Climate Change:

national and international responses

Christchurch University,

9 Oct 2006

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The nature of the problem

- Is not that projected warming may hurt ‘us’ at some time in the future, but that it is …

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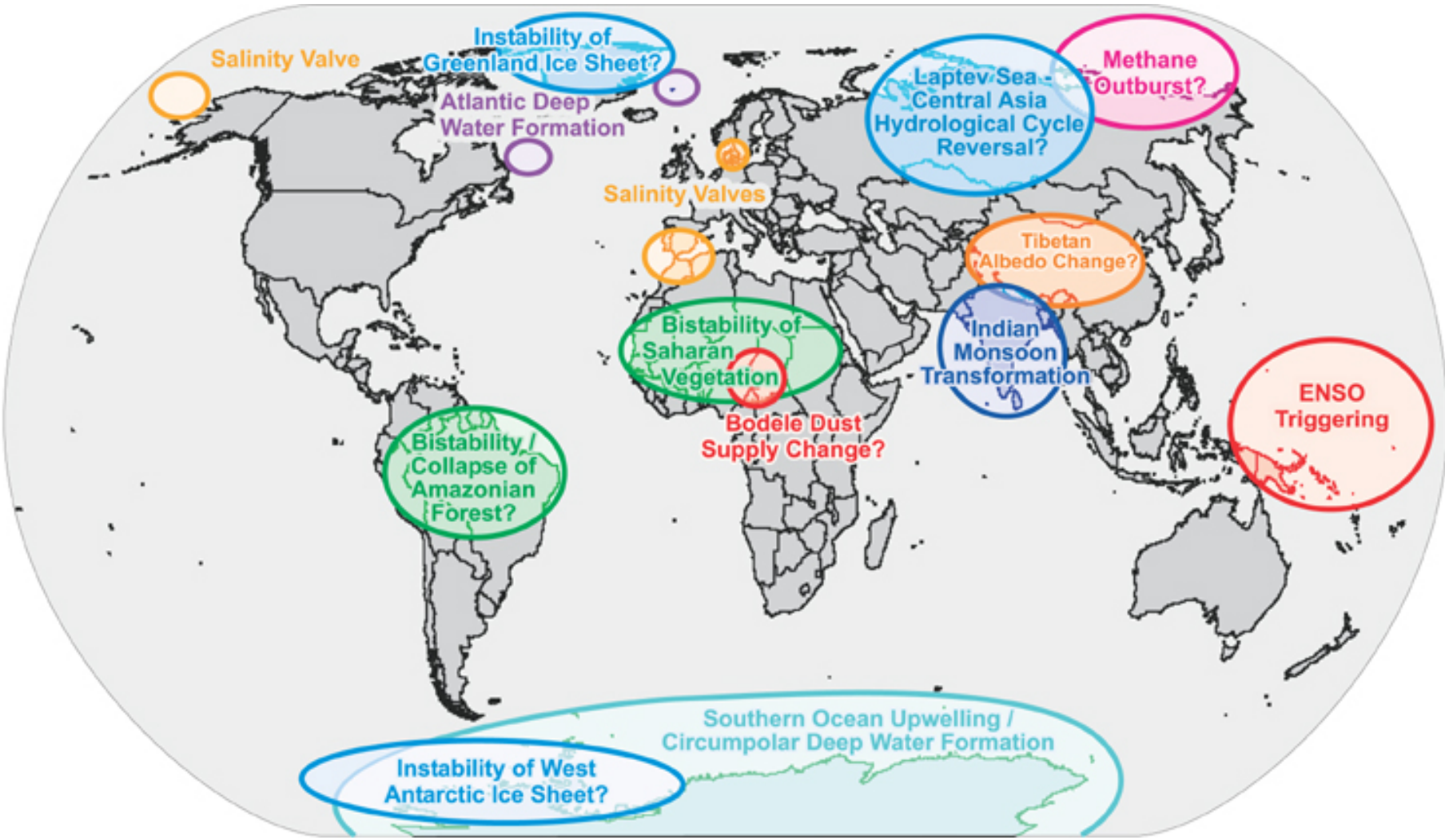
.. Already evident, probably implicated in some 'extreme events' , but unevenly distributed and (usually) difficult to isolate from other factors

(a) c. 1900

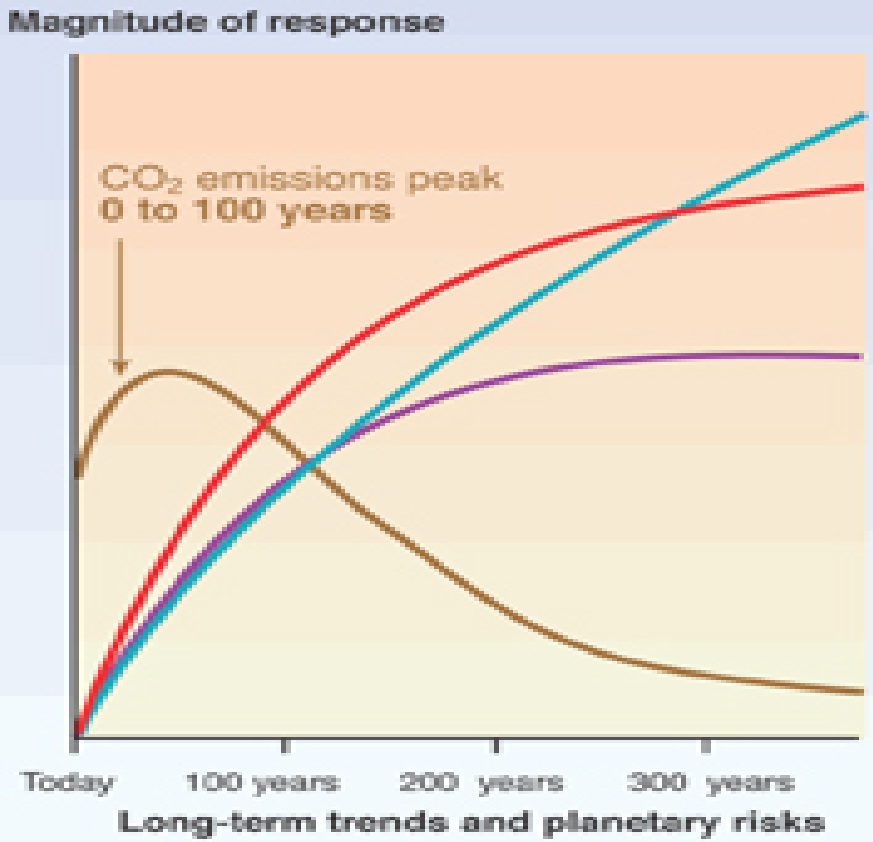
(b) Recent

Photos: Courtesy of Munich Society for Environmental Research

… inherently unpredictable concerning some of the most important potential impacts, which arise from instabilities rather than incremental change …



… and cumulative over huge time horizons with a lot of inertia and irreversibility



Time taken to reach equilibrium

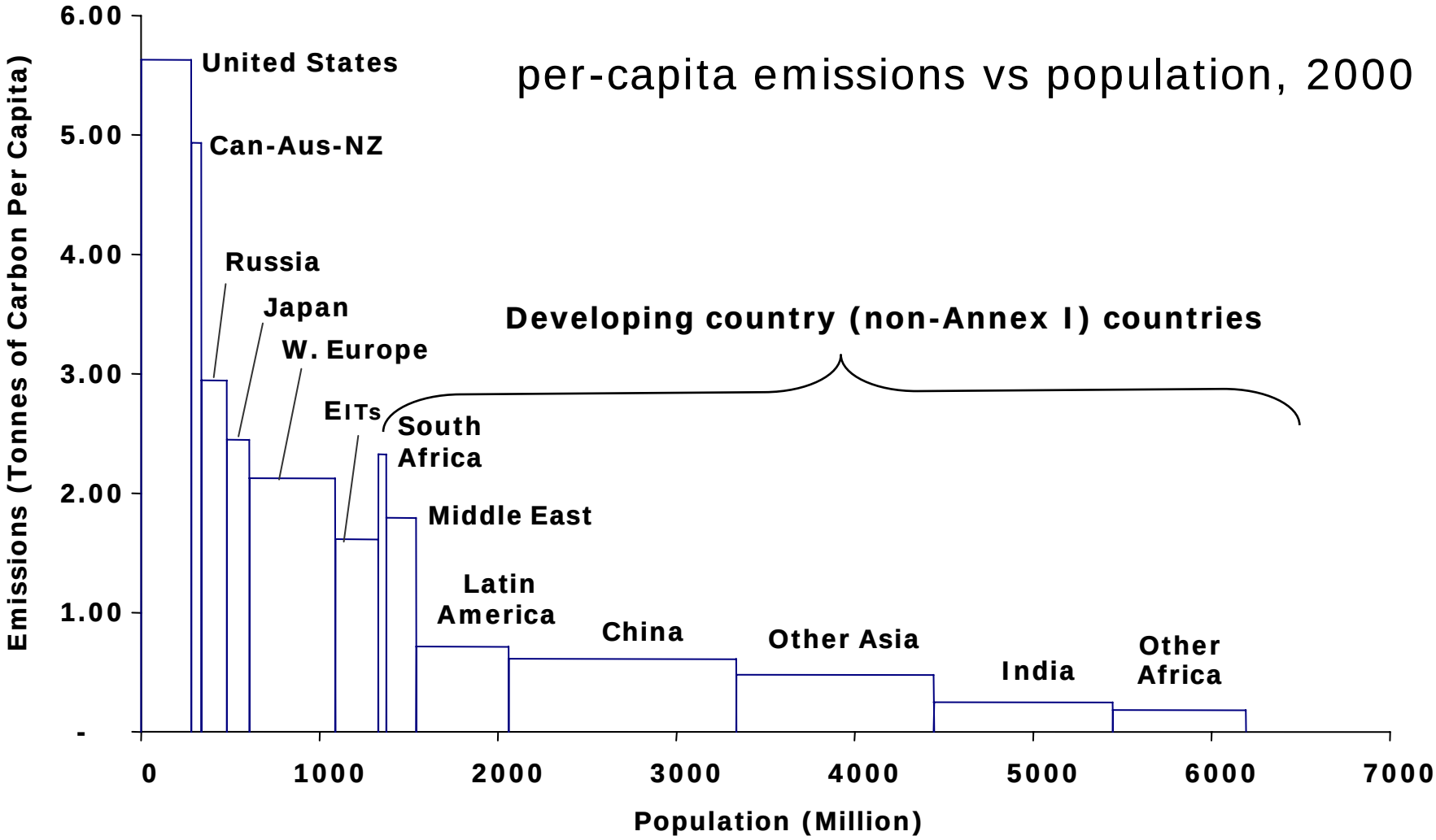
Sea-level rise from thermal expansion and ice melt
Centuries to several millenia

Temperature stabilisation:
A few centuries

CO_2 stabilisation:
100 to 300 years

CO_2 emissions

.. Whilst highly unequal patterns of emissions underlie both huge pressures for global emissions growth and political complexities



So .....

