

Analytical Audit

Executive summary

This paper is based on analysis prepared by the Office of Climate Change to facilitate discussion within government departments – it is not a statement of Government policy.

The OCC Board commissioned this audit to provide a consistent analytical base for climate change policy

All Departments with an interest in climate change conduct high quality analysis.

However, there is a perception that this is not always presented consistently across government.

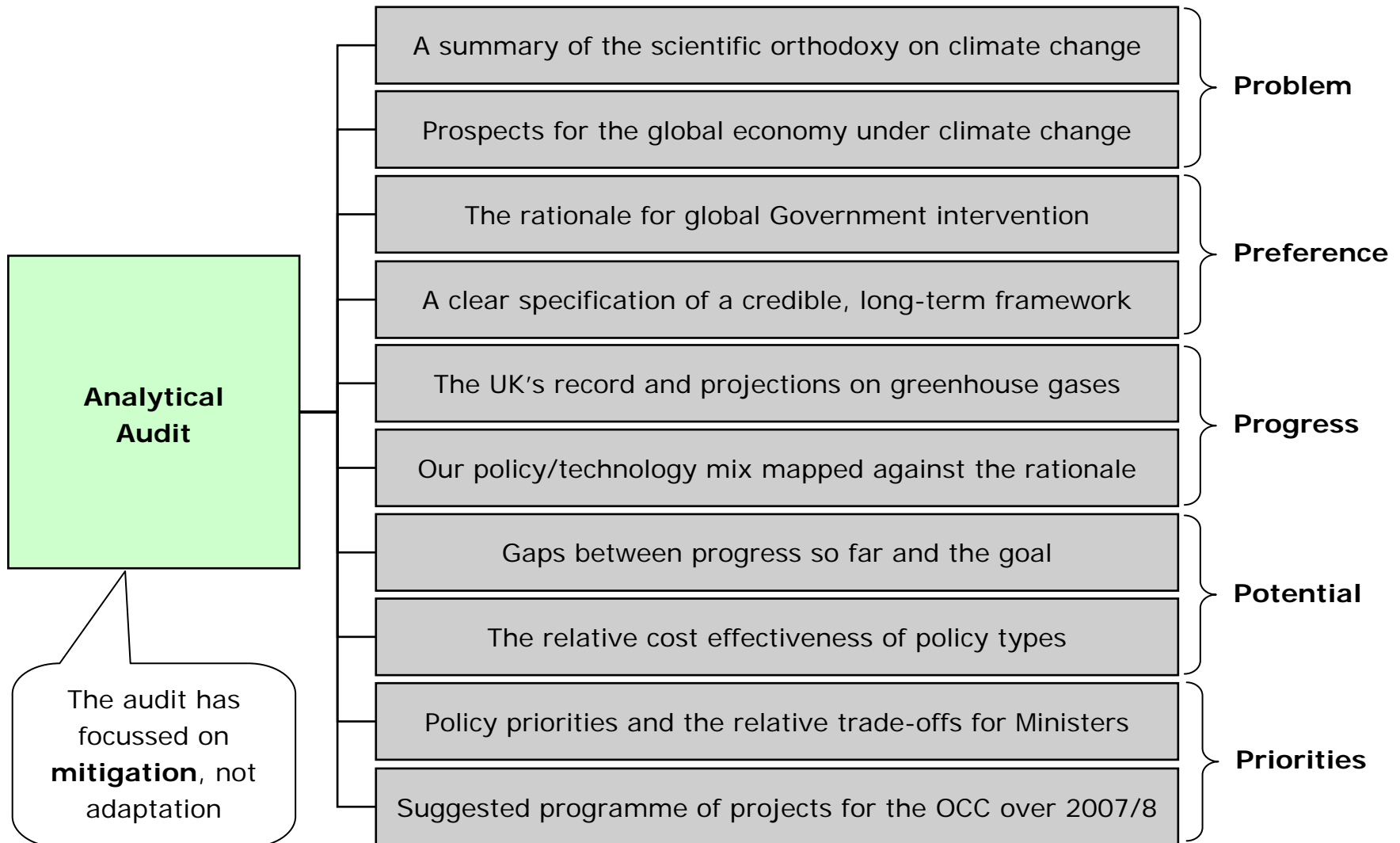


Analytical Audit – Terms of Reference

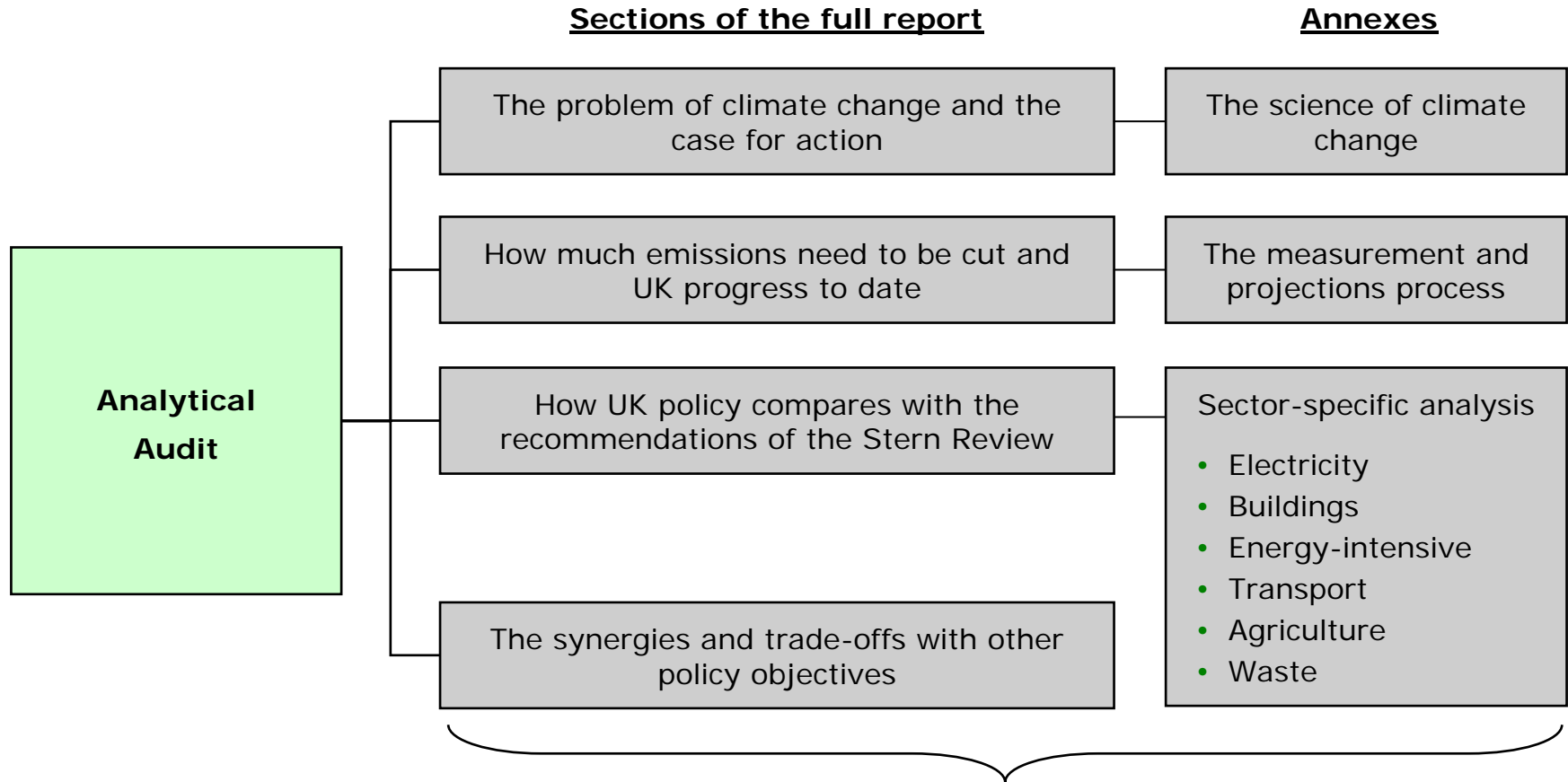
The project will present an analytical audit on issues, progress and priorities in climate change by:

- auditing our current knowledge and policy choices, to advise on progress and evidence;
- consolidating the existing analysis on UK and international climate change issues and our existing and projected emissions;
- presenting a balanced view of the trade-offs that Ministers face, based upon a consistent overview; and
- identifying priorities that Ministers may want to explore further.

