



# Targets, prices and other policy instruments

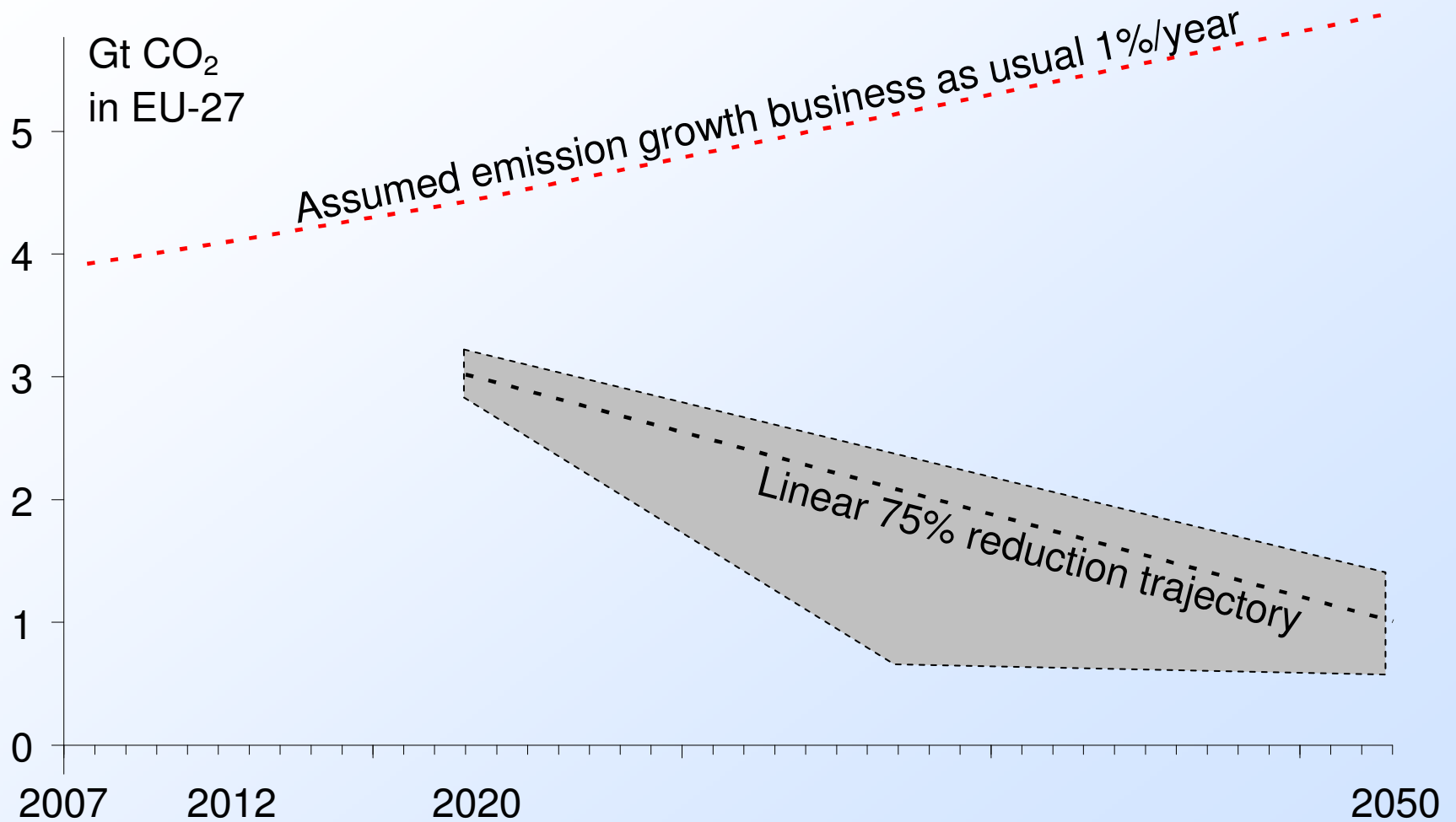
Electricity Policy Research Group  
Winter Seminar 2007

Karsten Neuhoff  
Cambridge University

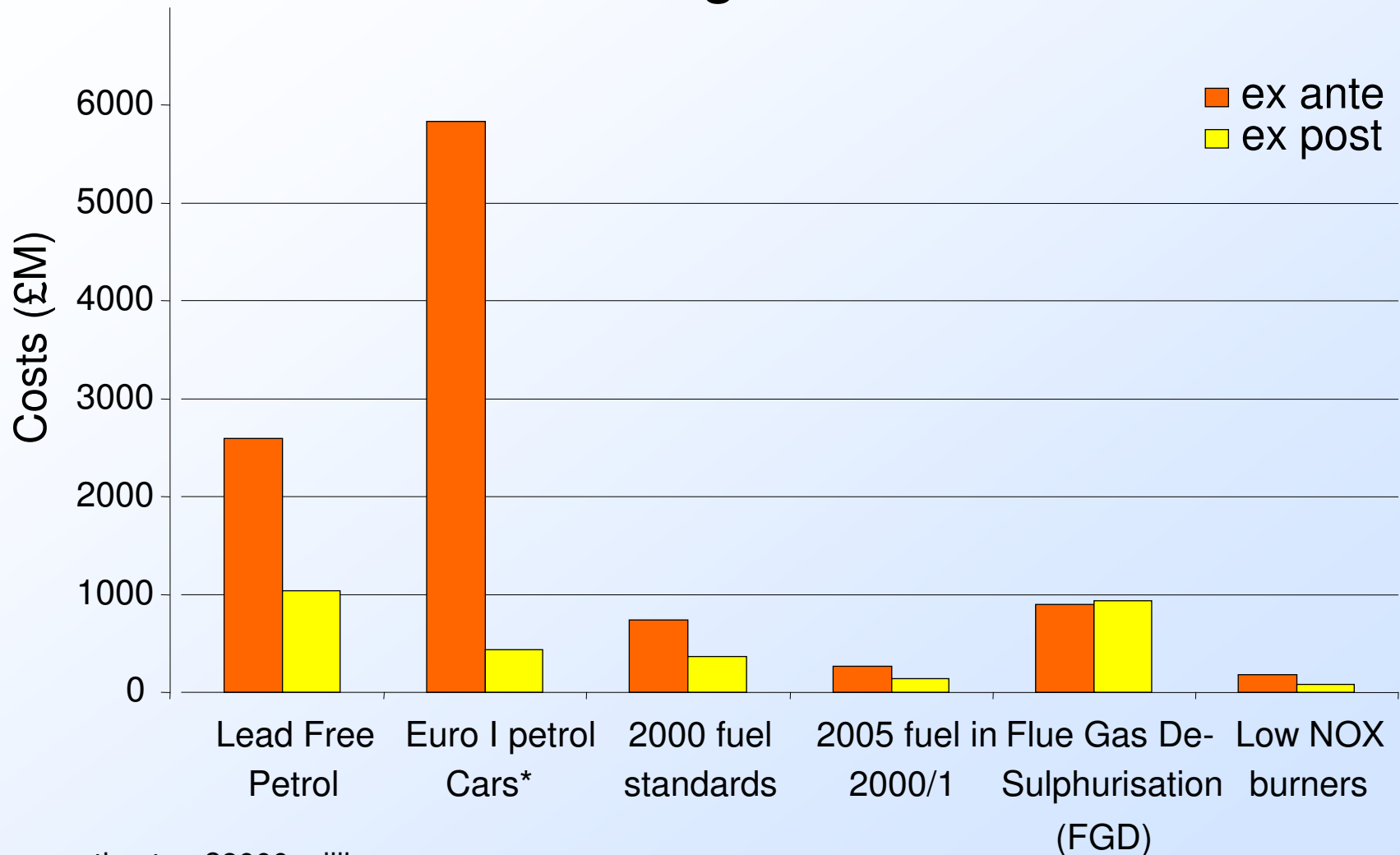
[www.electricitypolicy.org.uk/tsec/2](http://www.electricitypolicy.org.uk/tsec/2)

