Ten propositions on climate change and growth

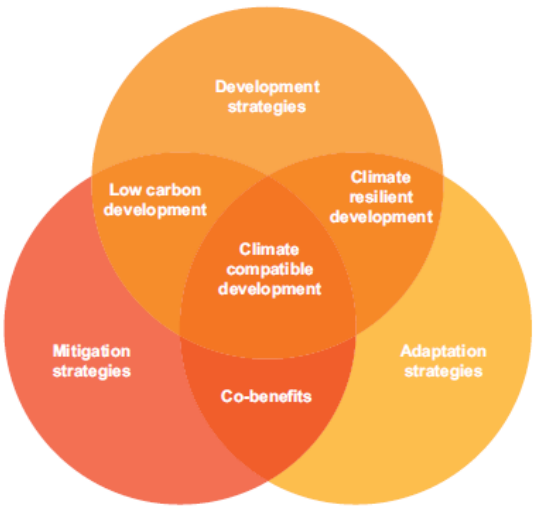
Simon Maxwell

The impact of climate change on growth, and vice-versa, the impact of growth on climate change, are both much-debated. Growth optimists argue that green growth options will make it possible to continue growing while simultaneously avoiding the warming of the planet. Growth pessimists argue the opposite – and sometimes add that we anyway consume too much, and could be happier with lower growth.

From the perspective of developing countries, especially the poorer developing countries, continued growth looks like an imperative if the Millennium Development Goals and their post-2015 successors are to be met. The main concern of developing countries is that climate change, or measures taken to combat climate change, might dampen growth. Equally, however, it does not take much for fast-growing developing countries to begin contributing to climate change in their own right. For example, manufacturing in Vietnam is growing at 10% a year, which puts it on a trajectory to grow eight times in the next twenty years – but the country is already emitting 1.3t of CO_2 p.a., more than half way to the 2050 target ceiling.

Much of the current debate focuses on mitigation and adaptation, both important components of climate-related policy. In the CDKN, we add a third dimension, development, and talk about 'climate compatible development', defined as development that minimises the harm caused by climate impacts, while maximising the many human development opportunities presented by a low emissions, more resilient future. See Figure 1[1].

Figure 1: Climate compatible development



Source: adapted from Zadek, 2009, and informal communication with staff from the UK Department for International Development

[1] http://cdkn.preprod.headshift.com/wp-content/uploads/2011/02/CDKN-CCD-DIGI-MASTER-19NOV.pdf

From that position, here are ten propositions about climate change and growth.

1. **Growth does matter for poor countries – even though most poverty is not in the poorest countries**

It is self-evident that very poor countries with very high levels of poverty will need to grow, if basic human needs are to be met. Take Burundi, where 81% of the population lives on less than $US 1.25 a day, and where national per capita income is only $US 1.04 per day. No redistribution from rich to poor within the country could eliminate poverty.

That is an extreme example, and it is notable that 72% of the poor now live in what are formally described as middle income countries, including China, India, Nigeria and Pakistan. Do those countries need to grow, or could they solve the poverty problem through redistribution? Martin Ravallion at the World Bank has explored this question[2], and concludes that 'the marginal tax rates (MTRs) needed to fill the poverty gap for the international poverty line of $1.25 a day are clearly prohibitive (marginal tax rates of 100% or more) for the majority of countries with consumption per capita under $2,000 per year at 2005 PPP. Even covering half the poverty gap would require prohibitive MTRs in the majority of poor countries. Yet amongst better-off developing countries—over $4,000 per year (say)—the marginal tax rates needed for substantial pro-poor redistribution are very small—less than 1% on average, and under 6% in all cases.'

According to the figures published in the World Development Report for 2010, 35 or so countries had per capita income of below $US 2000, including Bangladesh, Cambodia, Haiti, and many countries in Africa; and about 20 lay between $US 2000 and $US 4000, including India, Indonesia and Pakistan. For all these countries, accounting for the bulk of the world's poor, there should be no doubt that growth is a priority.

China and some others lie above the $US 4000 threshold, but for all countries, reducing core poverty is only the first step on the development path. Convergence with rich countries makes quite other demands, and raises other questions, to which we shall come.

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2 http://elibrary.worldbank.org/docserver/download/5046.pdf?expires=1301493327&id=id&accname=guest&checksum=6A4ADAEC776E2B51F7980DB94A3EB8B0

2. Climate change is one driver, but the measures taken to tackle climate change will also have effects on growth

Climate change will impact directly on growth, as the Stern Report, the IPCC, and many other reviews have concluded. Most of the impacts will be negative. Heat and water stress will affect crop productivity. Glacier melt will reduce the potential for irrigation. Extreme climatic events will disrupt livelihoods and damage productive infrastructure. One rule-of-thumb estimate is that each 1 degree rise in temperature above the optimum during the growing season leads to a 10% decline in grain yields.

At the same time, measures taken to tackle climate change will also have an effect on growth, at least in the short run. A carbon tax, for example, would increase production and transport costs, and could result in an increase in prices, reducing demand and real income.

Karen Ellis and colleagues have looked systematically at the effects of mitigation policies in developed countries on developing countries. They cover such topics as carbon taxes, border tax adjustments, emissions trading schemes, carbon labelling, and financial flows associated with the Clean Development Mechanism. A summary of likely impacts on trade, capital flows, development finance, technology and growth is in Appendix 1. There are complex inter-linkages and variegated patterns of winners and losers.