Its findings will give us a common understanding of the problem we face and the priorities for tackling it



The full report is organised into four sections plus more detailed annexes – this paper is an executive summary



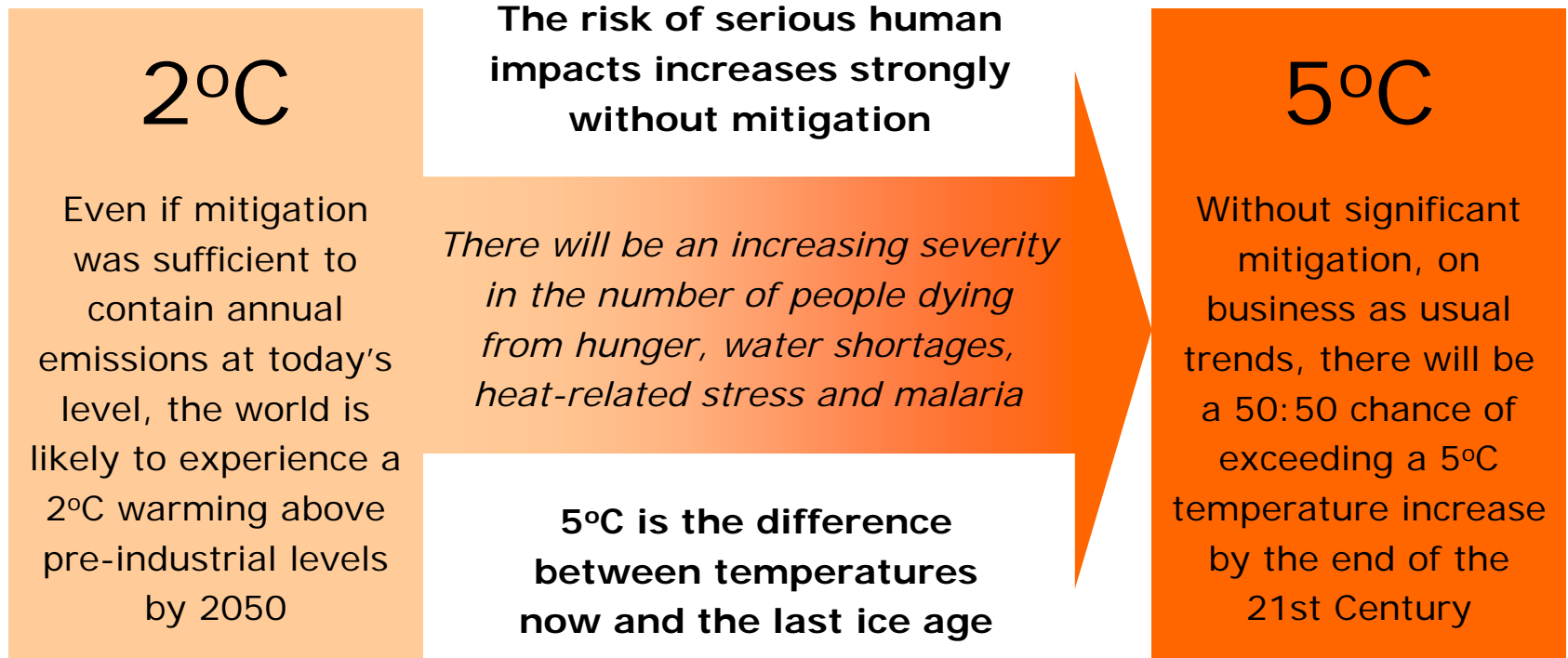
This paper is an executive summary of the full report and all of its accompanying annexes

Contents

- The problem of climate change and the case for action
- How much emissions need to be cut and UK progress to date
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Our *scientific annex* demonstrates that there is a resounding consensus on the central scientific case

- **Global warming is real:** average surface temperature has increased by 0.74°C over the last hundred years, a rate and scale likely to have been greater than at any time in at least the past 1000 years
- **Global warming is man-made:** most of the warming over the last 50 years is attributable to greenhouse gases from human activities



Furthermore, Stern has shown that there is an undeniable economic case for urgent action

1% GDP

Cost of mitigation in 2050 of recommended stabilisation path

vs

5% GDP

Income loss if we do nothing
(market impacts only)

20% GDP

Income loss including non-market impacts, risk and equity

- **This low global cost is achievable if:**
 - low cost abatement is realised
 - high cost abatement is not pursued
 - international action is coordinated
 - Stern's policy framework is followed

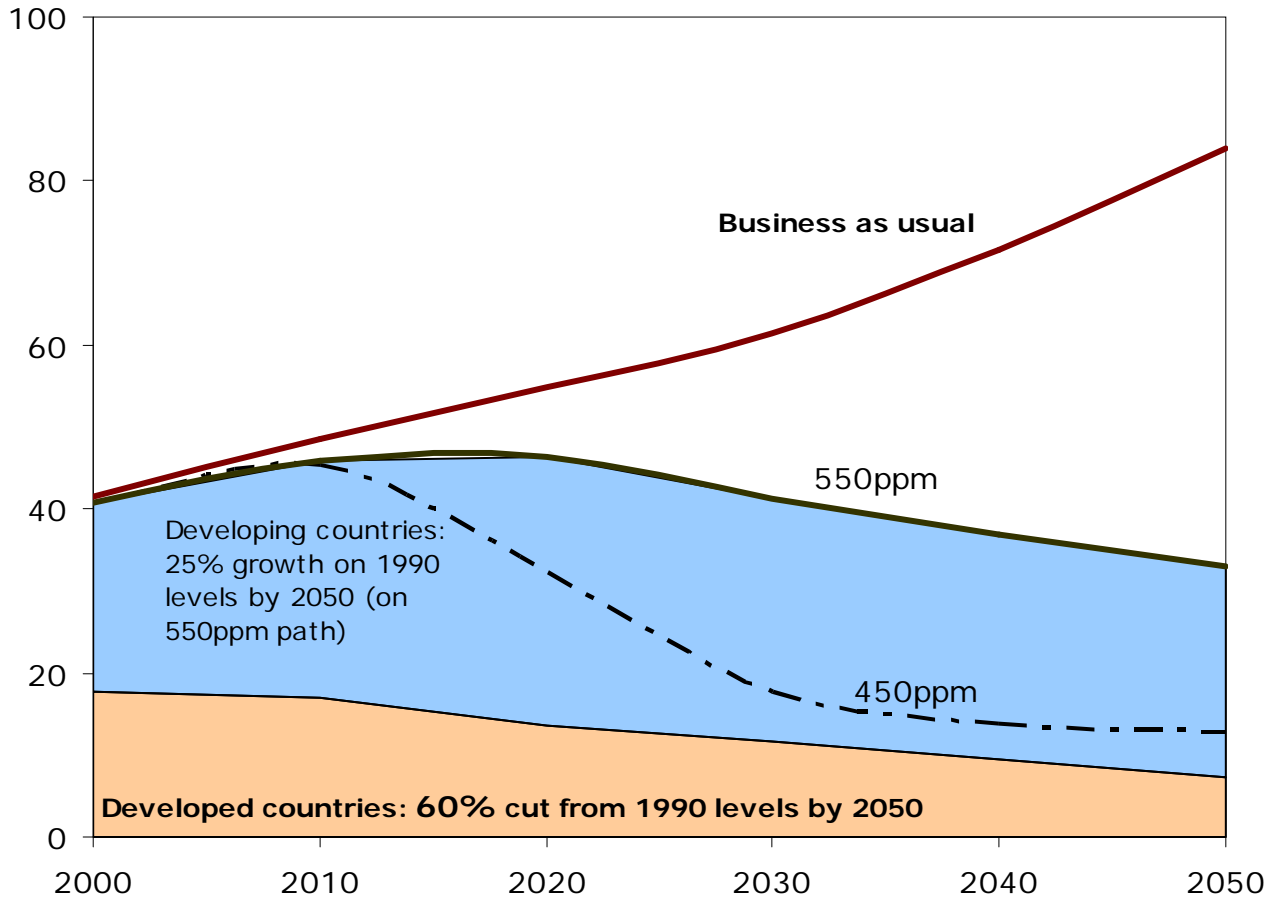
- **Delay is a dangerous option** because damages from climate change rise disproportionately with temperature
- Adaptation is crucial for responding to unavoidable climate change but **there are limits to how much it is possible to adapt to the worst effects**

