Policies for low-carbon growth and development: creating a new era of progress and prosperity

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Slides for basic record - rather than detailed presentation

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Growth and learning in a decade of change

- The defining challenges of our century are overcoming poverty and managing climate change: require strong, urgent and international action.
- Policy must foster a new energy and industrial revolution, and intensify the fight against poverty, during a decade of great challenge, including deficit reductions, great international macro imbalances, sustaining a fragile recovery, continuing recasting of the international division of labour, etc. Will do better on each if we understand them together.
- Can move forward on both managing climate change and overcoming poverty if people understand not only the great risks from inaction, but also the attraction and dynamism of the transition to low-carbon growth, plus the attractions of low-carbon growth itself.
- Both parts of the argument are crucial: this discussion is basic to action and is intensifying around the world including China, India, US…..

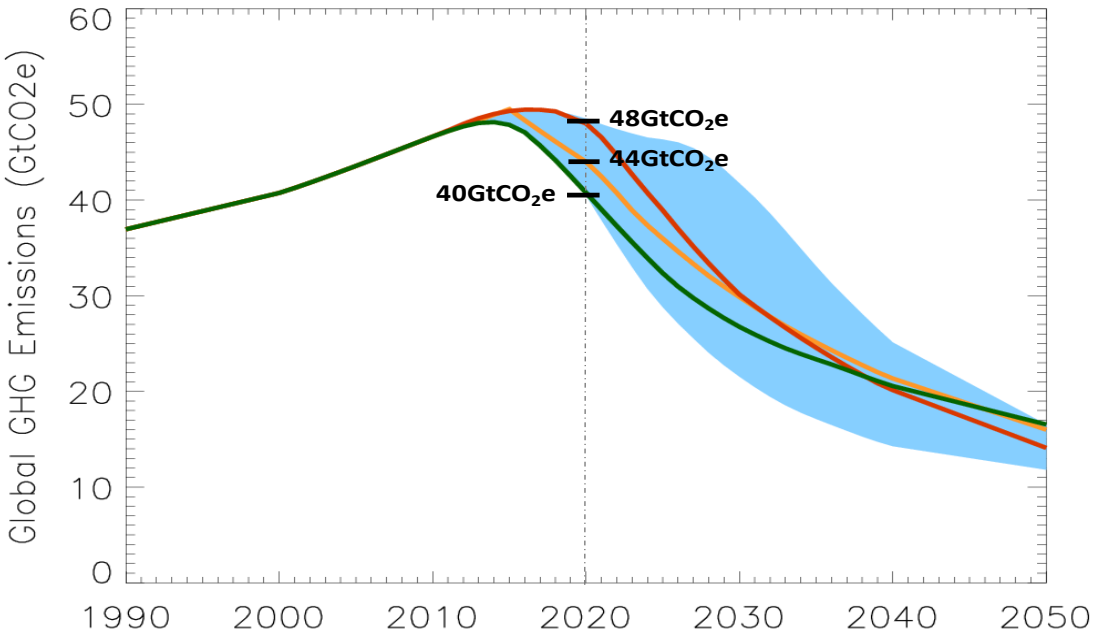
Three Part Structure

- Part 1: Areas of action

- Part 2: Low-carbon growth

