Investment risks in a decarbonising electricity market

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International Energy Agency Emissions Trading Workshop

Paris, September 2013

Investment challenges

- Uncertain carbon prices lead to investment risk
  - Demand, fuel prices, policy, technology cost & performance
- During decarbonisation, electricity price may drop
  - Increasing penetration of low marginal cost generation plant creates downward pressure on electricity prices
- Unpromising investment conditions
  - Drop in electricity demand – overcapacity in UK, EU
  - Financial markets under pressure, banks & utilities attempting to de-leverage
  - Political focus on high energy costs for consumers

UK policy response: Electricity market reform

- Carbon price floor

	Confirmed			Indicative	
	2013-14	**2014-15**	**2015-16**	**2016-17**	**2017-18**
£ / tCO_2	4.94	9.55	18.08	21.20	24.62

- Feed-in tariffs for nuclear & renewables
  - Contracts to pay the difference between an agreed strike price and the market price of electricity
- Capacity mechanism
  - Payment to plant (& flexible demand) for being available
  - Move away from energy-only markets, government decides how much capacity on system
- Emissions performance standard
  - 450g/kWh, regulatory back-stop to prevent new unabated coal

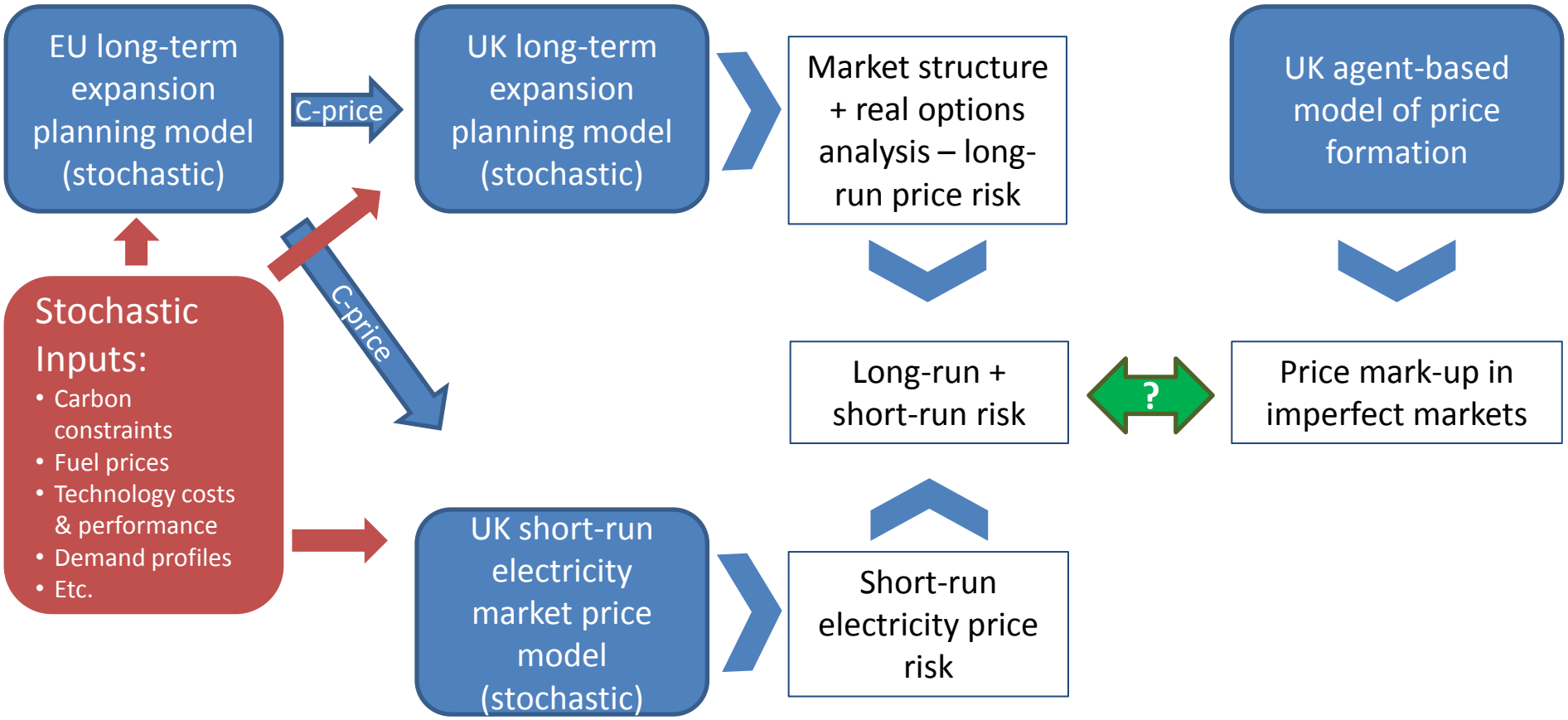
Low-C generation support levels in UK

Renewable Technology	Levy Control Framework – Upper Limits on Spend (£m) (2011/12 prices)[11]						
	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21
	3,300	4,300	4,900	5,600	6,450	7,000	7,600
	Draft Strike prices (£/MWh) (2012 prices)					Potential 2020 Deployment Sensitivities (subject to VfM and cost reduction) (GW)[12]	
	2014/15	2015/16	2016/17	2017/18	2018/19		
Advanced Conversion Technologies[13] (with or without CHP[14])	155	155	150	140	135	c. 0.3	
Anaerobic Digestion (with or without CHP)	145	145	145	140	135	c. 0.2	
Biomass Conversion[15]	105	105	105	105	105	1.2 – 4	
Dedicated Biomass (with CHP)[16,17]	120	120	120	120	120	c. 0.3	
Energy from Waste (with CHP)[18]	90	90	90	90	90	c. 0.5	
Geothermal (with or without CHP)[19]	125	120	120	120	120	< 0.1	
Hydro[20]	95	95	95	95	95	c. 1.7	
Landfill Gas	65	65	65	65	65	c. 0.9	
Offshore Wind	155	155	150	140	135	8 – 16	
Onshore Wind	100	100	100	95	95	9 – 12	
Sewage Gas	85	85	85	85	85	c. 0.2	
Large Solar Photo-Voltaic	125	125	120	115	110	2.4 – 3.2	
Tidal Stream[21]	305	305	305	305	305	c. 0.1	
Wave[22]	305	305	305	305	305		

Modelling Exercise

- Model development undertaken for EPRI
- Project aims:
  - Quantify investment risks through stochastic modelling, including impact of structural changes during decarbonisation
  - Look at system-wide impacts of investment risk
  - Take account for imperfect market pricing (ability of companies to raise prices above SRMC)
  - Identify likely trajectories for policy support

