environmental SCIENTIST

December 2012
Journal of the Institution of Environmental Sciences

GREEN GROWTH

A BLUEPRINT FOR THE FUTURE?

‘Green’ growth:

the only growth story for the future

With a rapidly growing population of more than seven billion and a hesitant recovery from the global crisis, the world faces complex economic, environmental and social challenges. To address them we must work to boost economic growth, create jobs, tackle rising inequality and protect the environment.

And we know that we can only accomplish these goals over the long term if we tackle them simultaneously. This means that we also need to re-think the world economy and come up with new approaches that will deliver ‘greener’ and more innovative, inclusive sources of growth, the focus of this issue.

To do so, the OECD has launched an initiative called New Approaches to Economic Challenges, with the objective of revisiting our economic models and theories, enriching our analytical frameworks and identifying a renewed strategic policy agenda for inclusive growth and well-being that also takes into account sustainability and respect for the environment.

The world faces colossal environmental challenges. By 2050, the world population is projected to reach over nine billion people. According to OECD analysis[1], fossil fuels will supply 85 per cent of global energy demand. This will increase greenhouse-gas emissions by 50 per cent and further worsen urban air pollution. With global water demand projected to increase by 55 per cent, competition for scarce water resources will intensify, leaving over 40 per cent of the world’s population living in severely water-stressed river basins. This highlights the importance of de-coupling energy usage from economic growth.

The costs and consequences of inaction could be colossal, both in economic and social terms. To avoid such a grim new world, the OECD has launched a Green Growth Strategy, and is working with countries to develop policies tailored specifically to their level of development, particular resource endowments and environmental pressures. ‘Green’ growth is relevant for all countries across the development spectrum. With energy efficiency, technology transfer, ‘green’ investment and innovation, and good governance, ‘green’ growth can be a win–win opportunity for all, and it is the responsibility of environmental professionals to ensure that these new policies for growth are underpinned by sound science.

Recent action by emerging economies is strong proof that a cleaner pathway to a strong economy is possible. Korea has shown how ‘green’ growth can be anchored in a national vision and mainstreamed across all areas of policy, including the budgetary process. China is a world leader in renewable-energy investment and has identified ‘green’ development as a strategic priority for its 12th Five-Year Plan. South Africa – as part of its New Growth Plan – is working to boost its ‘green’ economy and create new jobs.

To rise to the challenges ahead of us, the OECD encourages all governments, all countries, to support national and international efforts to promote ‘green’ growth, which is why this issue of the *environmental SCIENTIST* serves as both a timely reminder and a call to arms for environmental scientists worldwide.

SOURCE 1.

OECD (2012) *OECD Environmental Outlook to 2050: The Consequences of Inaction*. OECD, Paris.

Angel Gurría has acted as OECD Secretary-General since June 2006. Under his leadership the OECD has expanded its membership to include Chile, Estonia, Israel and Slovenia and opened accession talks with Russia. Mr Gurría chaired the International Task Force on Financing Water for All and continues to be deeply involved in water issues. He is a member of the International Advisory Board of Governors of the Centre for International Governance Innovation, and was the first recipient of the Globalist of the Year Award of the Canadian International Council.

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environmental SCIENTIST
The Journal of the Institution of Environmental Sciences

Volume 21 No 4
ISSN: 0966 8411 | Established 1971

The Environmental Scientist examines major topics within the field of environmental sciences, providing a forum for experts, professionals and stakeholders to discuss the key issues.

Views expressed in the journal are those of the authors and do not necessarily reflect IES views or policy.

Published by
The Institution of Environmental Sciences
34 Grosvenor Gardens
London
SW1W 0DH

Tel 020 7730 5516
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Web www.ies-uk.org.uk

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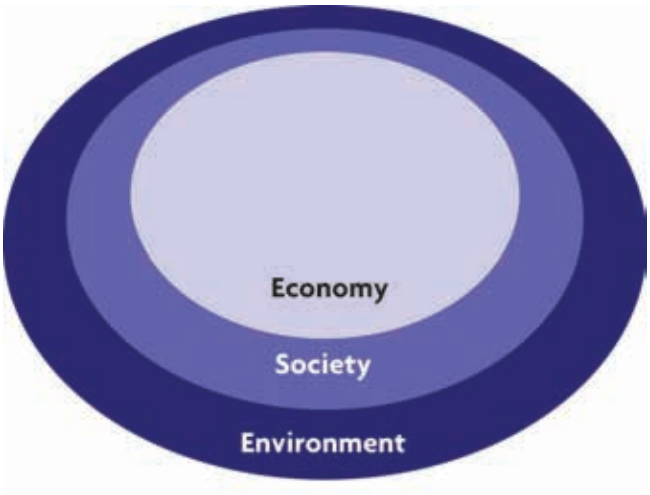
Printers Lavenham Press Ltd

Making the growth equation work



Adam Donnan outlines the motivations for the topic of this issue of the environmental SCIENTIST.

Most readers will be familiar with the phrase often quoted by Kenneth Boulding: "Anyone who believes in indefinite growth...on a physically finite planet, is either mad – or an economist". This view presumes that growth must always be quantitative (e.g. more people having more possessions) and ignores the qualitative aspect of adding value (e.g. having better or more useful possessions that are made from a comparable or smaller amount of materials).

Rapidly rising populations, increasing living standards – particularly in Asia – and the continued popularity of consumer culture means that in the short term, quantitative growth is inevitable, regardless of any qualitative gains. Already society is facing real and imminent resource constraints. Rising demand for key raw materials in finite supply are driving prices up in commodities such as copper, oil and steel. By the end of 2011, average prices in real terms for energy and base metals were three times as high as just a decade ago[1].

These issues are set against the "most serious financial crisis we've seen, at least since the 1930s, if not ever" (Mervyn King, *Daily Telegraph*, 6th October 2011) to which politicians around the globe are still struggling to find a coherent policy response. The IES believes that the positive promotion of 'green' growth might be a solution to a number of these interlinking crises. It is within this context that we are publishing this issue of the environmental SCIENTIST, which seeks to:

- Act as an introduction to 'green' growth and environmental economics;
- Highlight some of the good environmental practices and environmental innovations already taking place; and
- Paint a vision of how a bold 'green' growth agenda could solve the current financial crisis.

AN INTRODUCTION TO 'GREEN' GROWTH

As the title indicates, the environmental SCIENTIST is a publication for environmental scientists. So why then is the IES publishing an issue on economics?

The IES has always believed that in order to effect positive societal change, its members need to be knowledgeable in a wide range of disciplines. Environmental scientists need the technical skills to understand natural processes, and the communication skills to transmit the message and effect behavioural change. The three strands of

sustainability are environmental, social and financial. In order to adequately assess that their actions and projects are sustainable, an environmental scientist needs to understand the systems that underpin financial capital.

Economics is ultimately about choice, scarcity, opportunity, and the impact of decision-making on aspects of society. It is a social science, closely related to subjects such as sociology, politics and even international relations. As Paul Ekins clearly argued at the recent 2012 Burntwood Lecture, the aim of growth should be to service and improve human welfare. If it is not achieving this aim then something needs to change.

GOOD ENVIRONMENTAL PRACTICE

Resource efficiency, decoupling and the circular economy are concepts bandied around by industry to convinced investors that high growth rates are possible despite the rising costs of raw materials and a need to decarbonise the economy. Whilst neither of these has the power to prevent the use of natural resources (see **Box 1**) they can slow down the rate at which society consumes resources, providing a breathing space for a transition to an economy not reliant on quantitative growth.

Many of the authors in this issue touch upon these examples of good practice. Mark Everard challenges the orthodoxy that businesses are in a state of outright competition, instead exploring the history of collaboration, agreement of standards and cooperative behaviours, explaining that this is far more reflective of the natural world. Paul Ekins looks at the need for decoupling growth from material flows, emissions of pollutants and greenhouse gases, and policy initiatives to encourage this.

A 'GREEN' GROWTH AGENDA?

A common complaint is that governments around the world are not doing enough to promote 'green' growth. The articles in this issue recognise that it will be a blend of policy drivers and initiatives by businesses that drive 'green' growth.

Ann Pettifor puts forward a powerful argument that the finance for a transition to a 'green' economy is readily available if the desire to transition is there. Samantha Heath and David Fell look at three environmental policies from the Greater London Authority and measure their impact. Simon Bullock discusses the kind of policies that would be favourable to the renewable-energy sector, and Simone Meili, Ueli Bernhardt and Stephen and Maureen Martin all put forward the case for environmental education as a driver of 'green' growth.

We realise that this will be a new topic for many of our readers. Therefore we have therefore explained terms and concepts that may be unfamiliar. These appear in glossary boxes throughout the journal. ES

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BOX 1. AT A GLANCE: THE CIRCULAR ECONOMY

Traditionally society has had a linear approach to resource use: we mine or harvest resources, use them, then dispose of them in landfill or by incineration. The circular economy (also called the closed-loop system) replaces this with harvest, use, retrieval, and reuse.

In a circular economy, waste is designed out of products and reduced through improvements to the supply chain. Consumers buy fewer, more durable products, and repair, upgrade or reconstitute them wherever possible.

The laws of both thermodynamics and economics make a completely circular economy impossible. At some point in any system it becomes too costly to get the last gains in efficiency of resource use. Many substances, such as paint, are inherently dissipated through their use. However, it is possible to move toward a more efficient, and therefore more circular economy.

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‘Green’ growth: what does it mean?

Alex Bowen reviews current thinking about the role of ‘green’ growth.

For many economic policy-makers around the world, the term 'green' growth has become a talisman, a way of invoking steady increases in output without adverse environmental consequences. The advanced industrial nations' economic advisory think tank the Organisation for Economic Co-operation and Development (OECD) has developed a 'green' growth strategy[1]. The multilateral development banks have taken up the term, emphasising in June 2012 in the context of the Rio+20 Conference that "the need to transition toward green growth has been recognised as key to sustainable development and prosperity". The Asian Development Bank insists that "… green growth is an imperative, not a luxury, for developing Asia"[2]. The World Bank published *Inclusive Green Growth: The Pathway to Sustainable Development* in May 2012 and has set up a Green Growth Knowledge Platform in collaboration with the OECD, the UN Environment Programme (UNEP) and a new international organisation, the Global Green Growth Institute. Some emerging-market economies have been at the forefront of this movement, with the Republic of Korea in particular organising its economic recovery efforts around a 'green' growth strategy announced in June 2009 and aggressively promoting the concept in international forums.

However, it is not clear whether this new emphasis on 'green' growth represents a paradigm shift or just spin to cover up inconsistencies between economic and environmental objectives of governments.[3] In principle, there are enormous opportunities for policy-makers around the world to improve economic and environmental outcomes at the same time. In practice, several difficult challenges will have to be overcome if these improvements are to be brought about. Although these definitions (see **Box 1**) extend beyond concerns about climate change, the last two definitions explicitly flag the need for growth to be low-carbon growth, while the OECD and World Bank emphasise the need to cut greenhouse-gas emissions drastically and decarbonise production, especially in the energy and transport sectors. It is clear that concern about the possible consequences of human-induced climate change has increased the urgency of making growth more sustainable. The other striking feature of the definitions

is that they treat economic growth as desirable. There is no sympathy for the view that "[T]he term sustainable growth should be rejected as a bad oxymoron" or that one should seek "prosperity without growth"[7,8]. Growth – of the right type – is seen as an effective way of lifting people out of poverty, reflecting a widespread view among development economists[9,10,11]. The growth narrative also recognises the attachment of politicians in both developed and developing countries to growth in the short term.

BOX 1. WHAT IS 'GREEN' GROWTH?

Despite the widespread use of the term 'green' growth, there is no universally agreed definition, but there is a broad consensus about what it means. It is very often treated as a synonym for or an aspect of sustainable development. For example, the OECD defines 'green' growth as "fostering economic growth and development, while ensuring that natural assets continue to provide the resources and environmental services on which our well-being relies"[1]. That brings to mind the well-known definition of sustainable development in the Brundtland Report of 1987 – development that "meets the needs of the present without compromising the ability of future generations to meet their own needs"[4].

The World Bank regards 'green' growth as "growth that is efficient in its use of natural resources, clean in that it minimises 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"[5]. It adds the rider that "this growth needs to be inclusive", thus acknowledging the three pillars – economic, environmental and social – of sustainable development. And it argues that "inclusive green growth is not a new paradigm. Rather, it aims to operationalise sustainable development by reconciling developing countries' urgent need for rapid growth and poverty alleviation with the need to avoid irreversible and costly environmental damage". For some other development agencies, "Green growth is, in general terms, economic progress that fosters environmentally sustainable, low-carbon and socially inclusive development"[6], while for the Asian Development Bank, "Low-carbon green growth is a pattern of development that decouples economic growth from carbon emissions, pollution and resource use, and promotes growth through the creation of new environment friendly products, industries and business models that also improve people's quality of life".

Glossary: Steady state economics

Herman Daly combined limits-to-growth arguments, theories of welfare economics, ecological principles, and the philosophy of sustainable development into a model he called steady state economics. A steady state economy is an economy of a relatively stable size, with a stable population. Consumption remains at or below the Earth's carrying capacity.

DOES 'GREEN' GROWTH MAKE ECONOMIC SENSE?

As the author of the influential Stern Review of the economics of climate change argues, "High-carbon growth would kill itself: first from the high prices of hydrocarbons that could result, and second, and more fundamentally, from the very hostile physical environment it would create"[12]. The World Bank agrees, concluding that "[E]conomic growth alone is unlikely to be fast or equitable enough to counter threats from climate change, particularly if it remains carbon intensive and accelerates global warming. So climate policy cannot be framed as a choice between growth and climate change. In fact, climate-smart policies are those that enhance development, reduce vulnerability, and finance the transition to low-carbon growth paths"[13].

This conclusion is strengthened if a risk-management perspective is taken, given the possibilities of catastrophe and the passing of irreversible tipping points in ecological and geophysical systems. And it is strengthened still further if the consequences of inaction across a wide range of environmental challenges are considered[14].

Nevertheless, there are concerns that future economic benefits will only be secured by heavy investment in low-carbon infrastructure, buildings, plant, equipment, and research and development (R&D) in the near term, crowding out households' consumption and reducing their real purchasing power. This is the message from most conventional economic modelling exercises of the gross costs of keeping the global mean temperature increase since pre-industrial times to below 2 °C (although the scale of these incremental costs is much debated, ranging from 1 per cent of world output to an order of magnitude higher or, in some cases, infinite – which would make it technically impossible to keep below 2 °C). Politicians worry that, when it comes to the ballot box, today's voters will not attach very much weight to enhancing growth for generations as yet unborn. Also, politicians are inclined to focus on performance indicators that the public can monitor over the electoral cycle rather than the longer term, so real gross domestic

product (GDP) receives more attention than forecasts of what the concentration of greenhouse gases in the atmosphere will be towards the end of this century.

The 'green' growth' narrative offers policy-makers a more optimistic view about short-term growth prospects. The key economic insight is that, to tackle climate change, several interlinked market failures have to be tackled. Market failures arise when the competitive markets do not result in efficient patterns of production and consumption (given the distribution of income). Greenhouse gases create one market failure because they are an externality to production – economic activities such as electricity generation result in emissions that damage the climate without the emitters having any market incentive to limit them. The economists' prime remedy is to price emissions, preferably uniformly across countries and sectors, so as to create a powerful incentive to achieve emissions reductions in the most cost-effective way without requiring policy-makers' intervention in detailed production decisions. A carbon tax or emissions trading system are possible tools.

But just as modern economies tend to produce too many emissions of greenhouse gases without policy intervention, they tend to produce too little in the way of innovation, because people with useful new ideas are not rewarded by all the other people who could benefit from them – the generation of new knowledge has positive externalities. Hence the benefits to society as a whole from R&D investment are often much greater than the benefits captured by the firms undertaking the investment. The social returns exceed the private returns, perhaps on average by a factor of four, so the private incentive to innovate is less than is socially desirable[15]. One way of dealing with this problem is to strengthen intellectual property rights but, without appropriate regulation, that can simply create monopoly power, another source of market failure. There may also be economies of scale in knowledge production, another phenomenon likely to lead to problems with a purely *laissez faire* solution. Highly imperfect information unevenly distributed across market participants makes financing novel technologies difficult. Other market failures have been described in setting up networks (such as electric vehicle charging points and carbon capture and storage (CCS) pipelines) and in providing public infrastructure (such as low-carbon public transport).

The advocates of 'green' growth argue that all these market failures need to be corrected to reduce greenhouse-gas emissions in a cost-effective way and that, if they are, there will be broad benefits across the economy as a whole, many of which will accrue in the short term. In particular, there will be more innovation, and economies will be nudged on to development paths with more appropriate infrastructure and land use. Working out how to correct any given market failure may be difficult: not every environmental problem is analytically as straightforward as climate change and some market failures have persisted – for example, in the world of finance – because this challenge has not yet been cracked. But the difficulty is primarily one of instrument design rather than resource cost.

"it is fortunate that the dawning realisation of the need for a step change in investment in low-carbon technologies has coincided with a period where such a step change is more likely to boost growth than displace other spending."

It is a moot point whether all the potential benefits of attacking market failures should be attributed to the mitigation of environmental problems. After all, the incentive problems facing potential innovators have been well known for a long time and have given rise to imaginative thinking about patent law, R&D subsidies, regimes for intellectual property transfer across borders and incentive mechanisms such as prizes. Innovation is worth encouraging for its own sake. But a case can be made that it is the dangers of environmental degradation, and particularly the threat of sharp climate change, that have raised considerably the perceived costs of neglecting market failures.

The possible short-term benefits of 'green' growth policies are perhaps best illustrated by reference to a particularly large-scale market failure that occurs intermittently – macroeconomic recession[16]. One way of correcting such a failure, if it is rooted in an excess of planned private saving over planned private investment, is to use time-limited, debt-financed fiscal expansion. But how should such an expansion be structured? The proponents of 'green' growth argue that the silver lining to the cloud of the worldwide economic slowdown is that increased spending on 'green' investments – the 'smart' grid, renewable energy, insulation of housing and so forth – is less likely to crowd out other investment or household consumption. According to this line of argument, it is fortunate that the dawning realisation of the need for a step change in investment in low-carbon technologies has coincided with a period where such a step change is more likely to boost growth than displace other spending.

More speculatively, there may also be longer-term benefits of a shift towards 'green' growth. A sustained change in relative prices will open up new markets for low-carbon and other more environmentally friendly good and services. If that change is complemented by efforts to improve incentives to innovate, particularly in 'green' technologies, a long wave of productivity growth could be triggered, with firms competing to introduce new 'green' products and ways of doing things – an example of the type of burst of innovation that the Austrian economist Joseph Schumpeter argued is at the root of long-run growth. However, any New 'Green' Industrial Revolution will be peculiarly dependent on credible, consistent and very long-term government policy with respect to market failures[17]. It will also need ingenuity in devising new 'green' goods and services that appeal to consumers. For example, on the one hand, the problem with 'green' energy from renewable sources is that it often appears indistinguishable from traditional energy. But, on the other, the IT control systems necessary for 'green' energy and enhanced energy efficiency could be used to deliver novel services to the home, such as remote control of household appliances and real-time monitoring of energy use.

THE CHANGING STRUCTURE OF THE ECONOMY

'Green' growth, especially if it amounts to a New Industrial Revolution, is likely to transform the structure of economies. For example, although the energy sector accounts for only a few percentage points of GDP in most developed countries, energy use is pervasive. Carbon pricing would change production methods and technologies in construction, transport and manufacturing. Carbon pricing would incentivise people to buy fewer carbon-intensive manufactured products and more services with a low carbon footprint. If other greenhouse gases were to be treated in the same way, that would have profound consequences for agricultural practices – discouraging cattle-raising, for example. More broadly, 'green' growth is consistent with the development of the 'weightless economy', in which a much higher proportion of economic activity is dependent on the generation of new ideas and a much lower fraction on the throughput of physical resources[18,19]. Thus 'green' growth goes with the grain of the shift towards service industries seen in most developed countries in recent decades.

This perspective draws attention to how 'green' growth is likely to change the structure of economies across all sectors. High-carbon activities at one end of the spectrum and environmental goods and services at the other are likely to see the biggest quantitative changes in output and employment as a result of a shift towards 'green' growth but qualitative change will be widespread – and not necessarily where most expected. There is a parallel here with the impact of the information and communications technology revolution, which (according to some studies) has had its major effect on US productivity not via the ICT sector itself but in the wholesale and retail sector.

BOX 2. WHAT IS A GREEN JOB?

'Green' jobs can be regarded as those associated with environmental objectives and policies. Some definitions of 'green' jobs or related concepts focus on occupations and skills with an identifiable environmental focus, but most focus on employment in industries (or specific projects) with products deemed to be of environmental benefit. Such benefits can be defined more or less broadly – for example, some concentrate on renewable energy, including or excluding biofuels, while others also include environmental services and employment related to improving energy efficiency or developing less-carbon-intensive products (e.g. building railways). UNEP has adopted a definition that attempts to incorporate aspects of job content as well as the characteristics of industry goods and services[20]. It defines 'green' jobs as "work in agricultural, manufacturing, research and development (R&D), administrative, and service activities that contribute substantially to preserving or restoring environmental quality". The European Commission's Environment Directorate have used the OECD/Eurostat definition of the environmental goods and services industry comprising "activities which produce goods and services to measure, prevent, limit, minimise or correct environmental damage to water, air and soil, as well as problems related to waste, noise and eco-systems. This includes technologies, products and services that reduce environmental risk and minimize pollution and resources"[21].

'Green' jobs account for around 1.7 per cent of total paid employment in Europe[22] on the OECD/Eurostat definition of the environmental goods and services industry and perhaps 0.25 per cent of the global employed labour force of around 1.8 billion on the UNEP definition. Jobs in renewable energy in particular are forecast to by UNEP to rise from 2.3 million in 2006 to 20 million in 2030. The 'clean energy economy' defined by the US Pew Center[23] accounts for around 0.5 per cent of US jobs while the environment industry is responsible for 1.6 per cent of Korean employment directly and indirectly[24].

These numbers appear relatively small. Also, the transition to 'green' growth is likely to lead to job losses in traditional high-carbon sectors such as mining and oil refining. But in one sense the estimates miss the point.

'Green' growth policies could in principle create jobs in sectors not covered by statisticians' definitions of environmental goods and services, such as education, media and business services. This could be even more important in poorer countries, where 'green' growth policies with respect to agriculture, forestry and off-grid solar power could raise rural employment and reduce migration to the cities. 'Green' innovation is taking place in many different industries, including some such as the car industry that are not thought of as particularly 'green'. The evidence on patents related to climate-change mitigation suggests that China and the Republic of Korea have taken this to heart more than several higher-income countries.

