



Centre for
Climate Change
Economics and Policy



Grantham Research Institute on
Climate Change and
the Environment

Fostering the transition to the new climate economy: policies, political economy, innovation and growth

Nicholas Stern

IG Patel Professor of Economics & Government
London School of Economics and Political Science

President of the British Academy

For The World Bank

6 January 2014



The New Climate Economy

The Global Commission on the Economy and Climate

Seven Part Structure

- **Part 1: Six years since the Stern Review**
- Part 2: Where we are going and why action is so slow
- Part 3: Describing the risks: the scientific models
- Part 4: Economic models and discounting
- Part 5: Sustainable growth and development
- Part 6: Policy for the low-carbon transition
- Part 7: Collaboration and understanding others

Six years since the Stern Review

- ***Stern Review underestimated the risks.***
- Emissions are at the top end or above projections (e.g. IPCC AR4, SRES A1) (Peters, et al. 2012). And see IPCC AR5.
- Some effects coming through more quickly or severely than anticipated: extent of Arctic Sea ice decline; ocean acidification and functioning of ocean systems.
- Interactions of climate, ecosystems, planetary boundaries (Rockström, et al. 2009) mostly omitted from models and look more worrying.
- Some feedbacks and tipping points such as thawing permafrost omitted from models look more serious.
- All this underlines further the potential for radical transformation in how and where people can live: migration and conflict omitted from models.
- And see further below on problems with modelling.
- ***Technical progress faster than anticipated then; political will more problematic.***

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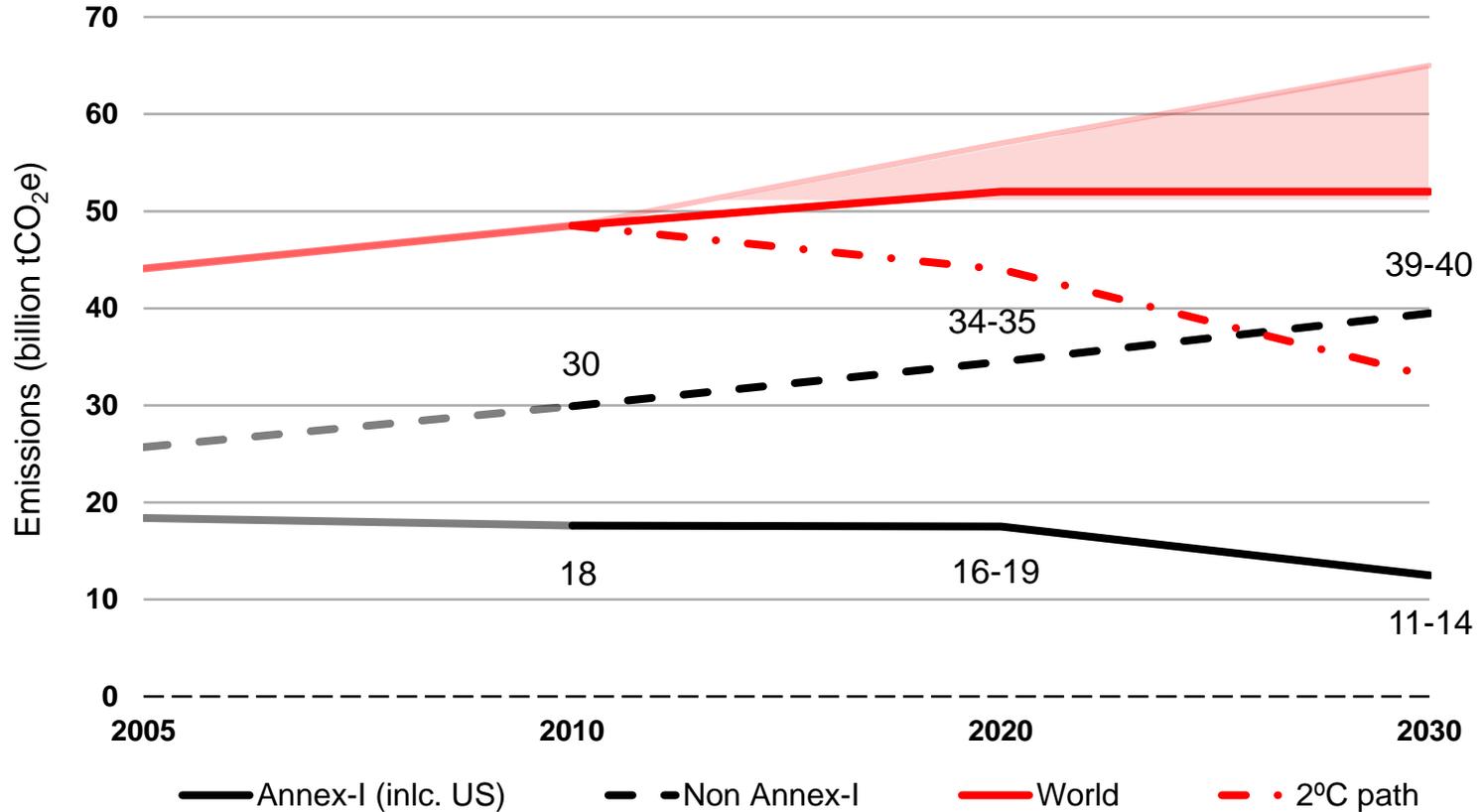
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Where we are going (I)

