

Climate Change solutions in theory and practice:

national and international dimensions

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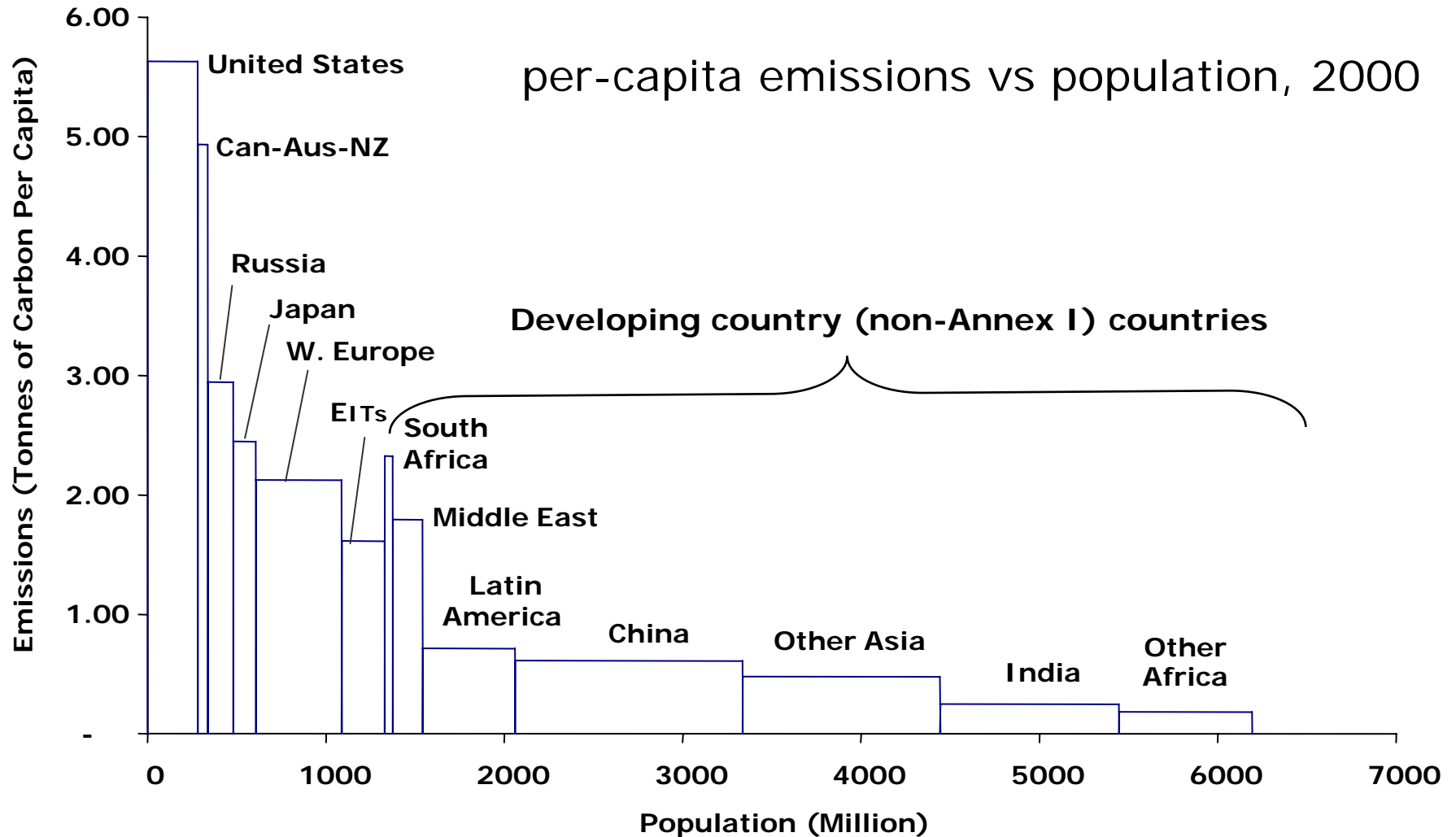

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Outline

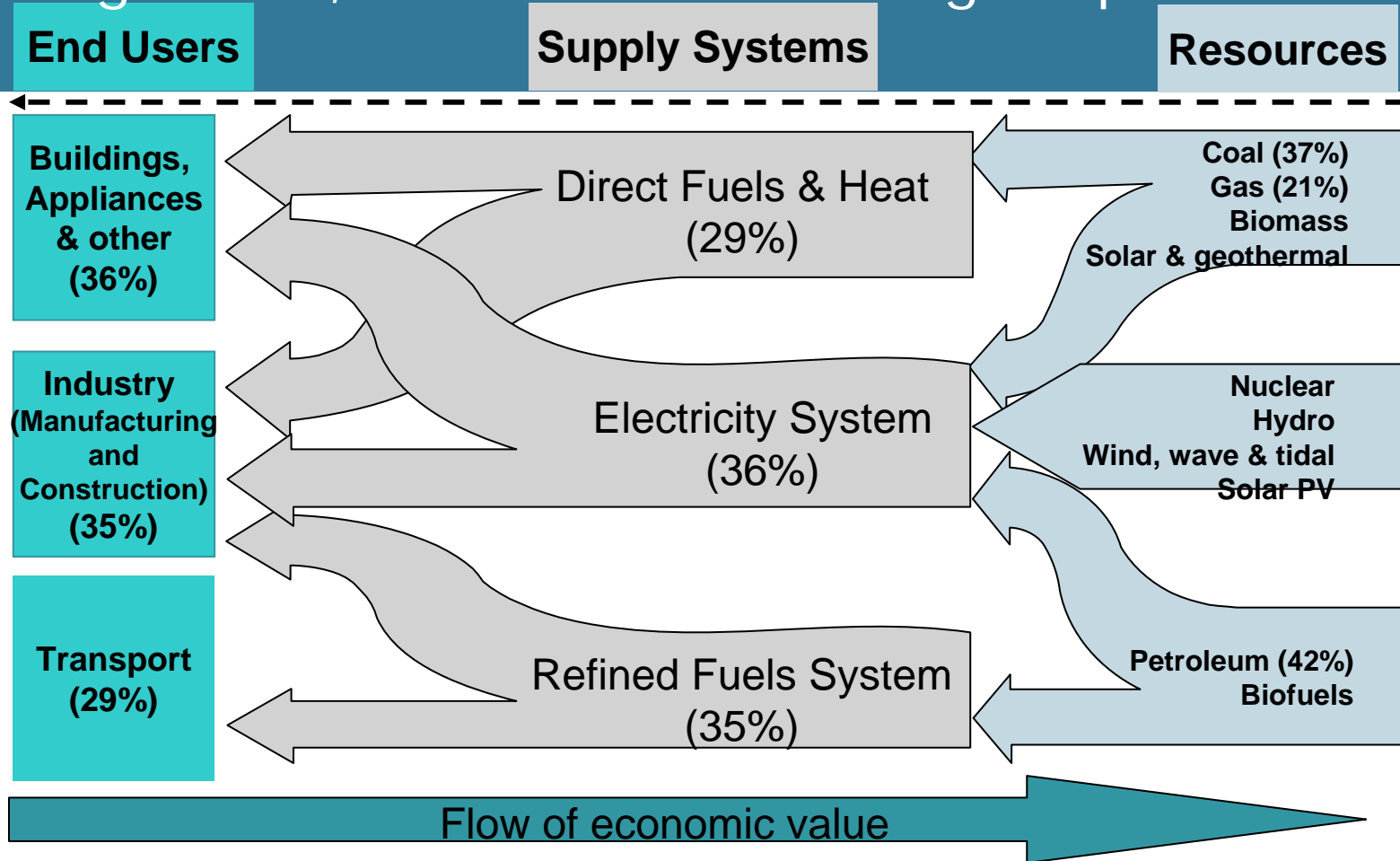
- Structuring solutions: the economic components of CO₂ emissions and potential mitigation
- Business behaviour and energy efficiency
- Economic instruments and insights from the EU Emissions Trading Scheme
- Low carbon innovation: potential, costs and delivery
- The international stage
- Conclusions

Structuring solutions: components of CO₂ emissions and potential mitigation

Highly diverse patterns of emissions underlie political complexities and huge pressures for global CO2 growth – successful leadership examples are essential in each group



Energy-CO2 emissions arise from six main components that are diverse in structural & economic characteristics, driving forces, resource & technological possibilities ...