EPSRC

# The challenge for the energy transition



# Expected (Ex Ante) and Actual (Ex Post) Total Costs of some UK Policies during 1990-2001



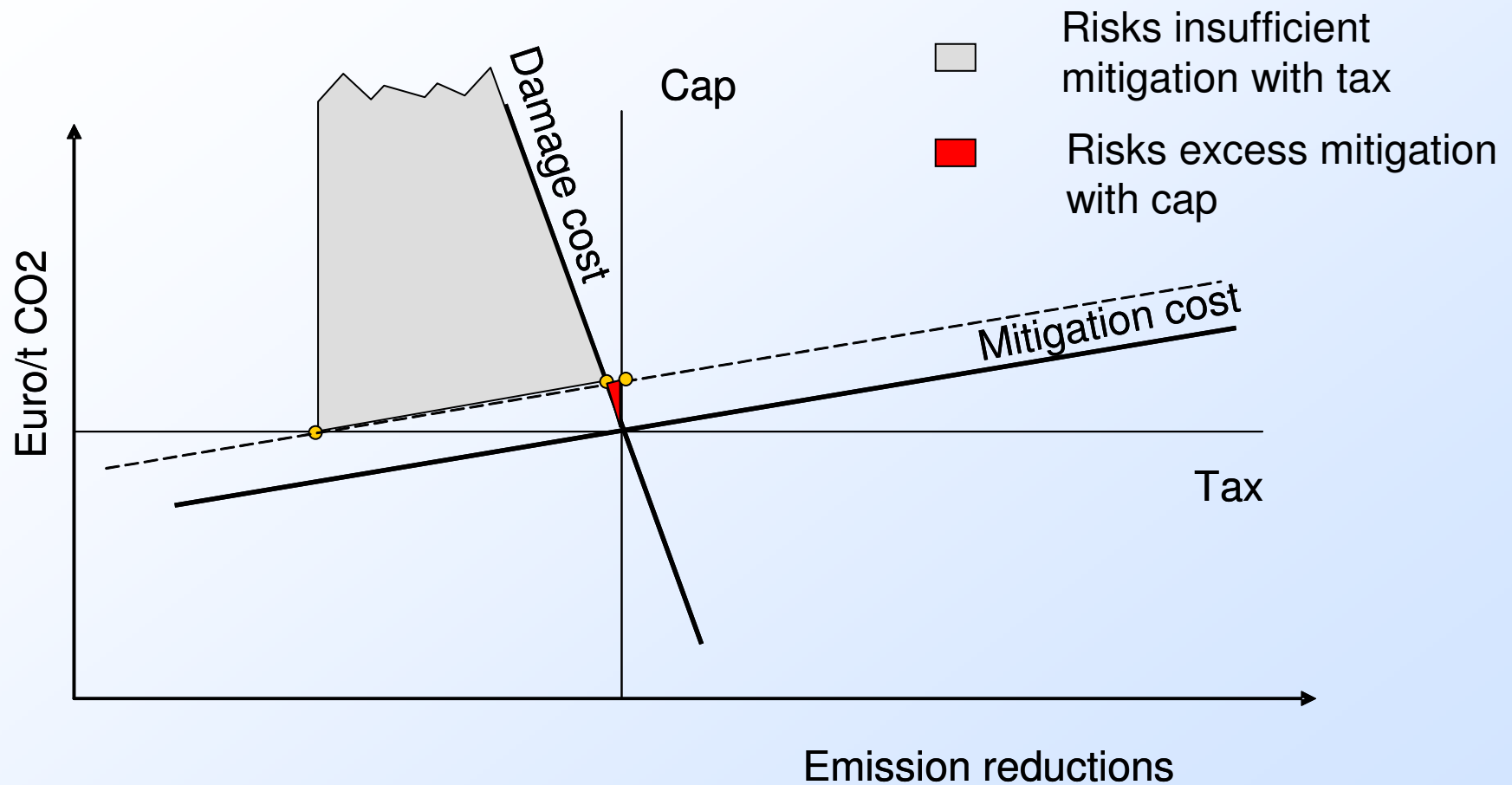
\* Upper estimate >£8000 million.

Source: AEA Technology Environment, 2005, An Evaluation of the Air Quality Strategy, Report to DEFRA, available at: <http://www.defra.gov.uk/>

# Targets, prices and other policy instruments

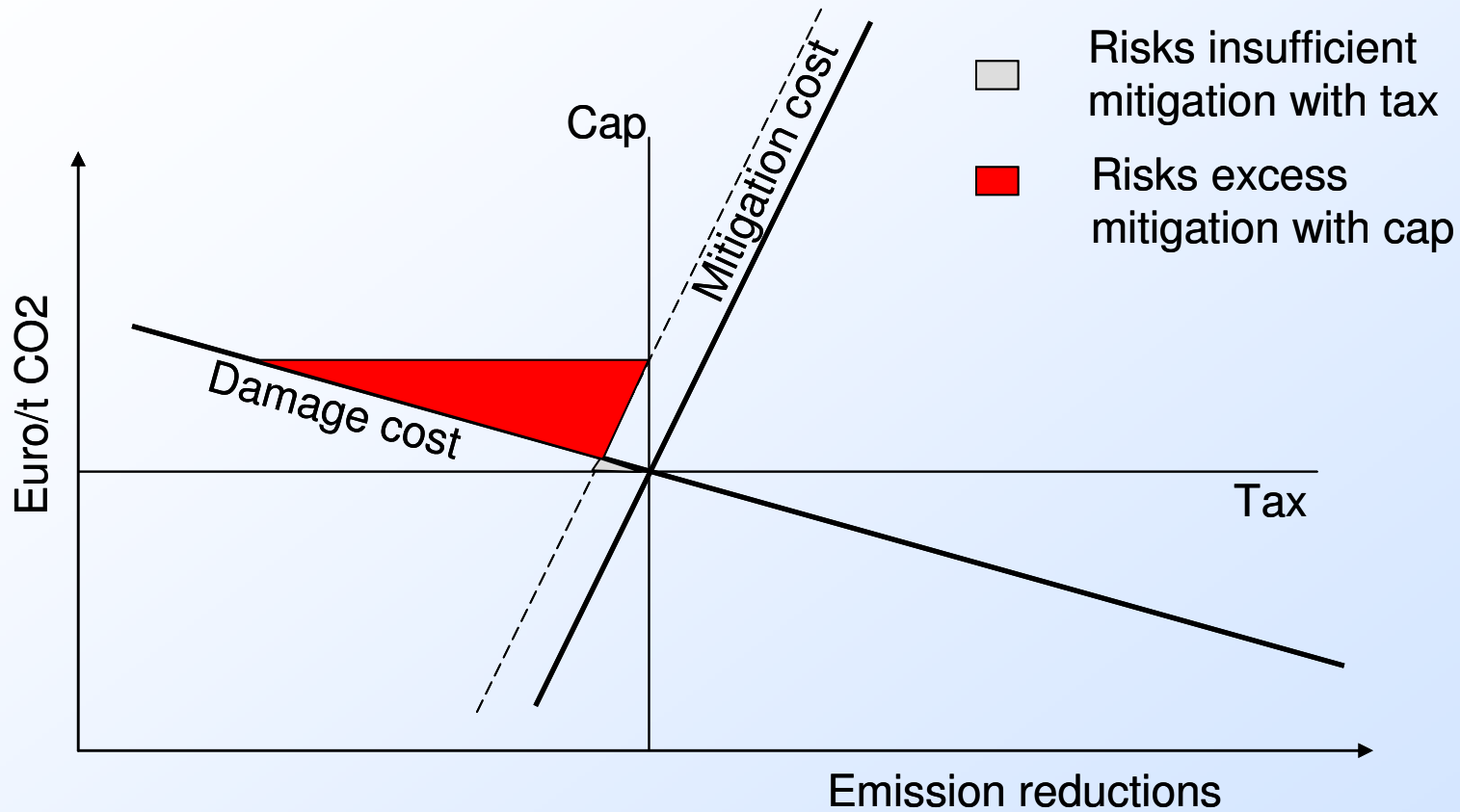
- Weitzman's least cost approach
- And now with real investors
- Did we forget new technologies?
- Well, and the role of government
- How to match all of this up?