- Greenhouse gas concentrations or stocks have increased from around 285ppm CO₂e in the 1800s to around 445ppm today. BAU likely to take us over 750ppm by the end of the century or thereabouts (adding at a rate of over 2.5ppm per year).
- Some climate models suggest a median temperature increase over the next one or two centuries in the region of 4°C or warmer, with substantial probabilities of well above 4°C (see, e.g. IEA, 2012 and 2013; Rogelj et al, 2012). Global mean temperatures regularly exceeding 4°C above pre-industrial have likely not been seen for at least 10 million years, perhaps much more (e.g. Zachos et al. 2008). Have not seen 3°C for around 3 million years: 450ppm gives around a 20% chance of greater than 3°C.
- High probability of extreme weather events.
- Global sea-level peak 22m higher than present for the Pliocene interval (2.5-5.5 million years ago), which was 2-3°C warmer than today (Miller, et al. 2012). Deserts, coastlines, rivers, rainfall patterns, the reasons we live where we do, would be redrawn. (See WB, 2012 and 2013, for a description of possible impacts at 4°C)
- Potential cause of migration of hundreds of millions, perhaps billions, of people around the world: likelihood of severe and sustained conflict (note that those such as CIA who worry about security also worry about climate change).

Where we are going (II)

Prospects for world emissions 2020 and 2030
based on current ambitions, targets and plans



Source: UNEP, 2012, The Emissions Gap Report, Appendix; own calculations.
Consistent with AR5 (RCP8.5). See Riahi, et al. (2011).

Why action is so slow

- Main obstacle to action is lack of political will. Due to:
 - A failure to understand the magnitude of the risks and the dangers of delay (ratchet effect of emission flows to concentrations, physical capital/infrastructure lock-in);
 - A failure to understand the attractiveness of the alternative paths and that these can combine growth, poverty reduction and climate responsibility; and
 - A failure to understand what others are doing and a presumption it is very little.
- Global economic challenges/crises have diverted attention:
 - Major macroeconomic structural imbalances; debts and deficits in rich countries; unfinished financial sector reform; fragile growth in many countries; radical changes in international division of labour and skills.
- Science deniers; dubious cost estimates; vested interests.
- We can do better on all these challenges, including climate change, if we tackle them together in a coherent and integrated way. But creation of political will requires deeper understanding of above issues.

