

# Climate Policy Risk and Power Investment

**Derek W. Bunn**

*London Business School*

dbunn@london.edu

# *Electricity Markets are now at a Delicate Balance of Liberalisation and Re-Regulation*

- Government climate policy is subject to **scientific evidence, social attitudes** and **geopolitical self-interests**.
- Implemented through a mixture of **regulations, incentives** and **markets**:
  - *The cap-and-trade “markets” (eg EU-ETS) are expanding*
  - *But interact with other mitigation mechanisms*
  - *And link to the energy commodities....*
- *So Carbon Price Formation is a **Complex & Evolving** mix of **Fundamentals** and **Policy Risk***

# *Carbon Price Formation*

## ***TWO MAJOR DRIVERS:***

### **Compliance Activities by Agents in the Market:**

- **Qualified Emitters must trade yearly to comply....**
- **Motivates models of supply and demand**

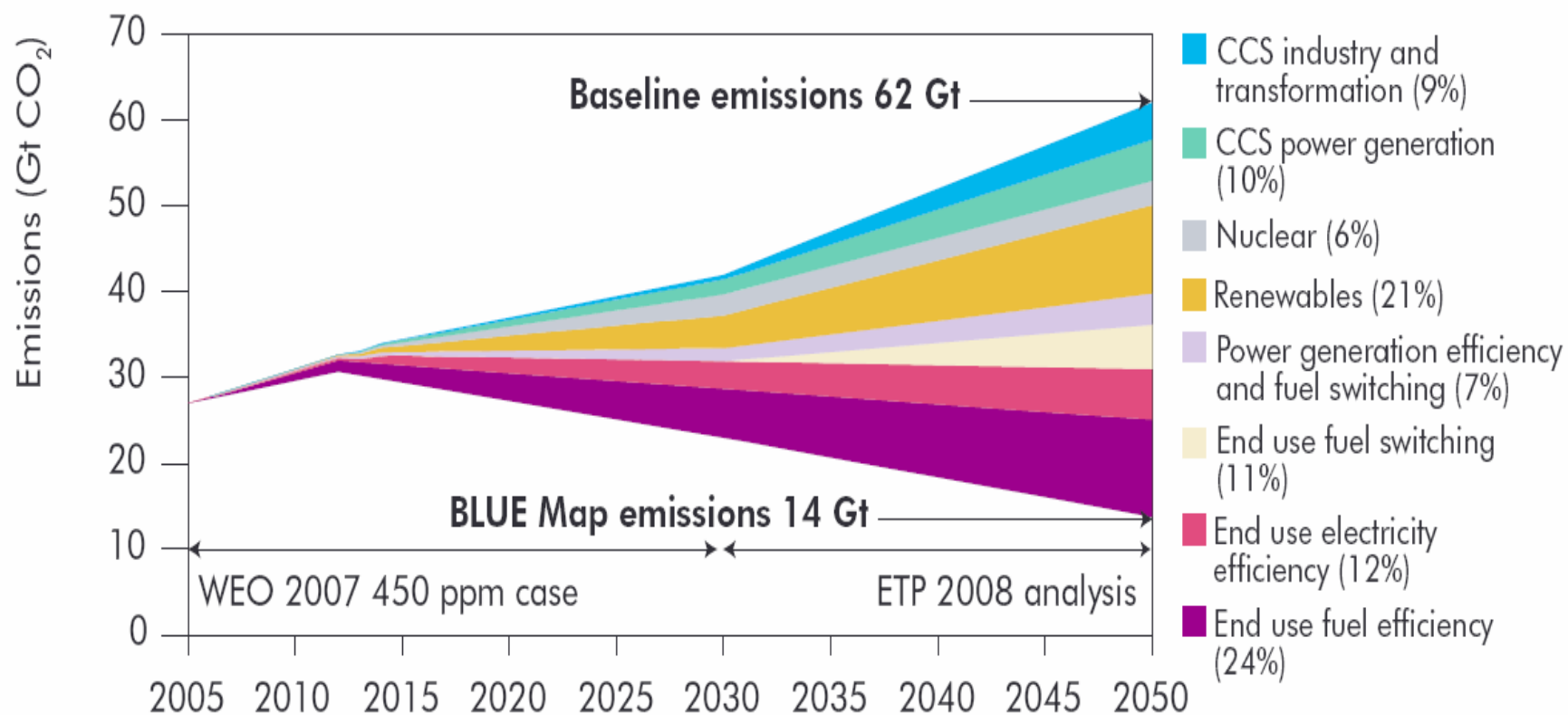
### **Expectations about Future Prices:**

- **Allowances are bankable indefinitely.....**
- **Motivates models based upon discounting forward expectations**

# Policy Analyses start by Projecting Baseline Emissions, and then consider the Costs of Abatement

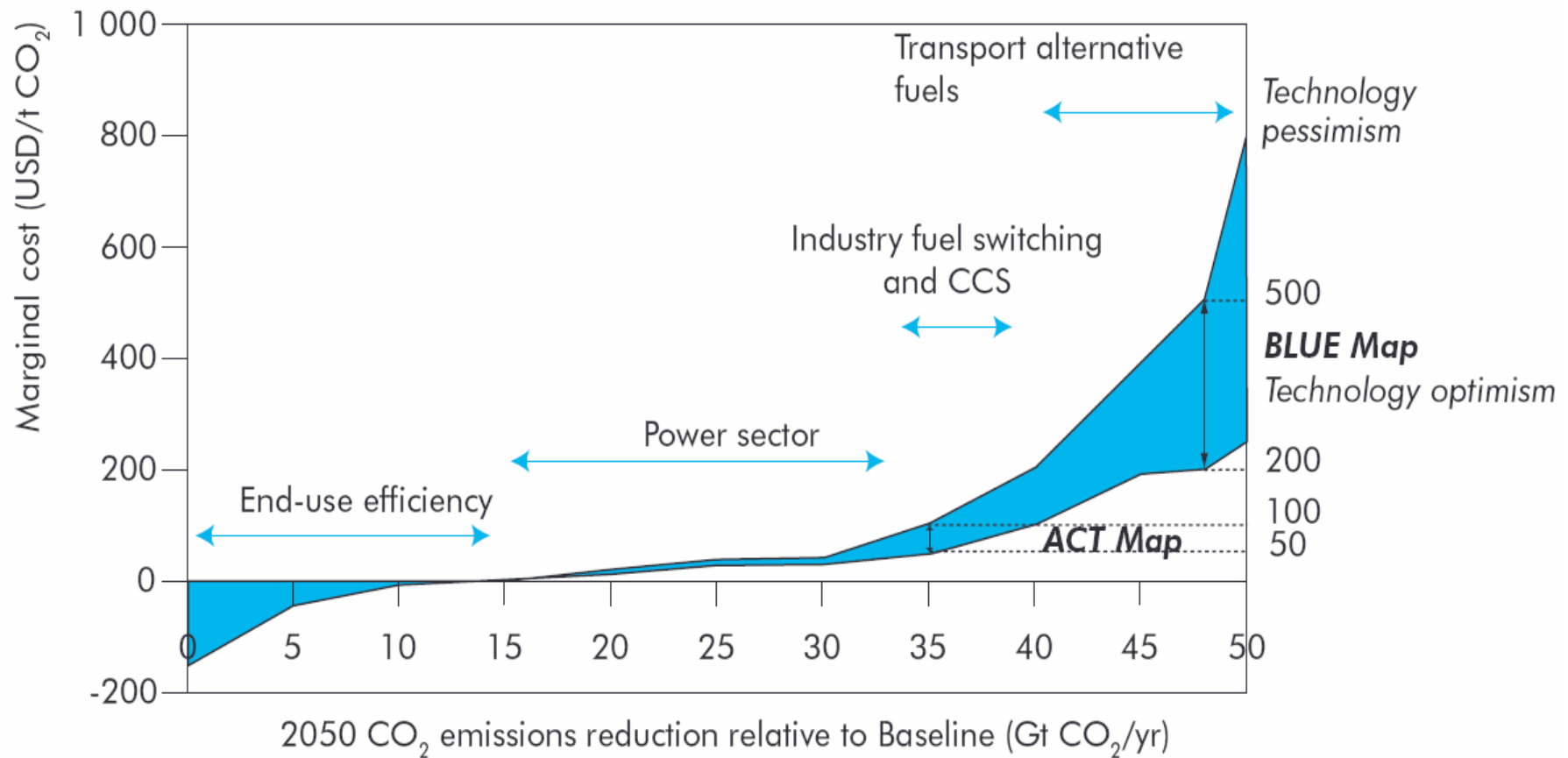
IEA Energy Technology Perspectives 2008

**Figure 2.2** ► Contribution of emission reduction options, 2005-2050



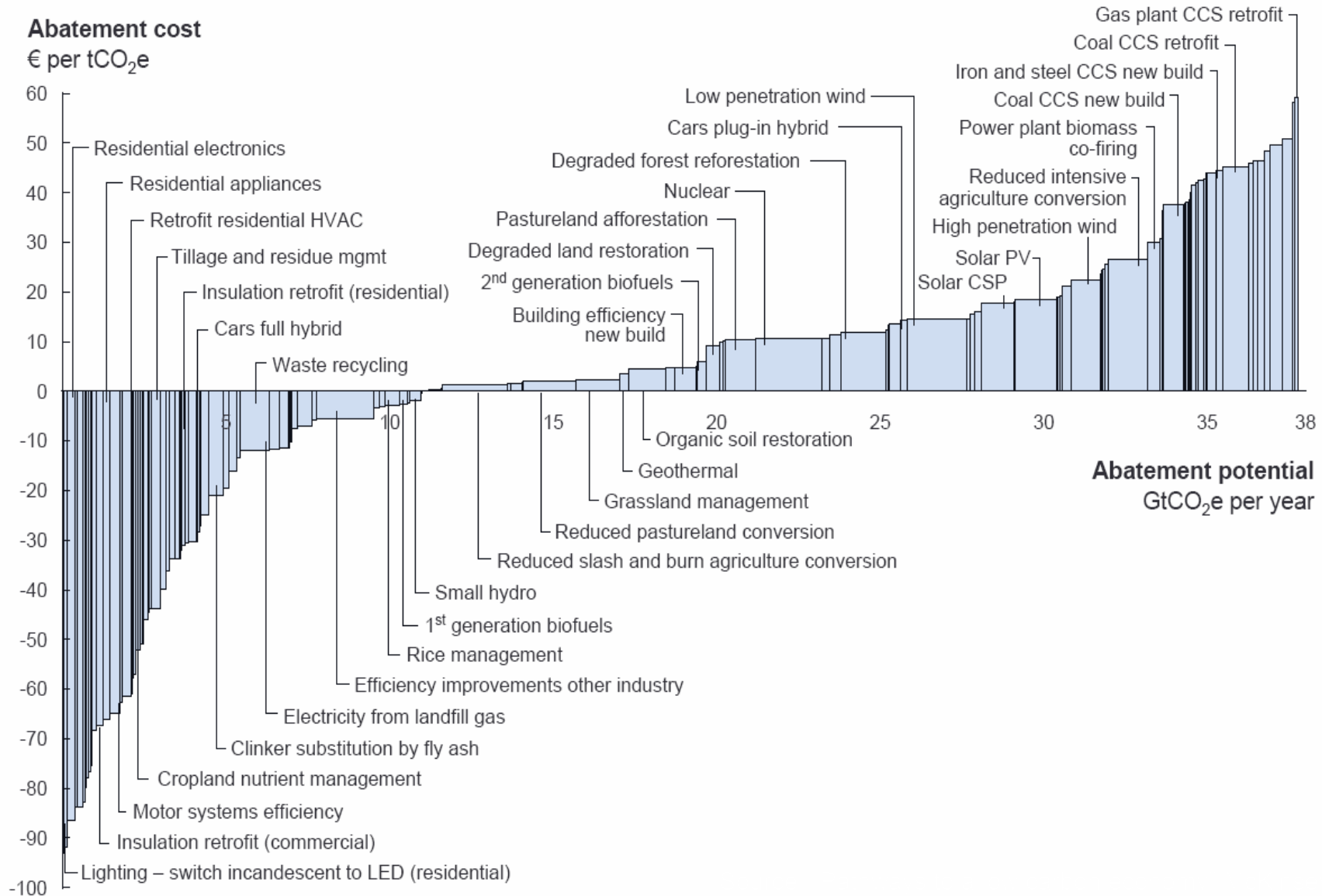
These can be stacked in increasing marginal cost to give a supply function for a target date

**Figure 2.14** ► Marginal emission reduction costs for the global energy system, 2050



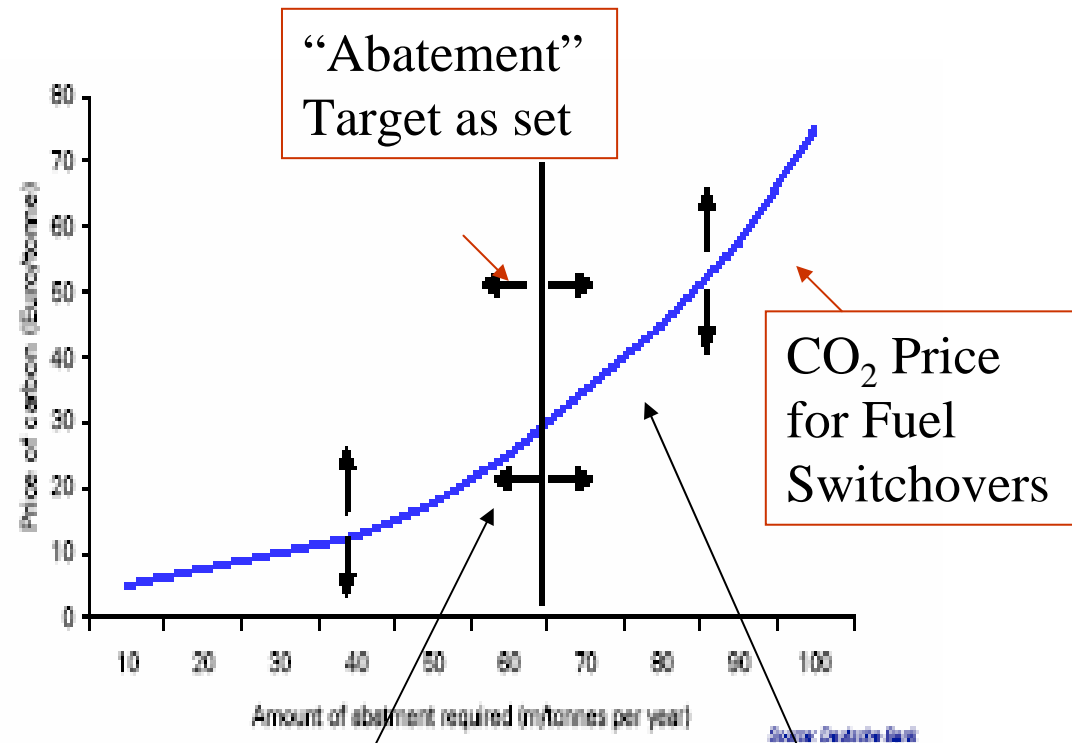
# McKinsey Global abatement function for 2030

