



Centre for
Climate Change
Economics and Policy



Grantham Research Institute on
Climate Change and
the Environment

Green Growth: Economic Theory and Political Discourse

Michael Jacobs

October 2012

Centre for Climate Change Economics and Policy

Working Paper No. 108

**Grantham Research Institute on Climate Change and
the Environment**

Working Paper No. 92

The Centre for Climate Change Economics and Policy (CCCEP) was established by the University of Leeds and the London School of Economics and Political Science in 2008 to advance public and private action on climate change through innovative, rigorous research. The Centre is funded by the UK Economic and Social Research Council and has five inter-linked research programmes:

1. Developing climate science and economics
2. Climate change governance for a new global deal
3. Adaptation to climate change and human development
4. Governments, markets and climate change mitigation
5. The Munich Re Programme - Evaluating the economics of climate risks and opportunities in the insurance sector

More information about the Centre for Climate Change Economics and Policy can be found at: <http://www.cccep.ac.uk>.

The Grantham Research Institute on Climate Change and the Environment was established by the London School of Economics and Political Science in 2008 to bring together international expertise on economics, finance, geography, the environment, international development and political economy to create a world-leading centre for policy-relevant research and training in climate change and the environment. The Institute is funded by the Grantham Foundation for the Protection of the Environment, and has five research programmes:

1. Global response strategies
2. Green growth
3. Practical aspects of climate policy
4. Adaptation and development
5. Resource security

More information about the Grantham Research Institute on Climate Change and the Environment can be found at: <http://www.lse.ac.uk/grantham>.

This working paper is intended to stimulate discussion within the research community and among users of research, and its content may have been submitted for publication in academic journals. It has been reviewed by at least one internal referee before publication. The views expressed in this paper represent those of the author(s) and do not necessarily represent those of the host institutions or funders.

Green Growth: Economic Theory and Political Discourse

Michael Jacobs¹

Grantham Research Institute on Climate Change and the Environment,
London School of Economics and Political Science

Forthcoming as Jacobs, M. (2013) 'Green Growth', in R Falkner (ed), *Handbook of Global Climate and Environmental Policy*, Oxford: Wiley Blackwell 2013

October 2012

Abstract

The paper explores the concept of 'green growth' as it has emerged in international policy discourse over recent years. Identifying the core meaning of the concept and sister terms such as 'green economy', it relates green growth to the prior concept of sustainable development. The paper distinguishes between a 'standard' version of green growth which asserts the long-run economic benefit of environmental protection and a 'strong' interpretation which claims, more boldly, that environmental policy can be a driver for growth. Three different forms of this claim are identified and the evidence for them surveyed. The first is a Keynesian argument for short-term 'green stimulus' in times of recession. Second, a revision of standard growth theory identifies the contribution made to growth by investment in natural capital and the correction of a variety of market failures through environmental policy. Third, the theories of comparative advantage and long waves of capitalism emphasise the importance of technological innovation in generating growth. The paper offers some conclusions on the political economy of green growth and how likely it is to succeed in increasing the priority given to environmental policy.

Key words

Green growth, sustainable development, climate change, environment, resources, green Keynesianism, growth theory, market failure, green jobs, environmental innovation

Acknowledgements

I am grateful to Alex Bowen, Simon Dietz, Robert Falkner, Sam Fankhauser, Michael Spackman and Dimitri Zenghelis; and to colleagues at the Grantham Research Institute whose comments on an early version of the paper at a Grantham seminar much improved its subsequent drafts.

¹ Visiting Professor, Grantham Research Institute on Climate Change and the Environment, London School of Economics and Political Science.

Address for comments

m.u.jacobs@lse.ac.uk

Introduction

Over recent years the concept of 'green growth' has burst onto the international policy scene. A term rarely heard before 2008, it now occupies a prominent position in the policy discourse of international economic and development institutions. The World Bank, along with five other multilateral development banks, has committed itself to this goal (World Bank 2012a, 2012b.) The OECD has adopted a 'green growth strategy' of research and publications (OECD 2012). A new international body, the Global Green Growth Institute, supported by a number of governments, has been created to advise countries on its implementation (GGGI 2012). Using its own preferred label of 'the green economy', the United Nations Environment Programme has published a 600-page report (UNEP 2011). These four institutions have jointly established a 'Green Growth Knowledge Platform' to provide a locus for research and knowledge about the field (World Bank 2012c). A number of high level meetings and networks have been established (Global Green Growth Forum 2012, Green Growth Leaders 2012). Several countries have adopted green growth as an explicit policy objective (OECD 2012a), while at the G20 Summits in France and Mexico in 2011 and 2012, the largest economies in the world committed themselves to its promotion (Government of France 2011, Government of Mexico 2012). The 'green economy' was a major focus of the 'Rio+20' United Nations Summit in June 2012 (UNCSD 2012).

The core meaning of the concept of green growth can be simply stated. It is economic growth (growth of gross domestic product or GDP) which also achieves significant environmental protection. The 'significant' matters. Few doubt the compatibility of growth and some kinds of environmental improvement: this would not require a special term.² But *how* significant the concept leaves open. In early uses of the term the focus was entirely on the mitigation of climate change (Huberty *et al* 2011); but it now more normally covers a wider range of environmental resources (soil, water, fish stocks, habitats and so on). Some definitions leave the precise degree of environmental protection undetermined: thus to the World Bank (2012b), green growth is "growth that is efficient in its use of natural resources, clean in that it minimizes pollution and environmental impacts, and resilient in that it accounts for natural hazards and the role of environmental management and natural capital in preventing physical disasters."

But others apply a more stringent 'sustainability' standard. For the OECD (2011), "green growth means fostering economic growth and development, while ensuring that natural assets continue to provide the resources and environmental services on which our well-being relies."

² There has been considerable debate about whether some kinds of environmental improvement, particularly in local pollutants, is a 'normal' outcome of economic growth. For a survey of this 'environmental Kuznets curve' literature, see Ekins (2000).

What these definitions have in common, however, is made clear in the analysis which follows them: it is a level of environmental protection which is not being met by current or 'business as usual' patterns of growth. It is this in turn which gives the concept its political traction.

It is not the only one occupying this terrain, however. A range of sister concepts are now also in frequent use, most of them seeking to widen the idea of economic growth to become the more socially equitable 'development'. Such development may be 'low carbon', 'low emissions', 'climate-compatible' and / or 'green' (Climate and Development Knowledge Network 2012). UNEP's definition of a 'green economy' captures these ideas: it is one that "results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities" (UNEP 2011). While these terms do not have exactly the same meaning as 'green growth', they should nevertheless be seen as variants of the same concept, both because they all embrace the same core idea of growth compatible with environmental protection, and because the networks and institutions in which they are being discussed and supported are largely the same (World Bank 2012c, Green Economy Coalition 2012).