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Describing the risks: the scientific models

- Structure and calibration of scientific and economic models have broadly underestimated risks. See Stern, 2013, Journal of Economic Literature.
- The scientific models mostly leave out dangerous feedbacks/tipping points. If modellers cannot capture or model effects “sufficiently clearly” they are omitted. But best guess surely not zero.
- The models do not generally represent the lasting/dynamic impacts of extreme weather events.
- The models are not built in a way that help us describe the impacts on people, e.g. at 3-4-5°C may see radical monsoon changes in India and substantial changes in flows of major rivers off the Himalayas (a billion plus people depend on them).
- Models should focus on understanding probabilities of events with severe consequences for lives and livelihoods. Need new generation of models.

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Economic models and discounting (I)

- Severe limitations in the economic modelling structures; flawed in both calibration and structure.
- Output generally modelled assuming underlying exogenous exponential growth and minor percentage GDP damages (around 5-20%).
- An exogenous growth rate (say around 1-2%) overwhelms the damages in these models. Possible scale of climate change could deeply damage growth possibilities and rates.
- In standard models the damage function impacts output only in the current period (other than through reducing saving). This is a key modelling error.
- Absence in the models of migration, conflict, loss of life.
- Some problems not too hard to fix within models. But also a new generation of economic models is needed. And broader perspectives for more profound effects such as conflict.

Economic models and discounting (II)

- Modelling failures compounded by ignoring key principles of discounting.
- Discount factor (discount rate is its rate of fall) depends on future development of the economy and on good chosen for accounting.
- Failure to recognise that future generations may be poorer than us; magnitude of possible effects could put growth into reverse and lead to large-scale loss of life. Thus discount rates could become negative.
- Pure-time discounting is discrimination by date of birth; a key asymmetry. Many or most structured ethical positions would indicate symmetry.
- Failure to understand that cannot 'read-off' the relevant discount rates from market interest rates or rates of return (different decision-makers and decisions, market failures....).
- In most models discount rates should be riskless because risk/uncertainty handled directly via expectations of discounted utility.
- Overall failure to understand discounting and modern public economics. (See Stern, 2013, *Economics and Philosophy forthcoming*, Ely Lecture, AER 2008).