## Global GHG abatement cost curve beyond business-as-usual – 2030



Early in Phase 1,  
2005-2006,  
conventional  
thinking was about  
fuel switching  
amongst  
compliance buyers

*Abatement Functions have also been  
central to Short Term Forecasts.....*

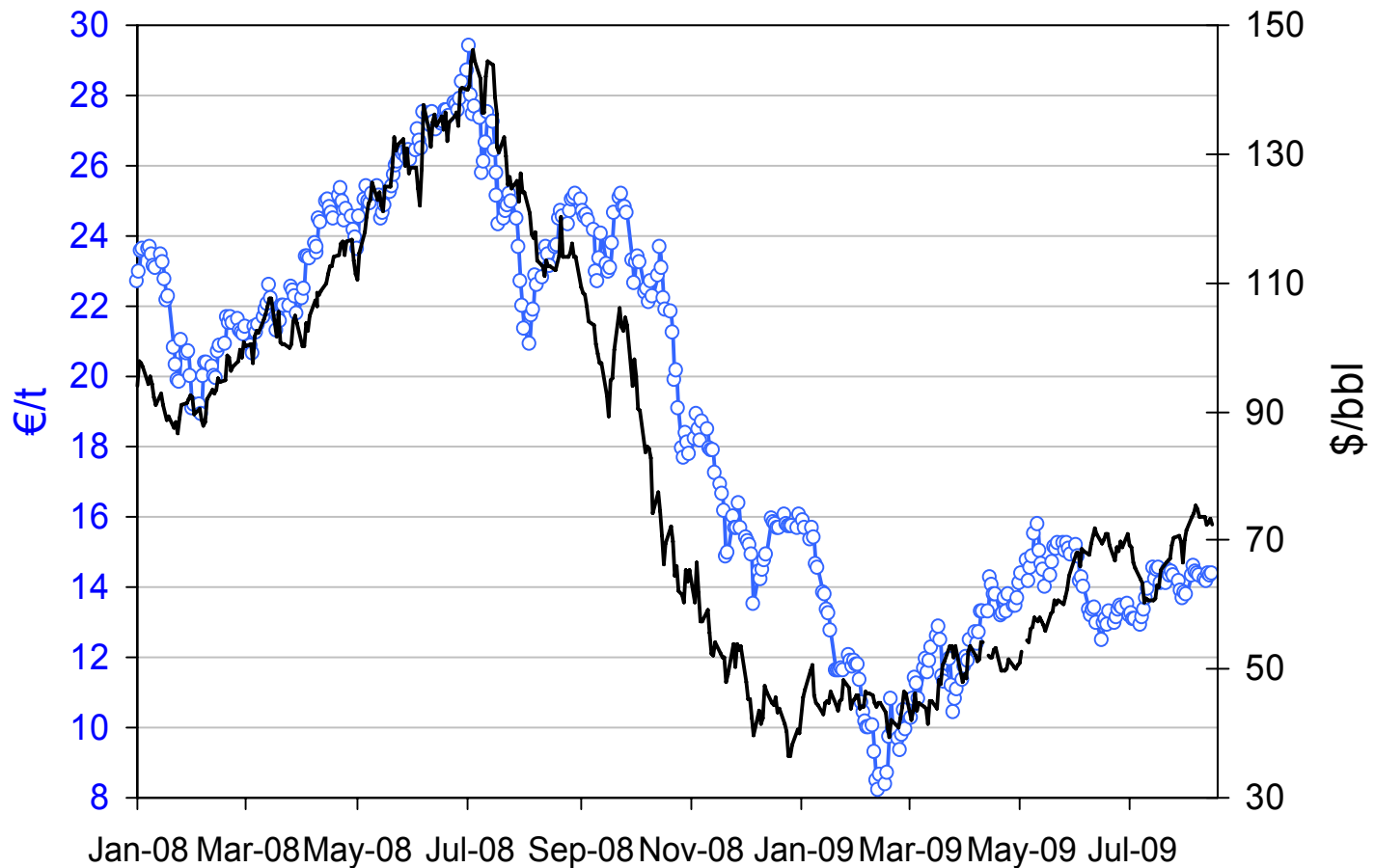


German  
Lignite  
displaced  
by coal

UK/Spain Coal  
displaced by Gas

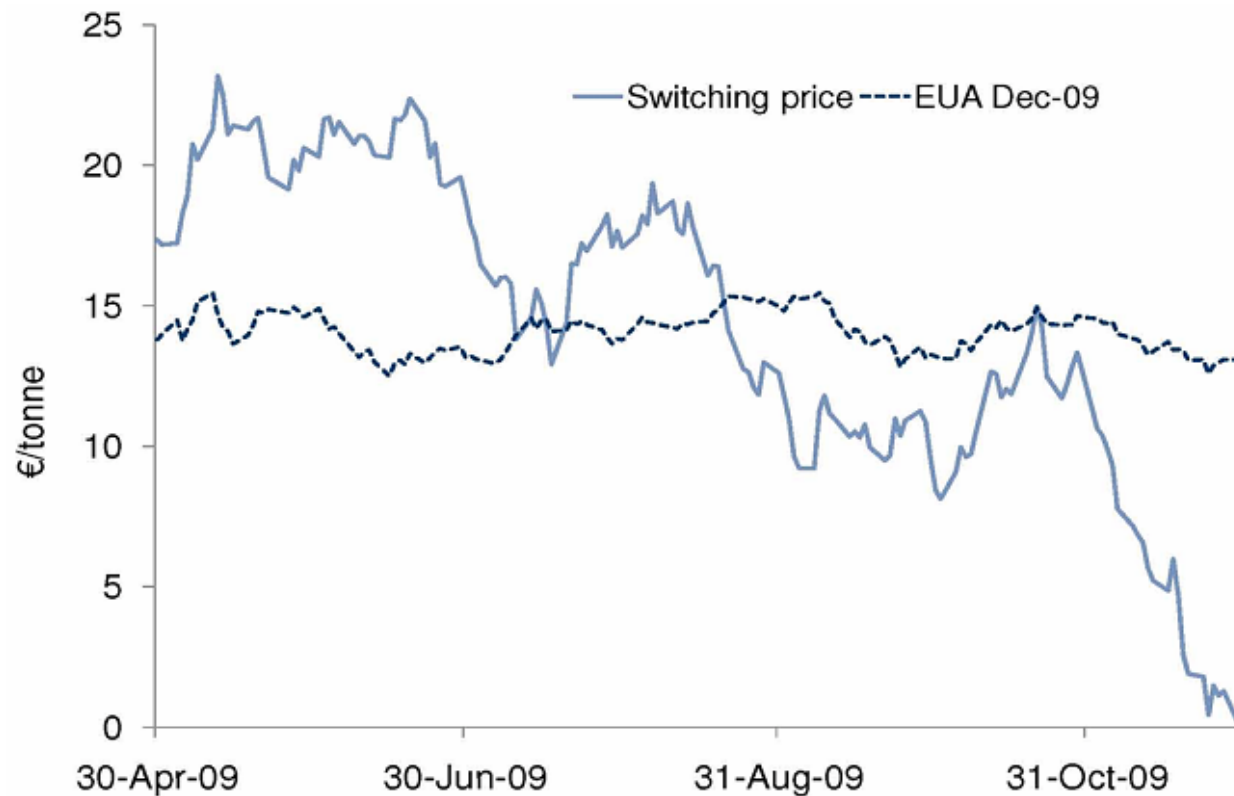
# But *Oil* is a Key Driver of Carbon Prices

Why should Carbon depend upon Oil?

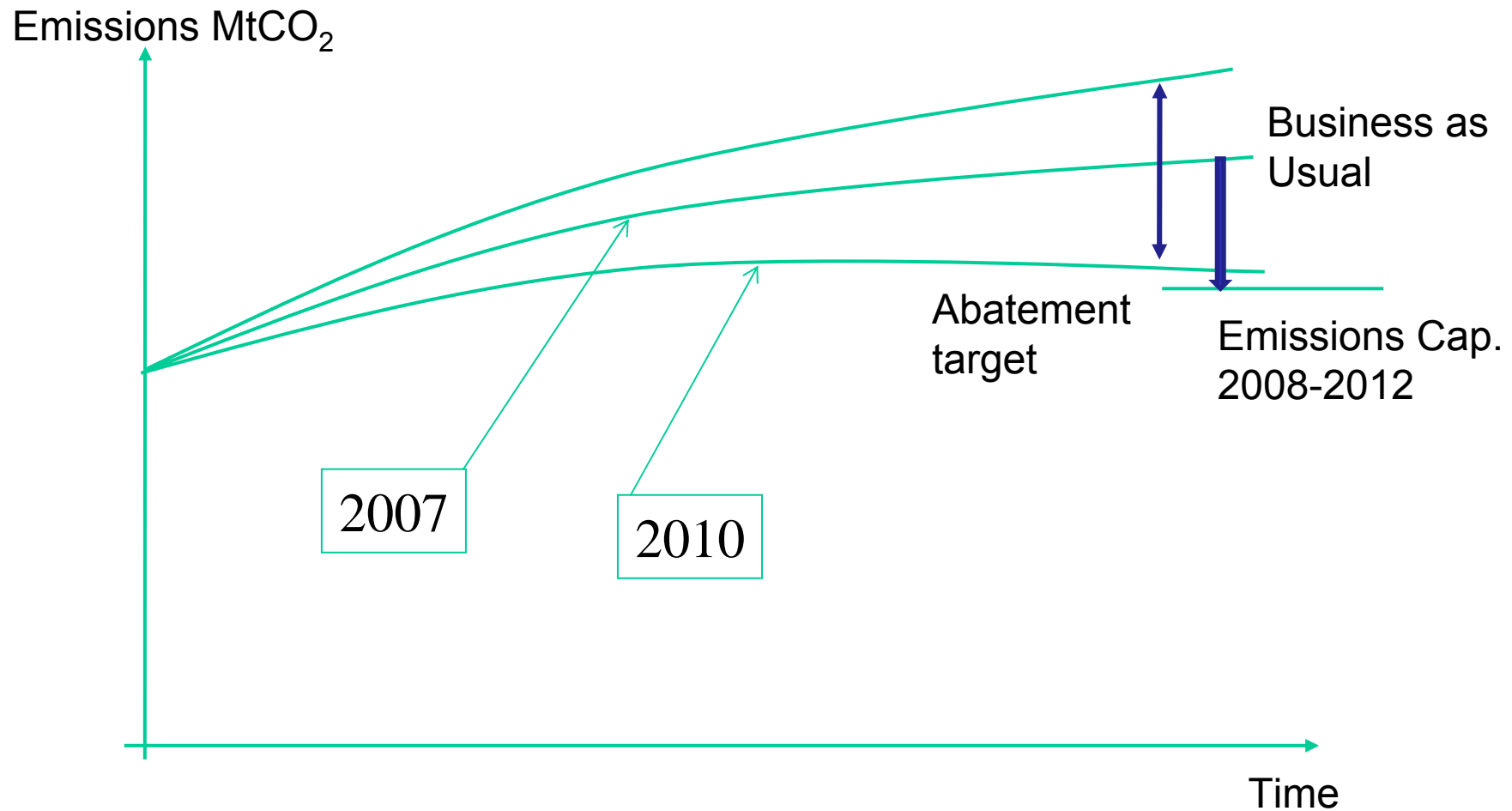




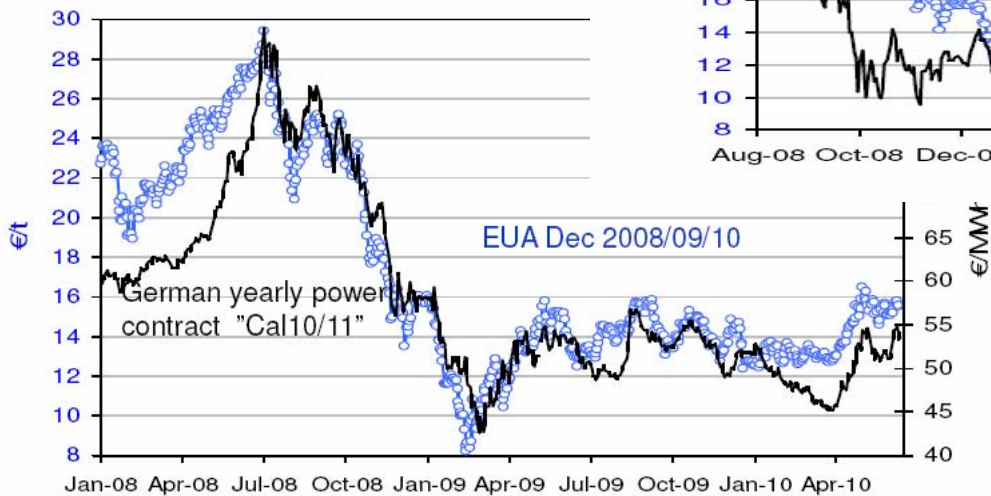
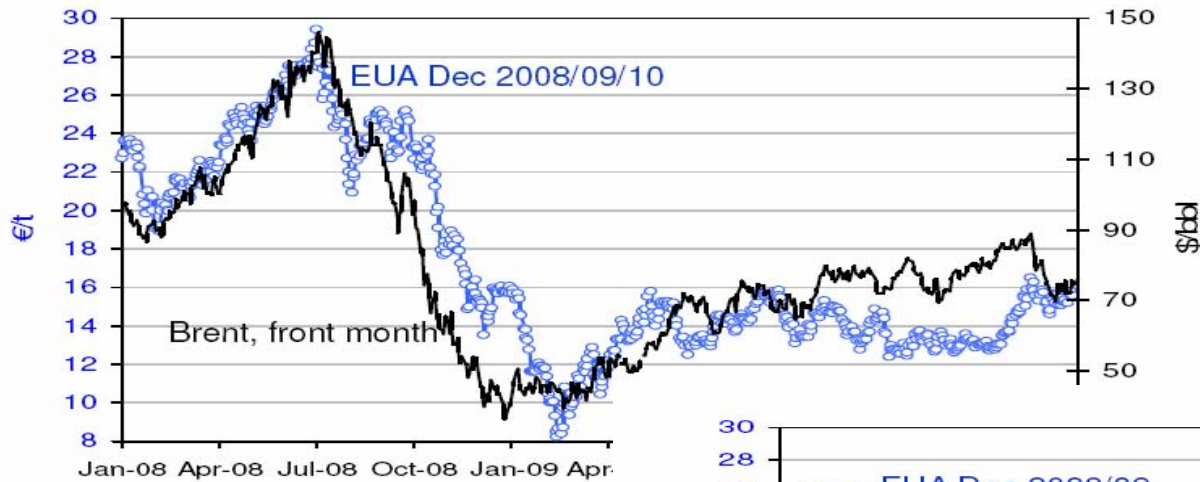
# More so than fuel switching



