

Imperial College
London

The European Utility Model for a low-carbon future

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<http://www.eprg.group.cam.ac.uk>

Outline

- From liberalized markets to EU targets
- EU objectives
 - Deliver **secure low-C electricity affordably** in an unbundled **integrated** liberalised market
- Problems with the European model
 - credibility of targets & instruments
- Examples: UK, Germany
 - EMR, Energiewende
 - Capacity payments and cross-border trading

Does Europe need to adopt the US utility model?



- 1990s: EU Directives influenced by UK experience
 - 1990's **UK Energy policy** = *competition will deliver*
 - => unbundle G&T, privatize, incentive regulation
 - context: cheap gas, CCGTs, coal-based duopoly
 - => “dash for gas” by IPPs on PPAs to franchised retail
 - => companies divest => competition, prices fall
- 2000's concern over **sustainability**
 - market fails to price carbon, collapse of R&D
 - => need for **new energy policy**
 - => targets for 2020-50 CO₂, renewables

Tension between market and policy



Conservative policies 1982-97

‘Our task is rather to set a framework which will ensure that **the market operates** in the energy sector with a minimum of distortion ..’ (Lawson, speech to IAEE, 1982)

Labour policies 1997-2010 More objectives, less coherence

- Protect the environment *and* equity
- Protect coal *and* reduce CO₂ emissions
- Lower energy tax *but* pass on environmental costs
- Retain independent regulators *but* increase ministerial ‘guidance’ - *Utilities Act 2000*

Consensus: Climate Change Act 2008, EMR 2013

- Deliver **secure low-C electricity affordably**



- EU Sustainability policies to 2020
 - Emissions Trading System to price CO₂ from 2005
 - to support mature low-C options
 - fixes quantity not price => poor guide for low-C investment
 - 20-20-20 Renewables Directive 2007:
 - demand pull for not-yet-commercial renewables
 - justified by learning spillovers and burden sharing
- Target Electricity Model for 2014
 - complete market liberalization: unbundle G&T
 - Integrate EU market: couple interconnectors
 - day ahead, intraday, balancing
- EU targets 40% carbon reduction by 2030
 - still arguing over whether to have RES targets



Little recovery after backloading and tightening post 2020

EUA price October 2004-January 2014



Source: EEX

Market coupling

- Market coupling makes efficient use of interconnectors
- Markets are cleared at a single price over largest area
- Transmission constraints determine price zones
- 9 Nov 2010 Central West Europe moves to Interim Tight Volume Coupling