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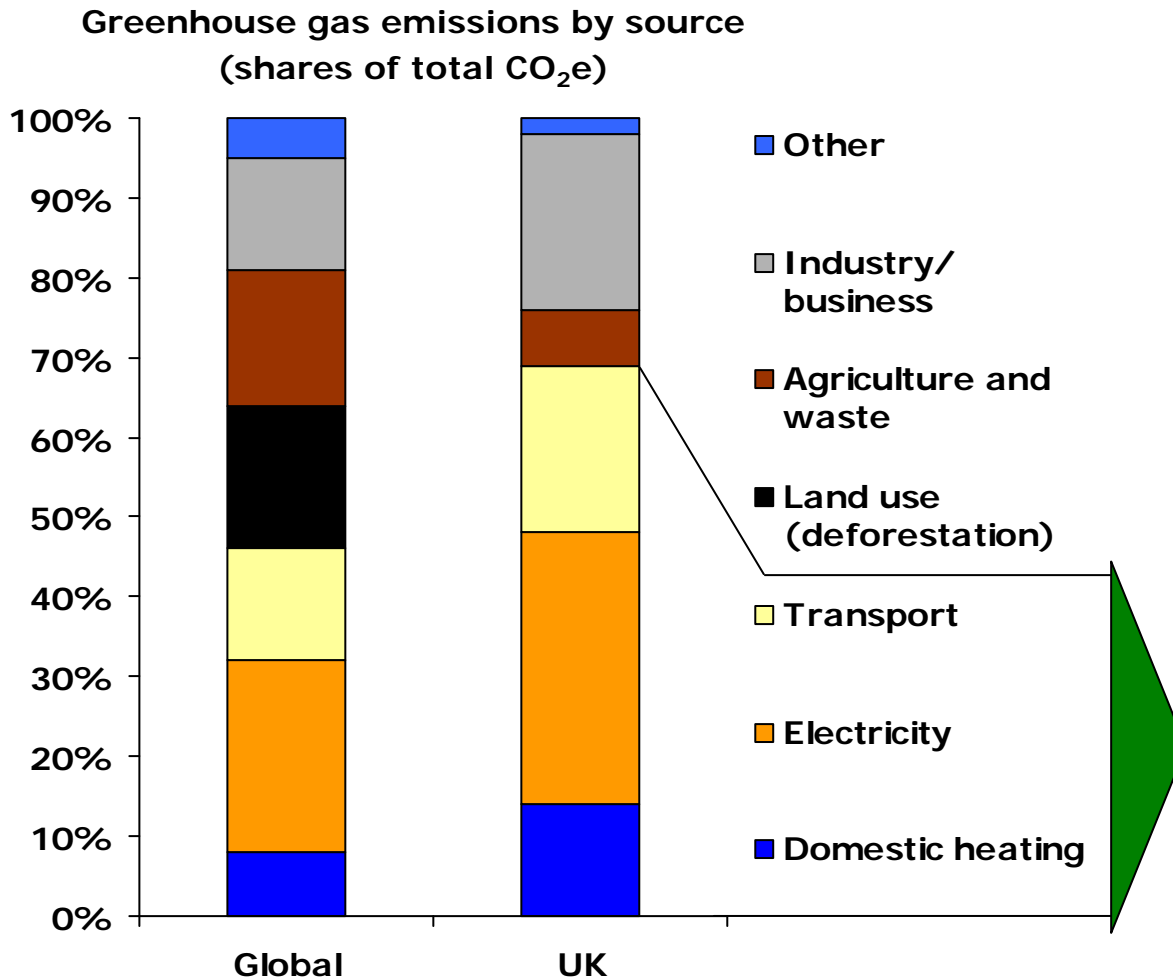
The challenge is to stabilise global greenhouse gas concentrations at a level to avoid the worst of the risks

Global emissions (GtCO₂e)



- The Stern Review recommends a stabilisation goal of 450ppm-550ppm CO₂e
- To achieve this would require that global emissions peak in the next 10-20 years
- Delaying the peak in emissions by 10 years would double the rate of reduction required
- **UK targets are broadly consistent with the Stern goal**

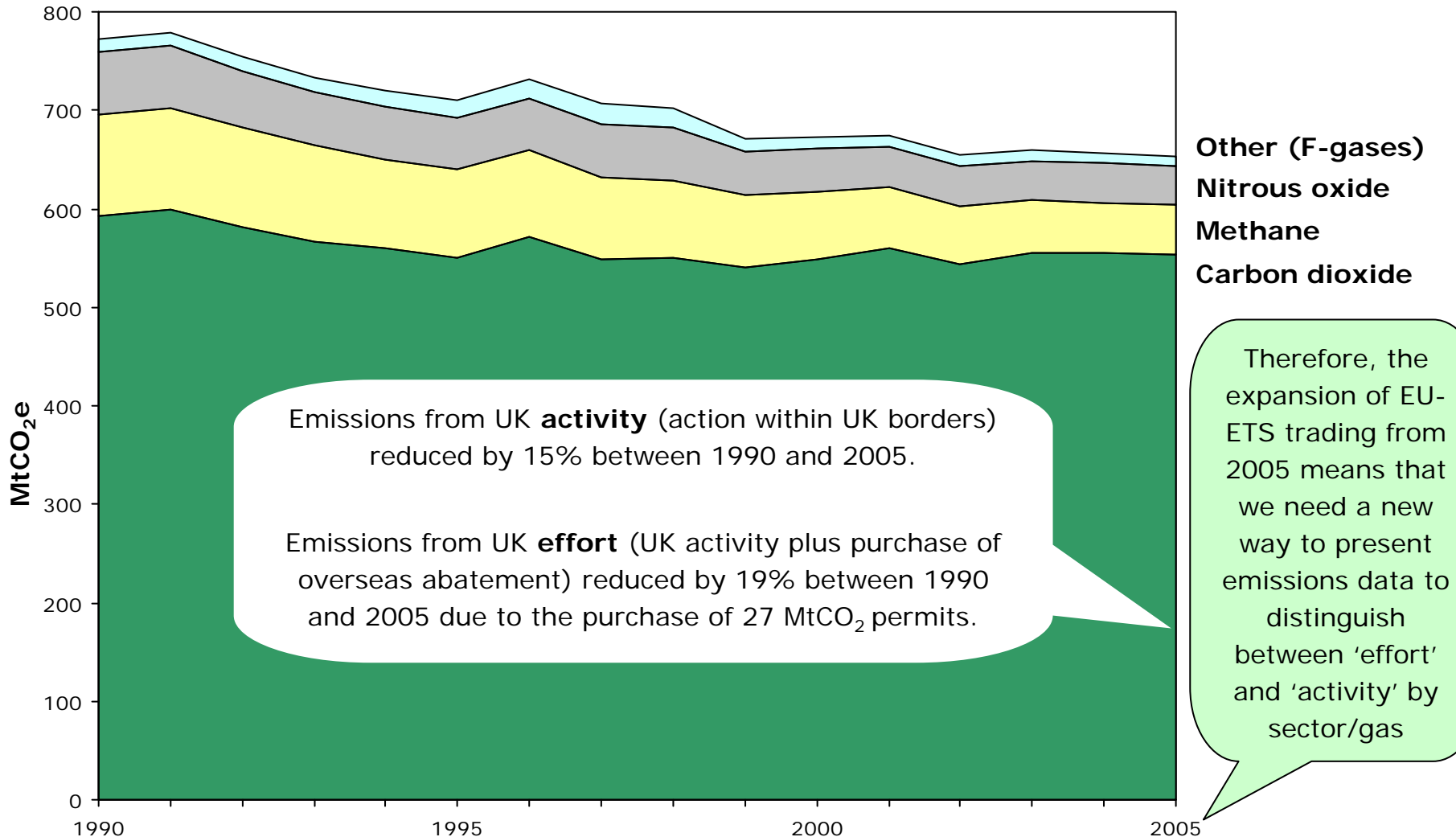
Stern has shown that this is manageable, but it requires a fundamental re-wire of the economy



