UNIVERSITY OF CAMBRIDGE | Electricity Policy Research Group

Electricity Market Reform in the UK

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Outline

- Thanks to Aoife Brophy Haney and CRIEPI
- Introduction and background
- Wholesale electricity market
- Implications for Japan

INTRODUCTION AND BACKGROUND

Context for recent reforms: what's new?

- Wholesale market
  - Increase investment to decarbonise
  - Renewables
  - Security of supply
- Retail market
  - Rising prices
  - Fuel poverty
  - Competition?

The objectives of UK energy policy

- The impossible trinity:
  - –Energy Security (secure)
  - –Decarbonisation (clean)
  - -Competitiveness (affordable)
- Also:
  - -International action on mitigation of climate change

- The other ones:
  - –Elimination of (energy) poverty
  - –Renewables
  - –Green jobs/economy/technology

UK Decarbonisation targets

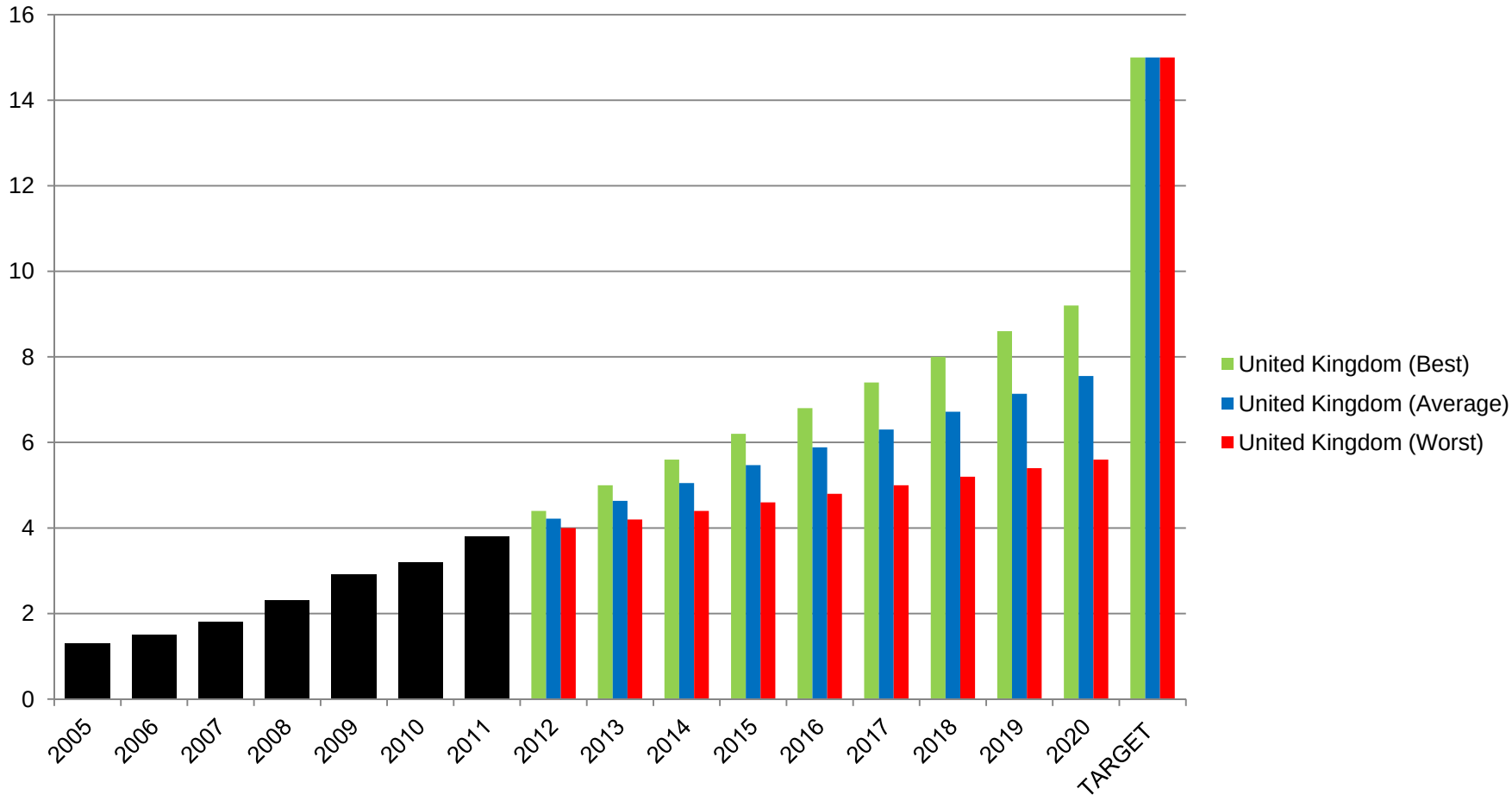
- UK in 2012 GHGs: -26.1% relative to 1990
- Kyoto Target: -12.5% by 2012; UK Target -34% by 2020

