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# Global Technology Investment Challenge

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# Outline



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- Introduction
- Context: EU Objectives and the Future Landscape
- The Economics of Transformation
- Issues in Technology Deployment
  - IPR, Public Goods and Competitiveness
  - Technical Standards
  - Regulation and System Change
- Ideas?

# Introduction: My Background



- **UK Prime Minister's Strategy Unit:** Energy Policy; Climate Policy (Domestic and Gleneagles); Innovation and Wealth Creation
- **UK Foreign Office:** WSSD; G8 Renewable Energy Task Force; REEEP
- **London Business School:** Climate Change Economics/Modelling; Economics of Technology and Innovation.
- **MIT Energy Lab:** Energy System and Technology Policy
- **GEC/PowerGen:** Energy market development and Power Engineering

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# What does EU need from technology?

- **Rapid global diffusion of near-to-market low carbon technology:** “best-case” 2 degrees target depends on large scale renewables, CCS and efficiency deployment.
- **A new generation of solutions:** need more radical technology – especially in bio-fuels, cars, planes, ships, and solar – to deliver from 2030 onwards (and help solve the hard politics of climate change).
- **Credible international collaboration mechanisms:** to lower the cost/risk of technology investment and to buy in major developing countries to a global deal.

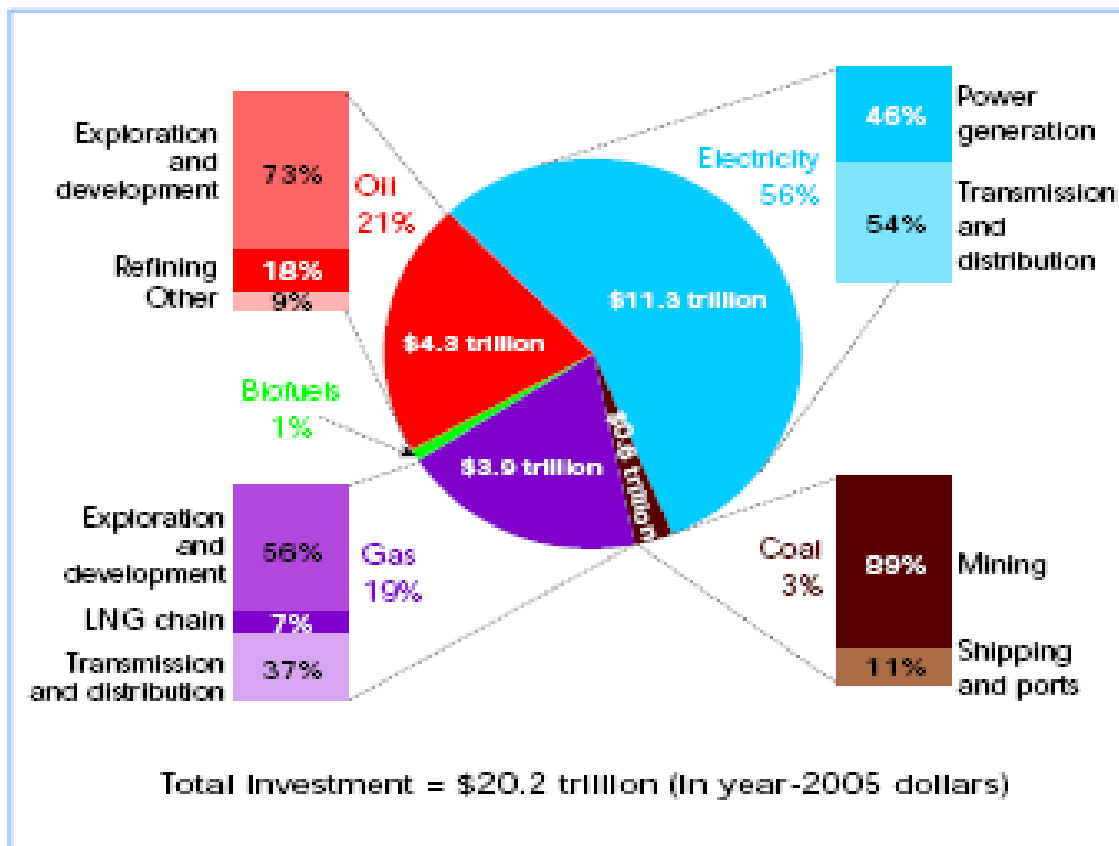
# Next 20-30 Years will be different to the past