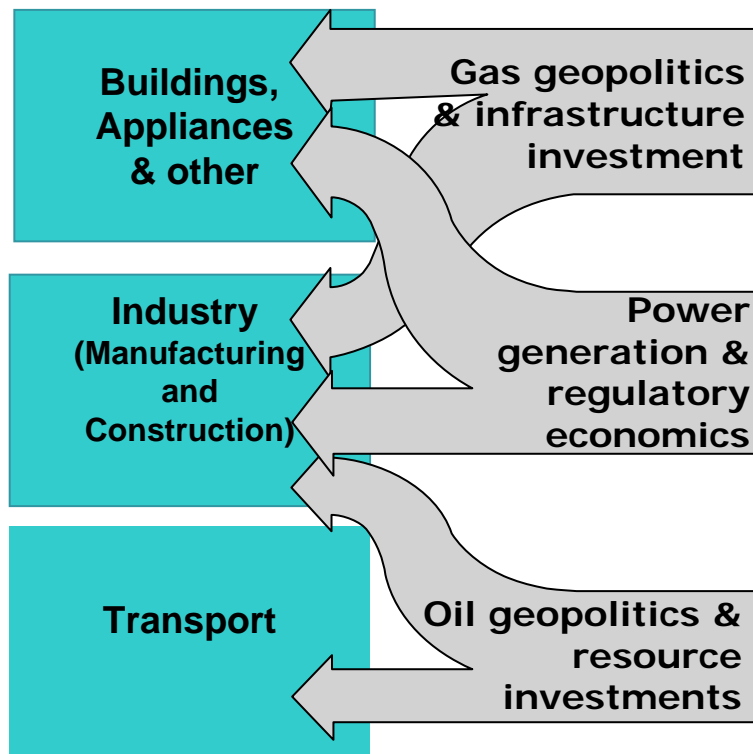
The data show the % of global energy-related CO2 emissions associated with the different parts of the energy system (including emissions embodied in fuels and electricity). Note that patterns vary between regions (eg. industry is lower and transport higher in developed economies), and the sectors are 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 %CO2 assumed equal to Petroleum % CO2; direct fuels and heat is the residual.

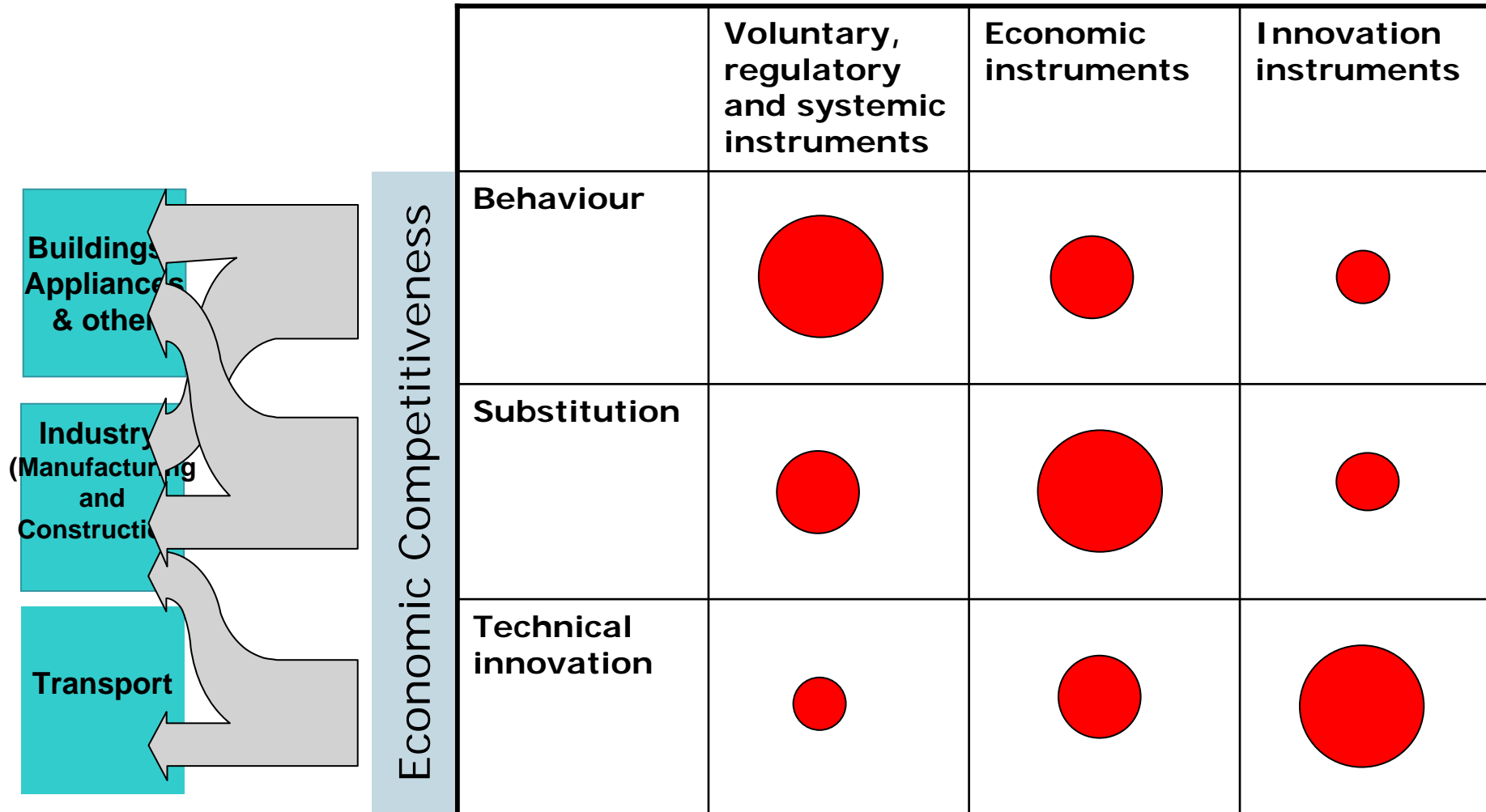
Resources: Source EIA

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 by one tech
 - costs and competitiveness reflect the range of +ve & -ve impacts