This chapter first seeks to place the concept of green growth within the history of recent discourses of environmental protection. It will then distinguish between a 'standard' version of green growth and a 'strong' interpretation which seeks to present a much bolder argument to policymakers. Three different forms of this argument will be identified, and the evidence for them surveyed. Finally, the chapter asks whether the idea of green growth is likely to be 'successful': will its arguments prove sufficiently convincing, and the interests gathered around it sufficiently strong, to change the priorities of economic policymaking?

From sustainable development to green growth: the role of environmental discourses

The concept of economic growth which also meets environmental objectives is not new. Indeed it lay at the heart of the discourse of 'sustainable development', first popularised by the Brundtland Report (World Commission on Environment and Development 1987) and subsequently institutionalised by the Rio 'Earth Summit' in 1992 (Dresner 2008). Sustainable development remains the core principle of international environmental policymaking, and of national environmental planning in many countries. Indeed, the official institutions now promoting green growth insist that it is not a substitute for sustainable development but a way of achieving it (OECD 2011, UNEP 2011, World Bank 2012b). But why then invent a whole new discourse around it?³

³ It is not the only rival discourse. In the academic literature the concept of 'ecological modernisation' was developed in the 1990s to provide a more theoretical framework for the same basic set of ideas as applied to developed economies. For a survey see Mol and Spargaaren (2000).

The answer (though not officially acknowledged) is that the concept of sustainable development has had decreasing traction on economic policymaking over recent years. In the period immediately following the 1992 Earth Summit the sustainable development goal was widely adopted by governments and others, and in many countries had a tangible impact on the priority given to environmental objectives. The 1990s saw a clear upsurge in environmental legislation and policy and, in the business sector, environmental management. Yet by the early years of the new century momentum had significantly slowed. Moreover, it became clear that countries' apparent commitment to sustainable development had not been sufficient to reverse the historic decline in the health of the global environment which had led to its invention: almost all significant global indicators have continued to worsen. The evidence of dangerous human-made climate change, in particular, demonstrated that something much more profound had to be done. An existing concept, already universally supported, could not help here: sustainable development was too much part of the furniture of government commitments to motivate more radical change.

Yet at the same time policymakers were highly conscious that an environmental discourse focused on costs and limits and the need to constrain growth to address them would be unlikely to attract political support in a world where GDP growth (and the employment it generates) remain the core interest of voters and businesses and the overriding policy objective of governments. This is especially true in the field of climate change, where the dominant discourse has centred on the economic cost of mitigation and international negotiations have been concerned with how the global 'burden' should be distributed (Stern 2007).

The purpose of the discourse of green growth has therefore been to shift from this negative and politically unattractive framing to something more positive. Like sustainable development, it seeks to show that environmental protection need not come at the expense of prosperity. Unlike sustainable development, however, it faces the issue of growth head on. Sustainable development was a deliberate exercise in holding together a wide coalition of political support by sidestepping the question of the fundamental compatibility of growth and environmental protection and reframing the economic objective as 'development'. Green growth not only insists on that compatibility, but claims that protecting the environment can actually yield *better* growth. In this it reflects its different provenance: whereas the concept of sustainable development came out of the environmental movement, where ideological argument about the 'limits to growth' was widespread, green growth has emerged from the more mainstream and pragmatic community of environmental-economic policymakers.

This also makes green growth a much more focused concept. As frequently observed, sustainable development was a baggy idea, incorporating a variety of often ill-defined objectives. Its meaning was contested, interpreted in more conservative or more radical ways by different interests (Jacobs 1999). By contrast green growth is more or less self-explanatory: it might attract fewer adherents (and already has some 'green' opponents), but it's fairly clear what it means.

In this sense green growth is indeed something new. It is a child of sustainable development. But it is a response to its inadequacies, and to the particular focus on both climate change and economic growth which have dominated mainstream policy debate in recent years.

The standard argument for green growth

Embedded in the concept of green growth is an assertion. This is that economic growth can occur even while environmental impacts are significantly reduced. In this sense – rather more than was true of sustainable development – green growth is not just a normative ideal, but carries within it a strong economic claim, both theoretical and empirical.

Since the historical record of industrialisation in every country is that economic growth is associated with a wide range of forms of environmental damage – from resource depletion to climate change – the claim that this relationship is contingent, not necessary, clearly needs some theoretical basis. At a simple level that was provided in the early 1970s by John Holdren and Paul Ehrlich (1974), who proposed the explanatory identity $I = PCT$, in which I = environmental impact, P = population, C = consumption and T = technology (or more specifically, the productivity of technology in relation to environmental use). The equation showed that with a rising population and (given economic growth) rising consumption, environmental impact would inevitably increase *unless* the rate of technological improvement was sufficient to overcome it. The maths was straightforward but daunting. If over a given period of, say, fifty years, population doubled and consumption quadrupled (which would happen with an annual compound growth rate of no more than 3%), the ‘environmental productivity’ of technology would have to improve eight-fold to prevent worsening environmental damage – and by much more if impact was to be reduced to ‘sustainable’ levels. But subsequent analysis showed that such improvements were not in principle impossible: through a whole variety of methods, including use of renewable resources and new materials, industrial and consumer productivity improvements, recycling of wastes, sustainable harvesting practices and changes to the structure of the economy (especially by making it more ‘intellectually’ than ‘materially’ based), it was possible to conceive of very dramatic technological and social changes which could at least in theory allow growth to occur even while resources were sustained and environmental quality improved (Jacobs 1991, Ekins 2000).

These arguments provide the theoretical foundation for the claim that growth can be green. The modern ‘green growth’ concept, however, rests on a more empirical basis. Two claims are made. First, that the costs of tackling environmental damage are not so great that they reduce the natural growth rate of a well-performing economy to zero. And second, that if such damage is *not* tackled, the costs to growth of a worsening environment will be greater.

These claims were most famously argued for in the ‘Stern Review’ of the economics of climate change (Stern 2007). Building on similar work done by others, the report

modeled the cost of stabilising greenhouse gas emissions (using well-designed policies, implemented early) as between 4% and minus 2% of GDP, with a central estimate of only 1%. By contrast, if the world failed to reduce emissions, the economic costs of the climate change that would then follow would be much larger: the equivalent of between 5% and 20% of GDP every year. So the core message of the Stern report was straightforward: the costs of acting on global warming were significant but manageable, they were compatible with the continuation of economic growth, and they were much less than the costs of not acting.