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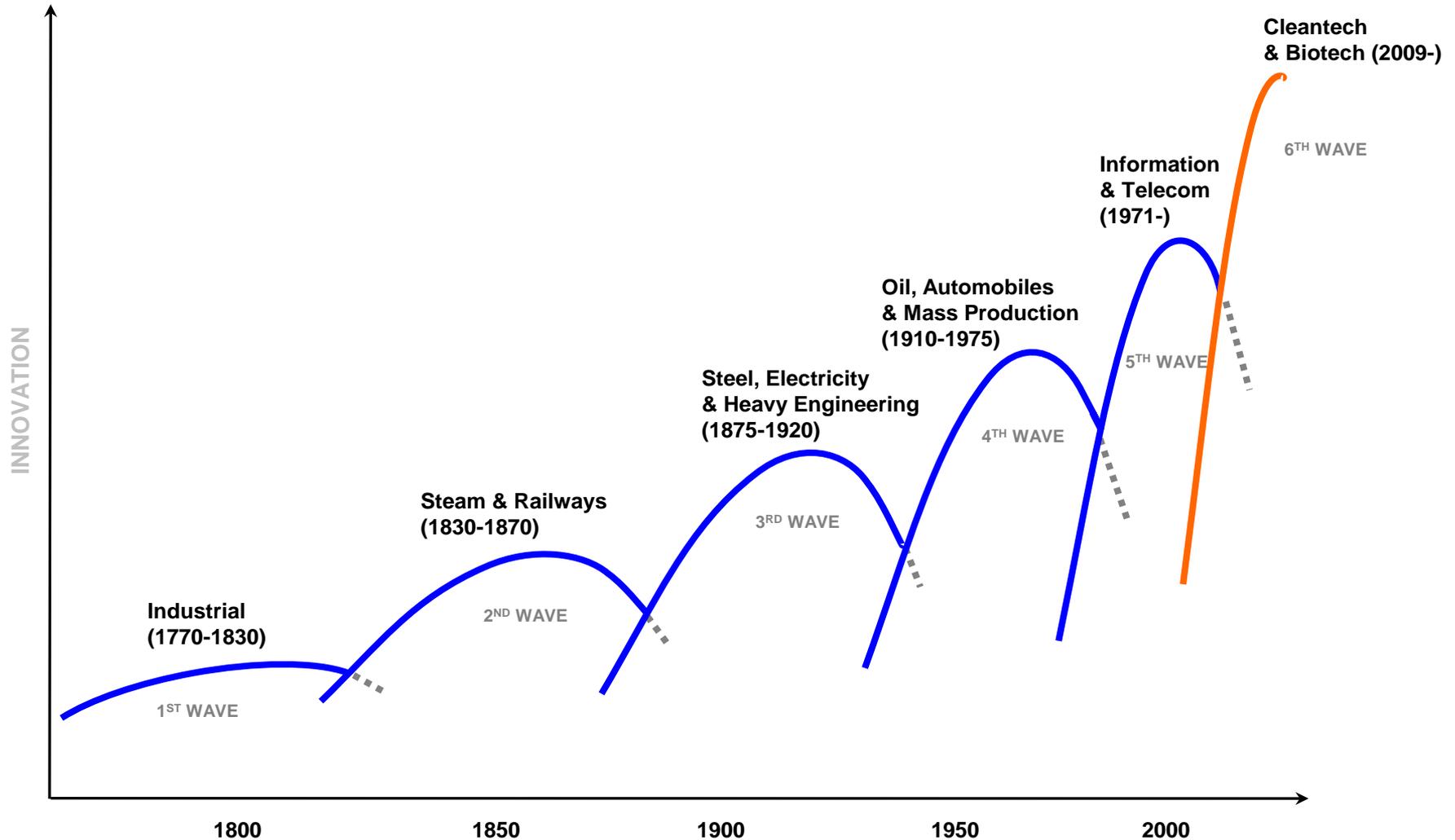
The new energy-industrial revolution (I)

- Transition to low-carbon growth / new industrial revolution gives more than a fundamental reduction in climate risks.
- Through a combination of strong policy that sets clear expectations and private self-interest it is likely that market forces and tipping points have the potential to shift economies onto new low-carbon pathways.
- What the transition path will look like and where we end up will depend heavily on expectations, norms and behaviours.
- If policy is strong, clear and credible, which would sets clear expectations the transition is inevitable, we could see a dynamic period full of innovation, investment, creativity, opportunity and growth, with large and growing markets for the pioneers (see, for example, Perez 2002 and 2010).
- If policy is weak and the transition is not seen as inevitable, or is expected to be delayed, it is important to identify the behavioural and political economy barriers that reinforce these expectations and how we might tackle these.

The new energy-industrial revolution (II)

- With strong technical progress and breakthroughs, the growth effects may be similar, or larger, to the railways, or electricity in earlier eras, inter alia, because more widely spread, more rapid, and complementary with other technical changes and urbanisation.
- When achieved, low-carbon growth will be more energy-efficient, more energy secure, more community based and inclusive, safer, quieter, cleaner and more bio-diverse.
- Potential to achieve growth, overcome poverty and be climate responsible.
- An attempt at high-carbon growth likely to self-destruct. But with weak policy, weak expectations of a transition and weak international collaboration, waiting may appear the rational choice for the decision-maker and we may end up on a high-carbon path for several decades to come.