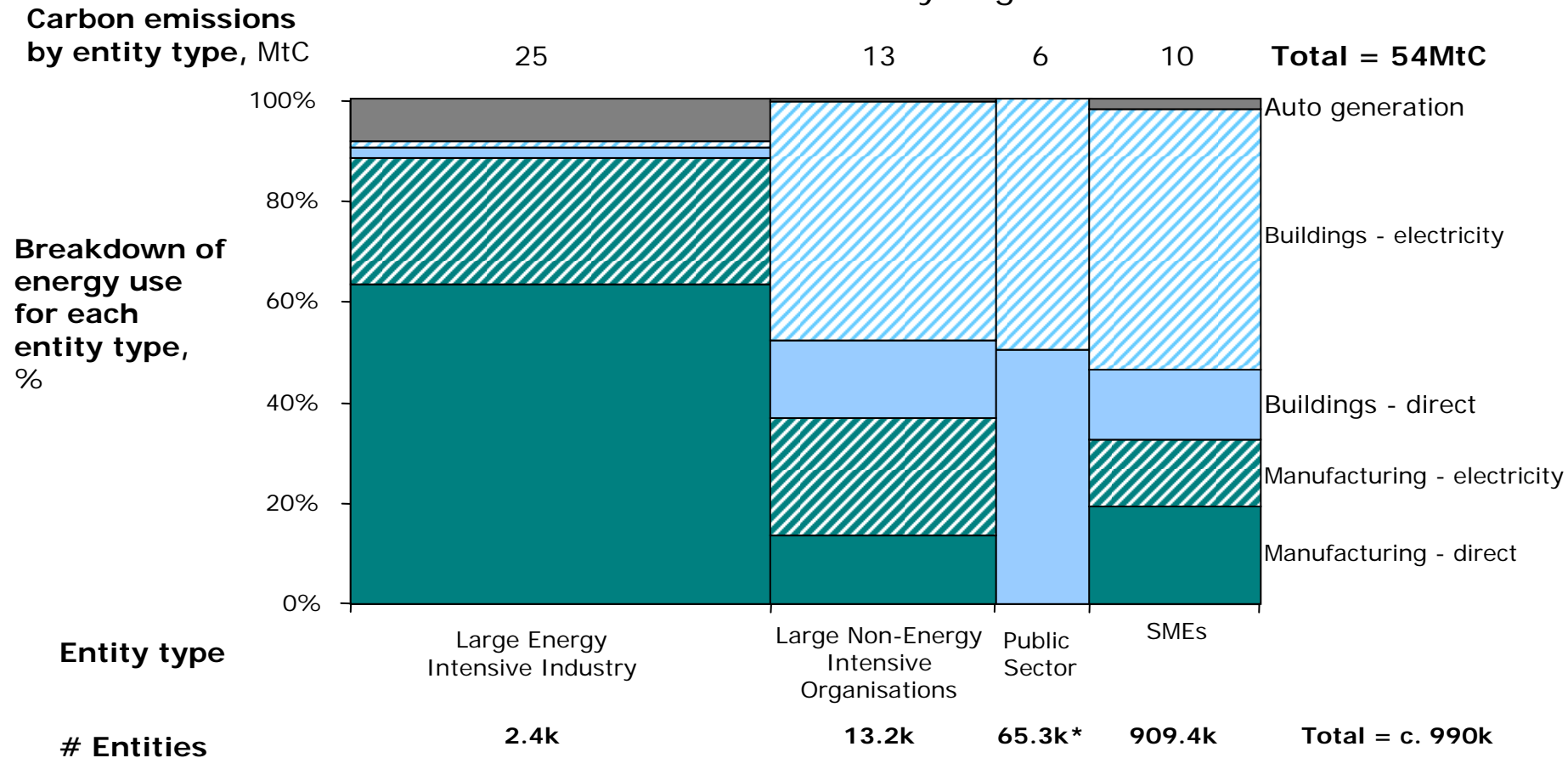


Business behaviour and energy efficiency

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

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

Carbon Emissions by Segment



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)

Cost effective abatement opportunity

Technical potential

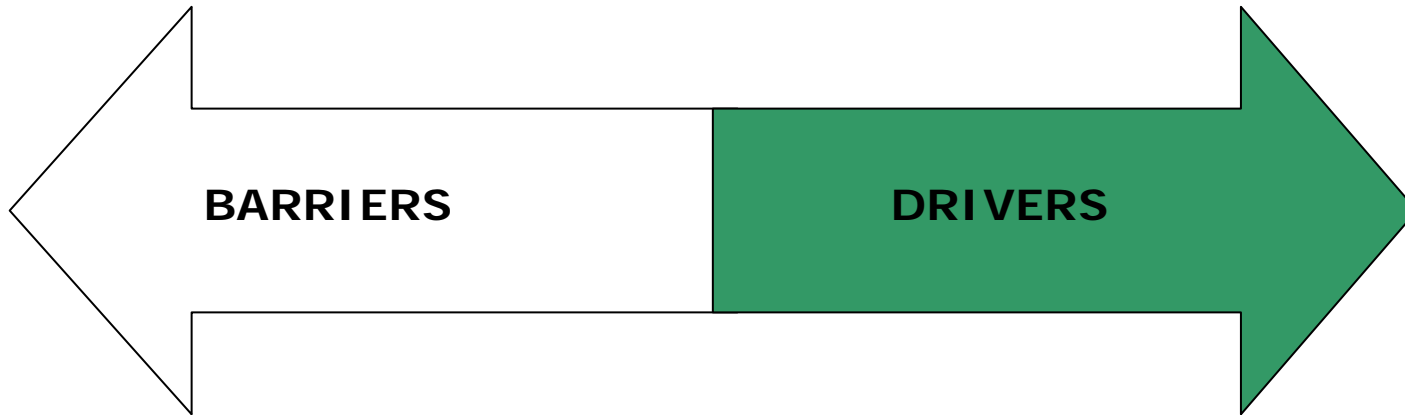
MtC (% of total emissions in brackets); NPV positive at 15% discount rate

(current technologies)



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

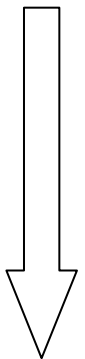
Efficient policy needs to target the factors that drive and impede organisational decision-making, in four main categories



- **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."*

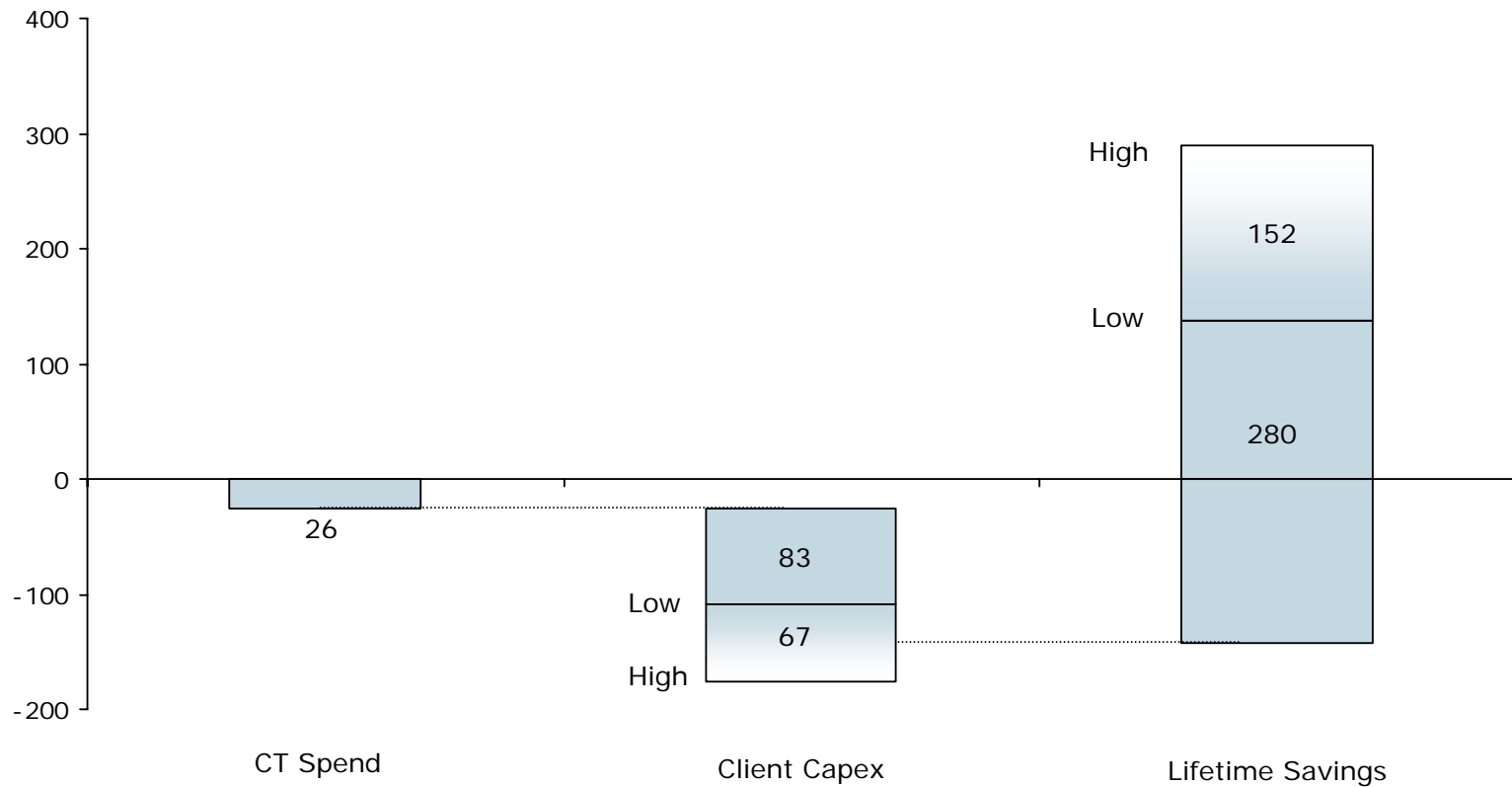
Combined effect is to make Awareness and Motivation critical aspects:

"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

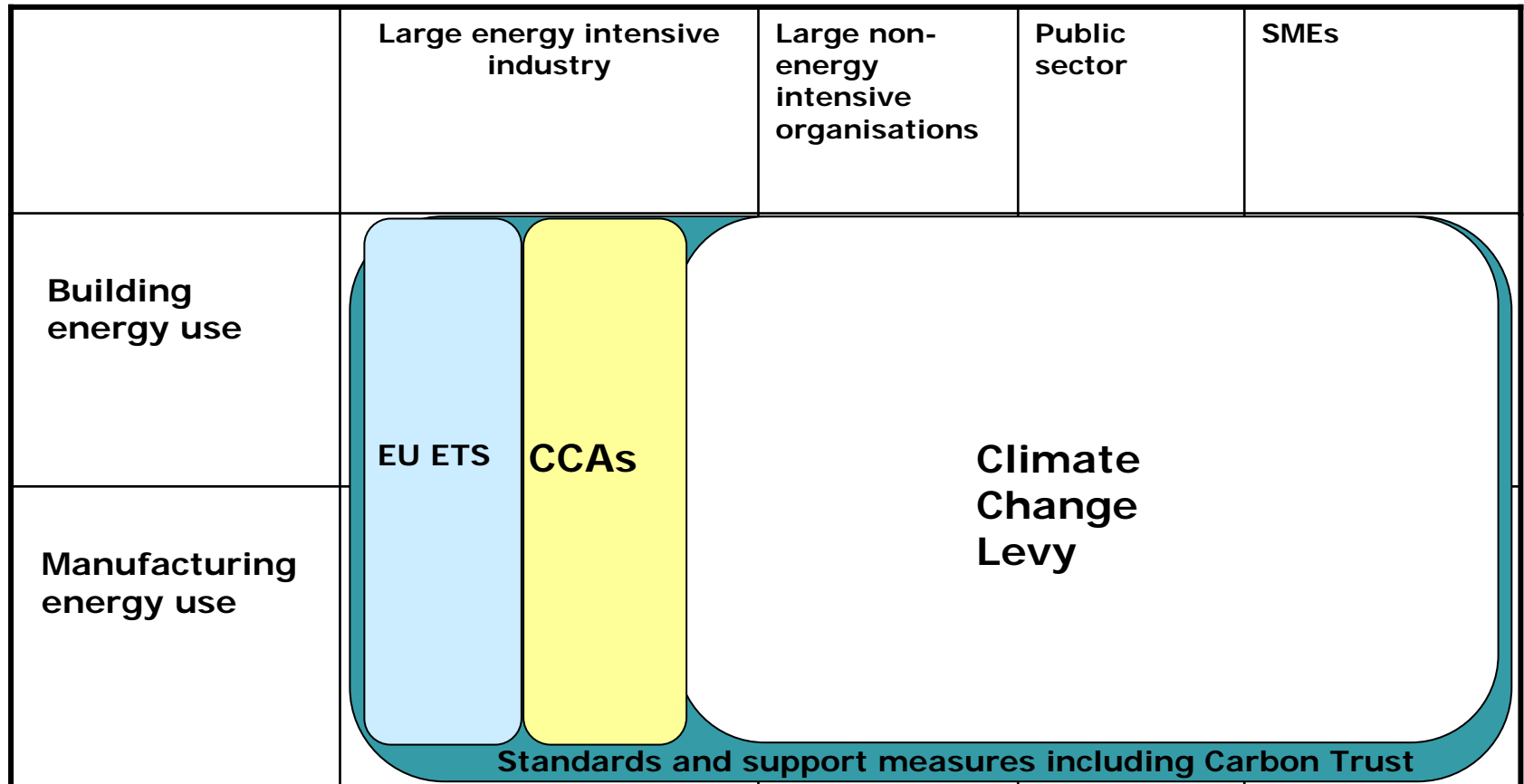
Investment costs and lifetime energy savings

2004-05 (£m)



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

Gaps in CCP for less energy intensive segments need addressing

... to increase transparency and leverage corporate drivers for large companies

UK carbon embodied ETS

- Includes electricity
- Company based
- 100% auctioning (rebate on CCL)
- Based on good metered data
- Results in annual reports
- Potential to include other emissions, e.g. haulage
- Possible to link to other schemes

... to take symbolic lead and use government purchasing power

Public sector leadership

- Improve governance and accountability
- Increase internal capability
- Top quartile buildings procurement
- Interest free ring-fence funds for energy efficiency investments

... to overcome SME transaction costs and financial barriers

EEC for SMEs

Product standards

Loans for SMEs

- EEC for SMEs: place the burden on suppliers
- Product standards: remove poor equipment from the marketplace
- Interest free loans for SMEs: provide access to capital

Economic instruments and the EU Emissions Trading Scheme

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

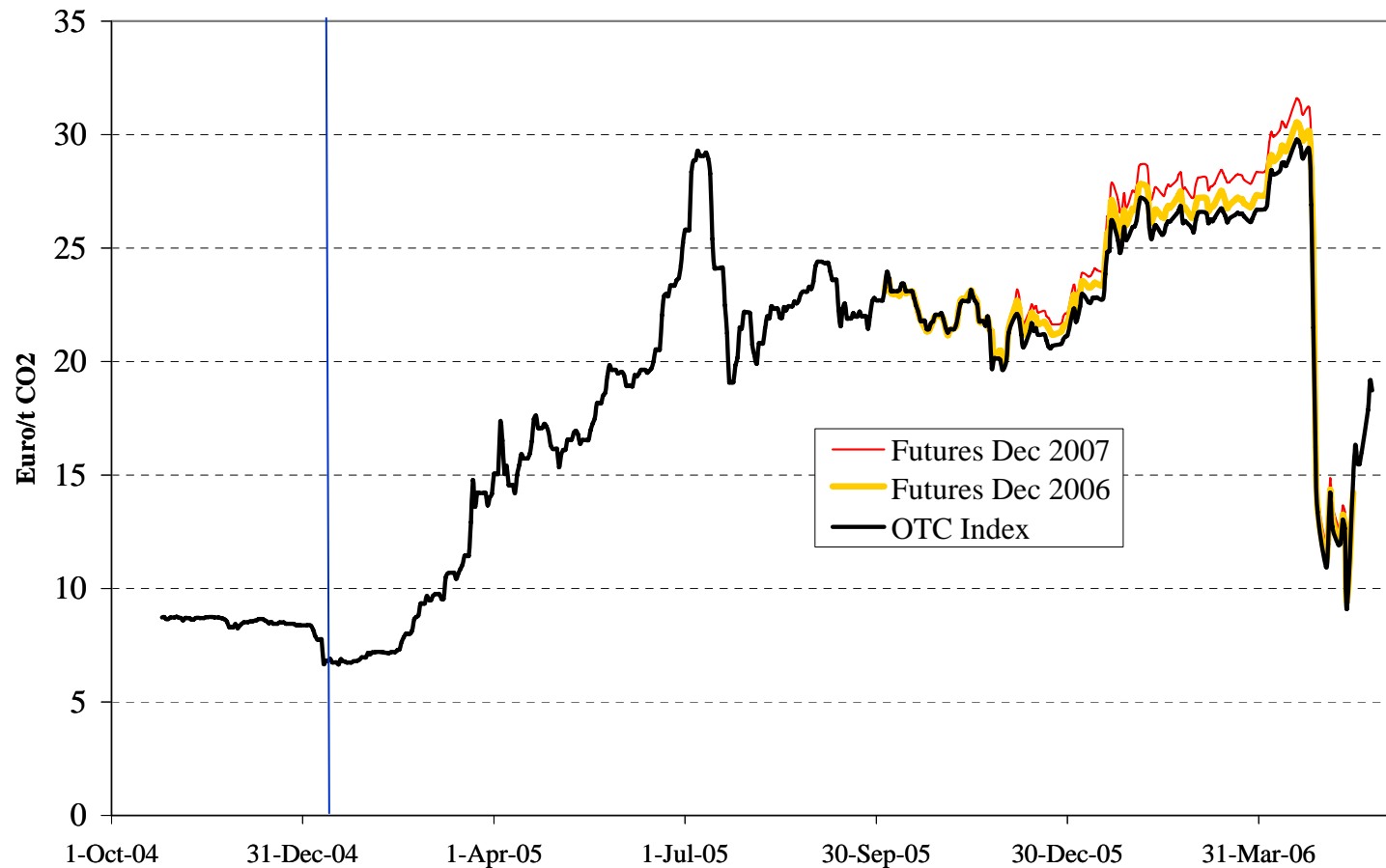
Timing

- 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.