3. A global perspective is needed

An important insight of work on climate compatible development is that the drivers of climate change impacts on growth are external as well as internal, and may be positive as well as negative. The oil price example above illustrates the point: a carbon tax in developed countries has direct impacts on developing countries. The current global food price crisis provides another example. Simplifying somewhat, fires in Russia and floods in Australia, combined with the use of 100mt of corn for biofuels in the US, have contributed to world record food prices, which affect welfare, political stability and growth prospects around the world.

Thus, discussion of mitigation and adaptation policies conducted in a national context is misleading.

Furthermore, climate change creates opportunities as well as threats. Two examples are lithium in Bolivia and solar cell production in China.

Bolivia has an estimated 50% of the world's reserve of lithium, needed for a new generation of low carbon batteries for electric vehicles, found in brine deposits below the Uyuni salt

flats. The Government has valued these at $US 1.8 tn, and has plans to use the resource as the basis for development of battery and other downstream manufacturing.

China has developed a large solar cell industry, largely for export. China itself has installed capacity of about 220 MW, but one firm alone, Renesola, produced more than 1 GW in 2010 alone, entirely for export. This is a $US 1bn business, contributing jobs, tax revenues, and foreign exchange to the Chinese economy.

These negative and positive cases illustrate the way in which climate change and climate-related policy will (a) shift production possibility frontiers which determine what outputs can be produced with what inputs, (b) change relative prices, and (c) create entirely new markets. It may be too strong to say that global production will be restructured, but the impacts are likely to be significant.

4. A climate compatible strategy needs to be at the heart of the response

Four conclusions follow from the previous discussion. First, climate change will change development options and pathways. Second, adjustment is likely to be disruptive, with winners and losers as between sectors, geographies, genders and generations. Third, a focus on mitigation and adaptation alone is unlikely to encompass the range of likely effects. And fourth, some kind of national strategy is necessary to manage change on the scale expected.

National strategies can be problematic. The current generation of climate-related plans are heir to a long tradition of national plans, ranging from the top down and strongly interventionist, to the lighter touch and more strategic. Examples include national development plans, like those found in India or China, integrated rural development programmes, food security strategies and plans, sustainable development strategies, structural adjustment programmes, poverty assessments and poverty reduction strategy papers, and MDG plans of action.

In the worst case, national strategies have been data-hungry, time-consuming to prepare, top-down in nature, often with analysis disconnected from action, and, where action is foreseen, inflexible. They have also often been vehicles for the interests of one Ministry or sector within Government, at the expense of others. They have consisted of a list of projects for donor funding, rather than addressing the incentive and regulatory framework. And private sector and civil society actors have been excluded. The worst case is sometimes described as ‘blueprint planning’

In the best cases, national development planning has been an open, participatory and flexible process, led from the centre, starting with objectives, addressing both the

regulatory framework and public expenditure, subject to flexible implementation, and with frequent monitoring and re-planning. It sometimes uses scenario planning, as a tool both to explore options, but also to build consensus. The best case is sometimes described as 'process planning', drawing more recently on the lessons of complexity theory.

Note that the style of plan is independent of the content. It would be easy but misleading to characterise blueprint plans as necessarily being associated with state-led, top-down development, and process plans as being associated with market-led options. Sadly, many market-friendly Governments have fallen into the trap of blueprint planning.

Climate change planning has so far concentrated on two documents mandated by the UNFCCC: for mitigation, the NAMA, or Nationally Appropriate Mitigation Actions; for Adaptation, the NAPA, or National Adaptation Programme of Action. These have begun to be superseded at national level by more comprehensive documents, like Low Carbon Development Plans, Low Carbon Growth Plans, or Climate Compatible Development Plans. In principle, these have the potential to deal with the wider development agenda.

There are too few of the new generation plans to reach unambiguous judgements about their quality. What, however, in terms of growth, should they aspire to achieve?

5. Low carbon growth appears feasible

From the previous discussion, low carbon – or green – growth is not the only aspect of a new growth policy, which needs to deal with a range of climate-induced shifts to input-output relationships, relative prices and market opportunities. Nevertheless, though not sufficient, low carbon growth is a necessary aspect, as illustrated by the Vietnam example cited earlier.

Pessimists argue that the lower energy efficiency of non-fossil fuels will inevitably slow growth[3]. Indeed, more generally, estimates from the Stern report that tackling climate change will cost 1% of GDP also imply that growth will need to be sacrificed. Stern has increased his estimate to 2%[4]. With specific reference to energy, the argument is that increases in energy efficiency or 'energy productivity'[5] will be insufficient to offset higher costs, and that this will constrain growth.

[3] See, for example, the work of Hannes Kunz (http://www.theoildrum.com/node/6641)

[4] Stern, N, 2009, A Blueprint for a Safer Planet, Bodley Head, London

[5] http://www.mckinsey.com/mgi/publications/global_energy_demand/Energy_Productivity.asp

A practical insight is provided by recent analysis of the impact of rising oil prices. Dirk Willem te Velde[6] examines the impact of a one third increase in oil prices over two years. This is a larger increase, and more sudden, than could be expected as a result of carbon pricing. Nevertheless, it would cut 1% from global GDP and cost sub-Saharan Africa $US 8bn, with the bulk of the costs, and the biggest proportional GDP losses, suffered by some of the poorest countries: Ghana, Swaziland, Lesotho and Togo all lose more than 3% of GDP, as do Honduras and Nicaragua. Poor households suffer most. Of course, oil exporters gain from a general increase in the oil price.

In contrast, green growth optimists argue that low carbon options will boost growth in both the short- and long-terms, leading to immediate resource savings and job creation in the short term, and to the creation of competitive advantage in the longer term.