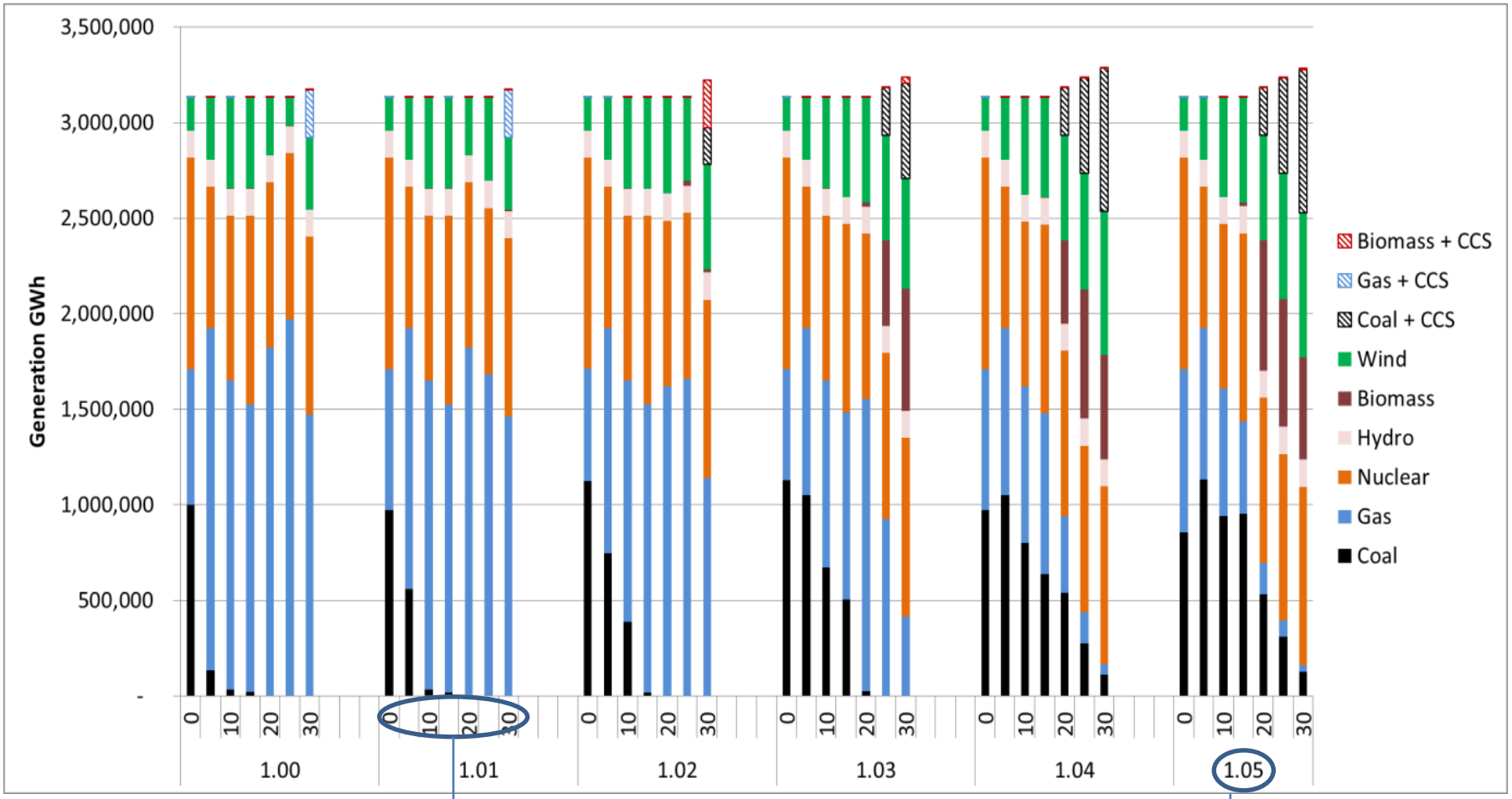
Model Structure



1. LONG-RUN OPTIMISATION MODEL

Structure of electricity system is stochastic

EU mix under 'central' carbon cap



Projection year

Gas price: annual escalator