Market coupling - status 2014

**GB coupled to
NWE 4/2/14**

**SEM not
until 2016**

**SWE coupled to
NWE 13/5/14**



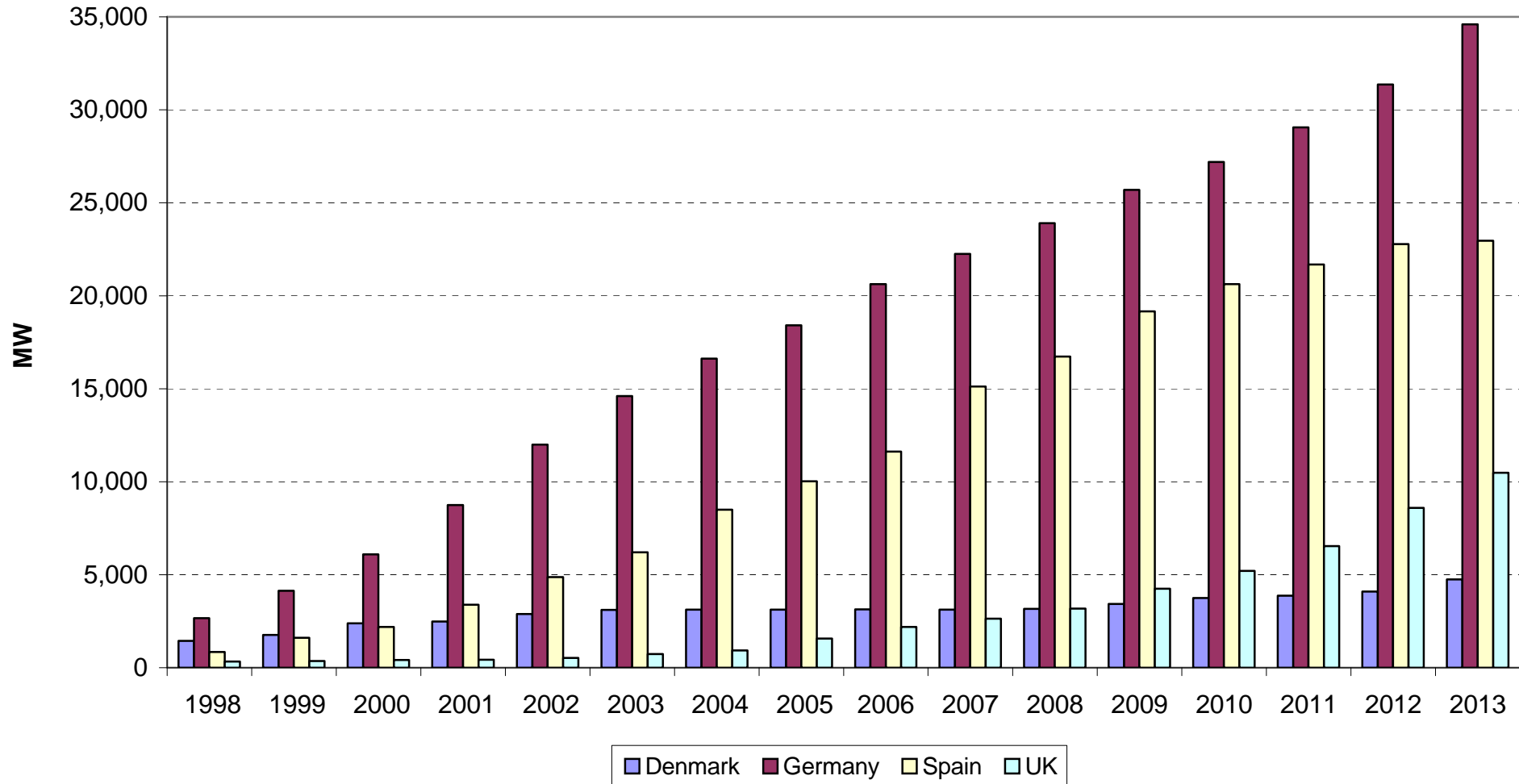
- Ambitious RES targets **crash wholesale prices**
 - Fixed Feed-in Tariffs stimulate mass take up
 - Germany, Spain for wind and PV, Italy for PV, UK lags
 - high EU gas prices + cheap coal create impasse
 - gas unprofitable, future CO₂ targets make coal risky
 - Large Combustion Plant Directive 2016 limits coal
 - Integrated Emissions Directive further threat to coal
- Future prices now depend on **uncertain policies**
 - on carbon price, renewables volumes, other supports
 - on policy choices in neighbouring countries