Though the Stern report did not itself use the term, this is what we might call the 'standard' argument for green growth. It is rooted in the economics of climate change (rather than consideration of a wider set of environmental costs), and relies on a relatively simple cost-benefit analysis of alternative paths of economic development.

It did not go uncontested, however. Critics of the Stern report focused in particular on the estimates of the costs of allowing climate change to occur. Many argued that these were so far in the future as to be incommensurable with the present costs of preventing it: in the future human societies would be richer (because of economic growth) and would develop the technologies to adapt to or otherwise prevent warming (Nordhaus 2007). Though they did not convince everyone, these criticisms nevertheless politically weakened the claims of 'green growth'. While in the long term controlling environmental damage might be beneficial, in the short term it was not obvious that the costs to GDP were worth the almost entirely future benefits that would result. When the economic climate worsened after the financial crash of 2008, a strategy whose first effect was to slow growth down did not look very attractive to policymakers.

The 'strong' versions of green growth

So it was at this point that a much stronger argument for green growth began to be made. From 2008, as the term itself came to be used, its proponents made a much more immediate claim. Environmental protection was not just compatible with continued economic growth: it could positively promote it. So far from slowing the economy down, policies to make it greener could be a driver of higher output and rising living standards. And they could do so in the relatively short term, not merely in the long.

Over the last few years three different kinds of argument and evidence have been used to justify and explain this claim, each using a different framework of economic theory. They are not mutually exclusive – many of those writing about green growth use many or all of them. Some are applicable only in some circumstances and some kinds of countries, others at least in principle to all. Each leads to a different set of policy conclusions. (For helpful surveys, see Huberty *et al.* 2011 and Bowen and Fankhauser 2011.)

Green Keynesianism: environmental stimulus in recession

The original case for green growth made in the wake of the 2008 financial crisis was primarily a short-term one. Economies which had experienced a huge recessionary shock could be stimulated back into growth – particularly employment growth – partly through measures aimed at improving the environment (Pollin *et al* 2008). Fields such as energy efficiency, renewable energy, water quality improvement, agricultural and landscape management, public transport and pollution control provided opportunities to get people into work and to increase demand for a wide range of goods and services. Almost all countries which introduced fiscal stimulus packages in 2008-09 included within them significant ‘green’ programmes of these kinds. South Korea’s environmental spending was generally acknowledged to be the largest, estimated at around 79% (\$59 billion) of its total stimulus package. But others were also significant: China identified a third of its stimulus package, a total of \$219bn, as ‘green’; the US around 12% (\$118bn). While individual European states’ figures varied, as much as 60% (\$23bn) of the European Union’s collective stimulus package was environmental in content (Barbier 2010b, Robins *et al.* 2010).

The core argument used to justify these sums was the simple Keynesian one that in a slump, governments should sustain aggregate demand in the economy by replacing lost private sector demand with public expenditure. This in turn creates a multiplier effect which generates further income and employment growth. Such spending does not have to be green, but given the extent of the environmental opportunities available, and the various additional amenity and health benefits they offer, a green stimulus package offers particular advantages. A particular rationale can be given for spending in those areas where green investments are in due course going to be required anyway, such as to replace ageing power stations or upgrading transmission lines. In these cases, the Keynesian stimulus would merely bring forward investment from the future to the present, where it could both have a larger stimulatory effect and benefit from the cheaper labour, materials and financing costs available in a recession (Bowen *et al.* 2009). Governments do not even necessarily have to spend or borrow themselves to achieve a green multiplier: regulatory or tax policies which force or incentivise firms to invest in environmental improvements can have the same impact without increasing public deficits (Zenghelis 2012).

These kinds of general Keynesian arguments can in principle be applied as much to ‘brown’ or non-environmental spending as to ‘green’. But some proponents of environmental spending go further, arguing that green measures in a recession are *better* for short-term growth. They point out in particular that many environmental measures are labour-intensive, and so give greater employment growth per dollar spent than non-green measures (Green New Deal Group 2008, Engel and Kammen 2009). Making buildings more energy efficient, for example, can employ large numbers of relatively unskilled workers, distributed widely in terms of geography. Much environmental spending is for various kinds of construction and resource management activities (wind turbines, solar panels, agricultural and water management) which, because they are location-specific, are not susceptible to ‘offshoring’ in the manner of much manufacturing. At the same time, it is argued,

improvements in energy efficiency (and other forms of resource efficiency) are cost-saving to the economy, releasing resources for firms and households to spend elsewhere, and thus generating their own stimulus effect (Roland-Holst 2008).

Estimates of the impact of the green stimulus measures taken in 2008-10 give some credence to these arguments. Around half a million net jobs were estimated to have been created by the environmental elements of the US stimulus package (Barbier 2010a), with as many as 960,000 by the similar measures taken in South Korea (OECD 2010). Indeed there is some evidence that in terms of job creation the environmental stimulus measures may have out-performed (as their proponents predicted) the non-green elements: one estimate for the US suggests 20% more jobs were created by green measures than by traditional infrastructure spending (Houser *et al.* 2009).

Both the theoretical and empirical claims, however, are disputed. Indeed, unsurprisingly, the case for a specifically green form of Keynesianism has become mired in longstanding economic disputes about the effectiveness of Keynesian policy in general. Critics argue that stimulus spending – whether green or brown – is ultimately ineffective in creating employment or growth. Public expenditure simply crowds out private spending by forcing interest rates upwards; as governments spend more, rational firms and consumers save more, since they know that eventually taxes will have to rise to pay for public borrowing (Moore 2011). Keynesians counter that in a slump there is no private spending going on which can be crowded out: what happens rather is simply a new recessionary equilibrium, with low investment and low demand. Firms and consumers do not act with collective rationality: on the contrary, a ‘paradox of thrift’ operates, in which lack of prospective demand leads private actors to save rather than spend, which in turn ensures the lack of demand. Only government action can reverse this vicious circle (Zenghelis 2012).