- **Changing global economic balance:** new carbon intensive investment is as much in MICs as OECD
- **Global Innovation Space:** “South” is a producer not just a consumer of technology
- **Energy Security:** political priorities of energy security are driving investment into high carbon solutions using direct policy tools (spending, subsidy, regulation)

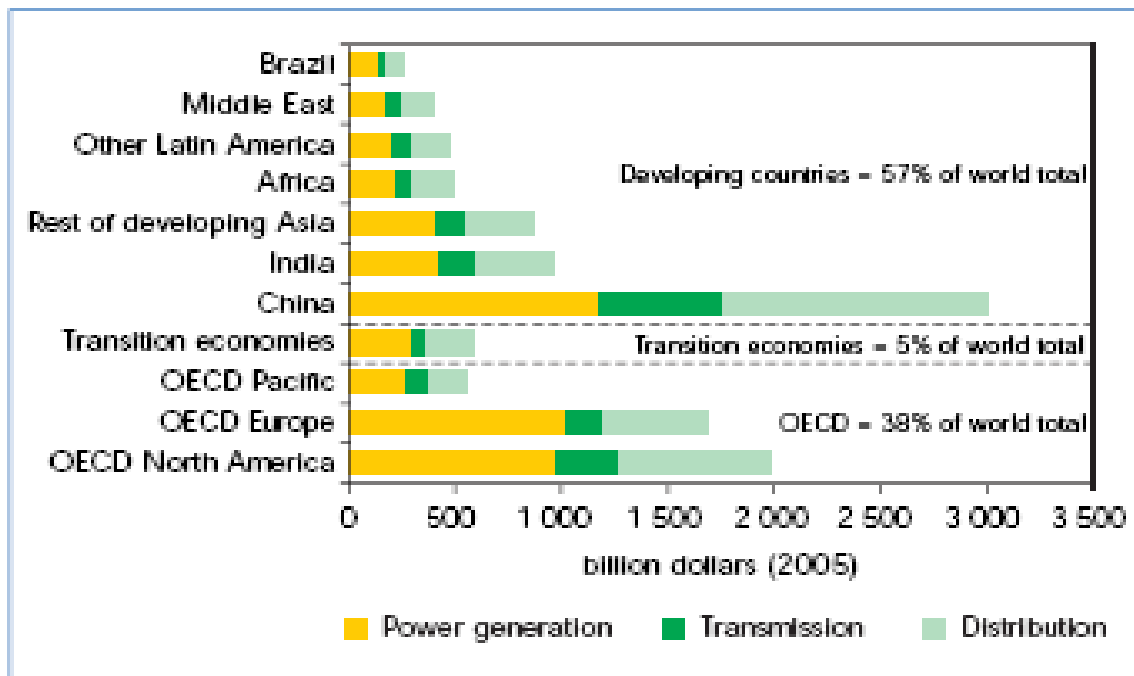
# Power Generation dominates next 25 years of energy investment

Cumulative Investment in Energy Infrastructure in the Reference Scenario by Fuel and Activity, 2005-2030 (in year-2005 dollars)



# Higher investments focused on middle-income countries

Cumulative Power-Sector Investment by Region in the Reference Scenario, 2005-2030



- A large part of all the energy investment needed worldwide is in middle-income countries, where demand and production increase most quickly.
- China alone needs to invest about \$3.7 trillion – 18% of the world total. Russia and other transition economies account for 9% of total world

Source: IEA, WEO 2006

# Global Innovation Space



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Innovation is not confined to OECD countries – strong R,D&D policies in all major developing countries

- China: space; aircraft; nanotechnology; energy
- India: space; IT; nuclear energy
- South Africa: nuclear energy; coal-to-liquids
- Brazil: biofuels

# Energy and Climate Security are public goods; markets will not automatically give right signals to shift major investment



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- Recent fossil fuel price increases dwarf equilibrium carbon price in Stern Review but are not leading to carbon-free economy
- Price rises and energy security are driving investment in climate instability:
  - rapid rise in coal power investment
  - coal to liquids investment in US and China
  - Large increase in carbon inefficient biofuels
- Impact on energy efficiency of high energy prices has been very slow, even in transport sector

**Need coherent, clear and effective policy signals to drive investment to deliver energy and climate security together**

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# Economics of Transformation: From “What” to “How?”