CONCLUSIONS

'Green' growth has become a familiar buzz word among economic policy-makers in rich and poor countries alike. The concept is closely related to that of sustainable development, but with more emphasis on growth and on mitigating climate change, which is widely perceived as the major long-term challenge to sustainability. But its use amounts to more than just spin. Given the threat of runaway climate change and environmental degradation, 'green' growth is likely to be the only sort of growth that is feasible in the very long run. And in the shorter term, there will be substantial potential benefits from a comprehensive correction of market and policy failures connected to environmental problems. In a sense, it is fortuitous that this realisation is dawning at a time when, because of the global slowdown, there is less competition for funds for investment. Engineering a transition to 'green' growth could also kick-start more innovation across the board, leading in more optimistic scenarios to a New Industrial Revolution. Much will depend on learning more about how economic activity affects the environment and what precisely are the features that lead to market and policy failures. ES

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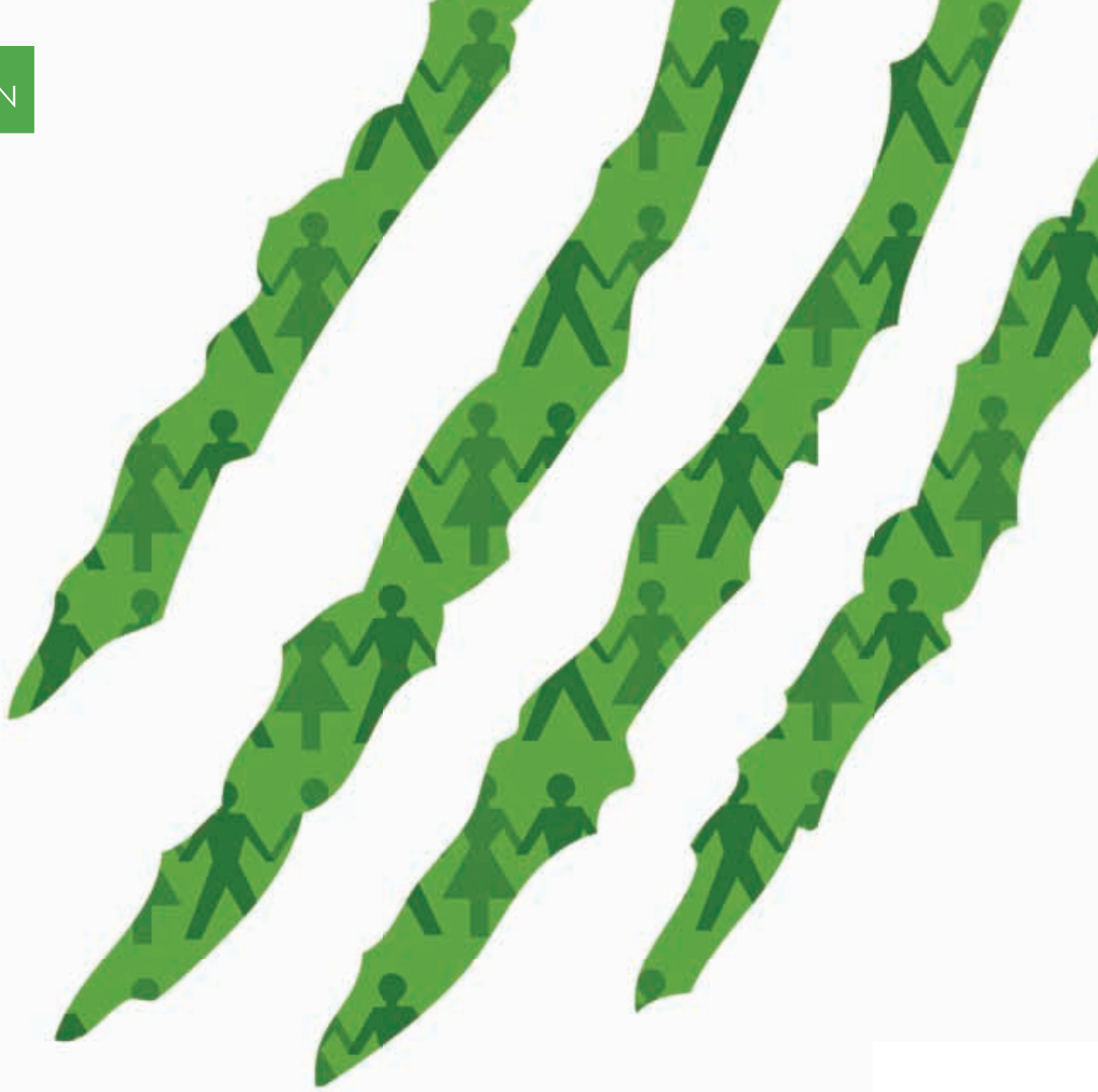

Green in tooth and claw

Dr Mark Everard describes business behaviours other than simple competition.

"Nature, red in tooth and claw", the famous line coined in 1849 by Alfred Lord Tennyson, had long been appropriated to describe 'survival of the most fit' in the face of myriad competitive pressures[1]. For nature has frequently been painted as a gladiatorial contest of the hunter and the hunted, and aspects of this conception of natural selection are, of course, true. However, particularly since the 1970s, scientific and subsequently societal appreciation has deepened significantly about wider dimensions of what fitness may mean, significantly including the biological basis of altruism, mutually supportive intraspecific and interspecific community interactions, and a diverse range of other genetically beneficial co-operative behaviours.

EVOLUTION AND BUSINESS

There are some striking parallels between nature and business, notwithstanding its near-ubiquitous portrayal in the media and some business schools as a purely competitive 'dog eat dog' world of deals, deceptions and winning at all costs. Operational business reality is different, incorporating a great deal that is cooperative.

Trade associations are one obvious example where businesses within a sector combine their influence and resources to campaign, lobby, research or otherwise collaborate to achieve mutually advantageous goals. Brussels is a hotbed of trade associations, not simply due to efficient transport links but, most importantly, for its proximity to politicians and legislators upon whom the not insignificant mass of collective business interests is brought to bear. Contrary to common expectations, not all of this influence is there to dilute the stringency of regulation; there are also campaigns for more uniform regulation and voluntary agreements rather than less control.

A good example of this is seen in trade bodies such as VinylPlus and the European Council of Vinyl Manufacturers (ECVM). These two bodies campaign to ensure that the transparent commitments of member companies to establish and improve published sustainability codes and targets is not undercut by retailers importing vinyl-based goods from countries lacking equivalent guarantees. These and similar commitments can also progressively integrate the interests of extended value chains, as businesses realise that disclosure of unethical, depleting or polluting practices along supply chains not only creates business risk but can have real business impact. This is particularly apparent if concealments or oversights are disclosed by an ever more web-connected and environmentally-literate world. All in the value chain accrue mutual benefit by working together to ensure that higher standards become the market norm, and they also accrue a more sustainable basis for competition than a 'race to the bottom' through cost-cutting.

PRODUCT SYMBIOSIS

Products also arise from collectives of otherwise competing businesses. Buy pretty much any European brand of car and you are buying a composite of interchangeable parts. For example, Bosch may well make the fuel injection system whether the bonnet carries a luxury or a more urbane badge. Co-licensing of modules and patents within software products is commonplace in the computer industry, just as competing brands of road fuel, fishing tackle, musical instruments and peanut butter may in reality emerge from the same factories.

Common standards of all kinds – from internet protocols to HDMI and DVDs – ensure interoperability between products produced by ostensibly rival companies. As those affected by the war of the 1980s between VHS and Betamax videocassette formats found, lack of standardisation is a constraint on the growth of whole sectors as customers lose confidence. Close attention to the 'selection pressure' of customers is key here, recognising that groups of businesses either progress together (in this instance by strategic choice) or else feel the redness of tooth and claw in the rejection that consigns them to evolutionary history.

Businesses also innovate together, seeking selective advantage in a changing world, and sometimes for the explicit purpose of sustainable development. The Forest Stewardship Council (FSC) and Marine Stewardship Council (MSC) supply chain accreditation schemes were both business-led, as part of wide consortia. These included NGOs, local communities and other interests brought together by common recognition that resource security and supply chain accountability are central to continued positive reputation and profitability. Signing up to FSC, MSC, Organic food, Rainforest Alliance, Fairtrade and many other such supply-chain accreditation marques is non-exclusive to a club of pioneering interests, but is open to any enterprise willing to commit to published standards and assurance schemes. Thus, the sector progresses as a whole, with brand competition within the confines of agreed standards. Over time, such market-changing agreements may be cemented in regulation or retailer requirements, changing the market more permanently.

This model of 'co-opetition' – collaboration on key important common interests but vigorous competition on brand distinctions – is commonplace in business and of course finds its analogue in the mix of collaborative and competing behaviours that keep ecosystems dynamic.

THE GROWTH MODEL

Interesting as all this is, what has it to do with alternatives to the growth model? Well, it is all to do with the purpose served by business. This includes how the business frames

itself, how it governs itself, and its spur for innovation. At a greater scale, it is all to do with a conception of the economy that *serves* rather than rules people.

The plainest example of this conflict of ideologies – of sufficiency versus technocentric advancement – was played out in post-independence India. Jawaharlal Nehru (1889–1964), independent India's first Prime Minister, famously described large dams as the "temples of modern India", emblematic of an increasingly technologically capable nation aspiring to a place amongst developed-world powers by equating science with progress in the big engineering of cities, weapon systems, power plants, steel mills and other massive schemes[2]. This technocentric drive starkly contrasted with the ideals of Mohandas Gandhi (1869–1948) of locally-appropriate technologies and lifestyles founded upon sufficiency rather than competitive Western development. Nehru came to regret his statement within his own lifetime, later frequently referring instead to "the disease of gigantism" to describe the proclivity of large dams and related large infrastructure schemes to accelerate depletion of forests, displace local people and appropriate huge sums of public money through corruption, all in the name of a blinkered, technical model of progress of questionable use to the Indian public[2].

Other regions have eschewed a narrowly economic model of progress, the upland Himalayan nation of Bhutan and the southern Indian state of Kerala famously prioritising personal wellbeing over the narrow economic measures of GDP. And, as we know, the UK is currently compiling a wellbeing or 'happiness' index to set beside national accounts. It is all a matter of what purpose growth and the economy serve, and what is fittest to service it.

So, though many business 'bads' – various shady and historic practices – are apparent to the environmentally literate, business is inherently not a bad thing. In a capitalist world, it is simply the means by which we select appropriate resources and convert them into beneficial products. That system is deeply embedded, but many businesses and business associations are showing some impressive leadership towards sustainability.

AN EVOLUTIONARY PERSPECTIVE ON BUSINESS

So how can we integrate the lessons of evolution into the business model?

The first principle is to recognise the purpose of business: connecting resources with people. The second, consequent from the first, is to recognise that even virtual trading mechanisms (futures, derivatives, reinsurance, etc.) are in fact different degrees of speculation – many of them little more than gambling as the sub-prime fiasco revealed all too clearly – built on top of biophysical materials such as sacks of wheat, fleeces, containers of ore and volumes of water. The whole top-heavy mass of the economy ultimately rests on just two things: what nature provides and what people do. It is then a travesty and vulnerability of the economic basis of developed society that markets largely exclude precisely the two facets that underpin it.

Responsible business can redress, and in many cases is redressing, these perilous oversights. First. by asking itself what societal purpose it serves, as a means to pre-empt inevitably changing markets and so seek selective advantage in a fast-changing world. Second, by taking increasing account of social and environmental dependencies as key features of risk management and product innovation. So, if business is with us to stay, it has a central role to play in innovating the way it appropriates and stewards resources to make the products that fulfil the shifting needs and wants of people.

Some interesting observations can be made from companies like DuPont, which has been trading for more than two centuries, diversifying since its inception making 'black powder' for the French Revolution to manufacturing a wide range of chemical products today. Business must remain profitable to remain viable, necessitating changes in a changing world: the red teeth and claws are always close at hand in selecting out those that fail to keep their heads above water in the evolutionary pool. Successful businesses that have evolved for decades or centuries have shifted with customer needs and opportunities, also maintaining an eye to the longer term and its shifting priorities and risks. Sustainability concerns are certainly prominent in a world that is increasingly resource-constrained and overpopulated, and so will become a defining selective pressure bearing down on businesses seeking to serve human needs by manipulating the material of the biosphere.

"Ironically, whist the environmental movement found its feet and voice by bashing business, it is today largely from business that innovations to address these challenges are occurring."

LIMITS TO GROWTH

I recall the alarmism that greeted publication of *The Limits to Growth* in 1972[3]. Tales were told of families having to make do with a single light bulb by the turn of the millennium. A huge amount of effort has since been spent on trying to dispel this and other similar spectres, most significantly as they relate to the marginal costs of exploiting formerly uneconomic resources such as deep-sea oil. And of course virtually no politician - at least none hoping to win the populist vote for re-election to office - wants to constrain the dreams of the electorate.

But, on a finite planet with a burgeoning human population, the objective scientific reality is that there really have to be limits. Perhaps not exactly in the simplistic 'arithmetic versus logarithmic growth' conflict described by Thomas Malthus, but the Malthusian principle remains. The only questions remaining are when those limits will be reached, and what form they will take. The answer to the "When?" question is "Already". The authoritative UN Millennium Ecosystem Assessment[4] provides clear evidence of the massive and global erosion of ecosystems and their services to humanity, with dire implications for the prognosis for our species, or at least our lifestyle expectations, if we fail to adopt a more sustainable trajectory. The phenomenon of 'peak oil', when global demand exceeds supply, is now widely accepted and indeed already upon us. Add to this 'peak phosphorus', Chinese annexation of rare earth metals, substantial global soil erosion and degradation of soil quality as we face up to the need to produce 50 per cent more food by 2050, and military conflicts over contested water resources since at the very least the Six-Day War of 1968.

The question of what form the limits will take is more searching, as our choices of behaviours going forward are significant determinants. Our current trajectory faces us with the near certainty of ever-deepening austerity and resource conflicts. But permitting that is not, of course, in the nature of the human spirit, overcoming as it has throughout history the ravages of food and water scarcity, epidemics and predation. Already, we are seeing intense innovation, and in many instances impressive market penetration, of renewable energy generation and renewable production of biologically based chemical feedstock, an upsurge in recycling and other forms of resource recovery, business models changing from selling goods to hiring out services rather than physical products in sectors as diverse as floor coverings and pest control. The grail of the decoupling of economic growth from linear material throughput is as tantalising as it is necessary if we are to survive rising human population and dwindling ecosystem capacity.

Ironically, whist the environmental movement found its feet and voice by bashing business, it is today largely from business that innovations to address these challenges are occurring. The world is changing, challenging those that are less than fit to live sustainably, and equally selecting the products, services and businesses that may have a place in a future where meeting the needs of more people using fewer materials will be a defining pressure.

GOVERNANCE FOR GROWTH

Grasped proactively and bravely, then, there is nothing wrong with the concept of growth. It is a matter of what is doing the growing.

Human numbers are growing and, with them, demands for food, water, habitation, worthwhile employment and all sorts of other goods. We have to see the business model continue to change profoundly to reward innovations that better respond to the needs of all people, doing so with less material throughput, and where the wealth of the minority no longer increases at cost to the masses. 'Green' growth in businesses, when selection pressures see responsible and innovative business succeed, is indeed essential for the future wellbeing of all.

Growth with purpose to serve the needs of people in more sustainable ways is different growth – 'good growth' if you will – and in all probability a necessity to grow a different future in an inevitably much-altered world. We should be urgent in encouraging it through the right forms of rewards in regulation, markets, customer understanding and cooperation along value chains to bring sustainability into the mainstream, allowing other business models to wither on the vine, for this is the evolutionary way. ES

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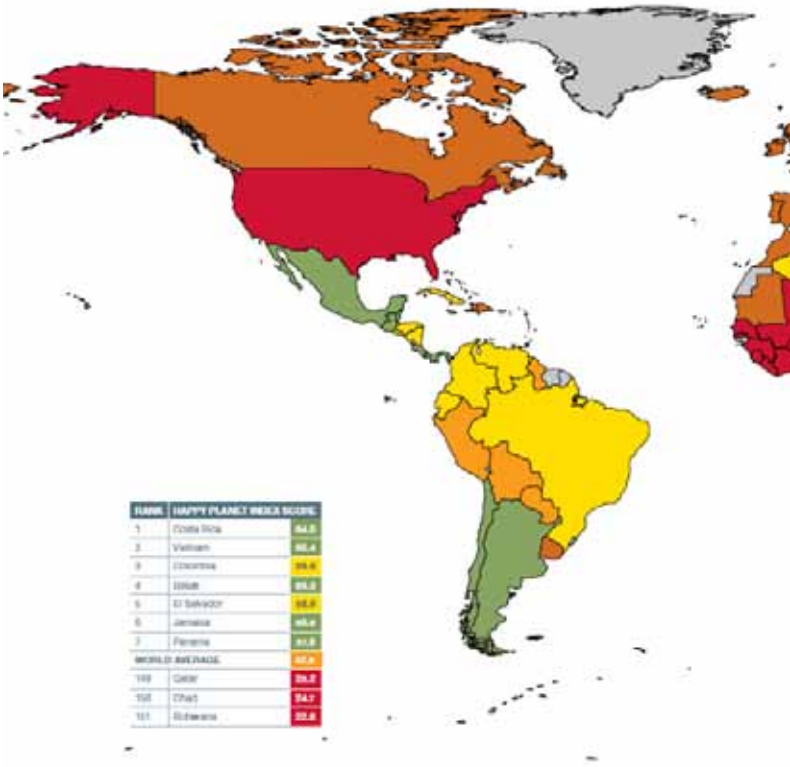
Alternative growth indicators: the Happy Planet Index

Emma Fenton explains the origins and uses of an index of human happiness.

Many governments around the world have realised that valuing an economy purely using gross domestic product (GDP) can produce only a very narrow view of a country's welfare and growth. It is therefore necessary for modern economists to calculate growth based on more appropriate assumptions about national well-being. One such method, the Happy Planet Index (HPI), was suggested by Nic Marks at the New Economics Foundation (NEF) and it flies in the face of traditional economics based on Pigou's Dictum (see **Box 1**).

BOX 1. PIGOU'S DICTUM

In calculating growth, economists are able to distinguish between social welfare (also called welfare at large) and economic welfare, for which economists use national product as "the objective, measurable counterpart of economic welfare"[1]. However, rather than calculating growth based on a logical combination of these two concepts of welfare, economists have historically disregarded possible differences between the two concepts and operated on Pigou's Dictum: "That there is a clear presumption that changes in economic welfare indicate changes in social welfare in the same direction, if not in the same degree"[1].



▲ **Figure 1. A map of the world, colour-coded by HPI ratings (Sour**

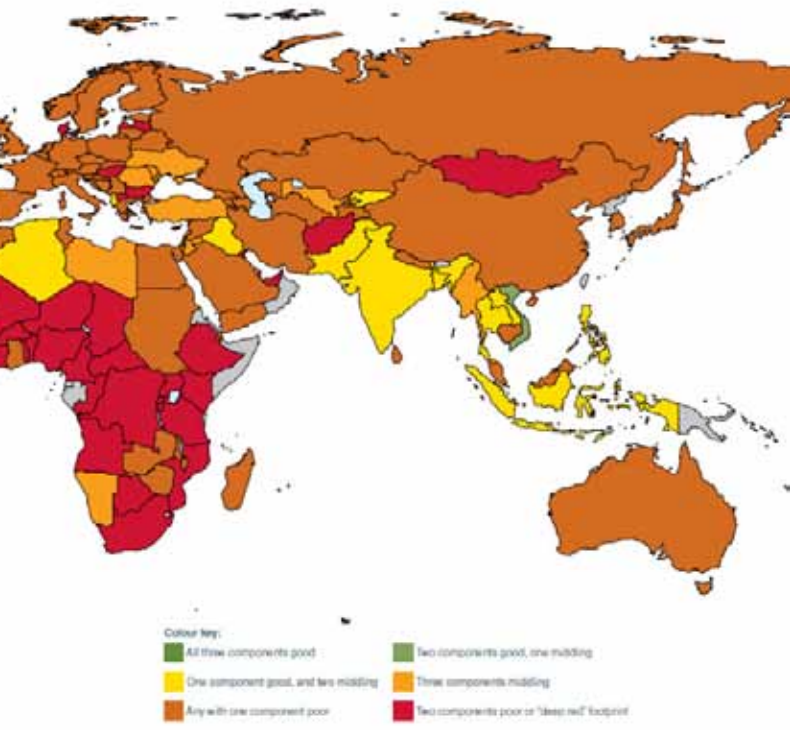
The HPI has been described by NEF as: "A measure of progress that focuses on what matters: sustainable well-being for all"[2]. The index allows direct global comparisons of the efficiency with which different nations produce long, happy lives for their inhabitants whilst simultaneously maintaining the conditions for future generations to do the same[2].

The HPI takes into account three factors: experienced wellbeing, life expectancy, and ecological footprint, and is calculated as follows:

$$HPI = \frac{(\text{experienced wellbeing} \times \text{life expectancy})}{\text{ecological footprint}}$$

The most recent report from the NEF has ranked the world's countries according to their HPI scores. The distribution of different HPI scores is displayed in **Figure 1**.

In the 2012 report, Costa Rica came out as the most efficient nation at converting natural resource usage to better human wellbeing. The UK was ranked at 41, with the USA further down the rankings at 105.



ce: NEF 2012)

BOX 2. THE HISTORY OF MEASURING HAPPINESS

Although the science of using happiness to indicate an economy's value is relatively novel, the first mention of the fact that measuring GDP might not accurately reflect a nation's happiness was proposed by Abramovitz in 1959 when he stated:

"we must be highly sceptical of the view that long term changes in the rate of growth of welfare can be gauged even roughly from changes in the rate of growth of output." (Easterlin, 1974)[1]

LIMITATIONS

One of the main issues with the HPI is that it is often misused as an absolute measure of progress or as a clumsy indicator of where geographically one might live in order to have a good life. The report is not intended for this use; rather it is intended to be used as an efficiency index. For example, in the 2012 report, Iraq is ranked at 36 – higher than the USA (105) or the UK (41). This does not necessarily mean that Iraqis live better lives than people in the countries ranked below them. What it *does* mean, however, is that Iraq is more efficient at converting the natural resources it consumes annually into the wellbeing of its inhabitants. ES

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How we *can* afford to rebalance the UK economy

Ann Pettifor debunks the myth that there is no money for 'green' growth.

"We destroy the beauty of the countryside because the unappropriated splendors of nature have no economic value. We are capable of shutting off the sun and the stars because they do not pay a dividend."
(Keynes, 1933, p755)[1]

'Rebalancing' is a fashionable term with British politicians. The Chancellor, George Osborne in his March 2011 Budget speech spoke hopefully of "a Budget for making things not for making things up". He called for "a more balanced economy…encouraging exports and investment". He ended his speech by saying that he wanted the phrases: " 'Made in Britain', 'Created in Britain', 'Designed in Britain', 'Invented in Britain', to drive our nation forward. A Britain held aloft by the march of the makers"[2].

But Britain's makers are not inclined to march through an economy crashed by the finance sector in 2007–9 and depressed by subsequent (and consequential) government austerity policies. In aggregate real gross domestic product (GDP) has declined by £60 billion since the peak level of activity in 2008. Investment has contracted by £50 billion, with the decline in public investment as the main problem[3].

The British economy is one where the overhang of (largely unpayable) private-sector debts, including those of banks, corporates and households, continues to inhibit investment and employment. This reluctance is reinforced by the British Government's actions to decrease public investment and local and national government employment, and to synchronise Britain's austerity measures with those applied across the Eurozone, the US and Japan. All these policies have caused both investors and consumers to be more cautious.