# Economic Sentiment is crucial because Abatement targets have a forecast business as usual baseline

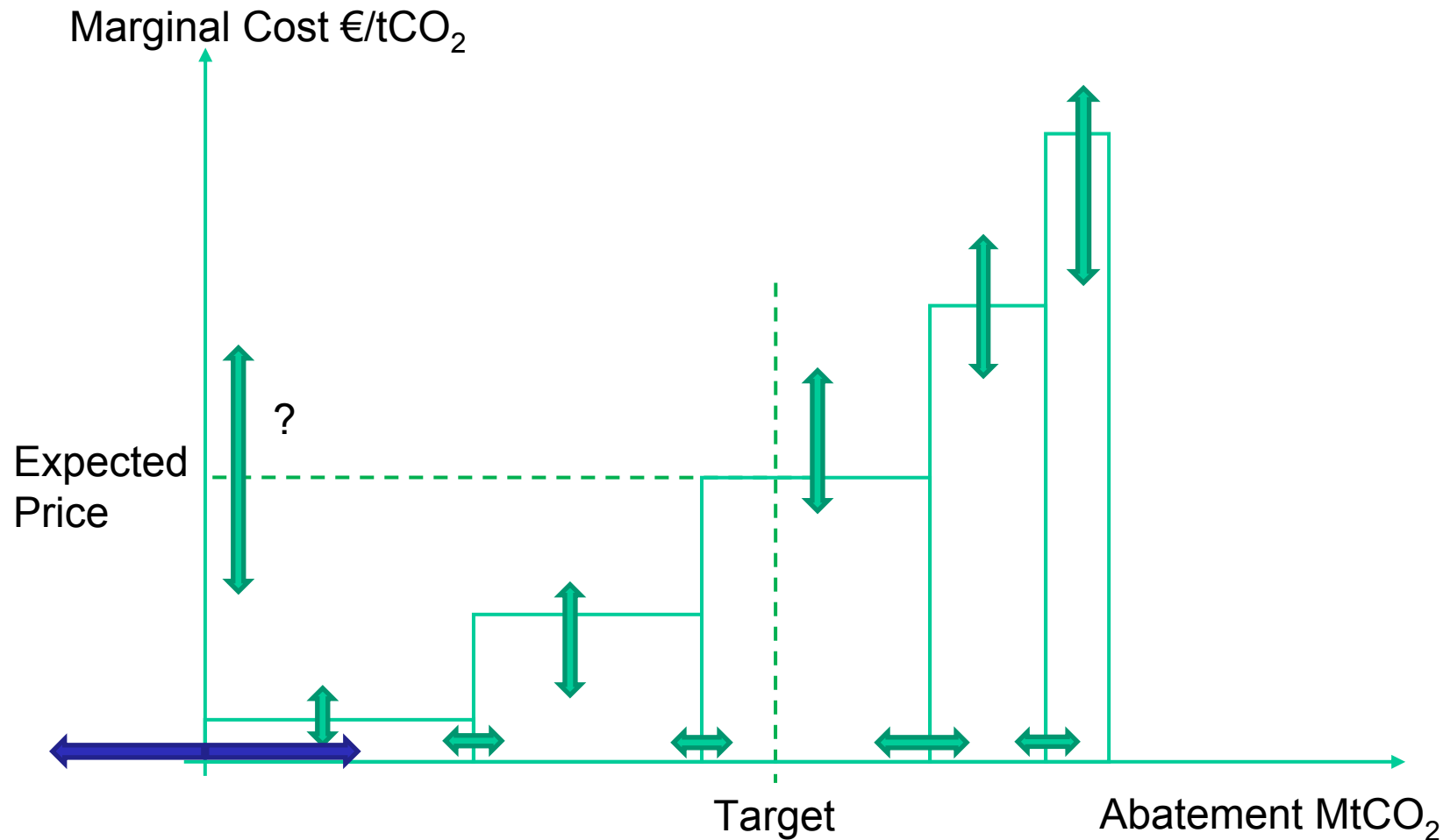


# The Drivers of Short-term Prices are Several and Variable.....

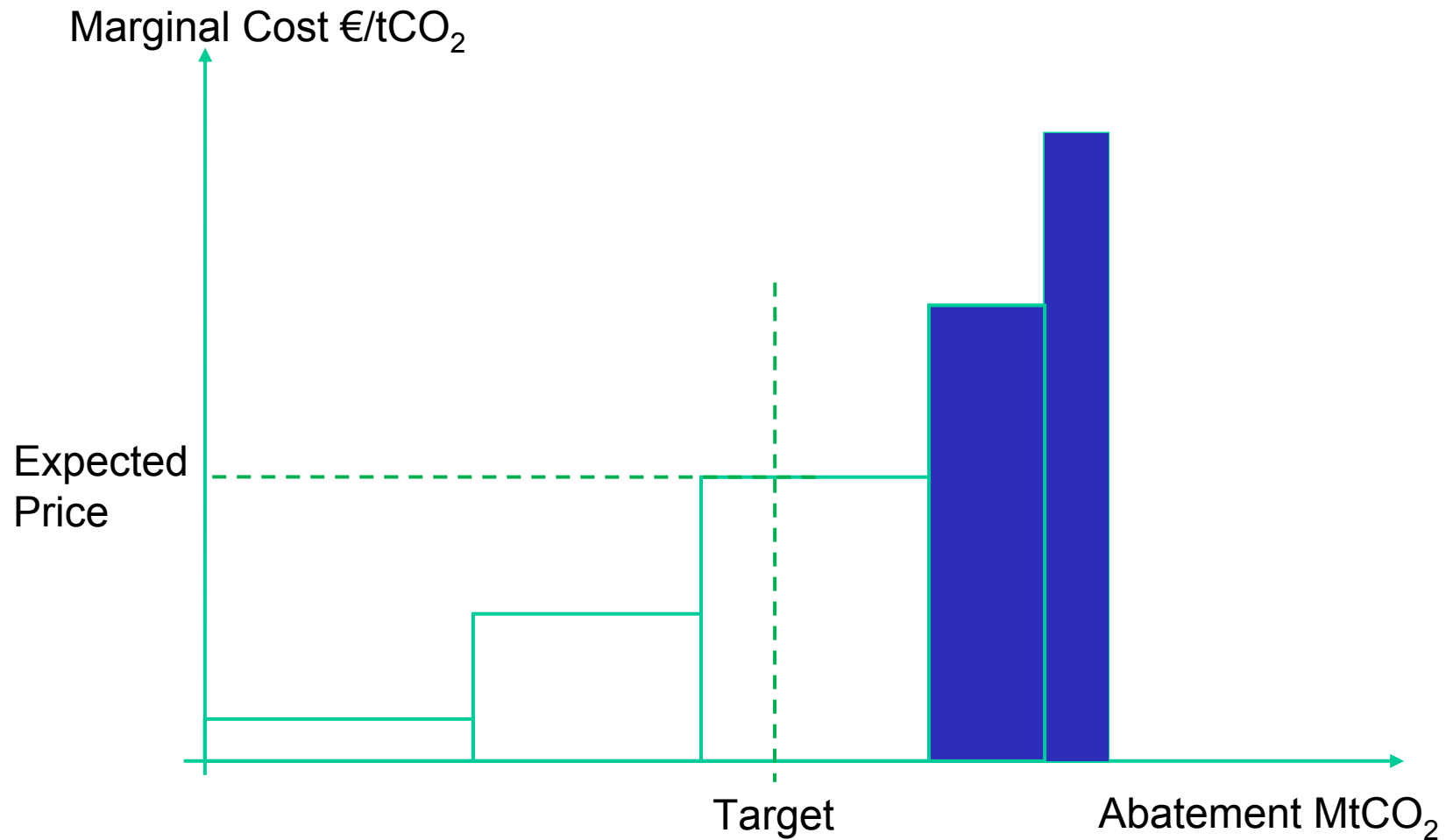


Source: Point Carbon

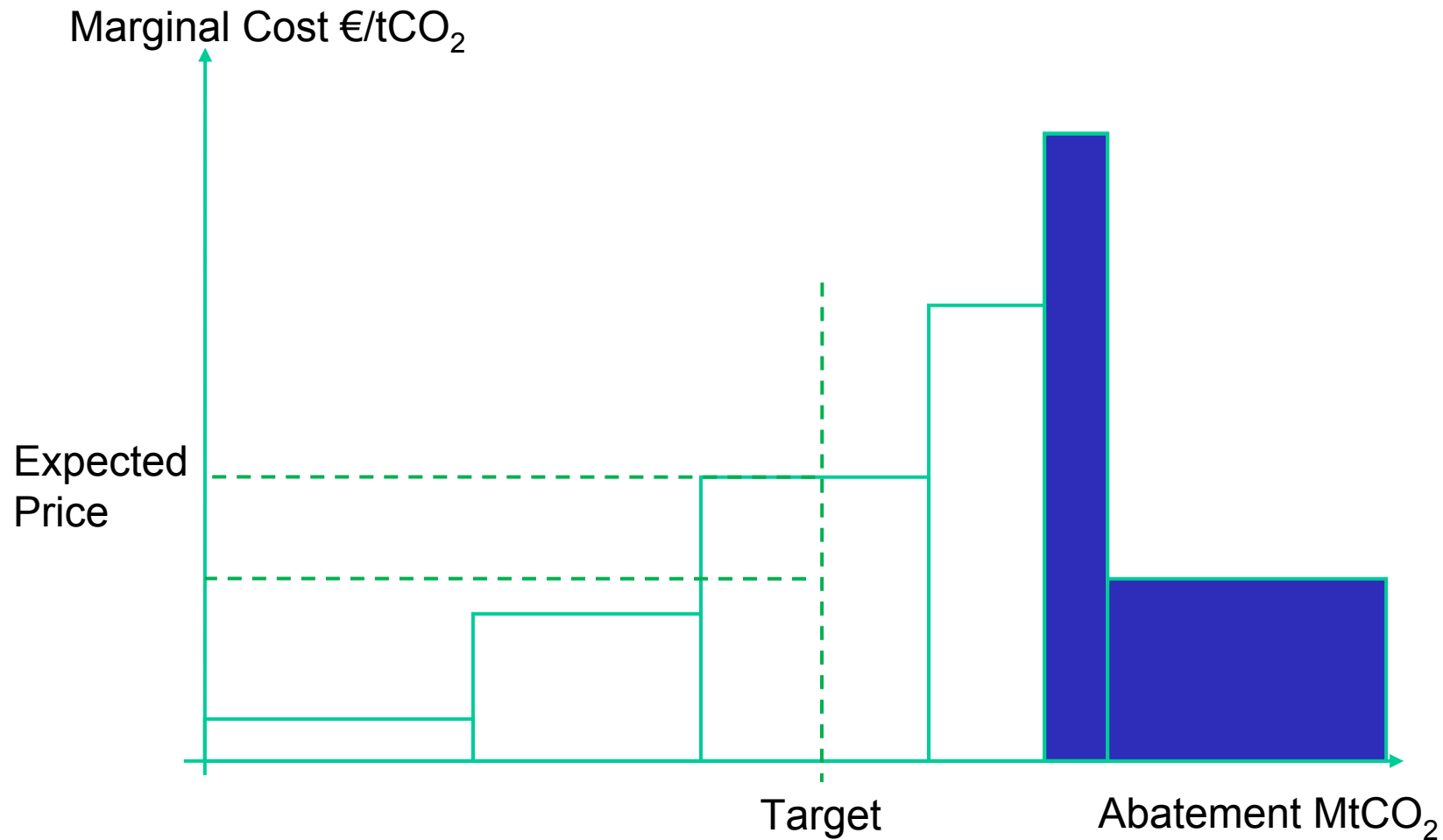
In the longer term Abatement depends not only BAU risk but also on policy interactions, eg, the quota on offset credits (CERS) may change...



# Some technologies may receive policy support



# And some technologies need help in their learning curves



# Simulation Model

Abatement Stack of 16 Technologies with marginal costs and capacities for abatement by 2020 and 2030. BAU Projection to 2030.