- 2008 Climate Change Act:
  - 80% reduction by 2050
  - Climate Change Committee
  - Five Year Carbon budgeting
  - Latest projections: 90%+ decarbonisation of electricity by 2030
  - Latest target: -50% 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) (3.8% in 2011)
- Currently support regime only envisages 15.4% renewables in electricity by 2015-16 (10.7% in 2012).
- 2010 target of 10% for electricity from renewables (2001/77/EC). 7.3% was achieved
- Clearly, current policies not working.

Can wholesale market reform work? UK renewables target credible?



Methodology for three scenarios: Using the highest, average and lowest differences in figures between 2005-2011, we project the best, average and the worst cases from 2012 onwards.

Can wholesale market reform work? Can we fix it for nuclear power?

- **If EMR is about reducing the risk of nuclear investment (not likely before), then the environment is challenging:**
  - History of negative learning in (western) nuclear (Grubler, 2010).
  - Nuclear costs are high and rising – e.g. MIT 2009 study on nuclear costs has doubled its estimates compared to 2003 study.
  - Recent escalating construction costs due to higher commodity prices.
  - History clearly shows that estimated costs are less than outturn costs:
    - E.g. Olkiluoto 3 in Finland:
      - reported contract price in 2004 was 3 billion of Euros. Today it is estimated at 5 billion (+).
      - Now due to take 9 years to construct (against 4 planned).
      - Design of the deal in fact makes consumers' bear the risk (Schneider et al. 2009).
    - E.g. Flamanville 3 in France:
      - Cost estimated at 3.3 billion Euros in 2006, 4 billion in 2008, 4.5 billion in 2009, 6 billion in 2011, 8.5 billion in 2013. Now due to take 9 years to construct.

WHOLESALE MARKET REFORM

EMR – Electricity Market Reform

- Four elements proposed in December 2010:
- 1. Fixed prices for low carbon generation (CfD-FiTs)
- 2. Carbon Price Support (CPS)
- 3. Capacity Market (CM)
- 4. Emissions Performance Standard (EPS)

- Draft Energy Bill issued in May 2012, in Parliament November 2012, due to be legislated in 2013.
- Does represent increase in role of ministry, DECC, at expense of independent regulator, Ofgem.

