

THE GREEN ECONOMY: BACKGROUND, CURRENT POSITION AND PROSPECTS

OVERVIEW PAPER FOR THE SHANTOU DIALOGUES, CHINA, NOVEMBER 2008

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1.1 Introduction

The phrase the 'green economy' has come to refer to an economy which has reduced its negative impacts on nature – air, water, biodiversity and climate. Since the industrial revolution economic growth has been associated with ever greater use of materials and energy, and considerable damage to the natural environment. Over the last forty years there has been mounting concern that this route to development is unsustainable, particularly with the continuing growth of world population, and ever more evidence of the dramatic potential impact of climate change.

The promise of the green economy is to 'decouple' economic growth from both greater use of resources and damage to the environment, through the development of new products, processes, services and ways of life. A central concern is to accelerate a shift towards low carbon products and processes. However the green economy label is used much more widely, to encompass changes to water use, forestation, lifestyles and biodiversity. It also encompasses strategies of abatement (to prevent climate change) as well as strategies for adaptation and mitigation.

The current economic crisis will have a contradictory impact on moves towards a greener economy. Fiscal stimulus packages in many countries (including President Obama's expected programme) look set to speed up the shift to renewable energy, retrofitting of public buildings and housing, and other measures that create local jobs.

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However, economic pressures may delay action to raise the price of carbon and tougher measures on climate change.

In China the importance of the green economy has grown significantly since the 16th Party congress committed to a 'circular economy' as part of China's ambition to realise a *Xiaokang* society by the year 2020¹, constructing a well-off society in an all-round way². This theme has been further developed through the Scientific Development Concept, which emphasises improving the relationship between "man and nature"³, alongside the drive to achieve a harmonious society.

There is now a vast and rapidly growing literature on the green economy in all its many forms. This literature includes official reports and surveys; consultancy studies; advocacy books and pamphlets; corporate strategies and analyses. The literature sometimes puts numbers on the different parts of this economy – for example the value of traded carbon emissions; or land restoration; or the world market for pollution abatement technologies which is estimated to amount to more than EUR 500 billion, with an annual growth of 5%.⁴ Different measures of the greening of the economy have been provided in the IPCC and Stern reports, which include the costs and benefits of mitigating climate change. Alongside the literature there are also places which showcase the possible future direction of the economy: pioneer cities (such as Hammarby Sjostad, Vauban in Freiburg, Masdar in Abu Dhabi, and China's ecocities); and pioneer companies (such as Interface) whose business models are based on a very different use of materials and energy.

The shift to greener economies depends on new technologies in all fields; changes to the design of markets; and also social changes, including the adoption of different lifestyles. So far, most of the policy focus has been on technology and market design. These will continue to be priorities as more is learned about where best to concentrate R&D and how to design markets. However, we expect much greater attention to issues of social design and social innovation over the next 10-20 years, much of it focused on cities, since social barriers to adoption are already proving more important than strictly technological barriers.

Advocates of a shift to a greener economy range from the incremental and conservative to the radical and revolutionary. Incrementalists argue for greening the existing industrial economy - cutting pollution and emissions; making industrial processes less resource and energy intensive; and expanding reduce, reuse and recycling. They often see the green economy as one manifestation of wider changes to a 'new economy' driven by innovation⁵. At the other end of the spectrum there are advocates of a much more radical 'green economy' which marks a decisive break with the industrial models that dominated the 19th and 20th centuries, and is either in balance with nature or actively pro-ecology, with very different ownership models (usually with more community ownership), systems of exchange (including parallel currencies, and carbon as a currency), ethics and aesthetics (eg biomimicry in design) and rights (as in the 'contract and convergence' responses to climate change). Some of the radical arguments echo the 'limits to growth' claims of the 1970s⁶ that the only solution to environmental problems is to sharply restrict economic growth. Others argue that capitalism cannot provide the solution to the environmental challenges we face.⁷

A central challenge in all discussions of the green economy is how to deal both practically and morally with the huge unevenness of development which has left some parts of the world with far greater ecological footprints than others. Both within nations and globally, the green economy debate brings together questions of technology, economics, politics and morality.

This paper draws on a wide range of perspectives and analyses to explore:

- The pushes and pulls that are greening economies around the world, including the pressures of regulation, law, consumer demand, financial markets and campaigns. We focus particularly on issues of carbon reduction while also addressing the other dimensions of the green economy.
- The specific issues in different areas of design – product, process, service, institutional, social, regulatory, policy, information, land and urban.