This is unfortunate, because rebalancing remains imperative if Britain is to recover from the greatest financial crisis in our history, and if we are to forge economic and social stability for both this and future generations. Above all, rebalancing towards an economy less dependent both on the City of London and fossil fuels is vital not just for economic reasons, but for a liveable planet. Rebalancing away from consumption

as the major driver of economic activity and towards an economy based on greater self-sufficiency is essential if we are to tackle the triple threats of climate change, energy insecurity and environmental degradation.

PERIODIC CORRECTIONS TO IMBALANCE

Human civilisation has for a long time had rebalancing hard-wired into its economic and social systems. We may not have been conscious of how deeply embedded this economic framework was, but until recently it governed a great part of economic life.

The jubilee principle, also called Sabbath economics, is an economic system for periodically correcting economic and ecological imbalances, with a special focus on correcting imbalances caused by high levels of debt. Despite determined efforts to spiritualise these laws, the regulations of the Sabbath, the principle of debt redemption and of jubilee (as spelled out in the Torah, the Old Testament and the Qu'ran) are essentially economic laws. They were designed in the first instance to liberate the people of Israel from debt bondage and to ensure they never fell into bondage again. On the Sabbath believers were expected to cease to exploit each other or their animals. They were to cease, for a whole day, to exploit the land, and to consume. Every seven years the land had to be left to lie fallow for a whole year. This was an early manifestation of soil conservation and concern for the environment – a humble reminder that we are not the first generation of environmentalists. At the same time, every seven years, those who worked hard were to be given time to rest – a *sabbatical*. Every seven times seven years, in the 49th year, debts were to be cancelled, slaves freed and land restored to its rightful owners. In the 50th year, the hallowed year, the jubilee holiday could be celebrated.

The jubilee principle, while it may not have been applied in full, was a powerful motivation in struggles for social and economic justice. It inspired the struggle against slavery. Americans sought inspiration from it as they struggled against a foreign occupier. On the Liberty Bell in Philadelphia the words of the biblical text are engraved: "sound the trumpet of Jubilee and declare liberty throughout the land". Echoes of the jubilee, the struggle for redemption from debt and slavery can be heard in Bob Marley's 'Redemption Song'.

There are real questions as to whether the jubilee principle of periodic debt cancellation was ever applied. Nevertheless, we know that the Sabbath laws played a vital role in periodically re-balancing economies because they had to be repealed for financial and trade liberalization policies in mainly Anglo-American economies to succeed. Today in their place, we have the phenomenon of '24/7'. Shopping, work and exploitation take place all hours of the day, all days of the week and year. Short-termism and financial methods for discounting the future mean that land is too valuable to be left fallow. Bankers no longer limit money-lending or money-dealing to office hours. Instead new technology allows the money business to operate 24 hours a day, seven days a week.

While the old biblical laws are now outlawed, the principles and wisdom underpinning those laws – the human need for periodic correction to social, economic and ecological imbalance, and the imposition of discipline on both lenders and borrowers – remain highly relevant.

CAN WE AFFORD TO REBALANCE THE ECONOMY?

"Dear Chief Secretary, I'm afraid to tell you there's no money left." **Liam Byrne, Labour's Chief Secretary to the Treasury,** *The Guardian***, 17 May, 2010.**

"The British government has run out of money because all the money was spent in the good years. The money and the investment and the jobs need to come from the private sector…" **George Osborne, Chancellor of the Exchequer. Sky News. 27 February, 2012.**

Many argue that investing in the rebalancing of the British economy away from financial speculation and consumption of fossil fuels towards more productive and sustainable activity is too costly, that there is no money for developing alternative energy sources or retrofitting the housing stock to improve energy efficiency; that the nation's coffers are empty.

However, while there may be limits to human capacity and to the ecosystem's assets, there need never be a limit to the finance needed for tackling ecological and economic imbalances. That "anything we can actually *do*, we can afford".[2] But first it is necessary to re-state facts known about money to economists down the ages, but most clearly explained by Keynes, and then subsequently lost to the field of macroeconomics. It is also necessary to rebut the case made by politicians and orthodox economists, that 'there is no money'.

THE NATURE OF MONEY

"The study of money, above all fields in economics, is the one in which complexity is used to disguise truth, or evade truth, not to reveal it." (Galbraith, 1975, p5)[4]

Thanks to the dominance of Adam Smith's ideas, there is a widespread assumption that credit or money plays only a secondary role in capitalist economies. For those orthodox economists who follow Adam Smith, the economy is based on barter and money is just its 'neutral veil'. This view is most succinctly expressed by an economist, Paul Samuelson, who must rank as amongst the most influential. In his book, Economics (taught in every *Economics* 101 course in most of the

world's universities, and now in its 17th edition) Samuelson wrote that:

> *"Even in the most advanced industrial economies, if we strip exchange down to its barest essentials and peel off the obscuring layer of money, we find that trade between individuals or nations largely boils down to barter."* (Samuelson, 1973)[5]

In this view of economics, banks and bankers are mere 'intermediaries' between borrowers and savers. According to classical theory, repeated by Keynesians like Samuelson, saving was necessary prior to investment. Money (deposits or savings) existed only as the *result* of economic activity. These savings (or vaults of silver and gold) then *created* economic activity.

However, economists, sociologists, central bankers, commercial bankers, presidents and politicians have known since before the founding of the Bank of England in 1694 that the very opposite is true:

- Savings are *not* needed for investment;
- Private bankers are *not* mere intermediaries.; and
- Bank loans issued by commercial bankers *create* deposits.

Keynes's great contribution was to demonstrate that saving, which is another word for non-consumption, or delayed consumption, is not necessary prior to investment. In other words, if a bank promises credit for an investment it really disposes of something belonging to the future. Thus:

- Credit creates deposits and savings;
- Deposits create economic activity; and
- Economic activity generates income – with which to repay the credit.

However, for that economic activity to be sustainable and repayable, Keynes argued that credit should always be carefully allocated and regulated. In other words it should be 'tight' money. Above all, for credit to be repayable, and ecologically sustainable, its price, the rate of interest, has to be low. 'Tight but cheap money' was fundamental to Keynes's monetary theory. The sound investment of bank-created credit leads to a virtuous circle, in which income is generated and the credit repaid. Financial crises proliferate when the credit is used for speculation, not productive investment, and when credit is too costly and therefore exceeds the rate of profit from an investment.

"Anything we can actually *do*, we can afford."

(Keynes, 1942, cited in Mason, 2011)[2]

It is hard for non-economists to understand that there is no money or savings in the bank when a borrower applies for a loan. However, the fact is that it is the loan application itself that, together with the promise of both collateral and repayment, creates deposits. Deposits in turn create economic activity (employment) and income – wages, salaries, profits and tax revenues. If used wisely, the income from this economic activity can be used to repay debts. The sustainability of the financial system depends on this 'virtuous circle': the creation of credit for sound investment and economic activity, which in turn generates the *income* for repayment of the carefully regulated, low-cost credit.

Despite these fundamental aspects of capitalism being known for many centuries, and practised during the 'Golden Age' of economics (1945–71), many persist in denial of capitalism's greatest power: the elastic production of money. And the financial crisis erupted because the 'virtuous circle' of creating credit only for sustainable, productive activity (not speculation) and then ensuring that the income generated repaid the debt was deliberately ignored. Money from speculation (whether on property, race horses, stocks and shares, works of art etc.) proved to be far more profitable over much shorter time periods than investment in sound, productive and sustainable activity, notably employment.

To understand that there is indeed enough money for society's purposes, we need to understand that the nature of money is highly peculiar. It is very different from the point of view of an individual and from the point of view of the system as a whole. Individuals cannot magic money from nothing. But the banking system as a whole is able to do so. This money or credit can be used to bring economic activity into existence. Credit creates savings and deposits. Economic activity generates saving; it is not constrained by saving.

Once society accepted the public good that is bank money and a sound banking system, money was no longer a scarce resource. Economic activity was, and is, no longer bound up with and dependent on the few with savings in excess of income. Investment was no longer constrained by saving.

To recap: to make loans, banks (both central banks and private banks) do not have savings or deposits –

either theirs, or those of others – to extend to others as credit, and on which they charge interest. The money for a bank loan does not exist until the borrowers apply for credit. (The myth of 'fractional reserve banking' is just that: a myth.) Central banks do not need to tax the population or to mobilise savings for the Bank of England's quantitative easing (QE) or the European Central Bank (ECB)'s outright monetary transactions (OMT). These operations have taken place since the founding of the Bank of England in 1694 and have always been known as central bank money market operations.

At the height of the financial crisis, Governor Ben Bernanke was asked where he had found US$160 billion to bail out the insurance company AIG. When asked if he had raised the funds from taxation, he replied:

> *"It's not tax money. The banks have accounts with the Fed, much the same way that you have an account in a commercial bank. So, to lend to a bank, we simply use the computer to mark up the size of the account that they have with the Fed."* (Bernanke, 2009)[6]

In today's economy, there is no tangible quantity corresponding to the aggregate of bank money in an economy at any point in time. Such a tangible quantity or even quality is not a necessary characteristic of money. The acceptability and hence validity of bank money is due to its being able to facilitate transactions. To enable society, in Keynes's terms, to 'afford that which we can create'.

For investors who operate in today's monetary economies, the relevant consideration is the availability of finance, not savings, and there need be no constraint on finance, because credit is not a commodity and therefore, unlike commodities, there need be no limit to its availability. This makes credit both a powerful resource for human development and protection of the ecosystem, but also a dangerous power if unchecked and governed only by 'light-touch regulation'. If more credit is created by the banking system than there is potential for economic activity, then the outcome is inflation. If less credit is created than there is potential for economic activity, then the outcome is deflation. Furthermore, if loans are made at rates of interest above a sustainable rate of return, the loans become unpayable.

There are two more important constraints on the availability of finance: labour and the ecosystem. In other words, the amount of financing available to the economy is constrained by the capacity of the world's labour force, and by the physical limits imposed by the ecosystem.

SUPPLY AND THE PRICE OF MONEY

Fortunately, bank money has a second great advantage, the very thing that had motivated its invention: lower interest rates. Public banks could increase the supply of money, and thereby lower its price – the rate of interest.

Entrepreneurs could do business with people other than those with savings in excess of income, who were often also usurers.

An important point about credit, unlike gold or oil, is that it is not subject to the laws of supply and demand, and because of this, its price (i.e. the rate of interest) should always be low, and is necessarily a social construct. In other words, the price of credit is influenced not by shortages or gluts, but above all by committees of men and women, based in central banks and in the private banking system, who determine the most appropriate rates of interest for the economy or for the private banking sector. (Consideration is not, so far, given to the ecological sustainability of rates.) Think of the Monetary Policy Committee (MPC) of men and women at the Bank of England who determine the nation's base or policy rate or the 'submitters' in the back offices of high-street banks who, on a daily basis, fix the London Inter Bank Offer (LIBOR Rate), on which millions of mortgages and other loans are based.

The 2009 creation of extraordinary levels of 'support' – estimated by the US Government Accounting Office at US$16 trillion[7] – for the banking system was accompanied by decisions by central bank committees to push base or policy rates to the lowest levels in history. While rates across the spectrum did fall, central banks have unfortunately lost control over the full spectrum of rates set by the private sector (for short and long loans, safe

and risky loans). These are now largely determined by private bankers, behind closed doors, and in negotiation with borrowers.

Bank money was a remarkable and very welcome development; a great public good. Indeed capitalism owes much of its advance to the development of sound banking systems.

USING THE BANKING SYSTEM TO FACILITATE THE 'GREEN' TRANSITION

The United Nations Environment Programme (UNEP)'s publication, *Towards a Green Economy*[14], tackles the vexed question of financing the 'Green' Transition and estimates that

> *"to halve CO_2 emissions by 2050, requires investments of approximately US$750 billion per year from 2010 to 2030 and US$1.6 trillion per year from 2030 to 2050. The World Economic Forum and Bloomberg New Energy Finance, on the other hand, calculate that clean energy investment needs to rise to US$500 billion per year by 2020 to restrict global warming to less than 2°C, while HSBC estimates that transition to a low-carbon energy market will require US$ 10 trillion between 2010 and 2020."* (UNEP, 2011, p33)[8]

The Green Economy team at UNEP make their assessment based on achievement both of the above carbon emissions target and also the Millennium Development Goals, estimating a range of US$1.05 trillion to US$2.59 trillion annually.

> *"On average, these additional investments amounted to 2% of global GDP per year over 2010–2050, across a range of sectors to build capacity, adopt new technologies and management techniques, and scale up green infrastructure."* (UNEP, 2011, p35)[8]

The report then proposes a range of potential ways of financing these investments. The UNEP team look to "institutional investors such as pension funds and insurance companies"; to "public financing" by which no doubt is meant taxation and government borrowing from capital markets; to global development institutions (e.g. the International Monetary Fund (IMF), the World Bank and other multilateral institutions); and finally to "stable and resilient capital markets".[8]

The financing of a 'Green' Transition is affordable, and need not be drawn down from what can broadly be defined as savings, namely the share of income not consumed by individuals, households, firms, governments and global institutions, and instead 'saved' as taxation, capital, pension funds, and reserves. Instead the financing of a 'Green' Transition should be undertaken in much the same way as the financing of the Industrial Revolution, the Second World War, and the recent 2007–9 bank bailout, for example: by the banking system's creation of credit at low, sustainable rates of interest. This financing must then be used for investment in productive activity – both public and private – that substantially lowers emissions, facilitates the transition to a de-carbonised economy, and generates the income to repay those public and private banking system's loans.

The annual sums required for the 'Green' Transition are not excessive when compared, for example, to the intervention undertaken to support the banks in the UK, US and Eurozone during the financial crisis. According to the Bank of England's 2008–9 *Financial Stability Report* "overall, the total value of actual and contingent support in North America and Europe rose to over US$14 trillion, equivalent to about 50% of annual GDP"[9]. UNEP's requirement of 2 per cent of GDP for financing the 'Green' Transition is modest by comparison.

Savings are not needed to finance the Green Transition. The financing and investment of 2 per cent of global GDP in the Green Transition will in turn generate economic activity, and with it the deposits and savings needed to repay lending. There will be no need to resort to taxation, pension funds or other sources of savings. Indeed sound economic activity will generate additional savings for individuals, firms and governments.

By increasing the amount of credit in circulation, bank money facilitated what we have come to regard as progress. The development of modern technology (such as the light bulb and the steam engine) would not have taken place if entrepreneurs had not had their research and development funded by low-cost finance made available by bank money. Trade was made possible with bank money. The welfare state was made possible by bank money. And financial crises have been ameliorated by the issuance of bank money.

The 2009 financial crisis demonstrated to the public that the relevant consideration is the availability of finance, not savings, and there need be no constraint on finance. Society now needs to argue that just as there was no constraint on the financing of the 2009 bailout, so there need be no constraint on the financing of the 'Green' Transition. Instead there must be careful regulation of that financing, and of the rate of interest attached to loans for investment in the de-carbonisation of the economy.

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‘Green’ growth begins with ‘green’ shoots

Dimitri Zenghelis outlines the financial reasons why now is the ideal time to push forward with investment in ‘green’ technologies.

The notion of ‘green’ growth has a variety of definitions, but perhaps what distinguishes it from preceding notions of sustainable development is its claim that environmental protection is not only compatible with growth, it could act to positively drive it[1]. It moves the debate beyond a discussion of the limits to growth, acknowledging that growth will continue to play the central part in lifting billions of people out of poverty in the developing world[2]. In addition, growth also tends to be correlated with a number of desirable properties such as gender equality, tolerance, social mobility, physical and mental health, education opportunities, rule of law and reduced crime and conflict[3].

Glossary: Total Factor Productivity (TFP)

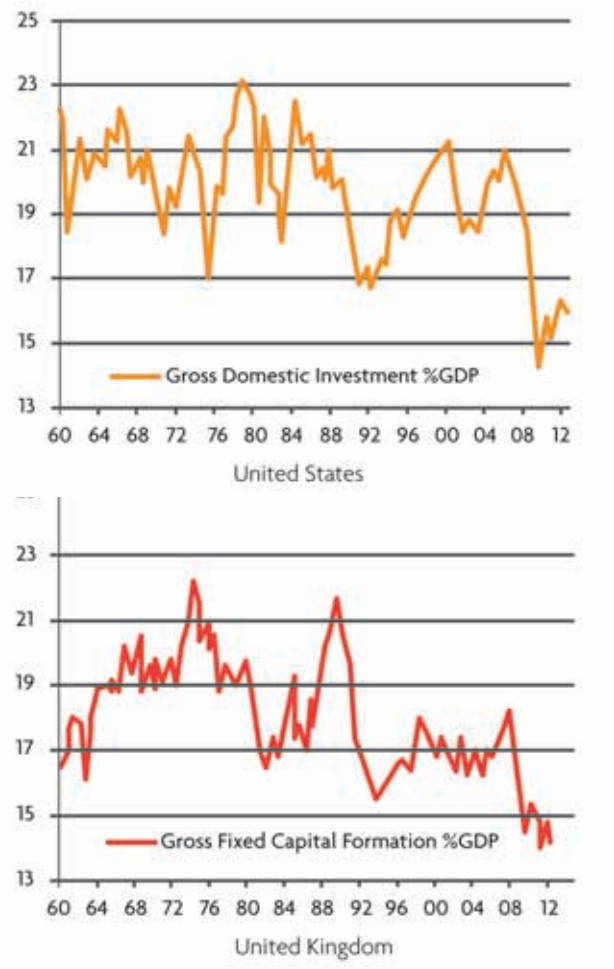
TFP is the portion of output not explained by the amount of inputs used in production. As such, its level is determined by how efficiently and intensely the inputs are utilized in production.

Comin, D. (2008) *Total Factor Productivity*. **In**. S.N Durlauf and L.E. Blume (eds.) The New Palgrave Dictionary of Economics. New York: Palgrave MacMillan.

The ‘green’ growth literature points out that ‘business as usual’ is likely to undermine growth as the impacts of climate change take their toll, while rising demand for key raw materials in finite supply steadily push up their price. Environmental limits still threaten growth unless conscious action is taken[4]. Until a decade ago, these limits appeared not to bite. There seemed to be empirical support for the view that commodities were becoming more economically abundant[5], given the long-term trend of declining commodity, food, mineral and energy prices over the 20th century[6]. But over the past decade there has been a marked reversal of century-long commodity price declines. With billions of people in Asia and other developing regions rightly aspiring to the living standards and consumptions levels of the rich world, investment in resource efficiency and renewables will be the only way to raise productivity while cutting resource use, waste and inefficiency[7].

Thankfully, output and growth are a function not just of the input of the number of people and the amount of capital and materials into the production process, but also a function of innovation in the processes, techniques and technologies with which these inputs are used. This element is termed total factor productivity (TFP). Growth accounting shows clearly that economic growth in most rich countries stems almost entirely from growth in TFP rather than increased labour employment, material extraction or

investment in capital. And because knowledge and ideas are weightless and build on each other, TFP is not subject to the second law of thermodynamics, with intrinsic energy losses. New equipment enables new ideas and better technologies[8]. For example, investing in computers for one purpose induces bright ideas on how to use them for others. This fuels increasing returns to scale in production, where investment in knowledge begets increased output and resources for further investment, a virtuous-growth spiral called endogenous growth[9]. Once a firm or an economy embarks on a high-innovation, high-productivity path, that path tends to reinforce a technological lead[10]. The benefits of induced innovation from learning and experience are already evident across a range of renewable technologies. Onshore wind power costs have fallen by 38 per cent in the last four years and generation is now competitive with conventional coal power, while the cost of solar photovoltaic power has fallen by factor of five in last five years and is expected to be fully competitive with coal this decade[11].



▲ **Figure 1. Fixed investment expressed as a percentage of gross domestic product (GDP) in the second quarter of 2012. The trend is clearly downwards. (Sources: Bureau of Economic Analysis[15] and Office of National Statistics[16])**

However, resource-efficient innovation will not happen without a conscious policy steer to invest in alternatives with high initial costs. Thankfully, intellectual activity has never been more productive. Rapid technical change is always disruptive, but the impact of the ICT revolution is probably bigger than steam or electricity. Networked ICT has the potential to vastly increase resource efficiency by providing a platform for knowledge dissemination and real-time monitoring and management of resource flows[12]. There is no previous example of a new technology whose price has fallen so fast or diffused through the economy so rapidly as has been the case with innovations in computers and mobile devices. Promoting sustainable future growth now requires policies to shift the tax base towards materials and resources and away from intellectual activity by focusing on the factors that generate knowledge and induce innovation.

Setting public sector challenges boosts innovation[13]. Economic history tells us that investment flows to pioneers[14], and there is growing evidence that environmental concerns enhance prosperity. Prosperous states and cities in Germany, Scandinavia, Asia and the USA have a track record of applying 'green' policies to energy, public transport and buildings. These regions benefit from resource efficiency, energy security, reduced pollution and more desirable, vibrant neighbourhoods. Additional 'green' comparative advantages will be forged over the coming century, and although there are certainly risks to firms and nations moving too early, in world where the transition to resource efficiency is all but inevitable, the risks of moving too late are arguably greater.

Many will accept the need to invest in resource efficiency in 'normal times', but will argue that now is not the time to make costly investments. Instead, the focus now should be on jobs and growth. In fact, far from there being some trade-off between investing in 'green' innovations or investing in growth, the current period of low confidence and sluggish private investment presents a unique opportunity for policy-makers to boost employment and economic growth by supporting resource-efficient 'green' markets.

GROWTH AND INVESTMENT

Growth requires investment, yet investment has slumped to record post-war lows in the rich world (see **Figure 1** for examples). Households, businesses and banks are nervous about future demand, and have responded by forgoing more risky investments in physical capital.

Much of the slowdown in business and household spending was inevitable. In the aftermath of the financial crash – which many governments helped to fuel through excess fiscal borrowing at the peak of the economic cycle – households, businesses and banks undertook necessary and unavoidable long-run stock readjustment in balance

sheets[17]. This required additional saving, a reduction in private spending in order to restore private-sector net worth. A slowdown in growth or even recession was an inevitable consequence of this balance sheet adjustment. With general retrenchment over a period of years, fear of recession becomes a self-fulfilling prophecy, sustaining a vicious circle of low demand and low investment that affects the whole economy.