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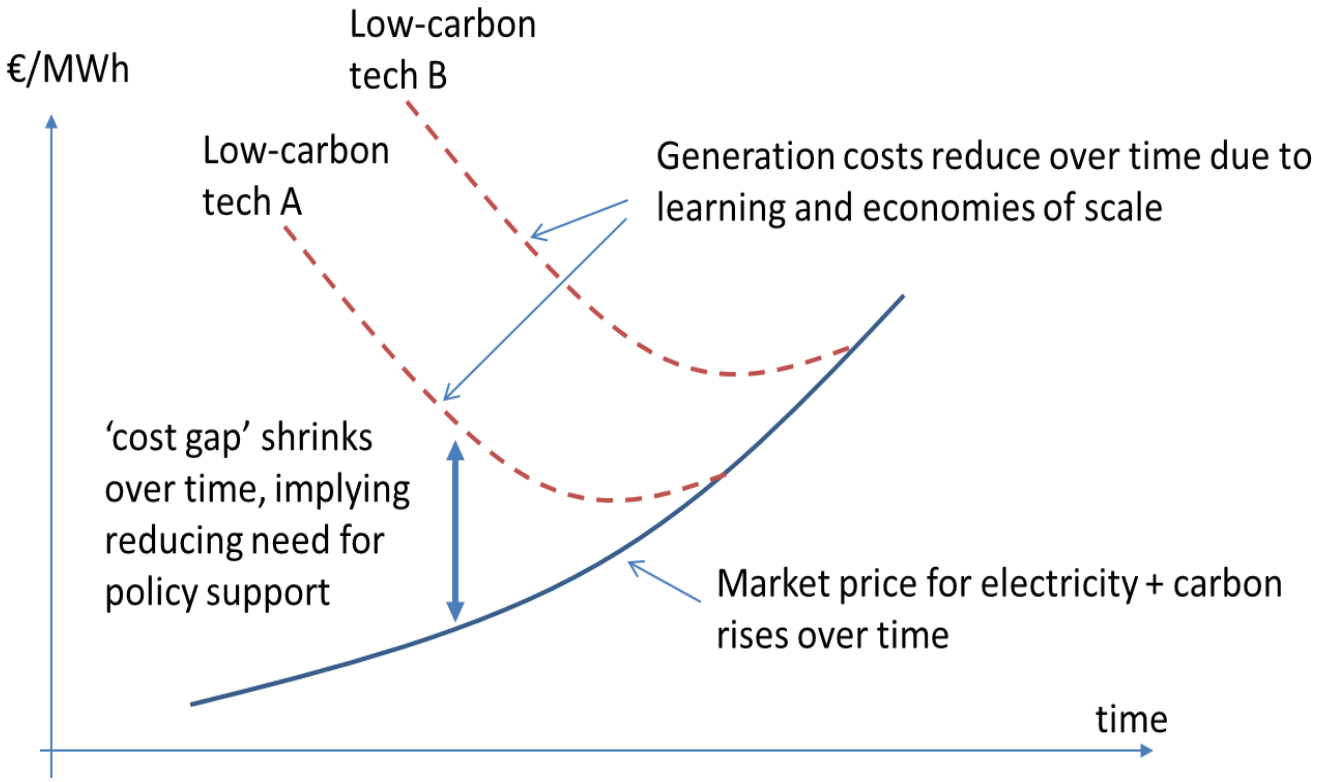
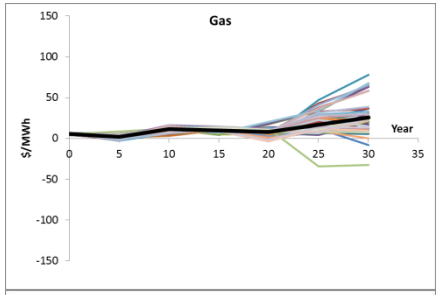
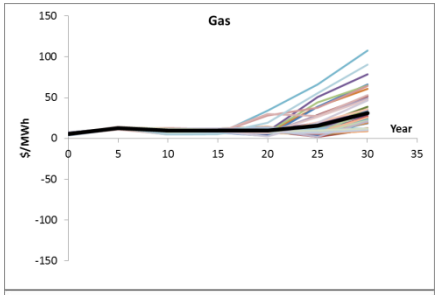
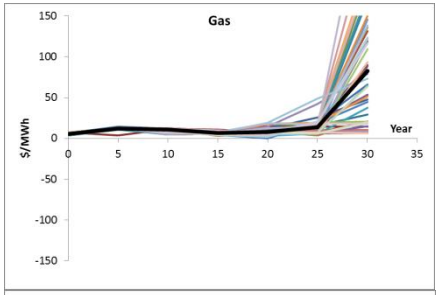
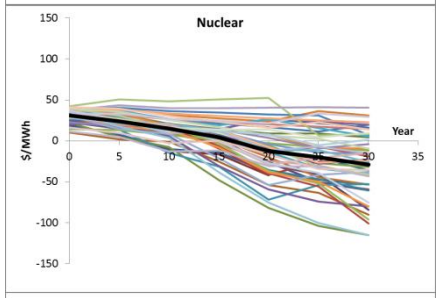
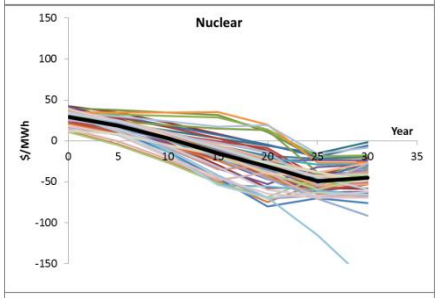