Dirk Willem te Velde is among those who argued for a (part) green fiscal stimulus during global financial crisis, partly to encourage energy efficiency. He reported that

> 'Preliminary research suggests that productive firms tend to be more energy efficient, so private sector development policies that promote productivity growth can also promote greener growth. Support for the adoption of green technology can help to narrow the energy efficiency gap between the actual energy savings and energy savings that are economically and socially efficient.'[7]

More generally, the Green New Deal Group argued in 2008 for a package of measures in the UK, including:

- 'Executing a bold new vision for a low-carbon energy system that will include making 'every building a power station'. Involving tens of millions of properties, their energy efficiency will be maximised, as will the use of renewables to generate electricity.
- Creating and training a 'carbon army' of workers to provide the human resources for a vast environmental reconstruction programme.
- Ensuring more realistic fossil fuel prices that include the cost to the environment, and are high enough to tackle climate change effectively by creating the economic incentive to drive efficiency and bring alternative fuels to market.

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6 http://blogs.odi.org.uk/blogs/main/archive/2011/03/16/oil_prices_poor_countries_africa_shocks_vulnerabilities.aspx

7 http://www.odi.org.uk/resources/download/2863.pdf

- Developing a wide-ranging package of other financial innovations and incentives to assemble the tens of billions of pounds that need to be spent.'[8]

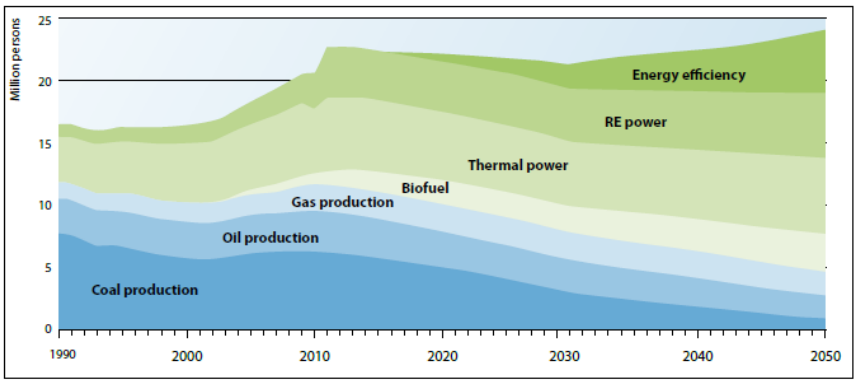
Similar lists are found in many prescriptions for climate-friendly growth, including by authors such as Thomas Friedman, George Monbiot, Lester Brown and Tim Jackson. Most recently, UNEP has published its proposals for a green economy, arguing that

> 'Perhaps the most widespread myth is that there is an inescapable trade-off between environmental sustainability and economic progress. There is now substantial evidence that the "greening" of economies neither inhibits wealth creation nor employment opportunities, and that there are many green sectors which show significant opportunities for investment and related growth in wealth and jobs.'[9]

The 'green sectors' referred to as offering potential for job growth include agriculture, buildings, forestry, transport, renewable energy, and waste management. For example, Figure 2 illustrates the total employment potential in the energy sector under a 2% green investment scenario, illustrating the shift from coal to alternative sectors.

Figure 2

Total employment in the energy sector and its disaggregation into fuel and power, and energy efficiency under a 2% green investment scenario.



Note: Roughly half of the investment is allocated to renewable energy and energy efficiency. See Annex I for absolute values.

Source: http://www.unep.org/greeneconomy/Portals/88/documents/ger/GER_synthesis_en.pdf

[8] http://www.neweconomics.org/sites/neweconomics.org/files/A_Green_New_Deal_1.pdf

[9] http://www.unep.org/greeneconomy/Portals/88/documents/ger/GER_synthesis_en.pdf

The UNEP modelling does not make allowance for the growth of nuclear power, but it is worth noting that many countries are likely to consider this option, despite temporary hesitations caused by the post-tsunami difficulties at the Fukushima facility in Japan.

A final example comes from work on scaling up low carbon infrastructure investments in developing countries, carried out by the World Economic Forum[10]. In one stream of work, the objective was to investigate how South Africa might finance renewable generating capacity of 20GW by 2020. The case was made not on environmental grounds alone, but equally in terms of employment creation, export potential and energy security. For example, up to 50,000 jobs could be created if renewables accounted for 15% of total energy production. Greening the economy was presented as an industrial policy just as much as a climate policy.

Nick Stern is unambiguous in his conclusion: 'low carbon growth can be a reality if we so wish' (ibid: 46).

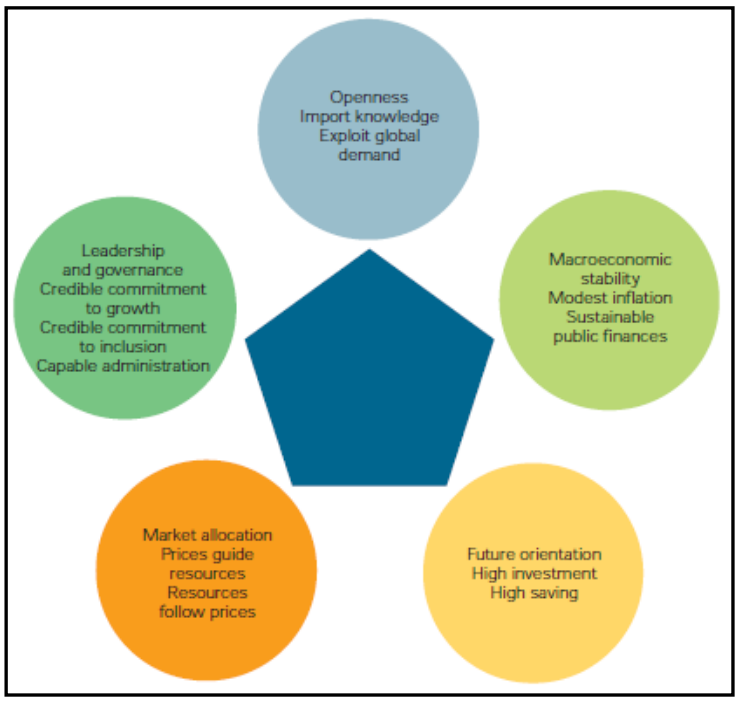
6. Get overall policy right: the need for a flexible and competitive economy