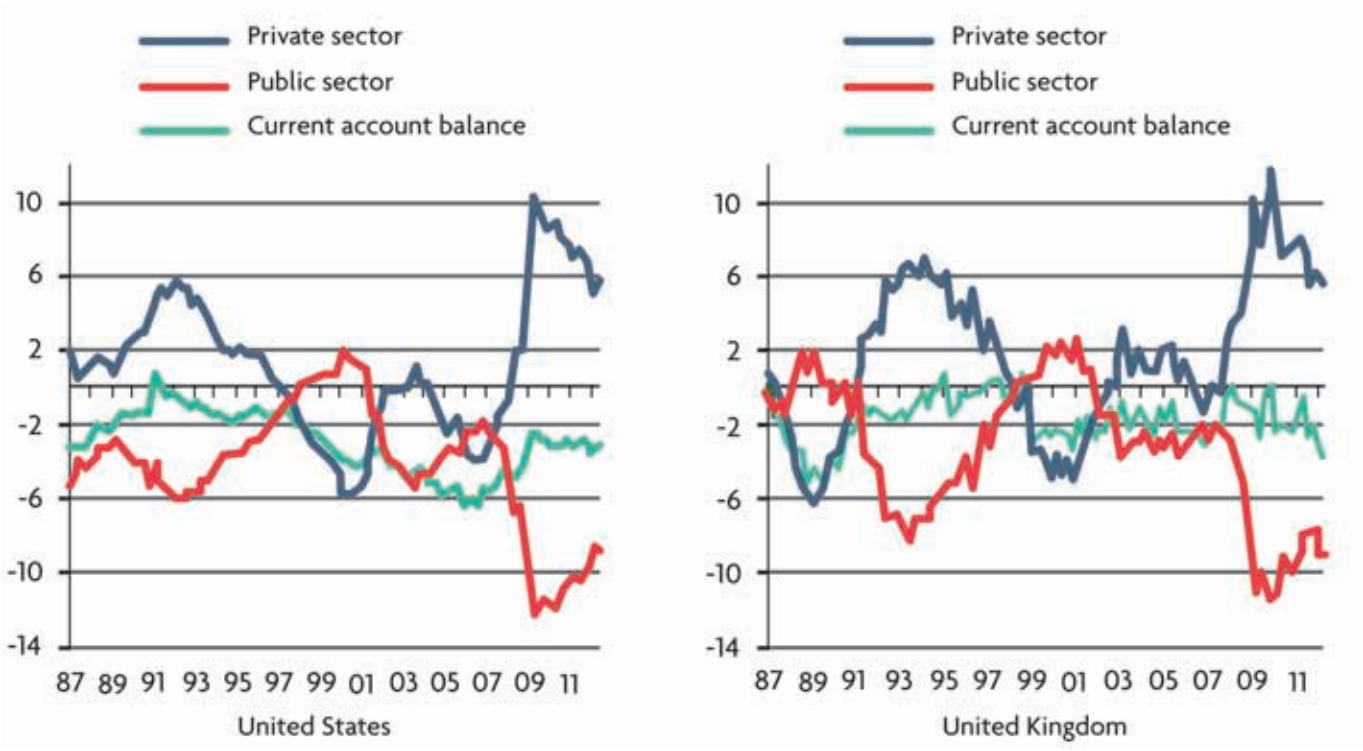
NERVOUS SAVERS

The problem is that once confidence collapses, economies can enter a downward spiral that is hard to escape. This is the mirror image of the hubristic confidence that fuelled the previous bubble. Where ten years ago the talk was of a 'new economy' that would secure non-inflationary growth, now it seems the rich world is destined for decades of slow Japanese-style growth recession. In fact, the underlying productive capacity of the economy is likely to have changed little over the last five years. It is only sentiment that has swung. So instead of investing in assets whose prices have fallen in recent years, companies and households are saving in 'risk-free' assets such as solvent sovereign bonds. As a result, annual private-sector surpluses (net lending – the difference between saving and investment) over the past few years have been at record levels and amounted to £99 billion last year in the UK (and close to US$1 trillion in the US), equivalent to 6 per cent of gross domestic product (GDP). As private spending and incomes collapsed so net fiscal revenues slumped, fuelling a strikingly symmetrical surge in global public-sector deficits. With the public sector mostly borrowing from the private sector, net borrowing from abroad (given by the current account balance) has in most major economies remained little changed (see **Figure 2**).

COLLAPSE IN GLOBAL RETURNS TO CAPITAL

Desired saving has exceeded desired investment to such a degree that global real 'risk-free' interest rates for the next 20 years have been pushed to zero and below (see **Table 1**). Savings are losing value by the day as pension funds and financial institutions pay real interest to (rather than receive interest from) governments, a truly perverse state of affairs given the need for productive investment. These low rates do not reflect a collapse in the underlying returns to capital, but instead reflect desperately depleted confidence. This is no longer just a market adjustment – it is a crisis of confidence.

Standard macroeconomics tells us that the best time to support low-carbon investment is during a protracted economic slowdown. Resource costs are low and the potential to crowd out alternative investment and employment is small. There is no shortage either of private capital or investment opportunities with potential for profitable returns. But why 'green'? For one thing, unlike much conventional infrastructure investment, which requires large sums of public spending, private 'green'



▲ **Figure 2. Sector financial balances (net lending) in the second quarter of 2012. (Sources: Bureau of Economic Analysis[15] and Office of National Statistics[16])**

investment can be leveraged through coherent policy signals like standards and regulations, which cost the exchequer little, or carbon pricing, which raises revenues.

Investment in the sector is long-run credible because a transition to resource efficiency is widely recognised as inevitable. It will be transformative, creating sizable new markets in all the global economic sectors: buildings, transport, agriculture, manufacturing and communications. The 'green' sector is one of the few vibrant parts of the global economy at the moment. For example, the Department for Business, Innovation and Skills (BIS) stated that the UK low-carbon and environmental goods and services sector had sales of £122.2 billion in 2010–11, growing 4.7 per cent from the previous year[19].

Two of the world's fastest-growing economies, South Korea and China, have moved decisively to embrace high technology low-carbon growth in their recent stimulus packages in 2008 and 2009, and in China's outline for the 12th five-year plan, of the seven "Magic Growth sectors" identified, three are low-carbon industries: clean energy, energy efficiency and clean energy vehicles; the others are high-end manufacturing. These countries recognise that investment flows to the pioneers.

Glossary: Yield Curve

The yield curve is a curve showing several yields (interest rates) across different contract lengths (e.g. two months, two years) for a similar debt contract. The curve shows the relation between the interest rate (i.e. the cost of borrowing) and the time to maturity (the term).

HSBC forecasts the global low-carbon energy market will triple to US$ 2.2 trillion a year by 2020[20]. Even in the present uncertain global 'green' policy environment with its lack of ambitious, coordinated policy response, renewable-energy generation and energy-efficiency investment has quadrupled since 2004, according to Bloomberg New Energy Finance[21]. New investment in clean energy surpassed investment in conventional energy generation in 2010, rising to between US$180 and US$200 billion.

This is about more than correcting market failures, such as those associated with greenhouse-gas emissions; it is about restoring confidence through mission-driven investment that spurs innovation in a way comparable to, but bigger in scale than previous programmes to restore economic health like Roosevelt's New Deal, the push for rearmament in 20th century Germany or the space race.

However, the private sector is not investing as heavily as it could in 'green' innovation and infrastructure in many countries because of a lack of confidence in future returns in this policy-driven sector. The government could incentivise such investment by taking on elements of this policy risk which it 'controls'. By backing its own low-carbon policies, it can stimulate additional net private-sector investment, and thereby make a significant contribution to economic growth and employment, such as through a Green Investment Bank offering loans to private companies sharing some of the investment risk.

Sending credible market signals in the form of clearly identified market-based policy instruments – involving long-term carbon pricing, standards and regulations, together with carefully designed technology support – has the potential to unlock private investment in renewable energy, energy efficiency and low-carbon vehicles. This could unleash sizeable macroeconomic benefits by boosting private spending, creating jobs, generating tax revenues, and allowing the monetary authorities greater leeway to stimulate demand.

There is no shortage of private money, just a shortage of perceived opportunities. Now is a perfect time to invest in jobs, growth and innovation to leave a lasting legacy in the form of clean, resource-efficient infrastructure. This opportunity to be 'green' and grow should not be missed.

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Date	1 month	3 month	6 month	1 year	2 year	3 year	5 year	7 year	10 year	20 year
29 Oct 2012	0.13	0.14	0.16	0.18	0.30	0.40	0.47	1.16	1.74	2.48

▲ **Table 1. Daily United States Treasury yield curve rates (Source: United States Treasury[18])**

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Policies for low-carbon 'green' growth

Paul Ekins explores the changing relationship between economic growth and environmental damage, and the prospects for 'green' growth to be realised in practice

While it is clear that there has been a trade-off between growth and the environment in the past, there is no necessity for this to be so in the future, and there is evidence to show that for some issues this negative link has already been broken. However, for emissions of greenhouse gases, and carbon dioxide in particular, this decoupling has yet to be widely achieved. To do so will require stringent policies to transform the energy sector and to direct innovation towards the creation of low-carbon energy systems and more general environmental sustainability. For the latter, these policies will need to encompass the whole range of environmental and resource issues. Despite the transformative nature of the measures required, the macroeconomic costs that they incur are likely to be modest at worst, and there are some conditions under which they may even be negative. However, governments everywhere find it very difficult to introduce policies that will substantially reduce greenhouse gas emissions and take decisive steps towards environmental sustainability more generally.

Glossary: Decoupling

Decoupling is the idea that economic output because progressively less dependent on material throughput. Relative decoupling is the decline in the ecological intensity per unit of economic output. As economies grow in economic outputs, impacts may actually increase under relative decoupling. Absolute decoupling is a situation where resource impacts decline.

DECOUPLING GROWTH AND EMISSIONS

Following the Copenhagen, Cancún and Durban Climate Change Summits in 2009, 2010 and 2011 respectively, international climate policy is recognising that curbing global warming requires international cooperation between, and commitments from, all countries to reduce emissions of greenhouse gases. But the fact remains that developing countries will not accept emission controls if they think their development will be impeded. Committed industrial countries will need to show that deep emissions controls are compatible with continued

economic growth and development, so that the best hope for emission controls is the emergence of a 'green race' for low-carbon technologies, leading to the development of a 'green' (sustainable) economy. 'Green' growth is now the strategic economic imperative if meaningful greenhouse-gas emission reduction is to be achieved.

First, it needs to be recognised that any aspiration for 'green' economies or economic growth must start from the recognition of the need for the sustainable use of resources and ecosystems, and be rooted in basic laws of physical science, which hold that indefinite physical expansion of the human economy on a finite planet is impossible; and that all use of non-solar energy creates disruption in the natural world. Work by Rockström *et al*.[1] suggests that the scale of expansion has already been exceeded for biodiversity loss, climate change and the nitrogen cycle, with the phosphorus cycle also fast approaching its limit. This analysis is entirely consistent with the more detailed assessments of climate science of the IPCC[2] and the Millennium Ecosystem Assessment[3], which make it clear that without a radical reform of the human–nature relationship in favour of nature, human civilisation is gravely threatened. Specifically, the evidence strongly suggests that nine billion humans cannot live current Western lifestyles and maintain a habitable planet: the first casualty will be climate stability, with knock-on effects on the whole biosphere. Any aspiration for a sustainable economy must start from the recognition of the need for the sustainable use of resources and ecosystems, rooted in those basic laws of physical science.

The physical reality of economic activity is that human populations and economic activities extract high-grade energy, materials and ecosystem services from the natural environment, and discharge low-grade energy and wastes back into it, with consequent degradation of ecosystems. When human populations and economic activities were relatively small compared to the global ecosystem, of which they were a subsystem, such economies would be likely to experience, at most, local environmental constraints. However, as economic activity expanded with the Industrial Revolution, so the throughput of energy and materials expanded. The physical requirements of, and consequent wastes from, a much bigger economy are more likely to cause global environmental disruption.

Physical growth is growth in the amount of matter or energy mobilised by the economy. Indefinite growth of this kind is clearly impossible in a finite biosphere. Economic growth is growth in money flows, incomes, value added and expenditure. There is no theoretical limit to this kind of growth. To most economists, the physical size of the economy is not a matter of much interest and has been very little studied relative to the study of financial measures. What is considered important is an economy's size in terms of gross domestic product (GDP), and the growth of GDP from year to year. What economists actually *should* focus on is not growth in GDP, but growth in human welfare. All these different issues – the physical size of the economy, its monetary size, and the human welfare it produces – have a complex relation to each other[4].

Since the Industrial Revolution growth in money has been positively linked to growth in physical flows, but there is no theoretical reason why this has to be the case. Indeed, for many environmental issues in a number of countries there has been absolute decoupling between economic growth and activity, such that the economy has grown but environmental impacts have decreased. Thus, in **Table 1** absolute decoupling has occurred in any emissions columns where the number is less than 100, from which it is clear that this is the case for most local air pollutants, especially in the richer countries shown in the table.

	GDP	SO_x	NO_x	Particulates	CO	VOC	CO_2
France	132	35	66	67	50	52	98
Germany	123	10	50	10	33	35	82
Ireland	258	38	95	**106**	55	58	**126**
Japan	120	76	94		67	88	**107**
Portugal	135	69	**104**	**133**	70	94	**143**
Turkey	173	**128**	**166**		92		**184**

▲ **Table 1. GDP and domestically produced emissions indices, selected OECD countries, 2005 (1990=100)** (Source: Everett *et al*.[5]). **The highlighted figures are those for which absolute decoupling has not occurred.** Note: international aviation and shipping emissions are excluded from the territorial emissions figures, but the economic benefits from aviation and shipping are included in GDP.

However, **Table 1** also shows that policy attempts to date to break the link between GDP growth and carbon dioxide emissions have not been particularly successful, and will need to be far more effective if serious environmental disruption from climate change is to be averted. Such absolute decoupling of economic growth from global systemic environmental impacts such as greenhouse-gas emissions and biodiversity loss is probably the greatest challenge for environmental sustainability.

Economic growth arises from applied knowledge and innovation that turn non-resources into resources or use existing resources more efficiently. Fossil fuels existed for millennia before they became resources for human activity, because of lack of knowledge of how to use them. Investment in knowledge and innovation is now at an all-time high globally. Moreover, there is no shortage of renewable energy if people knew how to harness it (cost-effectively) for their purposes, just as there may be no shortage of materials if people knew how to manipulate and use them.

However, the key insight from environmental sustainability thinking is that, to be sustainable, economic growth must be consistent with biophysical reality, and is currently not so. As Tim Jackson[6] has shown, the policy challenge of achieving the necessary rates of carbon decoupling, and by extension the necessary decoupling from other resource use and environmental impacts, is enormous.

THE COSTS OF 'GREEN' GROWTH

In respect of policies to address the challenge of climate change, the Stern Review[7] recommended the simultaneous application of three kinds of policies to mitigate climate change. Most important was carbon pricing, which could be implemented through carbon taxes or emission trading. This needed to be supplemented with policies in two other areas.

The first area was technology policy, to accelerate the development and deployment of low-carbon energy sources and high-efficiency appliances and buildings, to incentivise a huge investment programme and to remove other barriers to technology deployment. The second area was the promotion of behaviour change, to facilitate the take-up by consumers of new technologies and high-efficiency options, and the adoption of low-energy behaviours (including less driving, flying, meat-eating, and cooler room temperatures in winter and warmer room temperatures in summer).

For full environmental sustainability beyond climate change, the basic insights from the Stern Review need to be applied to the use of other environmental resources (water, materials, biodiversity, land use/space). As with carbon, in a market economy, pricing is the key to resource efficiency, investment and behaviour change, which emphasises the importance of environmental tax reform (ETR), to be discussed in more detail below.

Over the last fifteen years the UK has shown enormous policy innovation in relation to climate change and introduced many different policies, including the Climate Change Act in 2008, which set a greenhouse gas reduction target of 80 per cent below 1990s level by 2050, and put in place a mechanism for five-yearly carbon budgets in the years until then to ensure that progress towards the target was adequately monitored. As a result of this experience, it is now clear what needs to be done to reduce greenhouse-gas emissions significantly, but so far their application has had only limited effect, because they have not been applied stringently enough. The main contributions to UK emissions reduction since 1990 have been the shift from coal to gas in power generation in the 1990s and the recession in 2008–09, neither of which were part of climate policy. Moreover, although many national policies need local implementation or enforcement, there is no evidence of effective autonomous local policy action.

UK climate policy includes numerous examples of all four of the main types of policy instrument: economic instruments, regulation, voluntary (sometime called negotiated) agreements and information/education instruments.

The economic instruments include energy taxes on business and transport fuels, the EU Emissions Trading System (EU ETS), the Feed-in-Tariff scheme (FITs) for small-scale renewable electricity generation, a Renewable Heat Incentive (RHI), the Green Deal to improve energy efficiency in buildings, a Green Investment Bank, capital grants and subsidies for demonstration projects (for example, in relation to carbon capture and storage, CCS).

Regulatory instruments include the EU-driven target for renewable energy (15 per cent of final demand by 2020), the Renewables Obligation (RO), the Renewable Transport Fuel Obligation (RTFO), the Carbon Emissions Reduction Target (CERT) to improve household energy efficiency and the Energy Company Obligation (ECO) that replaces it, the Integrated Pollution Prevention and Control (IPPC) Directive (now applied at the EU level), and Building Regulations, which are due to deliver zero-carbon new homes by 2016.

The most important of the voluntary agreements at the UK level are the Climate Change Agreements (CCAs). At EU level they include the EU fuel-efficiency agreements, now extended to 2020.

Information and education instruments include energy-efficiency labels for appliances and vehicles, and the projected roll-out of smart meters to all households in the UK by 2019. There has also been an increase in government funding for energy research and development.

Over the last ten years it has also become clear that the current liberalised electricity market will not deliver the large quantity of low-carbon new power capacity that will be required to meet the UK's emissions targets, leading to proposals for a far-reaching Electricity Market Reform (EMR)[8]. There are four proposed elements to this:

- Carbon price support (a carbon tax on the fossil-fuel inputs to electricity production);
- Feed-in tariffs for low-carbon generation, to replace the RO;
- Capacity payments (per MW of reserve), to ensure that there is adequate back-up capacity for the higher proportion of intermittent renewables that is expected; and
- An Emissions Performance Standard, to ensure that no new coal-fired stations are built without CCS, as well as new arrangements for charging for transmission and distribution, to ensure that the requisite infrastructure is built to transmit the new sources of low-carbon power.

The carbon price support was announced by HM Treasury in 2011 and is intended to guarantee a carbon price on the inputs to power generation. Electricity is included in the EU ETS, but the current and projected prices of EU ETS permits are too low to give adequate incentive for low-carbon generation. It is therefore proposed to top up the EU ETS allowance price with a carbon tax on the inputs to power generation, which will put the carbon price in electricity on a fixed rising trajectory, to give certainty to low-carbon generators about the carbon price which their fossil-fuel competitors will face. In the 2011 Budget the carbon price was set to rise from £16/tCO_2 in 2013 to £30/tCO_2 in 2020[9]. The other three elements of EMR are included in the UK's Energy Bill 2012.

The question now arises as to the likely costs of these extensive policies for carbon mitigation and, by implication, of moving towards environmental sustainability more generally. As on many other issues, there is little agreement among economists as to what the costs are likely to be.

Optimists tend to stress that the costs are really investments, which can contribute to GDP growth; that there are considerable opportunities for zero- (or even negative) cost mitigation; that a number of resource-efficient technologies are (nearly) available at low incremental cost over the huge investments in the economic system that need to be made anyway; that experience suggests that the costs of new technologies will fall dramatically; and that resource-efficiency policies can spur innovation, new industries, exports and growth. Pessimists tend to counter that constraining resource use is bound to constrain growth, and that cheap, abundant energy and other resources have been and continue to be fundamental to industrial development.

Which of these views is right, and to what extent, is an empirical matter. For the issue of climate change (though not so much for other global environmental issues), there is now a considerable body of evidence available on the basis of which a judgement between these positions can be made.

The hope for affordable climate-change mitigation essentially rests on three hypotheses: that carbon emissions can be reduced substantially by changes in human behaviour that have almost nil cost (for example, cycling short distances instead of driving; turning down the thermostat and wearing more clothes indoors, etc.); that further significant emissions reduction can come from improved energy efficiency in households, companies and transport that is also available at low or nil cost; and that renewable and low-carbon energy sources are available at low cost as a percentage of GDP.

Glossary: McKinsey marginal abatement cost curve

A marginal abatement cost curve or MAC curve is a set of options available to an economy to reduce pollution. McKinsey & Company's analysis focused on greenhouse gas emissions reductions for the United States.

An oft-cited example of the relatively low costs of substantial initial tranches of carbon abatement is the so-called McKinsey marginal abatement cost curve[10], which suggests that a sizable volume of global carbon emissions can be abated at negative net cost, and another significant volume more can be abated at a marginal cost of less than €40/tCO_2e. If these numbers are correct, the GDP cost of such abatement would not be high.

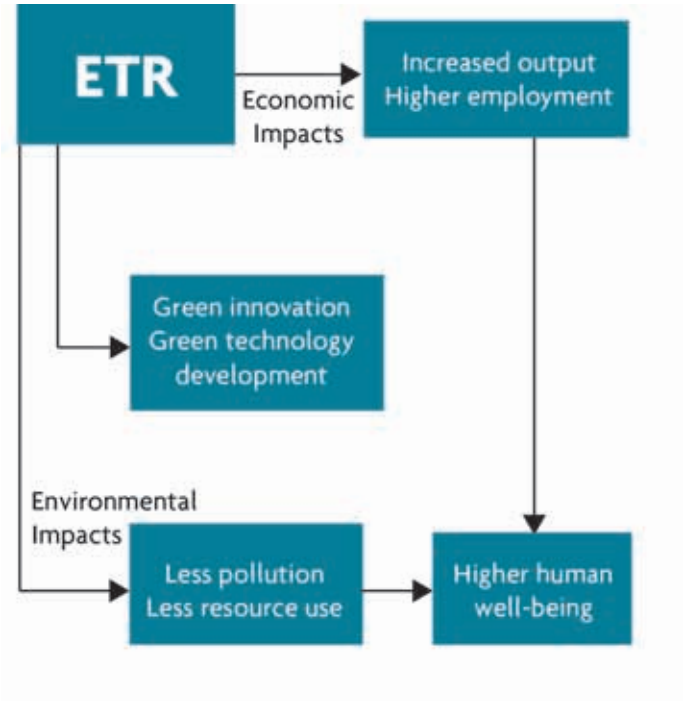
The required deployments of the abatement technologies in the cost curves are very considerable, and would require huge investments. However, the argument is that the technologies are now available, or very close to being so, and what is now required are the incentives to cause them to be deployed at scale. Although these technologies currently cost more, and in some cases significantly more, than their fossil-fuel alternatives, it is expected that their large-scale deployment would cause their cost to reduce, as has been the case with other new technologies, and indeed there is evidence that a number of new low-carbon technologies for power generation have experienced significant cost reduction as they are progressively deployed[7].