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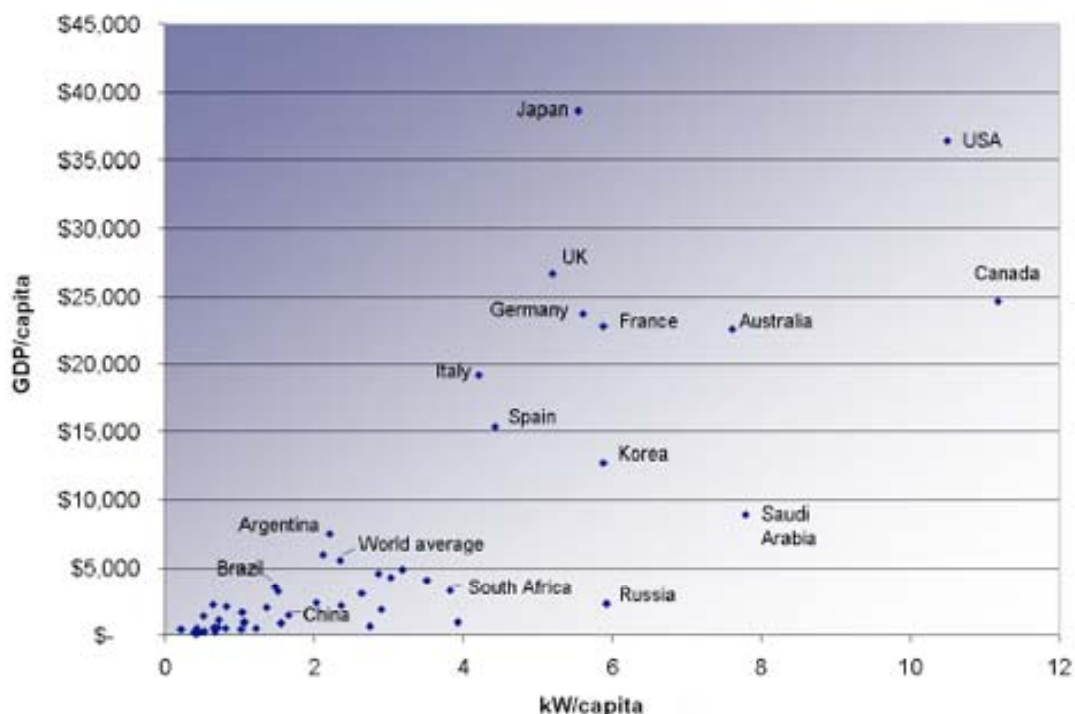
- The major strategic choices facing different regions and nations, focusing in particular on the choices between technology-oriented zero waste strategies, and alternatives which emphasise new ways to replace materials, energy and capital with labour under the ‘green jobs’ slogan. These latter strategies are likely to become much more important against a backdrop of shrinking output and rising unemployment in many countries.

1.2 Context

For two centuries economic growth has been associated with a steady growth of energy and material inputs. However, for several decades it has been argued that growth could be compatible with a substantial reduction in the ratio of energy/material inputs per unit of output, in some sectors by factors of four or ten or more (as promoted in the mid-90s by Amory Lovins and others⁸, and by McKinsey in the late 2000s⁹).

These proposals – which ran directly counter to ‘limits of growth’ claims - go with the grain of some features of recent economic development. Globally, energy intensity is estimated to have decreased by 1% a year between 1860 and the 1970s, and by 2% in most countries from then until the 1990s¹⁰ (though there are some concerns that it may be declining¹¹). This trend is significant, though modest in comparison to changes in labour intensity¹² over a similar time frame.

As the chart below shows, countries have achieved prosperity with very different levels of energy input – compare for example Japan and the US, or Germany and Canada. Their stark differences are partly a consequence of different levels of settlement as well as different



approaches to industry, and different attempts to ensure that what economists call ‘externalities’ (like pollution or the costs of climate change) are internalised in the decisions of investors, manufacturers and service providers through taxes, charges and regulations.

2. Pushes and Pulls

To understand the dynamics of the greening of economies worldwide we begin with the forces which have pushed green issues up the economic agenda. Two decades ago, environmental questions were relatively marginal as aspects of economic policy. Today they have become increasingly central. One factor has been pressure from the public. Citizen **movements** demanding improvements in visible and measurable environmental conditions came to prominence in the 1960s and 1970s, campaigning against toxic emissions, poor air and polluted water. Books such as ‘Silent Spring’ galvanised opinion in the early 1960s, while the ‘Club of Rome’ reports in the early 1970s suggested that there were unavoidable environmental limits to growth. These movements succeeded in achieving a cascade of stricter rules across the world, partly correlated with income levels, and sustained by the growth of a global green movement in the form of organisations like Greenpeace, and green parties in many countries. Their influence was felt both in politics and in the market where the rise of **consumer** demands for higher environmental standards in products, processes and corporate policies became particularly influential in the 1980s to 2000s. These movements were in turn amplified by greater **scientific** knowledge about environmental harms and the costs associated with them (influencing, for example, the elimination of CFCs). After a lag their ideas had a growing influence on **business** in the 1990s and 2000s, as leading firms came to recognise that many environmental improvements were compatible with high levels of profit, and that in some cases green markets and regulations could accelerate innovation. Voices within business have increasingly supported regulations rather than only resisting them – for example Sir Mark Moody-Stuart, the

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former Chairman of Shell, advocates that new cars with fuel efficiency below 35mpg should simply be banned¹³.

These pressures achieved significant improvements in pollution levels, air quality and water in many countries. But over the last decade the environmental agenda has widened out with greater awareness of the *systemic* character of many environmental issues, in particular climate change and declining biodiversity. The Rio Earth Summit in 1992 was a watershed in raising global awareness of systemic environmental questions; Al Gore's film 'An Inconvenient Truth' in 2006 was a more recent landmark.

These shifting perspectives have led to radical changes in how economies are measured. GDP measures are increasingly augmented with satellite accounts to measure the impact of economic activity on natural resources. Ecosystems are increasingly seen as productive - providing food, fuel and fibre; purification of air and water; detoxification and decomposition of wastes; moderation of floods, droughts, temperature extremes and the forces of wind; generation and renewal of soil fertility, including nutrient cycling; pollination; and pest control. The value of these services has been estimated at anywhere between \$2900 and \$38000 billion, compared to a world GDP of \$54000 billion.