# The basics of Weitzman



With certainty taxes and cap-and-trade are equivalent  
 If mitigation cost curve flat (relative to damage) -> use cap

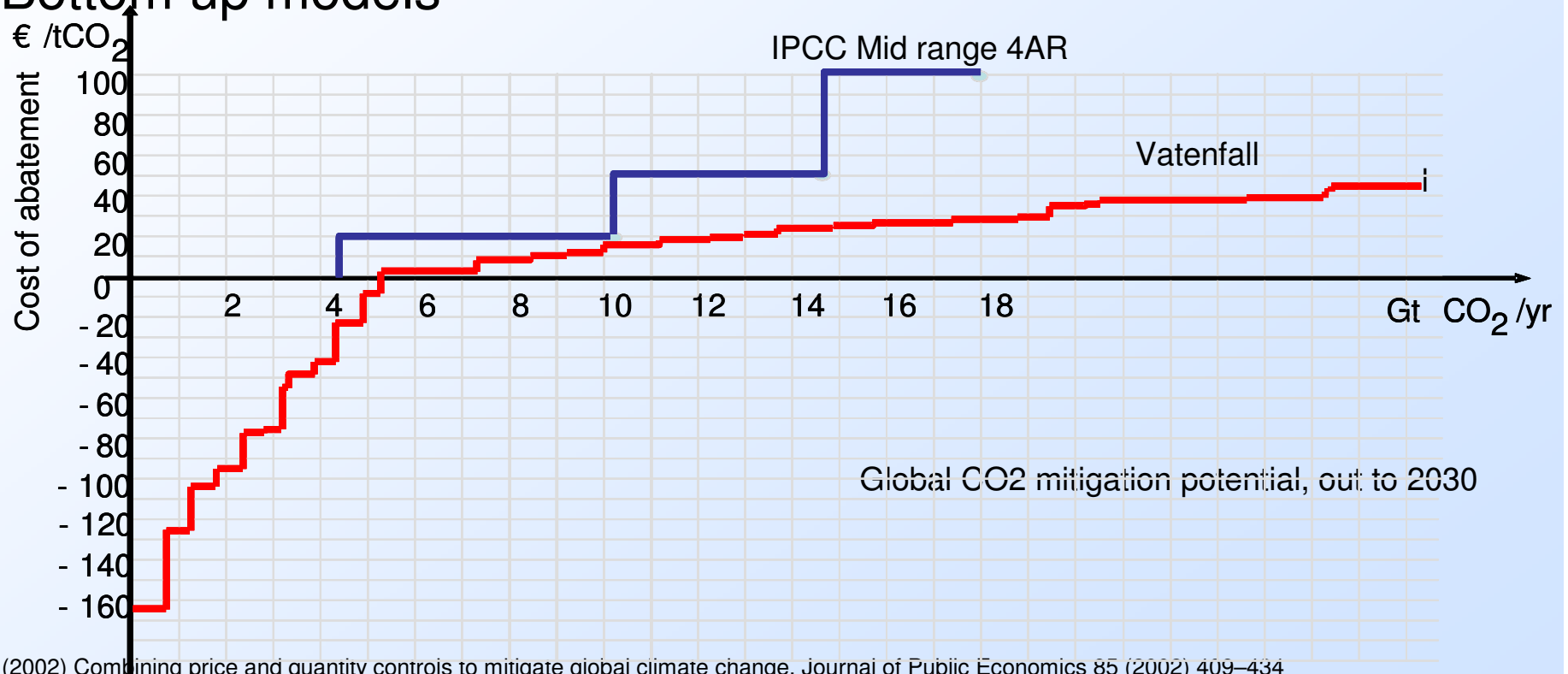
# Weitzman II – if mitigation cost curve is steep



If mitigation cost curve steep (relative to damage) -> use tax

## So what is the shape of the mitigation cost curve

- Top down economic models (e.g. CGEM)
  - Cost increases with (mitigation effort)<sup>2.9</sup> \*
  - With endogenous technology change, mitigation cost lower\*\*
- Bottom up models



\*Pizer (2002) Combining price and quantity controls to mitigate global climate change, Journal of Public Economics 85 (2002) 409–434

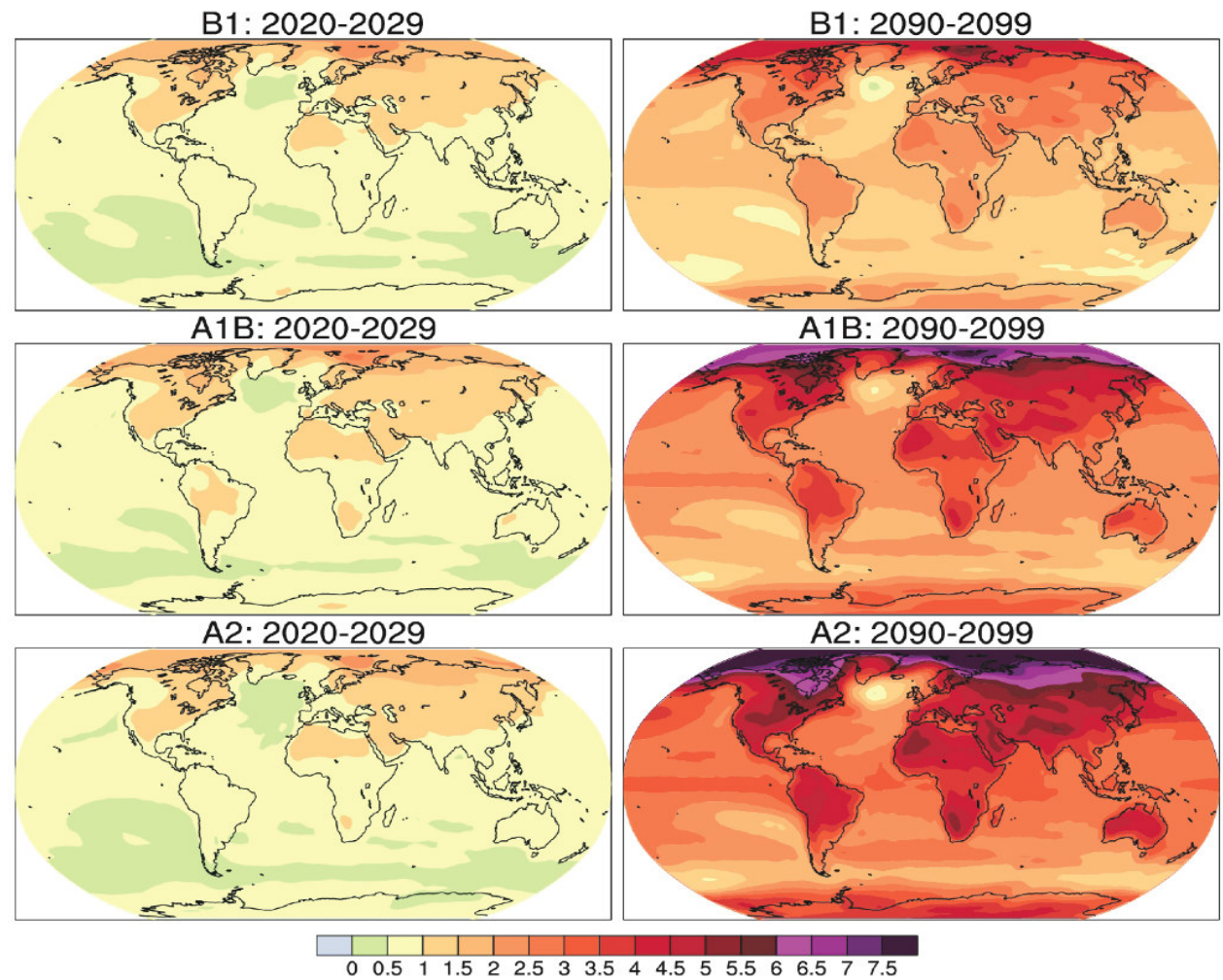
\*\*Edenhofer, O., Carraro, C., Köhler, J. and M. Grubb (2006). Induced Technological Change: Exploring its Implications for the Economics of Atmospheric Stabilization. Energy Journal, Special issue, p. 57-122.