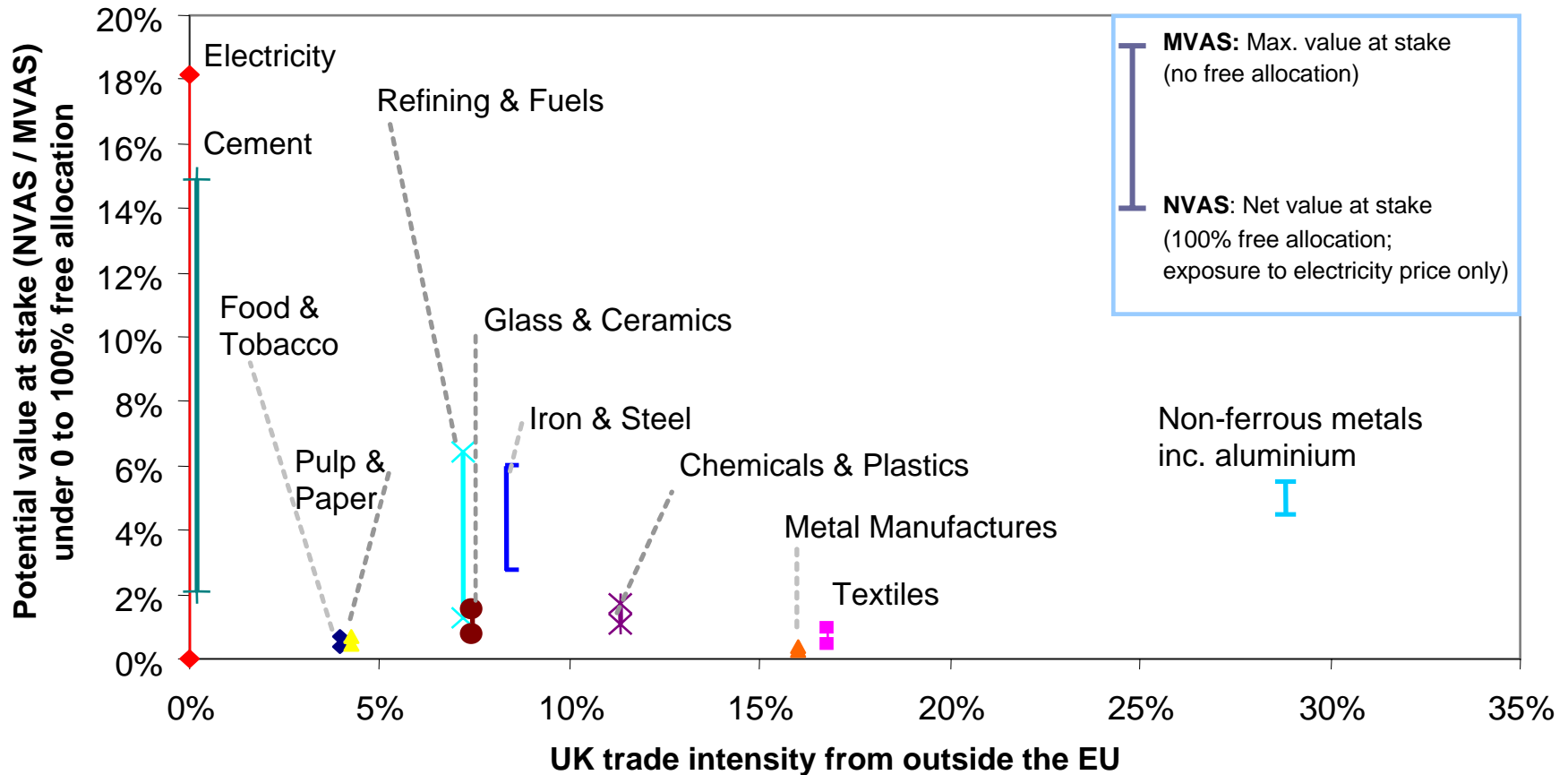
The market works but carbon price has had a bumpy ride since inception



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

Profit/loss depends upon pricing policies and incentives, allocation, and trade situation: potential to profit *net* value-at-stake insufficient for major Phase II problems



- **Upper end of range:** zero free allocation
- **Lower end of range:** 100% free allowances (effect of €10/MWh electricity price increase to sectors)
- Assumes allowance price of €15/tCO₂ and no CO₂ price pass through in 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

























Some specific conclusions around the EU ETS

- The major problems are not with market design, but with the allocation process
 - Allocation and efficiency *do* interact particularly with repeated-rounds
 - The logical solution to most problems with the EU ETS is to work towards greater auctioning over time
 - Free allocation can only work if there is a central authority empowered to accept or reject allocation plans according to agreed criteria
- For the longer term, continuing free allocation will require greater institutional independence of allocation authorities, tasked with neutralising P&L impacts rather than a host of other pressures
- Competitiveness is not an issue for operational costs in the present phase, but it is an issue for new investment in specific sectors: may imply structural changes post 2012

Low-carbon innovation: Potential, costs and delivery

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

- eg. SuperGen studies of very low carbon UK electricity

	Local rural network		Offshore wind		Tidal generation
	Local urban network		Onshore wind		Biomass
	Interconnector		CCGT		Photovoltaic generation
	Overhead AC transmission		CCGT with carbon sequestration		CHP
	Overhead DC transmission		Coal generation		FACTS
	Undersea DC transmission		Coal with carbon sequestration		Microgrid
	Underground AC transmission		Nuclear		Energy storage
	Underground DC transmission		Wave generation		Demand-side control