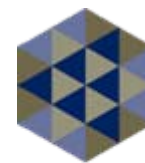
**Climate Change is unique challenge to drive global change in markets and technology towards a public good goal inside a specific timescale (outside WWII and Cold War).**

Post 2012 framework needs to target three core activities:

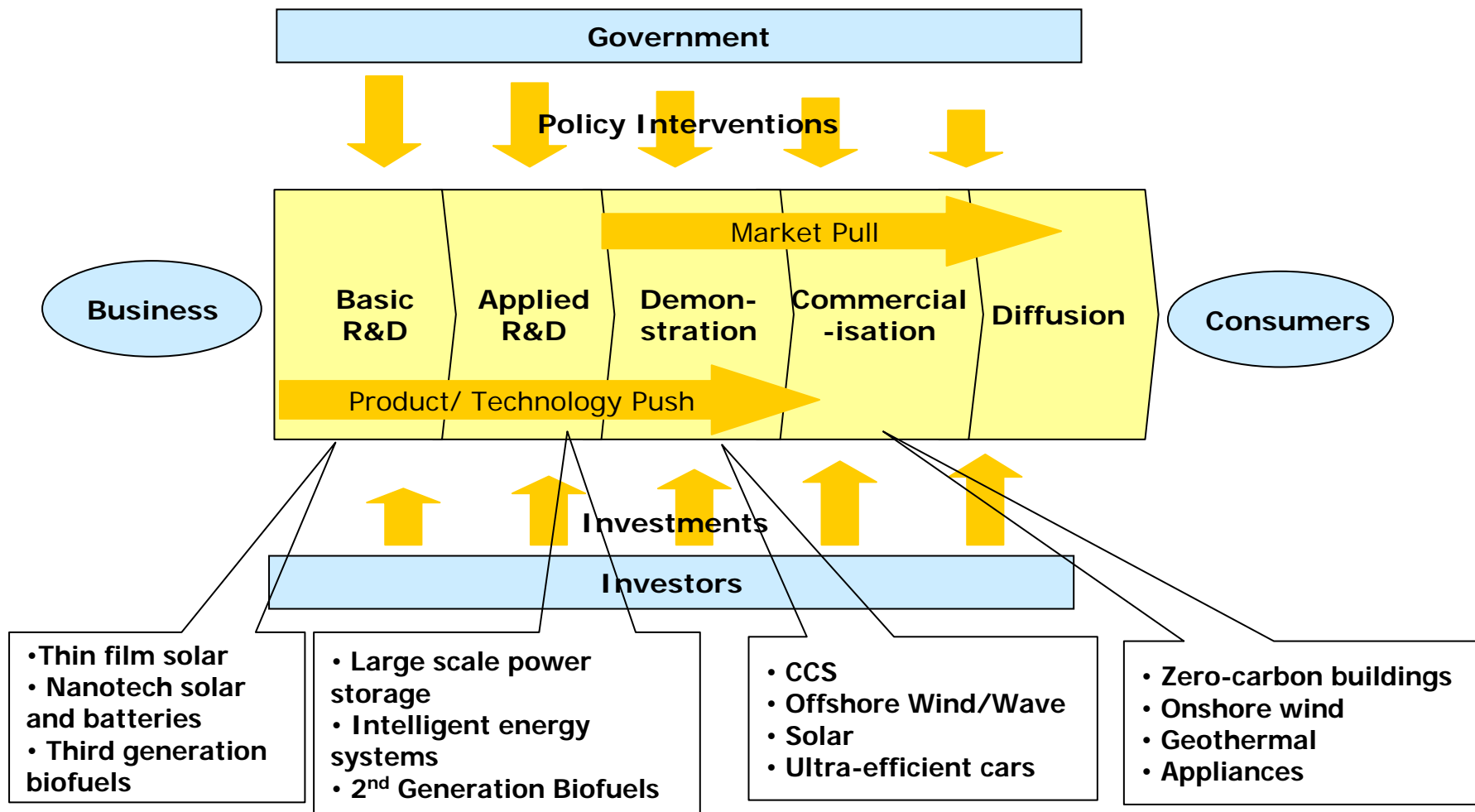
- **Investment:** consistent signals to investors to move on-going energy system investment towards low carbon alternatives.
- **Innovation:** produce sufficient “market pull” to generate radical investment in innovation in the next generation of low carbon technologies, services and businesses.
- **Institutions:** redesign the market, regulatory and business models currently shaping the energy system so they efficiently and effectively drive low carbon investment, and are increasingly sensitive to carbon price signals.