- Part 3: The role of public policy

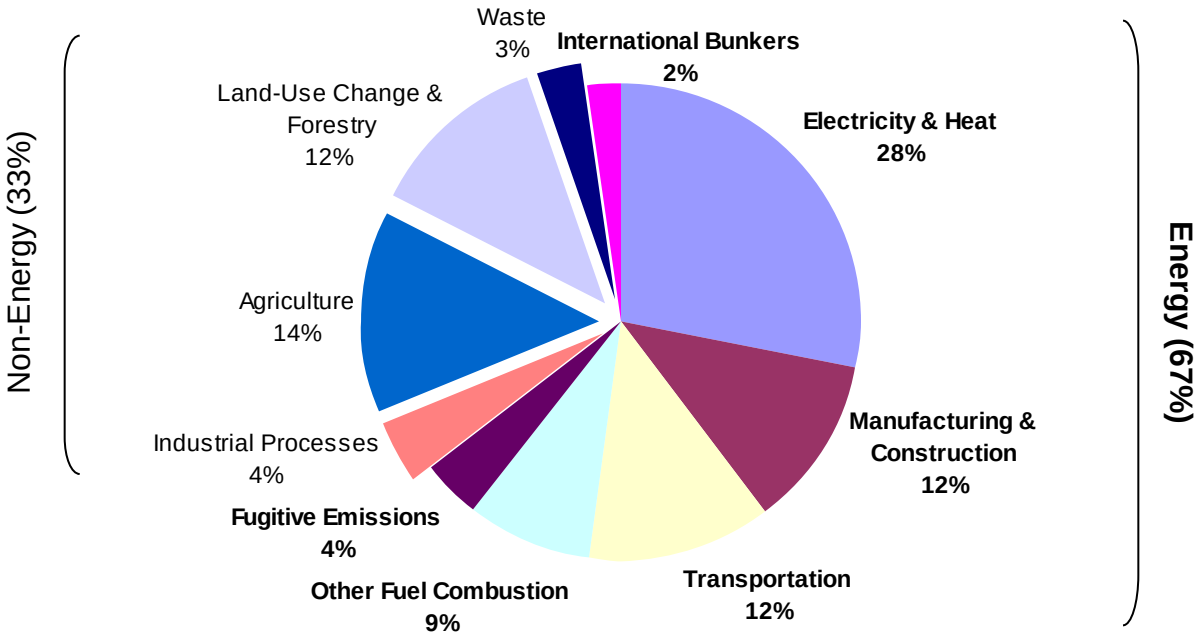
What our targets should be (reminder from lecture 1)



- Holding below 500ppm CO_2e, and reducing from there, is necessary to give a reasonable (say 50-50) chance of staying below 2 degrees. This requires bringing emissions down from 47Gt CO_2e today to below **20Gt CO_2e** (approx. 50% of 1990 levels) by 2050.
- A plausible emissions path is around **47Gt** CO_2e in 2010 (reduced by economic slowdown – might have been 50), **44Gt** in 2020, **under 35Gt** in 2030 and **under 20Gt** in 2050. Likely to have to go **'well under'.** Clearly necessary to 'peak' before 2020.
- Given population now is close to 7bn and in 2030 and 2050 likely to be 8bn and 9bn, this means global emissions per capita should fall from 7 tonnes now to around 4 in 2030 and 2 in 2050.

*These results are based on the Hadley Centre climate model MAGICC. Thanks to Jason Lowe and Laila Gohar for running these trajectories through the model.

Sources of emissions



Based on 2005 global emissions (CO_2e).

Source: Climate Analysis Indicators Tool (CAIT) Version 7.0. (Washington, DC: World Resources Institute, 2010).

- Reductions on scale will require progress in: energy efficiency, new low-carbon technologies, halting deforestation. And action necessary in all sectors and all countries.