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%

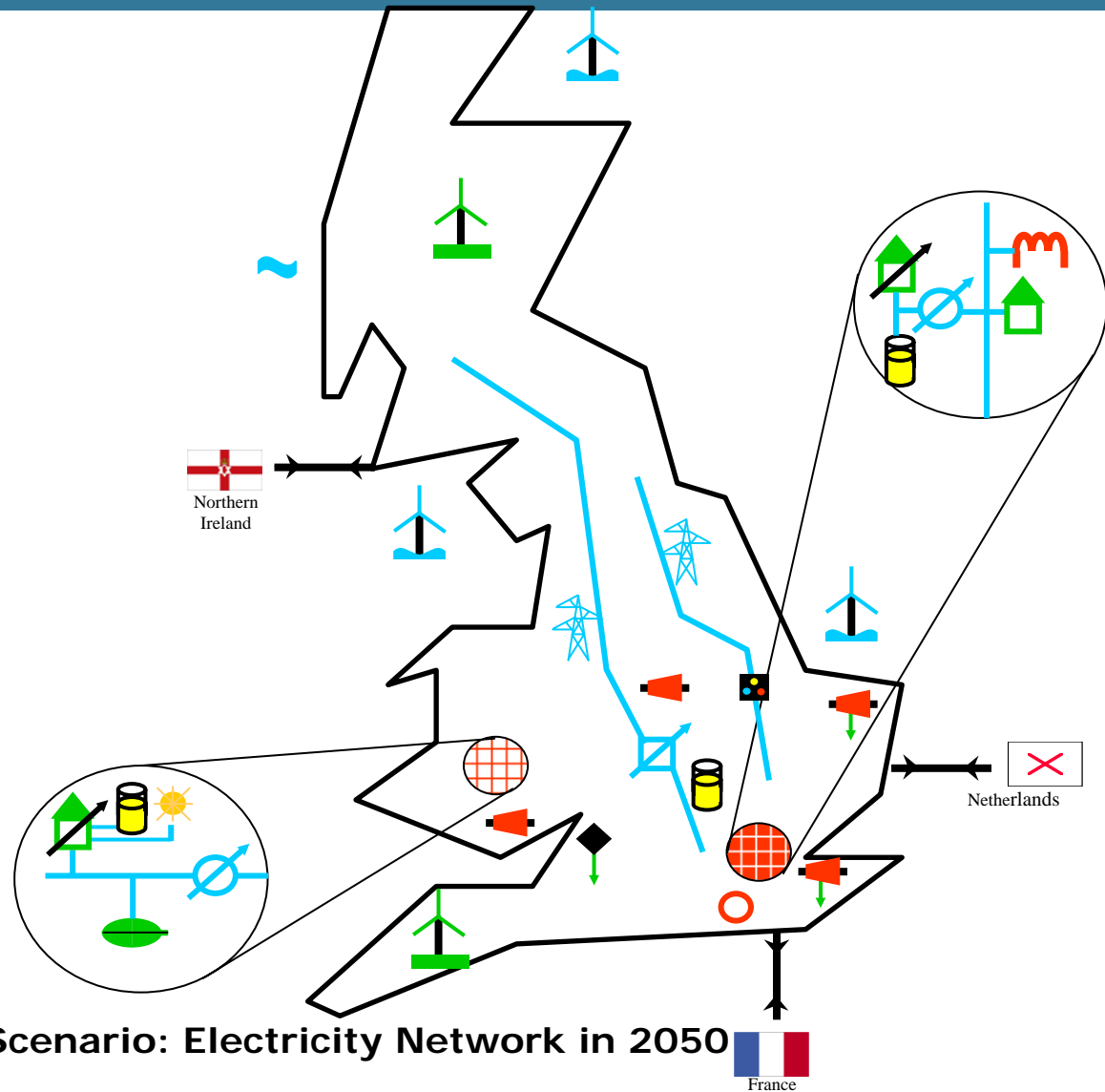


Figure 1.3 : “Business as Usual” Scenario: Electricity Network in 2050

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%

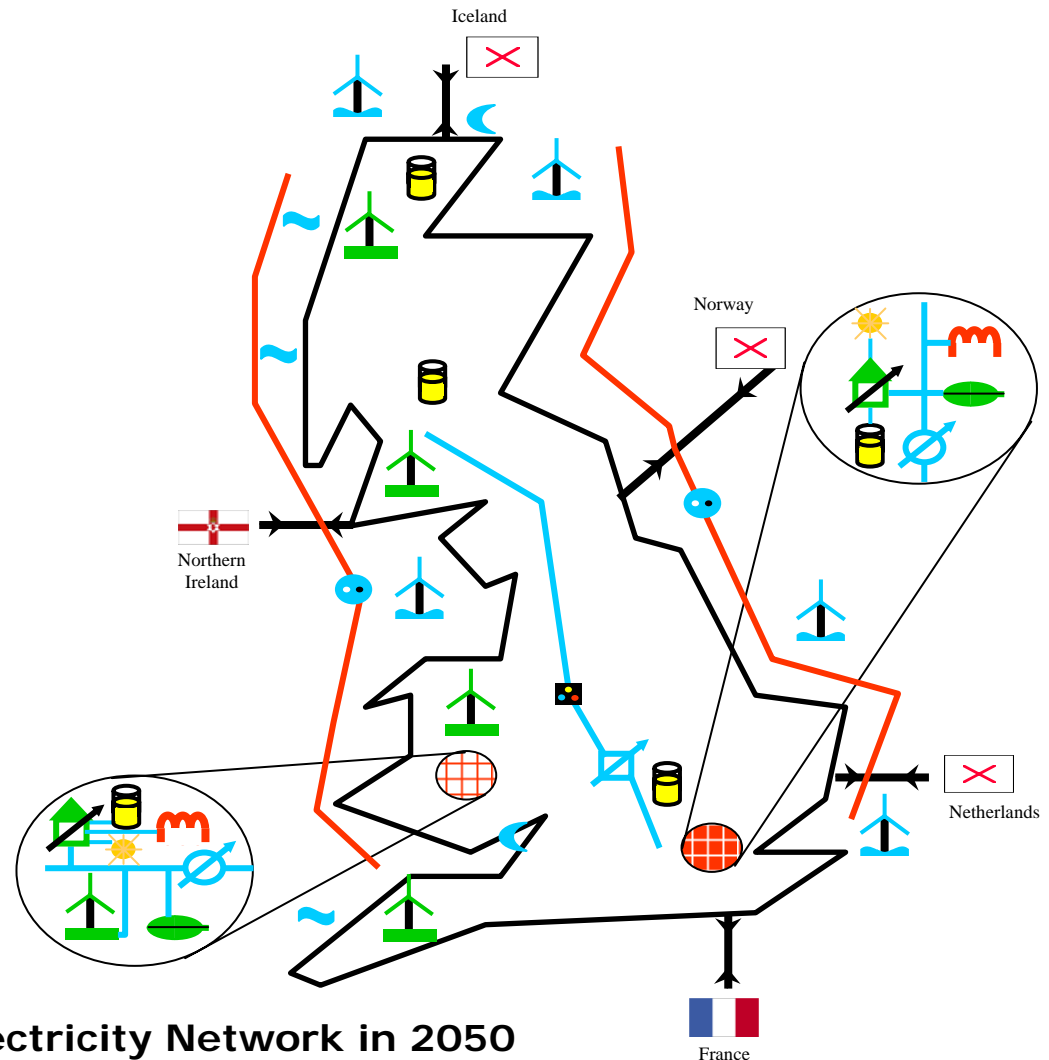
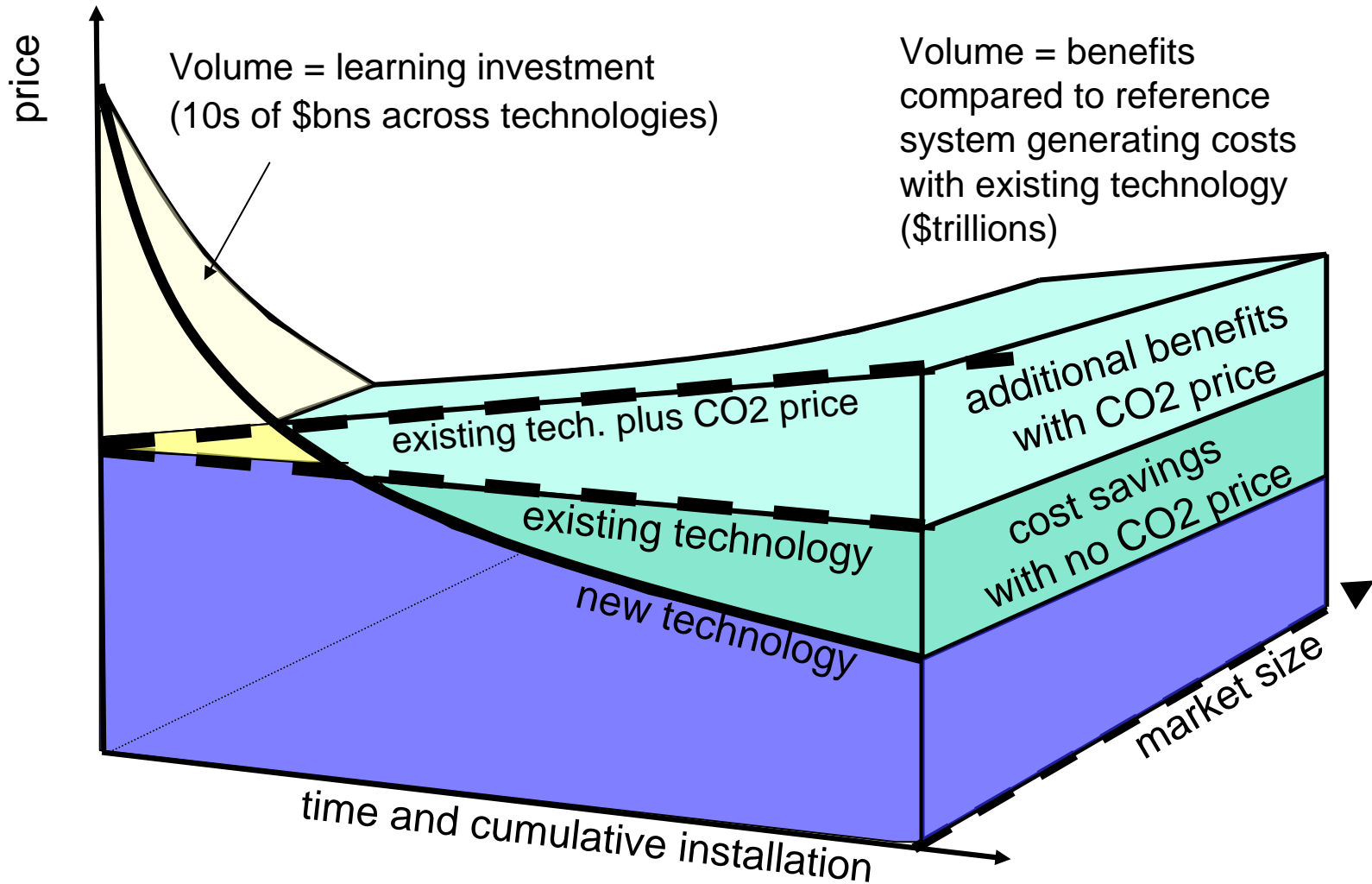
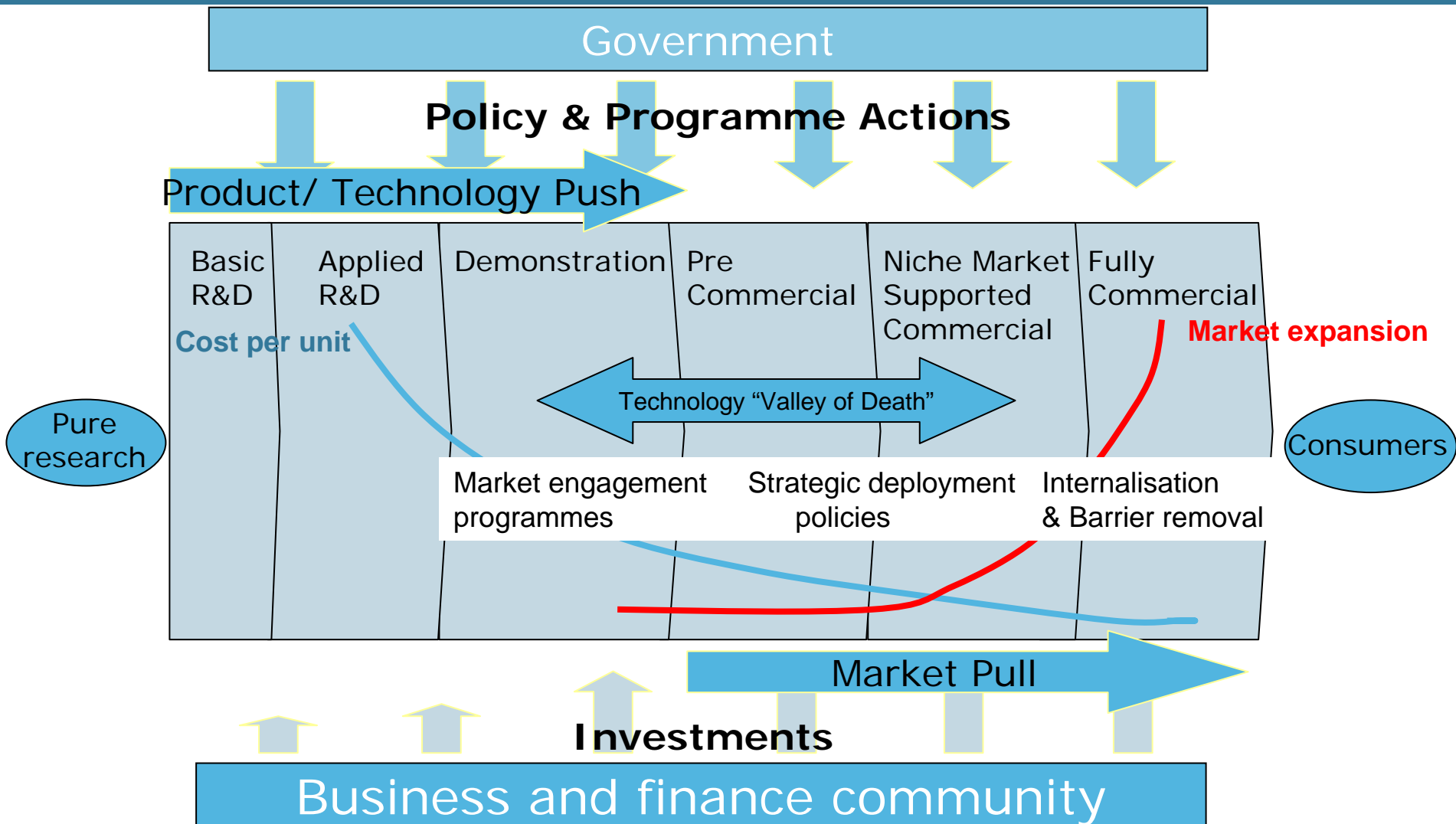