- Structuring solutions: the economic components of CO2 emissions and potential mitigation
- Economic instruments and insights from the EU Emissions Trading Scheme
- Business behaviour and energy efficiency
- Low carbon innovation: potential, costs and delivery
- The international stage
- *Not a technology talk!*

Structuring solutions:
the components of CO2 emissions and potential mitigation

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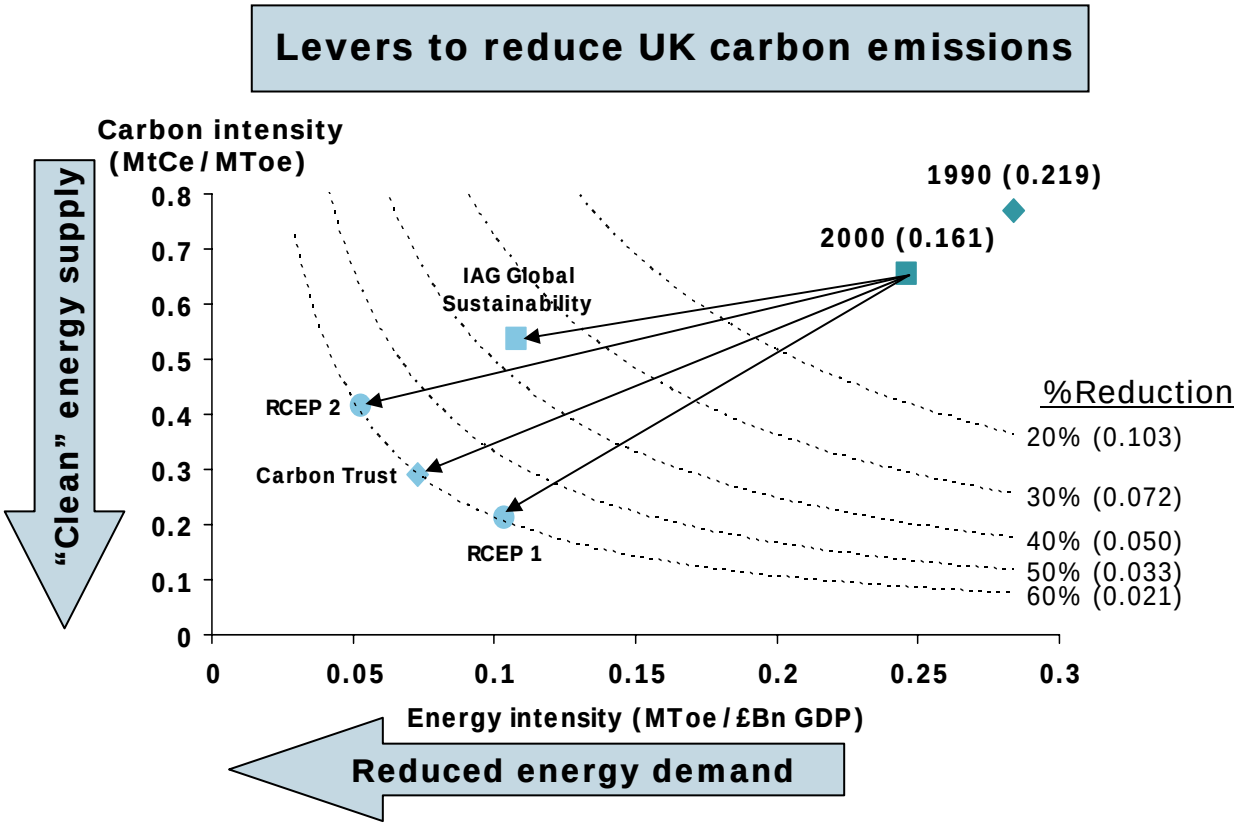
A low carbon economy will need both much cleaner energy and big reductions in energy demand on a rapid decarbonisation pathway for next 50 years



The UK 2003 Energy White Paper set the UK on a path to reduce carbon emissions by 60% by 2050 through a combination of energy efficiency in the short term and renewables in the long term:

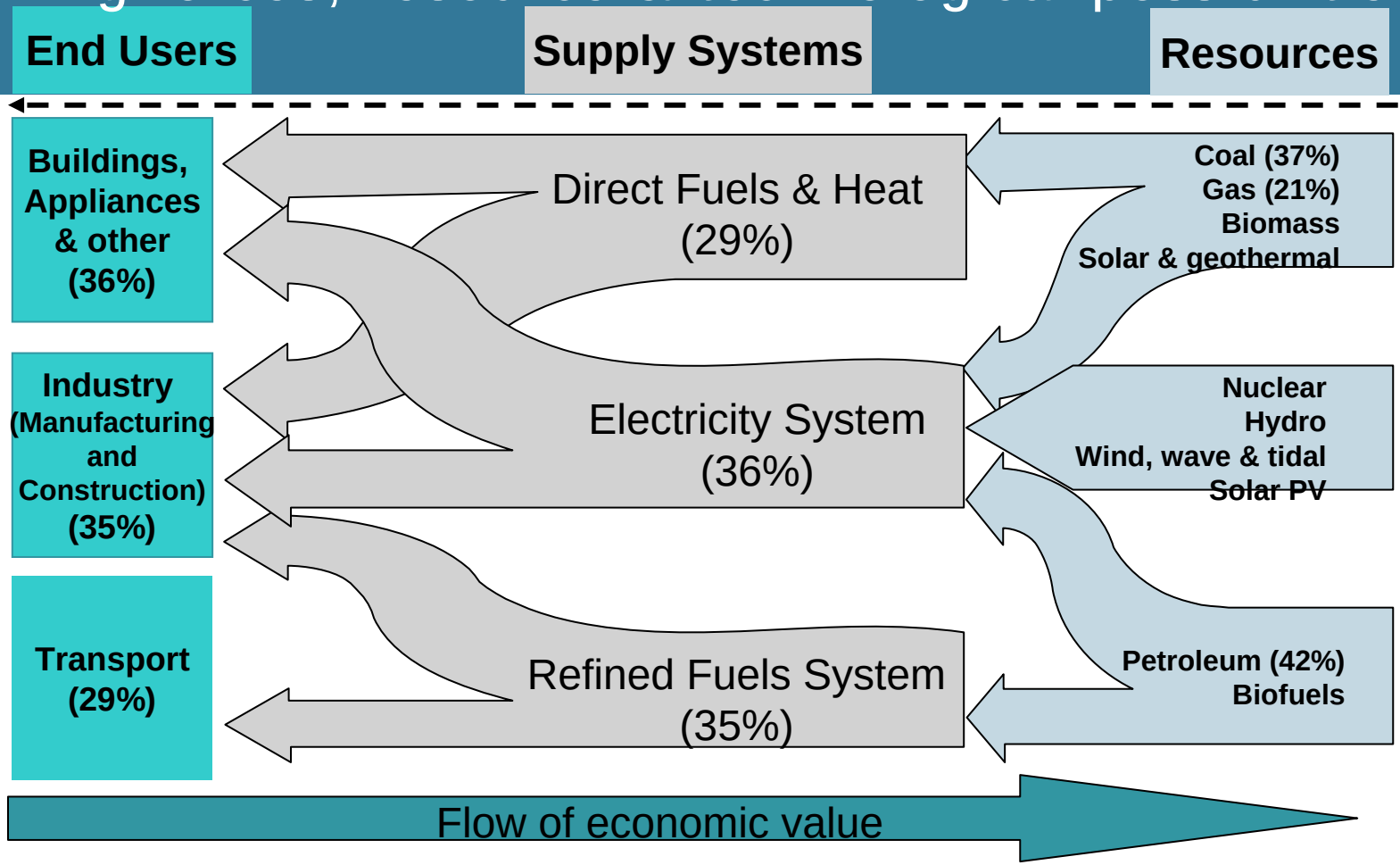
"[To achieve the required savings from energy efficiency] *would need roughly a doubling of the rate of energy efficiency improvement seen in the past thirty years*"

"Technology innovation will have a key part to play in underpinning all our goals and delivering a low carbon economy"

"To deliver these outcomes our aim will be to provide industry and investors with a clear and stable policy framework"

Note: Figures in brackets show UK carbon intensity (MtC/£Bn), Scenarios show 2050 projections
Source: RCEP 1998, DTI EP68 GDP growth forecasts, IAG "Long-term Reductions in GHG in the UK", Feb 2002

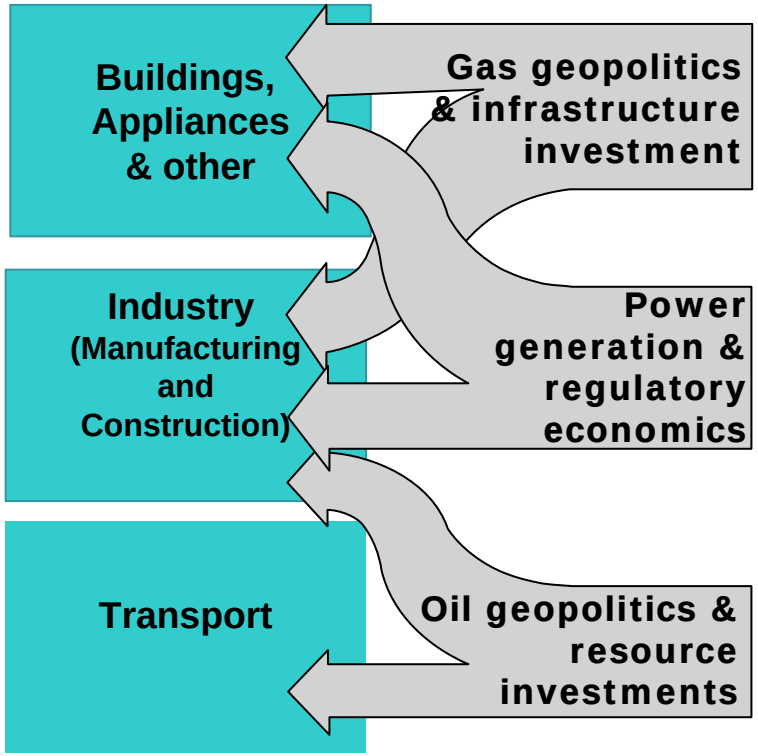
Energy-CO_2 emissions arise from six main components that are diverse in structural & economic characteristics, driving forces, resource & technological possibilities …



The data show the % of global energy-related CO_2 emissions associated with the different parts of the energy system (including emissions embodied in fuels and electricity). Note that patterns vary between regions (eg. industry is lower and transport higher in developed economies), and the sectors are growing at different rates (over past 30 years, energy demand for buildings:industry:transport has grown at 2.6%:1.7%:2.5% annual average (LBNL ref)

Note: Some small flows that comprise under 1% of global energy flows (eg. electricity and natural gas contributions to transport) are not shown **End Users:** Source: IEA. 'Non-electric energy industries' (emissions from refineries, gas etc) allocated 4:1:2 to transport:industry:buildings etc.
Supply Systems: Electricity System data IEA; Refined Fuels %CO_2 assumed equal to Petroleum % CO_2; direct fuels and heat is the residual.
Resources: Source EIA