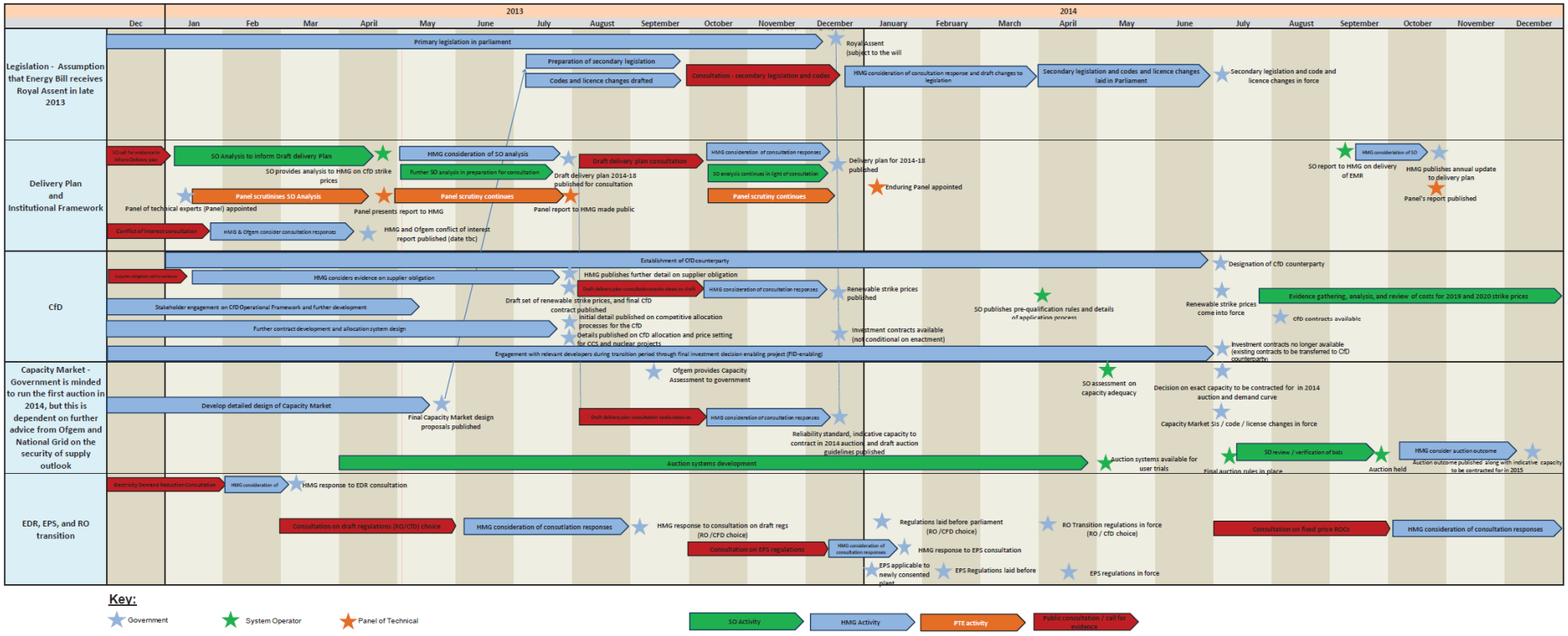
Origins of EMR proposals

- Nov 2008: Climate Change Act (passes 463-3 on third reading in HoC).
- December 2008: First report of Committee on Climate Change:
  - sets up electricity as lead sector for decarbonisation, with 90% per kWh decarbonisation by 2030.
  - Electricity identified as key to decarbonising heat and transport.
- 12 October 2009: Committee on Climate Change First Progress Report details key EMR elements.
- May 2010: Coalition Agreement, somewhat surprisingly, specifies 4 elements of EMR.
- Dec 2010 DECC publishes EMR proposals…
- It is absolutely clear that motivation for EMR lies with Committee on Climate Change, 5 year carbon budgeting and the Climate Change Act.

How the four EMR elements fit together

- Need to achieve carbon and renewables targets. Electricity is first sector in line for large scale decarbonisation.
- CfD-FiTs offer price (energy+carbon) certainty and are high enough to support low carbon generation such as nuclear etc.
- CPS needed to raise price of carbon for fossil generation to encourage switching and have added benefit of reducing CfD payments *and* raising some tax revenue.
- Under CfD-FiTs and CPS, fossil generation gets pushed to margin and has low plant utilisation, but is needed to back up intermittent sources such as wind, therefore needs an availability payment, via capacity market.
- Then just in case, we don't get price based incentives right, EPS ensures that high CO2 fossil plants do not get built.
- There is a logic, is it good economics?