**Very weak understanding of what is a robust system of incentives and institutions to drive the transition to a low carbon economy.**

# Innovation Chain is different for every Technology



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# Technology: Pathways to deployment at scale are uncertain



## Uncertainty around technological solutions under development....

Wind Energy	rate of cost reductions as global markets grow
Solar Energy	rate of cost reductions as global markets grow
Biomass Energy	cost-effectiveness of next generation technology
Nuclear Energy	cost-effectiveness and safety/proliferation characteristics of next generation technology
Carbon Sequestration	cost effectiveness and environmental integrity

## and potential surprises.....

Solar Technology	appearance of ultra-cheap solar technology
Biotechnology	development of high efficiency cellulose conversion
Nanotechnology	development of ultra-efficient energy use technologies

# Carbon Catch 22: balance of public and private investment depends on expectations and risk



- Decision makers are uncertain about the economic and technical feasibility of meeting ambitious cuts in CO<sub>2</sub>, so set “fuzzy” carbon reduction goals;
- Many technologies will only be developed with immediate market pull rather than technology push. Companies will only invest if future markets are certain enough;
- Some options require investment in radical system transformation but new innovations could appear which make these redundant;
- Fear of being seen to “pick technological winners” and desire to put risk onto private sector is stalling more radical technological options.

**Need to create a virtuous circle of demonstrating feasibility of emissions cuts so decision makers commit to credible targets for market pull**

# In medium term cannot eliminate core market risks



Markets will continue to discount future carbon price and “top-down” targets because:

- Political risks surrounding carbon commitments
- Market risk due to immaturity in the sector – no understanding of market robustness
- Transaction risks due to lack of track record with purchasing and selling entities
- Technology risks in many sectors

# Conclusion: What is needed?



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EU needs a credible way to move technology development and diffusion which complements carbon markets and:

- Focuses on outcomes – not reliant on “magic of price mechanism”
- Leverages on-going investment in MICs
- Maximises use of global innovation networks – ditch N-S dynamic – don't forget N-N collaboration!
- Fits with energy security priorities in MICs
- Gives bespoke instruments in each sector balancing push and pull factors – there is no technology neutral solution
- Engages private sector as collaborators and competitors – understanding investor risk-reward balance

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# IPR, Public Goods and Competitiveness



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- Developing countries see technology transfer as a key objective in climate deal - for industrial policy reasons
- EU has sold “clean industrial revolution” on domestic competitiveness and climate grounds
- Large public investment in renewables, CCS etc producing IPR for private firms
- But this conflicts with strategic imperative of technology diffusion
- Need to develop a public technology licensing agreement with technology developers operating in EU - leveraging March Council package (politics hard!).

# Technical standards are key component to agreements



- Innovation and diffusion in buildings and transport will be driven by technical standards not price (and some parts of power sector?)
- Trade and investment driven deals with dynamic developing countries can lower costs and drive diffusion
- Need to link tariff barrier reduction, investment policy, mutual standards recognition and joint efficiency standard policies

# Industry regulation and system innovation



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- “Market pull” through carbon price excludes system innovation and is diluted by poor regulatory environment
- Waste of public money if technology pull instruments not linked to regulatory reform in energy and power sector
- Need sectoral “Energy Charter Treaty Analogues” with reciprocal agreements on 3<sup>rd</sup> party system entry, energy subsidies, price transparency, unbundling, system incentives, investor treatment, anti-corruption etc. Similar to adaptation agreements?

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# Ideas for Technology Cooperation?



- Joint investment vehicles for power sector demonstrations: CCS; offshore wind; solar thermal
- Joint public sector fund for adaptation technology development
- Low carbon free trade zone – EU-China?
- Low emission vehicles agreement – EU, China, California...?
- Public equity share vehicles in subsidised technology: CCS, offshore wind etc
- Regulatory protocols for clean power system investment: India; Brazil?
- Clean aircraft partnership: Airbus and China?

**What is the best political framework for such agreements?**