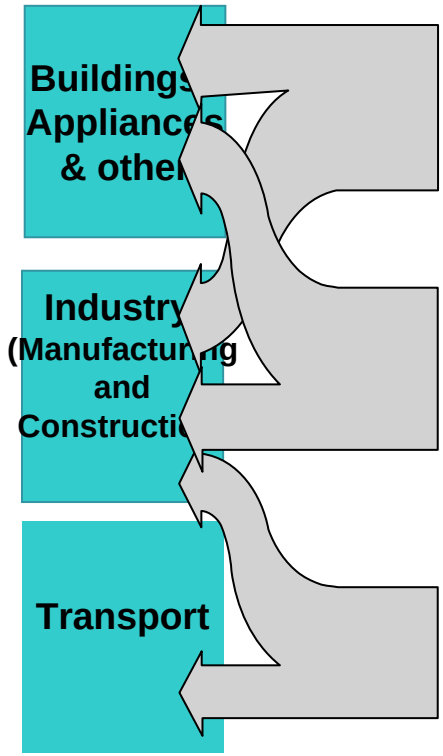
Differing structural characteristics are reflected in different behavioral drivers and concerns that policy must address



Sector	Dominant issues for energy-carbon management
Direct fuels and buildings (50%)	Consumer & organisational behaviour, barriers, co-benefits, infrastructure
Power generation and heavy industry (50%)	Prices, regulatory structure, competitiveness and industrial innovation
Oil and transport (30%)	Consumer behaviour, vehicle innovation, infrastructure, resource investment trajectory

Different drivers and concerns imply different instruments

- mitigation not delivered by one policy any more than one technology
- costs and competitiveness reflect the range of +ve & -ve impacts



Economic Competitiveness

	Voluntary, regulatory and systemic instruments	Economic instruments	Innovation instruments
Behaviour			
Substitution			
Technical innovation			

This structure defines the four topic-areas of talks on this tour ..

- Economic Instruments and the EU ETS
  - *Main talk, opening CEEM conference, 26 Oct 06, covering EU ETS, competitiveness & lessons learned*
  - Today's talk summarises a few key headlines from first year of EU ETS – and the current situation
- Energy efficiency and business behaviour
  - *Main talk, Greenhouse Gas Policy Office, Melbourne, Victoria, 19 October*
  - Today's talk will cover particularly UK domestic experience
- Innovation
  - *Main talk, at UNU Canberra, Friday 20 October, on innovation chain, instruments for innovation and UK / Carbon Trust investment strategy*
  - Today's talk outlines the basic innovation chain principles
- International policy and business strategies
  - *Main talk, Lowy Institute, 25 October with remarks from panel at end of CEEM conference*
  - Today's concludes by outlining the main linkages between the different themes and draws conclusions about way forward

Economic instruments and the EU Emissions Trading Scheme

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EU Emissions Trading Scheme – Overview

Participants

- All EU 25 countries
- All electricity, ferrous metals, pulp & paper, cement and all facilities > 20MW, total 46% of EU emissions
- International links through Kyoto project crediting

Allocation

- Member states develop National Allocation Plans (NAPs) by sector and installation
- To be consistent with Kyoto target and anti-subsidy provisions

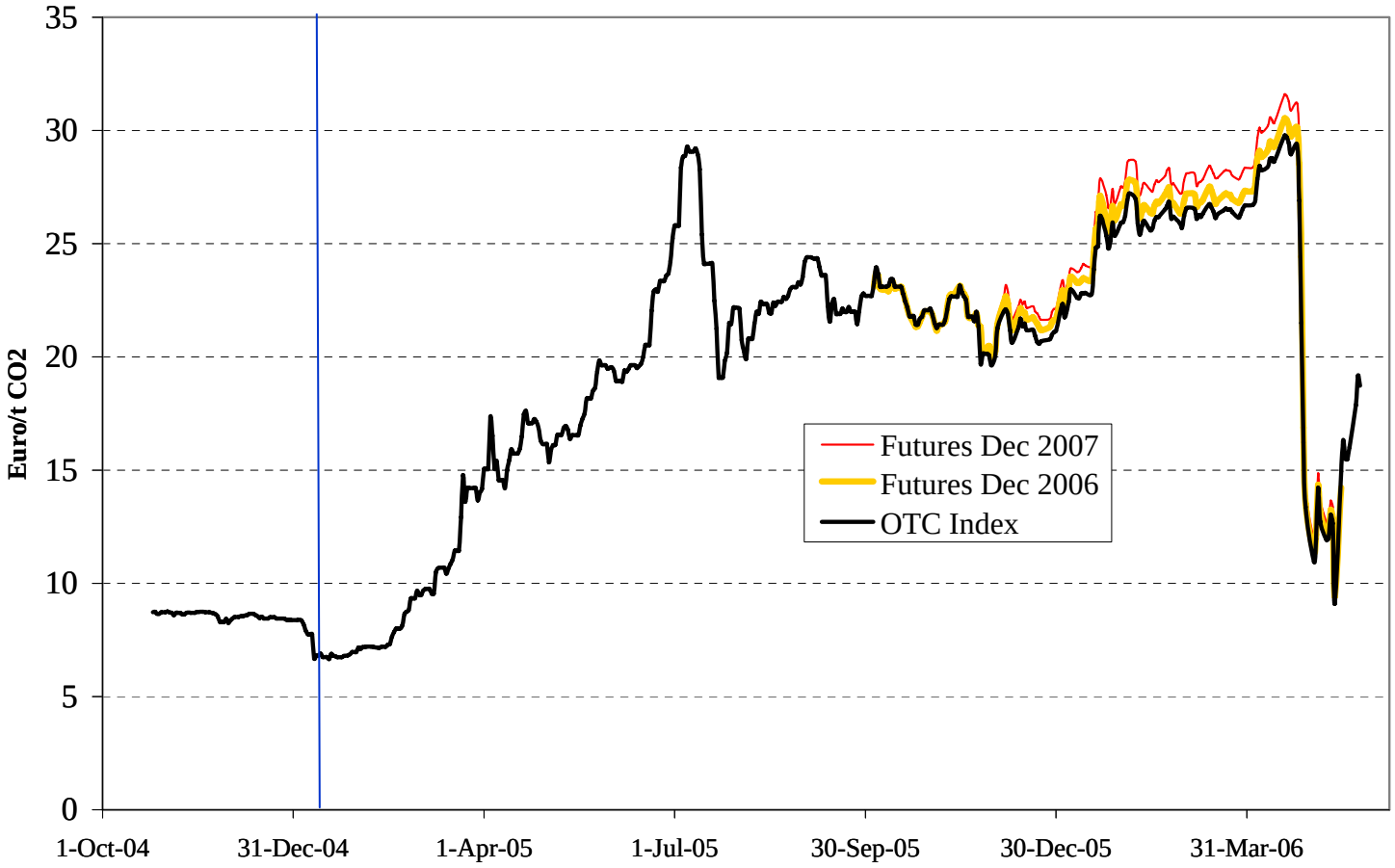
Timing

- 2005-7: phase 1, no national target, opt-out provisions
- 2008-12: governed by Kyoto target, opt-in possibilities
- 2013+ ? Likely to strengthen

Key issues

- Market price – uncertainty – driven by NAPs, relative coal-gas pricing, and emerging nature of market with mixed / late participation
- Specific allocation issues – including new plant, plant closure, etc
- Various legal issues surrounding legal nature, tax rules etc.

The market works but carbon price has had a bumpy ride since inception



BIG Money – though not quite in the way that some expected

- At €20/tCO2, the asset value of 2.2bnCO2 allowance is around €40bn/yr … €100ms have been won or lost in trades against erroneous price expectations
- Disputes continue over the reasons for the surplus in 2005 - but it is some combination of overallocation and greater than predicted abatement (eg. in cement sector)
- Where competitive electricity markets, pricing effects as expected lead to profits – probably totalling around **€5bn** across the EU, swamping the modest net purchases in the sector

Where are we now?

- In the middle of one of the biggest man-made rent grabs in modern history, as 25 governments and their industries struggle over allocations for 2008-12
- In a situation of high stakes and volatility, as the European Commission tries to exercise its role as ‘policeman of the governments’
- At a defining moment in European energy policy, as we struggle with the relationship between the Nation and the EU, and between further Liberalisation or Retreat to cope with the profit-making properties of EU ETS

Some initial high-level conclusions from EU experience with economic instruments

- No practical economic instrument is ‘pure’: because it aims to change relative prices in ways that favour lower carbon technologies over high carbon incumbents, fierce struggles are inevitable
- It has proved *possible* to implement a harmonised market in emissions cap-and-trade for industrial emissions across 25 diverse countries
- Industry attitudes change once the instrument is adopted: lobbying then focuses upon ‘getting the best’, and ‘the best’ has been large aggregate profits for some sectors,
- The EU ETS will continue post 2012 irrespective of progress elsewhere