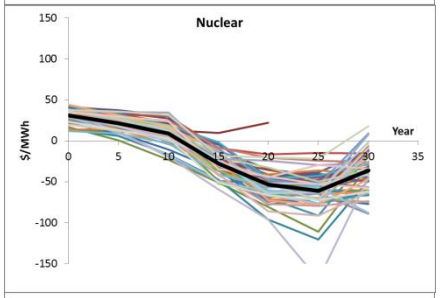
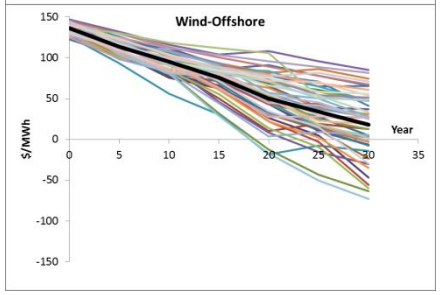
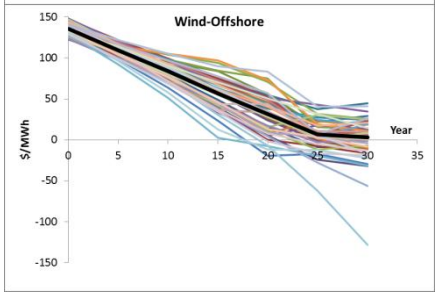
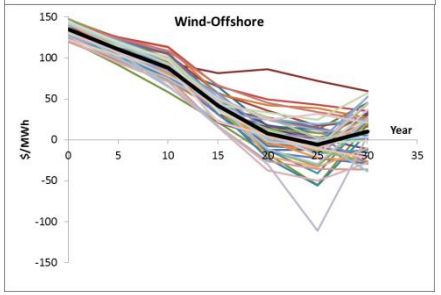
Testing climate policy approaches
"A rising tide lifts all boats"