EMR Implementation Timeline



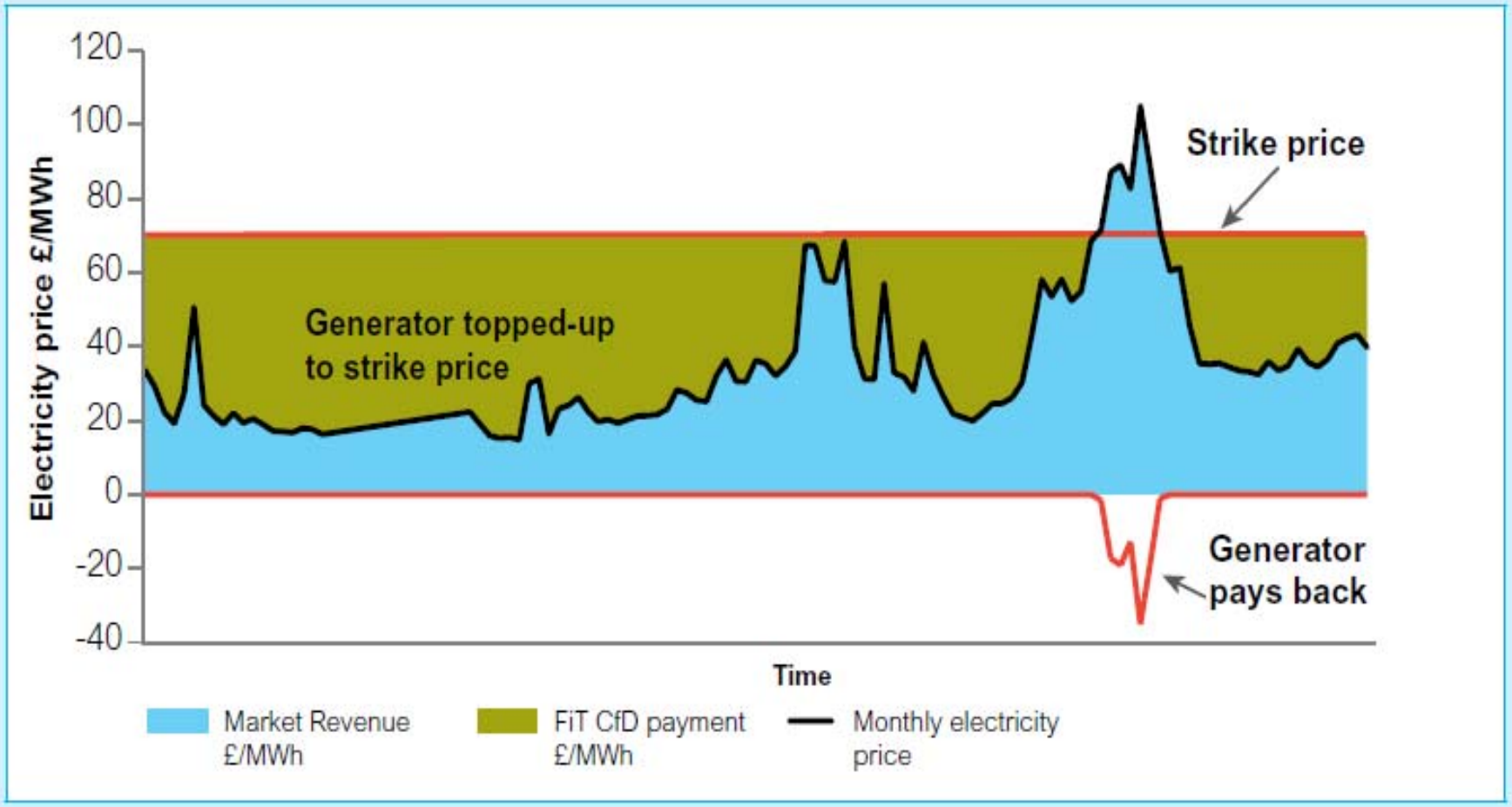
Source: DECC

(i) Support for Low Carbon Generation

The reform proposes the setting up of a system of contracts for differences (CFD-FITs) whereby the government would contract with low-carbon generators to supply electricity at fixed prices for a prolonged period. These contracts would pay the generators the difference between the average wholesale price of electricity and the contract price.