MODELLING PREDICTIONS

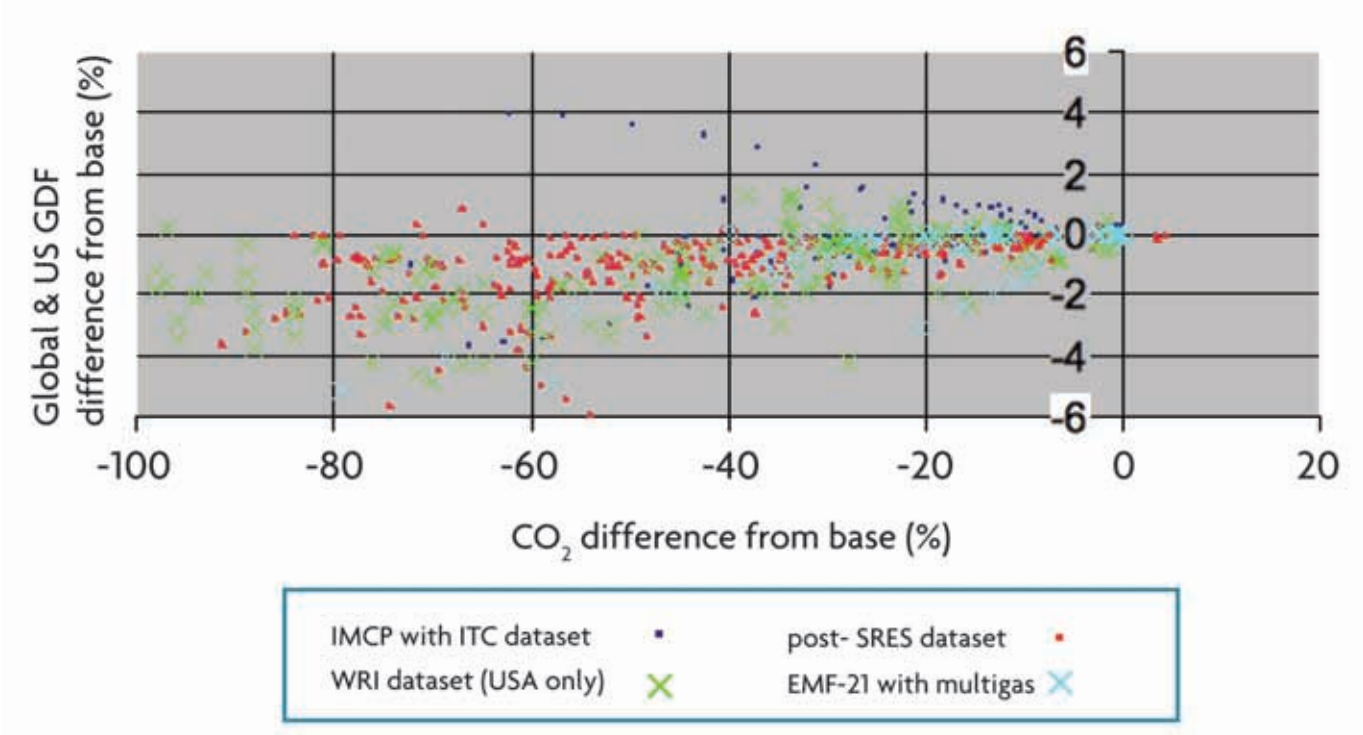
In order to make calculations of the macroeconomic cost of carbon abatement from the essentially microeconomic costs of individual technologies of energy efficiency or supply, it is necessary to make use of energy and economic models, with which, again, there is now a lot of experience in modelling the costs of mitigating climate change (though much less in respect of other environmental issues).

Much use has been made of such models to investigate the economic and environmental implications of a policy instrument called environmental (or ecological) tax reform (ETR), which is the shifting of taxation from 'positives' (like income, profits) to 'negatives' (like resource use and pollution). The basic hypothesis of ETR is illustrated in **Figure 1**, which suggests that ETR can lead to higher human well-being or welfare by improving the environment and by increasing output and employment, as well as potentially by stimulating 'green' innovation.

There is now considerable evidence that ETR does in fact lead to such outcomes[11,12], and which suggests suggest that ETR is a very cost-effective way of reducing greenhouse-gas emissions and stimulating new eco-industries that could contribute to future competitiveness. It would also result in a different trajectory for economic development.



▲ **Figure 1. The potential contribution of environmental tax reform to human well-being. (Source: Ekins & Speck 2011, Figure 1.6, p.15[12])**



▲ **Figure 2. Scatter plot of model cost projections. (Source: Barker et al.[13])**

Key: IMCP Innovation Modelling Comparison Project (University of Cambridge)
WRI World Resources Institute SRES The Special Report on Emissions Scenarios by the Intergovernmental Panel on Climate Change (IPCC) EMF Energy Modeling Forum.

It would rule out a resource-intensive growth path, and this would constrain growth unless it led to innovation in low-resource and resource-saving technologies. ETR would stimulate such innovation, but the implementation of complementary policies would probably be desirable to enhance its effect.

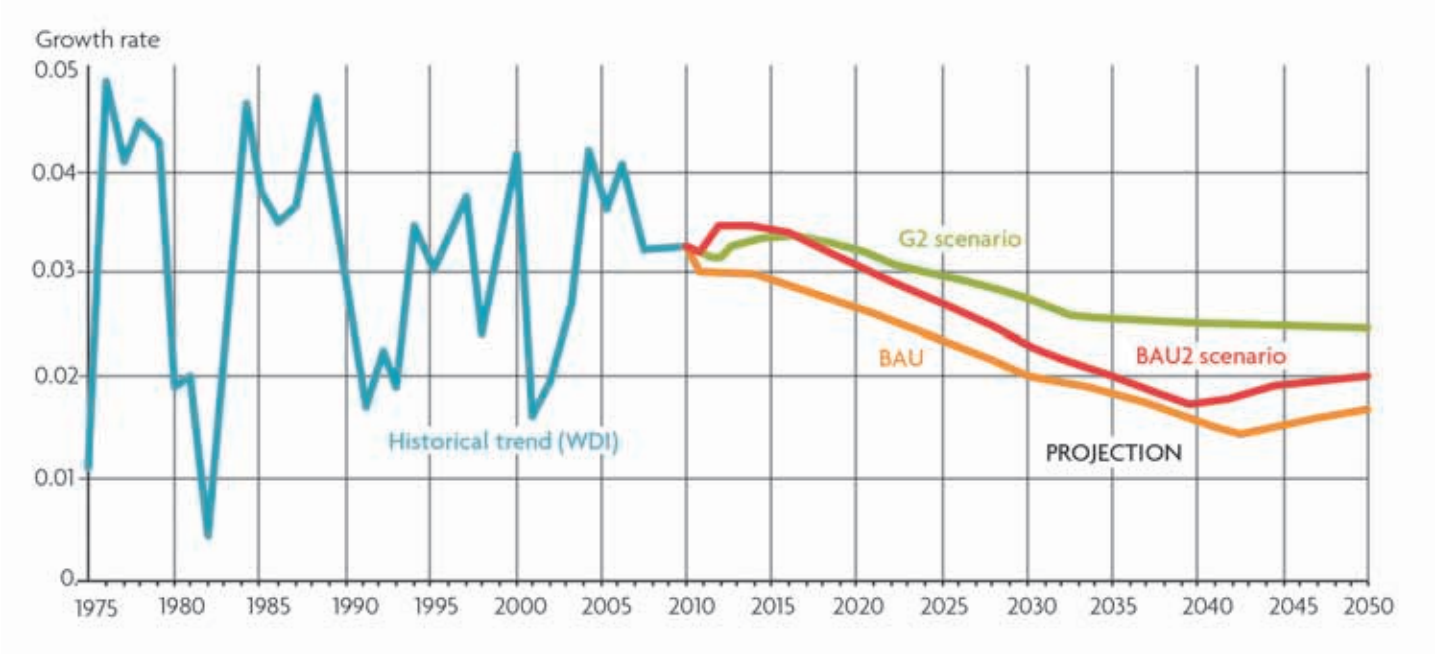
With regard to macroeconomic modelling more broadly, **Figure 2** illustrates the results of a meta-analysis of a large number of macroeconomic modelling exercises, using models of different kinds, but mainly computable general equilibrium (CGE) models, that have sought to estimate the GDP costs of decarbonisation. **Figure 2** shows that the majority of the runs estimated that an 80 per cent reduction in carbon emissions would cost between 1 per cent and 4 per cent of GDP. This was one of the pieces of evidence that caused the Stern Review[7] to come to the conclusion that

> *"Overall, the expected annual cost of achieving emissions reductions, consistent with an emissions trajectory leading to stabilisation at around 500–550 ppm CO_2e, is likely to be around 1% GDP by 2050, with a range of +/-3%, reflecting uncertainties over the scale of mitigation required, the pace of technological innovation and the degree of policy flexibility."* (Stern, 2007, p.267)[7]

Such results suggest that 'green' growth might be slower than 'brown' growth (the growth of economic activity that degrades or destroys the environment), but there are clearly doubts as to how long environment-degrading growth can continue before it undermines the environmental conditions necessary for growth and therefore slows down or comes to a halt (that, after all, is the meaning of the word 'unsustainable'). Modelling by UNEP[14] suggested that 'green' growth, as shown in the G2 scenario in **Figure 3**, would become faster than that in two business-as-usual (BAU) scenarios once the environmental damage associated with the BAU scenarios was taken into account (as it was not in the modelling exercise reported in **Figure 2**).

These sorts of results suggest that 'green' growth may, in the short term at least, turn out to be slower than 'brown' growth, unless:

- There are widespread negative net cost resource efficiency opportunities;
- Enhanced ecosystem services contribute more to monetary output than alternative investment of the policy costs;
- Disruption to ecosystem services that would have resulted in greater monetary costs than the policy implementation cost is prevented;
- Currently higher-cost technologies to protect ecosystems become cheaper than the currently cheaper technologies that damage them;
- International demand develops for technologies stimulated by environmental policy, stimulating the growth of export markets. If the world as a



▲ **Figure 3. Projections of business-as-usual (BAU) and 'green' scenarios. (Source: UNEP[14])**

whole moves towards sustainable growth, then the relatively high-growth countries will be those that have developed, and can export, resource-efficient technologies and industries; and

- Environmental policy stimulates innovation in the economy that would produce greater monetary output than would have been produced in its absence.

'Green' growth could produce higher employment than 'brown' growth if:

- With unemployment, environmental policy gives skills and training to people who would otherwise have remained unproductive;
- With unemployment, environmental policy such as ETR makes labour cheaper; and
- The new environmental industries stimulated by environmental policy are more labour-intensive than the industries they replace.

It also seems most unlikely, given the environmental pressures and damages for which there is very clear scientific evidence, that unsustainable growth will last beyond this century, and it could lead to environmental collapse well before 2100. Depending on the learning curves of new technologies and the economic impacts of climate change and other manifestations of environmental unsustainability, 'green' growth may start to exceed 'brown' growth as early as 2020. The Durban Summit may come to be regarded as the starting gun for a new 'green race'. The choice facing economic and other policy-makers is therefore clear, and from a cost–benefit angle environmental sustainability seems the correct social choice at any but the highest discount rates.

ES

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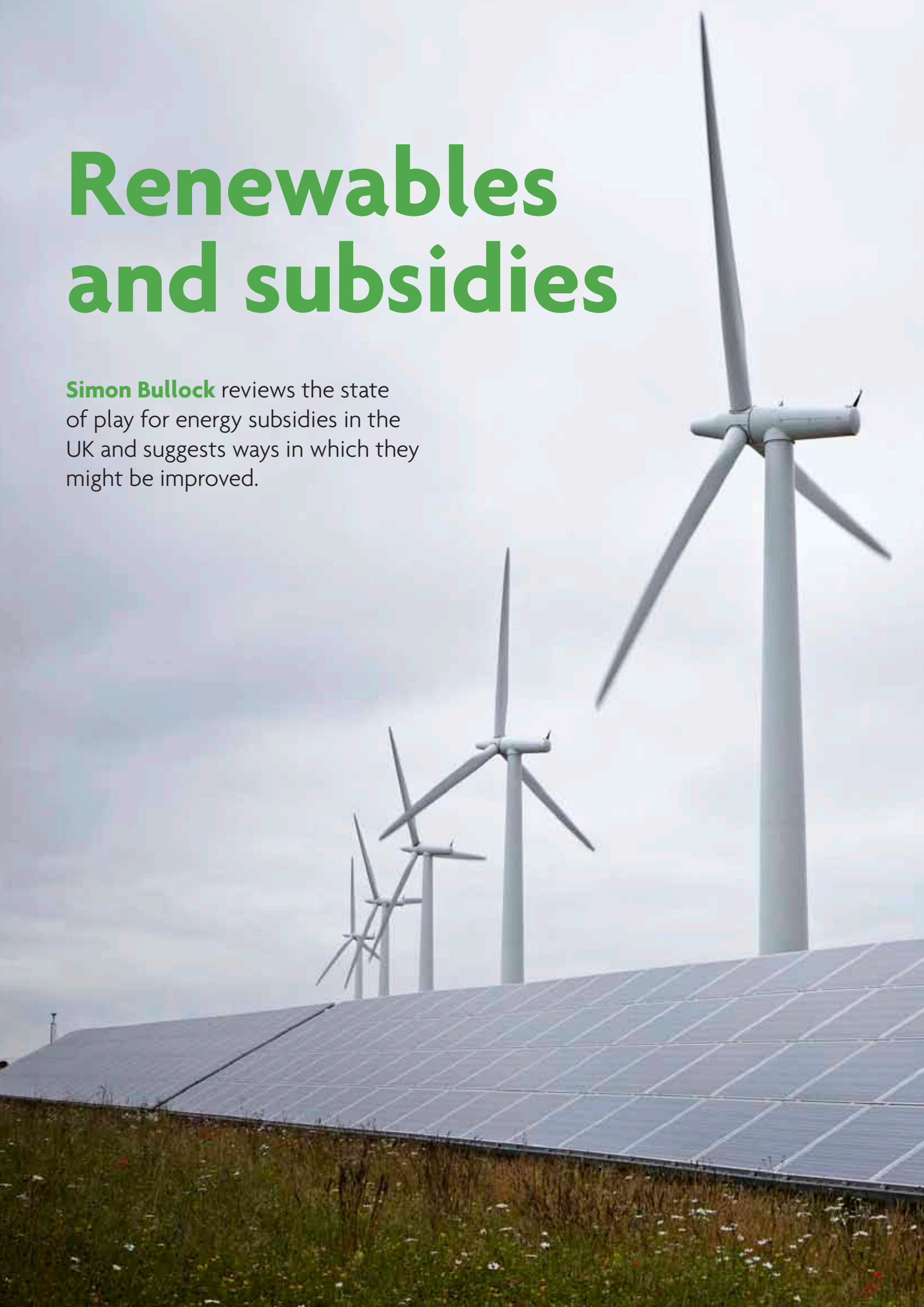
Renewables and subsidies

Simon Bullock reviews the state of play for energy subsidies in the UK and suggests ways in which they might be improved.



Governments subsidise different technologies and sectors in all sorts of ways, and have done so for well over a century. The car industry, aerospace, computing and bioengineering are just a few examples of sectors that have all benefitted from major state support and continue to do so. In the energy sector, governments have given major subsidies to the coal industry since the 19th century, the nuclear industry since the 1950s, the oil and gas industries since the 1960s, and they continue to support them all. In the last couple of decades, governments have also been subsidising the renewable energy industries – examples include solar power in Germany and wind power in the USA. Here in the UK, the main subsidies for the renewables sector are the Renewables Obligation (RO) and the Feed-In Tariff scheme (FiTs).

The renewable energy sector's subsidies are currently a much-discussed issue in the UK, mainly fuelled by a strong backlash against onshore windfarms and the public perception of high subsidies causing high electricity costs to consumers. This is peculiar, for fossil-fuel and nuclear energy technologies receive major subsidies but are not in the spotlight. In addition, the increased prices that consumers have paid for their electricity in recent years are overwhelmingly due to the increased wholesale cost of gas, which provides much of the UK's electricity and therefore sets its price. Therefore, renewables subsidies need to be considered in the context of the whole energy sector.

WHY ARE SUBSIDIES NECESSARY?

Subsidies have a clear and important economic role. Most obviously, they can help address difficulties new entrants can have in breaking into markets because of competition with powerful incumbents – incumbents that themselves benefitted from subsidies when they were new technologies.

The big questions are when and why energy technologies should be subsidied, and for how long. For Europe, the EU's State Aid rules clearly set out two main conditions: environmental protection and helping infant technologies. Two main actions follow from this:

- First, helping infant technologies is a good justification for providing subsidy. There is a follow-up – clearly, technologies are not 'infant' for long. Mature technologies should not receive subsidy, and infant technologies' subsidies should fall as their costs fall and the competion's unfair advantages diminish.

- Second, environmentally damaging industries should not be subsidised, whether they are infant or not. Indeed, environmentally damaging, mature technologies should be the absolute priority for having subsidies removed. This is the clear view of the EU again – its draft September 2012 paper on making the internal market work says Member States should "remove all direct and indirect support for fossil fuels".

Here in the UK, as in most European countries, there is a huge range of different subsidies, with changes happening all the time. There are three main sectors: fossil fuels, nuclear and renewables:

FOSSIL FUELS

The largest subsidy fossil fuels receive is the fact that the fossil-fuel industries do not pay the full costs of the damage they impose on the rest of society from climate change and air pollution. Putting a value on these externalities is notoriously difficult for two main reasons. First, what discount rate to use – ie how to price the impacts on future generations? There is little consensus here, and the value chosen makes a huge difference. Second, what is the cost of the various damages? Here, current estimates are huge *under*estimates – for example the Stern Review[1] could only prices one out of nine categories of climate damage, and with good reason. What would be the cost of large numbers of environmental refugees fleeing from rising sea levels? What is the cost of bleached coral reef? What is the cost of the unknown impact of a tipping point being exceeded, itself subject to a wildly imprecise probability of occurence? These are unpriced, and therefore not valued.

There is no valuation solution to this – the complexities are too great. Instead, climate-change strategies should be based on a political assessment about what level of climate change we want to avoid, and what trajectory for greenhouse-gas emissions is commensurate with achieving that goal. This is the approach in the UK, as set out in the Climate Change Act (CCA). So long as fossil fuel emissions are higher than a safe level, they continue to impose a heavy cost on society. Today's emissions are much higher than this, and so fossil fuel use is heavily subsidised by people suffering from climate change impacts both now and in the future.

These costs are partially addressed by the various carbon prices increasingly in place in the UK and Europe – the European Union Emission Trading Scheme (EU ETS), and the UK's carbon price floor, for example. However, this is only very partial: the EU ETS is still a deeply flawed policy, with its cap far higher than the EU's stated aims on tackling climate change, and with gaping loopholes weakening its impact even further. Increasing carbon prices should be one of the central components in strategies to bring carbon emissions within safe levels. The nuance matters too – carbon pricing is in effect a means to reduce subsidies to the fossil-fuel sector, rather than an increase in taxes.

Aside from climate-change subsidies, the fossil-fuel sector is in receipt of direct subsidies from government. These are not residual – here in the UK since 2011 the UK government has put in place five new tax-breaks for oil and gas industry exploration, and has recently announced it will put in place further tax breaks for shale gas[2]. It is not clear why such a well-established and profitable industry should require or receive additional help from government.

NUCLEAR

The nuclear industry in the UK in receipt of a number of subsidies, two of which are particularly large.

First, their liability in case of accidents is extremely limited – it is £140 million, due to be raised to £1 billion soon. However this is a minute fraction of the possible liabilities: the Fukushima disaster is reported to have cost £100–200 billion. Other industries have to plan for higher liabilities – BP, for example, put aside US$38 billion to tackle the effects of the Deepwater Horizon disaster. By not having to insure itself properly, the nuclear industry is getting a major subsidy from taxpayers. Proper insurance would make nuclear power uneconomic.

Second, the nuclear industry has to pay only tiny amounts for decommissioning and waste disposal. Before 2100, waste disposal responsibility will transfer from the industry to the UK government in perpetuity. The industry will pay into a fund to cover future costs. Again, the vexed question of discount rates has a major bearing here. Nuclear waste will need looking after for thousands of years, but the cost of this in decision-making today is negligible, due to discounting. If the Romans had built nuclear power stations, we would still be guarding the waste today, and it would therefore be a cost to us, but not to the Romans, who of course are long gone. Similarly, the UK is paying a multi-billion price now for nuclear decisions made in the 1950s. Future UK citizens will pay a heavy price for today's nuclear decisions, which is in effect forcing future generations to subsidise nuclear operators today. Viewed in the long term this is unethical, and is a good example of intergenerational inequity.

The subsidy issue, just as for oil and gas, is not static. The UK government wants to see new nuclear build in the UK. But this is a risky business for private operators, and no nuclear power station has ever been built without major state support. These risks add to costs. The government is systematically reducing the risks, and hence lowering costs, which is effectively providing a subsidy in a number of ways. It has removed a lot of the planning risk by dramatically curtailing public involvement in the planning process.

The forthcoming Energy Bill proposes introducing a Contract for Difference (CfD) Feed-In Tariff, which would remove the risk of unknown future electricity prices. The CfD, being negotiated behind closed doors, also seems likely to give a hugely inflated guaranteed price to nuclear, which is unprecedented, given the well established nature of the technology. Overall, nuclear's subsidies look set to increase, not diminish.

Glossary: Feed in Tariff (FiT)

FiTs were introduced in 2010 and are the main governmental financial incentive to encourage uptake of small-scale renewable electricity-generating technologies. They work on the premise that the owner of a renewable electricity-generator (i.e. through solar PV) will earn money for every unit of electricity that they generate.

Energy Savings Trust (2012) *Feed-in Tariff scheme (FITs)* (online). Available from: http://www.energysavingtrust.org.uk/Generating-energy/Getting-money-back/Feed-In-Tariffs-scheme-FITs. [Accessed: 26th November 2012].

Glossary: Renewables Obligation Certificate (ROC)

The Renewables Obligation is the main support mechanism for larger renewable electricity projects in the UK. The RO places an obligation on UK electricity suppliers to source an increasing proportion of electricity they supply from renewable sources.

ROCs are green certificates issued by the Authority to operators of accredited renewable generating stations for the eligible renewable electricity they produce. Operators can then trade the ROCs with other parties.

Ofgem (2007) *Renewables Obligation* (online). Available from: http://www.ofgem.gov.uk/Sustainability/Environment/RenewablObl/Pages/RenewablObl.aspx. [Accessed: 26th November 2012].

RENEWABLES

Renewables in the UK benefit from two main sources of subsidy – the RO for larger projects, and the FiTs for projects up to 5 MW. These have been successful at increasing the deployment of renewables, and their

costs have fallen. Feed-in tariffs were introduced in 2010 and levels have been cut a number of times since. The solar photovoltaic (PV) rate has fallen rapidly from over 30–40p/kWh (depending on installation size) to 7–16p/kWh by September 2012. The government has also set degression rates for new installations in future years – for example, the feed-in tariffs will fall for solar PV by 3.5 per cent a year.

The RO rates are very variable: more established technologies such as onshore wind power get one Renewable Obligation Certificate (ROC) per MWh generated (worth around 45p/kWh), establishing technologies such as offshore wind power get two ROCs, very infant technologies such as wave power get five ROCs. The ROC system is tweaked as appropriate – onshore wind power ROCs are being cut to 0.9 per MWh. There have been criticisms that ROCs is not the most cost-effective way of providing renewables support, and this is part of the reason that the forthcoming Energy Bill is planning to replaced ROCs with a CfD feed-in tariff.

In summary, the UK's energy subsidy regime is in a paradoxical state. EU rules state that subsidies should help clean, infant technologies. Fossil fuels and nuclear power have major environmental problems and are extremely mature technologies, yet they get huge ongoing subsidies, and are being granted more. Renewables are clean and infant, and their subsidies are being reduced. This situation was echoed in the attack by the environment minister on subsidies for renewables as being "Soviet-style" interventions, while the Chancellor announced a "generous new tax regime" for shale gas on the same day.

WHAT NOW FOR RENEWABLES SUBSIDIES?