Both sides of this argument can point to analysis of the economic impacts of the 2008-9 stimulus packages to justify their claims. While official estimates of the multiplier effect of the US package, for example, are strongly positive, others are negative (US Congressional Budget Office 2009; Mulligan 2010). (A negative multiplier would mean that the stimulus package actually destroyed output and jobs.) Much of the disagreement resolves around the timeframe in which effects are judged. Critics of Keynesian policy, green and otherwise, argue that any observed job gains are temporary, and will be ultimately offset by the jobs lost as a result of the higher interest rates demanded by the budget deficits which finance them. Proponents argue that Keynesian stimulus measures are only intended to be short-term, to be applied when the economy is in recession, and in those conditions perform a critical role in raising the economy’s equilibrium output and employment levels. In fact many green Keynesians have extended this argument into a stronger claim, that environmental measures can drive economic growth in the medium and long term as well (Spencer *et al.* 2012). But in doing so they have gone beyond purely Keynesian arguments to wider theories of growth.

Growth theory: correcting market failures

The second (and central) case that environmental improvement can positively contribute to economic growth is based on the core framework of economic theory which explains why and how growth occurs (Hallegatte *et al* 2011). Economic output results from the bringing together of factors of production or capital: labour, physical capital, and technology and human capital. Growth in output occurs when these factors increase either in absolute size or productivity. The different forms of capital depreciate over time; but can be increased in size and productivity by investing in them a proportion of output – such as in improved technology, and better education and health of the workforce. If the rate and forms of investment are sufficient, economic history shows that the outcome will be economic growth.

Green growth theory then starts from the simple observation that the natural environment is also a factor of production, but one which both classical growth theory, and historic patterns of economic growth in practice, have largely ignored (Nordhaus 1974, Solow 1974, Smulders 1999, Brock and Taylor 2005). The environment acts as a form of capital in three ways: it provides resources, it assimilates wastes, and it performs various ‘environmental services’ which sustain life, including climatic regulation and ecosystem health. This ‘natural capital’ has been undervalued both in economic theory and practice because it has been largely unpriced, provided as an apparently free gift of nature. Many of the environment’s functions occur as common or collective goods without the property rights which attach to other factors of production, and without therefore the private incentive to value them properly in economic terms (Jacobs 1991).

The standard economic concept to describe this is that of ‘market failure’. Markets ‘fail’ when they do not take into account the full value of the activities within them. The production and consumption decisions which economic actors take are therefore distorted relative to those they would take if the environment were properly valued, in a whole series of ways. Natural resources tend to be over-exploited: soil eroded, fisheries depleted, water over-abstracted. Ecosystems which provide valuable services, such as wetlands and forests, are allowed to be degraded or destroyed. Resources such as energy and materials are used inefficiently, with an excessive generation of waste (and therefore pollution). And the amenity, health and cultural value of natural environments are under-appreciated.

In all these ways, green growth theory argues that current patterns of economic growth are *prima facie* sub-optimal. They misallocate resources between the different factors of production. They under-invest in natural capital, and over-invest in activities which cause its degradation. If these systematic market failures were corrected, growth might be higher. Indeed, the situation is worse than this, because in many countries the environmental costs of using natural resources are not just unpriced, but their exploitation is actually subsidised. Subsidies for extracting and using fossil fuels, and for other forms of resource extraction and agriculture, are estimated at around \$1.1 trillion per annum (Dobbs *et al.* 2011). Such subsidies further distort production and consumption decisions away from their optimal path.

From these premises, advocates of green growth argue that a range of different environmental measures and policies can be growth-generating.

In developing countries, much of the emphasis has been on the conservation and enhancement of natural capital, such as soil quality, fisheries, forests and habitats such as mangrove swamps and coral reefs. Arguing that in economies dependent on these resources, the net depreciation of natural capital is a retardant of growth in the same way that the net depreciation of physical capital would be, the United Nations Environment Programme has gathered considerable evidence on the positive growth impact available from the conservation and sustainable management of natural resources (UNEP 2011). In some cases this arises from higher productivity in production of the resource; in others from the development of secondary, value adding, products which conservation of the resource allows; in some from the development of related industries, such as tourism. The UNEP report points out that many of these resources are controlled by the poor, and so strategies to conserve them and enhance their productivity are poverty-reducing as well as growth-enhancing.

Some of these growth benefits clearly show up in higher incomes, so are captured by the conventional growth indicator of GDP (gross domestic product). But others are unmeasured: it is difficult to capture the value which preservation of a mangrove swamp has for coastal defence, for example, or a forest for water supply. For this reason some of the focus of environmental policy has been on the creation of systems of payment which enable monetary value to reflect ecological value: payments for forest conservation (e.g. under Reducing Emissions from Deforestation and Forest Degradation (REDD) schemes) provide the prime example (UNEP 2011). If international financial assistance can enable those living around tropical forests to generate value out of forest preservation, its contribution to economic growth can become real and not just 'intangible'.

These arguments for green growth are not universally accepted. It is quite possible to argue that, though sustainable management of natural resources can lead to growth in these ways, much higher rates of growth can be achieved through their unsustainable exploitation. This was, after all, how most developed countries grew during their own industrialisation. They exploited resources to the full – creating severe environmental degradation and human health costs in the process – in order to build a foundation of wealth and productive knowledge which then enabled the creation of a different kind of advanced technology and service economy altogether. Effectively, natural capital was substituted by physical (human-made) capital, leading to a higher total capital stock, and therefore higher growth rates. Advocates of 'brown' growth in developing countries argue that this is the right strategy for them too: the rapid exploitation of natural resources can generate much faster growth in the short term than conservation, providing a base from which industrialisation can then be achieved. Such exploitation cannot last forever, but it can certainly continue for now.

Who is right? To a considerable extent the question hangs on the time period under consideration. The now-industrialised countries exploited resources at a time when nature was abundant, and where the costs of resource depletion were therefore in the far future. Today nature is much scarcer, and resource depletion is already upon us – trends in fish stocks, water supplies, soil quality and other resources reveal this clearly (Rockstroem 2009). The wider ecological costs of forest degradation, loss of wetlands, coral damage and so on are evident, and already occurring. So the green growth argument is that brown growth *was* possible, but is no longer: we have now reached the moment when over-exploitation has to stop. If it does not, it will undermine itself: the net loss of natural capital will not be compensated by the creation of physical capital. Environmental damage will cause more cost to output and welfare than it will generate benefit. By contrast, advocates of brown growth insist that that time has not yet come. Depending on the length of the period over which growth rates are projected, and the resources and countries in question, empirical evidence can be adduced on both sides.