2.1 The pushes:

The push factors that are influencing the decisions of consumers, investors, designers and businesses have come primarily, but not exclusively, from government policies, reflecting the concerns of citizens. These vary greatly according to national contexts – in some countries an overriding priority is to cut water use (eg Australia); in others to enhance energy security (eg the USA); and in others still to mitigate the impact of climate change (eg Bangladesh, Maldives). Some have used policy as a deliberate tool to grow green industries (as with Germany's renewable energy policies or California's targets for electric vehicles) over several decades. In others, changes have been brought

on or accelerated by shocks. Japan, which was then highly dependent on importing oil, pushed to increase its use of solar power and achieve higher energy efficiency in the late 1970s and early 1980s following the oil price hikes of the 1970s. Other countries, such as Denmark, have seen the development of a green economy as central to gaining international comparative advantage. These are some of the key pushes already in place:

- **Regulation** - governments are putting in place higher and better enforced environmental standards. Examples include the UK's Zero Carbon Homes initiative¹⁴, car emissions standards (where California and Germany¹⁵ have been leaders) and regulations on factory emissions. Regulations can apply at a range of levels from the very local to the national and international (EU standards for car emissions have helped shape the framework for car emission standards in China).¹⁶ Increasingly clever regulatory tools are being used to influence behaviour – such as Germany's provisions setting a feed-in tariff for selling into the grid. Japan's 'top runner' programme identified the leading performers and then agreed with stakeholders a timescale for making it the standard for the industry¹⁷. However, environmental regulatory standards are becoming increasingly political due to their uneven distributional impacts.¹⁸
- **Regulated and managed markets** – governments have learned to use regulated and managed markets to internalise externalities. The first emission trading scheme came as a result of US Clean Air Act Amendments 1990¹⁹, which created a system of tradeable sulphur dioxide emission permits. In 1997 the Kyoto Protocol created a framework to allow for emissions trading between nations, through the Clean Development Mechanism (CDM). Since then a number of greenhouse gas emissions trading schemes have been set up, including the EU Emissions Trading Scheme, UK emissions trading scheme, the NSW Greenhouse Gas Reduction Scheme²⁰ and the Chicago Climate Exchange. The global carbon market was valued as in excess of \$30 billion in 2006²¹. The importance of regulated markets is set to increase,

with emission trading schemes currently in development in Australia, Canada, Japan, Taiwan and New Zealand. In the United States, in the absence of a national emissions trading scheme, a number of states have come together through the Western Climate Initiative and the Regional Greenhouse Gas Initiative to develop pan-state emission trading schemes. Additionally, both of the 2008 US presidential candidates supported a national emissions cap-and-trade programme. Other green markets have also grown up in parallel, including markets with tradeable permits for water, or fisheries. In the USA the Clean Air, Clean Water and Endangered Species acts have created small but important offset markets.

The structure of emissions trading schemes varies greatly, from mandatory cap-and-trade systems to incentivised voluntary systems (as proposed in Japan). Permits can be auctioned, grandfathered (allocated on the basis of historical emissions) or allocated using a mixed approach²². Although regulated markets have so far applied to major energy consumers (e.g. aluminum, concrete, energy), proposals have also been made for individual carbon allowances.²³ Various advantages have been claimed for regulated markets over direct regulation. These include avoiding regulatory capture, creating a business lobby in favour of further environmental improvements, encouragement of innovation and, above all, greater efficiency as a result of encouraging emission reductions to be made where it is most cost-effective²⁴. However, there are many sceptics who point to the practical difficulties in particular markets, whether because prices have been set too low (as in the EU) or because of the difficulties of measurement and enforcement (as with the Clean Development Mechanism). So far, in most countries, regulations have proven much more powerful tools, though markets arguably have greater long-term potential.

- **Taxes, charges and subsidies** – are being used to promote more environmentally friendly behaviour. This includes shifting taxation from capital, income or labour to environmental bads²⁵ or introducing wholly new taxes, charges or subsidies. In the USA President-elect Obama has committed to \$4 billion in tax

relief to retool factories to make advanced cars in addition to \$25 billion in public loans. US consumers would get a \$7,000 tax credit for purchases of advanced cars. Carbon taxes are currently in operation in several countries including Sweden, Finland and the UK. Carbon or energy taxes are also being used sub-nationally. British Columbia²⁶, Oregon²⁷, Boulder, Colorado²⁸ and the San Francisco Bay Area²⁹ all having introduced or planning them. Advantages of tax and charges over permits include that they may be cheaper to administer and unlike grandfathered permits (which are allocated on the basis of historical emissions rather than an auction) they raise funds which can be used to reduce taxes in other areas. In the US, the introduction of biofuel subsidies has had a worldwide impact – demonstrating the power of fiscal incentives.

- **Direct provision** – by governments is also helping support the green economy. Examples include building publicly funded housing to higher environmental standards than those required by law³⁰ and improved or subsidised provision of public transport. In some cases provision is funded from hypothecated environmental taxes and charges. Examples include using receipts from the congestion charge in London to improve and expand bus transport and directing some of the funds resulting from the UK's climate change levy to set up the Carbon Trust (which provides free advice and interest free loans to help businesses reduce their carbon emissions)³¹.
- **Purchasing** – with public sector procurement estimated to make up around 10-15% of global output³², it is increasingly being used as a tool to encourage the green economy. The UK government has set mandatory sustainable operations and procurement targets and commitments for all departments and agencies³³, and aims to make the government office estate carbon neutral by 2012³⁴. In London, all new buses will also be hybrid.³⁵³⁶ The US Energy Independence and Security Act of 2007 will require all general purpose lighting in Federal buildings to be more environmentally friendly and set up a new Office of High-Performance Green Buildings (OHPGB) to promote the implementation of green building technology in Federal

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buildings.³⁷ Purchasing can help the green economy not only by directly making the public sector more environmentally sustainable, but by encouraging diffusion of new and developing technologies.