The UK cannot consider renewables subsidy in isolation. All the UK energy sector subsidies – indirect and direct – should be reviewed against the EU criteria of environmental protection and helping infant technologies. This means three things:

First, subsidies need to be removed for polluting or mature technologies as soon as possible. If the UK government is serious about its austerity programme, it should not be helping extremely well-established industries.

Second, new subsidies should not be given to polluting or mature industries – such as tax breaks for the oil, coal, gas and shale gas industries, and the proposed CfD feed-in tariff for nuclear power.

Third, renewables subsidies should be focused on driving down the cost of renewable power as soon as possible. The feed-in tariff for smaller projects is a strong example of this. Any feed-in tariffs should be limited to renewables, and a simpler German-style fixed feed-in tariff with degression built in should be introduced.

Subsidy is often a dirty word in politics. But well-directed subsidies have a major and necessary role in transforming economies. Subsidy policy, in the UK at least, needs a massive overhaul so that there are no subsidies for dirty or established technologies, and subsidies are reserved for clean, newer technologies, while also designed to be phased out as soon as possible. The aim in the UK should be that onshore wind power can operate without subsidy in around five years, offshore wind power within 10 years, solar power within 15 years, and wave and tidal power within 20 years. This would create a subsidy policy that would perform the essential task of driving our energy generation towards renewable sources. ES

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Government policy on community-owned renewables: is it FiT for purpose?

Sarah Payne and **Simon Steeden**

show that the current government's rules are creating difficulties for communities wanting to set up their own energy projects.

The coalition government has presented itself as a flag bearer for the growth of community-owned sustainable energy. However, policy decisions around feed-in tariffs (FiTs) have too often created unnecessary hurdles for fledgling projects..

One of the pledges set out in the coalition agreement was to "encourage community-owned renewable energy schemes where local people benefit from the power produced"[1]. Suggesting a continuation of previous Labour Government policy, the pledge indicated a cross-party consensus that generating renewable energy at a community level is essential if the UK is to reach its legally binding carbon reduction targets.

Community-owned renewables are seen to provide a dual benefit: contributing directly to the UK's target of 15 per cent of energy consumption from renewable sources by 2020, and indirectly by encouraging a deeper public engagement with renewable-energy generation that is then expected to generate widespread behavioural change. Following its introduction in April 2010, the key policy tool for delivering growth in this sector was the payment of FiTs by licensed electricity suppliers to generators of small-scale low-carbon electricity.

However, despite cross-party support for FiTs, the devil has been in the detail. A combination of UK Government and European Commission policy decisions have undermined the scheme's potential to provide solid foundations for growth in the community renewable sector.

Earlier this year a glaring example of this trend was highlighted by Friends of the Earth and others at the Supreme Court with their success in reversing the Government's 2011 decision to halve the FiT for solar photovoltaic (PV) generation without appropriate consultation. However, other examples remain unresolved, such as in the interpretation of European state aid law as applied to FiTs and community projects.

COMMUNITY PROJECTS AND STATE AID

The European state aid rules prohibit national governments from providing selective financial

▲ **Figure 1. Community renewable energy installations. (Photo**

assistance or other economic support where such intervention may distort competition and affect trade between EU member states[2]. A number of exemptions to the state aid rules apply, including in relation to state aid below a certain threshold.

The European Commission (EC) formally decided that the FiT regime constitutes state aid in April 2010, following notification of the FiT scheme by the UK Government[3]. That decision could be challenged. Particularly when considered in the context of EC decisions on comparable schemes elsewhere in the EU, it is far from clear that the UK scheme should constitute state aid at the level of FiT generators such as community projects.

However, even if the EC decision were accepted, the UK Government's implementation of that decision has been consistently and unduly cautious, to the detriment of the community energy projects that the Government is purportedly committed to supporting. Originally, Government policy was that the FiT would only be available to projects where state aid rules were not offended. However, there was a lack of clarity about what this would mean in practice, and particularly whether projects could benefit from both public grants and FiTs. Some public grant schemes at that time seemed to provide that clarity by suggesting that equipment installed using the grant would also be eligible for the FiT, such as the Government's Low Carbon Communities Challenge (LCCC) grants provided to a number of community energy projects in early 2010.

One recipient of the LCCC was MOZES (Meadows Energy Services Limited), a not-for-profit community-owned energy company working in the Meadows, a deprived residential area of Nottingham. MOZES planned to install solar panels throughout the Meadows, donating some to the local schools and community buildings on which they were installed, with the remainder generating FiT income for use by MOZES to alleviate fuel poverty among Meadows residents.

In early 2010 the group received an LCCC grant to develop the project. It was an express term of the LCCC

credit: MOZES)

grant that equipment installed by MOZES using the grant would be eligible to receive the FiT. However, following the EC's decision that the FiT constituted state aid, Government policy changed. From May 2010, it was made clear that any organisation that had received any public funding for their renewable installation above the state aid threshold (when combined with anticipated FiT payments) was prohibited from claiming the FiT[4].

The change of policy threw the MOZES project and others into turmoil. Many had taken out loans, committed expenditure and framed business plans on the basis of the government's assurance that they would be able to claim the FiT once their renewable-electricity-generation equipment was installed. With a raft of *pro-bono* legal support facilitated by Carbon Leapfrog, MOZES is continuing to seek a solution to its resulting difficulties. Many other projects will not even have been this fortunate.

However, worse was to come for more recently established community groups that relied on public funding to launch their projects. From July 2011, a further change of Government policy has meant that a community project will not be eligible for the FiT if it has previously benefitted from *any* previous public funding, irrespective of state aid considerations (and without the application of any minimum threshold).

Community groups, by their nature, are often dependent on voluntary time and donated income to get them off the ground. This is particularly true of groups established to operate in the community energy sector for projects that often require considerable start-up capital. These groups will often have received grants from public bodies or deriving from public funds. So, prohibiting the receipt of both grant funding and the FiT, without any consideration of the unique circumstances of community projects, inevitably slants Government policy against the growth of community-owned schemes.

TAX RELIEFS AND STATE AID

The application of state aid rules to investment tax relief has been similarly problematic for community energy projects. Of particular interest to community groups in this area is the Seed Enterprise Investment Scheme (SEIS), which provides income tax relief of up to 50 per cent of the value of an investment into a small, newly established enterprise. Following recent reductions in the amount of FiTs paid for solar PV projects, some community projects are likely to be viable only if SEIS can be used to incentivise community investment.

Businesses using FiTs to generate income are not eligible for SEIS unless they are structured as community projects (meaning a community interest company, co-operative or community benefit society), a positive recognition of the importance of community projects.

However, HMRC guidance requires that the £150,000 investment into an enterprise that can qualify for relief under the scheme must take into account any other state aid received by the organisation in the previous three years[5]. Since many community projects will have received unrelated public funding prior to engaging in an SEIS-qualifying community share offer, this limitation could detrimentally affect the viability of many community energy projects.

IS SUPPORT OF COMMUNITY PROJECTS REALLY STATE AID?

The first question that should be asked in these cases is whether the payment of FiTs and grants, and the provision of tax relief to community projects should really be considered as state aid in the first place. Even if the EC's general case for FiTs being state aid is accepted (which, as noted above, is arguable), there is a strong case for taking a different approach to community projects.

The state aid rules are concerned with economic undertakings (i.e. organisations in some form of competitive market) which have been given a preferential advantage that may distort competition and affect trade between EU member states. Considering the size, location and economic realities of most community-owned energy projects, it is questionable how far they can really be seen to engage in any functioning commercial market. Many community energy organisations exist precisely because proper support to their beneficiaries is not provided by market competition. It is also debatable how far engagement in local markets, in reality, affects trade between member states.

If the EC and UK Government departments were to take a more thoughtful, case-by-case approach in applying these considerations to particular community projects, it would be much more likely that payments of public grant funding and FiTs (and the provision of tax relief) to projects such as MOZES would not be viewed as state aid.

An alternative focus could be the grant. A grant is not automatically state aid. Equally this is only so if the relevant conditions are present and again the support is not, in reality, to competitive undertakings. This means that the grant (disregarding the status of the FiT) is not properly relevant to any calculation of whether the organisation has received state aid in excess of the permitted amount.

HOPES FOR A MORE PROPORTIONATE APPROACH?

There are already precedents for the creation of a more appropriate approach to the incentivisation of community energy projects. In 2011 Budget, it was announced that businesses using the FiT to generate income would no longer be able to receive investment eligible for the Enterprise Investment Scheme (EIS), which provides income tax relief of up to 30 per cent of the value of an investment qualifying under the scheme (and a relation of the more recently established SEIS)[6]. After a concerted campaign by the community renewables sector, the government partially reversed its policy decision such that community projects retained their eligibility for both receiving FiTs and EIS relief[7].

More recently, as part of its recent comprehensive review of the FiT regime this year, the government has pledged to introduce a similar community energy project definition for use in the FiT scheme. DECC promises to use this new definition to "facilitate greater access to the FiTs for community energy projects" by removing "upfront barriers"[8]. It is not yet clear how this will be achieved, beyond lighter energy efficiency requirements for community projects. However, formal recognition of their unique circumstances and benefits could provide an opening for advocating a more proportionate application of state aid rules to community-benefit projects.

Community-owned energy schemes like MOZES, which benefit both the Government's own renewables agenda and local people in their communities, will be watching with hope. ES

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On creating the environment for change, and fostering a 'green' economy

Samantha Heath and **David Fell**

discuss three initiatives that helped to create a 'greener' London.

Irrespective of how it is defined as – 'low carbon' or 'environmentally friendly' or even 'genuinely sustainable' – it seems that there are few voices arguing that a 'green' economy will come about entirely of its own accord. In the absence of specific and deliberate action by legislators and regulators, the free choices of consumers and producers are considered likely to continue to produce a 'brown' (unsustainable) economy rather than a 'green' one.

Given the complex nature of the modern economy, however, identifying the optimal form, nature, focus and timing of policy intervention is daunting. Learning the lessons from the successes and failures of policy to date may prove instructive. The first term of the London Mayor (2000 to 2004) provides an ideal opportunity for such lessons, a decade having passed since the Greater London Authority (GLA) was itself new and a number of entirely novel policies needed to be developed.

Here, we draw on our respective experiences of that time to discuss three initiatives that were developed and implemented during the 2000–2004 period. Whilst each of them individually could not be said to have delivered a 'green' economy; and whilst it may (depending on definition) turn out to be the case that policies in quite different areas will in due course be required; it is nevertheless the case that the process of formulating, developing and bringing these polices to life provides useful lessons and insights.

THREE ENVIRONMENTAL POLICIES

From a policy development point of view, the primary concern in the 2000–2004 period was concentrating on areas of influence. The newly constituted GLA had relatively few direct powers: only if key partners and agencies could be persuaded and engaged was it possible to develop meaningful policy. The GLA Act was a refreshing read in that it set out seven strategies that the Mayor was legally obliged to provide. Five of these concerned environmental issues: air quality, waste, biodiversity, noise and transport. Mayor Ken Livingstone very quickly added energy to that list. This meant that, potentially, quality of life would be moved up the political agenda.

There were also some day-to-day threats that meant that making a case for taking action on environmental issues was strong:

- **Waste mountains** – London was running out of places to put waste, which was costing the city more and more. A key driver here was Landfill Tax.

- **Energy consumption** was beginning to become a concern. Although it may seem strange now, carbon dioxide emissions were not discussed by policy makers. Considerable hard work was required to get carbon targets discussed in the first iteration of the London Plan[1], the statutory spatial development strategy for London.

- **Air quality** in London was becoming of increasing concern. Air quality targets were a statutory obligation and the city was facing potentially very heavy fines (although the European directive was changed, in 2003, to read "working towards" the EU targets).

Although the GLA had few formal powers, what was not lacking was a wealth of enthusiasm. Many groups and individuals were beating a path to the GLA's door with a great number of ideas that would improve the quality of life for Londoners. The secret here would be how to make best use of the few powers that London had at its disposal so as to develope a 'green' economy as well as improving quality of life. Key areas of thinking were:

- **Targets** – how stretching were the targets in any given strategy? Targets were in many cases set by the EU or national government. But, there was considerable debate, for example, on setting the target for London's recycling rate, a debate which led to the insight that something like a 'green' procurement code could be extremely helpful.

- **Implementation** – once the targets were set, how were they going to be met? Although the London Plan set out the planning requirements for renewable energy, it was clear that a great deal of help and explanation would be required – hence the formation of the London Energy Partnership; and

- **Key developments** – understanding how key drivers were likely to interact with policy ambitions was incredibly important. Hence, for example, the relationship between the timing of the announcement and implementation of the Low Emissions Zone (LEZ), to segue with replacement cycles and Euro III emissions requirements.

Glossary: Replacement cycles

A replacement cycle is the pattern over which capital equipment is replaced, ie. the time from purchase to replacement.

In addition to these factors – most of which were, in fact, invisible to the general public – the issue of public attitudes was an important topic of debate. Although policies are always required to pass a whole series of technical tests (in terms of assessing value for money and other factors) they are always decided upon by politicians, who have to consider their mandate for that particular policy. The Mayor had been elected with a manifesto that included the congestion charging zone – a genuinely radical idea – and, as a result, he had a very clear mandate for that particular policy. Across the other environmental strategies, by contrast, the situation was more ambiguous, though, as it happened, public attitudes towards the environment were fairly positive at the time. This emboldened the politicians elected to the first Assembly – and, indeed, the first Mayor – to adopt a range of strongly progressive environmental policies. Ken Livingstone sought to cultivate the 'green' vote, an ambition reinforced by political reality, to get his budget through and shore up his position with the electorate.

As illustrations of the initiatives that emerged from the 2000–2004 period, three case studies on the following pages.

▲ **Day-to-day threats that meant that making a case for taking action on environmental issues was strong: waste mountains, energy consumption, and air quality.**

Mayor's Green Procurement Code

Rationale: Developing demand for products made using recycled materials, as part of an overall strategy to reduce London's reliance on landfill

Key Partners
- London Waste Action (LDA)
- Mayor of London
- Local Authority
- London First
- Waste collection
- Authorities
- Businesses

Key Activities
Engaging with boroughs and businesses (including SMEs) to procure recycled products
Business support
Awards

Key Resources
Recycling across London was 3-15 per cent with only one or two exemplar boroughs.

Value proposition
Products from recycled materials are value for money: they are cheaper and made to an equal standard of products made from virgin materials.

Driving up the value of recyclate, thus enabling boroughs to invest in collection and processing facilities.

Customer relations
Key to this was the relationship with the boroughs.

Channels
Business networks at London First
London Council borough networks.

Customer segments
- Early adopters – key corporate who were keen to work with the Mayor
- Key boroughs who were keen to create a business case for recyclates
- Initially signing onto the system was free. Businesses and boroughs were encouraged to join and operate at whatever level they felt comfortable with.

Cost structure
Initially funded under SRB programme, follow on funding from the LDA.

Revenue streams
LDA funding
Signatories pay a membership fee for service

Outcomes
Higher value of recyclate.
Boroughs enabled to meet their EU recycling target.
Award structure provided valuable recognition for improvement, thus inspiring greater achievement.

Results
Value of recyclate has increased. 888 signatories 2007 – 2010. Since October 2007 members of the Green Procurement Code have spent over £742 million on 'green' products and diverted 191,131 tonnes of waste from landfill. This represents a saving of 78,863 tonnes of CO_2 emissions. Signatories also make a valuable contribution to the 'green' economy – reported purchases from over 680 suppliers have supported more than 1,300 jobs.

London Renewables Partnership

Rationale: Capitalize on the new renewable obligation in the London Plan (new developments were, wherever feasible, required to have 10 per cent of their energy come from renewable sources; and to increase understanding of climate change in the broader development community.

Key Partners
Mayor of London
Greater London Authority
Government Office for London
LDA
EdF Energy
London First
Imperial College, London
London Sustainability Exchange
Creative Environmental Networks,
Solarcentury
Renewable Power Association
London Environment Coordinators Forum

Key Activities
Creating a series of supporting documents that enabled the development community to include the renewable technology in new developments.
Exploring key messages for policy makers and the development community makers .
Specific guidance on how to ascertain the benefits of renewable to a project
How skills would need to be developed in order to benefit from renewable expansion, and how develop of new skills would enable renewables to develop.

Key Resources
Planning support
Support to councillors

Value proposition
In order to develop support for renewables in London it was vital that those involved in new developments were given guidance on how to meet the new planning requirements.

Customer relations
Initially businesses were keen to engage.

However, once the message about the 10 per cent renewable target being mandatory was understood, there was some dissent at the requirement.

Channels
- Business Networks
- Councillor networks - including through political parties

Customer segments
The London Renewables Toolkit created a suite of documents that supported a broad range of those involved in new developments across London.

- Councillors who approved planning applications
- Planners
- Registered Social Landlords
- Architects
- Building services engineers
- Building Contractors

Cost structure
Initially funded from a DTI fund.

Revenue streams
Initially funded under DTI funds, planning support was provided through the Planning Decisions Unit at the GLA, and the GLA Environment team.

Outcomes
The cost of renewable energy installation reduced, the renewable explosion led to lobbying for a revised 'feed in tariff' (FiT) regime.

Results
A target of 20 per cent of energy used in new developments came from on site renewable energy.
According to a study conducted by London South Bank University[1] more than half the planning applications achieved 30 per cent carbon reduction on previous applications.

<table>
<tr><td colspan="2">London Low Emission Zone (LEZ)</td><td colspan="3">Rationale: EU air quality targets were not being met.</td></tr>
<tr><td>Key Partners
• Mayor of London
• Transport for London
• Local Authorities
• London Fire and emergency planning authority
• MPA
• Businesses</td><td>Key Activities
Engaging with larger freight and large fleets to ensure fleets met Euro III

A series of 1:1 meetings prior to the mayoral announcement that London was going to impose a Low Emission Zone.

Key Resources
The programme was delivered by TfL

There are no barriers or tollbooths within the Low Emission Zone (LEZ). Instead, technology available through congestion enforcement was deployed.</td><td>Value proposition
It was imperative that fleet managers understood that compliance would be essential; and a fair and cost effective compliance system was put in place.</td><td>Customer relations
The Freight Transport Association and the London Councils.
There was little cost to the boroughs. However, since they were required by statute to work towards the EU targets, they had to bring something to the table.

Channels
Freight networks

Websites, road side notices, newspaper article and road side information boards.</td><td>Customer segments
The initial customers – or, rather, those engaged with the – LEZ were those needing to make purchasing decisions before the 4th February 2008, in order to comply with the requirements.

• Bus and coach operators
• Fire Authority
• Fleet managers

In order to give sufficient lead-in time the initial announcement was made in 2004 – as part of the Mayoral manifesto commitment.</td></tr>
<tr><td colspan="2">Cost structure
Initially funded under SRB; follow on funding from the LDA.</td><td colspan="3">Revenue streams
The scheme of automatic registrations uses the same technology as the congestion charge. Whilst the scheme is not self financing a small revenue is made from enforcement.</td></tr>
<tr><td colspan="2">Outcomes
The Low Emission Zone remains the most effective tool in the battle against poor air quality. In January 2012 the LEZ was strengthened to require vehicles to comply with Euro IV requirements.</td><td colspan="3">Results
Whilst the studies demonstrating the impact from the LEZ since 2008 are still being established, in 2008 TfL reported[2] that 91 per cent of target vehicles were LEZ compliant.</td></tr>
</table>

THE INGREDIENTS OF SUCCESS

Our first question on reviewing these initiatives was to ask: which, if any, of these initiatives were effective, with the immediate caveat that it depends what counts as success, and when. London appears to have more 'green' jobs[3] than other UK regions, and the strongest suggestion that this is directly related to policy is the work of the London South Bank University that investigated the impact of planning policy on the take-up of renewable technologies and the overall carbon reduction of new developments in London.[1] The London Renewable partnership played a strong role in supporting the use of planning as a tool to engineer change.

The Mayor's Green Procurement Code, was able to demonstrate some impressive figures in terms of the number of companies signed up and the value of spend that was diverted towards products made from recycled materials. This performance, however, is more difficult to evaluate in the longer term. As a proportion of total economic activity in the capital, the initiative is tiny, and it could be argued that it is, as a result, somewhat incidental. The influence on the London boroughs that actually collected the waste was somewhat stronger: having the Mayor's Green Procurement code inspired confidence that there would be value in the recyclate and therefore it would be in their financial interest to collect and segregate waste for sale. It may be it is only with a history of smaller, catalytic initiatives that future larger changes might come about, and that the Mayor's Green Procurement Code may, in the longer term, prove to have been a small but vital part of London's progress.

In the case of the LEZ, the case for straightforwardly describing it as a success seems stronger. Poor air quality is fast becoming acknowledged as one of the most pressing public health problems facing London, and the LEZ is by some margin the strongest and most dramatic policy instrument in place to tackle poor air quality. Ironically, the eventual impacts of the LEZ – reduced mortality among vulnerable Londoners – still lie in the future and will almost certainly be unattributable to the LEZ itself. Whilst there is anecdotal evidence that new technologies and businesses have grown up around the introduction of the London LEZ, the impact that the LEZ had on supporting new technologies to come to London is less clear.

Our second consideration having reviewed the case study initiatives was to draw out what seem to us to be the key

determinants of success; in this case, simply having been able to put the initiative in place. There was no room here to consider the numerous initiatives that did not see the light of day, and which by this measure failed.

We have identified four ingredients that contributed to the success of these initiatives:

- **Political will** – in the case of London, this was achieved by the election of a mayor, with sufficient political mandate to be able to direct change.
- **Key delivery agency** – in all three examples there was a named agency that was responsible for making the change happen.
- **Partners** – success required a manageable number of partners in whose best interest it was to make change happen; and
- **Other** – other factors such as detailed financial case appeared to be important, but they were hoops to be jumped through, rather than success factors in their own right.

Our third and final reflection is that the three examples and virtually all other interventions to promote the 'green' economy have so far been concerned with the *supply* of environmental goods and services rather than the demand side. Whilst there is plenty still to be done with this 'supply push', deeper and more self-sustaining changes in the economy are likely only when there is also 'demand pull'. To foster such changes could imply very different types of policy and instruments from the examples we have examined, including, potentially, more direct fiscal action[4]. Political will, the key factor in explaining the examples we have presented, may be even more essential in the future than it was in the past.

The underlying intention of the five environmental statutory strategies was to improve the quality of life for Londoners, and the opportunity to deliver this kind of outcome for Londoners emboldened the politicians and key decision makers of the 2000–2004 period. It may be that future progress towards a 'green' economy will require the same alignment of forces: only if it is widely believed that the 'green' economy would deliver a better quality of life in Britain will politicians summon the will to accelerate the pace of change. ES

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Education for a 'green' economy

Simone Meili and **Ueli Bernhard**

highlight the vital role of education in the transition to a 'green' economy.

Economic recessions have regularly been used as an excuse for delays in the implementation of ecological reforms, which are said to be costly and an impediment to growth. However, the recent findings of the International Labour Organization (ILO) suggest that the current recession provides further reasons for the need for a 'greener' economy. According to a new report led by the Green Jobs Initiative, the transformation to a 'greener' economy has the potential to create up to 60 million additional jobs worldwide over the next two decades[1].