Whereas in developing countries the focus of green growth arguments has been the conservation and enhancement of natural capital, in developed and emerging economies it has been on the way in which environmental policies, as well as tackling environmental costs, can address *other*, non-environmental market failures which inhibit growth. Growth theory acknowledges that current patterns of economic activity are far from optimal. At least four kinds of market failure have relevance to environmental policy.

First, energy and other resources are not used efficiently. For a variety of behavioural and structural reasons, firms and households fail to use myriad means of improving energy efficiency which would be of net benefit to them – that is, which would save them more money than they would cost (Gillingham *et al.* 2009). At the same time, energy use has externalities – particularly the role of fossil fuel emissions in causing climate change – which are not properly captured in energy prices. So in correcting the environmental market failure, environmental policy can also correct the behavioural and structural ones. Such policy includes taxes and emissions trading schemes which put a price on carbon; regulations which require minimum energy efficiency standards for buildings, vehicles and appliances; and public spending to promote innovation. When such policies are introduced, firms and consumers respond to the higher cost of energy use by raising their energy efficiency, and they innovate in doing so. Emissions fall, the economy saves costs, and the productivity of an important factor of production rises. The result is greener growth. The same effects can occur if environmental policy is applied to other resources, including water, material commodities and wastes (Dobbs *et al.* 2011).

Second, markets left to themselves under-invest in key productivity-improving activities such as research and development (R&D) and the creation of economic networks (relationships between firms and activities which enhance productivity and innovation). This is because these activities have ‘spillover’ benefits which cannot be captured exclusively by those who invest in them (Aghion and Howitt 1992). Since much environmental policy is aimed at promoting innovation, including specific

efforts to support R&D and to create new networks of firms or infrastructure (such as industrial clusters or distributed energy systems) it may stimulate innovation and network benefits more widely in the economy, with positive impacts on growth in general (Porter and Linde 1995, Ambec *et al.* 2011).

Third, environmental policy can have a range of co-benefits addressing other externalities. Improving energy efficiency and using non-fossil fuels both help to reduce air pollution, which can have a major impact on health costs and labour productivity (Graff Zivin and Neidell 2011). They can also improve energy security, which reduces the costs caused by the volatility of energy prices (Rozenborg 2010). Cutting transport emissions can simultaneously cut urban transport congestion, with significant benefits for overall productivity (OECD 2012b).

Fourth, environmental policy can improve the economic efficiency of the taxation system. Where taxes are used to achieve environmental goals, policymakers have the option of reducing other taxes to compensate. Since income and labour taxes, considered in isolation, penalise economic activity, their reduction in favour of environmental taxes may be growth-generating (Bosquet 2000).

In all these ways, growth theory allows a positive role for environmental policy to move the economy closer to an optimal growth path. Whether it will do so in practice, of course, depends on the scale of the costs which environmental policies impose on the economy. There is certainly evidence from a variety of countries that energy efficiency measures can generate growth and employment, releasing cost savings which are then spent in other areas of economic activity. (This ‘rebound’ effect of higher energy efficiency on demand means that the overall emissions reduction is smaller than anticipated: that is, growth is generated, but it is less green than advocates may believe (Jenkins *et al.* 2011).) But it is not clear that the same is true of investments in low-carbon energy sources or other forms of environmentally-motivated resource substitution. In general renewable energy has been considerably more expensive than fossil fuels, and therefore required substantial public subsidy. Though these costs to the economy have fallen as the scale of generation has increased and technological innovation has occurred, the overall effect on growth in the past has (in most countries) probably been negative. On the other hand, if at some point in the future – as is already beginning to occur in some countries – the cost of renewables reaches parity with that of fossil fuels, these past costs may be seen as an investment which has generated future growth. Again, assessment of the trade-off between the costs and benefits to growth of environmental policy depends to a large extent on the time period over which it is considered.

Comparative advantage and technological revolution: innovation and industrial policy

The third kind of argument for green growth relates to the commonly made claim that environmental policy creates significant numbers of new jobs in environmental industries. To meet higher environmental standards, firms and households require new products and services (energy efficient equipment, pollution control

technologies, engineering services, and so on). The global environmental sector is now estimated to be worth approximately \$5bn per annum, and to employ over 28 million people (Department of Business, Innovation and Skills 2010).

The creation of 'green jobs' dependent on environmental policy does not of course mean that such policy is driving economic growth. More jobs might be being displaced in 'brown' sectors and across the economy as a whole by the higher costs imposed. So two kinds of argument are used to justify the claim that environmental policy can be an engine of growth in this way.

The first is that countries which introduce stringent environmental policies give their domestic environmental sector firms a head start over those in other countries. Forced to innovate, they develop goods and services in response which enable them to win not only domestic business but export markets (Porter and Linde 1995, Lanoie 2008). Such a 'first mover advantage' is held to account for the success of the Danish and Spanish wind turbine sectors, the German solar industry and a range of Japanese and American environmental technology firms, each of which first developed in response to domestic environmental policies, and then grew to become world-leading businesses (Ambec 2011). Their contribution to domestic growth, it is argued, outweighs any economic costs which the original policies may have imposed.

The development of comparative advantage in international trade through environmental policy is obviously not something which can be replicated by all countries. In this sense it cannot be a means to generalised global green growth. But that does not mean that it is not a viable growth path for individual countries. A number of governments around the world (among them Denmark, South Korea, South Africa and Ethiopia) are now pursuing industrial strategies with this object in mind (OECD 2012, Global Green Growth Institute 2012). China is perhaps the most notable example: of the seven 'strategic industries' on which investment will be focused in its 12th Five Year Plan (2011-15), three – alternative energy, alternative-fuel cars, and energy saving and environmental protection – are green. China is already the world's leading exporter of both wind and solar technologies (China Greentech Initiative 2012).

The second argument for regarding 'green jobs' as the harbinger of wider green growth involves a larger and more general claim. This is that low carbon energy systems and other environmental technologies are on the brink of creating a 'new industrial revolution' (Stern and Rydge 2012). Their pervasive impact, it is argued, will unleash a wave of innovation in production methods, products and lifestyles which will transform the economy in the same way as previous technologies such as the steam engine, the railways, the internal combustion engine and the microprocessor. Those making this argument observe that economic growth has tended to occur in 'long waves' of around 50-60 years, driven by technological change but then encompassing, and restructuring, whole systems of production, distribution and consumption. The next long wave of growth, it is claimed, will be driven primarily by information technologies, but if combined with various forms of

low carbon and 'smart' energy systems, new agricultural and production technologies, new materials and new systems for recycling, it has the potential to create an economy with dramatically lower environmental impact (Perez 2010).