The proposal: CfD-FIT

Figure 5: The operation of an intermittent Feed-in Tariff with Contract for Difference



Source: DECC (2011), *Planning our electric future: a White Paper for secure, affordable and low-carbon Electricity, p.38.*

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The argument for CfDs

- The argument is around the volatility of the EUETS price. EUETS is not volatile if hedged by a simple buying strategy, but the average price is low.
- CfD-FiTs will raise the average price, however no real evidence that it will reduce the cost of capital (as is claimed).
- Any remaining risk is transferred to the counterparty. This will be the consumer, but ultimately the government. It does not go away.
- The main risks for nuclear are construction risk and appropriation of cash flows once built (as in Germany) these are not addressed.
- CfD-FITs are still subject to uncertainty around the strike price of future plants (e.g. second and third nuclear plants).
- In the end the theoretical argument for CfD-FiTs versus a price of carbon does not pay sufficient attention to the theory of finance.

Some Practical Problems with CfD-FiTs

- *What will be the reference price?* Over 40 years it is not at all clear that there will be one meaningful market price for residual fossil generation.
- *Who will be the counterparty?* The System Operator (NG) refused to take this role because of exposure to generation type cash-flow risks. The government will be the counterparty via agency to be determined and CfD payments will be a state aid.
- *How will there be competition in the CfD-FiT market for low carbon generation*, especially if there is technology banding? Only one company still in the first nuclear competition/negotiation

Current plans for CfD-FiTs

- The intention is to have a series of auctions in the long term, in the short term there will be technology specific reference prices.
- CfD-FiTs will be within levy control framework of maximum allowable expenditure.
- CfD-FiT payments to generators will be recovered by a supplier levy. Certain energy intensive users will be exempted.
- The counterparty will be a government agency, government will design contract.
- The strike price will be a long term indexed price to provide price certainty. The contract length will be determined but minded to be 15 years for renewable generators.

(ii) Carbon Pricing

The **reform has already introduced a carbon price support (CPS)** based on the existing climate change levy (CCL). This involves increasing the rate and coverage of the climate change levy to effectively increase the price of carbon emissions from the electricity sector in the UK above that in the rest of the EU.

Begins in April 2013, target CO2 price is £30/tonne (in 2009 terms) – forward EUA price + CPS - by 2020 (possibly £70/tonne by 2030). Note: that with inflation CO2 price in UK could easily be 50 Euros per tonne by 2020.

CPS – a theoretical analysis

- The CPS is fundamentally a tax policy. It needs to be analysed in the light of the principles of optimal tax theory.
- It is a carbon tax implemented on electricity, not on domestic gas or any other source of CO2, and hence distorts the use of electricity relative to other energy carriers.
- The CPS distorts international competition and trade in electricity. Energy intensive industry will shift to continental Europe and electricity imports (which can't be taxed on trade grounds) will be encouraged. This is simple tax arbitrage. Diamond and Mirrlees (1971) show that industry should be exempted from intermediate goods taxes for these reasons.
- The CPS will directly impact the wholesale price via raising the price of marginal fossil generation. In 2014 it will raise household bills by 3-6%.

Practical problems with CPS

- There is also a political problem, unlikely that the Treasury will want to reduce the total revenue from the tax to zero from its initially highly significant level, so the rate may not be increased as expected.
- CPS complicates the economics of CCS and CHP which will require more subsidy at higher carbon prices.
- CPS will lead to messy exemptions with arbitrary cut off points for energy intensive users.
- CPS, like CfD-FiTs, by reducing the number of EUA permits required by the UK undermines the EUETS.

(iii) Capacity Mechanism

The reform proposes the introduction of a (market wide?) capacity mechanism (CM) to contract for the necessary amount of capacity to maintain security of supply. This would involve the introduction of payments to generators for maintaining availability, supplementing the market for units of electrical energy that exists at the moment. This deals with predicted low capacity margins by 2018/19.

