO₂ per KWh, coal power stations
- 0.6 Euro cent per KWh at 15 Euro / EUA for gas

2008 Memo Numbers

- 1 therm of gas = 14.6 KWh electricity (at 50%)
- 25p per gas therm = 1.7 pence / KWh
- 385 TWh, total electricity production
- 400 TWh, total electricity demand
- 5.5% share of renewable generation
- 2.7p/KWh for CCGT at 25p per gas therm
- (1 TW = 10^3 GW = 10^6 MW = 10^9 KW)