The first approach to policy for low carbon growth is that an economy must be equipped for growth in a rapidly changing global economy. This is always true, and growth policies need to recognise that technologies and institutions can change economic prospects very quickly. Climate change and climate change policy simply add further elements.

What 'equipped for growth' means is an open question. The Commission on Growth and Development has concluded that there are no recipes for growth, only ingredients, summarising these in a diagram reproduced as Figure 3. Macro-economic stability, openness, market allocation, leadership, and 'future orientation' are all key factors. The Commission for Africa took a similarly eclectic view.

[10] http://www3.weforum.org/docs/WEF_EI_CriticalMass_Report_2011.pdf

Figure 3
The Common Characteristics of High, Sustained Growth

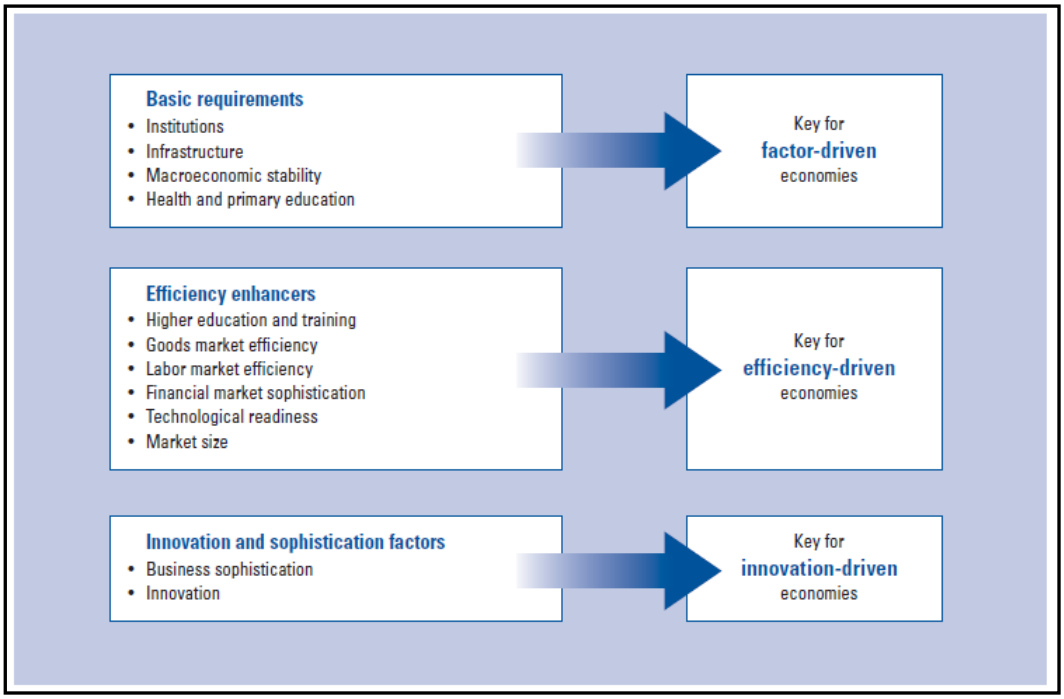


In practical terms, one way to judge whether countries have the characteristics required for high and sustained growth is to make use of the World Economic Forum Competitiveness Index. This offers a way of scoring and ranking countries at different levels of development, analysing 12 pillars of competitiveness, weighted differently for different kinds of economy, as in Figure 4. The pillars are broadly consistent with the Growth Commission. The scoring and ranking leads to a wide spread of performance. In 2011, Switzerland and Sweden ranked at the top, Chad and Angola at the bottom[11].