Business behaviour and energy efficiency

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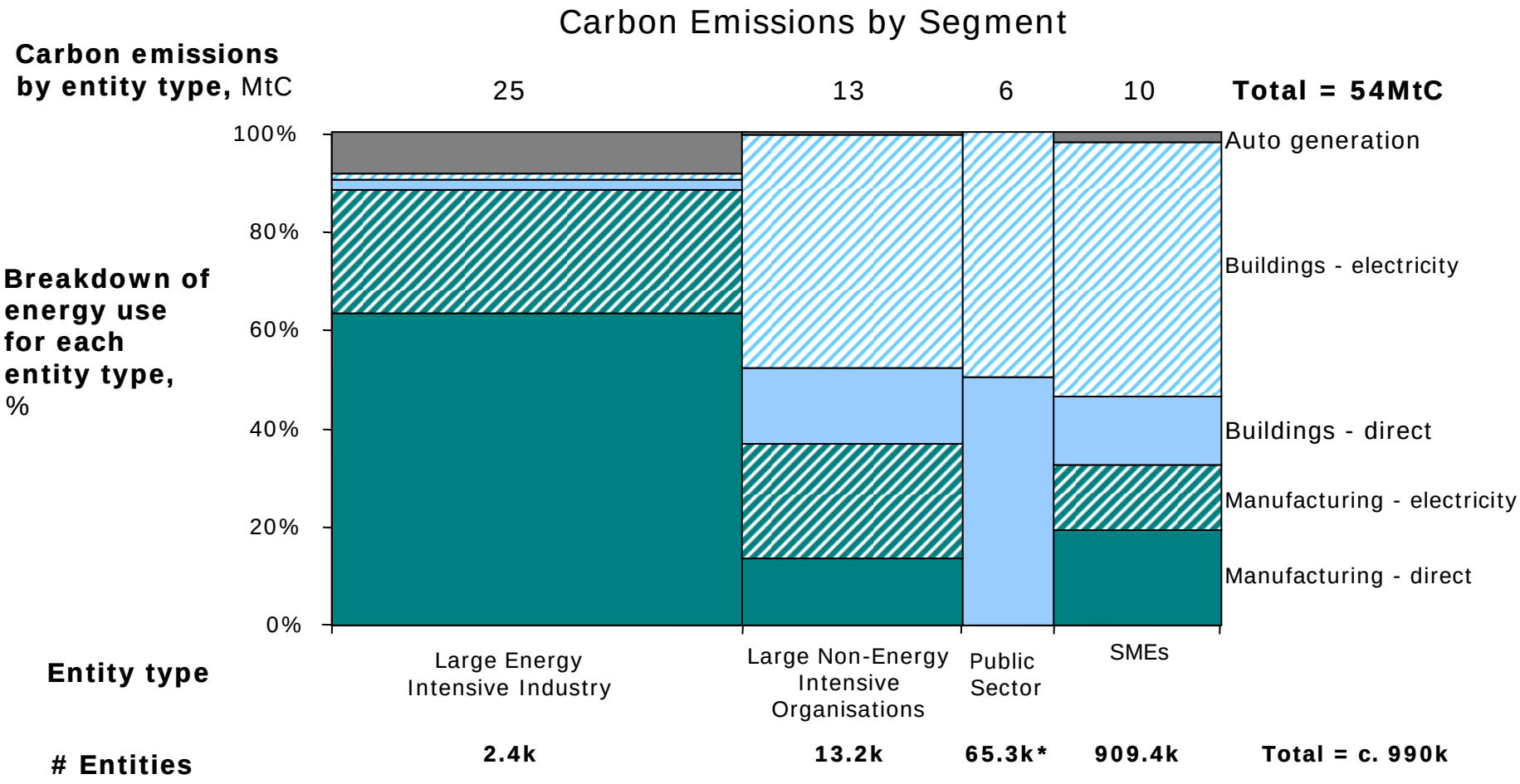
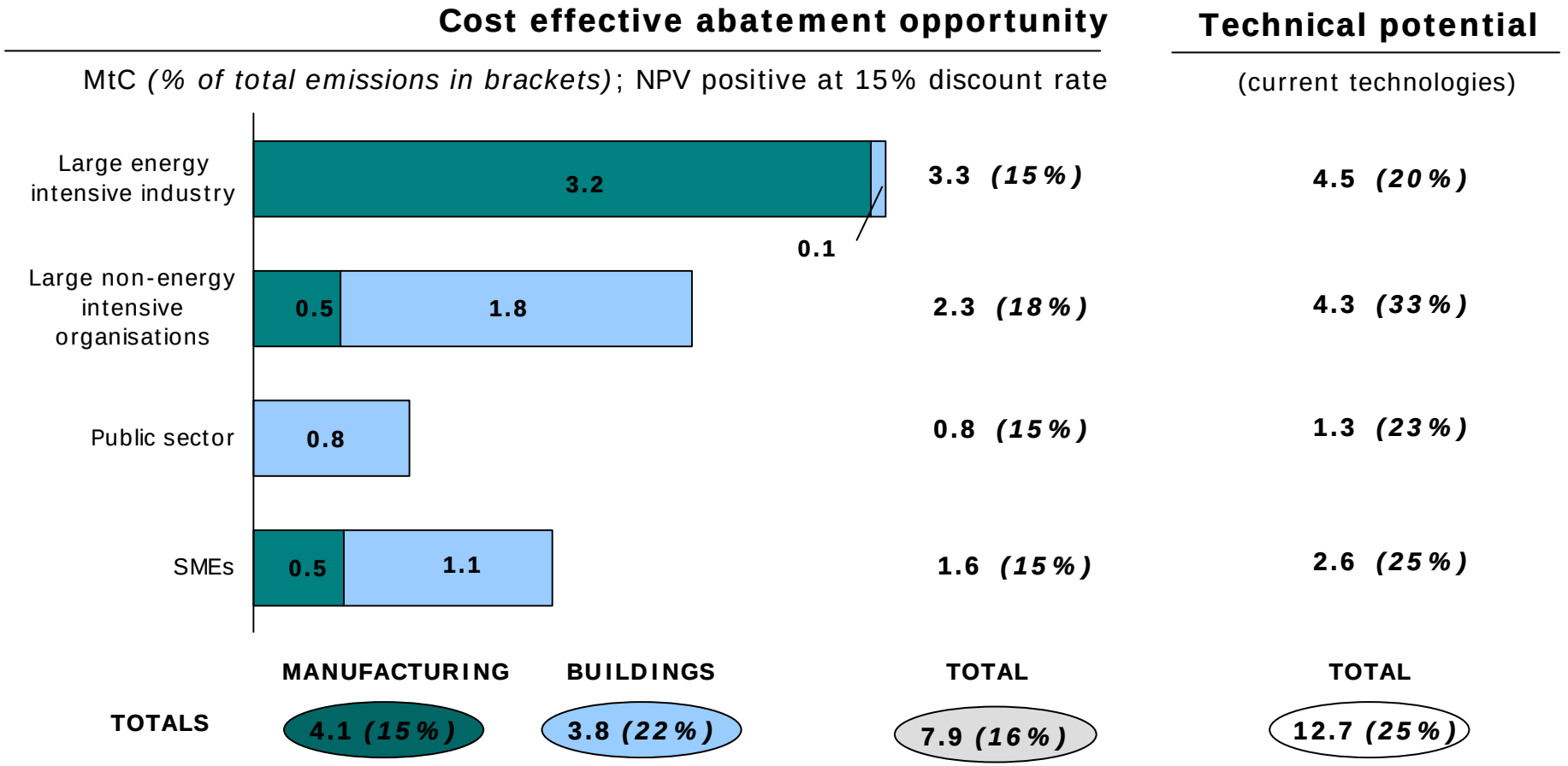
Understanding energy efficiency means understanding operational and organisational structure of energy use

- in UK, Large Energy Intensives < 50% business sector emissions



Note: *Includes a bottom-up estimate of numbers of central government organisations; Source: Ecofys

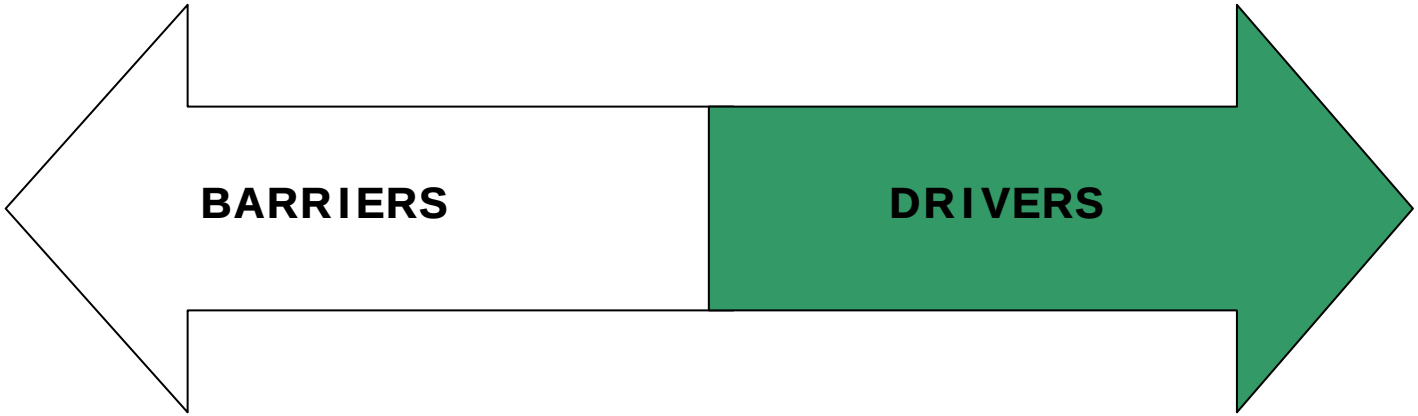
Technology-based 'bottom-up' models suggest large potential for cost-effective gains in energy efficiency
(CT analysis estimated over 15% C savings at >15% IRR)



Source: Ecofys: ENUSIM abatement curves, BRE buildings measures abatement curves

Why do companies not anyway do what appears economically rational from a macro perspective?

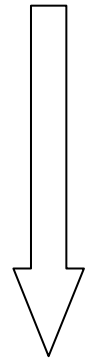
Efficient policy needs to target the factors that drive and impede organisational decision-making, in four main categories



- **Investment cost**
- **"Hidden" costs, including transactions**
- **Split incentives & other market failures**
- **Ignorance, inertia and lack of interest**

- **Value of energy savings**
- **Co-benefits and intangible benefits e.g. CSR**
- **Systemic efficiency and innovation leadership**
- **Awareness and motivation**

Classical economic



System & Behavioural

Strong evidence base on all elements of driver-barriers but the balance differs between uses and sectors

Cost/benefit depends on time horizons:

'The further down the organisation, the shorter the time horizon'

'Hidden costs' are diverse

- Perceived risk of new technologies giving lower quality and performance
- High transition costs to operations

"The new energy efficiency motors do not fit in the old imperial frames… transition costs are high."

Transaction costs also important

Market misalignments dominate 'embedded' performance

''Our worst property is 13 times worse than the best' – major retailer'

'You should be pleased if have the measurement systems in place to know that' – response from another retailer

"OEMs control the distribution of motors – most companies do not even know what type of motor they have purchased – hidden in kit."