# Well –who dares to quantify the damage of climate change?

Projected warming in 21st century expected to be

greatest over land and at most high northern latitudes

and least over the Southern Ocean and parts of the North Atlantic Ocean





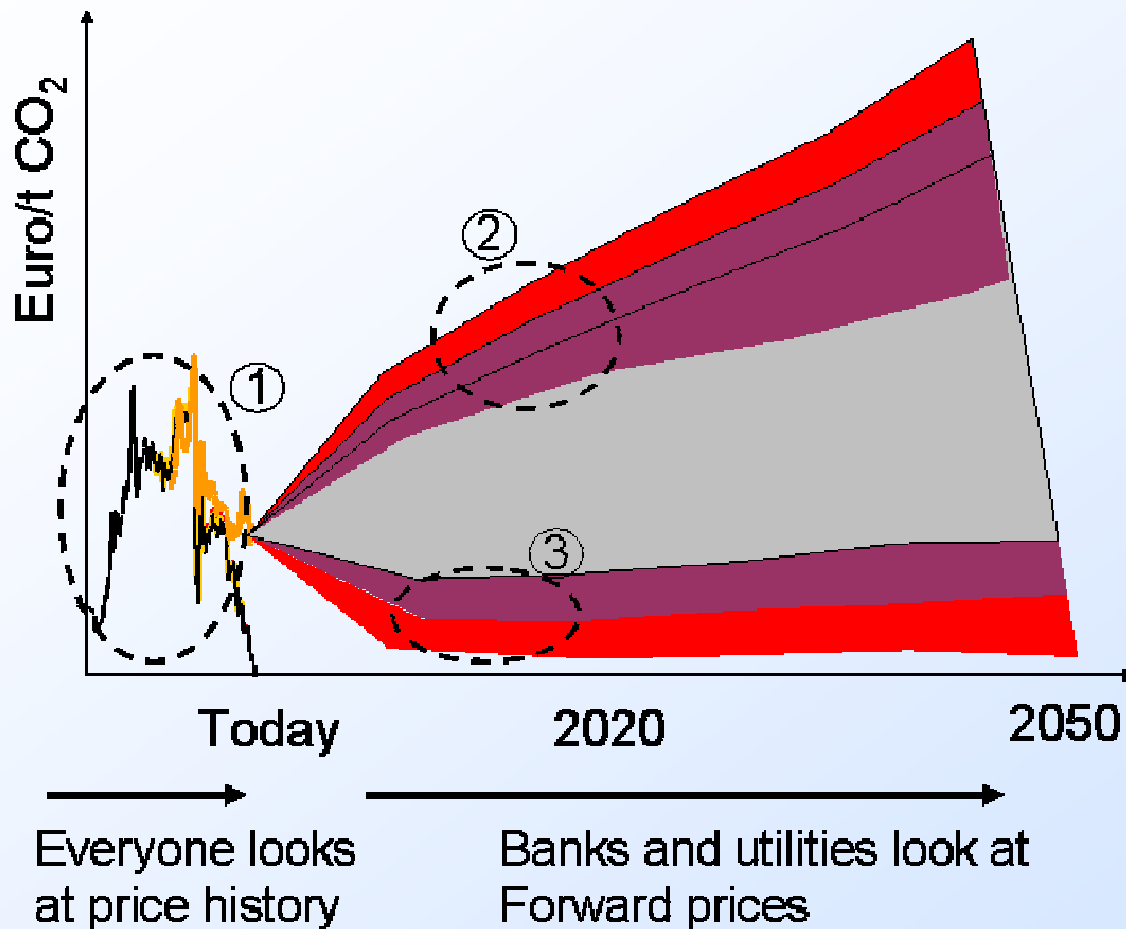
## Conclusion Weitzman

- In the short-term
  - MAC curve steep / some time flexibility on abatement
- In the long-term
  - MAC curve flatter due to technical change
  - Level of MAC curve difficult to judge

	Weitzman		
Short-term	Prices		
Longer-term	Cap-and trade		

# Investor's perspective – financing projects

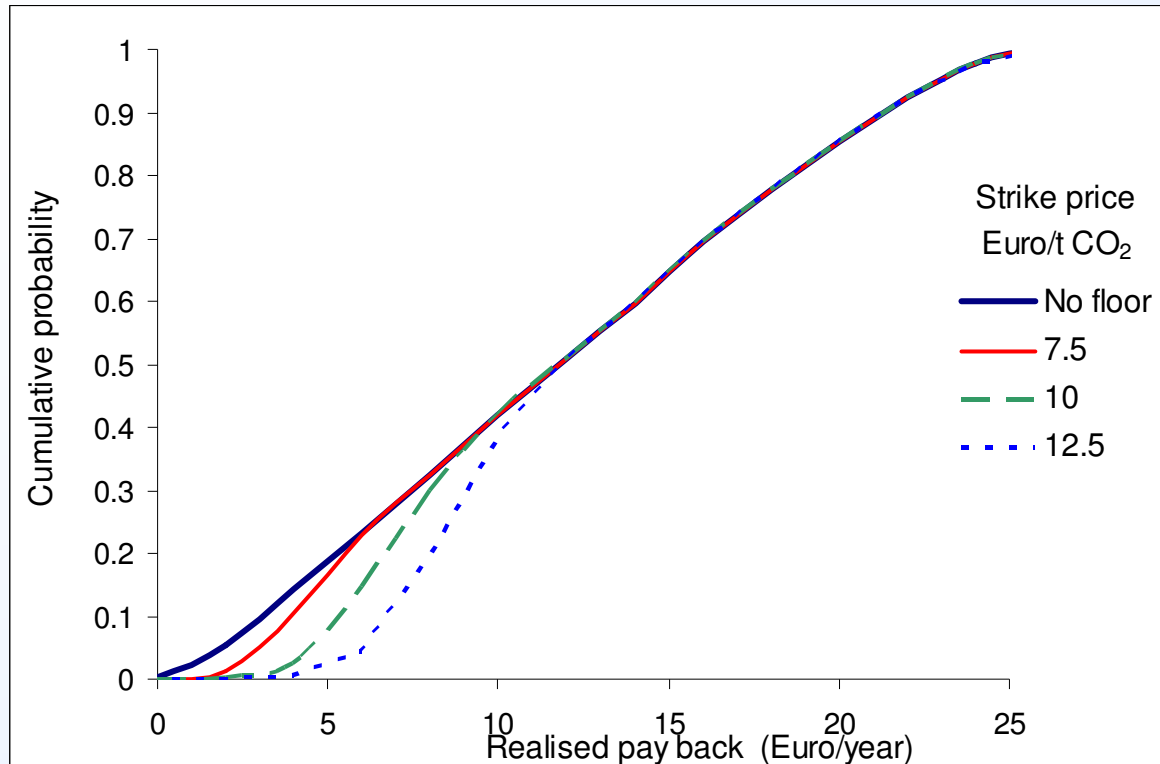
*Illustrative*



1. Short and not representative history
2. Downside risk for high Carbon assets main obstacle for coal investment
3. Difficult to quantify downside risk for low Carbon investments

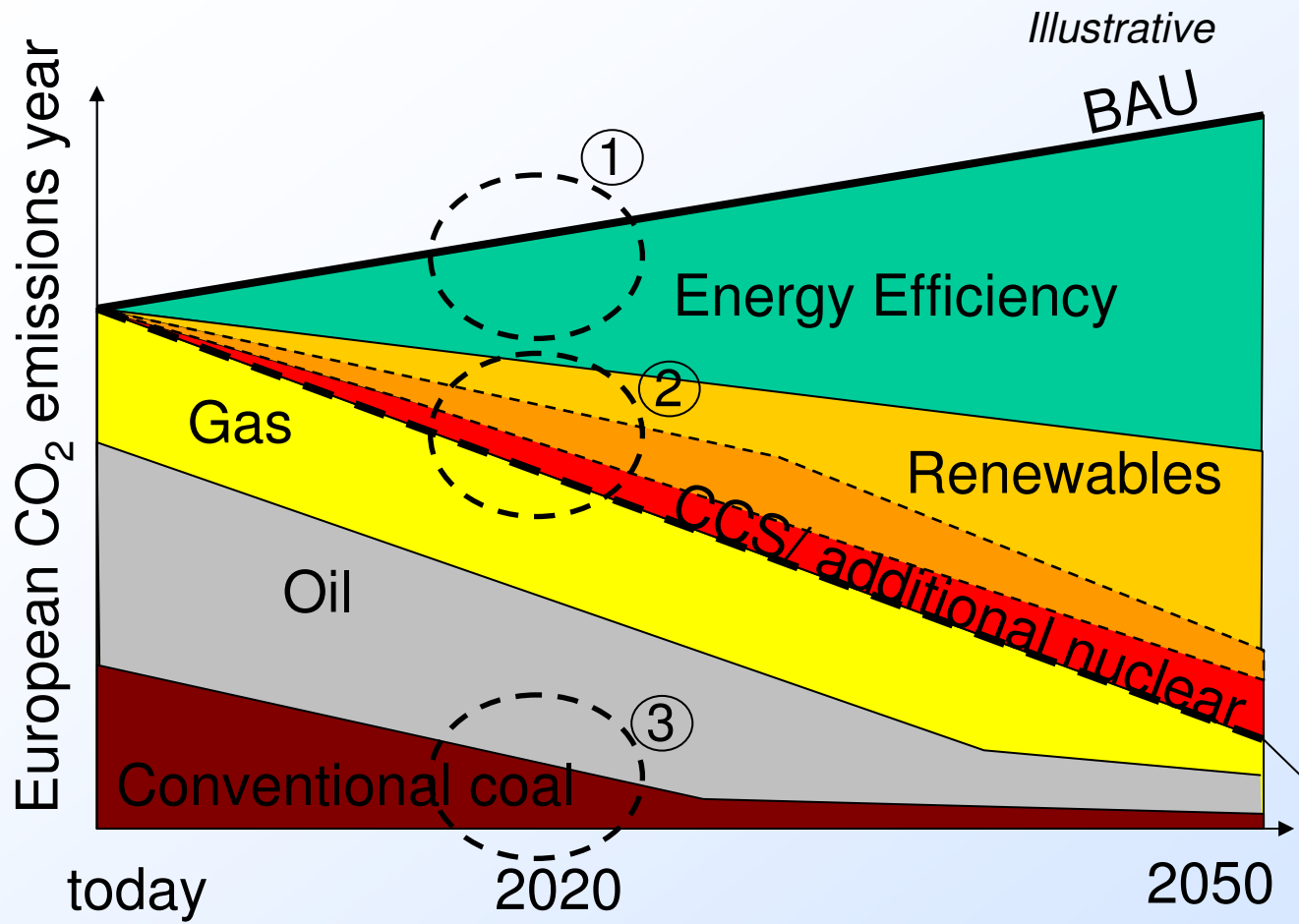
# Impact of project and CO<sub>2</sub> price uncertainty on payback