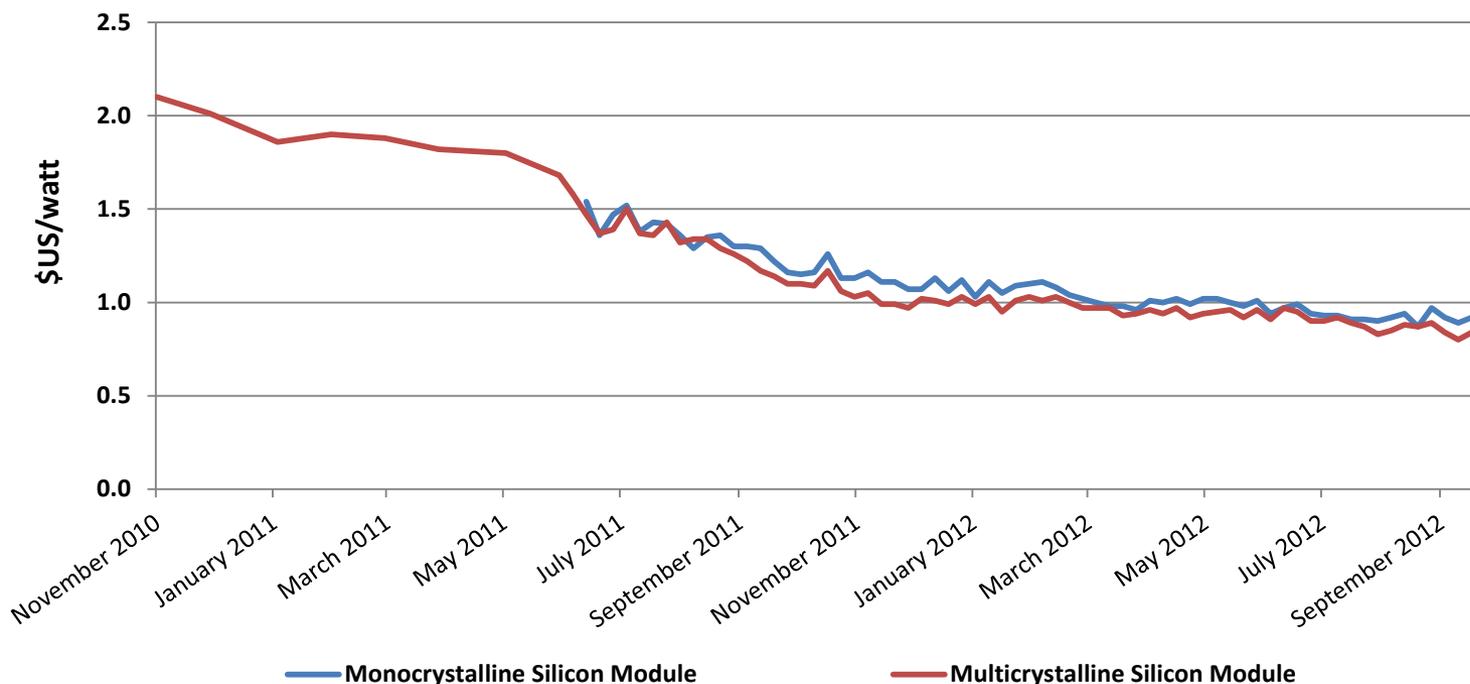
Waves of innovation



Technical progress - solar

- Solar PV module prices were \$3-3.5/watt in 2005 and around \$2/watt in 2010 (EIA, 2012). They have fallen around 50% since 2010: currently well below \$1/watt (BNEF, 2012). Prices have come down by a factor of 4 over the last 7-8 years.

Price for immediate delivery of silicon modules,
November 2010 – September 2012 (\$/W)



Source: BNEF (2012)