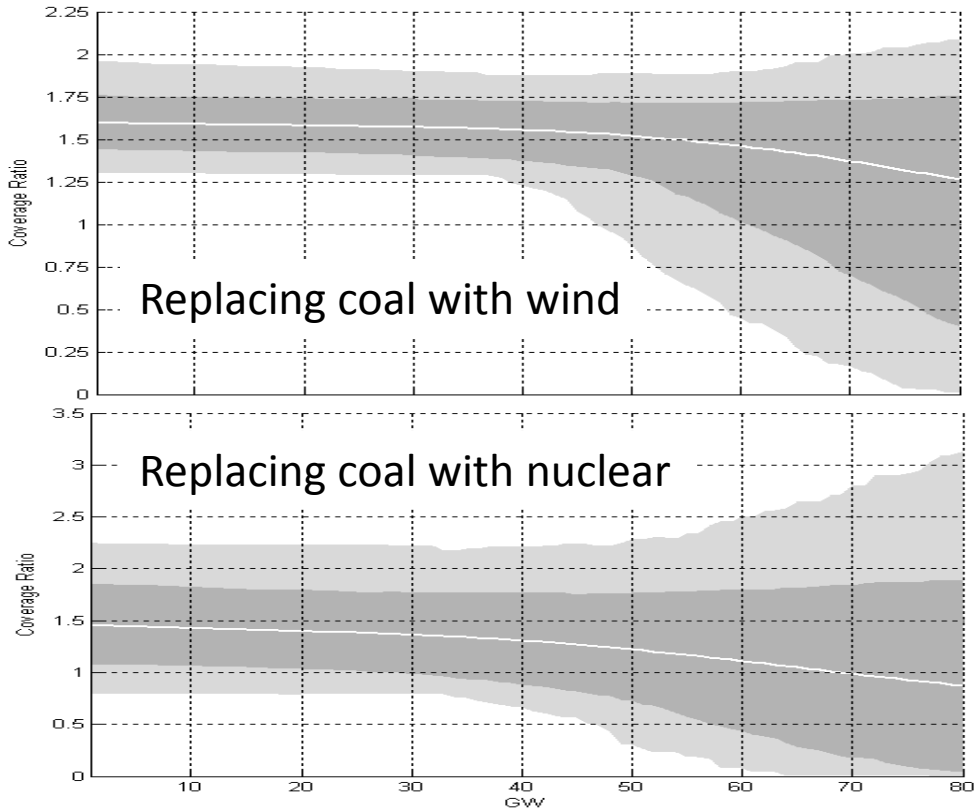
Gap between cost of generation and system short-run marginal cost

	Weak Cap (1.74% pa)	Strong Cap (3.5% pa)	Full Decarbonisation
Gas			
Nuclear			
Offshore Wind			