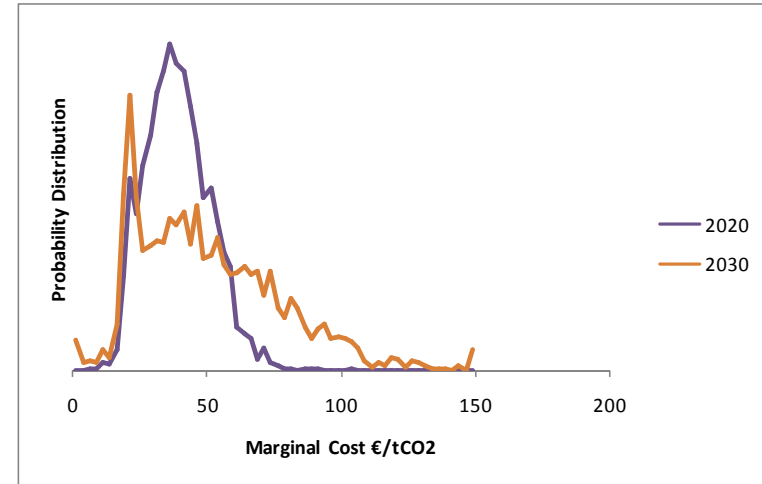
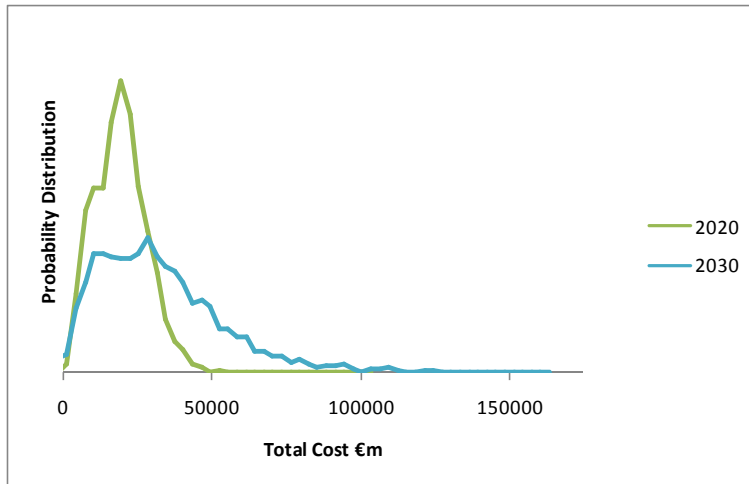
(Data from EU Primes model and IEA WEO)

Model Risk: Uncertainties on Demand, Costs & Capacities simulated by Monte Carlo methods.

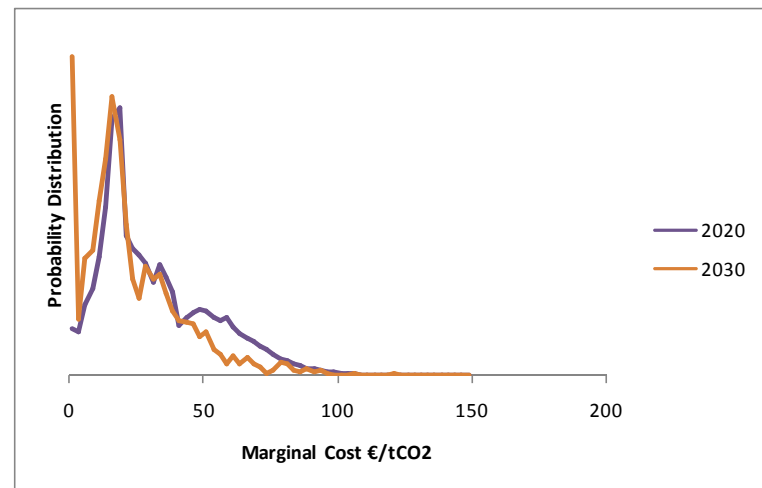
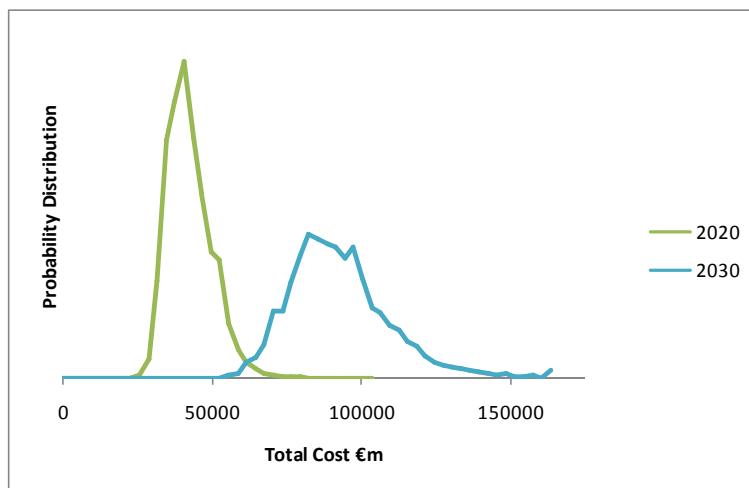
Policy Risk: Selective support for technologies and quota for offsets. Different abatement target levels for 2020

# 20% EU-wide abatement scenario

Base Case



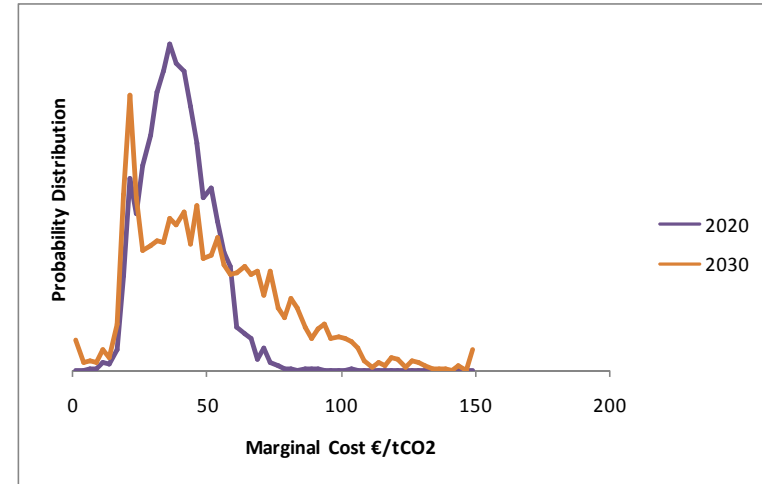
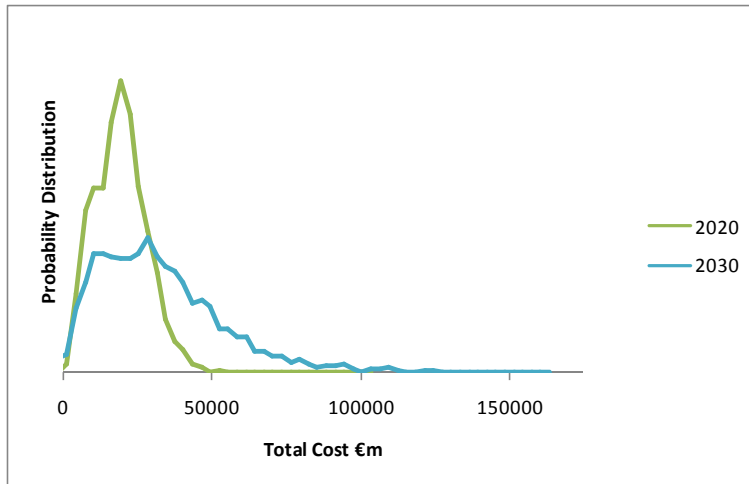
20%  
Renew +  
CCS  
support



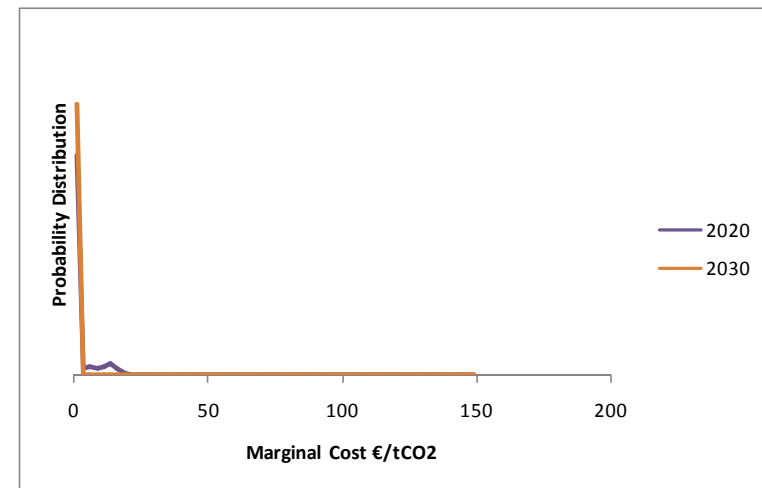
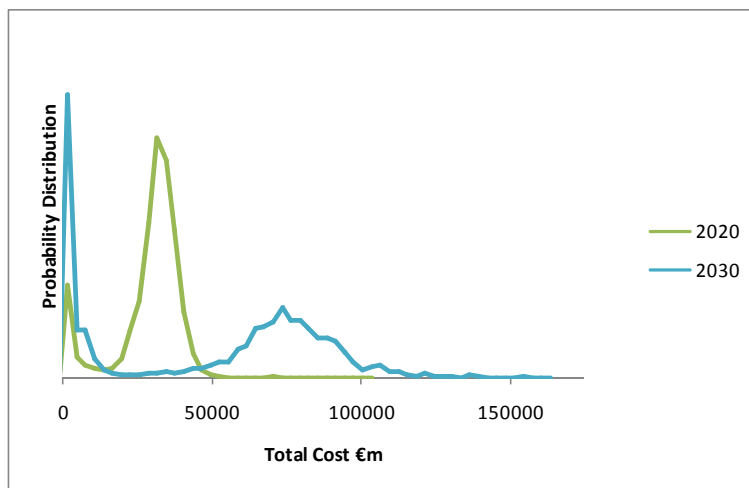


# 20% EU-wide abatement scenario

Base Case

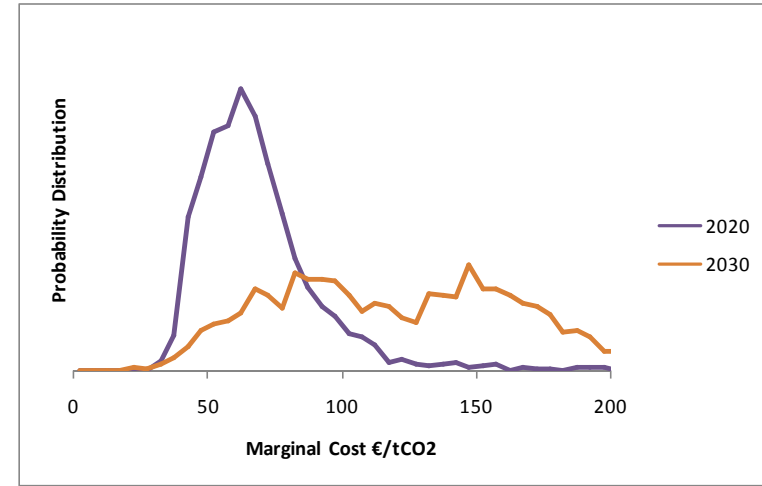
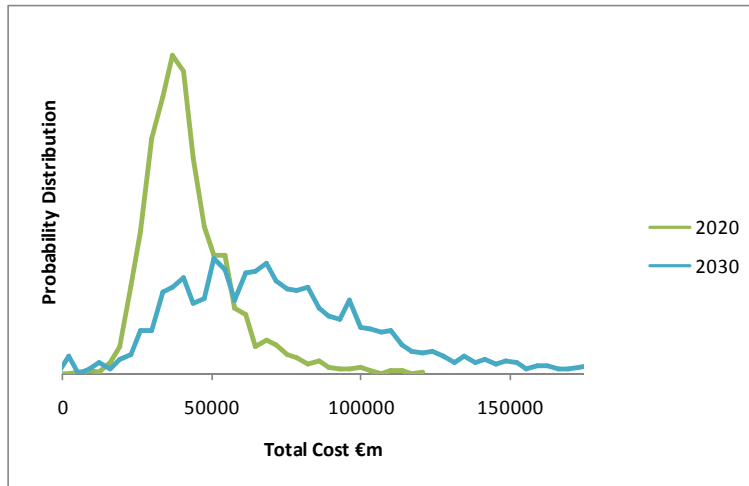


20%  
Renew. +  
20%  
Efficiency  
+ CCS

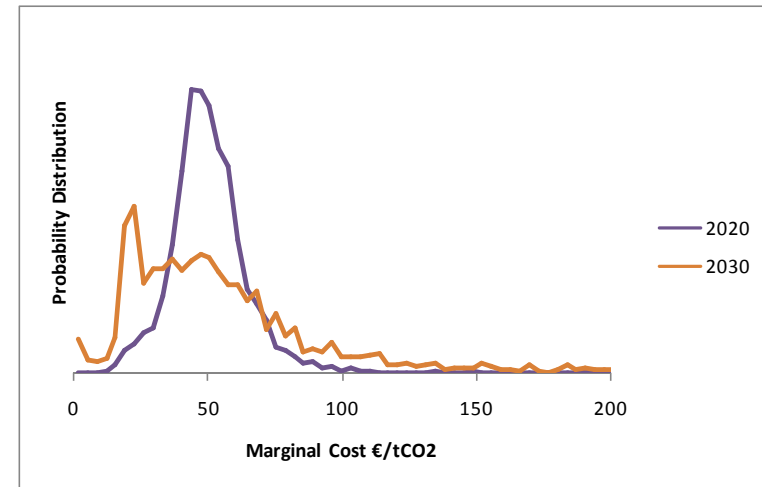
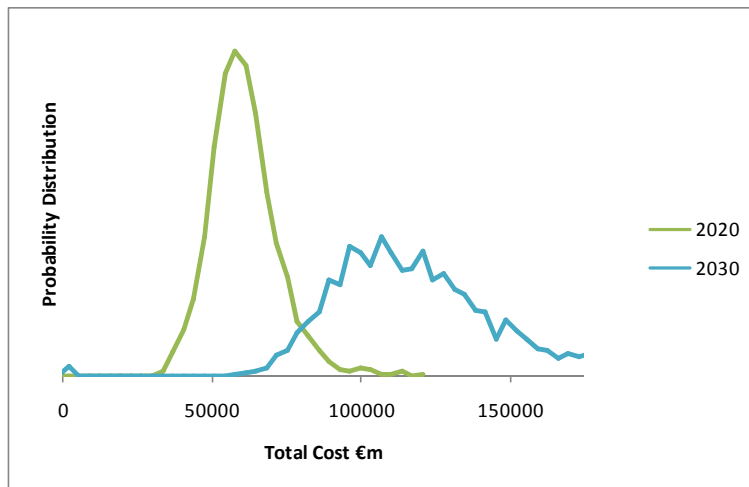