The transition to a 'green' economy requires new technologies, which have to be invented, developed and applied, and each of these steps demands specific skills. Meanwhile, millions of jobs are threatened globally by the rapid decline of natural resources due to the growing world population and increasing production and consumption. The sectors most affected are agriculture and fisheries, because of decreases in fertile land and fish stocks. Other sectors will be affected by the combination of a high dependence on fossil fuels and rising energy prices due to the increasing scarcity of the latter.

Traditionally, environmental protection has focused on changing the behaviour of individuals. This alone is not enough to stop the over-consumption of resources, and could also be said to be inefficient. A much larger impact in environmental protection would be achieved by targeting big companies, to encourage them to set up corporate environmental management policies and increase resource and energy efficiency in production. In other words, it takes a 'green' economy to protect the environment. 'Green' economy, as the United Nations Environment Programme (UNEP) makes clear, "does not replace sustainable development; but there is a growing recognition that achieving sustainability rests almost entirely on getting the economy right"[2].

A ROADMAP FOR 'GREEN' ECONOMY

In many countries, Switzerland among them, the concept of a 'green' economy is gaining ground. It has become clear that "the current economic structures, rules and activities are not able to respond to these challenges in a way that leads the world into a sustainable future"[3].

As a consequence, the Swiss federal government is actively seeking to improve resource efficiency in consumption and production through 'green' economy initiatives[4]. In preparation for the United Nations Conference on Sustainable Development in Rio de Janeiro in 2012 (Rio+20), the Swiss delegation commissioned a proposal for an international 'green' economy roadmap. The concept of this roadmap arose during the discussions

of 'green' economies in the context of sustainable development and poverty eradication. Switzerland's aim was to obtain the commitment of countries to develop a national 'green' economy action plan[3].

The proposal contained measures in specific and relevant areas, including market and trade transparency with respect to sustainable product information, a fossil-fuel subsidies reform, sustainable public procurement, sustainable agriculture, food security, sustainable energy, resource-efficient and cleaner production methods, and education for a 'green' economy[3]. This last point is of particular importance, since qualified professionals are essential for the implementation of any measure or step towards a 'green' economy. Professional experts are required not only for the development of 'green' products but also to provide the knowledge of how to construct and use these products. General knowledge about sustainable development at all educational levels is necessary to increase acceptance of a transition and to lay the foundations for innovation.

In Switzerland's proposal, the main objective is to promote 'green' economy skills in relevant education, thereby leading to a mainstreaming of 'green' economy and fostering innovation at all levels[3]. The following is a summary of the proposed measures.

'GREEN' SKILLS FOR 'GREEN' JOBS AND POVERTY ERADICATION

Initial and continuing vocational training are key to establishing professional skills in a 'green' economy, to improve the employability of workers and create new jobs in 'green' markets, thereby promoting welfare and helping to fight poverty. 'Green' skills need to be integrated in education and training programs for teachers and instructors working in vocational education and training (VET) and tertiary-level professional education and training (PET). The nature and the strength of the respective national vocational training systems will be taken into account when trying to integrate green skills into education and training programs, and therefore the different kinds of education systems in the respective countries need to be considered as there is no 'one-size-fits-all' recipe for the integration of education for sustainable development into a national education system. VET and PET play a very important role in the Swiss education system, but that is not necessarily the case in other countries. The goal is to teach as many workers and students as possible in green skills. This step may require assistance from experts in 'green' economy, particularly in countries with high unemployment rates, emerging economies and BRICS countries (Brazil, Russia, India, China and South Africa).

For best results, economic, labour, educational and youth policy strategies for a 'green' economy are to be coordinated on regional, national or international levels. The ILO, 'green' skills departments, the European Centre for the Development of Vocational Training (CEDEFOP) and others may serve as centres of excellence.

SUSTAINABLE UNIVERSITIES FOR A 'GREEN' ECONOMY

The aim is to promote those qualifications that help to shape a 'green' economy and support the development of sustainable economic models. One way is to promote University Leaders for a Sustainable Future (ULSF) and other university and student initiatives at a global and national level. University leaders would commit to establishing the concept of a 'green' economy in teaching, research and innovation. Strategies, accreditation tools, curricula, research and operations are to be developed with a view to their contribution to a 'green' economy in all academic fields relevant for sustainability, such as management and business administration, finance, engineering, architecture, agriculture, forestry and traffic engineering.

All of this could be promoted by the creation of an international network for 'green' economy universities, and the results could be measured by regular UN/UNEP sustainability rankings of the ten big global players in MBA university rankings. MBA university rankings should have integrated 'green' economy standards into their list of criteria by 2015.

'GREEN' ECONOMY SECTOR TRAINING AND KNOWLEDGE TRANSFER INITIATIVES

Since education is so important for the transition process, it should not be neglected when 'green' investments are made, and therefore investments in education should

make up a substantial part of the investments in 'green' economy. Education and vocational education and training need to be integrated into 'green' economy sector programmes. Improvements in this sector should be monitored and assessed along with other 'green' economy investments.

Measures to boost investments in 'green' economy sectors are innovation incentives for professional associations, science and technology transfers between universities and professional associations, and information transfer to trade unions and wider society. Another initiative would be to strengthen partnerships between global and national companies and NGOs through conferences, workshops, events and round tables on environment, development, consumption, and trade union issues.

BUSINESS TRANSFORMATION FOR A 'GREEN' ECONOMY

Human resources consultants should be encouraged to complete training programmes for change and transformation processes towards a 'green' economy. Training outcomes can be measured by the Green UN/UNEP ranking of the ten big global players in business consulting and of the ten biggest associations of business consultants which is due to be implemented.

Concepts like 'green' business leadership, 'green' business consulting and sustainable human-resource (HR) development need to find their way into the guiding principles of global, national, and regional companies. Training programmes for business consultants and leaders of global and national companies will invigorate their commitment to implementing plans for a 'green' economy. This commitment is crucial, since without the approval of business leaders, 'green' economy plans are unlikely to succeed. ES

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The 'green' economy and graduate employment

Stephen Martin and **Maureen Martin** set out the opportunities for and barriers for graduates in the emerging 'green' economy.

"Currently, atmospheric carbon levels are approximately 378 parts per million, with global emissions from energy approximately 30 gigatons of carbon dioxide equivalent per year. To stabilize the atmosphere, a carbon target of 350 parts per million is required, translating to a reduction in carbon intensity per unit of GDP from 768 grams/dollar to six grams/dollar, requiring a quantum leap in how we power our market economy. (U.S. Energy Information Agency)[1]".

Economic growth based on building a substantial 'green' economy in the UK is now a significant policy focus for the current UK government, and indeed, the UK is not alone in highlighting the impact of an emerging global 'green' economy on the world of work[2]. Efforts to tackle climate change could, for example, result in the creation of millions of new jobs in the coming decades. The Departments of Business, Innovation and Skills (BIS) and Energy and Climate Change (DECC) are the principal government departments driving this policy[3,4]. The main emphasis of this policy discourse is best described in the following quotes:

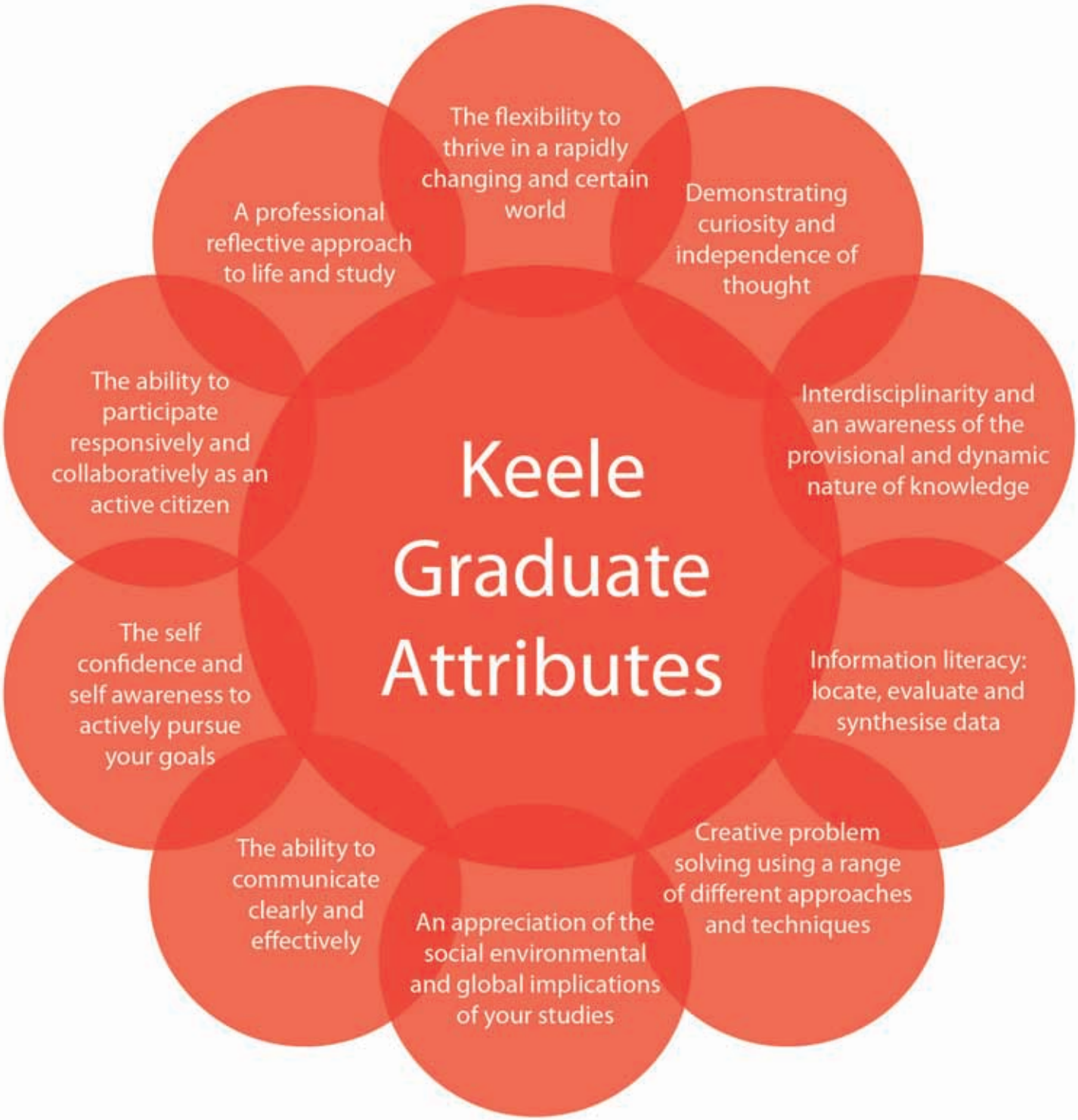
"*In every region, government is committed to realising the potential Britain has to make our transition to a low carbon and resource efficient economy effectively and compete in the new and adapted markets it will create.*" (DECC 2010, p2)[4]

"*A changing climate will bring fundamental changes to the UK economy and society... Skills will be needed to build adaptive capacity and take adaptive action. Building adaptive capacity across society will require further research on the adaptive skills needed in the long term, and will demand a response by schools, colleges, universities and professional associations as well as governments. It is clear that the scale and pace of change we could face is unprecedented.*" (DECC 2010, p51)[4]

The growth of low- and zero-carbon industries is central to the government's strategy to reduce carbon emissions by 34 per cent by 2020 and 80 per cent by 2050 compared with 1990 levels. But to comply with its obligations to the EU to provide 15 per cent of its electricity from renewable sources by 2020, the UK requires a huge scaling up in the deployment of renewable-energy technologies. Based on these challenging targets and the wider transition to a low-carbon economy, studies have suggested that employment in the low-carbon and environmental goods and services sector could grow by up to 400,000 jobs by 2017, an increase of 45 per cent on today's levels[5]. It is through the job-creation lens that politicians, green businesses and increasingly the environmental movement emphasise the wider benefits and political merits of energy efficiency and renewable energy policies. But this emphasis has yet to permeate and impact on the strategic and policy debate within the higher education sector at a time when graduate unemployment is at an all-time high (with one in five unemployed and many under-employed) and graduate debt may become a major barrier to university entry.

HIGHER EDUCATION AND SUSTAINABILITY

In 2009, BIS published Higher Ambitions[6], setting out the then-government's roadmap for the future of higher education. It highlighted the important role of higher education in promoting good practice in sustainable development and challenged universities "to establish themselves further as intellectual and practical leaders on environmental sustainability". Partnership working



▲ **Figure 1. The graduate attributes diagram from the University of Keele. (Source: University of Keele website)**

between universities and employers has also been a recurring policy objective in order to enhance skills development and support the low-carbon economy. Employers at a recent policy think tank organised by the Higher Education Academy (HEA)[7] demanded much improved forms of engagement in any university curriculum reform process so that their needs are better represented and more clearly articulated in an accessible language. This echoes many of the recommendations made in the recent Wilson review of business–university collaboration[8], in which both business and university leaders were encouraged to "reflect upon their organisational knowledge of the full landscape of business–university collaboration, and the management of partnerships they have". Yet employers still remain sceptical about many of the current means of engagement with universities on curriculum reform, especially in relation to the green economy.

As a response to the emerging national policy discourse on sustainability, the 'green' economy and the role of universities, the HEA, with support from the Environment Association of Universities and Colleges (EAUC) and the National Union of Students (NUS), ran a new institutional change programme in 2011 aimed specifically at institutions wishing to transform their university's curriculum to address sustainability and the 'green' economy. The change programme, Green Academy: Curricula for Tomorrow, was aimed at initiating a whole institutional change process in eight universities. It focused on reform of curriculum, and with it teaching and learning practice, to embrace education for sustainable development as an interdisciplinary teaching and learning experience for all students. It was also linked with the reform process described as Graduate Attributes for the 21st Century after a radical curriculum restructuring programme carried out by the University of Melbourne that became known as the Melbourne Model[9]. Harvard, Hong Kong and Yale Universities have undergone similar reforms along with a small number of universities in the UK: Aberdeen, Manchester, Keele and Southampton (see **Figure 1**).

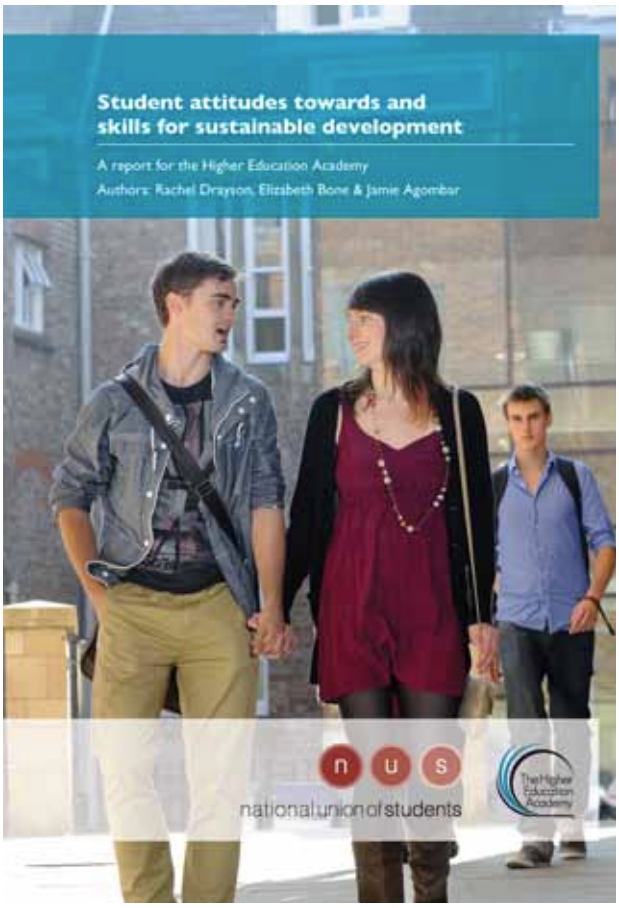
The Melbourne Model is based on five well-defined graduate attributes: academic excellence; knowledge across disciplines; leadership in communities; attunement to cultural diversity; and active global citizenship[9].

Two of these attributes focus directly on international learning experiences. Graduates of the university are expected to have an understanding of and respect for social and cultural diversity and value different cultures. They are expected to accept social and civic responsibilities and be advocates for improving the sustainability of their environment and have a broad global understanding coupled with a high regard for human rights, equity and ethics.

Another national project, involving five universities and funded by the Higher Education Funding Council for England (HEFCE), was also initiated in 2011 to explore how curriculum change for sustainability could be linked to strategic approaches to quality enhancement. The University of Gloucestershire leads this programme, Leading Curriculum Change for Sustainability, which supports strategic projects to advance the sustainability agenda in higher education. Both this and the Green Academy programme are an important but relatively modest response to the growing interest in skills for sustainability among students and employers given the predicted scale and range of job opportunities which could be provided by the 'green' economy.

BEYOND HIGHER EDUCATION

Many have argued that our universities have a key role to play in moving us to a more sustainable future. But in defining the contribution our universities can play it is important not to claim too much. It is tempting to charge education with achieving a radical shift in society's values but this view entails some controversial assumptions about the role and purpose of education,



▲ **Figure 2. The 2010 NUS survey of student views on the importance of sustainability skills was followed up in 2012. (Source: NUS)**

and quite aside from the issue of principle, it is far from clear what such an approach would achieve in practice. Values and attitudes – individual, industrial, public – are all moulded by many influences, including government policy and the media.

To say this is not at all to suggest that the university sector's treatment of sustainability issues is not a significant strategic issue. If the 2.5 million students currently enrolled in UK universities graduate with the skills and attributes to help society become more sustainable, then they will have undoubtedly contributed a great deal, and it is therefore right that universities should seek to lead the agenda. However, as has been stressed by Lord Browne's recent review[11], they must maintain due contact with the aspirations of their clients. These aspirations were recently highlighted by an NUS survey, commissioned by the HEA in 2010 of nearly 6000 new university entrants which found that over 80 per cent believe that sustainability skills are important for their future employment[12] (see **Figure 2**).

All of this raises some important questions. Are our universities systematically creating the conditions that offer under graduates the context, understanding, skills and values that will prepare them for the challenges of creating a more sustainable future? Do the 180,000 academic staff have the expertise and capabilities to create these conditions? We currently have no real mechanism for assessing this in any meaningful way. Of greater concern is the fact that Universities UK, the organisation that represents the leaders of our universities, does not have the sustainability literacy of graduates on their agenda at all.

Given the current pressure on graduate employment along with the "tyranny of internships" and limited future job prospects, preparing future graduates for these uncertainties as well as those of global sustainability is an essential element of a university learning experience, and one which the coalition government should be committed to supporting and leading through a range of policy interventions, including encouraging and galvanising vice chancellors to address this issue as a matter of urgency. Without this support, future generations of graduates are in real danger of becoming disenfranchised from 21st-century society and losing their capacity as global citizens as well as missing opportunities to become skilled 'green' practitioners and entrepreneurs. ES

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How useful are the concepts of 'green' growth and 'green' jobs?

Andrew Mearman and **Anthony Plumridge** discuss the issues at the intersection of environmental science and economics.

These broad disciplines environmental science and economics often meet, most frequently when considering the likely costs and benefits of an economic project or event, or in working out solutions to environmental problems that have a strong economic element, such as pollution caused by production in businesses. These meetings of environment and economy tend to be on a case-by-case basis and at what economists might call the microeconomic level.

Occasionally though, economists ask questions that are at the macroeconomic level, in other words they concern the whole economy. The Stern Review[1] was one such case. Stern's headline finding was that climate change was too expensive to ignore, and that relatively small expenditure now would save on considerably greater costs later. A corollary of this argument is that environmental protection can have economic benefits, i.e. that economic growth and environmental sustainability are complementary rather than competing goals. Such a contention lies behind recent claims about 'green' growth, the 'green' economy' and 'green' jobs.

All of these concepts have become more important recently, as they are seen as solutions to a multi-dimensional crisis of finance, international competitiveness and economic growth, social dislocation and ecological sustainability (including resource constraints). For example, in the UK, the Green New Deal group[2] have argued for a range of measures that can be grouped around 'green' growth and 'green' jobs.

IS 'GREEN' GROWTH POSSIBLE?

A key question in the macroeconomics of the environment is whether economic growth inevitably leads to environmental degradation. Malthus's is one expression of the hypothesis that growth is damaging, or at least is not sustainable: specifically, growth must cease because of resource depletion. Other effects of growth are, for example, that carbon emissions appear to increase with economic activity, leading to climate

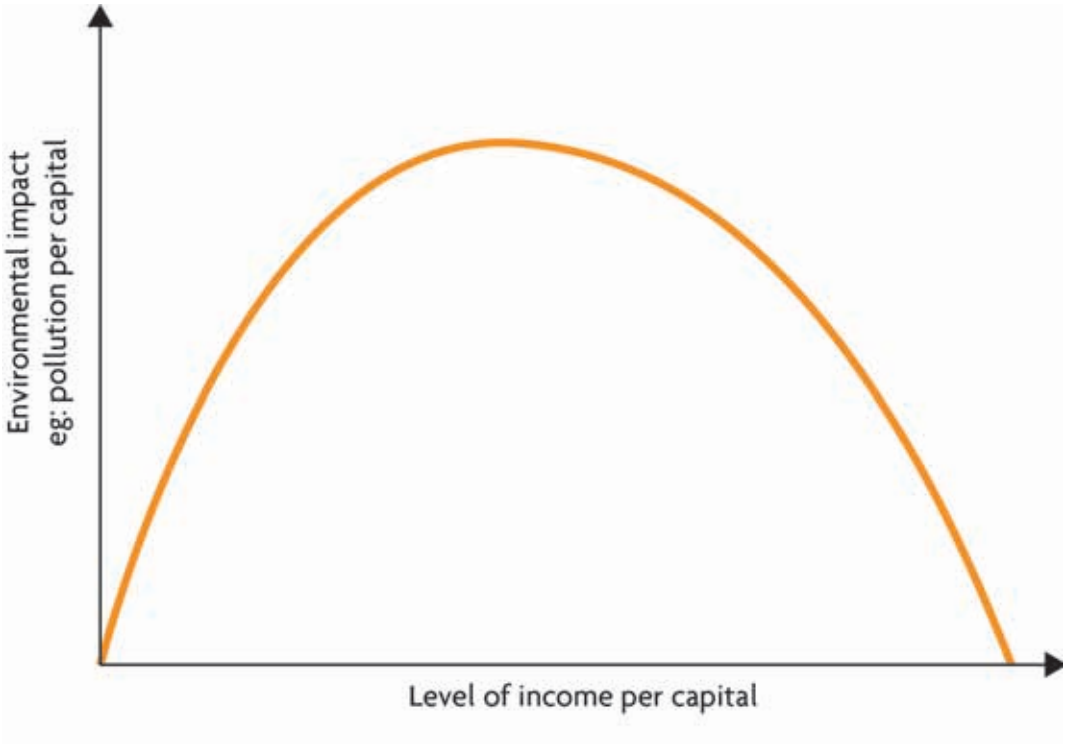
change. Many modern ecological economists have reasserted this negative relationship by calling for managed degrowth[3]. Degrowth is also associated with global objectives including "ecological sustainability, social equity, well-being, and economic sustainability"[4].