2. SHORT-RUN PRICE RISK MODEL

Impact of low-carbon generation on prices & investment returns

Coverage ratio = net operational earnings / financing costs



Investment criterion used in model: 95% chance that coverage ratio is above 1.2

Successive GW of coal replaced with low-carbon sources on an energy like-for-like basis

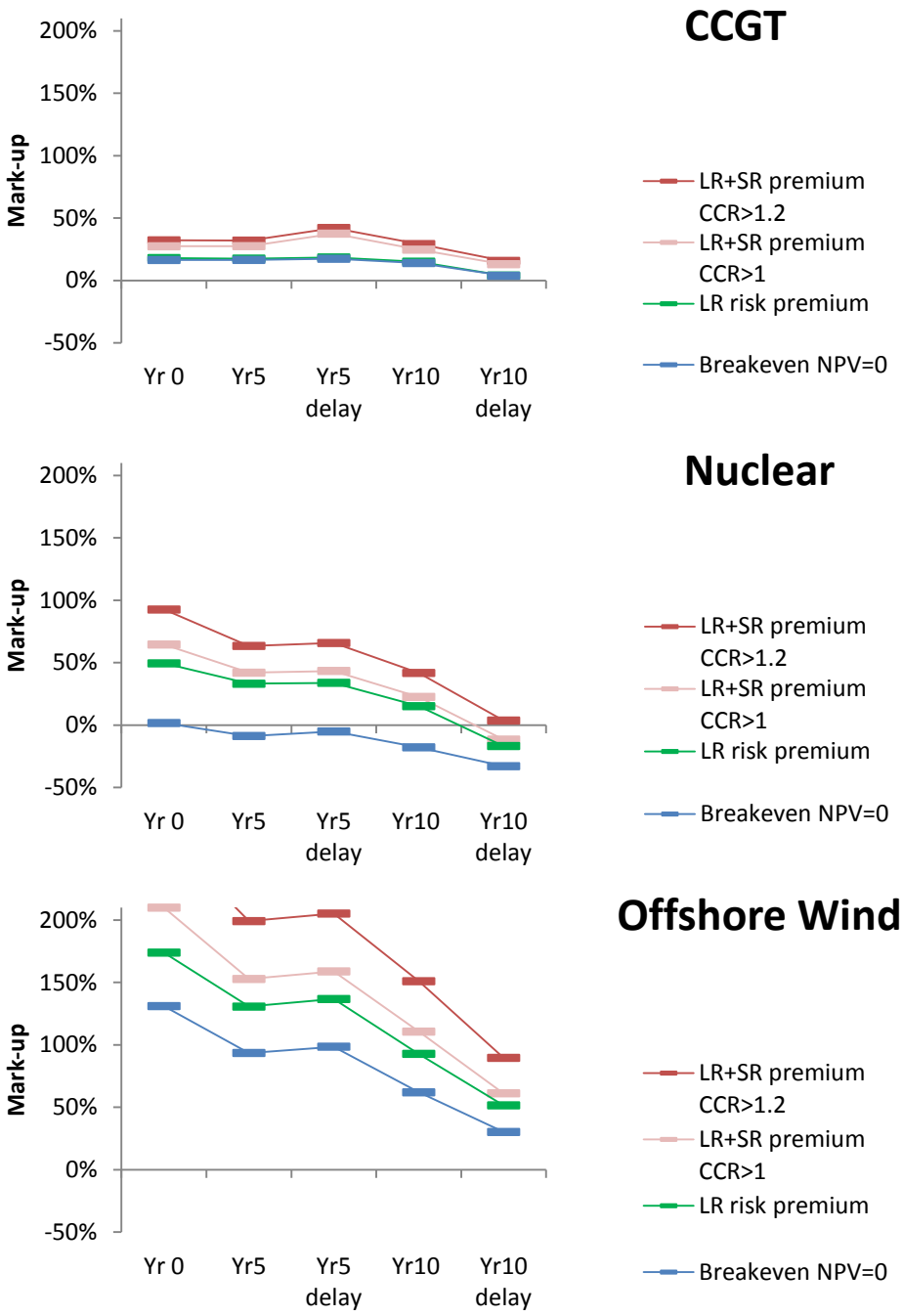
COMBINING SHORT-RUN AND LONG-RUN RISK

Estimating total investment risk

Long-run risk premium	+	Short-run risk premium	=	Total risk premium
(price mark-up required to overcome real option value)		(price mark-up required to overcome capital coverage investment hurdle)		(price mark-up required to overcome risk premia and incentivise immediate investment)