- **Innovation** – public funding for R&D directed to specific fields of green technology. This has been a particular priority of the US government, with the Bush administration investing almost \$18 billion since 2001 to research, develop and promote alternative energy technologies³⁸. Many governments have been attracted to high profile projects – carbon capture and sequestration, nuclear power and large solar or wind farms. Others have opted for more incremental approaches and many small projects. Germany, for example, successfully built up its solar business through a mix of regulations and direct funding. Denmark has invested substantially in green R & D (Danish Public R&D funding was about EUR 1.4 billion in 2005, and 5-10% of this had a significant environmental element) making Denmark a world leader in environmental technologies. As a result, at least 60,000 Danes currently work in enterprises that provide environmental solutions as a significant part of their business and Denmark exports more than DKK 45 bn in eco-efficient technology³⁹. Vestas is now the global lead in wind turbines, with a 23% market share.
- **Diffusion of innovation** – Governments are investing heavily to promote the diffusion and adoption of new technologies. Japan has been a world leader in solar energy, generating half of the world's solar energy as a result of providing subsidies to households who install solar panels.⁴⁰ This kind of support is especially relevant where network effects mean that there are returns to adoption, but an initial “kick-start” is needed. Internationally, efforts are being made to further speed diffusion of innovation and to encourage less developed countries to leapfrog over developed ones. For example, the United Nations International Development Organisation (UNIDO) is working with the Chinese government to support technology transfer through the International Centre on Small Hydro Power and the

International Centre for Promotion and Transfer of Solar Energy.

- **Information** – many efforts are underway to provide consumers and business with better environmental information to inform their choices, including kitemarks, or indicators of energy efficiency. These aim to shape behaviour and norms using a variety of measures including publicity campaigns, naming and shaming and presenting consumers with opt-outs rather than opt-ins. The EU directive on the Energy Performance of Buildings (EPBD) requires Energy Performance Certificates to be made available whenever a building is constructed, rented or sold. AMEE, a new web-service, is a platform aimed at measuring and tracking all global energy data⁴¹. More and better presented information is being combined with services to provide information and advice to consumers at lower cost, such as the Green Homes Concierge Service⁴² in London or Easy Being Green⁴³ in Australia. Businesses are also making more environmental information available as part of Corporate Social Responsibility Policies (CSR), requirement by governments, or as a result of pressure from international NGOs such as Global Witness⁴⁴.
- **The internet** – The internet is playing a role by making green information more easily accessible to individuals (for example, allowing easier purchase of green products and comparison different products' environmental standards), allowing social movements to organise better, individuals to co-operate on environmental projects and collections of environmental information (including to monitor business and government). Avaaz.org is an example of a web based organisation that can start and signs up hundreds of thousands of people to an environmental campaign, reaching nearly every country in the world within a matter of days. Websites like pledgebank allow individuals to agree to take environmental (and other actions) on the basis that "I'll do it, but only if you do it"⁴⁵. AMEE – mentioned above - aims to measure and track all energy, with help from energy users who can upload data to a wiki⁴⁶.

The biggest unknown amongst the various pushes is the future price of carbon, which will be influenced by national policies and global agreements. In the words of William Nordhaus ‘suppose you hear a public figure who speaks eloquently of the perils of global warming... Suppose that person proposes regulating the fuel efficiency of cars, or requiring high efficiency lightbulbs, or providing research support for solar power – but nowhere does the proposal raise the price of carbon. You should conclude that the proposal is not really serious...’⁴⁷ This comment is particularly interesting in the current US context where the new President proposes an ambitious target to increase the share of electricity from renewable energy from 8% to 25% by 2025, with the help of a range of public investments and subsidies, but with much less clarity on likely policies to influence the price of carbon.

Global pushes

These various pushes primarily manifest themselves in national economies – but they are being strongly influenced by global pressures. Overriding all of these are the pushes on climate change from the Kyoto protocol, the Bali Accord and the Accra Declaration and Accord. The latest assessment report from the Intergovernmental Panel on Climate Change (IPCC) projected continued global warming of about 0.2 °C over the next two decades; after that, the level of warming will be dependent on various scenarios with the best estimate of a “low” scenario at 1.8 °C and the best estimate for a “high” scenario at 4°C.⁴⁸

The Stern Review on the Economics of Climate Change⁴⁹ has thrown into stark relief the economic choices emanating from climate change that the world faces. Stern found that the cost of stabilising greenhouse gas emissions at between 500- 550ppm would be around 1% of global GDP each year, but that “if we don’t act, the overall costs and risks of climate change will be equivalent to losing at least 5% of global GDP each year, now and forever. If a wider range of risks and impacts is taken into account, the estimates of damage could rise to 20% of GDP or more.” In June 2008 Stern revised his estimate of the share of GDP needed to reach 500ppm to 2%, to account for climate change occurring at a faster rate than previously thought⁵⁰. Contrary views have come from other economists, notably William Nordhaus whose analyses of

alternative global strategies attempted to judge their impact on global GDP in a century's time.⁵¹

Whoever is right, the central challenge for the global community is how to arrest, and ultimately reverse, rising emissions in ways that are fair and acceptable both to developed countries with high levels of emissions, and high levels of responsibility for past emissions, and less developed countries which have contributed little or nothing to the current crisis. This acutely political challenge will once again come to the fore in the run-up to the Copenhagen summit in 2009.

It is easy to be daunted by the sheer difficulty of designing any serious agreement. However, past decades have brought significant progress in global responses to the environment:

- **Global treaties** – there are hundreds of international multilateral treaties dealing with the environment, including the Montreal Protocol, Kyoto Protocol, Bali Accord and many others. The Montreal Protocol is widely seen as the most successful of these treaties – described by then UN Secretary General Kofi Annan as “perhaps the most successful international agreement to date”⁵². Since the protocol came into effect, atmospheric concentrations of the most important Ozone Depleting Substances (ODS) have either levelled off or decreased, and the production of ODS that exceeded 1.8 million tonnes annually in 1987, had been reduced to some 83,000 tonnes in 2005⁵³.
- **Adoption of green standards by global corporations** - low environmental standards on one side of the world can now provoke shareholder revolts at their AGMs or consumer boycotts on the other side of the world. As a result, global corporations increasingly need to demonstrate consistent green standards. This has significant knock-on effects, as global corporations pay increasing attention to the environmental credentials and performance of the smaller firms that contribute to their supply chain.