Assume CDM project financed by CER revenues



- EU ETS price uniform distributed 5-30 Euro/t CO<sub>2</sub>
- Assuming 0, 7.5, 10, 12.5 Euro/t CO<sub>2</sub> price floor
- Investment cost 40.1 Euro, Operation costs 0-4 Euro/year (uniform)
- Delivery risk 20% only 85% delivery, 10% only 70% delivery,
- CERs receive 85% of EU ETS price, delivering 2008-2012

# Investors' perspective – strategic choices



What could European investors deduce from emission target?

1. Early role of energy efficiency
2. Long-term role for renewables, but no time frame
3. Phasing out of conventional coal

Emission target

... but in survey (June 2007) limited importance attributed to emission targets

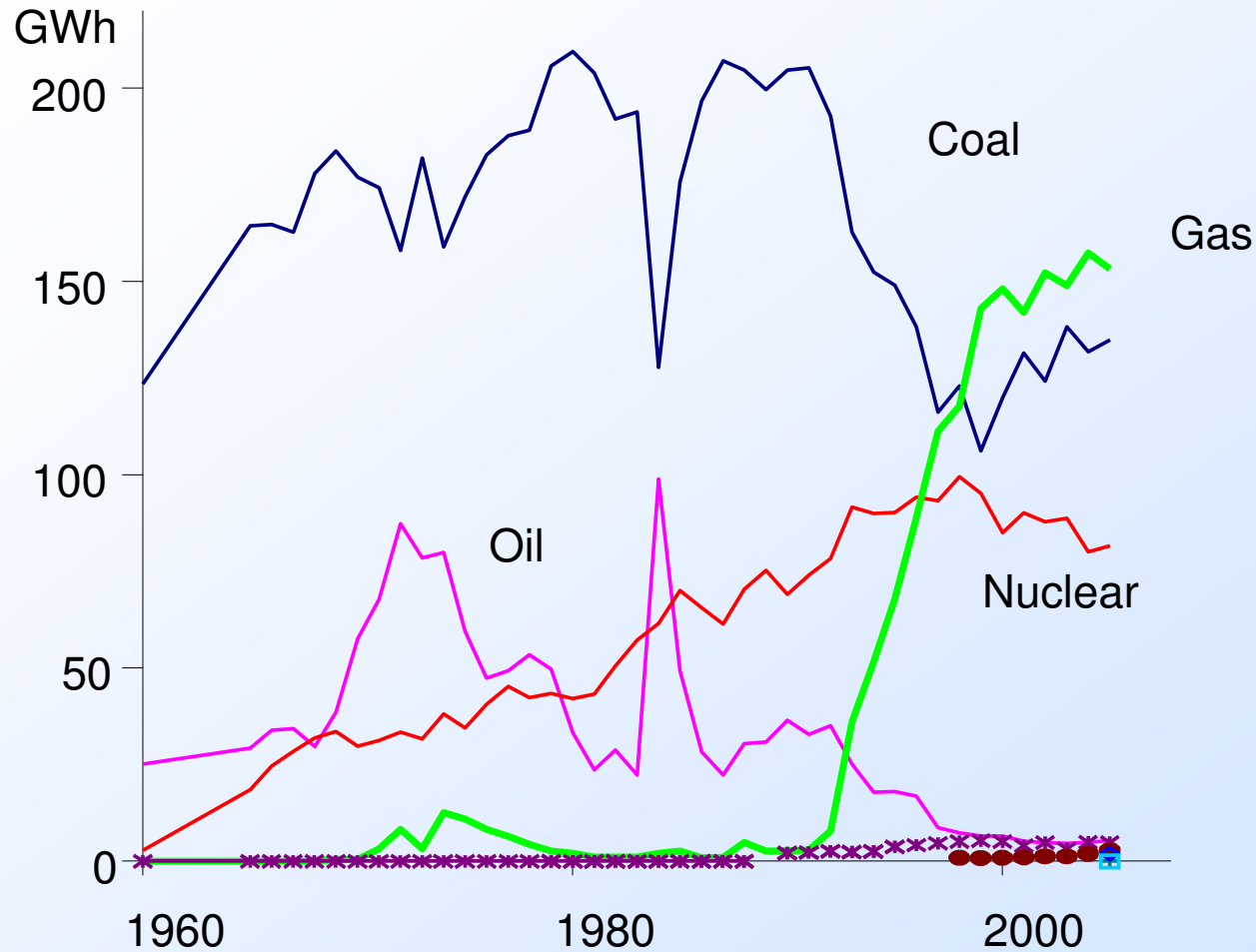
# Investment perspective differs across sectors

Summary from investors survey

	Oil majors	Technology companies	Large utility companies	Banks, Project investment
Historic prices			Replication of successful strategies	Required to calculate volatility
Current price	Determine operation	Short-term production	Perceive best guide for future	Main input for base case
Future price	Difficult to predict	Difficult to predict	Valuable where available	Value long-term contracts
Future market share of fuel/technology	Main driver for strategic choices	Main driver for strategic choices	Sometimes in modelling	