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Areas of action: how to cut

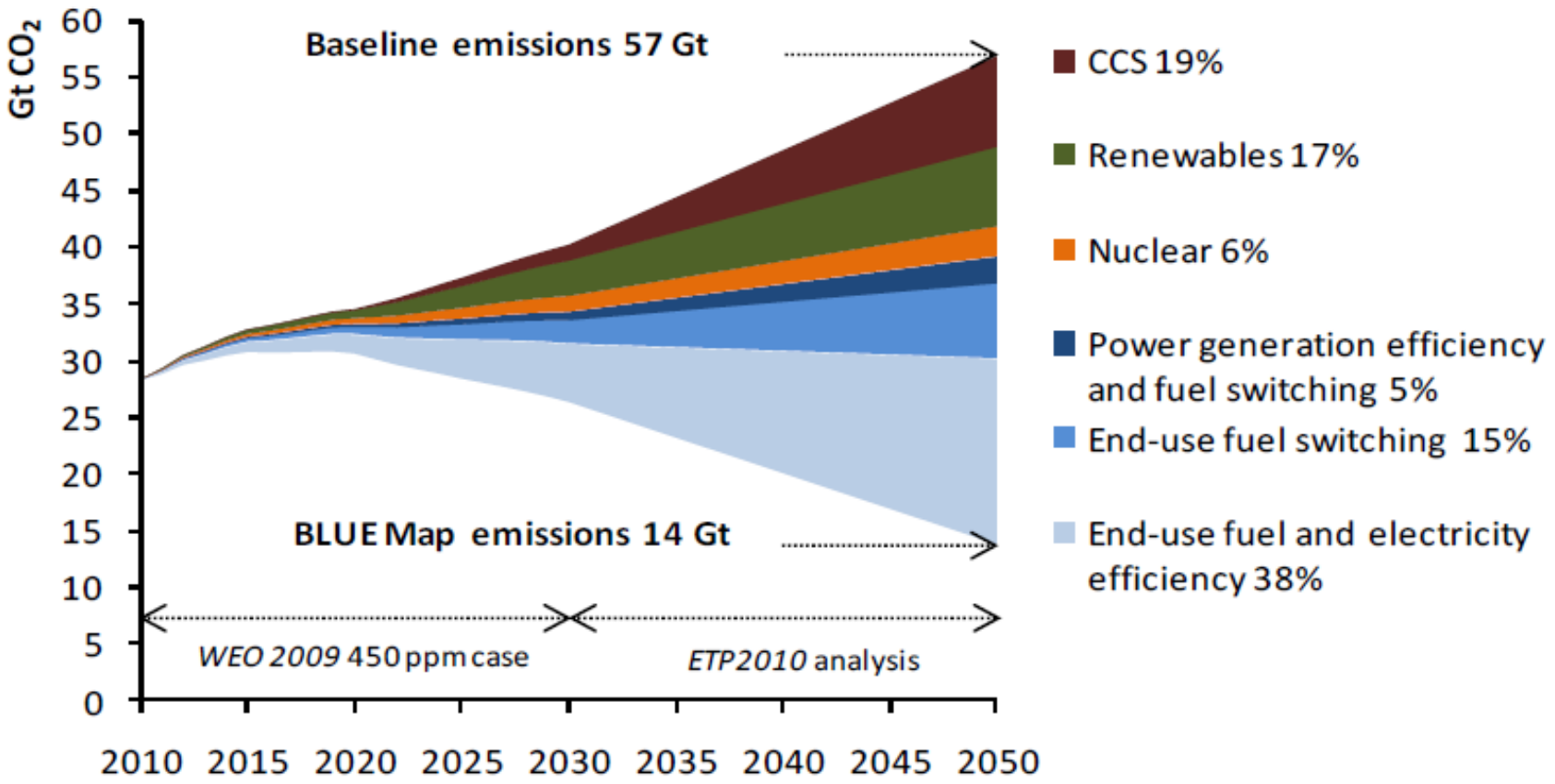
- **Energy efficiency:** need to seek out ways of radically improving energy efficiency across the board. Strong policy will increase incentives and reduce obstacles to improving energy efficiency.

  – Energy efficiency opportunities are available in most areas. Some are already acting strongly, e.g., Wal-Mart have achieved a 70% saving on energy in supermarket aisles by putting doors on refrigerated cases.

- **New technologies:** widespread advance in the development and diffusion of new technologies is required. Well developed carbon markets, taxation, regulatory and other policies will create a powerful stimulus.

- **Deforestation:** strong initiatives required, with public funding, to halt deforestation. Need to be incorporated into development programmes and preparations made to include avoided deforestation in trading.

Areas of action: sources of emissions reductions



Source: IEA Energy Technology Perspectives 2010, Scenarios and Strategies to 2050.

- Note that, with energy emissions, energy efficiency does around half the work.

Population?

- In 1930, 1960 and 1990 world population was 2, 3 and 5.3 billion; now 6.9 billion; in 2030 and 2050 likely to be around 8 billion and 9 billion, respectively.

- The 1 billion in developed countries likely to be static with population growth mainly in developing countries.

- Higher population means higher emissions; should direct population control be a part of policy?

- Assume will not try to increase death rates. How do birth rates fall? Assume will not use compulsion - raises other questions.

- Education of women and girls; labour market opportunities for women and girls; rights to family assets and decisions; incomes; child mortality; access to reproductive health services. All of these should be part of development policy for reasons of development and rights. Climate change simply reinforces.