hard to justify investing in reliable power



Capacity factor 25% but high max supply

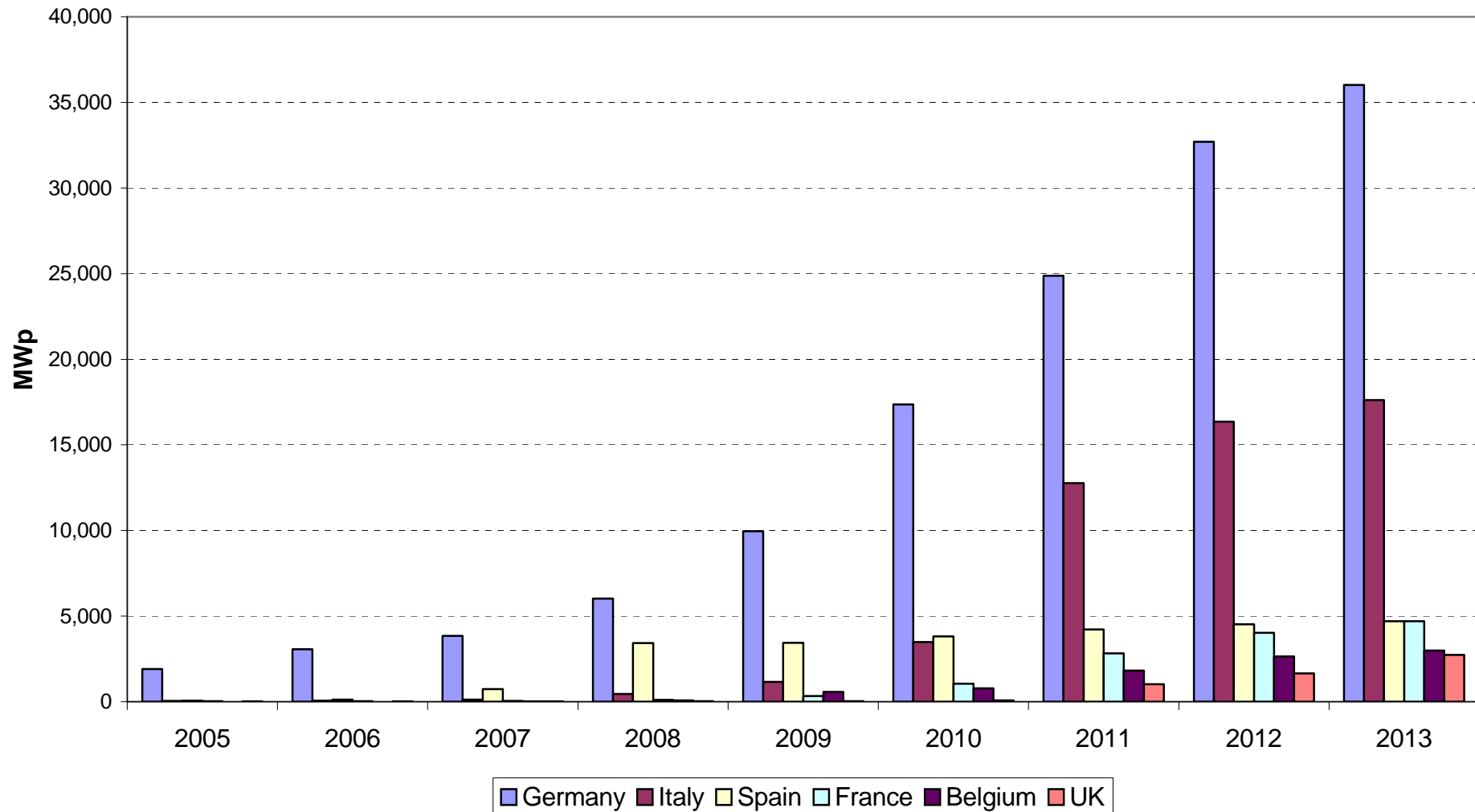
Installed wind capacity in MW



Sources: IEA to 2011, EWEA 2011-13

Capacity factor 10% but high max supply

PV peak capacity



Source: http://en.wikipedia.org/wiki/Solar_energy_in_the_European_Union

- Germany hostile to nuclear power
 - Fukushima Daiichi final straw => retire nuclear
 - To appear green => massive wind, PV => price crash
 - negative clean spark spread, nice dark green spread
 - dash for coal locks in future CO₂ for 60 years
 - population resistant to fracking, CCS, more transmission, ...
- Rapid rise in energy subsidies paid by consumers
 - fortunately Germany rich, but industry resists