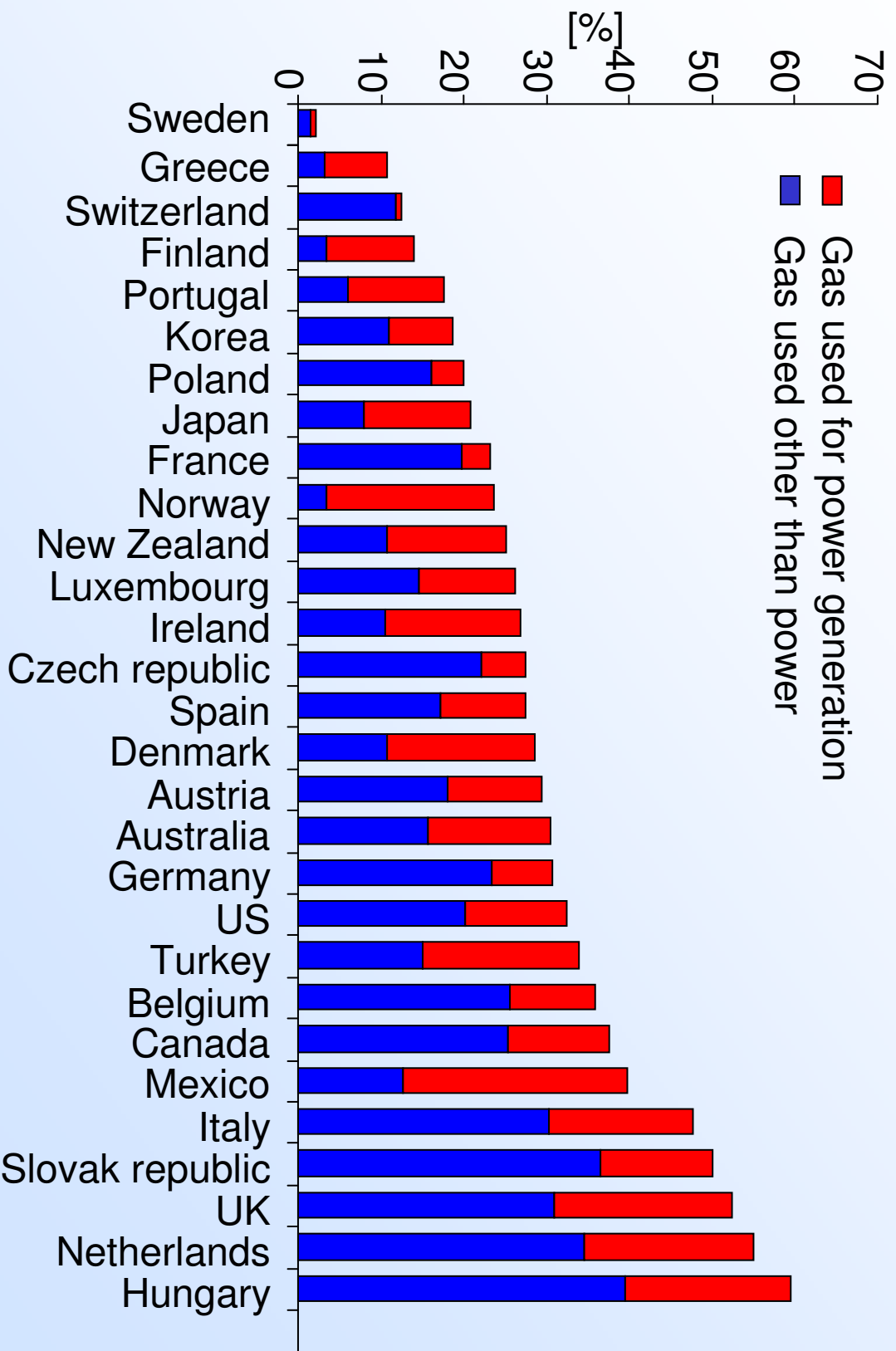
# With the right framework, markets can deliver rapid change

Evolution of generation shares in the UK



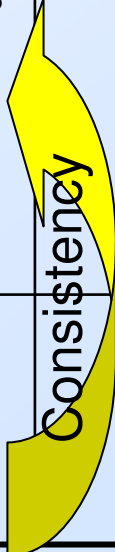
Source: 1960-1997 DTI Energy statistics, Fuel consumption for power generation, transformed to output using 1998 average efficiencies, 1998-2005 DTI Energy statistics, Power generated, Projections based on Survey among participants on Future generation technologies workshop (asking for demand evolution and generation shares), Cambridge 2003

# Share of gas in domestic primary energy consumption



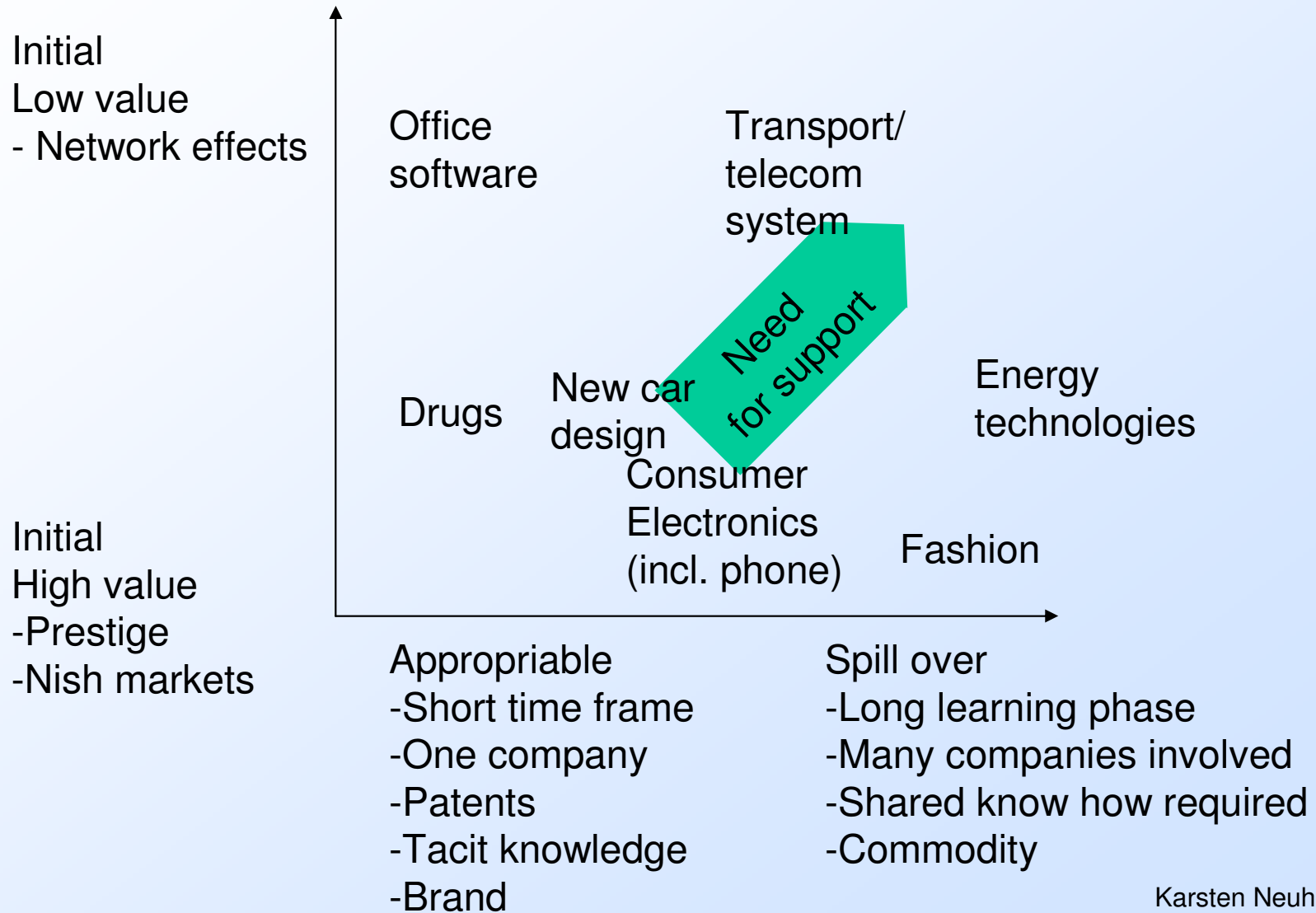
## Conclusion Investors

- In the short-term
  - Avoiding risk of low Carbon price facilitates financing
- In the long-term
  - Focus on market shares of technology/fuel