Investment for the transition

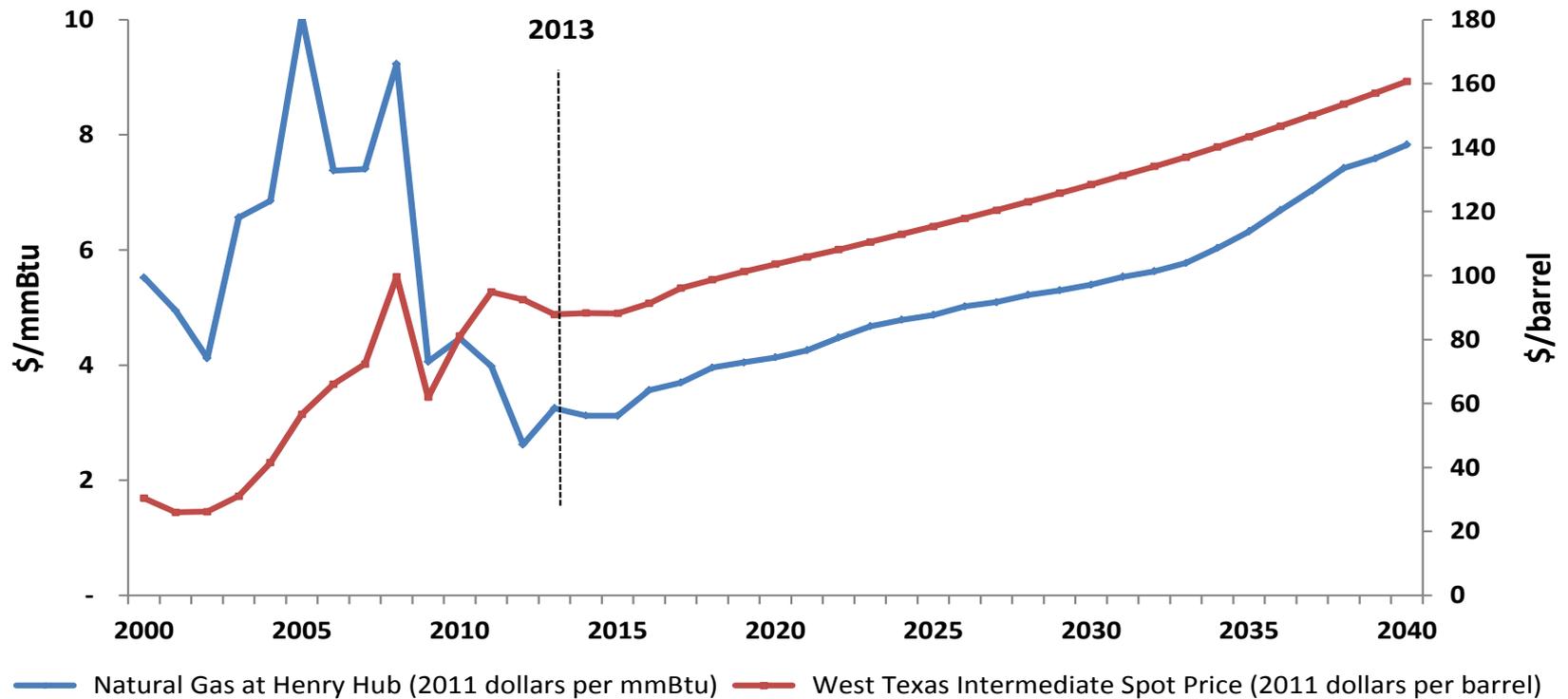
- Expenditure involved in making the transition to a low-carbon economy should be analysed as an *investment*, rather than only a net cost (many co-benefits outside climate change). Most is not a direct cost to the public purse, largely private (Romani, et al., 2011).
- This is about both the *dynamics* of innovation and learning and the creation of benefits beyond narrow GDP; *not simply static* shift to higher input-output/coefficients and lower growth.
- Stern Review (2007) - incremental global investment for transition in the range of 1-2% of GDP per year. Lower figure was for target of stabilising below 550ppm CO₂e. Other estimates in similar range, e.g.: den Elzen et al. (2007); Knopf, et al. (2009); Edenhofer et al. (2009); WB (2010).
- IEA (2011) - 450ppm requires incremental world investments in energy sector around US\$ 1 trillion p.a. to 2030, around 2% of current world GDP.
- Uncertainty around these estimates, but could be *lower* than 2% of GDP with energy and resource efficiency gains (see work on efficiency by McKinsey 2011 and also WEF 2012), and technological change. Other co-benefits are also potentially substantial and could deliver material benefits in the short run. *Higher*, if policy bad, muddled expectations, delay.
- Reduce emissions from stopping deforestation. Negative emissions from reforestation and restoration of degraded forests, or biofuel with CCS.