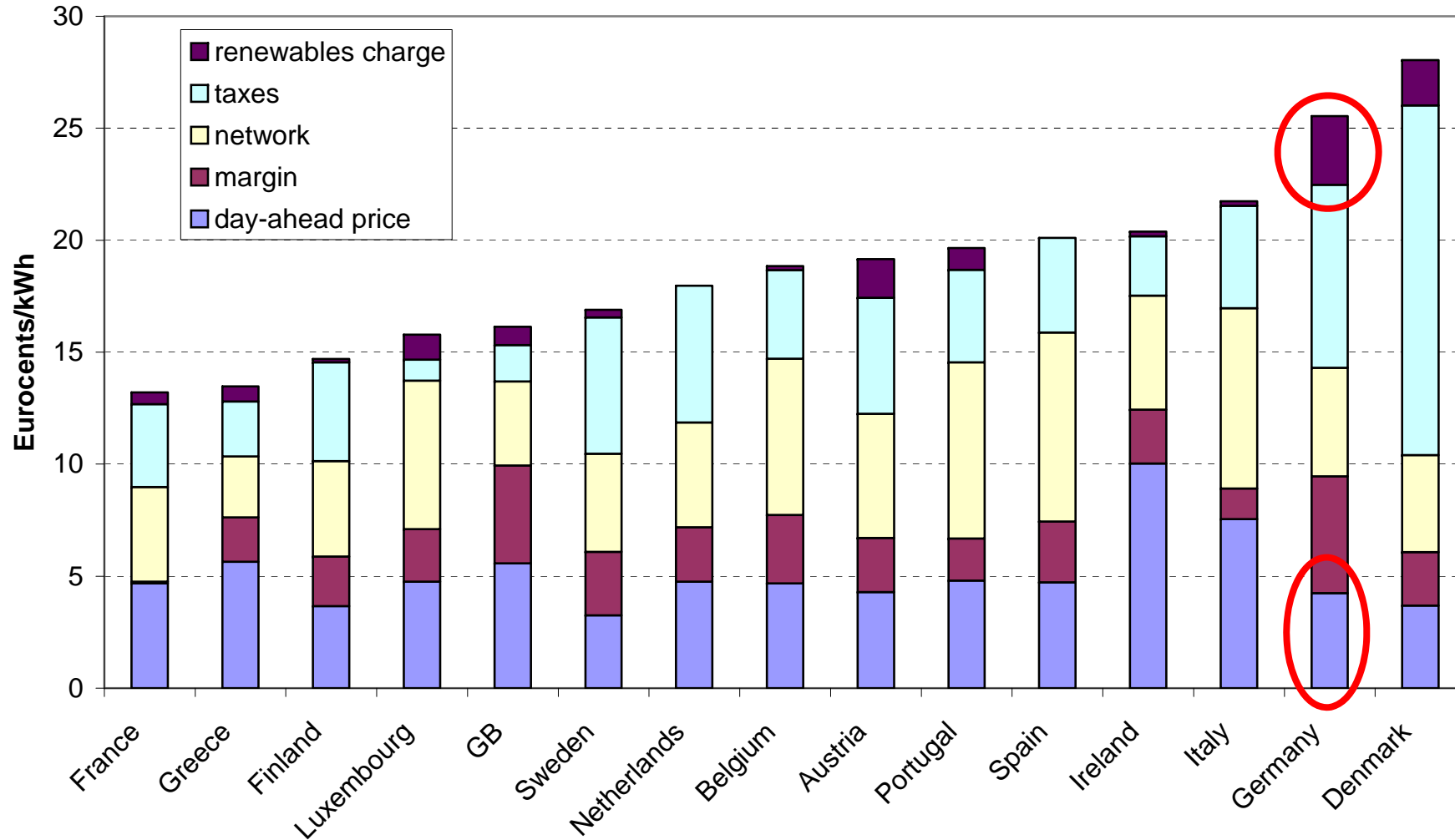
=> partial rebates for energy-intensive industry

Who will build the back-up generation?

Will capacity payments be needed?



Build-up of final retail domestic price 2012



Source: DECC 2013 at <https://www.gov.uk/government/uploads/system/uploads/.../qep551.xls>
 Source: Derived from the International Energy Agency publication, Energy Prices and Taxes