- **Action by global organisations**, including the G8, which at its recent meeting of Environment Ministers in Kobe promised increased action on climate change, biodiversity and the building of a material-cycle society⁵⁴. Less obvious intergovernmental organisations are also involved. For example, the WHO is working on the impact of environment on health (including the impacts of indoor and outdoor air pollution on respiratory infections).⁵⁵
- **Global action on technology**, cross-national collaboration on clean coal, carbon sequestration, avoided deforestation and more radical options including genetic engineering to create carbon consuming plants, and climate changing technologies.

2.2 Pulls - consumer demand

The other key factor influencing the green economy is demand. Consumers are demanding different types of products, and becoming increasingly conscious of the nature of products and services and their ecological footprints. Research by Henley Centre HeadlightVision indicates that around 2 in 5 UK consumers regularly buy from ethically sound companies and will boycott those that they feel are not responsible⁵⁶.

Consumers take environmental considerations into account when purchasing goods and services and a small but significant number articulate their discontent or invest heavily (whether through time, money or effort) to create more sustainable options themselves. These 'Pioneers', as they are referred to in the Henley data, are trying out new approaches, which can then be adopted by more cautious consumers. Their demand is driving the rise of new sectors, such as retro-fitting to improve efficiency in homes, green vehicles and residential microgeneration. Green consumption is becoming, in part, a lifestyle choice. The zero waste movement is harnessing the energies of the public to spread more sustainable living, providing consumers with advice on everything from planning a zero waste dinner party to finding a collapsible recycling bin⁵⁷. Another example is the rise of Urban Agriculture, with individuals from Melbourne to Seattle⁵⁸

spending time tending community gardens and selling produce at local farmers markets (e.g. New York's floating farm in the Hudson river).

A broader market in voluntary green measures is also developing. Whereas carbon offsetting was once only discussed in the context of inter-country agreements (e.g. the Kyoto Protocol), now individuals can offset their carbon emissions from a flight, home or car journey at a click of a button through websites such as the carbon neutral company⁵⁹. These shifts are encouraging business to take voluntary measures to green themselves. Sky⁶⁰, for example, plans to become carbon neutral, and retailers like Tesco and Marks & Spencers were the first to commit to labelling carbon footprints on products sold in their stores. Wal-Mart has also made some visible commitments to cutting waste⁶¹.

2.3 Investment and markets

Both pushes and pulls have encouraged financial markets to seek out opportunities in the green economy. "Cleantech" – the emerging financial industry covering efficiency technology firms⁶² - has expanded hugely over the last decade and is estimated to be emerging at twice the pace of biotech's rise in the 1980s and 1990s⁶³. The volume of Cleantech investments by US venture capital firms alone jumped from \$590 million in 2000 to over \$2.2 billion in 2007. Cleantech covers a wide range of sectors from energy to transportation, waste management, materials and agriculture. Over the last year, growth has been driven mostly by investments in solar technologies and second-generation biofuels, including concentrated solar thermal and algae companies.⁶⁴ The US currently has the most developed infrastructure for cleantech investment, but the investment class has worldwide reach, with China broadly level with Europe in terms of investment.⁶⁵ The most recent international cleantech forum was held in Mumbai and is a sign of the growing Indian interest in the subject. ⁶⁶

Approaches to investment vary from negative screening – avoiding the most environmentally damaging companies – to positive screening which seeks out companies which are making a positive contribution. Although the principles of screening have deep historical roots, in the Quakers and in a number of religions, the evaluation of individual

investments through the screening process has become more sophisticated than ever. Positive screening can be more flexible than negative screening, for example by allowing funds to include “best of class” firms in industries that would otherwise be excluded⁶⁷, and can help reduce risk in a portfolio⁶⁸. Other strategies, such as preference (taking into account environmental/social performance when making investments) and engagement (used the leverage power of large funds to change the behaviour of the firms in which they invest) are also increasingly being used⁶⁹.

The expansion of the clean and green financial industry has seen the entry of new investment funds. One high-profile example is Generation Investment Management LLP, which was set up by Al Gore and ex-Goldman Sachs investment chief David Blood. Generation combines a \$4 billion equity fund with advocacy aimed at “mainstreaming sustainability in capital markets”, research and allocating 5% of the firm’s profits to support global non-profit sustainability initiatives⁷⁰.

3. Twelve dimensions of design for the green economy

In the next section, we look at how the green economy is being shaped and influenced by design in twelve key dimensions. A fully green economy embodies radically different design principles– with emphases on low waste, circularity, harmony, reuse and ‘taking the long view’. These design principles manifest themselves in different ways in each of these dimensions.

- i. **Product design** – is perhaps the most evident way in which the green economy is being influenced by design. Energy efficient light bulbs, hybrid cars and biodegradable cleaning products are becoming increasingly mainstream consumables. The first car that went faster than 100km/hr was electric: the Belgian built *La Jamais Contente*, breaking the world land speed record in 1899. It has taken more than a century for fuel cells and lithium batteries to once again achieve levels of performance comparable to petrol. Design is also playing a key role in products from ICI (now part of AkzoNobel) water based paints⁷¹ to Rothamsted biodegradable pesticides and Vesta wind turbines. New light-emitting diodes

(LEDS), use 12% of the energy of traditional incandescent light bulbs, with light quality similar to warm halogen light bulbs⁷². In the more radical approaches to product design, quite new methods are being used including biomimicry, taking methods from the natural world and applying them to materials and things. Tools to promote ecologically sustainable product designs include prizes (current examples include the Live EDGE prize for environmental electronic design⁷³, the French Ministry for Ecology and Sustainable Development's "Enterprises and Environment" prize⁷⁴, the EUREKA Lillehammer Environmental Award⁷⁵ and the Progressive Automotive X Prize⁷⁶), design institutes, and funding or subsidies for Research & Design. Tools of this kind will be particularly important in economies where demand is rising fastest, as well as in centres of production. Future car design will be key in China, where ownership of cars is rising rapidly⁷⁷ and Chinese carmakers are breaking into the Russian and European markets⁷⁸. As China supplies more of the world cars, and other products, the design of these products will make an important contribution to determining carbon emissions around the world.