Hydrocarbons: rising prices/stranded assets? (I)

- Hydrocarbon prices rising (see next slide).
- And most are “unburnable uncaptured”. Only around 30 per cent of global proved fossil fuel reserves can be burnt “uncaptured” between 2012 and 2050 for a 2°C path (IEA WEO, 2012).
- Therefore, either the development and deployment of CCS on scale must be very rapid or 70 per cent of these resources must stay in the ground or the 2°C target will be greatly exceeded. Fundamental contradiction between current valuation methods and declared world climate policy.
- Risks of stranded assets a major issue.
- Gas before coal.

Hydrocarbons: rising prices/stranded assets? (II)

US oil and natural gas prices: historical and projected



Source: Source: EIA, Annual Energy Outlook 2013, Reference Case.

Hydrocarbons - Gas

- Potential role for hydrocarbons in the transition, e.g. gas as a “bridge technology”.
- Global trends appear to suggest a shift over the coming decades to gas; emissions benefits widely stated in the region of 50% of coal (provided gas escapes limited).
- Much technical progress in hydrocarbons. Horizontal drilling and “fracking” has enabled “unconventional” gas resources to be exploited economically (tight gas, shale gas and coal bed methane). US wholesale gas prices have fallen sharply; will rise with greater world market integration.
- If a role for gas as a “bridge technology”, how to substitute ‘gas for coal’ and not ‘gas for renewables’? Renewable investment has continued to rise over recent years, but could be threatened as shale boom changes perceptions. Need clarity now on future regulation/carbon prices.
- The development of Carbon Capture and Storage is crucial if we are to continue to use hydrocarbons in the future. Slow progress. Cross-country collaboration can accelerate technological development?

The New Climate Economy

- The Global Commission on the Economy and Climate, New Climate Economy project (NCE), will attempt to enhance the understanding around the transition to a low-carbon pathway, and thus the politics, in the shorter term.
- The project will test the following hypothesis; “Nations, provinces, cities, businesses and investors can achieve their 5-15 year goals (growth, jobs, poverty reduction, profits, energy supply, food supply, resource efficiency, etc.) while also achieving sustainable emission reductions in the short to medium term on a sufficient scale to reduce materially the risk from climate change.”
- The NCE will tell a simple story that is provocatively new and has the potential to shift expectations. Managing the transition becomes cost-effective when all players do act and are *expected* to act; delay becomes cost-effective when they are not. Changing collective expectations through making clear the potential short term benefits from acting for individual players at the individual, firm, city, and national level, could break the deadlock and end the waiting game.
- The focus of the project will be on the political economy, i.e. the interplay of real-world politics, policy and analysis, paying particular regard to winners and losers; incentives; and sectoral and national interests. Addressed particularly to economic decision-makers.

The New Climate Economy

- The project is structured around four themes:
 - Economics of low-carbon pathways, which work will provide an overarching narrative that frames the future growth story, with a focus on the next 5-15 years. It will also provide a better understanding of the political economy barriers and how to tackle these;
 - Country Transitions, which will focus on understanding possible low-carbon transition paths for key countries including China, India and Brazil;
 - New Drivers of Wealth, which will focus on the role of cities, innovation and land use in driving growth and poverty reduction over the coming few decades; and
 - Energy Systems and finance, which will examine the investments required to improve the rate of technical change and enhance energy productivity and how to manage the “stranded assets” issue.