In the UK

Emissions from electricity generation, domestic heating and transport account for around 70% of all greenhouse gas emissions (largely CO₂)

Our *measurement annex* shows that we have a credible record of abatement so far



However, progress on carbon dioxide abatement has stalled after early gains due to the 'dash for gas' in energy production

Gas (overall share)	Progress	Driver
Carbon Dioxide (85%)	5% decrease from 1990, but increasing since 2000	Energy price changes, but higher electricity and transport demand
Methane (8%)	50% lower than 1990 levels	Improved waste management at landfills
Nitrous Oxide (6%)	40% lower than 1990 levels	Improved chemical manufacturing process
HFCs and PFCs (<1%)	HFCs and PFCs are 22% and 75%, respectively, lower than their 1990 levels	Improved pollution abatement technology
SF6 (<1%)	9% higher than 1990 levels	Increased use in manufacturing processes

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Stern has demonstrated that we need to tackle a range of market failures to mitigate at low cost

Credibility can reduce abatement costs if policy is durable, enforceable and realistic

Flexibility over 'what', 'where' and 'when' abatement takes place will minimise costs

Carbon pricing

The first of Stern's market failures: the damage costs imposed on the world by greenhouse gas emissions are an 'externality' that needs to be reflected in the prices of goods

Technology policy

The second of Stern's market failures: uncertainty and knowledge spill-overs mean that carbon pricing alone will not be enough to induce low carbon technology at the pace and scale needed

Removing other barriers

The third of Stern's market failures: imperfections such as information asymmetry and capital constraints mean that abatement will be more costly if you rely on carbon pricing alone

International cooperation overcomes risks of free-riding, as the climate is a 'public good'

Carbon pricing is a necessary but not sufficient tool for a low-cost transition

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The Climate Change Bill will help improve credibility of climate change policy...

The Climate Change Bill aims to improve **predictability** in terms of:

- the expectations of a framework for carbon pricing;
- the split of effort between capped and non-capped sectors; and
- the timing of policy making and the conditions for possible revision.



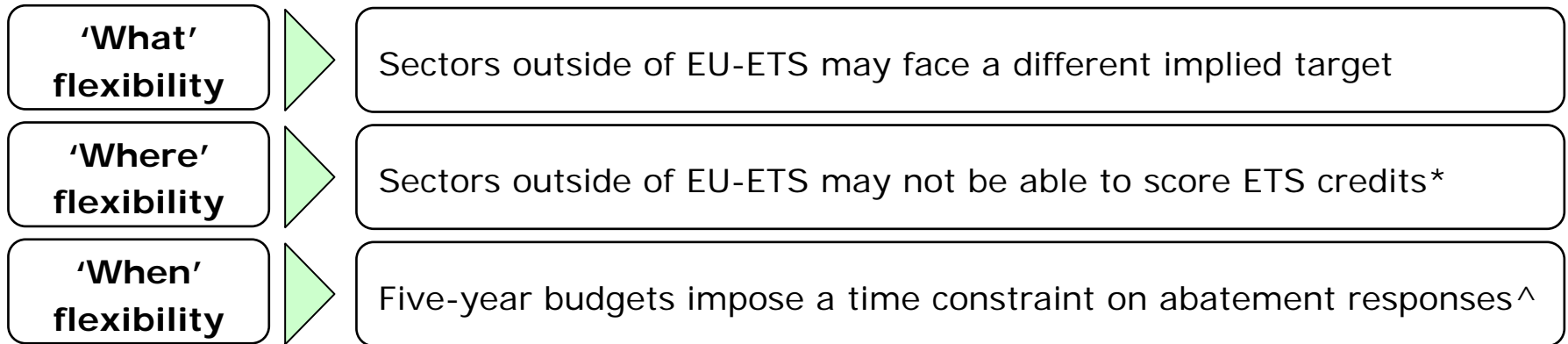
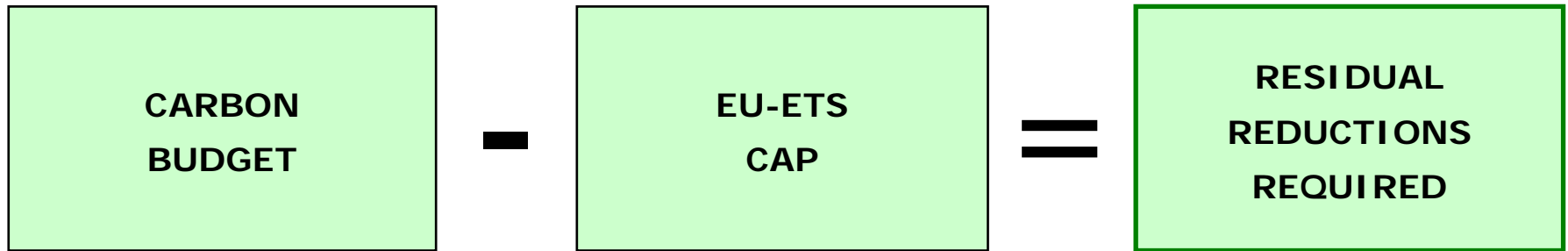
Credible
climate
change
policy

The Committee on Climate Change will publish a report recommending levels for **carbon budgets** and the split between capped and non-capped sectors for the next 15 years.

The **timing** of policy decisions will be to a large extent standardised into a 5 year timetable.

The **conditions** under which carbon budgets may be revised will be made more transparent.

...but it may have some implications for flexibility



Targets will need to be set in a manner that considers the interactions between traded and non-traded sectors, as well as our international commitments

* A decision on when, how and how many credits could be purchased and 'scored' against the UK emissions inventory is yet to be made. ^ The Climate Change Bill does allow for limited banking and borrowing.

Flexibility through trading will reduce costs and is consistent with decarbonising the economy...