Note: The amount of capacity to be contracted for would be decided by the government. The date of introduction could be in the 2020s!

Theory of Capacity Markets

- This is the theory of supply and demand. In most capital intensive goods markets payment is for production, not capacity.
- Indeed competitive markets strongly incentivise excess capacity (while government owned industries, usually suffer from shortages due to unwillingness to raise finance for new capacity), due to strong non-delivery penalties and duplication of reserves.
- The actual issue is not capacity but willingness to pay to avoid interruption. This is not well expressed by households (in the absence of smart meters), but can be captured directly by regulatory non-delivery penalties.
- What is clear is that capacity mechanisms in electricity (e.g. in the US) only seem to be necessary when energy prices are capped at arbitrarily low levels (Texas considering raising its cap).
- A case for capacity payments may emerge at high levels of renewables but only to encourage entry of small intermittent generators who will find it difficult to contract with fossil generators directly for back up generation. In such cases a capacity market might emerge privately.

Practical problems with Capacity Markets

- Who decides what the required level of capacity is? Is it the government and if so, how.
- Recent US experience suggests that far from guaranteeing revenue for generators, capacity markets can be used by governments to appropriate revenue from generators by licensing new capacity to drive down capacity market prices (e.g. FERC vs New Jersey, who was accused of monopsony activity in the capacity market).
- National capacity markets are problematic in the EU. It may not be possible to stop EU generators bidding into the capacity markets via interconnectors (who are also avoiding the CPS), thus supporting capacity in other countries rather than the UK (if for instance capacity markets are deemed a form of public service obligation).

Current Capacity Market plans

- Annual auctions for 4 years ahead on the basis of predicted peak subject to an enduring reliability standard (Loss of Load Expectation – e.g. 3 hours p.a. as in France).
- 'This will be informed by updated advice from Ofgem and National Grid which will consider economic growth, recent investment decisions, the role of interconnection and energy efficiency, as well as consideration of the outcome of the review of the 4th Carbon Budget.'
- First auction, potentially, 2014 for 2018/19.
- Bidders need to be available at times of stress.
- In theory, market wide capacity. However CfD recipients will not receive capacity payments.
- DSR and storage will be able to bid.

(iv) Emissions Performance Standard

New supercritical coal fired generation has average CO2 emissions of around 790g/kWh; a modern gas-fired power plant about 360g/kWh. The reform proposes an emissions performance standard (EPS) for all new power plants of 450g/kWh, designed to rule out the building of new coal-fired power plants without carbon capture and storage (CCS) technology fitted (to a substantial part of a new plant).

Note: that new peaking plant will be permitted as maximum emissions are calculated at an 85% load factor.

EPS

- This is a backstop command and control approach to environmental regulation.
- It appears to be innocuous in that no-one currently wants to build the plants that it rules out.
- However it does introduce an instrument which could be ratcheted up to eliminate the building of new gas fired power plants. It can be suspended in interests of security of supply.
- Given the problems that California, Italy, Germany and Japan have had from environmental standards ruling out ‘any’ timely new build/operation of large conventional power plants. It is a significant threat.
- Given that it serves no useful function in terms of renewables or decarbonisation, it has no place in the EMR package.

Proposed Reforms and Bills

- This has consistently been presented in a **very** misleading way in the documentation, relative to a baseline of an *enhanced* Renewables Obligation. Both the documents and ministers continue to argue bills will fall.

- Relative to 2010, EMR modelled real bill rises(July 2011):
  - Households: +32% by 2030
  - Medium Non-Dom: +56% by 2030
  - Energy intensive industrial: +69% by 2030
  - Wholesale price elements rise by higher percentage.

- Even assuming higher gas prices (as in EMR) 82% of domestic bill rise is policy induced (though not just EMR).

Conclusion on EMR

- EMR displays a huge amount of economic illiteracy:
  - on the theory of finance
  - on the theory of optimal taxation
  - on the nature of supply and demand in markets
  - on economic instruments for reducing externalities…
- EMR also suffers from a host of practical and implementation problems and has little empirical efficacy basis.
- EMR, if it is implemented in the UK, will fail to deliver society's overall energy and climate objectives at reasonable cost.