# 30% EU-wide abatement scenario

Base Case

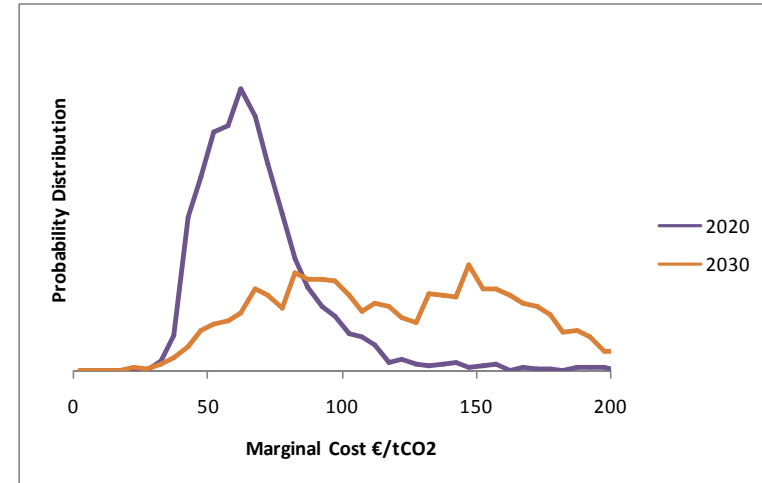
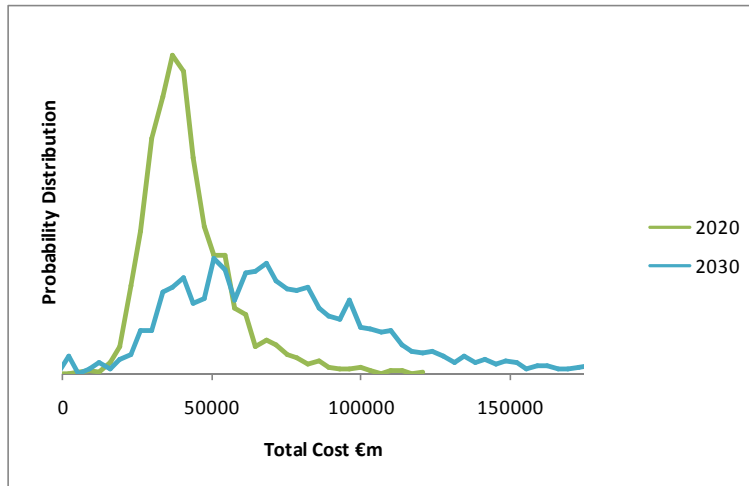


20%  
R.E. +  
CCS

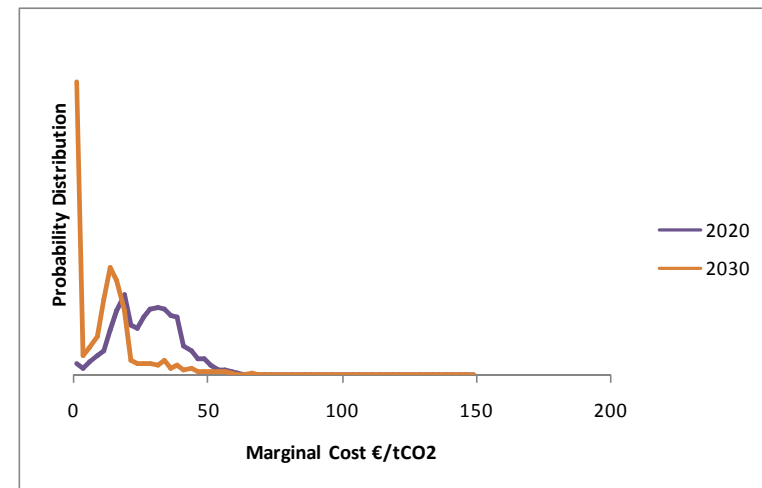
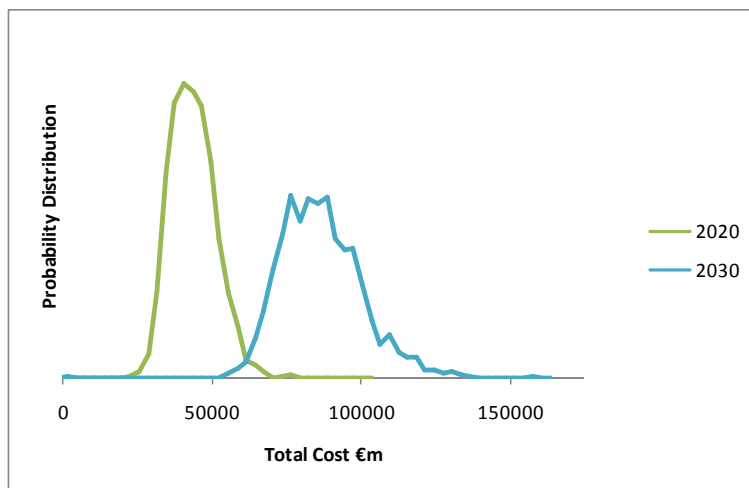


# 30% EU-wide abatement scenario

Base Case

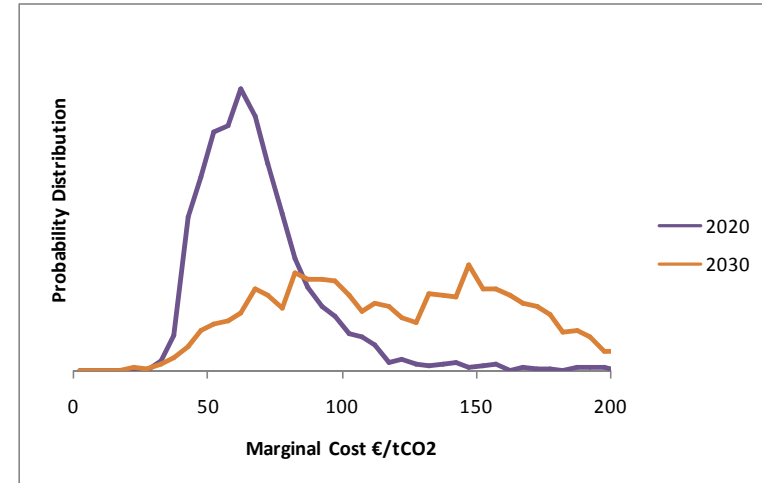
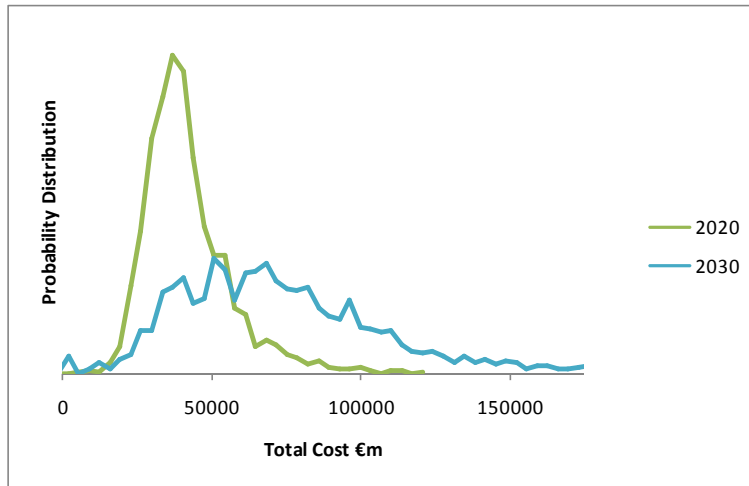


20%  
R.E. +  
E.E. +  
CCS

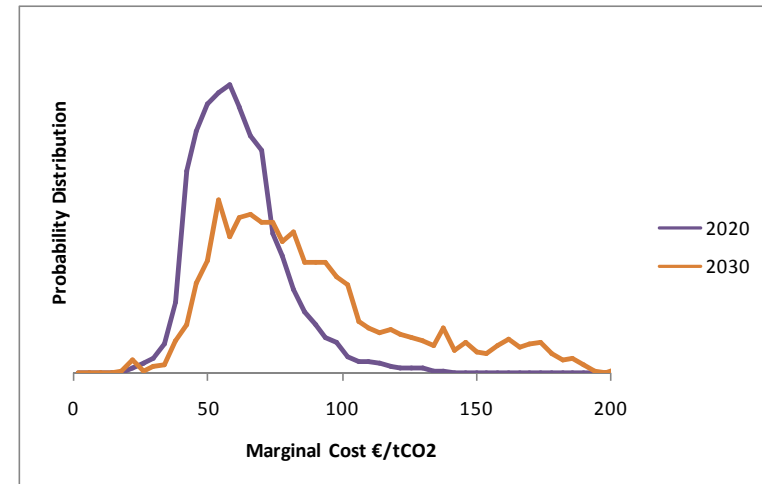
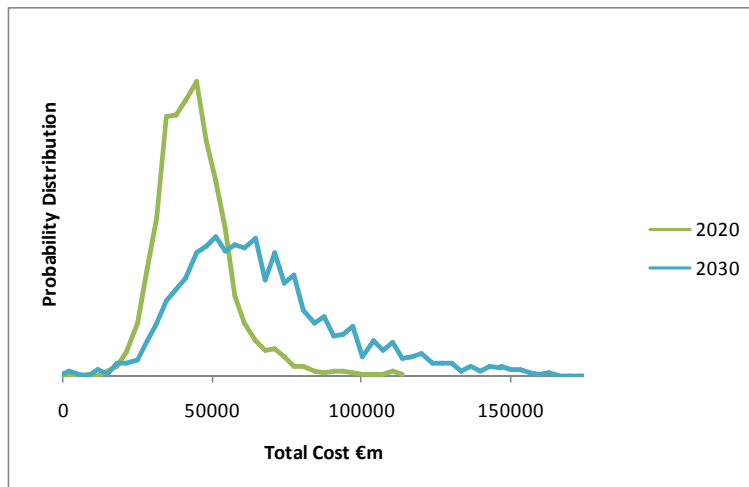