Weak drivers for change limit organisational commitment

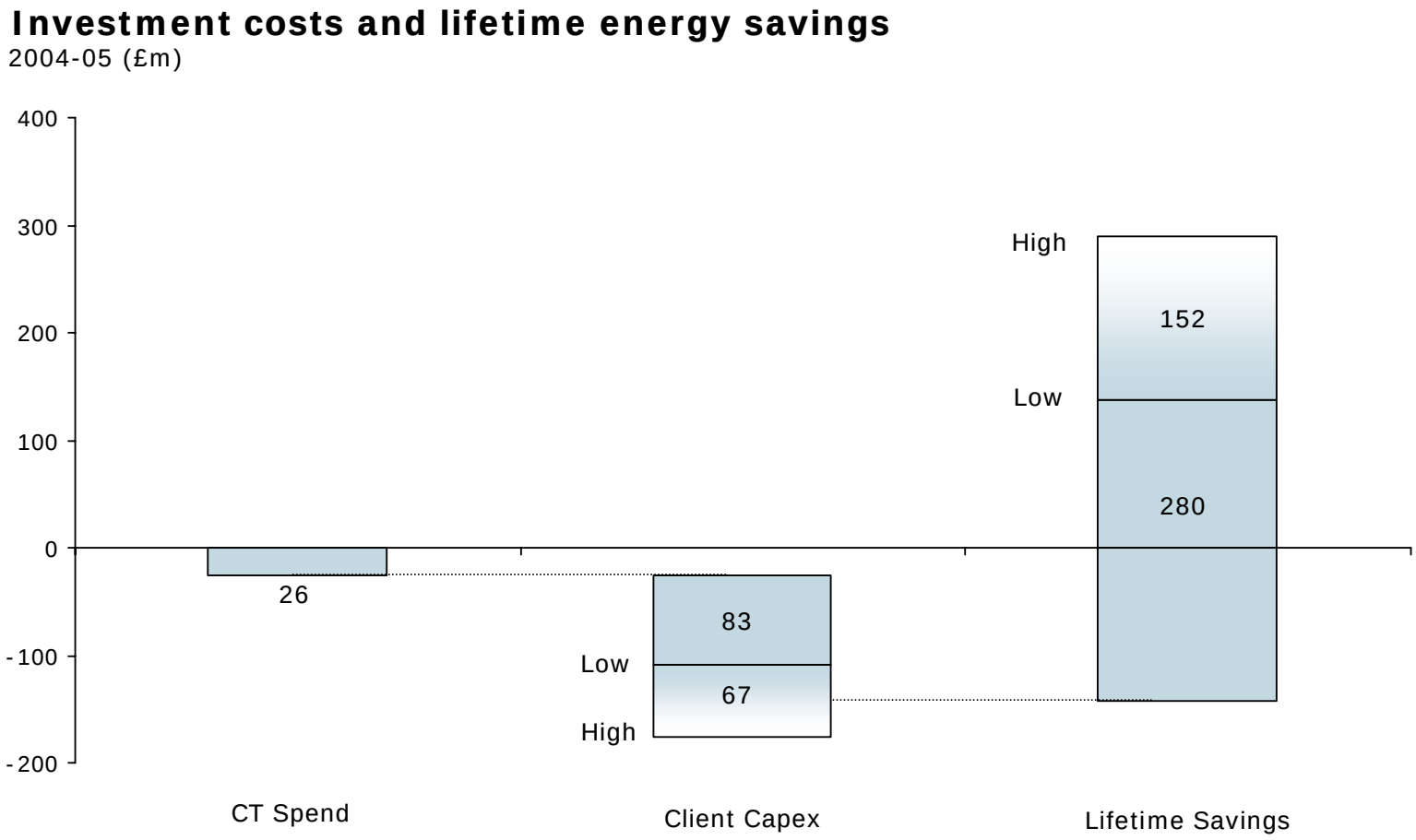
- Energy is not relevant to "core business"
- Lack of senior level commitment
- Lack of resources focused on energy management
- Engineers do not have a budget for energy efficiency improvements."
- "*Capital allowances target finance departments – engineers never receive the benefits of taking up ECAs."*

Combined effect is to make Awareness and Motivation critical aspects:

"CCLA's were far more likely to have taken action to improve energy efficiency …87% of CCLA firms had taken action or were planning to do so compared with 42% of non-CCLA firms" (Source: CBI/EEF review of CCL, October 2002)

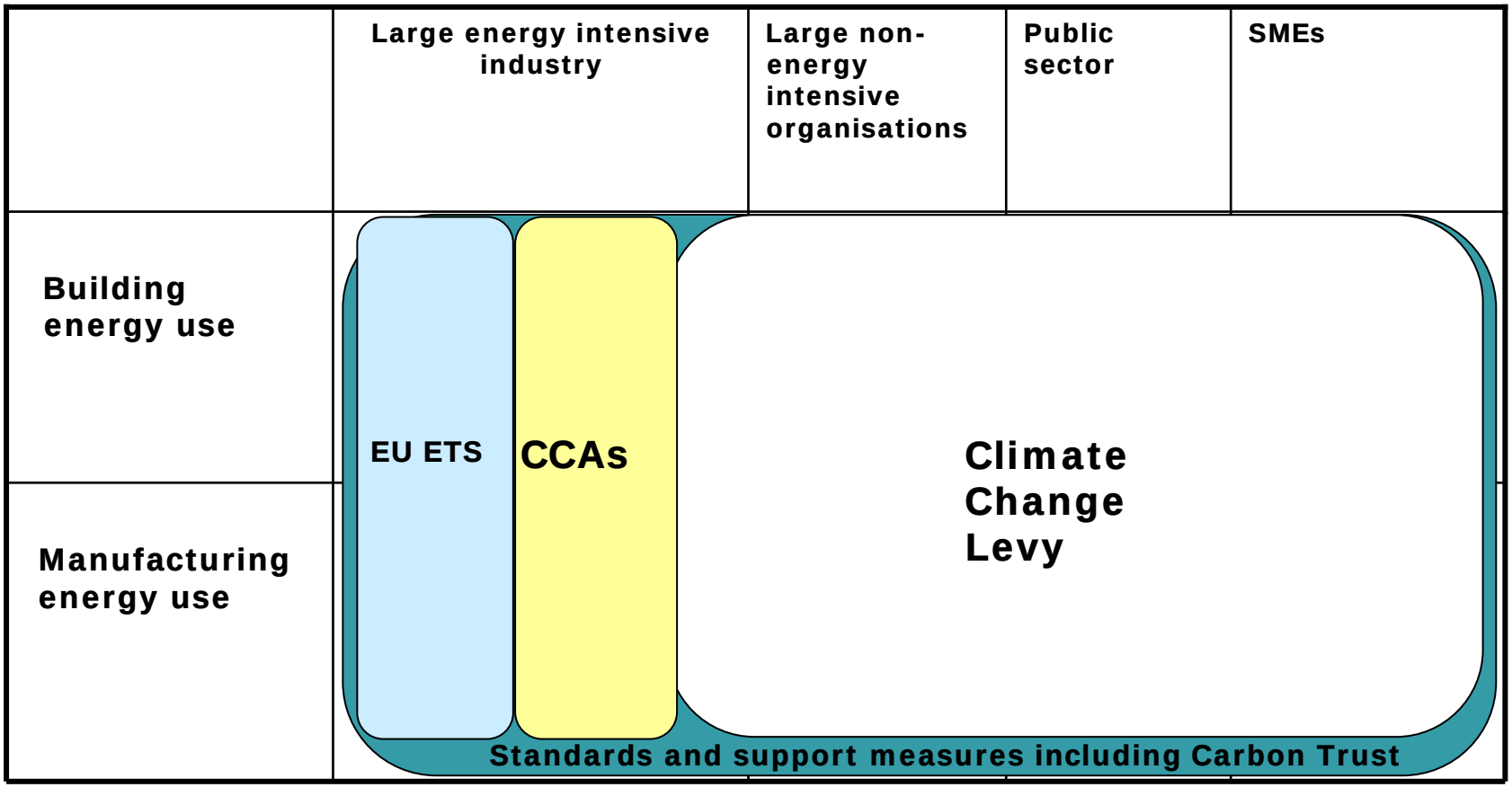
Exploiting ‘bottom-up’ potential has enabled Carbon Trust programmes to deliver major lifetime cost savings

- assessed value of energy efficiency savings from 2004-5 programmes at least twice the cost of policy and co-investment



Source: Carbon Trust Impact Assessment

The current Climate Change Programme has instruments appropriate to the large energy intensive operations but does not address main barrier-drivers in other categories



- EU ETS and CCA focused on large-energy intensive industry
- CCL is only economic instrument acting upon remaining sectors
- Standards and support measures used across all segments

A Consumption-based Emissions Trading Scheme would be most cost-effective way to target rapidly rising emissions associated with large *non*-energy-intensives

	Core features	Rationale	Extension?
Operation & incentive	▪ Companies to obtain allowances for emissions, in return for discount from Climate Change Levy	▪ **Need to acquire verified allowances addresses Organisational barriers & CS drivers better than paying distributed tax**	▪ Self-selection (opt-in) to escape rising CCL
Target sectors	▪ Large non-energy-intensive organisations and public sectors ▪ Industrial SMEs outside CCA and EU ETS coverage	▪ Exploits capacity of large firms to manage numerous sites ▪ Sector experiencing rapid emissions growth	▪ Some sectors presently in Climate Change Agreements
Emissions coverage	▪ Covers *direct and electricity-embodied* emissions	▪ Electricity accounts for 70% of sector emissions ▪ Enables rational trade-off with decentralised / local cogen	▪ Transport emissions (e.g. haulage)
Allocation	▪ Most allowances to be bought from auction or from EU ETS	▪ Sectors not energy-intensive so competitiveness is not problem ▪ Greatly simplifies allocation process – no company-specific projections etc needed	▪ EU ETS link may improve price & stability in EU ETS

Note: * Half hourly (HH) metering as a potential requirement for entry represents c.14k organisations with 94TWhrs of electricity consumption. Holders of HH meters have electricity consumption >100kW >x3per month, equating to an energy bill of >£13k pa

Low-carbon innovation:
Potential, costs and delivery

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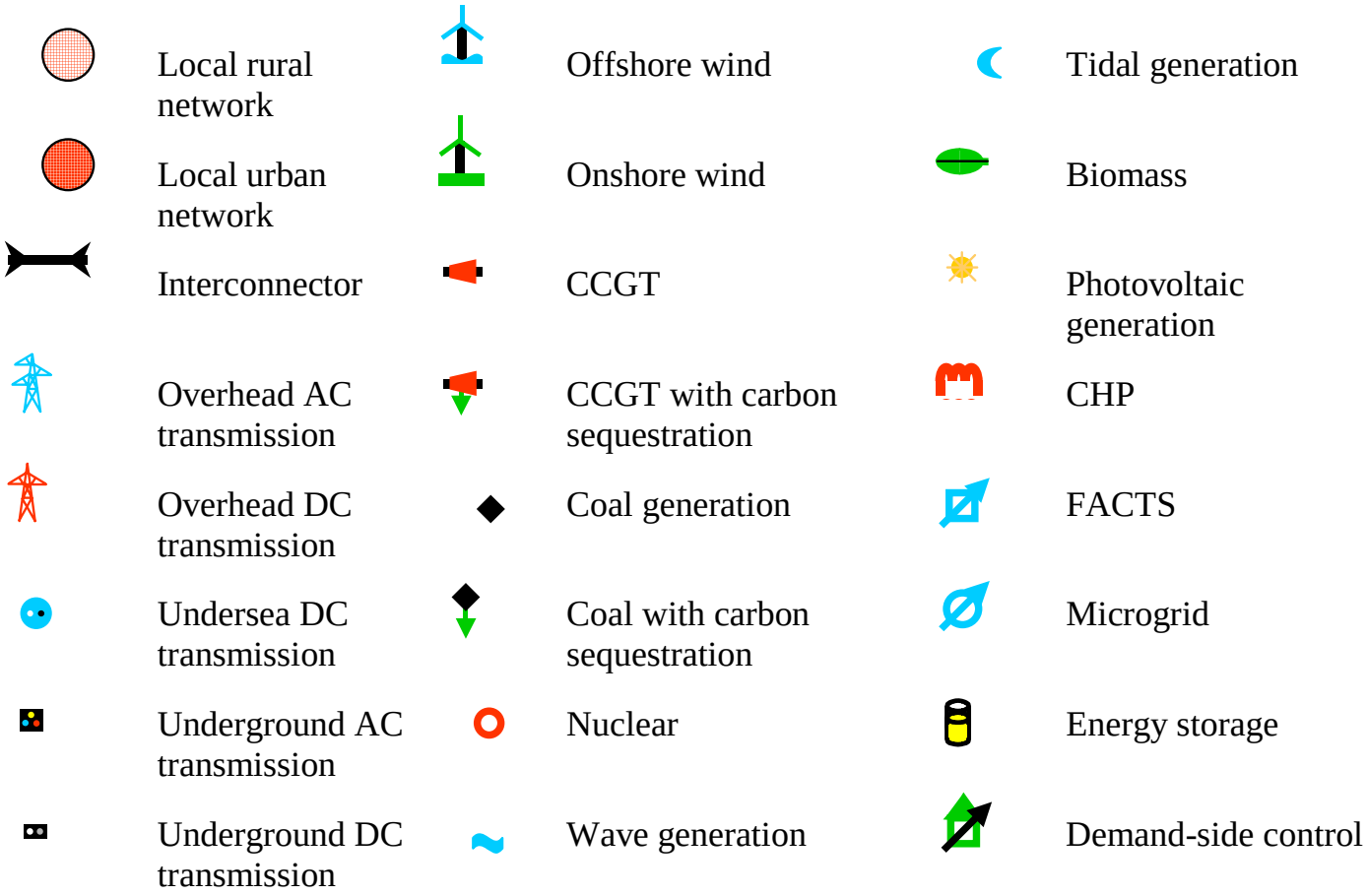
Deep reduction scenarios have to address the whole range of options *and systems*

- *eg.* SuperGen studies of very low carbon UK electricity



SuperGen scenarios overview: Ch.2 in *Future Electricity Technologies and Systems*, ed. Jamasb, Nuttall and Pollitt, CUP, 2006

Under “business as usual” structural assumptions, 60% CO2 reduction achieved with CCS, nuclear wind, and distributed gas & biomass –based generation..