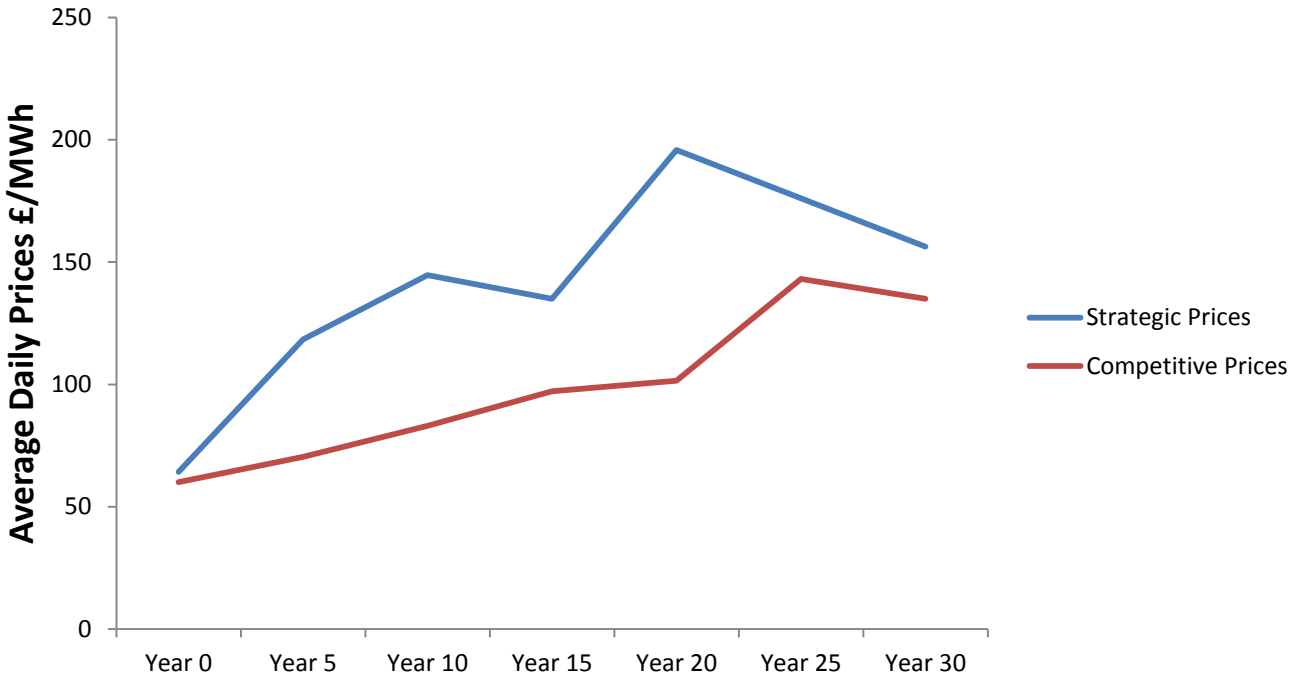
- Evolution of risk premia over time
- Impact on risk premia of a 5-year or 10-year investment hiatus

Price mark-ups required to overcome risk premia



3. STRATEGIC PRICING MODEL

Companies may be able to recover risk premiums even in an over-supplied market



Conclusions

- **Long-run risks are significant**
  - Fuel prices, policy risks, tech costs etc.
  - System structure uncertainty
  - Tight caps do not necessarily mean high returns for low-C plant
- **Short-run risks are significant**
  - System SRMC tends to fall in a decarbonising electricity market
- **Markets would probably adjust in short- to medium-term**
  - Investment hiatus increases incentive to invest due to increased carbon price and reduced reserve capacity
  - Market power could also result in sufficient profit margins

- **BUT, in the long run, market design needs to take account of deep structural changes from decarbonisation**
  - Capacity markets?
  - Other regulatory intervention?

Outstanding Policy Questions

- How will capacity markets and energy markets interact?
- How do well do market reference prices for CfDs work in a shrinking market?
- Are these markets more or less subject to market power?
- Who can finance these transitions?

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