- ***The contrast between the UK government's unwillingness to accept economic analysis vs. its willingness to accept climate change science is striking.***

IMPLICATIONS FOR JAPAN

Combining subsidies and market via EMR

- **Policy impacts significant, but fail social cost benefit test:**

  Bills rise substantially, large welfare transfers to companies, risks transferred to consumers, no impact on global carbon emissions, but more renewables (in UK, but not necessarily elsewhere). Public support for climate change and renewables policy is undermined.

- **Policy consistency not addressed for investors:**

  EMR increases policy complexity, international carbon strategy undermined. Policy specific risks increased.

- **Individual policy design not same as a consistent strategy:**

  EMR is not a fundamental redesign of the market based on sound economic principles. Two of four elements redundant, some movement towards comprehensive set of carbon taxes, RES support not rationalised, energy security socialised, need for optimal commodity tax policy not addressed, EU and global policies undermined.

Combining subsidies and market via EMRs

- **Macro-economic impact of EMR for UK not analysed, but impact on real consumption (rather than GDP) high:**
  - Headline rise in bills suggests for electricity of 33% of £14.495 bn (households) and 62% of £15.315 bn (non-households) = £14.275 bn of extra energy expenditure (from Dukes 2012, Table 1.4). This is 1% of GDP (*some* of this is tax and profit transfer).
  - Effect on jobs, 225k jobs in energy intensive industry not assessed. Exemptions from CfD-FiT levy proposed.
  - Long term effect on GDP and consumption per head likely to be negative for no benefit (see Krupnick and McLaughlin, 2011).

Is EMR a model for Japan?

- A key issue is whether national EMRs could be part of a global solution to climate change.
- Only if EMR can replicate the cooperative solution in equilibrium, but the following undermine this:
  - seams issues – how national policies interact;
  - free riding – how is cheating reduced;
  - inability to calculate national share of global solution.
- An EMR is a poor substitute for a sensible economy wide carbon price signal.
- Japan would be better off implementing a higher carbon price directly via a trading scheme or a comprehensive set of carbon taxes.

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- Latest EMR information from DECC is available at:
http://www.decc.gov.uk/en/content/cms/meeting_energy/markets/electricity/electricity.aspx

Appendix 1: Base capacity assessment

- Ofgem (2012) base de-rated margin in 2015-16: 4.20%.

- National Grid starting point de-rated margin 17-19% in 2012-13 vs. 14% from Ofgem.
- Difference in de-rated margin: +3-5%

- **Adjusted base de-rated margin: 7.2%-9.2%.**

- CCGT under construction for 2013-16: possibly 1.35GW vs 1GW from Ofgem (Abernedd is ready to start).
- Variance: +0.35GW, derated to 0.86*0.35GW (peak 56GW)
- Difference in de-rated margin: +0.5%

Appendix 2: CPS impact analysis in 2014

CPS rate from April 1 2014	£9.55	per t CO2
Typical domestic consumption	3300	kWh
Coal emission factor	912	g/kWh
Gas emission factor	392	g/kWh
Average electricity emission factor	443	g/kWh
So best case CPS impact (gas sets wholesale price all the time)	£13.50	
Worst case impact (coal sets wholesale price all the time)	£31.41	
Typical bill 2012	£470	
Best case impact per cent bill	**2.9%**	
Worst case impact per cent bill	**6.7%**	
Note also as CPS is paid by companies it is passed through in wholesale prices so will then have VAT on top.		