# 30% EU-wide abatement scenario

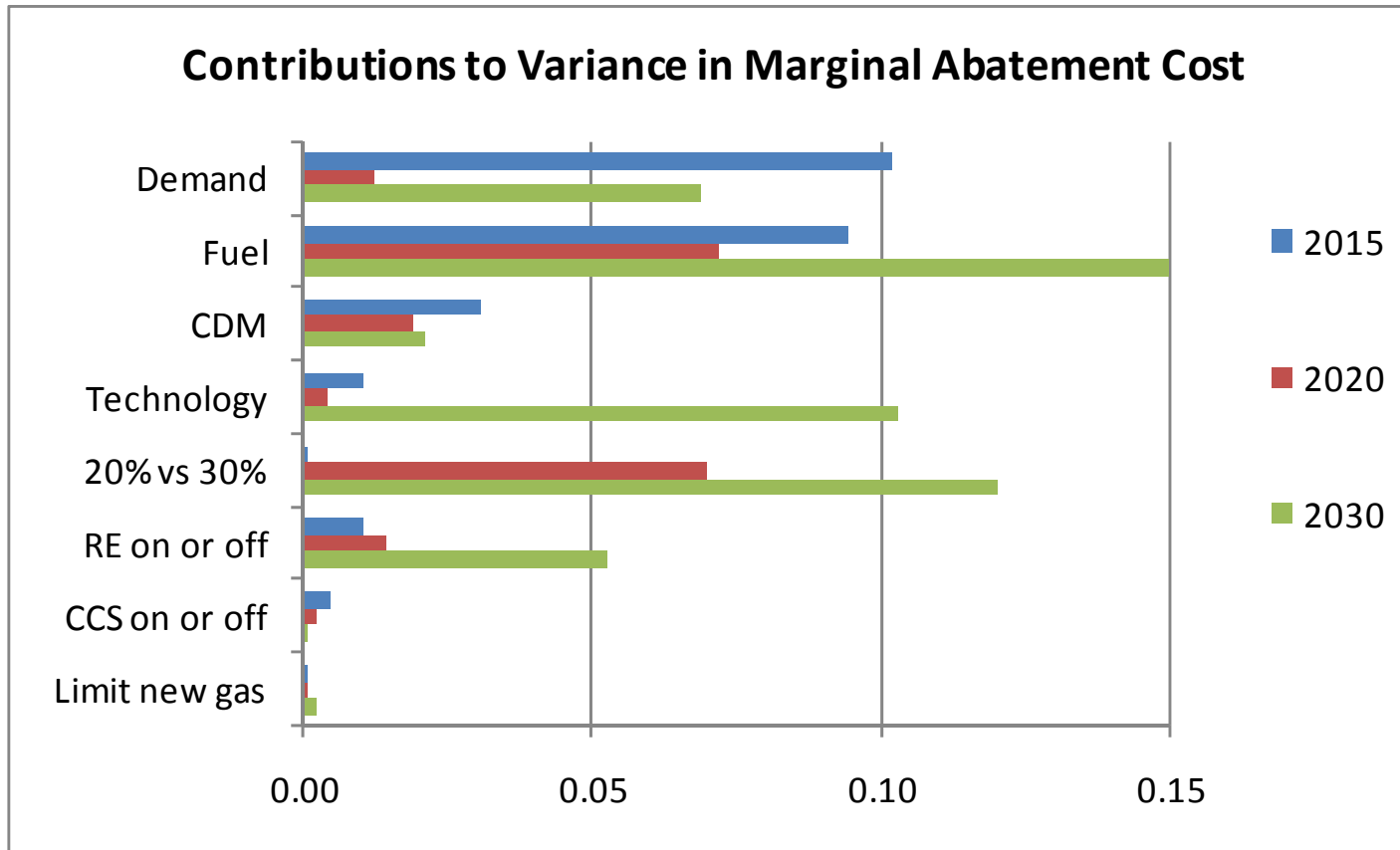
Base Case



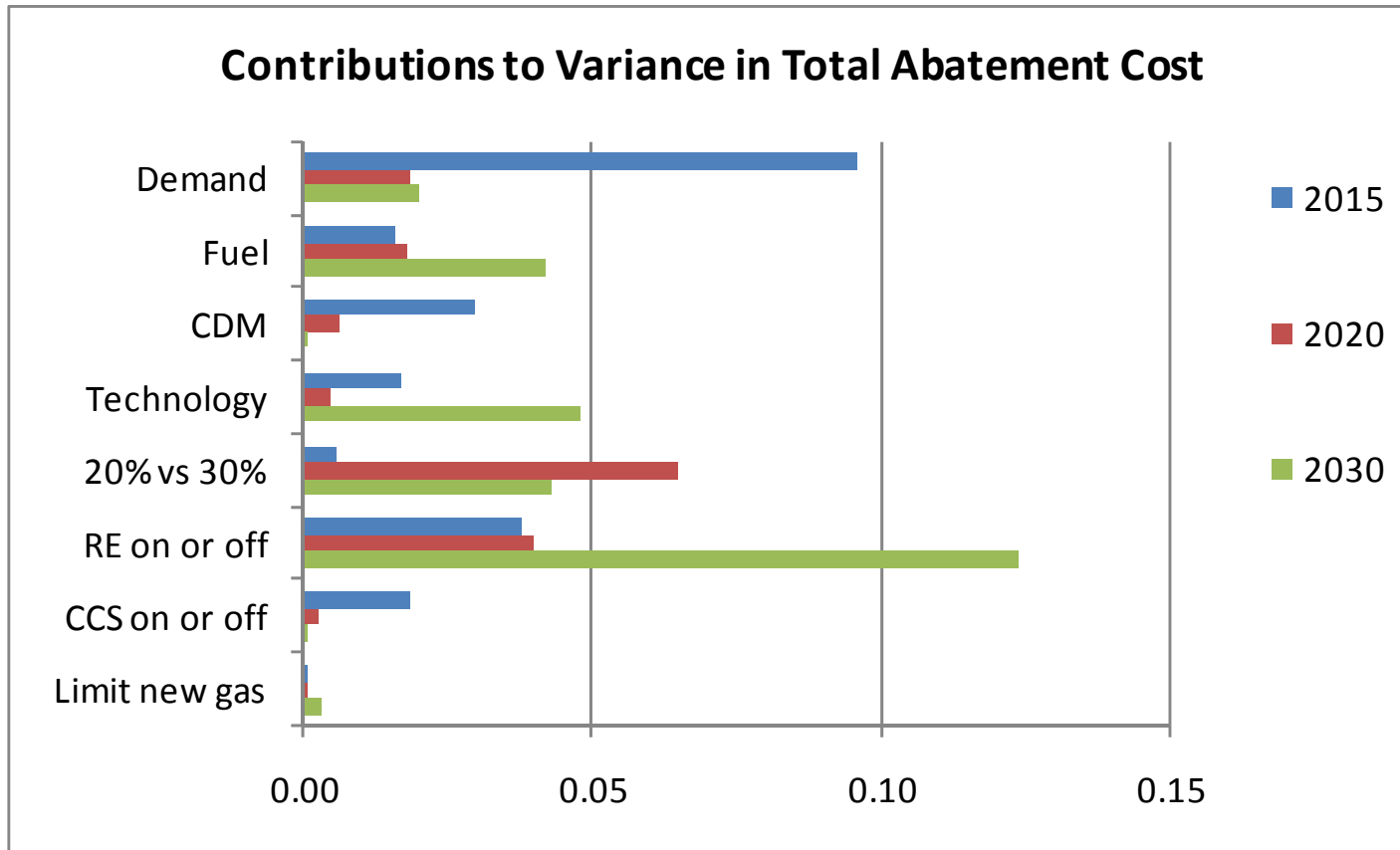
+ CCS demo plant



# Risk Factors: Marginal Cost



# Risk Factors: Total Cost



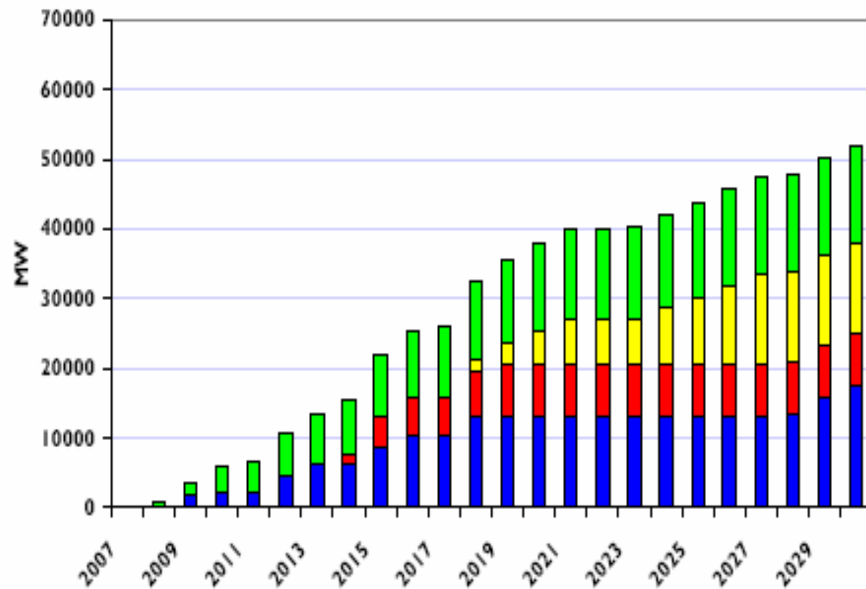
# Modelling Challenges

- Whilst **structural** models of **compliance** requirements in the power and industrial sector are the basis of short term fundamentals, **forward sentiment** appears to be a stronger driver...
- Simple banking models need to discount at a **policy risk premium**
- Abatement curve simulations are **partial equilibria**.
- Short-term econometric models seem to have fluctuating drivers, but carbon policy is all about new **long-term investments**....

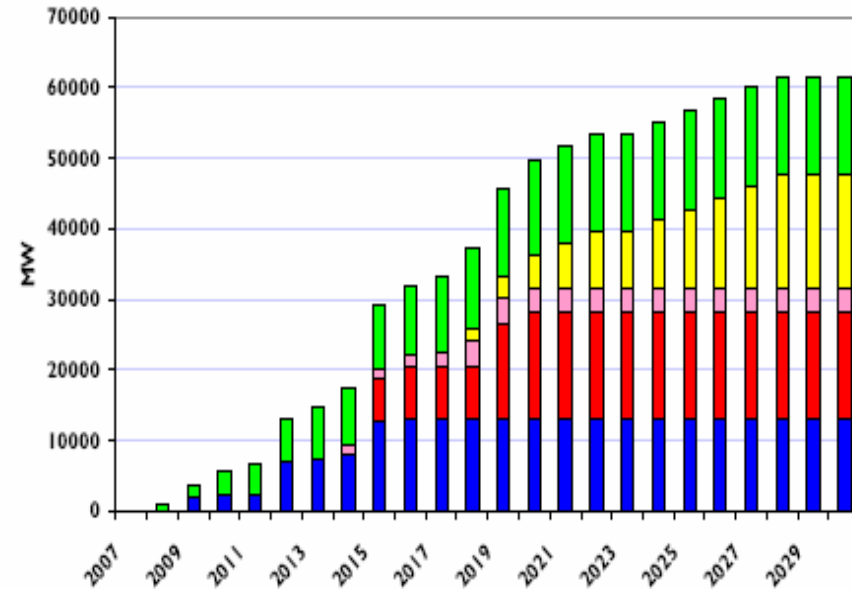
# Policy models suggest enormous new investment in power

Typical of Many, is the Report for UK Government by RedPoint, 2007, on *New Build*

Base Case



Challenging Case

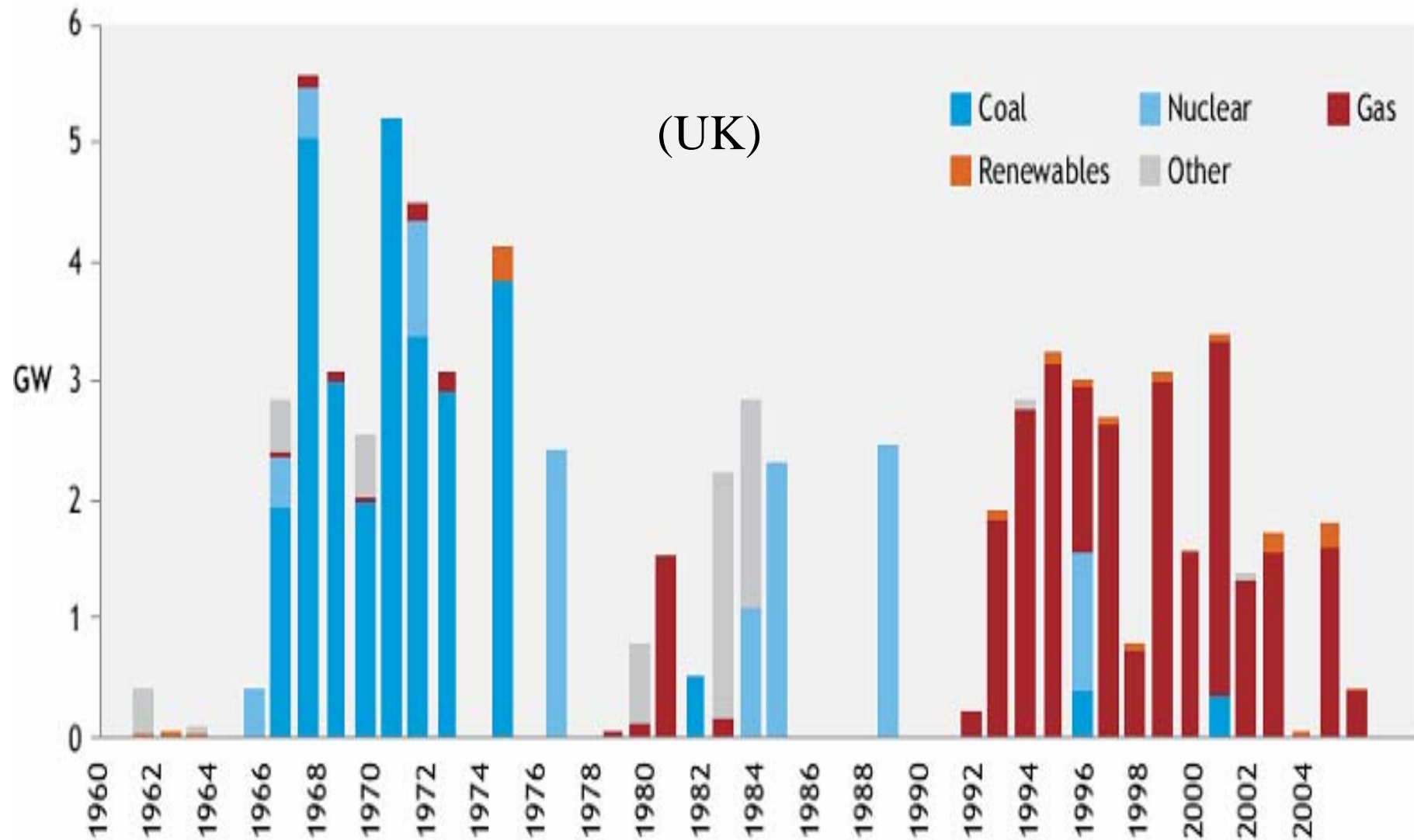


■ CCGT ■ Coal (ASC) ■ Coal (IGCC) ■ Coal (ASC) + CCS ■ Coal (IGCC) + CCS ■ Nuclear ■ OCGT ■ Renewables

*Models tend to project smooth trajectories.....*

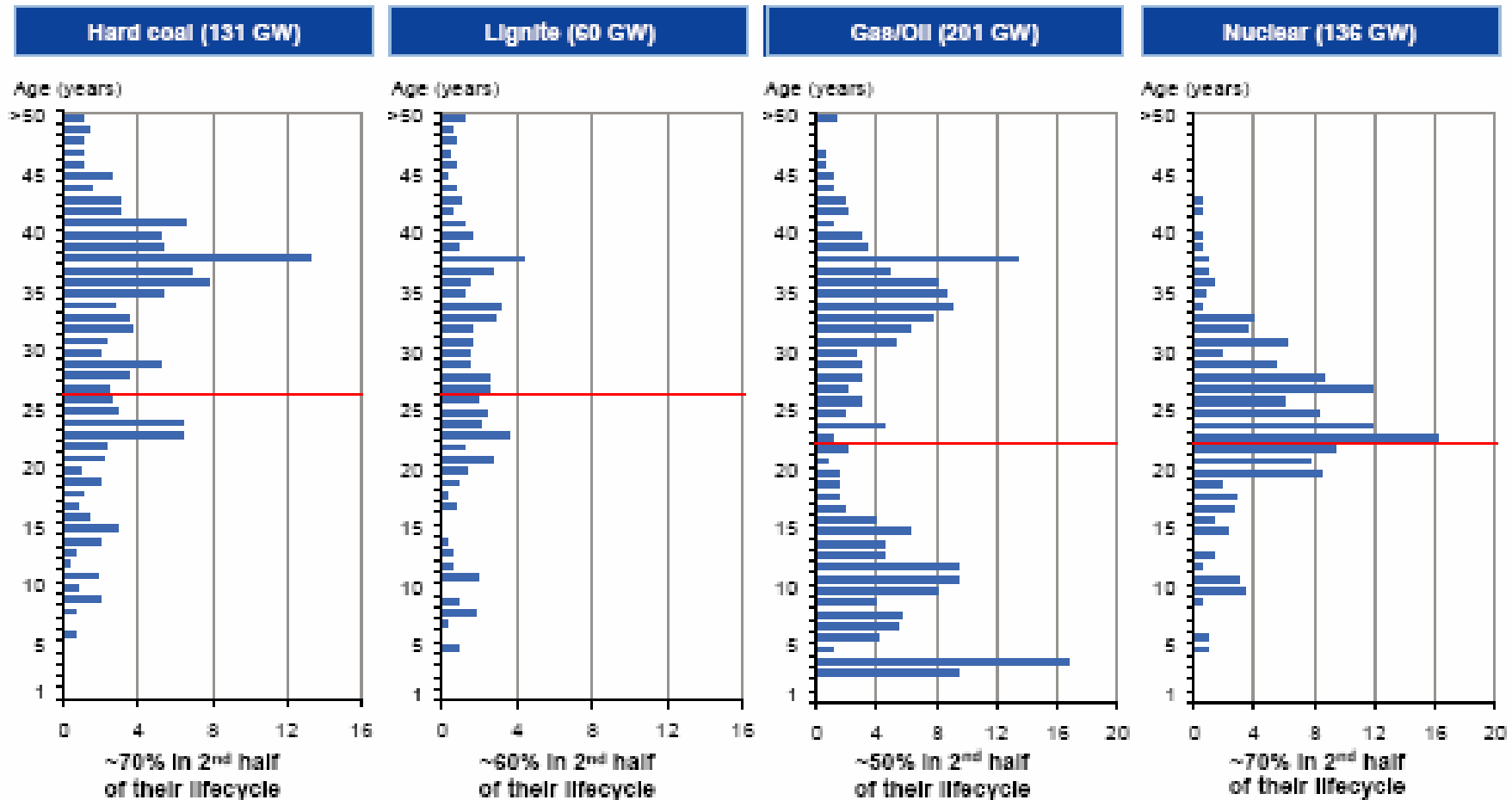


# Power Investment comes in Cycles



# Technology Cycles are evident in the Age Structure

## Age Structure of Power Plants in Europe in 2007



— Half lifetime (typically)

Sources: BCG, RWE.