This is the most radical form of the green growth argument. Here, environmental improvement is seen not just as a possible motor of economic growth but as one of its primary engines. In some versions this appears to be expressed almost as an inevitability – environmental policy is needed initially to set the new industrial revolution in train but it will then take off on its own. But in others a much stronger or 'entrepreneurial' role for the state is envisaged, in which the necessary innovation is guided and funded by public policy and new infrastructures of production and consumption are developed through public spending, regulation and planning (Mazzucato 2011). An impressive array of evidence can be cited for the role which the state has played in previous technological revolutions. For critics, however, this is precisely what undermines the case. It is not just markets which fail: the idea that the state should seek to 'pick winners' among competing technologies and direct the patterns of growth is a recipe for *government* failure (Winston 2006). If this is what green growth depends on, critics argue, it is not likely to succeed.

Conclusion: the political economy of green growth

As these different forms of the green growth argument have been articulated and debated in the period since 2008, each has found supporters and critics among governments and international institutions, and within the wider academic and policy communities. It is clear that in most countries the dominant economic view remains that the case for green growth is unproven: strong environmental policy continues to be seen largely as a drag on growth rather than a driver of it, particularly in the difficult economic conditions which have prevailed in most of the developed world since the financial crash. But amongst the disagreements, two clear conclusions do emerge.

One is that the theory of green growth (on whichever body of economic thought it is based) cannot determine the question of whether any particular green growth strategy or path will achieve the claims made for it. That will be an empirical matter. It is quite plausible that *some* environmental policies will be growth-enhancing, but others will act as a constraint. The difference could arise from the nature of the environmental problem being addressed, the stringency of the objective, or the efficiency of the policy instruments being used. So there isn't a general conclusion that green growth is or is not possible. It will depend on what kind of green growth is in question.

At the same time, it is clear that the case for green growth is stronger the further ahead one's frame of reference looks. Seen over a very short period, the costs of environmental policy loom large, and the output benefits uncertain. But over a longer timeframe, the potential for technological innovation to reduce costs and drive growth becomes greater, while the economic costs of failing to protect the environment – as resource depletion, pollution and ecosystem loss reach critical

levels – become larger. Few would now dispute the ‘standard’ green growth argument that in the long run protecting the environment will cost less than not doing so. The question posed by the claims of ‘strong’ green growth is how close that long run now is.

It was to cast light on this question that UNEP conducted a new form of economic modeling for their Green Economy report (UNEP 2011). Most modeling of environmental policy has sought to measure its costs against a ‘reference scenario’ in which such policy is absent – but where there are also no costs of environmental damage. UNEP sought to model an arguably more realistic reference scenario in which, because of the lack of environmental policy, considerable environmental costs are projected to occur. The results are instructive. The ‘green growth’ path, in which 2% of global GDP goes into environmental investments, starts off lower than the reference scenario (in which no such specific investments are made). But as the costs of environmental damage begin to constrain growth in the latter, the benefits of environmental policy in the green scenario begin to emerge, and the two growth trajectories cross over. Within seven years from the 2010 start date, the ‘green growth’ scenario has a higher rate of growth than the base case, and real GDP is greater by just after 2020.

No modeling exercise can in itself prove much: too many of the assumptions and equations are open to question. But the UNEP results clarify the nature of the green growth argument. It is that protecting the environment does have costs in the short term. But these should really be understood as the investments needed to generate growth in the medium to long term. There should be no surprise about this: growth theory tells us that growth results from investment, which inevitably subtracts from consumption now. There is a particular urgency about environmental investment, because in every year in which it is not made, environmentally damaging and high carbon capital will be laid down in its place, locking in high emissions and resource depletion for years to come. The case for green growth can in this sense be redefined: it is the case for a growth path which can be sustained over more than just the next few years.

None of this means that green growth is about to become universal economic orthodoxy. But there are nevertheless grounds for believing that it might prove a more effective discourse than sustainable development in marshalling momentum for strong environmental policy.

The first is that environmental degradation is far more evident now than it was twenty years ago. Climate change, water scarcity, food insecurity and rising commodity prices have made the environmental consequences of growth much more immediate to mainstream policymakers (Haas 2012). Second, the focus of the green growth discourse on economic growth gives it much greater purchase on mainstream economic policymaking. Indeed, it is striking how much of the advisory literature on green growth is about the importance of creating the right conditions for growth *per se* – in labour markets, fiscal policy, effective government institutions, and so on –

and not simply about well-designed environmental policy (OECD 2011, World Bank 2012b).

Third, and perhaps most importantly, the green growth discourse has a much stronger base of support among economic interests than did sustainable development. The huge growth over the last two decades of environmental industry sectors has meant that there are now many more, and more powerful, businesses with a direct commercial interest in strengthening environmental policy. For any discourse to succeed in shifting the goals of policy it must gather around it a 'discourse coalition' of actors with a strong interest in its success (Hajer 1995). In the low carbon energy and environmental sectors – allied to important elements of the environmental movement – green growth is developing just such a supporter base (see for example Aldersgate Group 2012).

Yet at the same time there are perhaps even more powerful interests which are threatened by it. For the fossil fuel, extractive and resource-intensive industries, stronger environmental policy means higher costs and greater operational restrictions. Even if such policy can generate growth overall, it does not mean that every sector will benefit from it. On the contrary, a green growth path in practice means a transformation in the structure of national economies which is bound to create losers as well as winners.

For this reason, the political battles over green growth will not take place simply at the level of discourse. It is clear that high carbon and resource-intensive industries will seek to ensure that the concept of green growth does not make intellectual or political headway. But even more vociferously they will oppose the particular environmental policies which are put forward to stimulate it. In practice it will therefore often be in these specific disputes that the more general battle will be manifest. What is not yet clear is whether articulation of the green growth discourse will help shift the balance of such policy debates towards the environmental side, providing an economic counterweight to the familiar claims of jobs, competitiveness and growth on which the 'anti-environmental' case will rest. That is its purpose. But whether it succeeds will ultimately be a consequence of the balance of economic and political forces which are marshalled on either side. The impact of the green growth discourse, that is, will rest less on its economic theory than on its political economy.

This will not be a straightforward struggle. For the concept of green growth is not only opposed by high carbon and resource-intensive industries. A number of civil society organisations have also come out against it. Some development groups see green growth simply as a rubric under which existing patterns of capitalist development are maintained with a green veneer, a means by which developed countries prevent developing ones from escaping poverty (Hoffman 2011, Lander 2011). Meanwhile many environmentalists continue to reject the claim that continuous exponential economic growth can ever be compatible with long-run environmental sustainability (Jackson 2009).