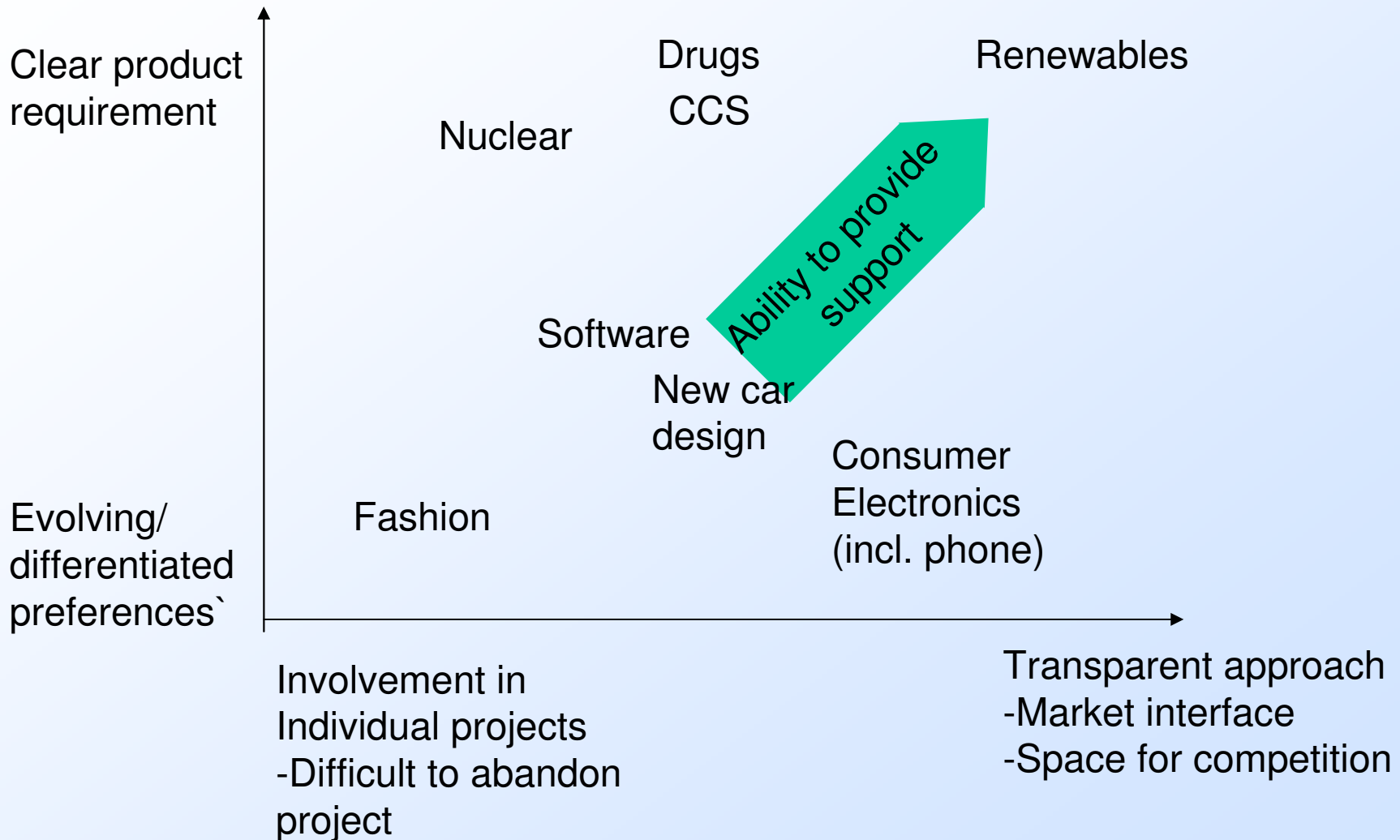
	Weitzman	Investors	
Short-term	Prices	Address risk of low prices	
Longer-term	Cap-and trade	Targets	



# Need for technology specific support



# Ability of government to manage technology



## Conclusions: Technology

- Tailor approach for sectors/technology
- Confidence in future role increases credibility of today's policy

	Weitzman	Investors	Technology
Short-term	Prices	Address risk of low prices	Carbon pricing + strategic deployment
Longer-term	Cap-and trade	Targets	Targets

## The role of government

- Renewables
    - Planning, Grid access, expansion, management
  - Housing
    - Regulation, standards, land use
  - Efficiency
    - Information, standards, institutional arrangements
  - Transport sector
    - Coordination with urban planning, network effects
- > transition to low Carbon requires active government

## Implications for policy instrument

- Pro-active government on many dimension required
- Usually facing inertia/incumbents/vested interests
- Similarity to government budget negotiations

## What can we learn from there?

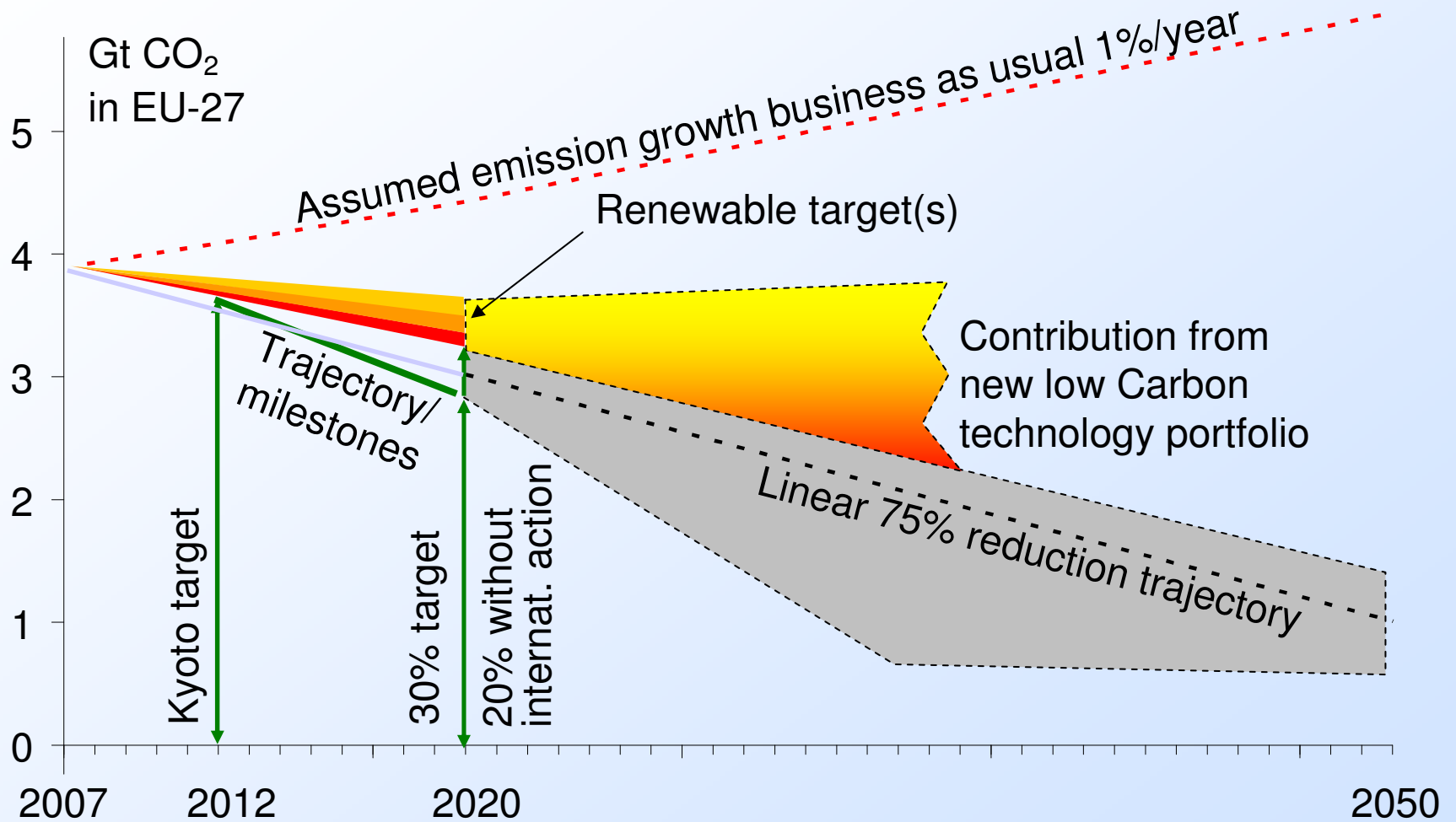
- Allocate responsibility for emission reductions to be delivered domestically
- Measure frequently to allow effective carbon management
  - Break targets down to key sectors
  - Use early indicators for inert investment response