# Policy Risk and Herding

**Cycles follow from risk aversion and herding,**

**.....and investors in the market are not very obedient to the models**

**Carbon Policy Risk in particular is inducing caution and delay.....**

*“we will not deliver decarbonized electricity without the right signal from carbon prices”*

(CEO of EDF Energy)

*“Shell has threatened to halt investment....as the uncertainty of this [emissions] policy is too high”* (Financial Times, 2008)

*“Regulatory uncertainty is delaying our work on biomass conversions of coal plant”*

(CEO of Drax Power, 2010)

To the extent at the UK Energy Minister noted the need, in 2010, "... **to unlock investment**“

**Government Policy also seeks Diversity, but why should investors choose Differently?**

# *How does Policy Risk Affect the Market?*

How does carbon policy uncertainty impact on the investment propensity of companies? *Does the extra risk threaten security by inducing delays?*

What are the effects of the carbon policy risk on the evolution of market structure? *Will it further consolidate the power of the large incumbents?*

How does carbon policy risk influence the technology mix? *Is there some path-dependency in technology introduction?*

*And would all this feedback to policy risk?*

# Decision-Making

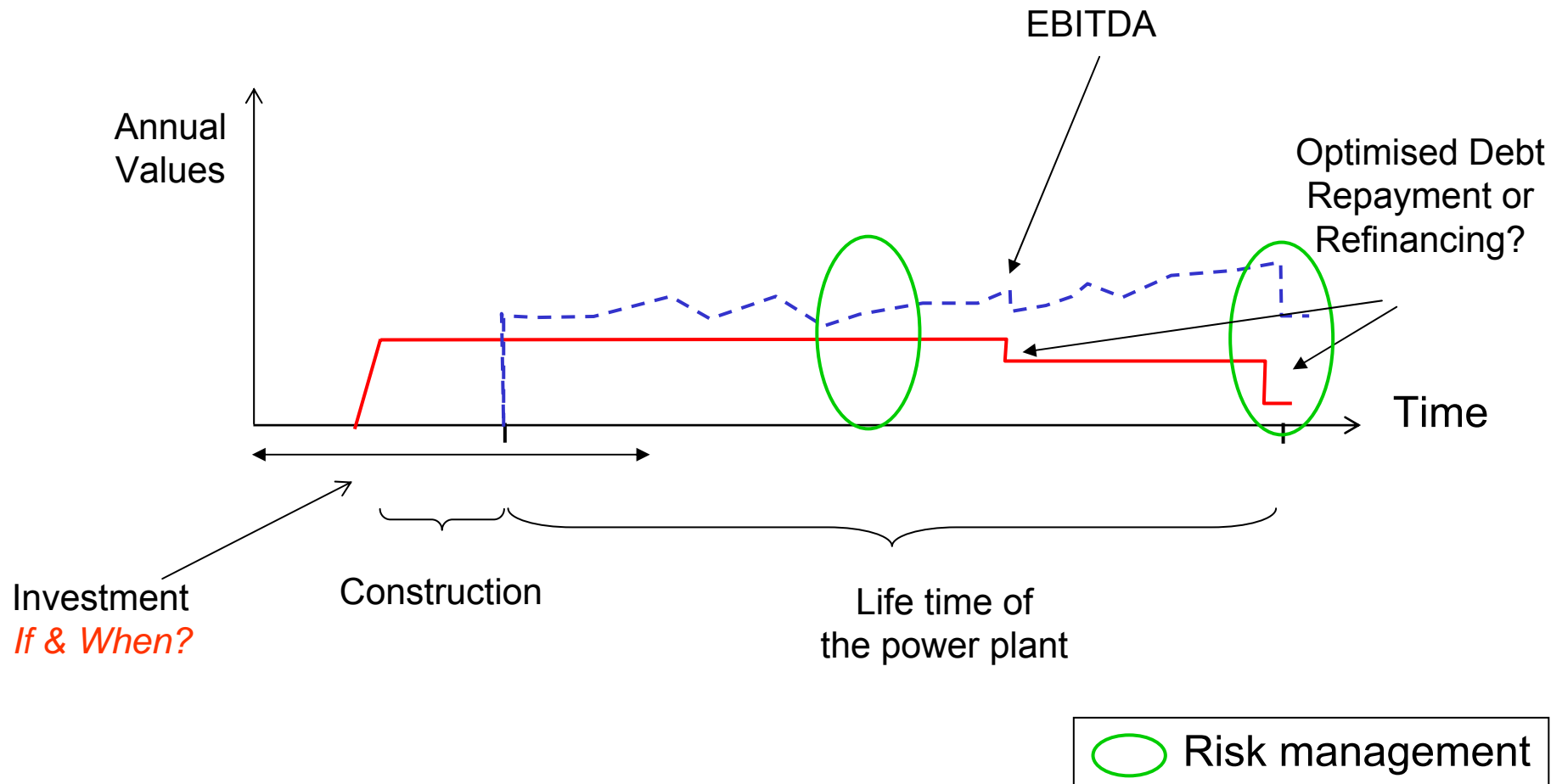
A **Risk Neutral** Company will look for a positive **NPV** and may **delay** investment if the expected cost of delay is less than the **option** of waiting.

- We consider tax, depreciation, optimised debt repayments in NPV

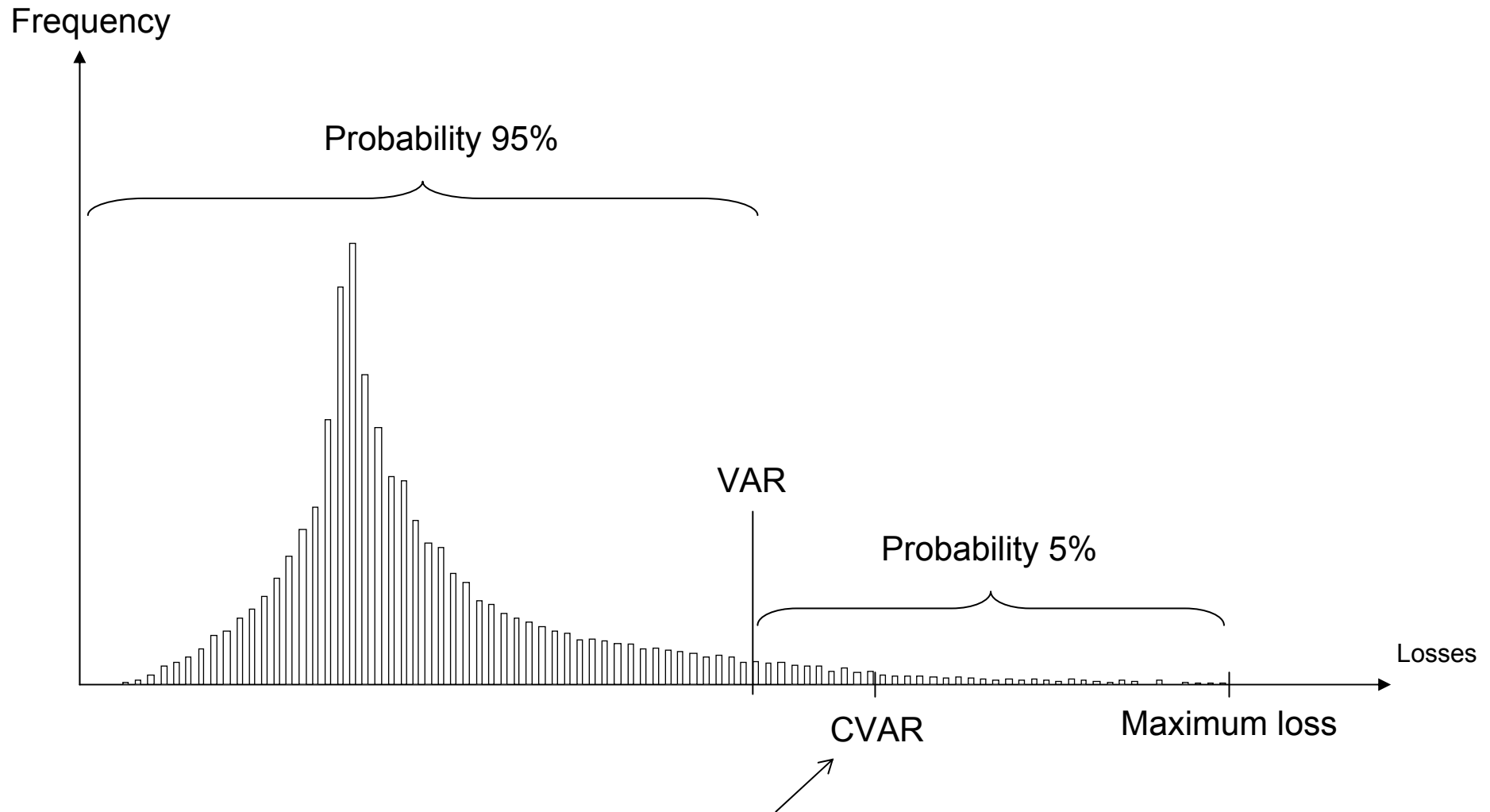
A **Risk Averse** Company will also look at the risk of **financial underperformance** over the investment horizon

*Would pro-competitive policies seek to close the gap between the risk averse and risk neutral behaviours?*

# Financial Investment Model under Uncertainty



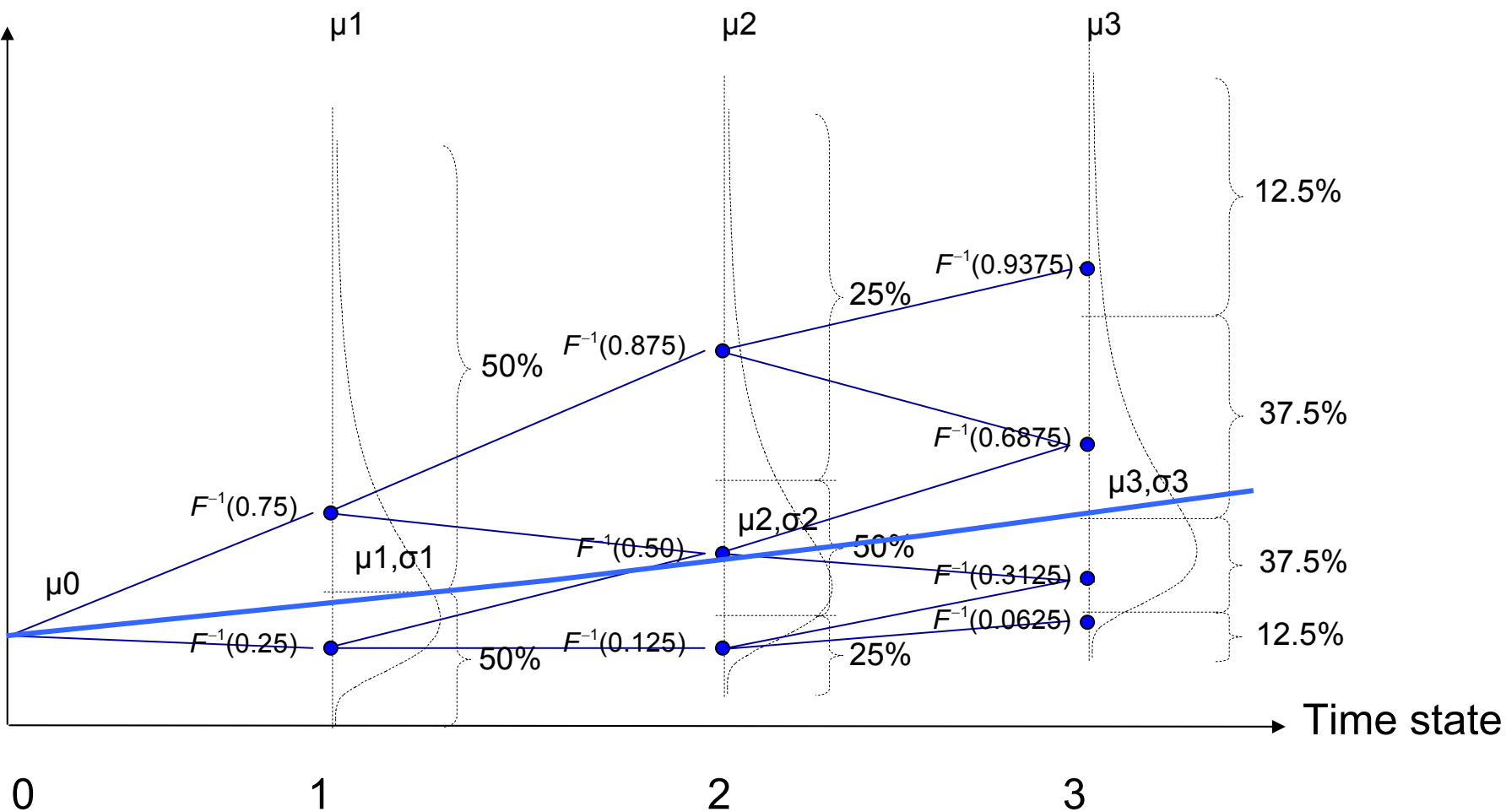
# Risk Measures: Value at Risk (VAR) and Conditional Value at Risk (CVAR)



At the 95% level: CVAR is the weighted average loss in the worst 5% of the scenarios