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Low-carbon growth

- High carbon growth will kill itself as a result of the hostile environment it will create – hundreds of millions displaced. Likely consequences are extended, severe and global conflicts.

- Low-carbon growth is the only option in the battle for higher living standards: Abandoning growth but maintaining current technologies will not reduce emissions.

- The transition to low-carbon growth will be dynamic and innovative.

- A perspective which embraces a Schumpeterian understanding of ‘endogenous growth’ and creative destruction will be central to the transition; new firms and methods drive out old. But will not happen without policy.

Low-carbon growth

- Endogeneity of technological progress: learning from experience; trial and error; direct investment in R&D.

- Acemoglu et al. (2009) and Aghion et al. (2009): support for green technologies can accelerate learning. Learning and environmental costs will be growth models of the 21st century: they speak the language of opportunity, substitutability, environmental services and change. The Leontief input-output approach speaks language of burdens and fixed coefficients of mid-20th century together with environmental destructiveness.

- Will be many new goods and quality improvements. Great 'job creation' potential (Kammen et al., 2006) or more precisely, opportunities in new technologies and industries. Language of 'opportunity' better than that of 'jobs'.

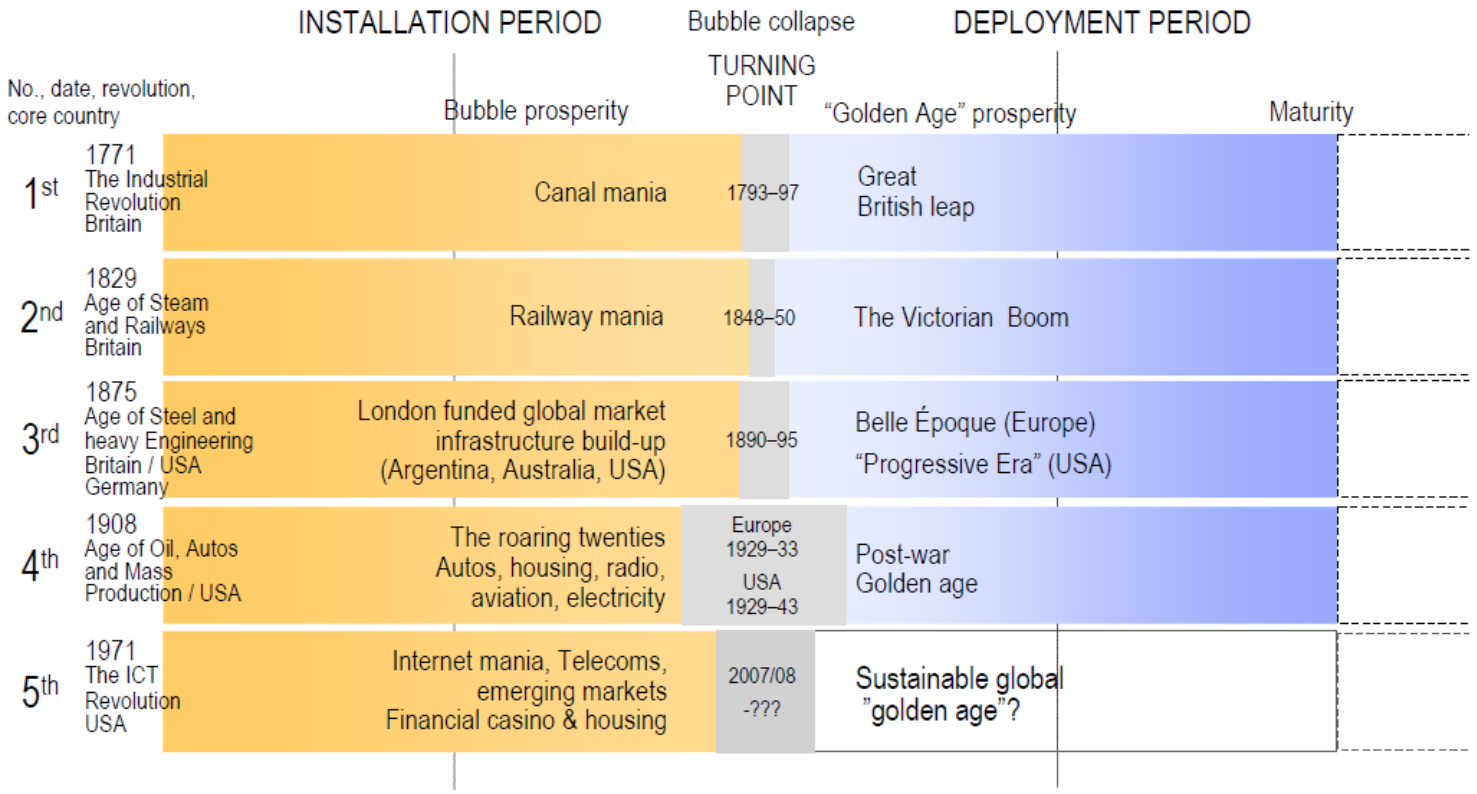
- When achieved, low-carbon growth will be more energy-efficient, more energy secure, more equitable, safer, quieter, cleaner and more bio-diverse. Far more attractive than what has gone before.