Figure 1.5 : “Green plus” Scenario: Electricity Network in 2050

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

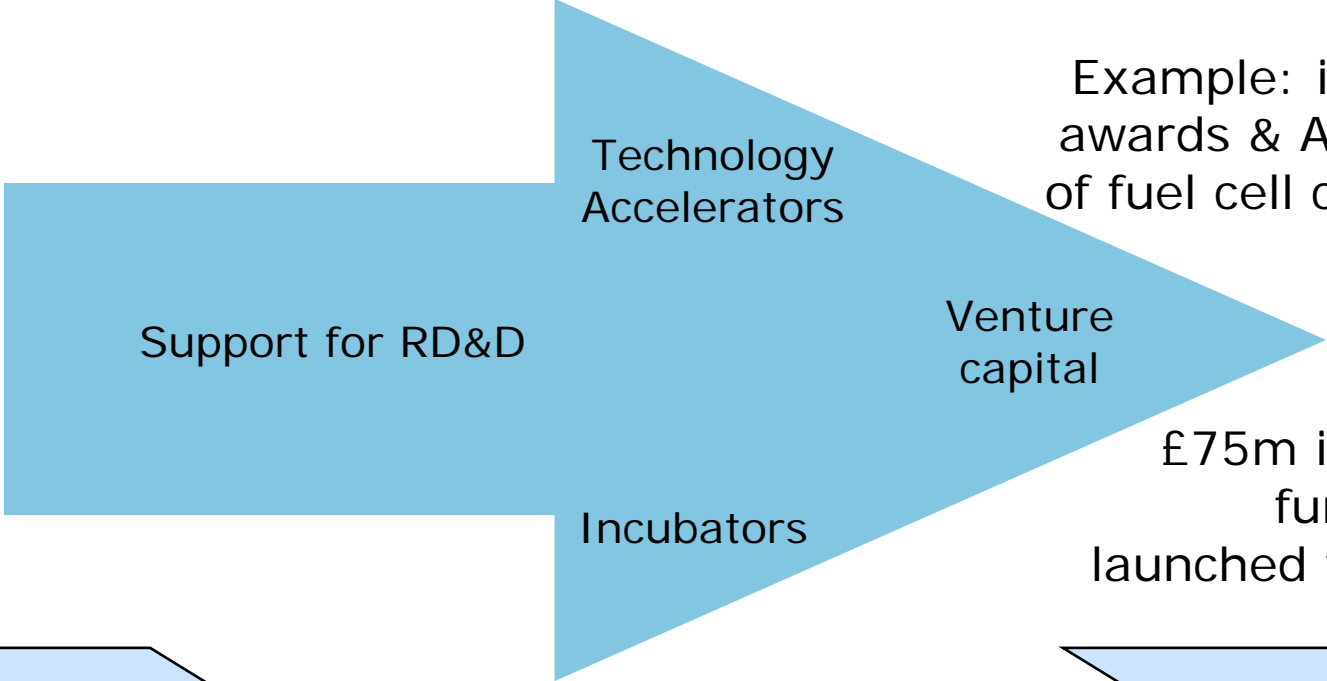
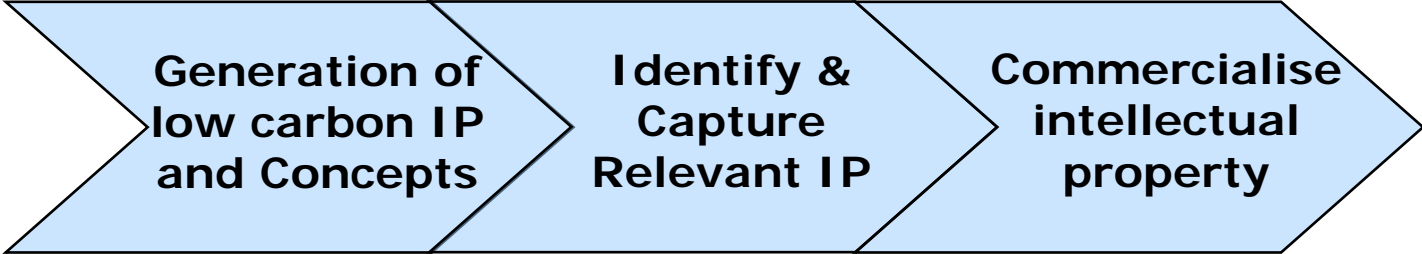


Accelerating innovation requires combining 'push' and 'pull' to drive investment in technologies and systems that traverse the entire innovation chain



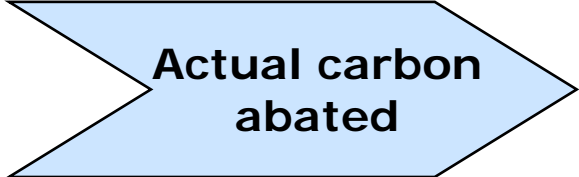
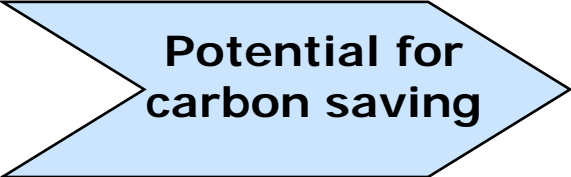
Even 'market engagement' requires a mix of instruments