In doing so they offer a sharp reminder that in the end the validity of green growth as a concept will depend not on whether, by creating demand for environmental products, correcting market failures and stimulating innovation, economic growth can be greener over the short to medium term. Ultimately the question will be whether such improvements in the productivity of environmental use can be sustained indefinitely. For 9 billion people aspiring to developed-world living standards, facing already severe pressures on planetary resources, is there any rate of global economic growth *in practice* which will nevertheless allow the environment to be properly sustained over the long term? For how long can global economic output be progressively 'dematerialized' at the required rate (Jackson 2009, Hepburn and Bowen 2013)? With respect to this question, green growth could yet prove to be a saviour, or an illusion.

References

Aghion, Philippe and Peter Howitt, 1992. "A Model of Growth Through Creative Destruction." *Econometrica*, Volume 60 (2): 323-351.

Aldersgate Group. 2012. "Green Growth." Accessed October 6. <http://www.aldersgategroup.org.uk/themes/green-growth>.

Ambec, Stefan *et al.* 2011. *The Porter Hypothesis at 20: Can Environmental Regulation Enhance Innovation and Competitiveness?* Washington D.C.: Resources for the Future.

Barbier, Edward B. 2010a. *A Global Green New Deal: Rethinking the Economic Recovery*. Cambridge, UK: Cambridge University Press.

Barbier, Edward B. 2010b. "Green Stimulus, Green Recovery and Global Imbalances", *World Economics*, Volume 11 (2): 1-27.

Bosquet, Benoit. 2000. "Environmental tax reform: does it work? A survey of the empirical evidence." *Ecological Economics*, Volume 34: 19-32.

Bowen, Alex, *et al.* 2009. "An Outline of the Case for a 'Green' Stimulus." Policy Brief. London: Grantham Research Institute on Climate Change and the Environment, London School of Economics.

Bowen, Alex and Sam Fankhauser. 2011. "The Green Growth Narrative: Paradigm Shift or Just Spin?" *Global Environmental Change*, Volume 21: 1157-1159.

Brock, William. A., and M. Scott Taylor. 2005. "Economic Growth and the Environment: A Review of Theory and Empirics." In *Handbook of Economic Growth Volume 1A*, edited by Philippe Aghion and Stephen N. Durlauf, 1749-1821. Amsterdam: Elsevier.

China Greentech Initiative. 2012. Accessed 6 October. <http://www.china-greentech.com/node/1666>.

Climate and Development Knowledge Network. 2012. "Green Growth: Debates and Resources." Accessed 6 May. <http://cdkn.org/2011/07/greengrowth/>.

Department of Business, Innovation and Skills. 2010. *Low Carbon and Environmental Goods and Services: An Industry Analysis*. London: BIS.

Dobbs, Richard. 2011. *Resource Revolution: Meeting the World's Energy, Materials, Food and Water Needs*. London: McKinsey Global Institute.

Dresner, Simon, 2008. *The Principles of Sustainability*. 2nd edn. London: Earthscan.

Engel, Ditlev, and Daniel M. Kammen. 2009. "Green Jobs and the Clean Energy Economy." Copenhagen: Copenhagen Climate Council.

Ekins, Paul. 2000. *Economic Growth and Environmental Sustainability*. London: Routledge.

Gillingham, K. *et al.* 2009. "Energy Efficiency Economics and Policy." *Annual Review of Resource Economics*, Volume 1: 597-619.

Global Green Growth Forum. 2012. Accessed October 6. <http://www.globalgreengrowthforum.com>.

Global Green Growth Institute. 2012. Accessed October 6. <http://www.gggi.org/>.

Government of France. 2011. "Cannes Summit Final Declaration." Accessed October 6. <http://www.g20-g8.com/g8-g20/g20/english/for-the-press/news-releases/cannes-summit-final-declaration.1557.html>.

Government of Mexico. 2012. "G20 leaders Declaration." Accessed October 6. http://g20.org/images/stories/docs/g20/conclu/G20_Leaders_Declaration_2012_1.pdf.

Graff Zivin, Joshua.S., and Matthew.J. Neidell. 2011. "The Impact of Pollution on Worker Productivity." Working Paper 17004. Cambridge, MA: National Bureau of Economic Research.

Green Economy Coalition. 2012. "Background Paper: Surveying the Green Economy Landscape Post-Rio+20." Accessed October 6. <http://www.greeneconomycoalition.org/updates/background-paper-surveying-green-economy-landscape-post-rio20>

Green Growth Leaders. 2012. Accessed October 6. <http://greengrowthleaders.org/>.

Green New Deal Group. 2008. *A Green New Deal*. London: New Economics Foundation.

Haas, Peter M. 2012. "The Political Economy of Ecology: Prospects for Transforming the World Economy at Rio + 20." *Global Policy*, Volume 3(1): 94-101.

Hallegatte, Stephen, *et al.* 2011. "From Growth to Green Growth: A Framework." Policy Research Working Paper 5872. Washington D.C.: The World Bank.

Hajer, Maarten A. 1995. *The Politics of Environmental Discourse: Ecological Modernization and the Policy Process*. Oxford / New York: Oxford University Press.

Hepburn, Cameron and Alex Bowen. 2013. "Prosperity with Growth: Economic Growth, Climate Change and Environmental Limits." In *Handbook on Energy and Climate Change*, edited by R. Fouquet. Cheltenham, UK: Edward Elgar.

Hoffman, Ulrich. 2011. "Some Reflections on Climate Change, Green Growth Illusions and Development Space. Discussion Paper 205. Geneva: United Nations Conference on Trade and Development.

Holdren, John, and Paul Ehrlich. 1974. "Human Population and the Global Environment." *American Scientist*, Vol 62 (May-June).

Houser, Trevor, Shashank Mohan and Robert Heilmayr. 2009. "A Green Global Recovery? Assessing US Economic Stimulus and the Prospects for International Coordination." Policy Brief 09-3. Washington DC: Peterson Institute for International Economics.

Huberty, Mark, *et al.* 2011. *Shaping the Green Growth Economy*. Berkeley, C.A.: Green Growth Leaders (http://www.uncsd2012.org/content/documents/Shaping-the-Green-Growth-Economy_report.pdf , accessed Oct 6 2012)

Jackson, Tim. 2009. *Prosperity Without Growth: Economics for a Finite Planet*. London: Earthscan.