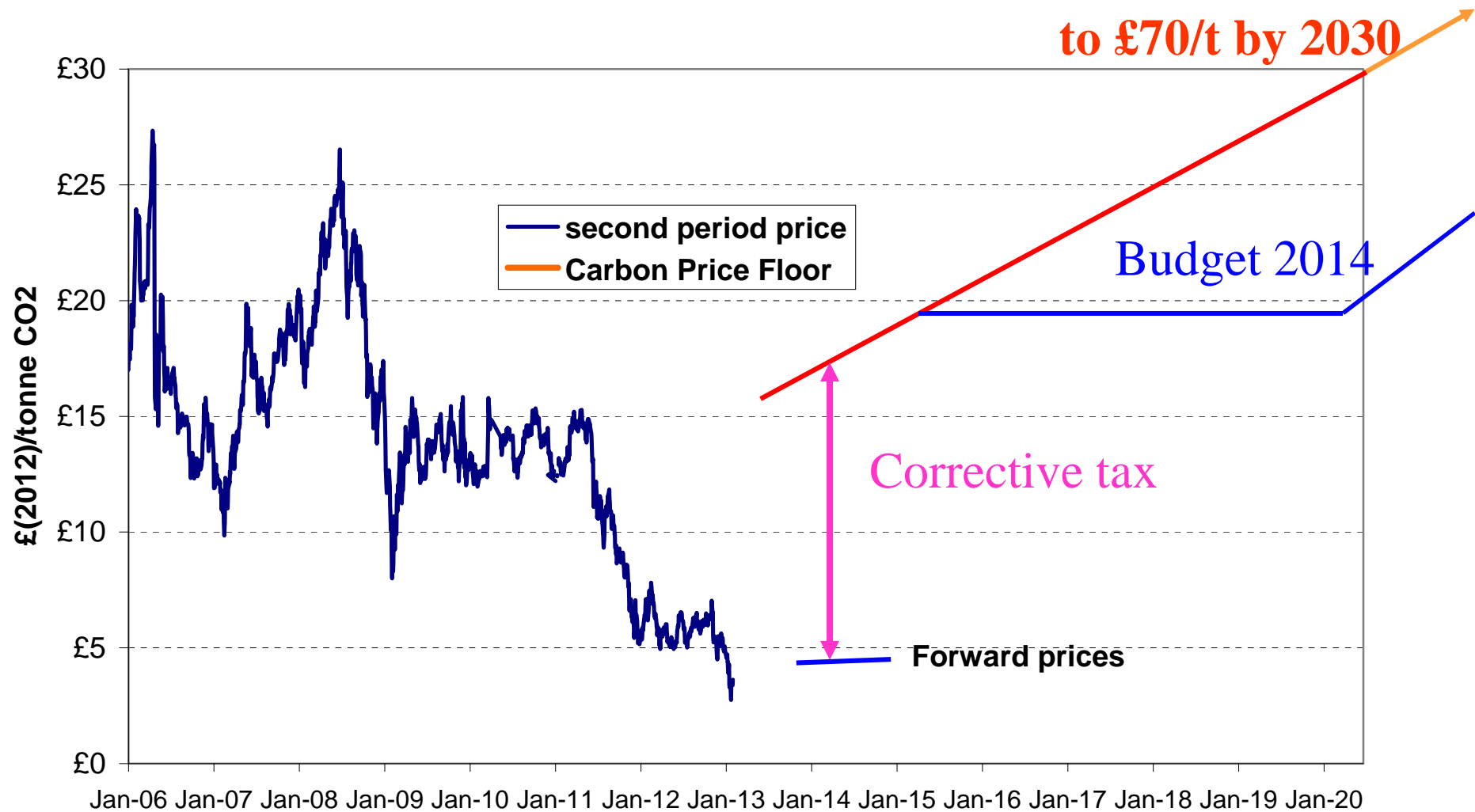
UK Electricity Market Reform

- **Energy Act** 18 December 2013 to address:
 - Security of supply and carbon/RES targets
 - problems with EU ETS
 - Market/policy failures
- To deliver **secure low-C in UK affordably**
 - ⇒ **capacity payments**
 - ⇒ **Carbon Price Floor**
 - **de-risk investment** ⇒ **Contracts** to lower cost of capital