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Policy for the low-carbon transition – medium-term structures

- Good policy needed to drive this industrial revolution – different from past revolutions.
- Six key **market failures**. Different failures point to different instruments, but the collection is mutually reinforcing:
 - **Greenhouse gases**: carbon taxes / cap-and-trade / regulation;
 - **R,D&D** (research, development and deployment): tax breaks, feed-in tariffs (FIT) for deployment, publicly funded research;
 - **Imperfection in risk/capital markets**: risk sharing/reduction through guarantees, equity, feed-in tariffs, floors on carbon prices. FIT straddles first 3 imperfections. Green/infrastructure development bank: reduces policy risk, provides leverage, longer-term horizon, power of example;
 - **Networks**: electricity grids, public transport, broadband, recycling, community-based insulation schemes. Government frameworks needed;
 - **Information**: for consumers labelling and information requirements on cars, domestic appliances, products more generally; awareness of options. Similar issues for producers.
 - **Co-benefits**: valuing ecosystems and biodiversity, valuing energy security, regulation of dirty and more dangerous technologies.
- Should not see these in terms only of static re-allocations or corrections: policy concerns the dynamics of change and learning. Fostering a transition – experience of EBRD.

Development, mitigation and adaptation are intertwined

- For example:
 - **Food:** low-till techniques for rice save inputs, including water and energy, and provide more resilience, reduce methane, reduce soil disturbance and emissions.
 - **Energy:** low-carbon energy, e.g. decentralised solar, reduces emissions, brings electricity and clean cooking facilities to poor people (around 1.3 billion people in the world without access to electricity and 2.7 billion without access to clean cooking facilities (WEO, 2011)), is less vulnerable than grids, and is more inclusive, e.g. enables women and children to study at night, reduces time spent collecting and transporting biomass, and enables women to open businesses such as solar charging stations. Less susceptible to corruption than grids.
 - **Public transport:** reduces congestion and pollution, increases the mobility and opportunities of people, if well designed is more resilient.
- Analytical and practical mistake to separate out the three issues into silos or, to portray as in conflict or tension.

Policy for the low-carbon transition – shorter-term issues

- Now is the time to invest for (low-carbon) growth: in many developed countries private sector sitting on record levels of savings and long-term real interest rates low.
- Good (clear and credible) public policy to correct market failures can restore confidence and leverage large private investment opportunities with little threat of crowding out.
- Will require government instruments that help manage risk. Mostly private investment and finance.
- Government is key source of policy risk. Policy uncertainty risks damaging short-run investment and hindering long-run structural change. Greater clarity can unlock private investment for a sound path for medium-term growth (Zenghelis, 2011 and LSE Growth Commission 2013).

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Collaboration and understanding others

- It is possible to move forward without full agreement, and we are seeing examples including China, Indonesia, Colombia, Mexico, etc.
- *Equitable access to sustainable development* (language of UNFCCC Cancun 2010) is an attractive way of framing the issues that may help bridge the gap between developed and developing countries and accelerate action.
 - Countries come together in a *dynamic partnership* where the *choice* of their sustainable development path is determined by the people of developing countries and that path is supported by rich countries (providing *strong example* and *access* to know-how, technology and finance).
 - Contrast with “burden-sharing”, “others should pay incremental cost”, zero-sum games.

Leadership from international institutions

- Collectively, their **mandates** are poverty reduction, growth, development, sustainability and stability.
- They can **integrate across the key problems** of our decade: economic crises, climate crises, medium-term growth, changing international division of labour.
- They can provide **finance** with a **longer-term** perspective for longer-term issues.
- They can bring nations together in an equitable way, in part **by showing what others are doing**, around what must be an **international** and **collaborative** endeavour.

Conclusion

- *Six years since the Stern Review*: Risks bigger, technological change promising.
- *Where are we going and why action is slow*: To a dangerous place; need political will.
- *Describing the risks - the scientific and economic models*: Both scientific and economic models badly under-estimate potential impacts; new generation of models needed.
- *Sustainable growth and development*: Transition to low-carbon economy likely to be full of innovation and benefits beyond reduction of climate risks.
- *Policy for the low-carbon transition*: Policy to overcome six major market failures is key to fostering the recovery of economies and the dynamic transition to a low-carbon growth and economy.
- *Collaboration and understanding others*: International institutions are key to addressing economic and climate crises together and building international cooperation.

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