For example, if the UK were to meet its emissions targets by making:
only **2/3** of savings from within **UK borders**
and **1/3** of savings bought-in from **overseas**
(for example, through the EU-ETS)

Abatement costs are lower

e.g. by an order of approximately
25-33% compared to doing all
abatement within UK borders

Still major infrastructure change

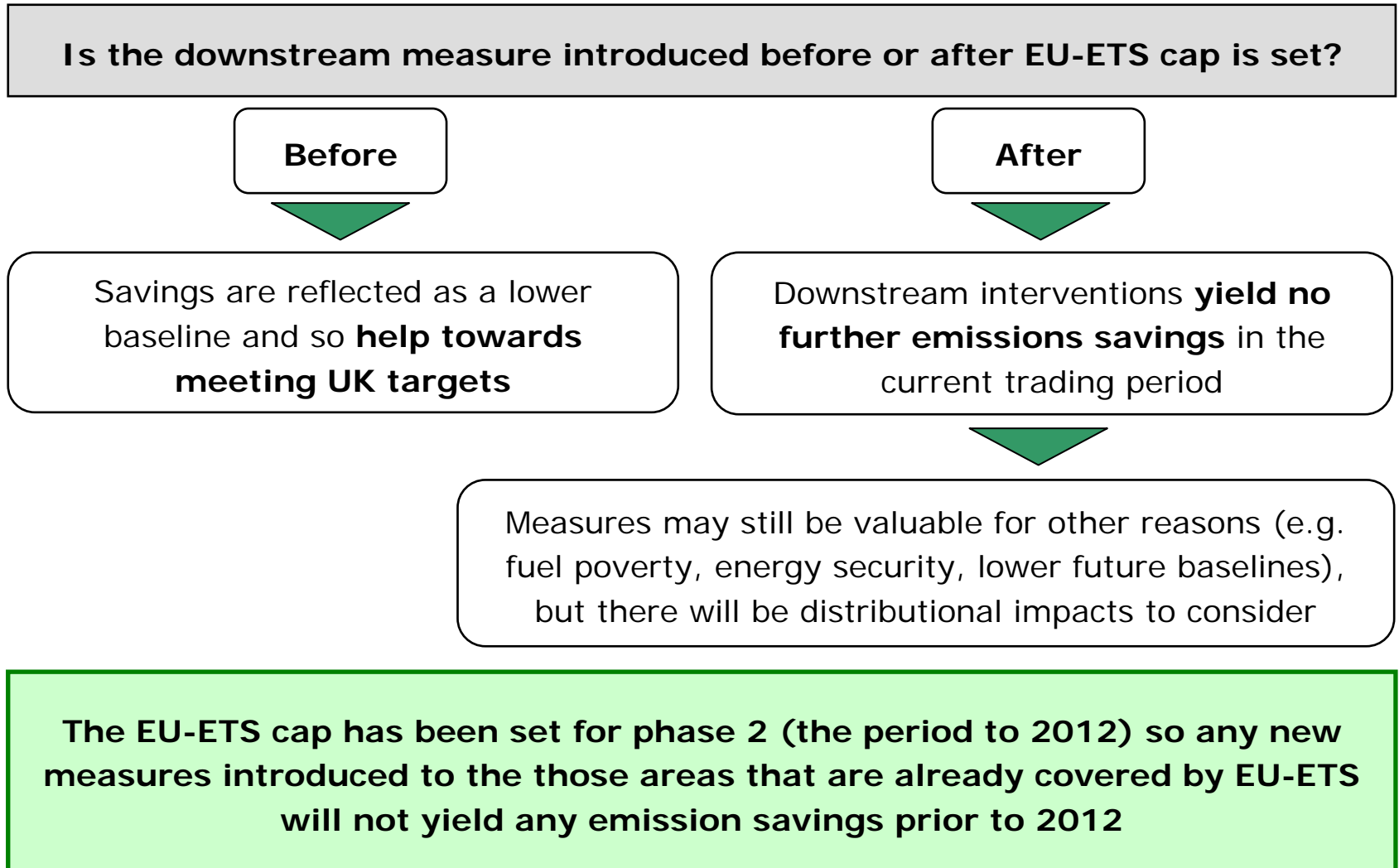
e.g. electricity generated in the UK is
mostly decarbonised (incl. carbon
capture and storage) by 2050

OCC calculations* suggest costs of meeting the 2050
60% target could be 25% lower in 2050

Preliminary analysis by Oxford Economics suggests that the GDP impacts of
meeting the 2020 (26-32%) target could be lower by nearly one-third

* The cost of cutting emissions by 40% within UK borders calculated from 'MARKAL' model results 2007, plus cost of buying 20% abatement overseas assuming an emissions credit price of €25/tCO₂ in 2050. Figures in 2000 prices.

...but we need to carefully consider sequencing when combining trading schemes with downstream measures



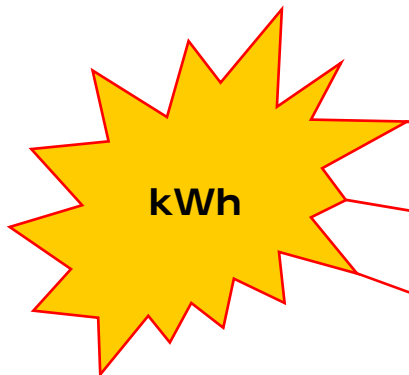
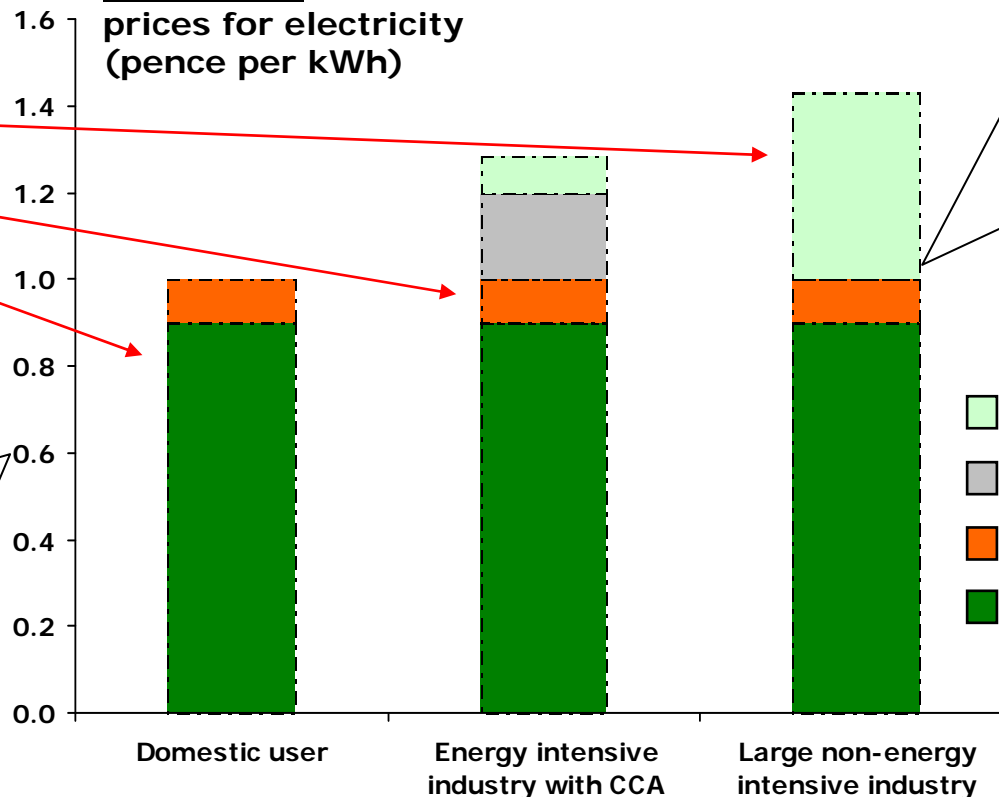
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On carbon pricing, Stern recommends equalising the carbon price – but we have many different carbon prices, not all of which are apparent

For example, for a given carbon-based source of electricity (e.g. coal) a different price results depending on its end-use...