[11] http://www3.weforum.org/docs/WEF_GlobalCompetitivenessReport_2010-11.pdf

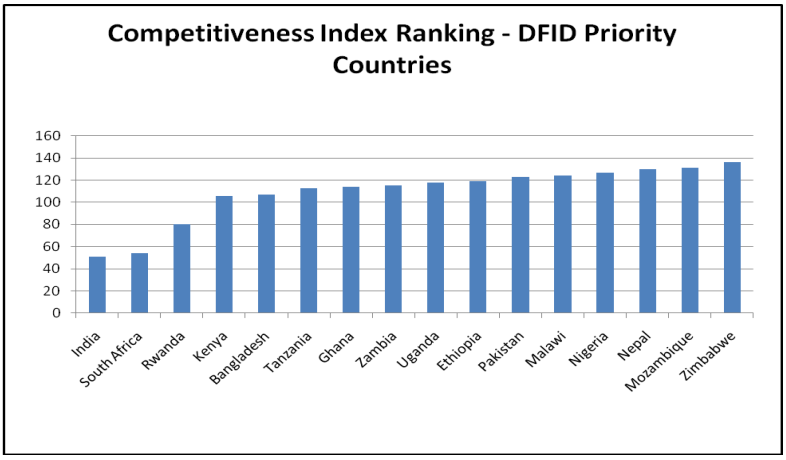
Figure 4

The 12 pillars of competitiveness



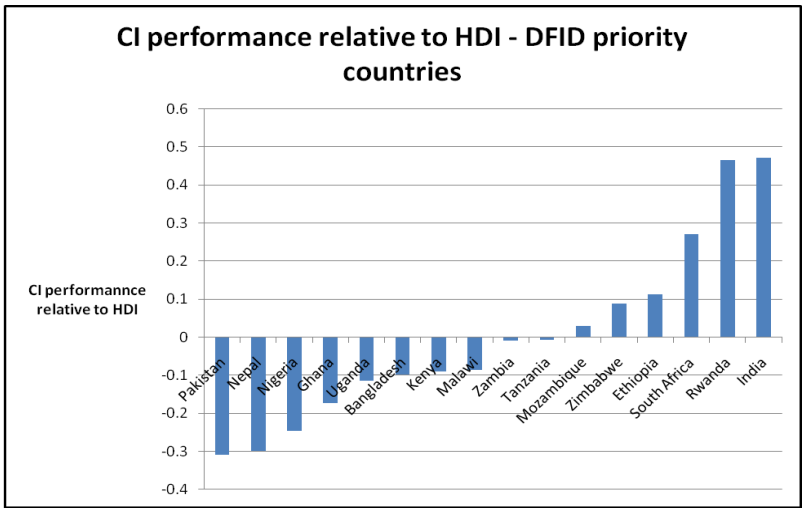
Inevitably, poor countries score poorly on the Competitiveness Index compared to rich countries. However, some score better or worse than others at comparable levels of development. Figure 5 shows the CI score for a range of DFID's priority countries, showing that most score poorly. More interestingly, Figure 6 shows CI performance relative to the

Figure 5



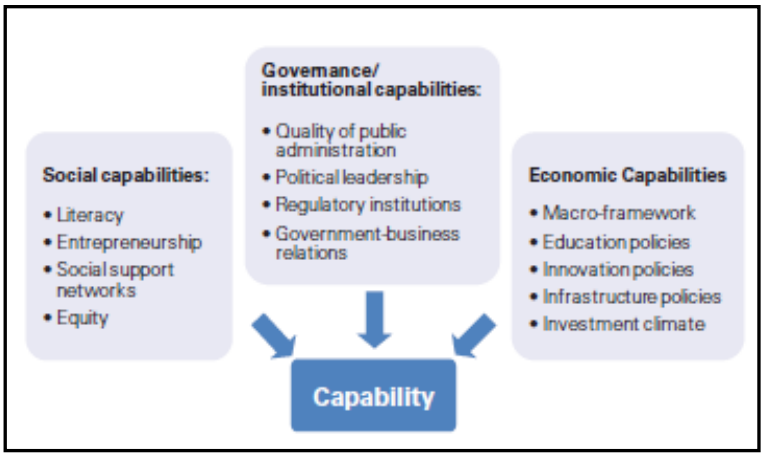
countries' Human Development Index. India, Rwanda, South Africa and some others score relatively well for their level of HDI, whereas Pakistan, Nigeria and Ghana, among others, score relatively poorly. This may indicate where the priorities are for donor engagement.

Figure 6



ODI and KPMG are developing an alternative way of analysing readiness for change, using a Capability Index. This is work in progress, but the model is summarised in Figure 7. A clear distinction is made between economic, social and institutional capabilities

Figure 7
The dimensions of Capability



Whatever measure is used, it is clear that growth can be accelerated with the right mix of policies and public expenditure programmes. If climate change challenges current growth models, it is all the more important to invest in readiness. But there is more: climate policies themselves also shape growth.

7. Link climate policies to growth

The ODI study referred to earlier looked at the impact of developed country mitigation policies on developing countries, concentrating on trade-related measures. Developing country Governments will be choosing policies from a wider set, a first listing of which is to be found in Figure 8. This distinguishes policies related to the incentive and regulatory framework from those concerned with public expenditure, and national policies from international. Countries can choose different combinations of policies, as the examples of the UK and Indonesia illustrate (Box 1).

Figure 8
Climate-related policies for Climate Compatible Development

	National	International
Incentive and regulatory framework	Climate Change Act Independent Climate Change Commission Low carbon transmission plan or roadmap National cap and trade Carbon tax Portfolio regulation of energy companies Targeted tax incentives for private sector R and D Regulate emissions from vehicles Regulate other emissions Strengthen forest law to reduce deforestation Strengthen planning laws on housing design and location Decoupling utility profits from gross sales	New post-Kyoto international targets International cap and trade International carbon tax International standards for fuel efficiency and emissions Extend emissions targets to aviation and shipping Regulate trade (e.g. in forest products) New international treaties on water sharing

Public expenditure	Increase R and D budget	Fund N-S technology transfer
	AMCs for renewable technologies	Fund S-S cooperation
	Subsidise retro-fitting of buildings	Extend scope of CDM
	Subsidise new technologies (e.g. CCS)	Regional risk facilities
	Subsidise renewables at domestic level	
	Provide subsidies to offset fuel poverty	
	Extend social protection for vulnerable groups	
	Invest in strengthening critical infrastructure	
	Invest in new infrastructure	
	Subsidise insurance mechanisms	
	Cut traditional fuel subsidies	
	Improved extension and entrepreneurial education	
	Education and consumer benchmarking	

Box 1

Climate Change Policy-making in the UK and Indonesia

Climate policy in the UK is shaped by the Climate Act of 2008, which mandates a carbon reduction target for 2050 of 80% compared to 1990. The Act created an independent Committee on Climate Change which advises the Government on emissions targets and progress against them. A UK Low Carbon Transition Plan was published in 2009, setting out how a 30% reduction could be achieved by 2020. It provides for 30% of energy to be renewable by 2020, with accompanying measures in sectors including housing, transport, farming and workplaces. There are provisions for support to new technologies and a commitment to help the most vulnerable through price support and help with grants. The UK is a member of the European Emissions Trading Scheme. A Green Investment Bank will be launched in 2012.