History of technological revolution (à la Perez)

- Great surges of technological innovation characterise past periods of economic change.
- Five technological revolutions since 1770 (Perez, 2002 and 2010).
- Each revolution displays similar characteristics - a breakthrough in a technology sets off a transformative, dynamic and innovative period of industrial and social change, e.g., the microprocessor or the Model-T Ford.
- What low-carbon technologies will provide the 'breakthrough' to drive the new low-carbon technological revolution forward? What Kuznets termed an *epochal innovation* capable of changing the speed and direction of growth.
- This time likely to see a range of technologies and methods rather than a single 'key idea'. The 'key' is the search for a low-carbon economy.

Waves of innovation

The historical record: bubble prosperities, recessions and golden ages **(according to Perez).**



- The sixth industrial revolution will be seen to have started a few years ago and may take a different form; it overlaps with the 5th.

Source: Perez (2010)

Green growth: what it might look like

- Already great breadth to this nascent low-carbon technological revolution. This is not sci-fi, this is the start of a real period of innovation and there will be (already are) exciting developments and 'breakthroughs' along the way. Some 'gleams in the eye?'

- May soon be possible to artificially create bacteria that produce biofuels or soak up CO_2 from the atmosphere.

- New high-capacity batteries made with titanium dioxide coated carbon nanotubes may be able to overcome the capacity and life-span problems that limit lithium-ion batteries.

- Solar cells printed on aluminium film using nanotechnology have the potential to significantly increase solar efficiency and reduce costs.

- EMC Cement has developed Energetically Modified Cement (EMC), a new manufacturing process where materials such as fly ash or blast furnace slag substitute for clinker. This can reduce CO_2 emissions in cement production by up to 70%.

- Carbon capture and storage (CCS) with storage in cement. California based company Calera has developed a technique to store GHGs in cement. They pump CO_2 (and other gases) from power stations through saltwater. This transforms the gases into carbonate (CO3), a synthetic limestone, one of the main ingredients in cement.

Green growth: what it might look like

More visible now:

- Agriculture:
  - Techniques for low-till agriculture can reduce emissions from tilling, save energy, save water, and provide climate resilience;
  - Avoiding flooding paddy fields reduces methane and saves water.
- Buildings:
  - Architectural engineers coming up with many ideas for energy efficiency and local power generation.
- Natural gas has the potential to play a transition role on the path to a low-carbon future due to new discoveries and improved extraction technologies (Brown et al., 2009): substituting natural gas for coal in electricity generation can reduce emissions by around a half.

Green growth: where are we now?

- Firms are taking a long-run view:
  - Car manufacturers, e.g., General Motors developing hybrid/electric vehicles (even Ferrari);
  - Banks and financial institutions, e.g., HSBC/Deutsche/Crédit Agricole climate research and products;
  - Retail: Walmart, Tesco, Marks and Spencer, The Warehouse…;
  - Many large long-term funds managing trillions of dollars seeking opportunities;
  - Firms are seeking and finding opportunities, e.g., DuPont finding $2bn p.a. in energy efficiency savings;
  - Firms are subjecting themselves to scrutiny and adopting tough targets, e.g., Carbon Disclosure Project.