- ii. **Process design** – new designs for the processes by which goods and services are produced and distributed are equally key to the green economy. Chief of these has been the rise of “closed loop” manufacturing with circular production used to minimise waste by reducing, reusing and recycling input materials and energy.⁷⁹ Examples include BMW manufacturing, p2p loop⁸⁰ and Hammarby Sjostad in Stockholm. Lateral solutions are being considered – for example using energy from data centres (which make up 2% of global carbon emissions) to heat nearby homes.⁸¹ Other aspects of process design include new generations of energy technology: new generation nuclear; carbon sequestration; fusion technologies; and new options for decentralised smart energy systems – all of which are competing for scarce R&D funding and public support.
- iii. **Service design** – The design of services is fast becoming as important as product design. Ray Anderson, founder of Interface

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carpet company, advocates a very different industrial model with incentives for producers radically changed through a switch towards *leasing* rather than *sale*⁸². One area with scope for development through changes in incentives is energy, where suppliers can be contracted to provide warm homes rather than to sell amounts of energy, shifting the incentives for energy companies with consumers and energy suppliers signing a single contract covering both energy supply and investments in energy efficiency improvements⁸³. Again, regulation has played a part in accelerating these shifts, pointing the way to radically different business models. Often, it is assumed that replacing face to face with virtual services is automatically pro-environment. However, it has been estimated that an avatar in second life has roughly the same carbon footprint as the average citizen of Brazil⁸⁴. Additionally, a move to an economic model based more heavily on services may lead to increasing consumption of resources – for example as a result of mobile phone tariffs that include annual replacement of customers' phones. This may be mitigated by developments in product design, such as by reducing the amount of hazardous substances in products, or changes to regulation requiring companies to take responsibility for the waste arising from their products⁸⁵.

- iv. **Systems design** – Many of the more radical options for coping with climate change involve the design of whole systems, going well beyond the processes associated with particular goods and services. Systems design is coming to the fore – both for firms concerned with the full lifecycle of products and also for governments. New technologies for private vehicles, for example, may need new networks for energy supply. Some industries (such as construction) with complex supply chains may need help to make them more environmentally friendly. Radical new approaches to natural environments also require a systems perspective – including the potential for ecologies that absorb CO₂, and other types of sink and sequestration.
- v. **Urban design** – has become a central issue for advocates of the green economy. Estimates of the contribution of urban areas and

cities to global greenhouse gas are hotly contested, with some arguing that cities' contribution to global greenhouse gas emissions is as high as 80%⁸⁶ whilst others believe this to be significant overestimate⁸⁷. In part, this depends on methods of account for greenhouse gas emissions. For example, how the greenhouse gas emissions produced by an airport or power station located in a city that serves a wider area are accounted for.⁸⁸ What is clear, especially at a time of continuing urbanisation⁸⁹, is that radically different approaches to urban design are needed if the greenhouse gas emissions of cities and urban areas are to be significantly reduces. In particular, urban design will need to encompasses and produce synergies between more energy efficient buildings, localised low-carbon energy sources and more environmentally sustainable modes of transport.

Reducing the greenhouse gas emissions of urban areas depends substantially on the promotion of energy efficient buildings that use low-carbon energy sources. Working Group III of to the Fourth Assessment Report of the IPCC identified residential and commercial buildings as the sector with the highest potential of those studied for cost-effective reductions in greenhouse gas emissions by 2020, with potential to reduce 29% of the projected baseline emissions by 2020⁹⁰. A further finding was that 'there is also a broad array of widely accessible and cost-effective technologies and know-how that can abate GHG emissions in buildings to a significant extent that has not as yet been widely adopted'. In addition, a recent UNEP report found that despite high potential for cost-effective emissions reduction both the effectiveness and use of the Clean Development Mechanism (CDM) and Joint Implementation (JI) was much lower than expected⁹¹. Some of the barriers to change may include overestimates of the costs involved in greener buildings⁹², poor design of standards putting off developers and fragmentation in the supply chain increasing the difficulty of building to a high environmental standard. Efforts to support more green housing could be encouraged by emerging evidence that building that meet green accreditation standards enjoy a market advantage over those that do not^{93 94}.

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Green urban design will need to combine adoption of more energy efficient technologies, both for new buildings and through the retrofitting of existing buildings, with changes that perhaps more fundamentally change the lives of urban residents. For example, higher densities can decrease the need to travel with improved public transport and designs that encourage cycling and walking leading to a low-car environment. Urban design can also promote the use of lower carbon energy sources, for example by planning for inclusion of decentralised energy technologies, such as Combined Heat and Power. The Shanghai Expo 2010 is likely to provide an influential platform for urban designers to share the knowledge and skills needed to plan and build sustainable cities for the 21st century. Dongtan will also be a showcase, demonstrating that cities can produce their own energy as well as depending less on cars and more on public transport and cycling. The city will include green 'corridors' of public space and aims to be socially, economically and culturally sustainable⁹⁵.

- vi. **Land management design.** The mirror of urban design are the changing approaches to land management. These range from innovations in agricultural technology (and the debate about how to increase yields without environmental damage, including whether GM crops have a role to play)⁹⁶; changing models of handling energy, water and land demand from livestock for meat production (and ensuring reductions in methane/deforestation)⁹⁷; and the crucial issues of future water-scarcity and the price of water.⁹⁸

- vii. **Social design** – A greener economy requires changes in behavior. Where 20th century industrial models tended to reduce labour in the household, the more recent models often entail greater labour inputs on the part of consumers, for example to separate waste. Intensive innovation is underway in the social design of green economies, including around local food sourcing, recycling, energy production and use, and monitoring. Another common example of social design is car pooling schemes or the many ideas

associated with 'transition towns'. We anticipate much more attention being paid to the social innovation required to achieve the shift to a green economy as it becomes clear that the social and attitudinal barriers to change are as great as the technological and economic ones.