Appendix 3: Price impact of EMR (July 2011)

- Key issue is what is BAU? Need to look at EMR Fossil Fuel Assumptions impact on today's energy mix.
- Assume: Coal cost: £70 per tonne *40m tonnes =£2800m; Gas cost: £0.6 per therm /29.3 KWh per therm * 342,000m KWh = £5889m. Actual costs for coal appear to be higher and gas lower.
- If coal falls to £50 per tonne and gas rises to £0.761 per therm then total fuel cost rise is £1089m if households take 37.4% of this, then cost per household (25m households) should be an extra £16.30 per household at constant consumption. This is a baseline for the absence of climate/renewable policy. This ignores market modelling (+ve or –ve) and household demand reduction (-ve).
- Even assuming wholesale prices rise by 27% (the rise in the gas price) and demand falls by 10%, the wholesale component of the household bill (assumed to be £190 in 2010) would only rise by £26.90. This is an upper end of (a moderately EMR consistent) BAU.
- Under the EMR central case rise bills (2009 prices) with energy saving is £485 to £642 from 2010 to 2030 (32%). Thus 82-100+% of this can be taken to be policy induced (mostly EMR, though some from RO and network costs)
- Worth pointing out that 2012 price of gas at 65p therm is below the central base price (of 60p) in 2009 money.

Appendix 4: Costs of Nuclear

- See: Du and Parsons (2009) from MIT (2009):
  - $4000 / kW in 2007 USD overnight cost
  - At 10% WACC = 8.4c / kWh (2007 prices)
  - Say 6.5p / kWh with inflation and exchange rate in 2012.

- Negative Learning in French Nuclear programme - Grubler (2010) – best guess construction cost (FF98):
  - 1977 Fessenheim 1, 920MW, 5.0bn FF
  - 1982 Blayais 2, 951MW, 5.5bn FF
  - 1987 Cattenom 2, 1363MW, 10.2bn FF
  - 1992 Penly 2, 1382MW, 13.4bn FF
  - 1997 Civaux 1, 1561MW, 18.7bn FF
  - 1999 Civaux 2, 1561MW, 31.6bn FF

Appendix 5: UK Total Nominal Policy Budgets in Million Pounds (2000-2012)[1]

Year [1]	CERT et al. [2]	CESP [3]	EU ETS [4]	FiTs [5]	RO [6]	WFS [8]	Total Policy Budget [2] to [8] [9]	Nominal GDP [10]	Budget as % of GDP [9]/[10] [11]
2000-01	95					72	167	976282	0.017
2001-02	95					197	292	1021625	0.029
2002-03	324				282	163	769	1075368	0.072
2003-04	324				416	164	904	1139441	0.079
2004-05	324				498	166	988	1202370	0.082
2005-06	419		2432		583	192	3626	1254292	0.289
2006-07	419		1437		719	320	2895	1328597	0.218
2007-08	419		872		876	350	2517	1405796	0.179
2008-09	1067		2708		1036	397	5208	1433870	0.363
2009-10	1067	35	1825		1109	369	4404	1393854	0.316
2010-11	1067	105	1438	14.4	1285	366	4276	1463734	0.292
2011-12	1319	105	N/A	N/A	1487	143	N/A	1507585	N/A

Source: Chawla and Pollitt, 2012.

[1] Figures have been calculated for each financial year.
[2] Available April 2012 at at http://www.ofgem.gov.uk/Sustainability/Environment/EnergyEff/Documents1/92-9march00.pdf (p. 3); http://www.aid-ee.org/documents/004EEC-UnitedKingdom.PDF (p. 9,10); http://s3.amazonaws.com/zanran_storage/www.defra.gov.uk/ContentPages/4234041.pdf (p. 94); DECC (2009) and DECC (2010b).
[3] Available February 2012 at http://www.decc.gov.uk/en/content/cms/funding/funding_ops/cesp/cesp.aspx.
[4] For detailed information on EU ETS figures, please see annexure A4.
[5] Available April 2012 at http://www.ofgem.gov.uk/Pages/MoreInformation.aspx?docid=278&refer=Sustainability/Environment/RenewablObl and http://www.ofgem.gov.uk/Media/PressRel/Documents1/RO%20buy-out%20Info%20Note%204%20Feb.pdf.
[6] Email correspondence with DECC.
[7] ONS (2012b, Table A2).
[8] Subject to revision.
[9] Ofgem (2011b).