Demand	540TWh
Wind	12-15%
PV	1%
Biomass	10-15%
Marine	3-5%
CO2 capture	10-20GW
Nuclear	5-10%
MicroGen	20%

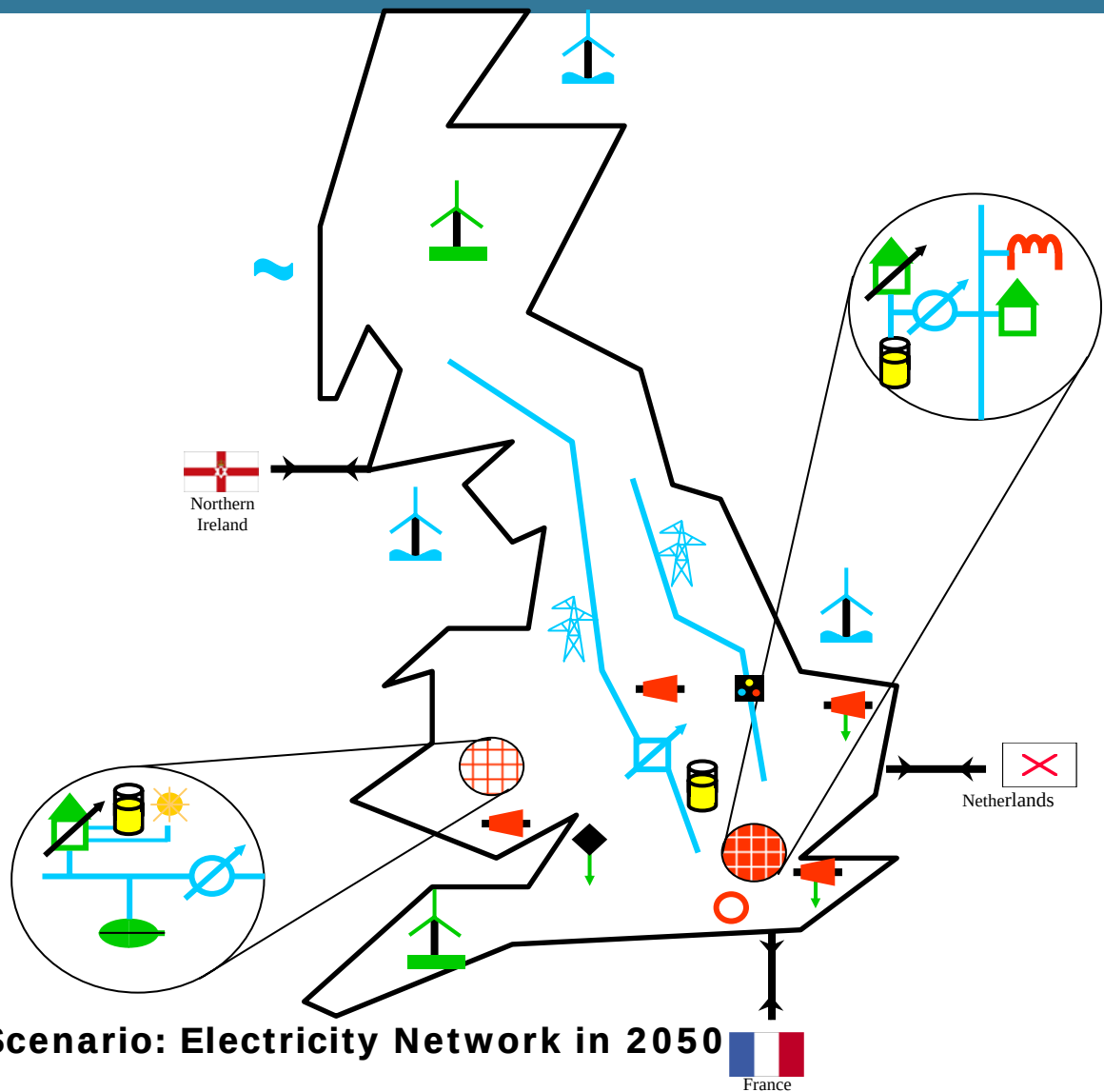


Figure 1.3 : “Business as Usual” Scenario: Electricity Network in 2050

Whilst a “Green plus” scenario requires more radical change to system structure and more use of advanced transmission and power control technologies

Demand	390TWh
Wind	45-50%
PV	3-5%
Biomass	25%
Marine	5-10%
CO2 capture	Only for hydrogen
Nuclear	-
MicroGen	20%

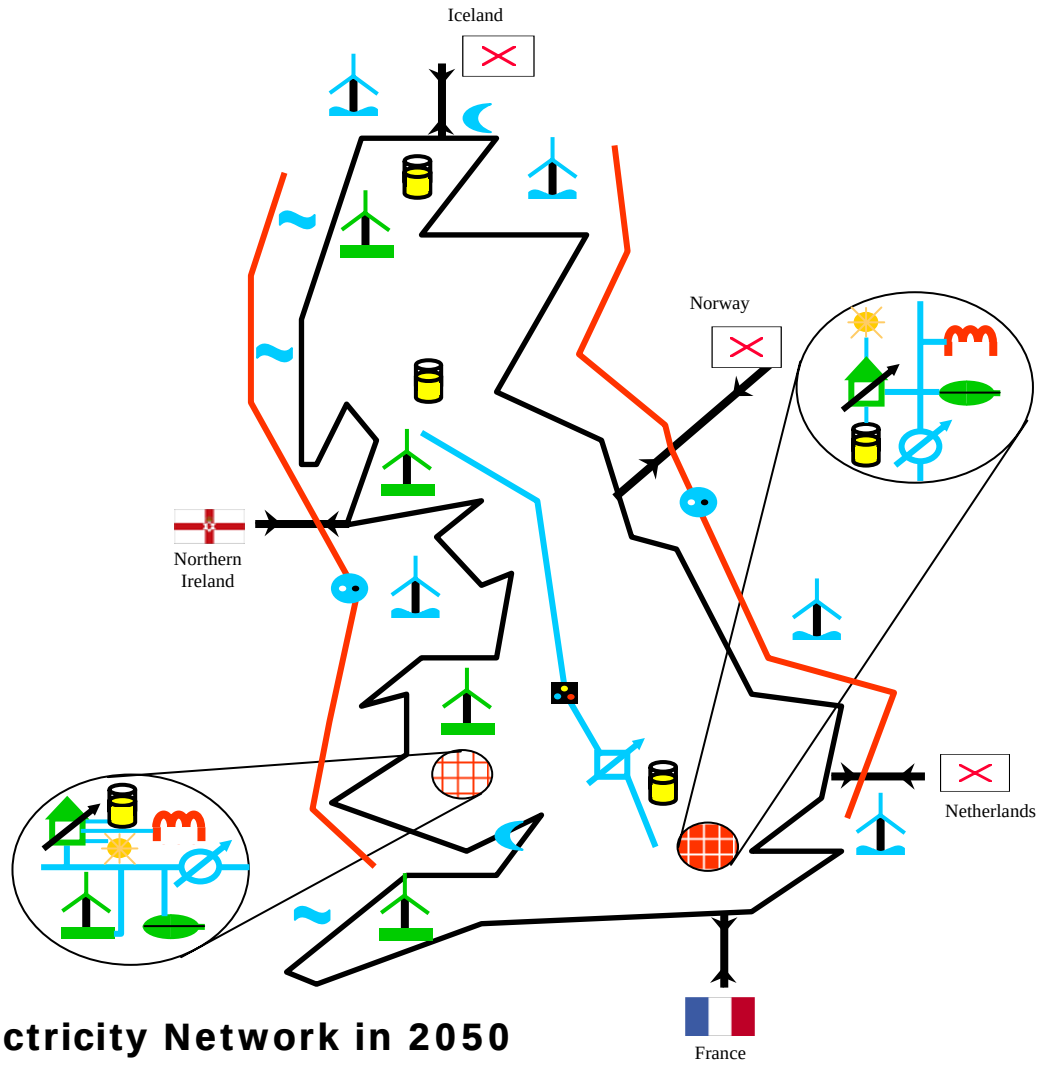
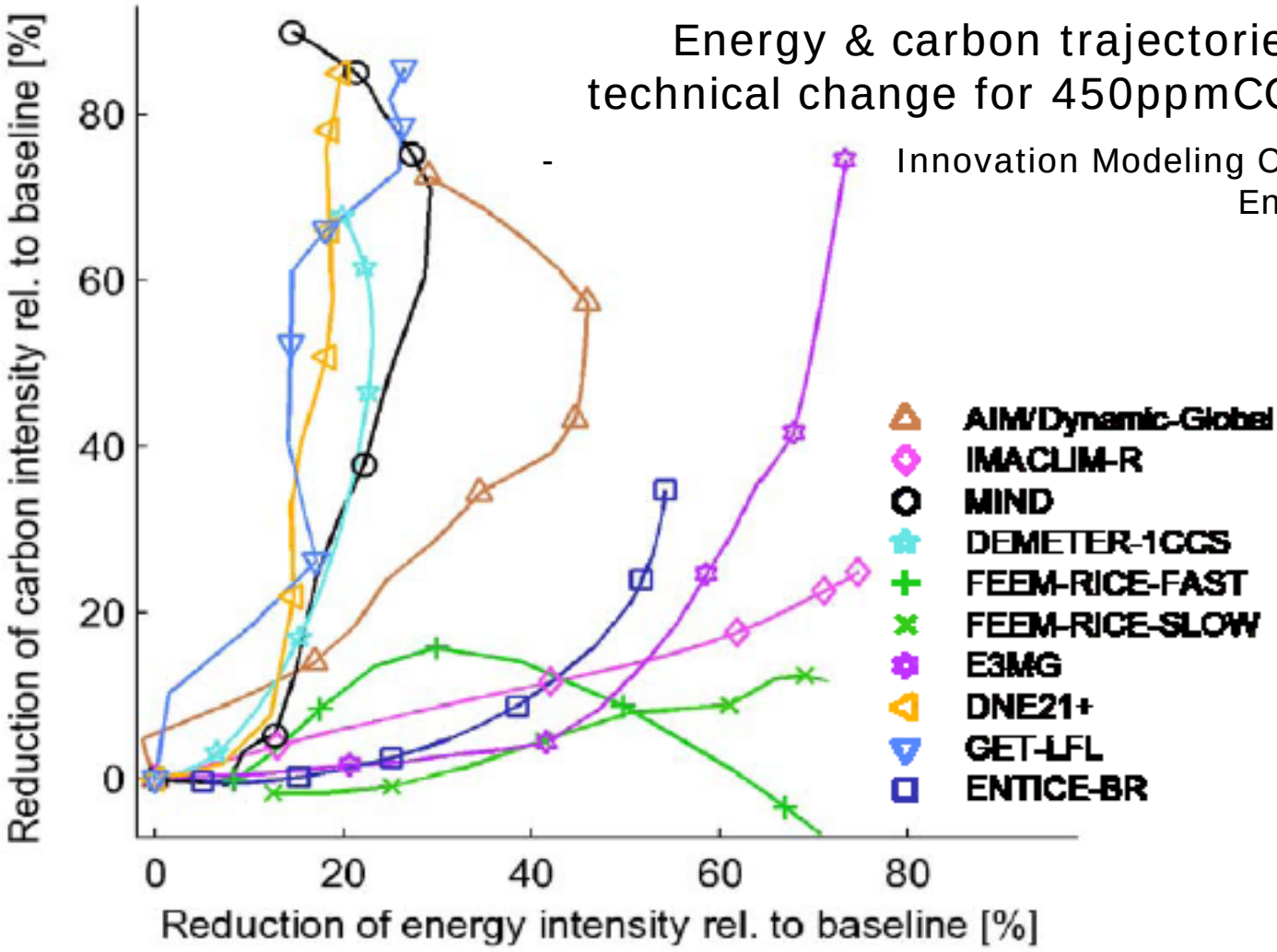