Jacobs, Michael. 1991. *The Green Economy: Environment, Sustainable Development and the Politics of the Future*. London: Pluto Press.

Jacobs, Michael. 1999. "Sustainable Development as a Contested Concept." In *Fairness and Futurity: Essays on Environmental Sustainability and Social Justice*, edited by Andrew Dobson, 21-45. Oxford: Oxford University Press, 1999.

Jenkins, Jesse *et al.* 2011. "Energy Emergence, Rebound and Backfire as Emergent Phenomenon." Report. Oakland, CA: Breakthrough Institute.

Lander, Edgardo. 2011. *The Green Economy: The Wolf in Sheep's Clothing*. Amsterdam: Transnational Institute.

Lanoie, Paul *et al.* 2008. "Environmental Regulation and Productivity: Testing the Porter Hypothesis." *Journal of Productivity Analysis* 30 (2): 121-128.

Mazzucato, Mariana. 2011. *The Entrepreneurial State*. London: Demos.

Mol, Arthur P.J. and Gert Spargaaren. 2000. "Ecological Modernization Theory in Debate: A Review." *Environmental Politics*, Volume 9 (1): 17-49.

Moore, Stephen. 2011. "Obama's 'Investment' Charade". *The Wall Street Journal*, 27 January.

Mulligan, Casey. 2010. "Simple Analytics and Empirics of the Government Spending Multiplier and other 'Keynesian' Paradoxes." Working Paper 15800. Washington DC: National Bureau of Economic Research.

Nordhaus, William. 1974. "Resources as a Constraint on Growth." *American Economic Review*, Volume 64: 22-26.

Nordhaus, William. 2007. "A Review of the Stern Review on the Economics of Climate Change." *Journal of Economic Literature*, Vol 45 (3): 686-702.

OECD. 2010. *Interim Report of the Green Growth Strategy: Implementing our Commitment for a Sustainable Future*. Paris: Organisation for Economic Co-operation and Development.

OECD. 2011. *Towards Green Growth*. Paris: Organisation for Economic Co-operation and Development.

OECD 2012a. "OECD Work on Green Growth." Accessed October 6. <http://www.oecd.org/greengrowth/oecdworkongreengrowth.htm>.

OECD 2012b. *Transport Outlook 2012: Seamless Transport for Greener Growth*. Paris: Organisation for Economic Co-operation and Development.

Perez, Carlota. 2010. "Technological Revolutions and Techno-Economic Paradigms." *Cambridge Journal of Economics*, Volume 34: 185-202.

Pollin, R. *et al.* 2008. *Green Recovery: A Program to Create Good Jobs and Start Building a Low Carbon Economy*. Washington D.C. / Amherst, MA: Center for American Progress / PERI, University of Massachusetts.

Porter, Michael, and Claas van der Linde. 1995. "Toward a New Conception of the Environment-Competitiveness Relationship." *The Journal of Economics Perspectives*, Volume 9 (4): 97-118.

Robins, Nick, Robert Clover, and D Saravanan. 2010. *"Delivering the Green Stimulus."* London: HSBC Global Research.

Rockstroem, J., *et al.* 2009. "A Safe Operating Space for Humanity." *Nature*, Volume 461 (24): 472-475.

Roland-Holst, David. 2008. "Energy Efficiency, Innovation and Job Creation in California." Research Paper. Berkeley, CA: Center for Energy, Resources and Environmental Sustainability.

Rozenborg, J *et al.* 2010. "Climate Policies as a Hedge Against the Uncertainty on Future Oil Supply," *Climate Change Letters*, Volume 101 (3): 663-669.

Solow, R.M. 1974. "The Economics of Resources or the Resources of Economics." *American Economic Review*, Volume 64: 1-14.

Smulders, Sjak. 1999. "Endogenous Growth Theory and the Environment." In *Handbook of Environmental and Resource Economics*, edited by J.C.J.M. van den Berg, 610-621. Cheltenham, UK: Edward Elgar.

Spencer, Thomas *et al.* 2012. "Exiting the Crisis in the Right Direction: A Sustainable and Shared Prosperity Plan for Europe." Paris: IDDRI.

Stern, Nicholas. 2007. *The Economics of Climate Change: The Stern Review*. Cambridge, UK: Cambridge University Press.

Stern, Nicholas, and James Rydge. 2012. "The New Energy-Industrial Revolution and an International Agreement on Climate Change. *Economics of Energy and Environmental Policy*, Volume 1: 1-19.

UNCSD. 2012. (United Nations Conference on Sustainable Development). Accessed October 6. <http://www.uncsd2012.org/rio20/>.

UNEP. 2011. *Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication*. Nairobi: United Nations Environment Programme.

U.S. Congressional Budget Office. 2009. "Estimated Impact of the American Recovery and Reinvestment Act on Employment and Economic Output as of September 2009." Washington D.C.

Winston, Clifford. 2006. *Government Failure Versus Market Failure: Microeconomics Policy Research and Government Performance*. Washington D.C.: Brookings Institution Press.

World Bank. 2012a. "MDBs: Delivering on the Promise of Sustainable Development." Accessed October 6. <http://www.worldbank.org/en/news/2012/06/19/Development-banks-vital-ensuring-inclusive-green-growth>.

World Bank 2012b. *Inclusive Green Growth: The Pathway to Sustainable Development*. Washington D.C.: The World Bank.

World Bank. 2012c. Green Growth Knowledge Platform. Accessed October 6. <http://www.greengrowthknowledge.org/Pages/GGKPHome.aspx>.

World Commission on Environment and Development. 1987. *Our Common Future* (The Brundtland Report). Oxford / New York: Oxford University Press.

Zenghelis, Dimitri. 2012. "A Strategy for Restoring Confidence and Economic Growth Through Green Investment and Innovation." Policy Brief. London: Grantham Research Institute on Climate Change and the Environment, London School of Economics.

Biographical note

Michael Jacobs is Visiting Professor at the Grantham Research Institute on Climate Change and the Environment at the London School of Economics, and in the Department of Political Science at University College London. He was formerly a Special Adviser to British Prime Minister Gordon Brown, and a member of the Council of Economic Advisers at the Treasury. A political economist, his books include *The Green Economy: Environment, Sustainable Development and the Politics of the Future* (Pluto Press, 1991), *Greening the Millennium? The New Politics of the Environment* (ed, Blackwell, 1997), *The Politics of the Real World* (Earthscan 1996) and *Paying for Progress: A New Politics of Tax for Public Spending* (Fabian Society 2000).