Green growth: where are we now?

- Innovative ideas are emerging to protect forests.

  – Ecuadorian government prepared to avoid oil extraction in sensitive rainforest areas if developed countries support with half the foregone oil revenue, US$ 3.6 billion. Funds will be held in a trust administered by the UNDP;

  – Indonesia plans to rehabilitate 35m ha of degraded forest by 2025. Aim to prevent deforestation or degradation of 40m ha by 2025. Aim to reduce forest fires by 95% on 2006 levels by 2025. Needs international support: Norway has pledged $1 billion for a 2 year moratorium on new logging concessions (implementation will be key);

  – Brazil aims to cut deforestation in Amazon by 80% by 2020 (baseline is the average deforestation rate 1996-2005 of 19,600 km^2). Good progress to date with deforestation falling to 7,000 km^2 in 2009.

Adaptation, mitigation and development are intertwined

- Adaptation is development in a more hostile climate.
- Many investments for adaptation are investments for development e.g., improved irrigation or changed agricultural productivity methods.
- Using energy and water more effeciently is vital for development and part of both adaptation and mitigation.
- Many low-carbon technologies can give greater access to and control of energy in rural or remote areas, e.g., solar power.
- In supporting action must not over-compartmentalise organisations and funding.

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Emissions constitute the greatest externality the world has seen

- An externality arises when the actions of one person directly affects the prospects of another, e.g., discharging toxic waste into a river system.
- When we emit greenhouse gases we damage the prospects of others. Unless appropriate policy is in place we do not bear the costs of the damage.
- Markets therefore “fail” in that prices give the wrong signals; they do not reflect the true cost to society of producing and using goods and services.
- The biggest externality the world has seen: all are involved; the potential effects are global and very large.

An externality with a difference

- It is **global** in its origins and impacts;
- It involves major **uncertainty** in most steps of the scientific chain;
- It is **long-term** and governed by a **stock-flow** process;
- Effects are potentially on a **huge scale** and **irreversible**.
- The implications of these crucial features for policy action and analysis must take us way beyond standard microeconomic theories for externalities. But the standard theories are a starting point.

Public policy: market failure

- Risk and urgency at a global scale are at the core of the issue and must shape the policy response; delay greatly magnifies risk (flow-stock, ratchet effects).
- Public policy must be examined in the context of a collection of market failures:
  - ***Greenhouse gases*:** emissions severely damage consumption and productive prospects of others;
  - ***Learning*:** R&D and demonstration/deployment bring learning and exploitation of economies of scale and scope;
  - ***Risk*:** weakness in capital markets, particularly in relation to risk and long term;
  - ***Networks*:** overcoming information barriers and transaction costs to promote energy efficiency;
  - ***Information*:** understanding the GHG properties of what we buy, consume, use;
  - ***Co-benefits*:** a low-carbon future will be quieter, safer, cleaner, more biodiverse and more energy secure.

The role of public policy

- Policy for the market failures. Different failures point to different instruments:
  - *Greenhouse gases*: carbon taxes / cap-and-trade / regulation. A combination of all three likely to be needed;
  - *RD&D*: Assistance with R&D, tax breaks, feed-in tariffs for deployment;
  - *Imperfections in markets*: risk sharing/reduction through guarantees, equity, feed-in tariffs, floors on carbon prices, green investment banks;
  - *Networks*: rules governing electricity grids, building regulations, mandatory efficiency standards, community based 'street-by-street' schemes;
  - *Information*: labelling and information requirements on cars, domestic appliance, products more generally;
  - *Co-benefits*: regulation of dirty and more dangerous technologies, valuing biodiversity.

The role of public policy: moving to scale

- Good policy must enable scale of action:
  - International standards;
  - Common procurement policies by cities;
  - Infrastructure, e.g., electric charging points, hydrogen stations, public transport;
  - Smart grids crucial: capable of cheap long-distance transmission and accommodating different kinds of generation and use.
- Good policy must also be: flexible (we will learn); targeted at the appropriate level (community, regional, national or global); encourage collaboration; risk sharing; and beyond simply economics.