- viii. **Information design** – Efficient green economies depend on flows of accurate information. This is already happening through increasing pressure from investors, regulators, and NGOs for companies to release environmental information and the spread of eco-labeling. In addition to making more information available, another challenge is how environmental information is analyzed and accounted for. This is especially important where policy instruments (such as carbon pricing) are linked to this information. One example of a challenge in this area is how international aviation and shipping should be accounted for and allocated between countries, businesses or individuals. The debate about the greenhouse gas emissions of cities and urban areas is another example⁹⁹. Solutions will in part involve developing better tools for measurement, in some cases using innovative approaches such as that developed by Geluids.net¹⁰⁰ and the Kennisland digital pioneers project to measure airport noise, but also common agreement on how information is handled once collected.

In China, the Ministry of Environmental Protection is enforcing greater information through its measures on Open Environmental Information, which came into effect in May 2008¹⁰¹. These standardise the provision of environmental information across government departments and agencies, building on existing initiatives, such as the China Water Pollution Map developed by the Institute of Public & Environmental Affairs¹⁰².

- ix. **Policy and regulatory design** –As we have seen, creative policy design has played a decisive role in nurturing the green economy, with new uses of taxes, regulations, hypothecation and use of targets. Future areas of focus include the potential for individual

carbon allowances, and new methods for multi-stakeholder dialogue to agree transition strategies. Regulatory design is equally important, through everything from building regulations to controls of car emissions, carbon trading, recycling requirements and taxes or charges.

- x. **Institutional design** - also plays an important role in defining the policy and regulatory direction of governments. Before climate change was seen as a major strategic challenge for governments, environment departments were perceived as second-tier in comparison to those dealing with spending or economic development. As climate change has risen up the agenda, governments have had to redesign institutional processes to reflect this change in priorities. For example, rather than having separate energy and environment departments pursuing separate and competing agendas, the functions can be merged to encourage more coherent policy making (as in Scandinavia, and has been recently announced in the UK). The UK's recent Climate Change Act created statutory carbon budgets and a powerful cross-government machinery to monitor implementation and make recommendations on how government should achieve carbon reduction targets. Globally, the design of new and effective institutions to orchestrate environmental change has become a prominent and acutely difficult issue.

- xi. **Design of incentives and choices** - The architectures that frame behaviour, incentives and choices are increasingly being recognised as an important lens through which to view design in the green economy. Research, including most recently by Robert Cialdini, Richard Thaler, Cass Sunstein, and Wes Schultz has shown that the way choices are presented and incentives structured can help shape behaviours and norms. Giving residents improved information about their own energy consumption (e.g. through 'smart metering') can lead to falls in energy demand. When combined with information about how others are acting, social norms can be changed. Research in California has shown that information about energy usage combined with injunctive messages – in this case a smiley face or

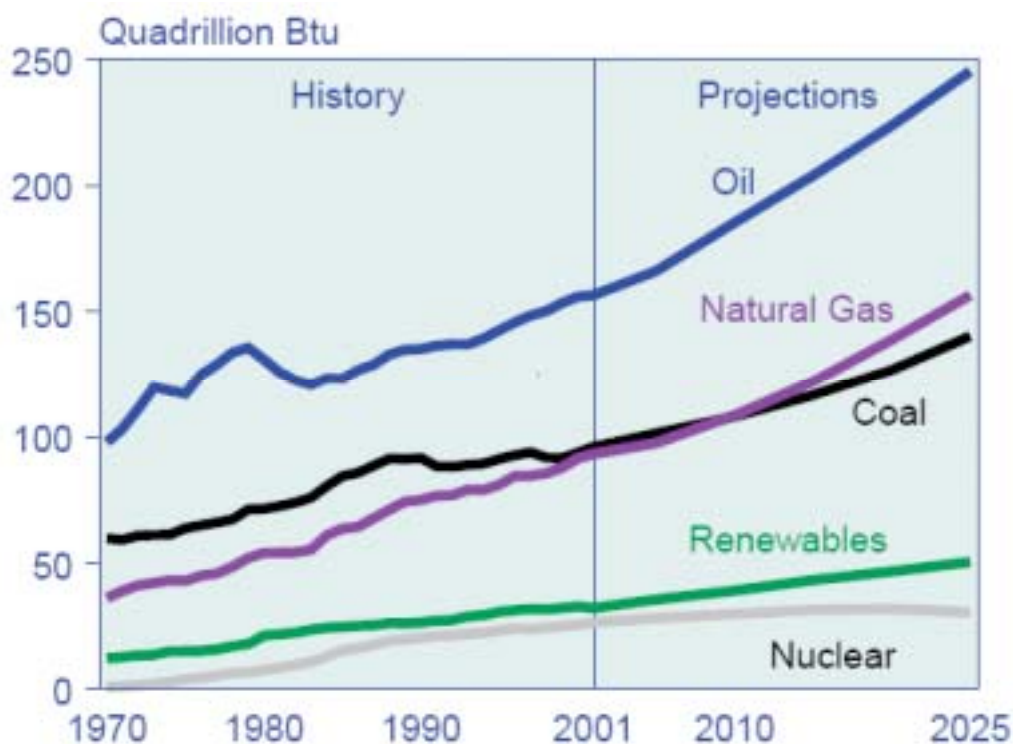
sad face on energy bills depending on whether customers were using more or less than average amounts of energy – resulted in an overall fall in energy consumption¹⁰³. The British Conservative Party has suggested that every household should have smart meters installed and that energy bills should include information allowing each household to compare their energy consumption with that of other households¹⁰⁴.