Illustrative unit carbon prices for electricity (pence per kWh)

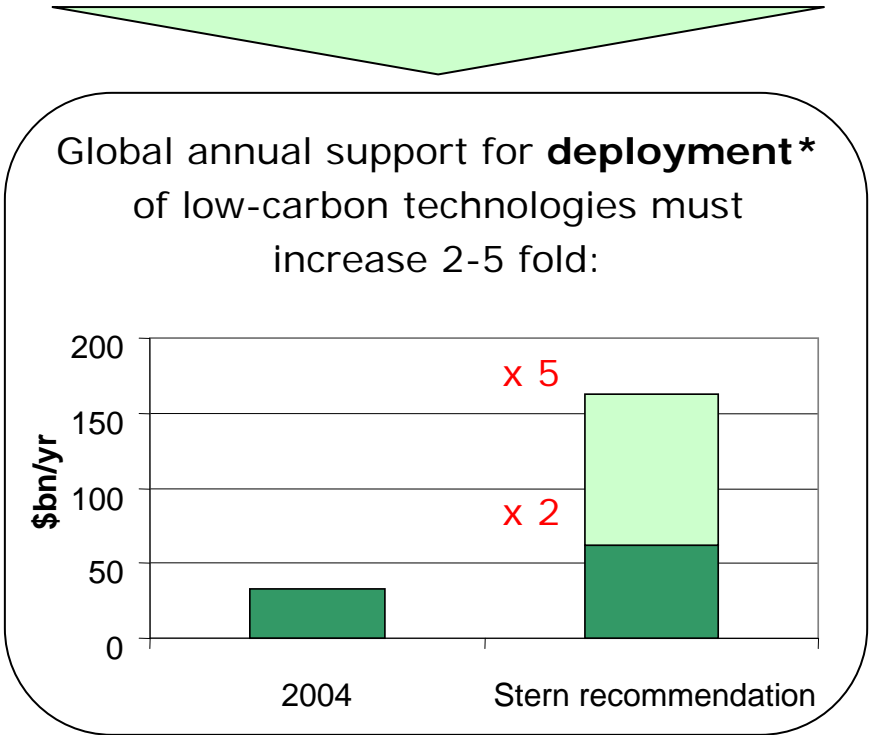
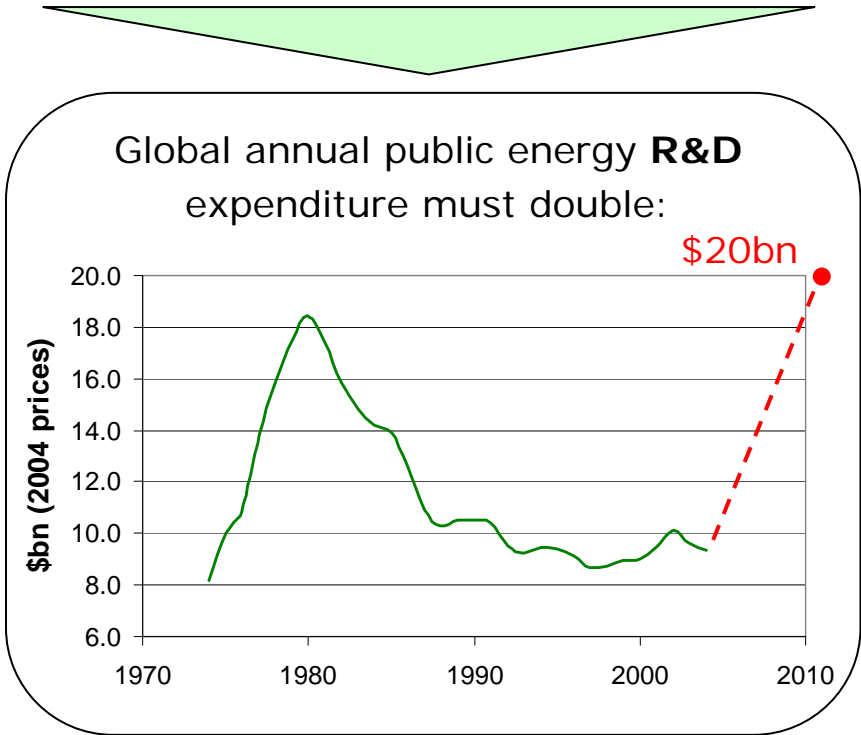


Carbon prices can be imposed explicitly or implicitly through taxes, trading or regulations - all of which may serve other policy ends (e.g. revenue)

Although the ordering of these prices is correct the price ratios between different instruments are illustrative only – they could be higher or lower

On technology policy, it is not clear whether action in the UK is on the scale required...

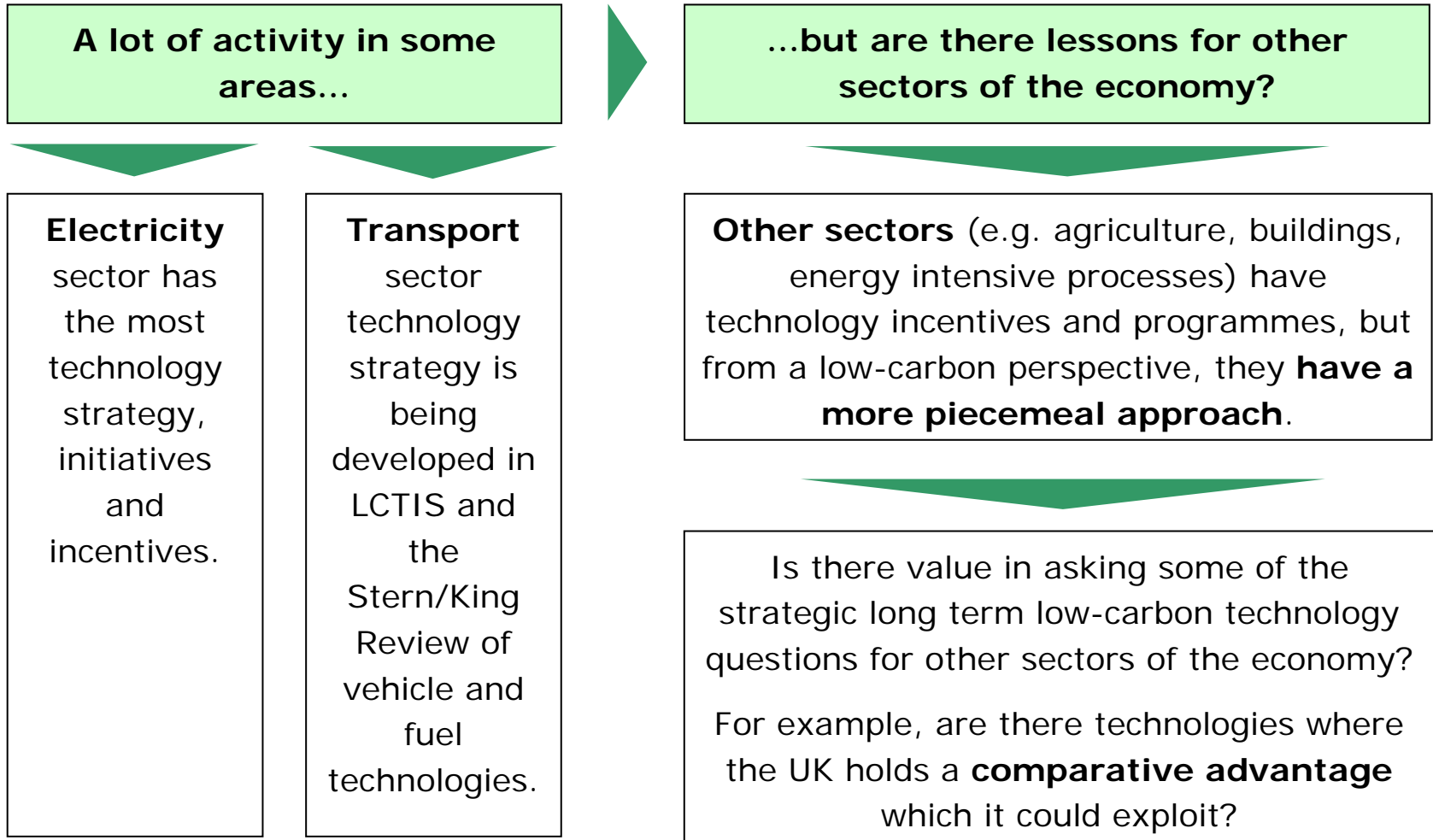
Stern suggests that **output of low-carbon energy must increase 20-fold over the next 40-50 years** to reach a 550ppm CO₂e stabilisation trajectory.
To achieve this, Stern finds:



UK spends less on public energy R&D than Japan, France, Germany and the USA[^]

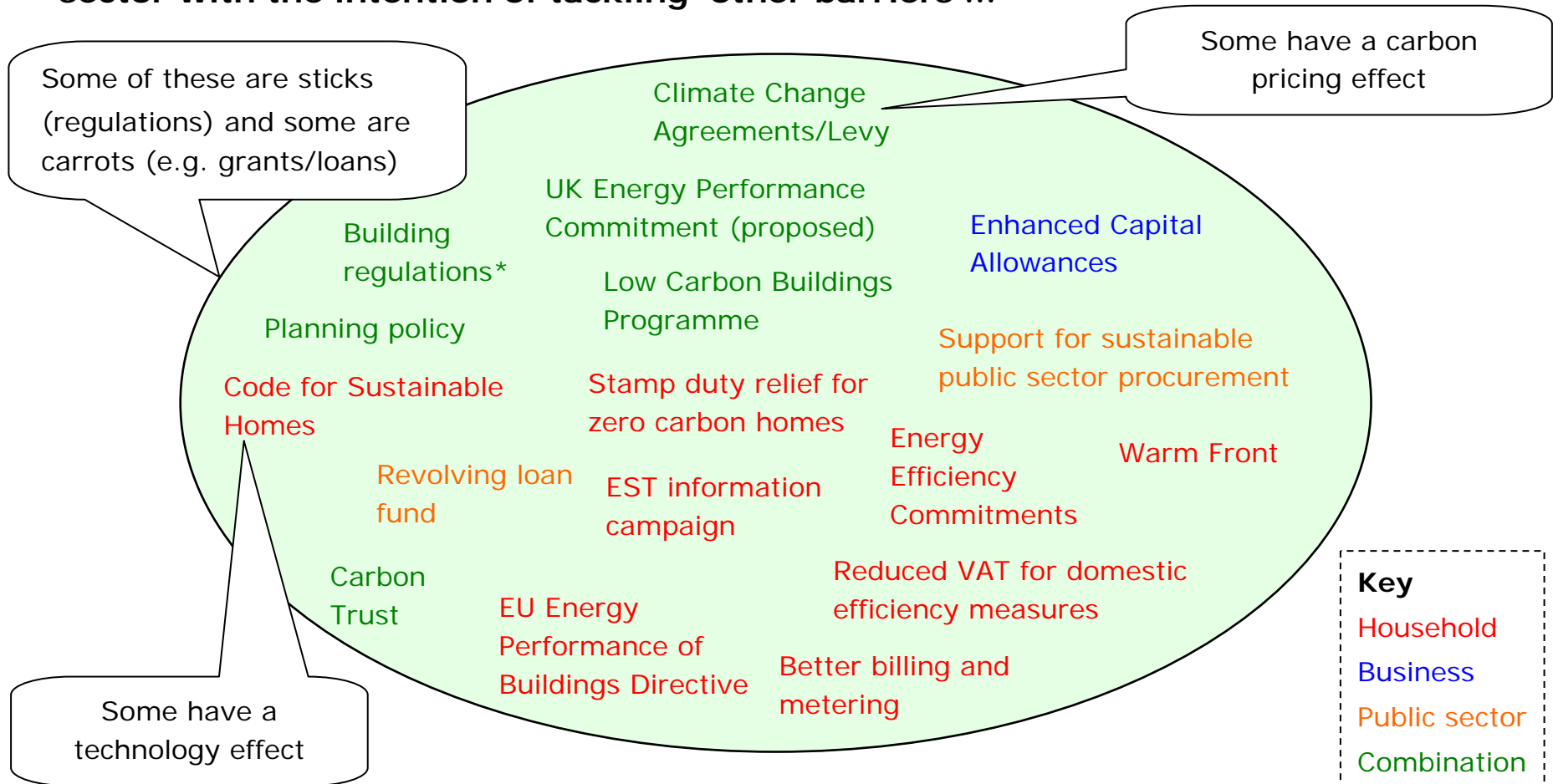
* Deployment support is defined as technology specific interventions - this excludes carbon taxes and emissions trading because these do not target specific technologies. ^ As a proportion of GDP.

...and it is not clear whether the UK has a comprehensive economy-wide technology strategy



On other barriers, we have no shortage of policy measures – but this may not be efficient

For example, all of these policies were introduced into the buildings sector with the intention of tackling 'other barriers'...



* Building regulations apply to new build and substantial refurbishment only.

Stern's framework also emphasises that we cannot rely entirely on the marginal abatement cost curve (MAC) for selecting policy instruments

Selecting the cheapest policies along the MAC will help us meet the carbon target at the least net cost, from among the subset of measures considered

But the MAC does not give us a framework for ensuring that the 3 market failures are being corrected appropriately – it won't separately tell you if a policy scores badly because: the carbon price is too high; there are innovation market failures; there are other market failures; or it's just poorly designed.

Are **carbon prices** equalised across sectors?

Is **technology policy** optimally designed?

Are **other market barriers** being tackled?

Low cost abatement could be missed if any of these 3 market failures are not addressed appropriately – carbon pricing alone is not enough

Applying this framework, our detailed *sectoral annexes* show that we still have some way to go to comprehensively address all 3 market failures

Electricity

A (non-nuclear) economic solution to low carbon electricity production does not yet exist – innovation is still required

Buildings

Regulation can act across all 3 Stern 'legs' and would be suited to tackling the consumer inertia that characterises this sector

Energy-intensive

There may be a case for looking at a technology strategy for the energy intensive sector in collaboration with EU partners

Transport

The cost of motoring arguably already reflects its carbon price but far-from-market technologies will require more support

Agriculture

Emissions from agriculture appear not to face their carbon price and there may be a case for further support for innovation

Waste

The current policy map is well balanced across the 3-legs but it is not explicitly directed towards climate change objectives

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In light of Stern's conclusions on international cooperation, a number of questions emerge

'**Adaptation** is crucial to deal with the unavoidable impacts...especially in developing countries that will be hit hardest and soonest.'

This project has focused on mitigation, but adaptation should not be overlooked, particularly for developing countries.

'Depending on the stabilisation goal, developing countries could have **flows** of up to \$40 billion per year.'

Do we have a clear idea of the likely finance flows under different framework solutions?

'Greater international cooperation to accelerate **technological innovation** and diffusion will reduce the costs of mitigation.'

Will current measures deliver the kind of portfolio of low-carbon technologies that Stern recommends?

'Curbing **deforestation** is a highly cost-effective way of reducing greenhouse gas emissions.'

How can rich countries provide sufficient support to deliver a global reduction in deforestation?

It is not clear that existing frameworks provide the incentives for international cooperation on technology...

Problems

Global R&D must double

Global support for deployment by increase 2-5 fold

National policy may not deliver global priorities

International cooperation may be more cost effective

Carbon infrastructure choices in developing countries

Collective action problem

Solutions

Information sharing

Pooling R&D

Product standards

Technology transfer

How can future frameworks provide incentives for these solutions?