These economists cite evidence that the ongoing crisis and recession have reduced carbon dioxide emissions[5]. For them, absolute decoupling between economic growth and ecological degradation appears impossible, and thus there is no alternative but to plan to shrink economies. Globally, this might mean a contraction and convergence process, in which the rich countries must shrink to make room for the poorer countries to grow.

However, others, on a number of grounds, reject these perhaps pessimistic scenarios. One of the most popular counter-claims is that although economic growth does involve ecological degradation through pollution and the emission of greenhouse gases and particulates, this is only a problem in the early stages of development. Rather, it is claimed that once an economy has developed it will begin to show concern for the environment, develop pro-ecological technology, experience structural change towards services, and develop structures for environmental regulation[6]. The net effect is that as their economies grow, countries are able to slow down and then reverse their ecological damage. Overall, there develops an inverted U-shaped relationship between growth and ecological impacts. This is the so-called Environmental Kuznets Curve (EKC). The EKC's origins lie in studies of income distribution. The original Kuznets Curve (KC) had a similar form to the EKC and suggested that, as economies developed and grew, they would initially experience an increase in income disparities, but after a certain level of per capita income was achieved, disparities would reduce with further growth. The empirical evidence for both the EKC and KC is patchy.

A related concept is decoupling. (Relative) decoupling is when economic growth is faster than growth in ecological degradation. Absolute decoupling occurs when damage seems to be falling (such as when carbon emissions fall). Some economists argue that the mechanisms posited are flawed. Further, some economists cite the Jevons paradox (the rebound effect) in which increased efficiency in the use of energy reduces its price and therefore increases its use[7]. However, evidence for rebound effects is scant.

Both the EKC and decoupling have generated a lot of empirical work. Typically, for both, economic growth is correlated against carbon emissions, or carbon or ecological footprint. Some studies suggest that there is an EKC, although some of them suggest it may only apply for a minority of pollutants. Selden and Song (1994)[8] suggest the existence of an inverted-U shape for carbon monoxide, oxides of nitrogen, sulphur dioxide and suspended particulate matter. However, Grossman and Krueger (1995)[9] cite evidence that while levels of most pollutants fall, carbon dioxide emissions and municipal waste continue to increase.



▲ **Figure 1. The Environmental Kuznets Curve.**

For reasons similar to those underpinning the EKC, it is argued that decoupling is possible in richer countries, and there is some evidence that decoupling does occur. Certainly data suggest that the relationship between growth and measures of ecological degradation is imperfect – countries grow in different ways. However, in response it is argued that developed countries can export their ecological damage to developing countries. Thus for a country such as the UK, for example, carbon emissions appear to have fallen and absolute decoupling occurred if one uses a measure based on UK production only. Yet if consumption data are used (based on the emissions embodied in imported consumer goods) then emissions rise again, and decoupling then appears to be at best relative. Crucially, whether an EKC is found can depend on whether production or consumption emissions are measured[10].

'GREEN' ECONOMY

Despite the above reservations, some economists and many policy-makers have argued for the possibility of a 'green' economy. Several agencies of the United Nations have done so. The United Nations Environment Programme (UNEP) defines a 'green' economy as one that generates improvement in human well-being, social equity, and the reduction in environmental risks and ecological scarcities. The structure of a 'green' economy could be significantly different from a conventional economy. The precise elements of the 'green' economy are debated, but would likely include "renewable energy, low-carbon transport, energy-efficient buildings, clean technologies, improved waste management, improved freshwater provision, sustainable agriculture, forestry, and fisheries"[11].

Crucially, policy-makers appear to believe that the 'green' economy is a potential route to economic growth. Investment in 'green' sectors is seen as having both short- and long-term benefits. In the short term, unemployed workers could be deployed in socially useful, pro-environment activities, such as improving home insulation (as in California, for example). In the longer term, major investment in 'green' sectors is necessary to promote a transformation in the economy. Furthermore, promotion of these sectors and their associated technologies is believed to increase international competitiveness and thereby create export opportunities. 'Green' growth can be seen as either the growth of these 'green' sectors or that portion of the growth of the overall economy that is not associated with unsustainable environmental impact. In practice, these may be much the same. It is likely that 'green' growth will be accompanied by 'brown' (unsustainable) decline and it is possible that the latter will dominate so that degrowth results.

The greater perceived strategic importance of the 'green' sectors, the attendant wish to assess progress towards a 'green' economy, and perhaps simply the desire to capture more effectively activity in the economy, has led statistical authorities to attempt to measure the environmental sector. Eurostat, for example, is attempting to define the environmental goods and services sector (EGSS). The Eurostat initiative has compelled national statistical offices to do the same, although the UK Office for National Statistics has yet to provide estimates. In respect of some countries, this has generated provisional estimates of the sector size (see **Table 1**). These numbers are not large, and overall

▼ **Table 1. Turnover and full time employment (FTE) in the environmental goods and services sector (Source: adapted from Livesey, D. (2010) Measuring the Environmental Goods and Services Sector, Economic and Labour Market Review, No. 12, December 2010. Office for National Statistics.)**

Country	Turnover (Euro billions)	Employment (FTE thousands)
Germany (2007)	4.6	76
France (2007)	1.0	209
Netherlands (2007)	n/a	8
Austria (2008)	n/a	76
Poland (2007)	2.9	262
Romania (2006)	2.1	123
Sweden (2006)	1.0	35

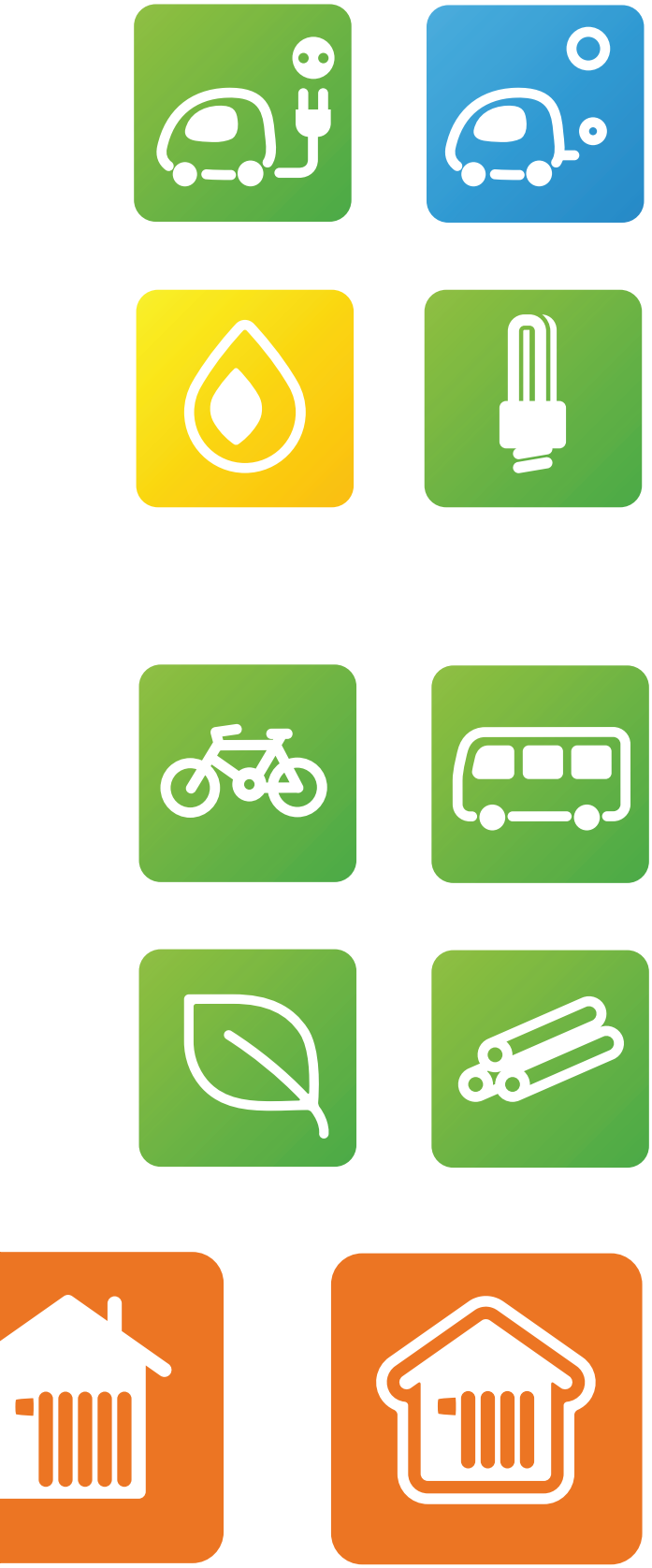
the EGSS may be only one to three per cent of total employment in the EU[12]. The Department of Business, Innovation and Skills (BIS) has reported on the UK Low Carbon Environmental Goods Sector since 2009, using a much wider definition than that used by Eurostat. The 2010/11 report indicates a sector turnover of £122 billion and employment of some 940,000[13].

However, these estimates are subject to considerable caution, because those involved in creating them become increasingly aware of the high degree of complexity of the sector and particularly its definition. A particular problem is that sectoral definitions do not necessarily capture all relevant activity. For example, energy managers employed in conventional firms may have large pro-environmental effects, but they are typically not captured in the EGSS.

This leads to a need to recognise a fundamental distinction in what is meant by the 'green' economy. Definitions of the EGSS often include some requirement that the business must be innovatory in terms of products or services offered. The focus is on activities that are more environmentally sustainable than conventional products, services or methods of production and provision. 'Green' is thus a relative concept defined in relation to the rest of the economy. Viewed in this way, the 'green' economy will always remain a minor part of the economy as a whole.

An alternative view considers 'green' to be an absolute concept applied to describe an economic activity. It can be defined in various ways including some level of carbon footprint or ecological footprint. Under such a definition, the 'green' economy can expand until it

▲ **Image credit: guukaa. Fotolia.com**



includes most economic activity. Under this conception, the 'green' economy is not defined solely by product but also by consideration of the backward and forward supply chains as encapsulated in cradle-to-grave life-cycle analysis. It could also be described as those parts of the economy that have been effectively decoupled. However, we should also note that many analysts are sceptical about the coherence of carbon or ecological footprint analysis.

'GREEN' JOBS

A concept related to all of the above is 'green' jobs. Several proposals exist to create 'green' jobs through the public and private sectors. More radically, Forstater[14] proposes a Green Jobs Corps, created by the government as employer of last resort, as a direct means to create employment in a pro-environmental way. Advocates of 'green' jobs claim that they can aid the process of transformation to post-carbon economies, enhance technology, create employment in good-quality jobs, and reduce the current dominance of the financial services sector. Jaeger *et al*[15] estimate that if the EU were to reduce its emissions (compared to 1990 levels) by 30 per cent rather than 20 per cent, six million new jobs could be created.

However, critics claim that the effects of 'green' jobs programmes may be deleterious and that the claims made by advocates overstate the potential and actual numbers of 'green' jobs. One particular claim of critics is that the definition of 'green' jobs is unclear and overstates their number. Arbeitskammer[16], an Austrian research institute, argue that many of the 'green' jobs created in Austria are in fact not new, because they replace jobs in other sectors. Similar criticisms have been made about the recent estimate by the US Bureau of Labor Statistics that there are currently 3 million 'green' jobs in the US economy[17]. There is some validity to these arguments, and advocates must be careful not to claim too much. However, all new categories will inevitably capture some previously existing category. The wider point is that 'green' jobs may not be additional, as they may simply replace jobs lost in 'brown' activities. Again, this is reasonable, but it is also the point of 'green' jobs.

Advocates and critics both have grounds for their claims, though arguments for 'green' jobs ought not to be taken as strictly positive. Rather they often reflect prior beliefs about the ultimate driver of concern for 'green' jobs, i.e. about the need for them, and in turn about climate change and related issues. In addition, there appears to be a presupposition in government that 'green' sectors are or will be strategically important and have growth potential. However, in fact, 'green' jobs could be consistent with conventional growth, 'green'

▲ **Image credit: guukaa. Fotolia.com**

growth, and even degrowth: some 'green' jobs could be those that lead to a contraction in economic activity or involve part-time work and job-sharing. Indeed, degrowth authors have addressed the possibility of basic income schemes replacing employment as a means to reducing economic activity.

CONCLUSIONS

Two threads run through the discussion in this article. One is concerned with issues of definition and the other with issues of measurement. There is a conundrum here: some researchers are attempting to define the 'green' economy, 'green' growth and 'green' jobs in ways we can measure using existing data-collection methods, while others start with a definition based on first principles of sustainability and then find they have no means of measurement. Definitions range from the relative – 'greener' compared with the rest of the economy, to absolute – 'greener' through not breaching some environmental constraint. As is so often the case, a middle way may serve us best. We need a working definition of the 'green' economy and 'green' jobs that will lead to measurement and policy targeting at reasonable cost, and we need to be able to capture the specialised innovative EGGS sector as well as tracking how far we have 'greened' the economy as a whole. ES

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This paper has benefited from assistance from Jonathan Hunter, Thi My Linh Nguyen, Sufyan Yesufu, and participants at seminars at the AHE conference, Paris, 2012, and at UWE, Bristol, October 2012.

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The fallacy of 'green' growth

James Meadway questions the compatibility of growth, 'green' or otherwise, with sustainability.

The failure of the developed world to recover convincingly from the economic crash of 2008–9 has prompted a fresh concern with economic growth. Growth, it is held, will turn stagnant economies round, boosting employment and improving living standards. For some, it offers the possibility of a win–win situation: restoring economic growth will not just allow a return to pre-crash stability, but also potentially to meet the pressing demands of sustainability. The UK's coalition government has raised the possibility of a 'green' economy, offering at least a rhetorical commitment to a form of environmental modernisation. The Organisation for Economic Co-operation and Development (OECD) has promoted a Green Growth Strategy internationally since 2011 so as to (in the words of its Secretary-General) "unlock new growth engines and job opportunities"[1]. The belief is that the very presence of environmental constraints will act to promote innovation and spur further growth. There are, however, two fundamental problems with this approach.

The first is the failure of the promise of growth itself. Gross domestic product (GDP) was first reliably recorded in the 1930s, building on a far-earlier tradition of national accounting stretching back to François Quesnay and the Physiocrats' attempts to enumerate the wealth of the Kingdom of France in 1758. Their early efforts at quantifying the sheer volume of trade and production that took place within a single country's borders were a glimpse into the future, hampered – like Leonardo da Vinci's designs for helicopters – by the lack of tools and techniques to develop them properly. By the 20th century, both statistical and survey techniques had developed sufficiently to allow the creation of credible estimates for national economic activity: the national account.

Simon Kuznets, who led the team that developed the first set of national accounts for the USA in 1934, was clear about the limitations of this exercise. He told a subsequent Congressional hearing, that "the welfare of a nation can scarcely be inferred from a measure of national income"[2]. The mere existence of a greater volume and value of economic activity was not necessarily a

reliable indicator of far more indeterminate (if desirable) social factors like 'happiness' or 'welfare'. It was simply indicative of the extent of economic activity, and little beyond that point.

Nonetheless, and given a significant fillip by the demands of management and production for total war, the techniques of national income accounting spread widely. The UK created its first comprehensive national accounts during World War II. Other countries followed after hostilities closed. A turn towards planning, and a confidence in the ability of governments to manage national economies, aided their spread. Demand management, inspired by John Maynard Keynes's writings, in which governments would loosen or tighten their economic policies to match the swings of the economy, depended on accurate statistics. GDP rapidly became the central measure of activity, in part because of its assumed objectivity.

However, GDP also became invested with a positive, political content. The interwar years had been wracked by conflicts over the distribution of economic wealth. With growth stalled, these were necessarily bitter. A bigger slice for capital was automatically a smaller slice for labour, if the economic pie could not be expanded. Economic policy could look like a zero-sum game.

MANAGING GROWTH

Yet if growth could be monitored and managed, these distributional conflicts could end. The pie may be unevenly distributed, but if everyone was growing richer over time, there was little purpose in arguing over the proportions of its slices. Everyone's slice would grow. Anthony Crosland, a Labour minister, perhaps put the case most effectively in *The Future of Socialism* (1956). Capitalism plus economic growth could provide most of what the earlier socialists had wished for: rising real living standards for the majority and a welfare state, with minimal real redistribution of wealth and resources. Developed countries could not boost growth by using more labour – although big labour movements across Europe and the USA had some impact – but a steady rate of investment and, more importantly, technological improvements over time would secure prosperity[3].

This programme worked for as long as real household incomes tracked increases in economic growth. For three decades, across much of the developed world, this was broadly the case. Indeed for some countries, like Britain, and for at least some years, real incomes growth outstripped growth in the wider economy. Problems emerged, however, as the post-war boom faltered coming out of the 1960s and into the subsequent decade. A series of unexpectedly sharp recessions broke the Keynesian growth machine, and, although the circumstances varied across economies, the previously solid attachment of average real incomes to GDP appeared to break down. For the USA, average weekly earnings have remained essentially stagnant since the mid-1970s, despite decades of growth, and are today below their level of 1975. For the UK, the picture is less stark, but real incomes for the bottom 50 per cent of households have stagnated since 2002 – again despite economic growth[4].

If this link to growth is not restored, growth will mean little for most of us. Its proceeds will, instead, as they have for the last few decades, transfer largely to the wealthy. There are any number of reasons to oppose this, morally or otherwise. One recent IMF paper argued that unequal and debt-burdened societies were more likely to suffer financial crashes[5], but it immediately suggests that a return to growth – of any kind – may do little to resolve fundamental questions over the economy. 'Green' growth, unless also attached to support for redistribution (as a minimum), will not be secure growth.

GROWTH VERSUS WELFARE

The second problem is a deeper one. It falls directly from Kuznet's early concerns about growth as a proxy for welfare. It hinges on the recognition that what we measure as growth – that is to say, increases in GDP – is not the entirety of our economic impact. Some of this is about welfare: housework, and other unpaid labour like care work, is not identified in GDP statistics as economic activity, and therefore goes unrecorded. Since much of this performed by women, GDP is gender-biased, and fails to adequately capture changes in women's welfare.

There is also the question of the external constraints on our activities. The economy does not float freely in space. Virtually every activity we perform has an impact on material resources at some point, either in production or as energy use. Those material resources are, ultimately, subject to constraints. There are, in the end, finite supplies of oil or copper or uranium. Historically, these material resource constraints have not been regarded as a necessary barrier to growth since, in theory, they can be substituted and more-efficient technologies devised. Scarcity of resources would push up prices, inviting a switch into alternatives and promoting innovation. The 'oil shocks' of the 1970s, for example, led to an improvement in the fuel efficiency of cars.

The case for 'green' growth, ultimately, depends on our ability to perform those substitutions effectively. We can, it is argued, move sufficiently rapidly between technologies and alternative resources that we will not run up against the constraints. GDP can continue to increase as long as we can substitute more-efficient for less-efficient technology. Material constraints will still exist, but our own ingenuity – led by price changes, perhaps helped along by government intervention – will ensure we never hit them.

SLOW CHANGE

The case falls apart if our rate of substitution of technology and resources is not fast enough. There are good reasons to think it will not be. Tim Jackson in *Prosperity Without Growth* (2009) presented one of the clearest statements of the case for greenhouse gas emissions. In 1979, every US dollar of GDP produced worldwide also produced about 1 kg of CO_2 emissions. By 2009, technological improvements and the substitution of resources had reduced this impact down to 700g per dollar of GDP produced worldwide.

This is a significant improvement. But if assume that population will stabilise, following mid-range UN forecasts, at 9 billion by 2050, and if we further assume that this population by then should enjoy a standard of living similar to that in the EU today, the global economy in 2050 will need to be six times larger than it is now. However, if we intend to meet the IPCC targets for stabilising the global temperature to a 2°C increase by the end of the century, we will need to cut global carbon dioxide emissions to below 4 billon tonnes per annum by 2050. A far bigger economy will have to produce far less carbon dioxide.

The figures are startling. By 2050, following these assumptions, each dollar of GDP produced will have to lead to no more than 6g of CO_2 being emitted, meaning a global economy that is 130 times more efficient than it is today. There is simply no plausible technology to be invented that will allow this rate of substitution. 'Green' growth, under reasonable assumptions, will not be enough. The rate of efficiency improvement is never going to be great enough to limit potentially catastrophic climate change.

It is not possible to maintain rising GDP, a rising population and improvements in equality with a stable climate. Something has to give. Better that it should be increasing GDP than the others. The implications are dramatic: as a minimum, we will need to find different, more subtle metrics to measure economic success – jobs created, real incomes, carbon and environmental impacts. Work on the measurement of wellbeing has already begun to indicate some new directions. There will also have to be some profound changes in how we work and manage our relationships with the wider

ES

James Meadway joined nef in November 2010. He works principally on the modelling of a just and sustainable macroeconomy as part of The Great Transition initiative.

James previously worked as a policy advisor at HM Treasury, where he covered regional development, science and innovation policy, and worked on the Barker Review of planning. Most recently, he was a senior policy advisor at the Royal Society.

SOURCES

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IES: New members and re-grades

Fellows	Occupation (F)
Sam Tsoi	Director of Consulting

Members	Occupation (M)
Alison Brand	Environmental Consultant
Martin Brannock	Associate Director
Jonathan Brown	Senior Environmental Geologist
Russell Corbyn	Senior Environmental Chemist
Ioanna Gegisian	Environmental Consultant
Philip Guthrie	Ecological Sustainable Design Engineer
Paul Hayward	Assistant Air Quality Consultant
Charles Humphries	Principal Consultant
Andrew Kram	Project Geo Environmental Engineer
Calvin Kwan	Senior Manager - Sustainability
Yuen Lam	General Manager
Caroline Odbert	Air Quality Consultant
Christopher Shields	Technical Officer (Pollution Control)
Niranjan Siddegowda	Assistant Engineer
Andrew Spooner	Environmental Geologist
Marcus Wright	Technical Director

is for esteemed individuals in the feilds of environmental science and sustainability who are held in high regard by their peers

is for those individuals who have substantial academic and work experience within the field of environmental science.

is for individuals beginning their environmental career or those working on the periphery of environmental science.

is for individuals with an interest in environmental issues but don't work in the field.

Associates	Occupation (A)
James Bellinger	Consultant
Rosemary Challen	Assistant Air Quality Consultant
Ryan Cridlin	Graduate
Robert Dawe	Graduate
Russell Francis	Assistant Air Quality Consultant
Adam Grant	Environmental Consultant
Peter Henshaw	Environmental Consultant
Wai Yiu Kan	Assistant Consultant
Hugo Mann	Farm Assistant
Thomas Meyrick	Technical Support Agent
Sophie Mullen	Graduate
Stina Nikolaysen	Graduate Environmental Scientist
Oladayo Obiyomi	Graduate
Vanessa Pilley	Sustainability Support Officcer
Edward Richardson	Laboratory Intern
Peter Schofield	Environmental Consultant
Christopher Smith	Countryside Advisor
Mobolaji Sunmoni	Graduate
Kathryn Walter	Graduate
Joanna Woof	Graduate Air Quality Specialist

Affiliates	Occupation (Af)
Russell Burton	Photographer
Ann Fitzpatrick	Civil Servant
Alexandros Konnaris	Student