In Indonesia, a series of laws between 1994 and 2009 dealt with ratification of the UN Climate Change Convention and with issues related to energy, water and environmental protection. A series of Presidential Statements and policy papers have set out to mainstream a National Action Plan on Climate Change into the five-year development plan. A National Council on Climate Change has responsibility for climate policy and has supported the preparation of a climate change sectoral roadmap. The objective is to reduce carbon emissions by 26% by 2020, or 41% with international support; and to change the status of forests from net emitter to net carbon sink.

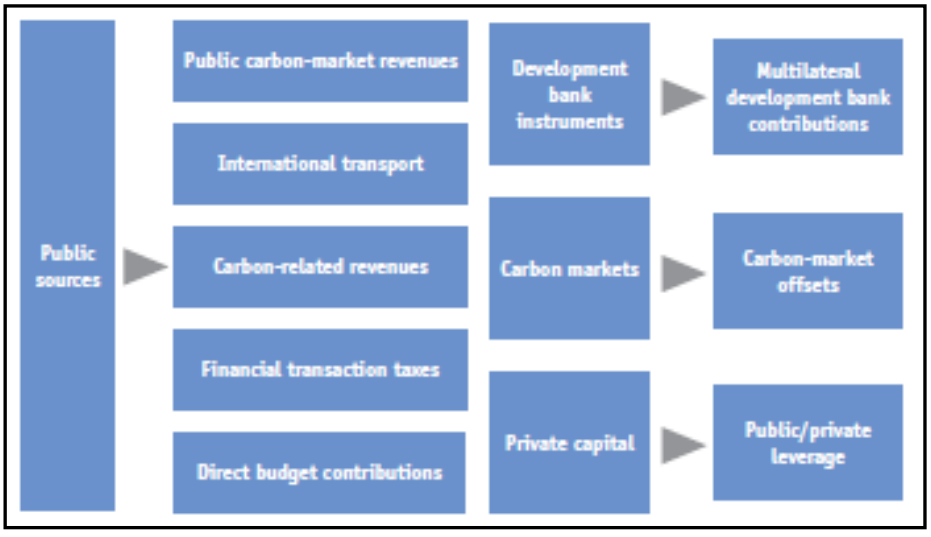
The challenge of decision-making is to choose an efficient, effective and mutually compatible set of policies from the list of those available. Methods which combine quantitative and qualitative analysis are likely to result in the use of multi-criteria tables, with criteria including: scale, speed, cost-effectiveness, administrative feasibility, political feasibility, and consistency with other policies.

8. The priority for funding is to leverage private flows

An important conclusion from the preceding discussion is that the definition of climate financing needs to have porous edges, recognising that countries need to be supported in a wide range of adjustments to changing global economic circumstances, some of which may not at first sight seem directly climate-related. As the work by WEF has recognised, climate-related growth policies have strong links to industrial policy more widely

Many other issues arise in relation to climate finance. The Advisory Group on Finance, which reported at the end of 2010, was charged with mapping how the $US100 bn of 'new and additional' public and private finance foreseen by the Copenhagen Accord might be raised. A range of options was identified, summarised in Figure 9. Public sources included direct budget contributions and a variety of tax-based instruments. Other sources include carbon markets and private capital.

Figure 9
Sources of climate finance



Source: Advisory Group on Finance

Monitoring is a major issue, addressed by initiatives like Climate Funds Update[12]. Not surprisingly, it proves easier to monitor public funds than private. Beyond monitoring, issues arise in relation to:

- Additionality – with many possible definitions still being debated, and an increasing likelihood that little genuinely new money will become available.

- Architecture – especially related to the tension between seeing climate transfers as entitlements rather than aid, with corresponding implications for governance and the role of donors.

- Conditionality – with the clear implication that transfer payments should not be subject to conditions by donors.

- Absorptive capacity – with the lesson from aid funding (and from commodity price surges) that a sudden inflow of foreign exchange can lead to Dutch disease, which harms productive sectors, unless additional funding is directed specifically to supply-side investments.

- Predictability and accountability – especially in relation to the volume and timing of public flows.

From the perspective of growth, the basic principles of aid effectiveness apply, especially the importance of country ownership, alignment behind Government plans, harmonisation of procedures, and mutual accountability. From the perspective of outside funders, a key pre-condition is the existence of a strong and credible policy framework, described in the WEF scaling-up report as an 'investment-grade' policy framework.

Investment grade policy is also a requirement for private sector engagement, and the question of how to secure the necessary private investment in low carbon development is arguably the most important new aspect of the finance debate. The key terms is 'leverage' – concerned with using public money to encourage or 'crowd-in' private investment. A ration of 18:1 is sometimes discussed – meaning that every pound of public money will result in 18 pounds of private investment.

Some of the ways to achieve this are well known. Aid donors are used to making investments in infrastructure as a way to encourage private investment, and have experimented with challenge or innovation funds to reduce the risks for business partners.

[12] http://www.climatefundsupdate.org/

Multilateral development banks and Development Finance Institutions are well-versed in blending grant and loan finance, providing loan guarantees, and using equity stakes in private business as a kind of quality guarantee for other investors. Newer instruments involve hedging foreign exchange or regulatory risk, so as to reduce the perceived disincentives to doing business in developing countries.