...or the means to arrest deforestation

Problems

Deforestation accounts for one fifth of global emissions

Carbon externality is not valued

National property rights, international impact

Measurement difficulties of abatement in deforestation

Threats

Conversion to agriculture is a lucrative driver

Measurement difficulties means that any carbon trading would need careful design

Opportunity

Significant potential for low-cost abatement

For example, the Papua New Guinea proposal on avoidance of deforestation*

Future frameworks need to provide incentives that will compensate deforestation nations for the opportunity cost of abatement

* Papua New Guinea and the coalition of rainforest nations have proposed that countries establish a national baseline rate of deforestation and negotiate a voluntary commitment for reducing emissions below the baseline.

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In conclusion, there are a number of conceptual issues that we need to embed into policy making

Scale of effort

- We need to give careful thought to whether we are investing enough to address Stern's recommendations, particularly in the area of technology investment.

Policy mix

- There is no shortage of policies in some sectors, creating a complex landscape – are they all necessary? New policies need to make it clear which of the three Stern market failures they address.

Sequencing

- To achieve a low cost transition path for the UK, we need to carefully consider the sequencing and wider implications of any new downstream measures in sectors subject to emissions trading.

Implied targets

- The combination of the new 'carbon budgets' and the EU-ETS means that sectors left outside of the EU-ETS face an implied target which may or may not be more ambitious than the cap on the EU-ETS.

Carrots or sticks

- Taking account of other market failures in the take-up of energy efficiency, it may be more economically efficient to consider a greater role for regulation alongside behavioural incentives.

There are a number of trade-offs that we will need to weigh up – not all of which are obvious

Fuel poverty

- Synergy: technology and efficiency lowers demand in long-run
- Trade-off: carbon pricing will increase fuel poverty in short-run
- **Issue: dealing with the social costs of transition**

Security of supply

- Synergy: energy efficiency and alternative power sources
- Trade-off: coal is more secure than gas, but has high emissions
- **Issue: technological solutions (especially CCS) are vital**

Competitiveness

- Synergy: new technologies open up new markets for growth
- Trade-off: some downsides to unilateral and multilateral action
- **Issue: a dynamic analysis of competitiveness is needed**

International development

- Synergy: many spin-off benefits to cleaner growth (health etc.)
- Trade-off: bio-crops could stress fragile food supply chains
- **Issue: carbon finance potential to assist development**

The Stern framework raises policy questions that it will be important to answer as we move forward

Carbon pricing

- We do not have a clear idea of the carbon prices created by different policies in different sectors, so how can we know if we're on a least-cost transition?

Technology policy

- Outside of the electricity generation sector, do we have a technology strategy for economy-wide decarbonisation?
- How can we ensure the world spends enough on technology policy and what should the UK's contribution be?
- Is our approach to technology policy consistent with bringing forward a portfolio of low-carbon technologies?

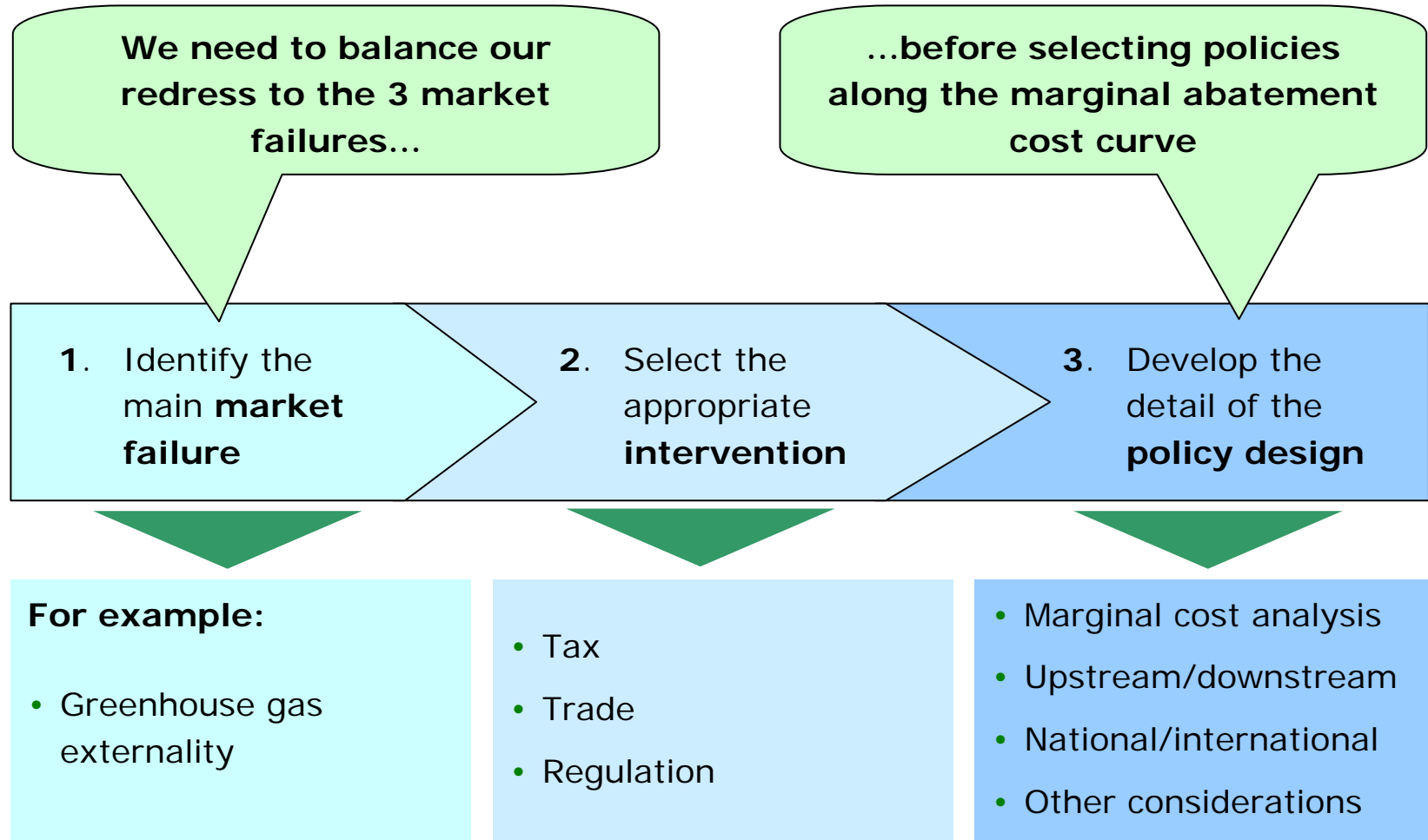
Removing other barriers

- Are we missing low cost abatement in any sectors because of the existence of other barriers?

International cooperation

- Do we have a clear idea of the scale of potential global carbon finance flows and the implications for carbon prices and incentives in the EU?
- Do we have the right global incentives to encourage international technology cooperation and stopping deforestation? It is not clear to what extent these incentives emerge through existing frameworks.

There are also implications for the way in which we use analysis to arrive at policy solutions



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If we promulgate its findings, the analytical audit will deliver a shared level of analytical understanding to all of those involved in climate change policy

Science

- Our *scientific annex* offers a brief digest of the central scientific case for climate change policy and the arguments to refute the common theories advanced by sceptics. **It should be a valuable part of the induction for anyone new to climate change policy.**

Measurement

- Our *measurement annex* offers a clear account of the complex world of progress and projections on climate change emissions. **It should be a valuable reference for anyone who needs to know more about the detail behind the numbers.**

Economics

- Our *full report* and the accompanying *sectoral annexes* offer a robust but accessible account of the complex conceptual implications of the Stern Review. **It crystallises a framework for approaching climate change policy** which emphasises that:
 - there are three separate market failures to address;
 - carbon pricing alone will not be a low-cost solution;
 - technology policy would benefit from added emphasis; and
 - regulation could be a more efficient solution in some areas.