Figure 1.5 : “Green plus” Scenario: Electricity Network in 2050

At global level, stabilisation trajectories involve a *pathway* that start with proven energy efficiency and move towards accelerated decarbonisation

Energy & carbon trajectories with induced technical change for 450ppmCO2 stabilisation

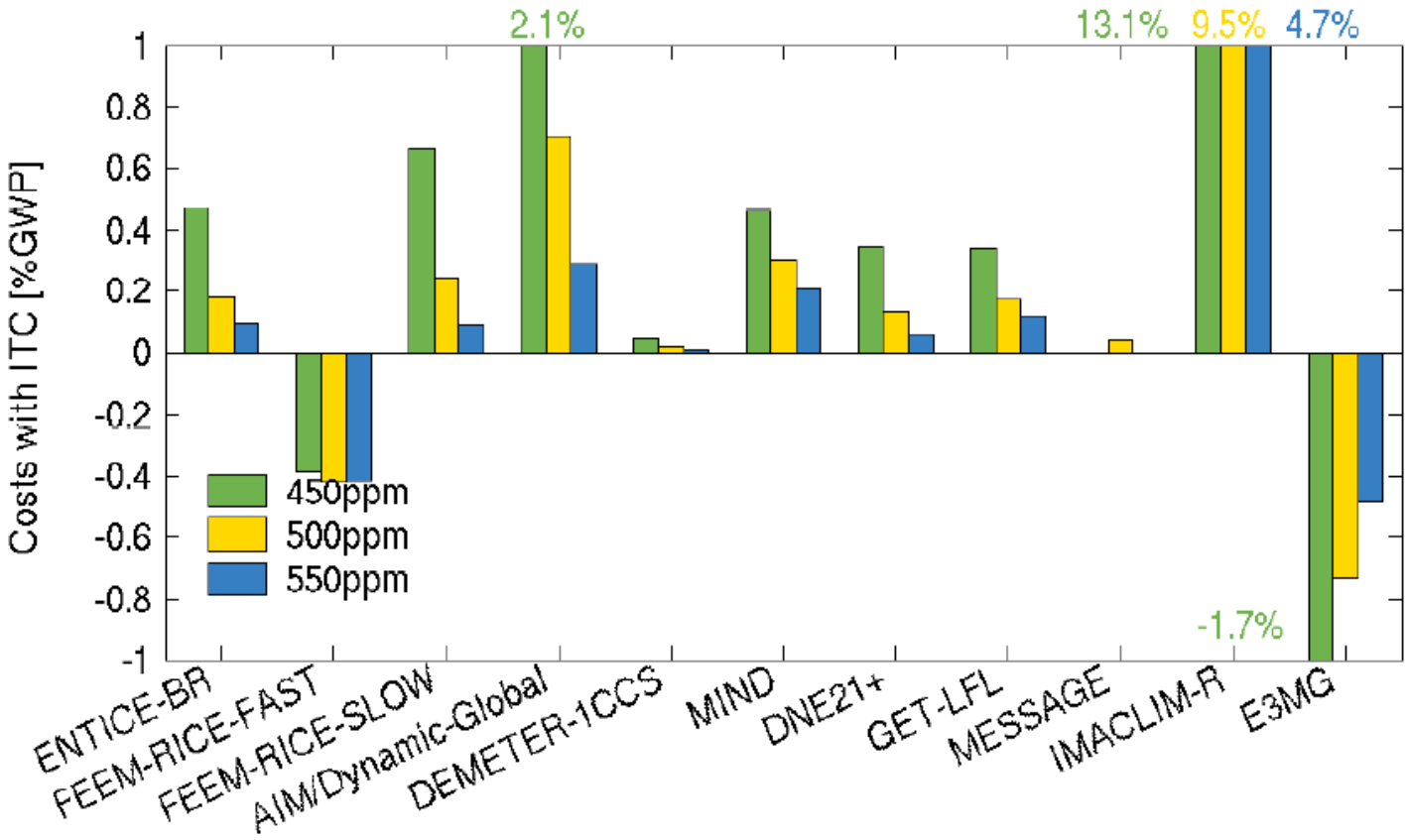
- Innovation Modeling Comparison Project, Energy Journal, 2006



Source: Edenhofer, Lessmann et al. 2006

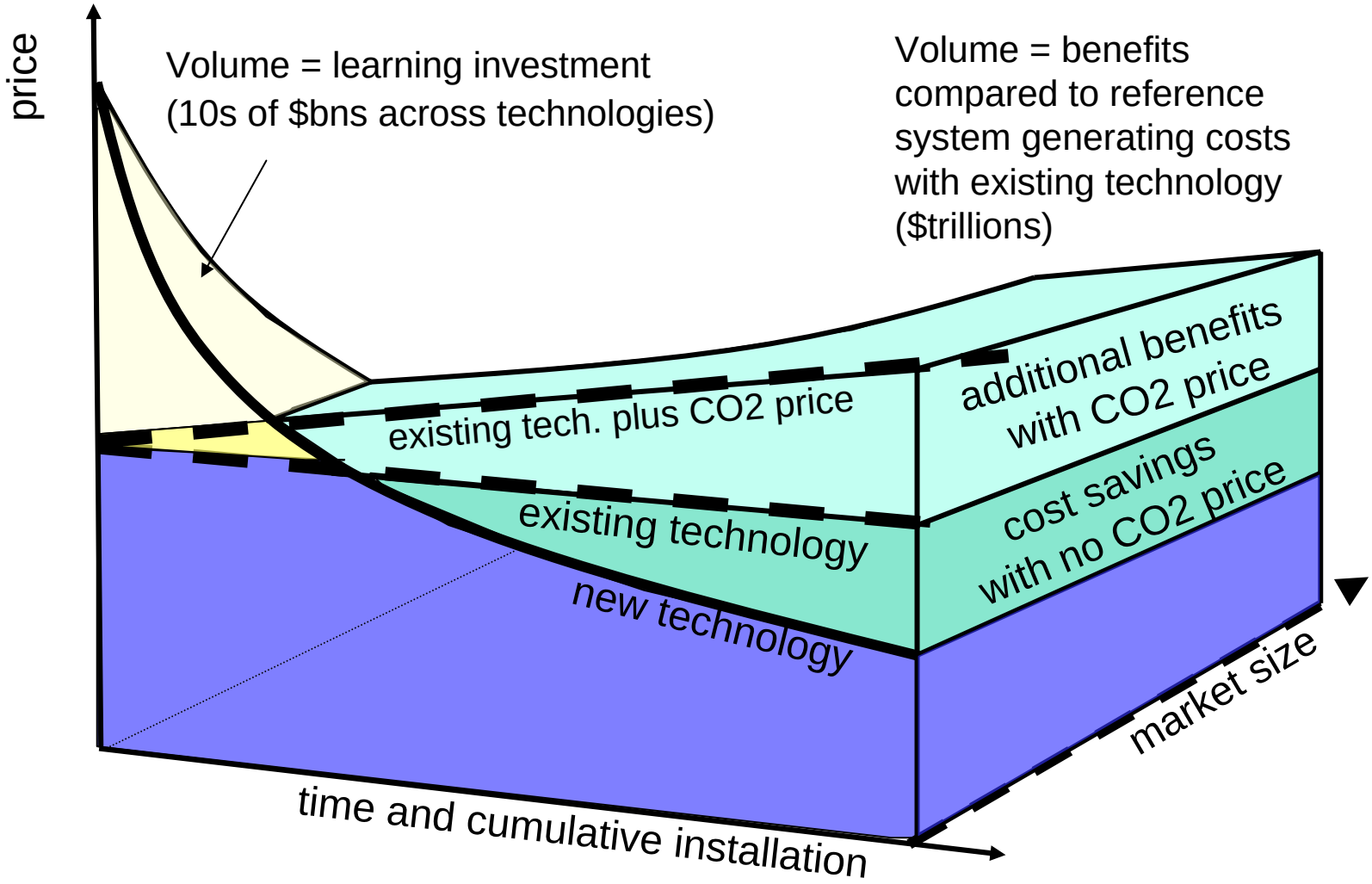
The costs of these trajectories are varied across the models but not earth-shattering, *if .....*

Net Present Value of global economic impacts of stabilisation, 2000-2100, as % Gross World Product