Carbon Trust support for innovation commercialisation



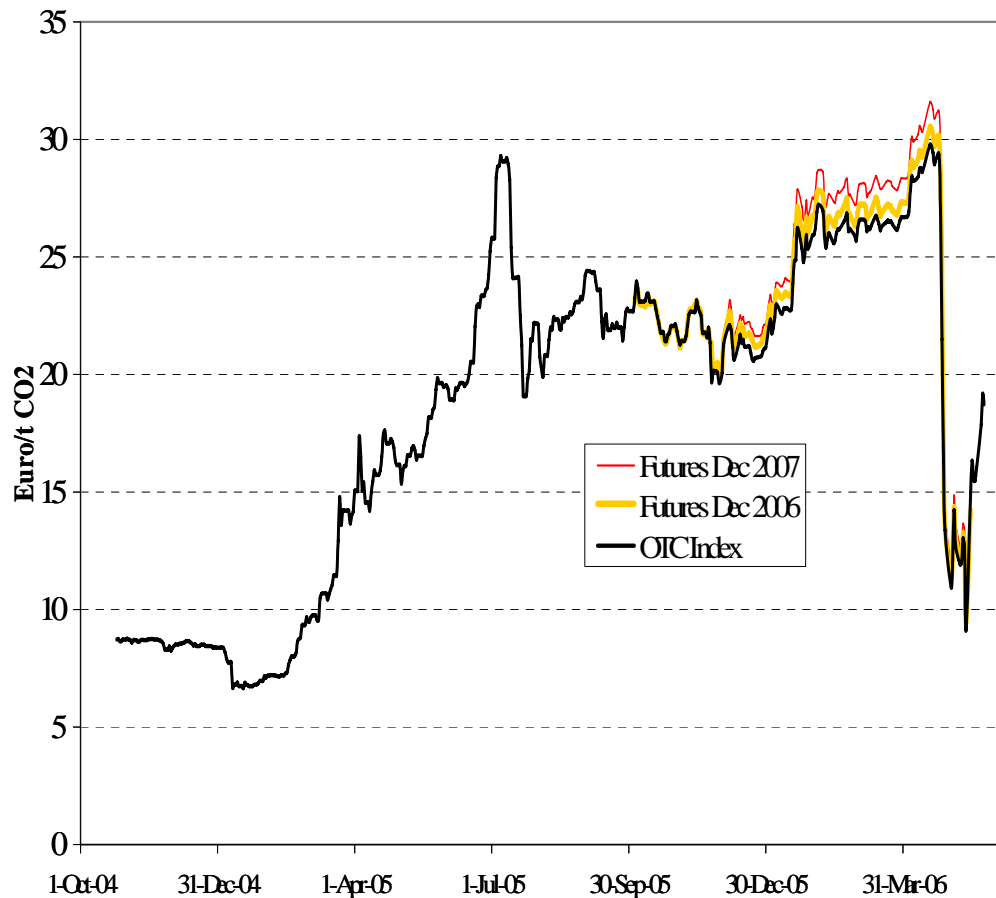
Example: innovation awards & AIM launch of fuel cell companies

£75m investment fund offering launched this month



Where might the money for innovation programmes come from?

Rents in the EU ETS – enough to pay the bill ?



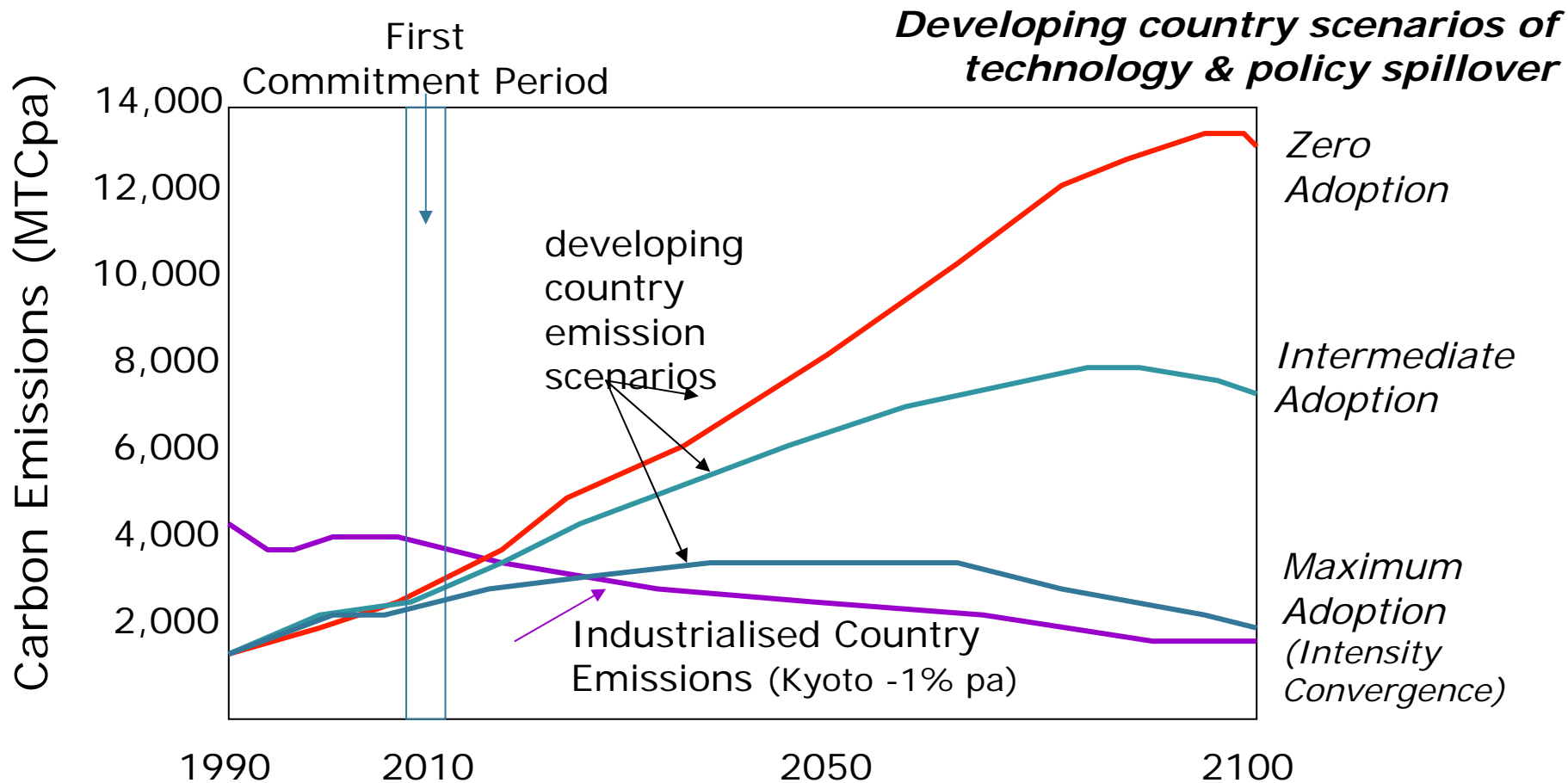
- Power sector profits from EU ETS c. €5bn during 2005
- E.On announce €100m R&D Centre
- UK Environmental Transformation Fund announced 'co-incident' with Auctioning decision
- UK £1bn National Institute for Energy Technologies (NIET) announced to be 50:50 co-funded with private sector, initial sponsors E.On, EdF, Shell, BP.
- International and sectoral investment linkages emerging through the CDM

The international stage ...

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

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

Any future development of the cap-and-trade structure could be usefully complemented by developing 'other legs' of the UNFCCC/KP package

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')
 - Joint Implementation
 - Clean Development Mechanism
 - International Emissions Trading
- + Range of other provisions concerning activities in developing countries, technology transfer, policies and measures, etc.

.. Whilst the EU ETS will continue, 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

Conclusions:

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

- 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
- 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
- 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'
- The most fundamental determinant of the future is whether the Kyoto Parties succeed in implementation
- New Zealand decisions could play an interesting role ..

Further information

Energy efficiency, innovation & the Carbon Trust:

www.carbontrust.co.uk

'UK Climate Change Programme:
potential evolution for business and public sector'

EU ETS & Kyoto mechanisms:

www.climate-strategies.org

'Allocation and competitiveness in the EU ETS'
Climate Policy Special Issue, 2006

Global economics:

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

The four topic-areas of talks on this tour

..

- Economic Instruments and the EU ETS
 - *Opening CEEM conference, 26 Oct 06, covering EU ETS, competitiveness & lessons learned*
- Business behaviour and energy efficiency
 - *Joint Lecture to IPS & Energy Federation of New Zealand conference on climate change mitigation, Wellington NZ, 18 Oct 06*
- Innovation
 - *UNU Canberra, Friday 20 October, on innovation chain, instruments for innovation and UK / Carbon Trust investment strategy*
- International policy and business strategies
 - *Lowy Institute, Sydney 25 October, and remarks from panel at end of CEEM conference on 26 October*