It is important to emphasise that the private finance to be attracted into low carbon growth will be national as well as international, involving small and large businesses in developing countries themselves. That is why countries such as the UK are exploring the value of a domestic Green Bank, to specialise in this area.

9. Invest in the politics of climate compatible development

The penultimate challenge is how to secure a strong and credible policy framework. The problem is that climate policy needs to provide long-term stability and predictability, in a political environment in which policy choices are contested and political systems provide for regular changes of Government.

A challenge to climate policy-makers is that dealing with climate change needs short-term action to avoid long-term consequences. Anthony Giddens has formulated this as a paradox. 'Gidden's paradox states that since the dangers posed by global warming aren't tangible, immediate or visible . . . many will sit on their hands and do nothing . . . yet waiting until they become visible and acute . . . will, by definition, be too late.'[13]

As noted, climate change and climate policy create winners and losers on a large scale. Another paradox, which, to match Giddens might be called 'Maxwell's paradox', is that the scale of change and the sheer numbers of winners and losers make it most difficult to create consensus on exactly those climate-related topics where long-term consensus is most needed.

Various authors have explored the potential for consensus-building. Giddens, for example, argues for a consensus-based "radicalism of the centre" involving a suspension of hostilities between rival parties, and for a "concordat" on climate. Colin Challen, argues that "to break out of this padded cell requires courage. It may, indeed probably will, mean abandoning tribal loyalties, and risking the approbation of one's political kin...".

[13] Anthony Giddens, 'The politics of climate change', 2009

Concretely, Giddens and Challen between them offer a series of options:

- Use all-party parliamentary groups to foster discussion and consensus-building.
- Aim for consensus on long-term objectives, without focusing at all on detail - as in Britain's Climate Change Act (2008), which mandates cuts in overall carbon-emissions without specifying how they are to be achieved.
- Set up independent bodies - such as the committee on climate change, created by the Climate Change Act - to monitor progress in achieving targets and to advise on (but not yet mandate) the measures.
- Require such bodies to help build consensus, for example by consulting all political parties.
- Seek ways to increase the costs of "defection" from the consensus.
- Encourage mass movements and civil-society action-groups to agitate for change.

Others add additional ideas. For example, think-tanks play a role in promoting the development of "epistemic communities" or "communities of practice" to help shape debate.

In recent work, Stef Raubenheimer has described the role of scenario planning in South Africa as an exercise in building consensus[14]. The South African exercise was known as the LTMS, standing for Long Term Mitigation Scenarios. It was a three-year exercise, involving stakeholders from many different sectors and a great deal of analysis of alternatives ranging from' business-as-usual' to 'required-by-science'. It generated radical options for transformation of the South African economy, approved by the South African Cabinet, an outcome which seemed highly unlikely at the beginning of the process. The approach is now being rolled out in various countries in Latin America.

10. Grow - and be happy!

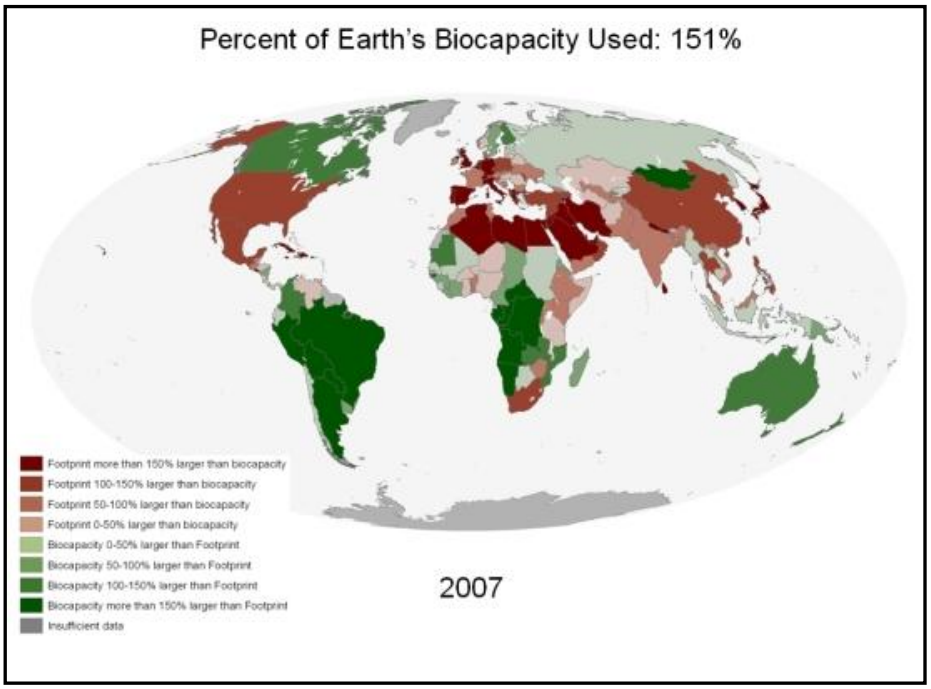
Finally, it is necessary to address the argument that even low carbon growth is unsustainable – and that neither happiness nor well-being depend on growth. This is an argument associated with Tim Jackson, whose book 'Prosperity Without Growth' makes the case for the impossibility of long-term growth, but also argues that ever-higher incomes are not an appropriate measure of progress. He specifically exempts developing countries from

[14] Raubenheimer, S, 2011, 'Facing Climate Change: Building South Africa's Strategy', IDASA

the argument, for the kinds of reasons laid out earlier in this note, but does emphasise the relentless impact on natural resource use of growing material consumption, even with greater energy and resource-use efficiency, aimed at de-coupling growth from raw materials. Lester Brown takes a similar view in his latest book, though again has poverty reduction and human development as one of the key legs of his plan to save the planet.