# Revenue & Cost Scenarios

Cash Flow

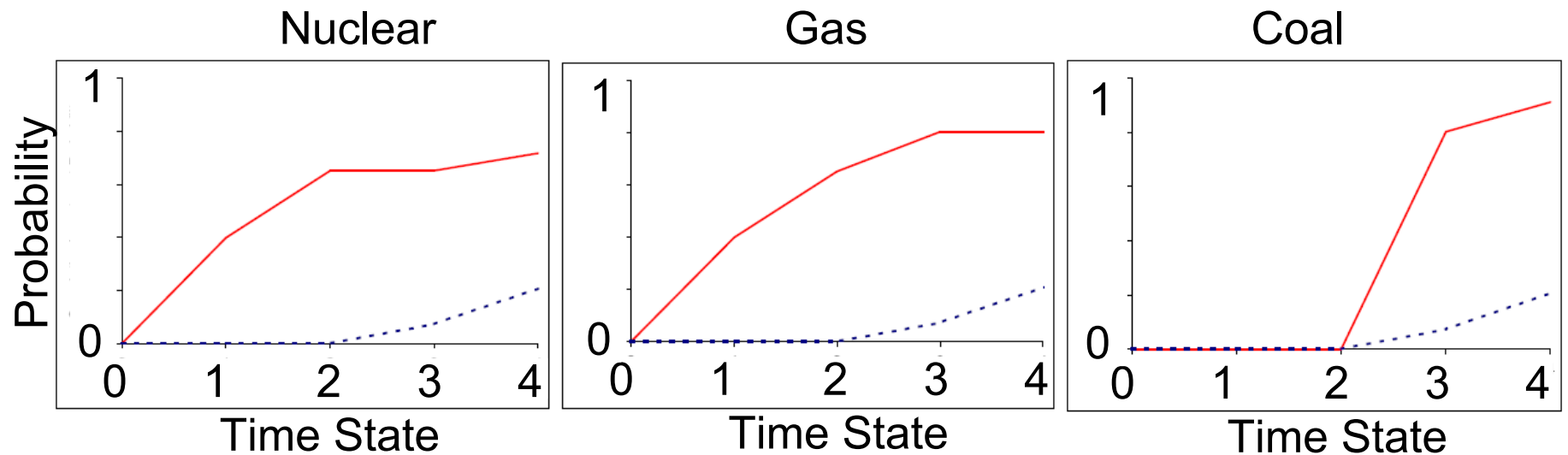




# Comparison of Different Investment Models

	Nuclear		Coal		Gas	
	NPV	ROCE	NPV	ROCE	NPV	ROCE
Conventional	-304	-20%	-168	-24%	-66	-19%
Uncertainty included	-245	-16%	-84	-12%	20	6%
Uncertainty and real options included	91	38%	123	73%	120	102%
Uncertainty, real options, and financial details included	349	54%	249	91%	197	131%

# Results: Base Case



— risk neutral investor  
- - - risk averse investor

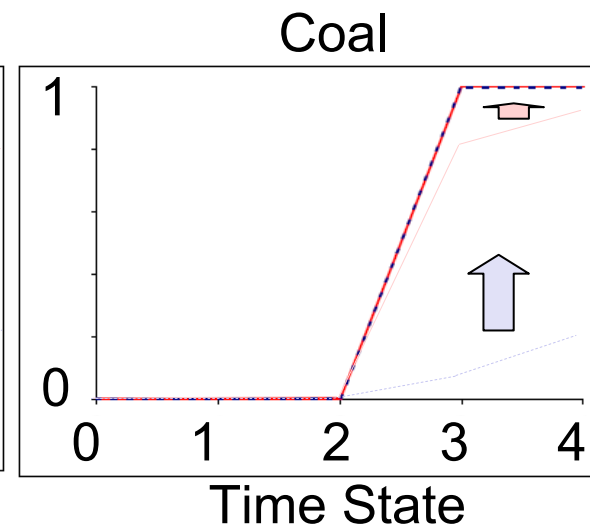
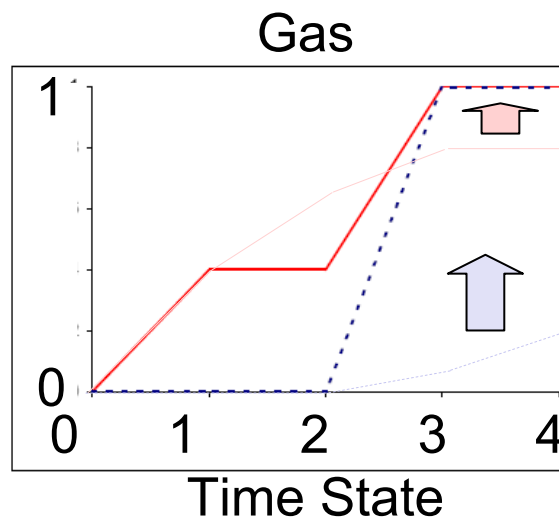
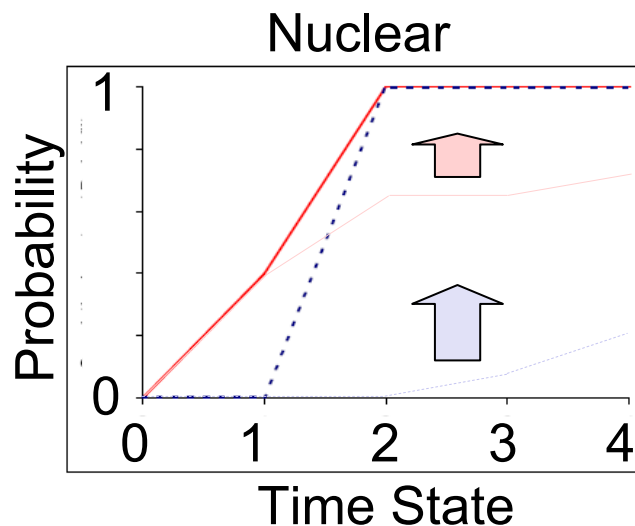
# Floors favour investment

Floor decreases the spread between the investment probability of the risk neutral and risk averse investor

Confirmed

Floor encourages investments in inframarginal technologies

Confirmed

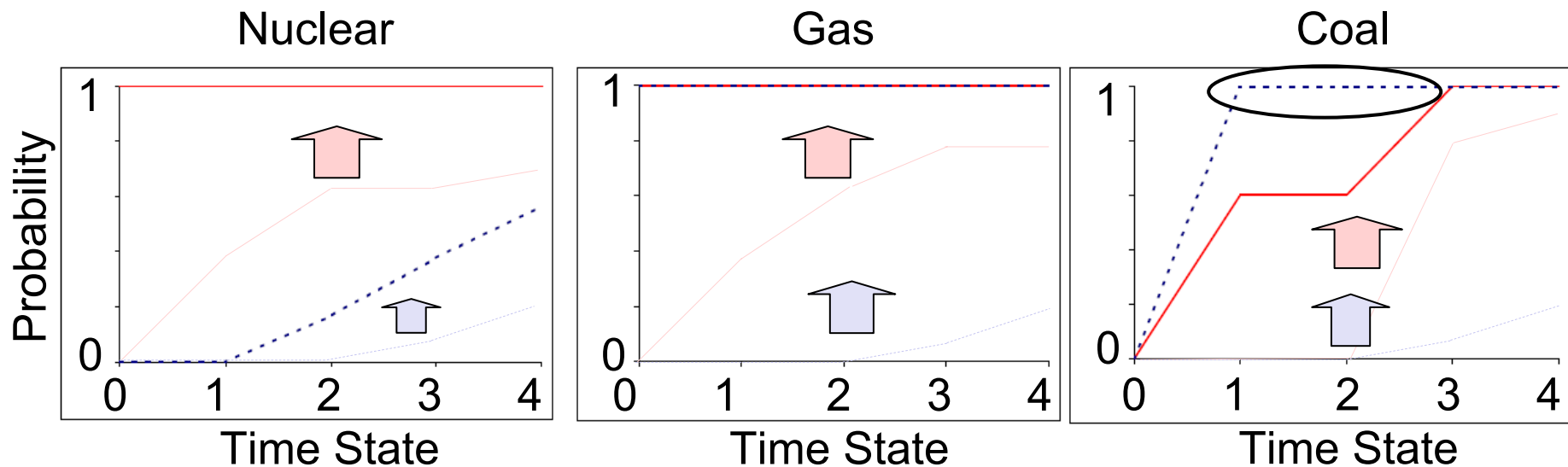


— risk neutral investor  
- - - risk averse investor

# More Profitable Energy Markets encourage the risk averse

More (less) profitable electricity market encourages (discourages) investments

Confirmed

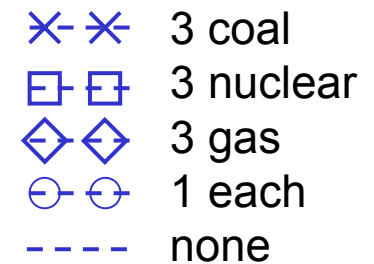
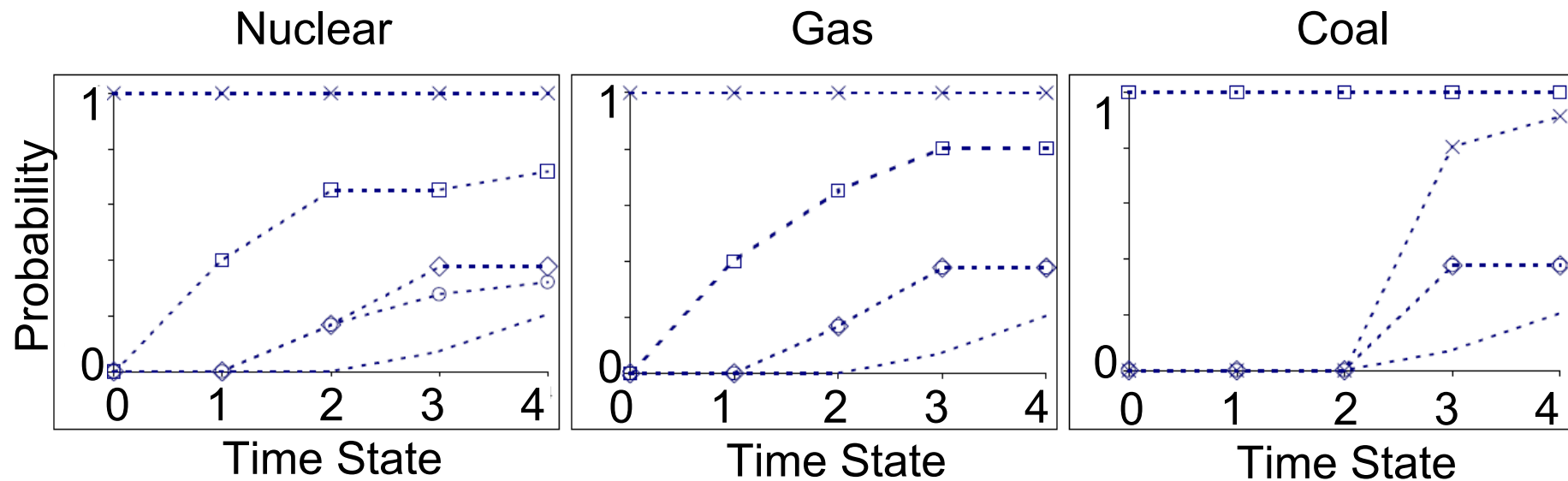


— risk neutral investor  
- - - risk averse investor

# But Pre-Existing portfolios create Path-dependencies....

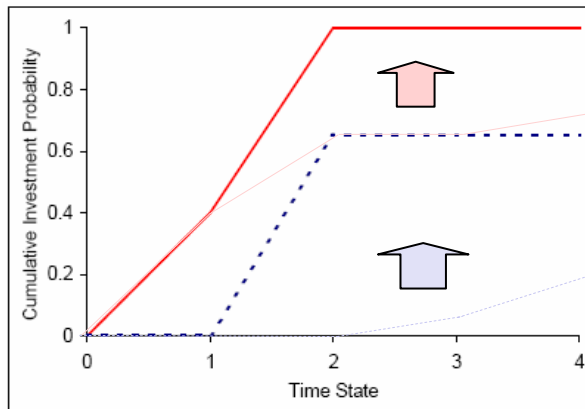
Existing portfolio encourages risk averse investments

Confirmed

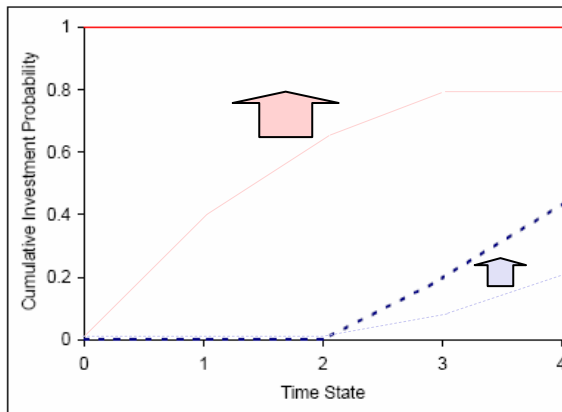


# Faster Adoption of Carbon Capture and Storage helps all technologies

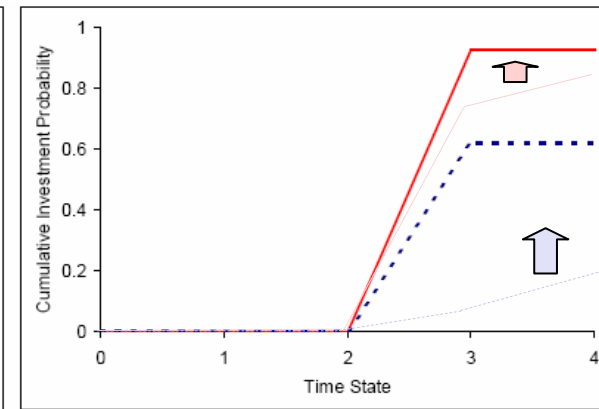
Nuclear



Gas



Coal



# Some Observations

- Carbon Prices
  - Adaptive mixture of compliance fundamentals, economic sentiment and discounting of policy risk
- Modeling Investment:
  - Financial details, real options, and uncertainties make significant difference
  - Pre-existing portfolios suggest path dependent investments
- Economic:
  - The effects of carbon policies and market instruments depend on the characteristics of the companies
  - Policy Risk results in more concentrated and less competitive market
- Behavioral:
  - Risk averse investor may sometimes invest before risk neutral investor (eg, if power market is very profitable and opportunity cost of capital is low, or if things are expected to get worse!)

## *Electricity Markets are now at a Delicate Balance of Liberalisation and Re-Regulation*

- Policy intent to ensure security and sustainability have a complex interaction with market liberalisation.
- If policy risk adds substantially to market risk, the market may become characterised by larger players with more co-ordinated activities.
- The nature of regulation may become more delicate and confusing.