UK's Carbon Price Floor - in Budget of 3/11

EUA price second period and CPF £(2012)/tonne



D Newbery 2013

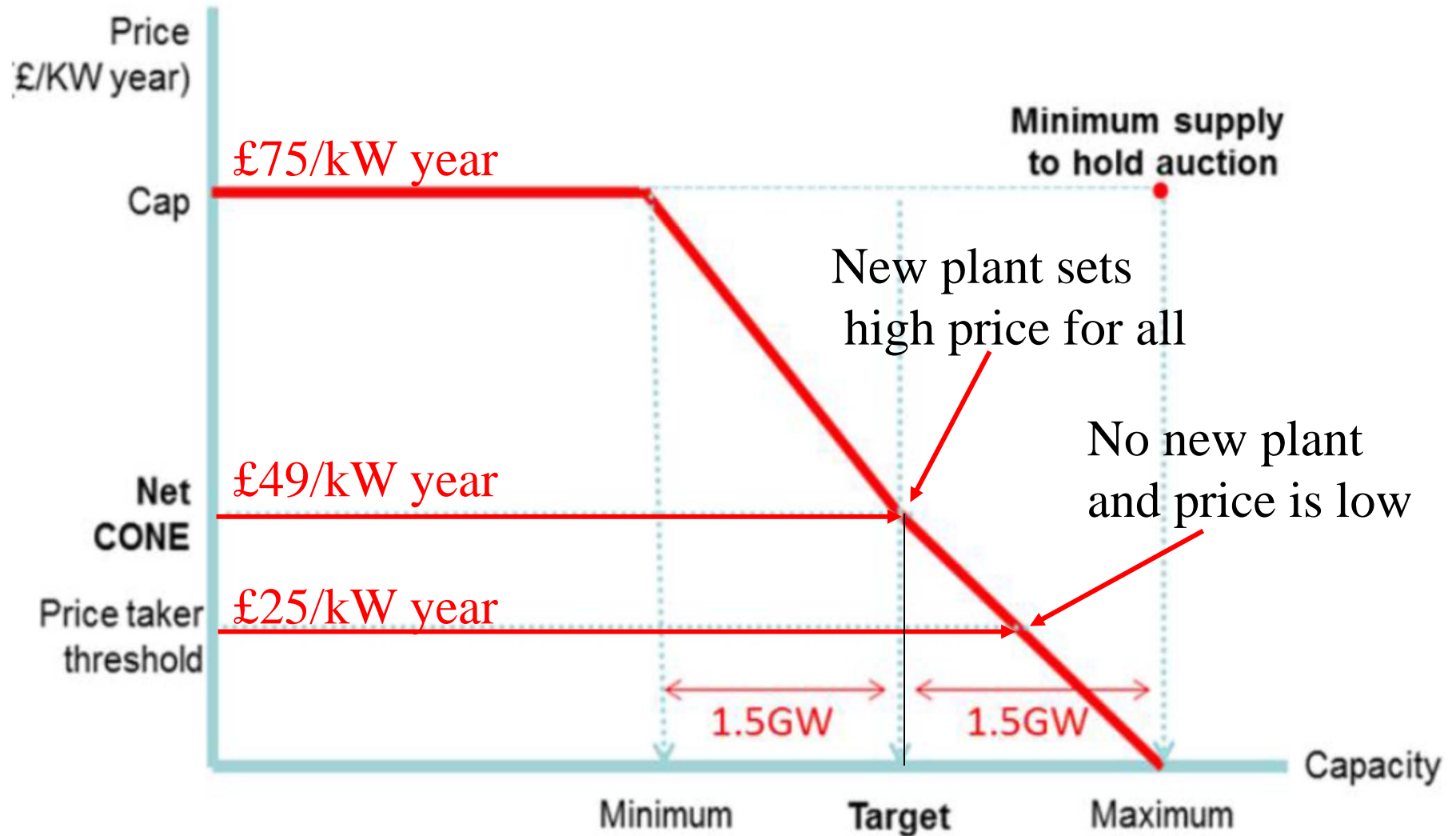
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Source: EEX and DECC Consultation

- **Pay-as-clear descending clock auction** in 2014 for delivery 2018/19
 - max energy price assumed £6/kWh
 - **LOLE = 3 hrs => VOLL = £17/kWh**
 - => missing money = 3 hrs*(17-6)/kWh = £33/kW**
- new build gets 15 yr contract at auction price
 - existing plant: 1 yr contract unless major refurbish
 - must be **price taker** unless good cause, **entrants set price**
 - existing plant can **delay** to 2017 auction but deducted from amount to procure in 2014 to deter gaming
- DSR auctioned from 2016: 1 yr contracts



Illustrative auction demand curve



Source: DECC·IA

- Interconnectors increase security of supply
 - provided they are free to respond to scarcity
- => they should displace **domestic reserve capacity**
 - Poyry estimates **50-80% for GB of 6+GW**
 - **France imported 9 GW at 2012 Feb stress moment**
- Efficient scarcity pricing benefits trading country
 - if partner mis-prices capacity they lose
- => **efficient pricing drives out inefficient pricing**
- But Euphemia imposes **€3,000/MWh cap**

Countries reluctant to rely on imports over-procure and further depress prices



What electricity models?