The role of public policy: “shaping the debate”

- Strong debate in China and many other countries over low-carbon growth, what it may look like, and the opportunities it might bring.
- Important in the debate to show that low-carbon growth is an attractive alternative, indeed the only growth-option (see previous lecture and section).
- Power of the example:
  - British Telecom saved £1.5bn between 2002 and 2006 from reducing energy costs;
  - Marks & Spencer plans to be carbon neutral by 2012 (plans to use food waste to generate power);
  - Walmart told 1,000 suppliers in China that high environmental and energy saving standards would be required: supply chains are crucial. And it is ‘zero waste’ and ‘100% renewable energy’.

The role of public policy: research for better design

- The design of policy is key – good analytical work in policy will help drive the transition.

- Fischer (2008) finds R&D subsidies are effective only if there is a price on carbon and spillover effects are significant. R&D subsidies on their own are ineffective. A carbon price is required to provide the incentive to adopt new technologies.

- Popp (2006) finds combining carbon taxes and R&D subsidies leads to the best outcomes.

- A number of studies find a portfolio of different policies, some broad and some targeted, facilitate innovation and lower costs of emissions reductions relative to any single instrument (e.g., Otto and Reilly, 2008; Fischer, 2008; Fischer and Newell, 2008; Acemoglu, 2009).

The role of public policy: research for better design

- Policy to ensure technology diffusion is also key. Research using patent data finds that capacity building, removing trade barriers and strong intellectual property rights regimes encourage technological transfer (Dechezleprêtre et al., 2009).

- The direction and rate of technical progress and the stages in the innovation process can be influenced through good policy (Jamasb and Köhler, 2007).

- Policy design must also consider constraints and general equilibrium feedbacks throughout the economy (Dreze and Stern, 1990).

- Crucial to consider how policy instruments will interact and change over time. For example, renewable targets focus efforts on technologies that are not necessarily the most cost competitive; this may result in slower development of other technologies with great future potential.

The role of public policy: communities

- An example of a community based insulation project that overcomes the complexity and barriers to energy efficiency:
  - A UK Council, Kirklees Council in West Yorkshire, offers loft and cavity wall insulation on a street-by-street basis, guaranteed by the council, free of charge and with no conditions. Over 25,000 homes have been insulated;
  - This policy removes many of the barriers associated with adoption of energy efficiency measures, e.g., complexity of financial subsidies, hidden costs, poor information, risks of poor quality contractors, psychological/sociological barriers, and regulatory barriers (CCC, 2008).
- Combined heat and power; public transport and car pooling; re-using and recycling… all require community focus.
- Community collaboration is a source of ideas, cohesion and sense of shared endeavour.

The role of public policy: behaviour

- Promoting a shared understanding of responsible behaviour – beyond sticks and carrots.

- For example, alcohol and driving. In 1966 in the UK laws were introduced limiting the permitted levels of alcohol in the blood while driving. From many there was uproar and the shouts were of limitations of freedom.

- It seems strange to reflect on these attitudes now. Public discussion, education, experience, and evidence changed attitudes and the notion of what is responsible.

- There are, of course, penalties for the offences of drink-driving, these are the economists' sticks and carrots, but they have not been the whole story of public policy.

- Related public discussions around what is responsible are already taking place on climate change and have recently taken place in New Zealand in the context of mobile phone use while driving.

The role of public policy: managing change

- Industrial revolutions involve dislocation – candle makers and whaling disrupted by electricity.
- There will be vested interests that oppose change.
- There will be those who sow doubt in science: smoking/health; HIV/AIDS.
- Dislocation must be managed.
- Responsible public debate (and responsible journalism) can deepen understanding.

Summary

- Low-carbon growth is feasible and attractive. It is the only alternative to high-carbon growth. The debate can and must take place on all levels: national governments, firms, local communities. Should be integrated with other macro and international challenges of this decade.
- Public policy must be designed in the context of a collection of crucial market failures.
- Different failures require different policy instruments.
- Moving to scale is key: standards, infrastructure, national and global policy action, etc.
- Research on better policy design will help drive the transition.
- Dislocation.
- The debate can move forward through the power of example and engagement of communities.

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