At first sight, global growth does present a very large challenge. As the Global Footprint Network has shown, based on a range of biocapacity indicators, and not just carbon-related, it currently takes the earth 1.5 years to regenerate what is used in one year. By 2030, it will take two earths to sustain consumption. Rapid change is therefore necessary, starting with the countries that currently consume most – those marked in red or brown in Figure 10.

Figure 10



Source:
http://www.footprintnetwork.org/en/index.php/GFN/page/ecological_debtors_and_creditors/

If developing countries, those coloured various shades of green on the map, are excluded from the charge of biophysical excess, then the growth they need to achieve minimum standards of human development - and 'happiness' - is certainly 'permitted'. The problem is with convergence, and the level of income at which it will take place.

To take a simple example, the average GNI per capita of low income countries in 2008 was $US 1407 in PPP adjusted terms, and the average GNI of high income countries was $US 37141. If the growth of per capita income in the poorer group were 4% p.a., and in the richer group 2% p.a., they would eventually converge – in 2180, by which time the per capita income in both groups would be approx $US 1.2m (in 2008 prices). Clearly, continued consumption growth at compound rates leads to very high numbers indeed, with implied

unsustainable impacts on the demand for resources. The income figure at which happiness is supposed to level off is about $US 20000, so this is 60 times the income apparently needed.

There is a conundrum here which needs to be solved, principally by developed countries, but with unavoidable impacts for developing countries. The question is whether developing countries need to act immediately on some or other set of assumptions about the stabilisation and reduction of over-consumption in the richer countries. It is probably dereliction of analytical duty to paraphrase St Augustine, and say 'yes, but not yet'. For the time being, poor countries should both grow and be happy.

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SJM

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Appendix 1

Effects of mitigation policies (in annex 1 countries) on developing countries: '+' indicates positive effect, '-' indicates negative effect, '+/-' indicates indeterminate effect

	Trade	Capital Flows	Aid/Development Finance	Technology	Growth
Carbon taxes	+ Production and hence exports to countries with no carbon taxes (leakage) - slower global growth reducing global trade opportunities overall - Higher price of carbon imports + / - shifts in comparative advantage and knock on impacts on other economic sectors transmitted through changes in real effective exchange rate	+ Carbon leakage increases FDI to countries with no carbon taxes esp. those with a good investment climate - Less investment in carbon intensive industries in mitigating countries	+ If countries with taxes will allocate revenues from a carbon tax to developing countries	+ / - Depends on overall impact on FDI and incentives for low carbon investment	+ / - Depends on impact on FDI, technology transfer & trade patterns
Emission trading schemes	+ Reduced cost of mitigation minimises growth sacrificed	+ More investment in abatement in countries	+ ETS could be implemented so that a share of	+ More cross border investment in energy	+ Faster growth through increased trade, FDI and

Similar impacts as carbon tax plus:	and trade opportunities lost ? increases in trade in CERs amongst participating countries, but affect on other trade not clear	with low cost abatement opportunities	proceeds are used as aid flows to poor countries	efficiency leads to more technology transfer and productivity growth	possibly also aid if revenues are used for that purpose.
Border tax adjustment	- Exporters of products to sectors affected by emission targets in developed countries face loss of export revenues - Lower global growth and welfare due to increased protectionist tendencies. + Reduced import prices for affected products in non-mitigating countries	- Less carbon leakage		- Less technology flows	- Reduced trade, capital flows and technology flows leads to lower growth

Carbon labelling	+ / - Depends on impact on competitiveness which in turn depends on methodology used for labelling, carbon intensity of production, and ability to obtain certification.	+ / - A well designed carbon labelling scheme could create incentives for production of different parts of the supply chain to move to lower emission locations, which may be in developing countries. High carbon exporters lose investment.	+ Aid may help cover certification costs with knock-on benefits in other areas	+ Carbon labelling could increase transfer of green technologies	+ / - Depends on impacts on export opportunities and technology transfer.
Liberalisation of environmental goods and services	+ Lower tariffs generate welfare gains for importers, and export opportunities for exporters. Will lead to more trade in EGS benefitting developing countries trading in EGS			+ EGS liberalisation would lead to technology transfer to developing countries through increased trade and developed country exports	+ EGS liberalisation leads to faster growth through new export opportunities and spillovers from imports.
REDD+	+ If fungible with carbon markets, then countries implementing CERs can sell credits to countries with	+ Financial inflows (FDI) used for mitigation, in those countries able to deliver forest-sector	+ Development finance, in those countries able to deliver forest-sector	+ Technology transfer through FDI	+ Spillovers from FDI and financial inflows if used wisely may stimulate growth for recipient

	emission targets, perhaps through intermediaries - If high aid inflows results in Dutch disease may damage competitiveness of some economic sectors	emissions reductions	emissions reductions - Through possible Dutch Disease effects unless appropriately managed		countries. - if generates significant Dutch Disease
CDM	+ Countries implementing CERs can sell credits to countries with emission targets, perhaps through intermediaries	+ Financial inflows (FDI) to countries with mitigation opportunities and good investment climate.		+ Technology transfer through FDI	+ Spillovers from FDI increase growth
Technology transfer	+ Increased technological capacities may increase capacity to export	+ Increased technological capacities may increase capacity to export and hence attract investment. - mandatory technology transfer might hamper FDI	+ If aid supports transfer of energy efficiency technologies	+ Whether FDI or aid induced, there will be more technology flows	+ More technology flows raise productivity and growth