- Decarbonising: high capital cost, low variable cost
 - Need to **de-risk, lower cost of capital**
- ⇒ hard in liberalised market without credible C-price
 - ⇒ contracts, capacity payments, price caps – **where is market?**
- Renewables are **intermittent**, paid **high price per MWh**
 - RES support distorts prices, location, trade => **Reform!**
- Options
 - Adapt US Standard Market Design
 - Single Buyer model based in ISO
 - State: owns nuclear; procures & auctions RES sites

Aims: cheap capital, socialize risks, efficiency



Several possible solutions

- Real public sector interest rates now near **zero**
 - **Govt finance attractive** when backed by productive assets
 - Aggregate risks low, markets amplify company risks
 - => finance low-C generation from **state development banks**
- **But** need **contestability** to deliver efficiency
 - => tender auctions for PPA contracts?
 - Or regulated revenues if flexibility needed? (but generating is simple!)
 - => single buyer (ISO) for efficient dispatch? Or **Pool**?
 - Or complex audited bids & central dispatch (SMD) e.g. SEM

Design market to fit technology

Commodity markets not good models



What is left for utilities?

- EU utility model = generator + retailer
 - wires businesses regulated, unbundled
 - Generators want long-term contracts
 - for low-Carbon generation as uneconomic
 - for new peakers as prices set by unstable policy
 - EU presses for footloose customers
- => need credible counter-party for contracts
- logically SO underwritten by State
- => uneasy compromise with regulated utility?

***Challenge: to retain contestability with investment
financed at low interest rates***



EU Standard Market Design?

- **Central dispatch** in voluntary pool
 - SO manages balancing, dispatch, wind forecasting
 - **LMP + capacity payment** = $LoLP * (VoLL - LMP)$
 - Hedged with **reliability option (RO)**
 - => reference prices for CfDs, FTRs, balancing, trading
 - **Auction/tender LT contracts for low-C generation**
 - Financed from state investment bank
 - Credible counterparty to LT contract, low interest rate
 - CfDs when controllable, FiTs when not, **or**
 - Capacity availability payment plus energy payment
 - Counterparty receives LMP, pays contract
 - Free entry of fossil generation, can bid for **LT**
- ## Reliability Options
- To address policy/market failures



- Low-C investment is durable and capital intensive
 - needs *stable credible future prices* to invest
 - and guaranteed contracts for cheap finance
- EU policy is a messy 27-state compromise
 - neither stable nor credible
- Each country searching for best solution
 - some mix of contracts and capacity markets
- Gains from cross-border trading higher with RES
 - share reserves, renewables to reduce investment

rapidly evolving environment for utilities



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BETTA	British Electricity Trading & Transmission Arrangements
CCGT	Combined cycle gas turbine
CEGB	Central Electricity Generating Board
CfD	Contract for difference
CP	Capacity Payment
EMR	(UK) Electricity Market Reform
ESI	Electricity Supply Industry
ETS	Emissions Trading System
EUA	EU Allowance for 1 tonne CO ₂
FiT	Feed-in tariff
FTR	Financial Transmission Right
G+T	Generation and Transmission
IPP	Independent Power Producer
ISO	Independent System Operator
LMP	Locational marginal price or nodal price
LoLP	Loss of Load probability
LRMC	Long-run marginal cost
LT	Long-term
NETA	New Electricity Trading Arrangements
PPA	Power purchase agreement
RDD&D	Research, development, demonstration and deployment
RES	Renewable energy supply
RO(C)	Renewable Obligation (Certificate) or Reliability Option
SMD	Standard Market Design (the US model)
SEM	Single Electricity Market (of the island of Ireland)
VOLL	Value of Lost Load