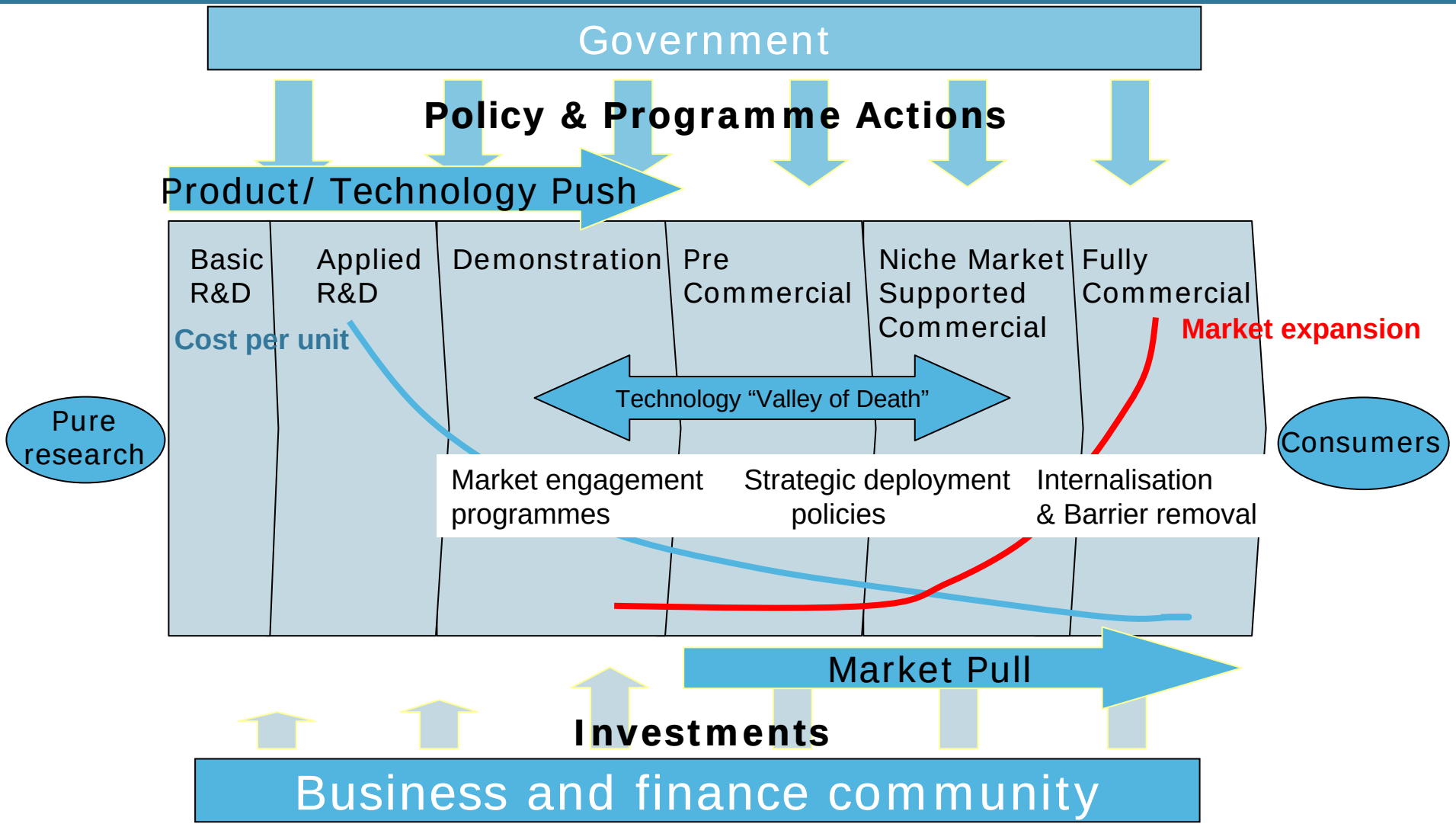


*Source: IMCP (Edenhofer, Lessman et al, **Energy Journal**, 2006)*

In *theory*, rising carbon prices can provide the incentive for strategic investment in innovation…



Accelerating innovation requires combining ‘push’ and ‘pull’ to drive investment in technologies and systems that traverse the entire innovation chain



The international stage ...

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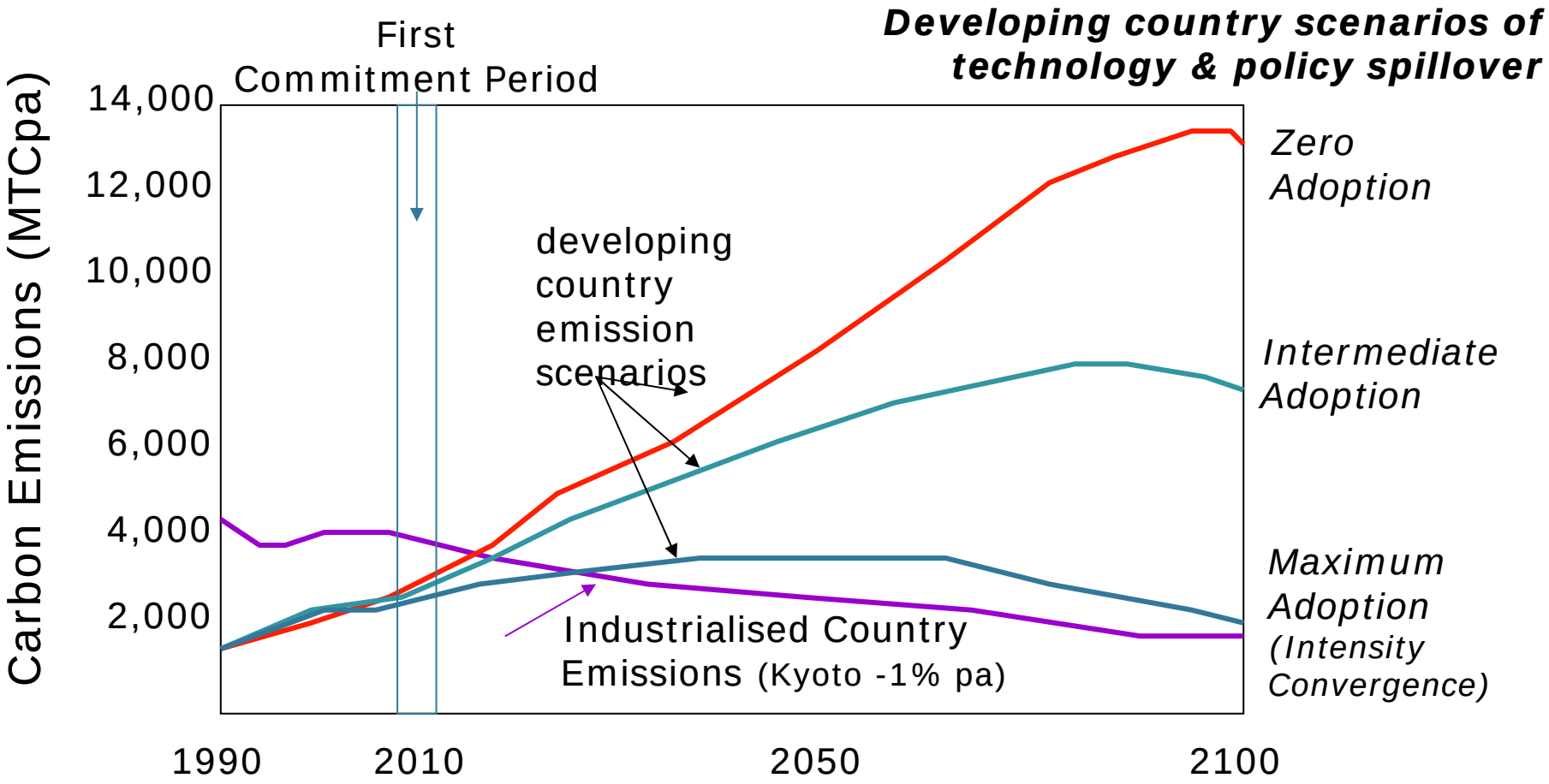
The Kyoto Protocol is a complex package, designed for the longer term

A core structure of sequential commitment periods capping national emissions ('assigned amounts'):

- First period defined for industrialised countries 2008-2012 with differentiated allowances: total 5% reduction below 1990
- 'Basket' of six greenhouse gases, plus some allowance for sinks / land-use change and forestry
- Extensive international adjustment / transfer provisions ('Kyoto flexible mechanisms')
- Negotiations on post 2012 commitments scheduled to start in 2005

\+ Range of other provisions concerning activities in developing countries, technology transfer, policies and measures, etc.

Impact of any Kyoto-like agreement will accumulate over time and depend upon scope & strength of future action



Source: Grubb, Hope and Fouquet, in Climatic Change, 2003

2005 saw the launch of *four international* negotiation processes about the future ..

- The Kyoto Second Period negotiations launched at the Montreal Meeting of Parties to the Protocol (153 countries of which 32 are currently Annex B with a couple seeking to join)
- The UN global dialogue on future action launched at the Montreal Conference of Parties to the UNFCCC (c. 180 countries)
- The Gleneagles (G8+5+?) Dialogue that culminates in Japan in 2008 including the world's Big Emitters
- The Asia-Pacific Partnership on clean technologies including the A-P Big Emitters

.. Whilst the EU ETS continues, joined by a range of other regional trading initiatives, and possibly in different form to avoid adverse investment impacts

- Profits generated under the EU ETS, as well as underlying EU commitment, creating a powerful lobby for continuation
- Competitiveness is a *strategic* issue about investment location: investment security and efficient operation require EU governments to commit unambiguously to continuation of the EU ETS, but in ways that do not drive investment abroad
- To be credible, design and allocation should be based upon joint exploration with other Kyoto Parties of three contingent options:
  1. Sectoral agreements covering all significant trade partners
  2. Sector- and carbon-specific border tax adjustments
  3. Output-based (intensity) allocation and downstream allocation
- Some hybrid of these may be likely

Conclusions and prospects

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Conclusions:
Tackling greenhouse gas emissions requires understanding and action in four broad areas

- Economic Instruments and the EU ETS
  - Emissions trading is appropriate for the sectors it covers; EU ETS reveals problems to be fixed, but it is here to stay
- Business behaviour and energy efficiency
  - The potential to improve energy (and wider resource) efficiency is real and can yield net benefits; this and the growing perception of strategic risks helps to form a locus of positive business involvement
- Innovation
  - Innovation is a complex process, carbon prices are a necessary but not sufficient component, a far richer mix of instruments are required; again, net benefits from successful strategies are possible

... and

After long hiatus, the international process is slowly gearing up ….

- There is not yet any feasible ‘zone of agreement’, but ..
- Conditions are changing and 2007-8 will see a number of forces combining for breakthroughs:
  - IPCC Fourth Assessment, and Stern Review, will force open the international debate on the basis of the seriousness of problem and the feasibility of solutions
  - Established carbon markets and investment flows through Kyoto mechanisms will embed these as a ‘reality’
  - Growing business concern about risks of inaction, and costs of an unstable and fragmented international regime, will help convergence
  - Growing appreciation that ‘energy efficiency’, carbon markets and technology innovation are not alternates, but complements appropriate to different parts of the problem, can expand the ‘solution space’
- But the key issue at present remains Implementation ..

Further information

EU ETS & Kyoto mechanisms:
www.climate-strategies.org
'Allocation and competitiveness in the EU ETS'
Climate Policy Special Issue, 2006

Energy efficiency, innovation & the Carbon Trust:
www.carbontrust.co.uk 'UK Climate Change Programme: potential evolution for business and public sector'

Global economics: 'Endogenous technical change & the economics of atmospheric stabilisation',
Energy Journal Special Issue, 2006

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