## Conclusion Government

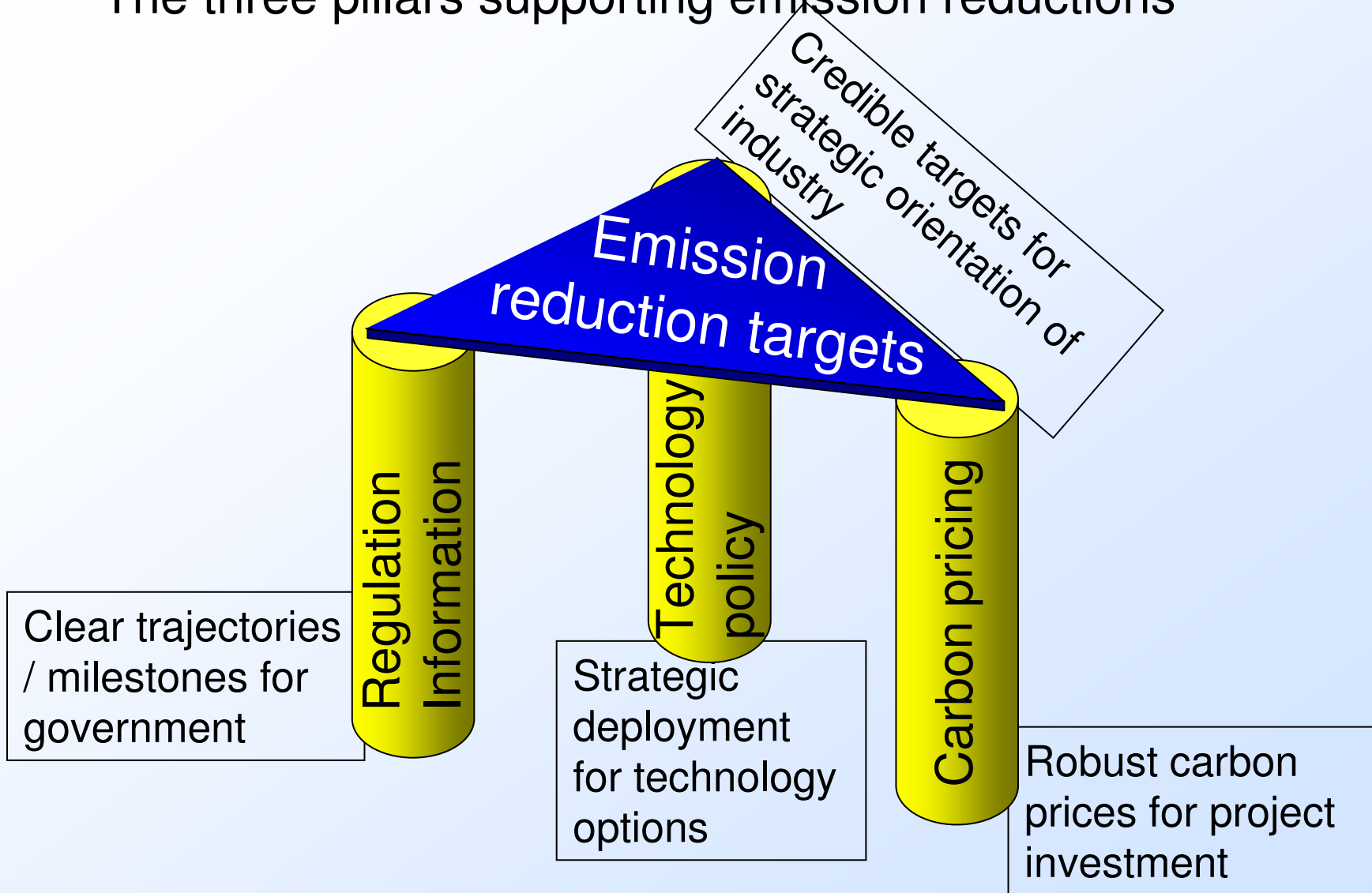
- Tailor approach for sectors/technology
- Confidence in future role increases credibility of today's policy

	Weitzman	Investors	Technology	Government
Short-term	Prices	Address risk of low prices	Carbon pricing + strategic deployment	Milestones/trajectories & Lead indicators
Longer-term	Cap-and trade	Targets	Targets	Targets

# The instrument mix to fill the gap

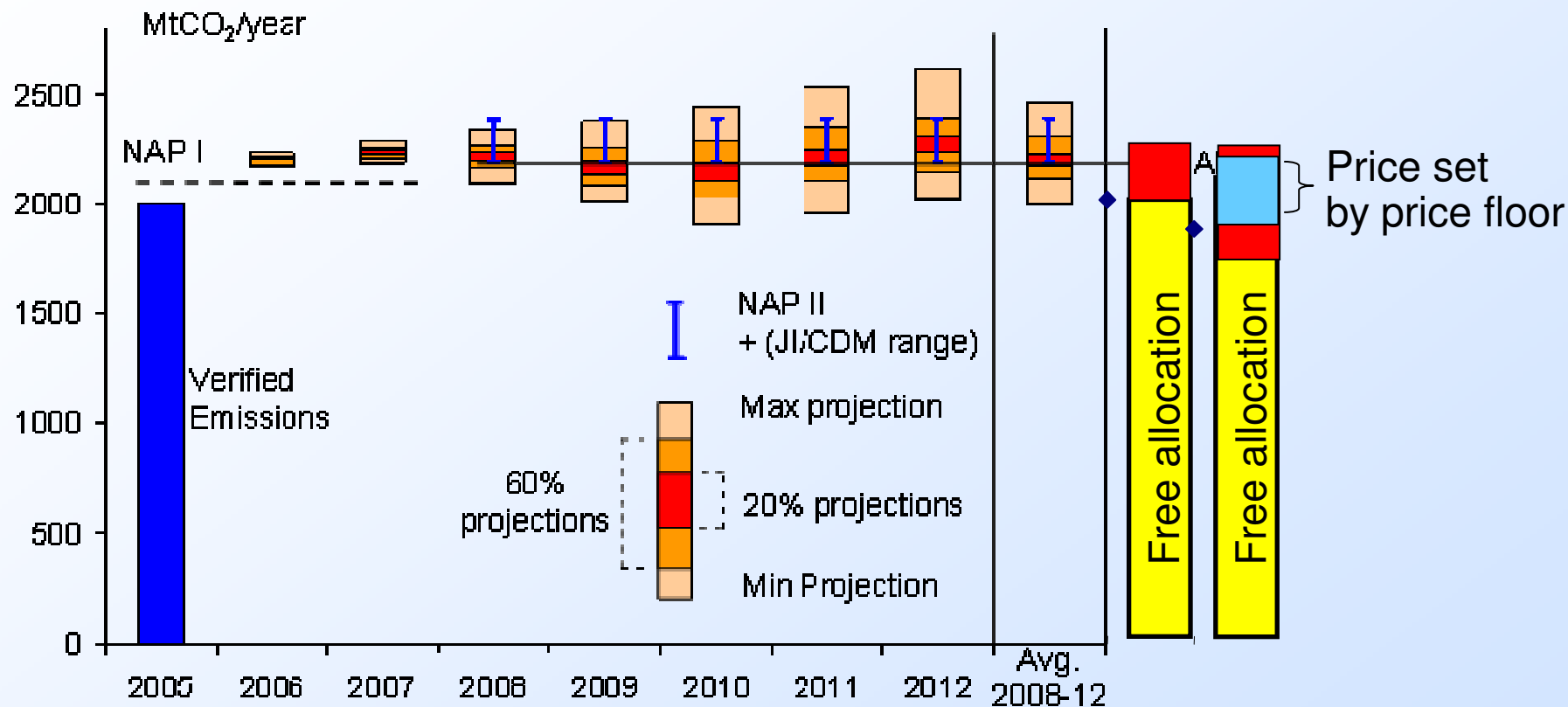


# The three pillars supporting emission reductions





## 10% auctions with price floor – could facilitate investment



Source: Neuhoff, Ferrarini, Grubb, Gabel, Keats (Sept 2006)

Coordinated auction with price floor can set floor to allowance price

- Facilitates low carbon investment
- Reduces emissions and thus allowance price

Source: Hepburn, C., Grubb, M., Neuhoff, K., Matthes, F. and Tse, M., 'Auctioning of EU ETS Phase II allowances: how and why?'

## Option contracts could create long-term price floor

- Governments sell option contracts to private parties
- Creates property right, strong enforceability
- Investors can call an option:
  - Hands in option + CO<sub>2</sub> allowance
  - receives strike price, e.g. 15 Euro/t CO<sub>2</sub>
- Direct hedge for investment
- Investors will call options if  $p_{CO_2} < 15 \text{ Euro/tCO}_2$ 
  - Reduce supply, pushes up price, implements price floor
- Governments avoid buying back allowances
  - Restrict issuing allowances to retain scarcity price

## Targets, prices and other policy instruments

- Weitzman's: short-term prices and long-term targets
- Project investment: Avoid risk of low prices
- Strategic investment: Targets imply fuel/technology mix
- Consistency required for credibility of policy
  - (i) Emission trading, initially with reservation price
  - (ii) Availability of necessary technology options
    - R&D and strategic deployment
  - (iii) Regulation and institutional set up
    - Clear trajectories and milestones for government