Retrofitting of existing building to make them more energy efficient is a key area where incentives are important both because the financial benefits of improved energy efficiency may be spread over a significant period of time and because in the rental market landlords may be reluctant to invest in energy efficiency measures that reduce energy bills paid by their tenants.

- xii. **Design of tools for handling time** - A central issue for the move to a green economy is how future threats and opportunities are valued, both within markets and within governments. A standard 5% discount rate values a gain of \$100 after thirty years at \$35.85 today, and after fifty years at \$7.69. Since many of the actions required to cut carbon emissions do not deliver benefits for many decades, the technical application of discount rates can be decisive in determining which technologies receive investment. Nicholas Stern, author of the influential UK government review, argued that the ‘inherent discounting’ of economists such as William Nordhaus (who advocated a 3% discount rate as a measure of future uncertainty in the costs and benefits of action on climate change) was ethically questionable because it devalued the future. His analysis applied a zero pure time preference and compared benefits today and in the future by comparing percentages of income (rather than cash), weighting income for the poor more than the rich, and for today’s citizens more than future ones since whereas current average global income is around \$7000 his forecasts projected average world income in 2100 at around \$100,000.¹⁰⁵ His approach has sparked intense controversy – yet no serious approaches to the green economy can avoid either implicit or explicit techniques for handling time.

4. The future of the green economy

There are many forecasts of the future of the green economy. The Stern review suggested that the world's power sector would need to be decarbonised by 60-75% by 2050 to stabilise greenhouse gas emission at or below 550ppm CO₂e with low-carbon energy products likely to be worth at least \$500bn per year by then.¹⁰⁶ McKinsey predicts that global solar generating capacity will be 20 to 40 times higher in 2020 than it is now.¹⁰⁷ Many forecasters expect that the green economy will bring with it millions of new jobs.¹⁰⁸ What is certain is that some parts of the green economy are inherently hard to change quickly – particularly energy and transport systems shaped by very high sunk investment. This chart represents a typical view of likely shifts in energy production worldwide reflecting this likelihood that change will be relatively slow and steady rather than discontinuous:



The range of predictions confirms that no one can be certain how the future will unfold even in a 5-10 year frame, let alone 30-50 years. Key variables include:

- Economic conditions – the overall state of the world economy will affect these predictions through many routes, both direct (growth leading to greater energy use &c), and indirect (as shrinking availability of capital changes the options open to companies, and as governments implement various fiscal stimulus packages to cut unemployment).
- Energy prices – the recent oil price spikes arguably achieved as much in terms of accelerating green investment plans as any public policies. Energy prices are affected by a range of factors, including oil and gas supply, technological advances and demand. Past attempts to predict energy prices have often failed dismally.
- Carbon prices – it's not clear whether, or when, international carbon taxes will come to be adopted, and imposed on key sectors such as aviation.
- Politics – a key factor is the willingness of the US government (and Congress) and other major governments to become proponents of stricter regulations.
- Events – very visible catastrophic events (such as Hurricane Katrina, or drought in Australia) could accelerate growing public and political awareness of the costs of environmental bads.
- Elite opinion – while the scientific arguments over climate change are largely resolved, political arguments amongst elites remain in flux, with skeptics such as Bjorn Lomborg and Richard Lindzen retaining influence.
- Public attitudes – a key issue will be how willing the public are to accept nuclear power as part of the carbon reduction

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strategies put forward by governments. Attitudes differ greatly around the world.

- Feedback effects – some apparently useful policies to cut emissions can have negative feedback effects. For example greater energy efficiency frees up consumer spending on other less energy efficient products and services. This rebound effect is already becoming visible in some societies.

Given this level of uncertainty, all straight line forecasts are suspect. However, all major institutions need to develop different scenarios for planning, looking at a range of likely patterns of global and national carbon pricing, regulatory frameworks, technological improvements and political, consumer and global pressures. Only some strategies will be robust against all these challenges – governments and businesses will need to decide which to pursue and to what extent they are willing to gamble or play safe.

5. Strategic choices

In the light of these uncertainties, governments and nations need to follow strategies that help them to be and stay ahead of the curve on likely changes to markets and regulations, while also being flexible in adapting to unpredictable events. These challenges are particularly complex for national governments since the solutions to many of these problems are simultaneously more global, and more local in nature than typical public policy.

The biggest challenge of all is time. Actions to cut pollution, or to improve water or land use can achieve relatively rapid results. By contrast, the impact of actions to reduce carbon emissions is likely to be very slow, given the great inertia of systems of energy and transport. Moreover, there are marked mismatches between the nations and institutions which need to bear the greatest burden in changing, and the likely beneficiaries. Governments influenced by short-term political pressures, and markets operating with discount rates and intense

pressures for short-term results, are strongly biased against the types of preventive action which are likely to be needed to avert climate change.

The treatment of time also has radically different effects on different parts of the world. For prosperous developed countries it may be easier to contemplate slowing down economic growth for the sake of future generations. For developing countries the need to face head-on trade-offs between growth now and climate impacts in 50-100 years time looks less attractive.

Here we briefly chart two possible strategic routes for the green economy which are already becoming visible within nations. Neither may be adequate to the challenge of cutting carbon emissions, but each will define much of what we mean by the green economy over the next two decades. Each extends the principles of existing parts of the economy – the first growing out of manufacturing principles, the second out of the expanding care economy.

The first approach dominated thinking in the first half of this decade, against a backdrop of strong growth, and low unemployment. The second approach is rapidly becoming more important as the likely depth of the economic crisis becomes more apparent.

- **D) Technology led, lean green strategies.** These extend the principles of late 20th century manufacturing, with intensive investment in R&D, cutting waste, a lean economy with products and processes that are radically more energy and materials efficient, and a further decline in labour inputs per unit of output. There are clear roadmaps for taking this route towards greater resource productivity, using a mix of policy tools. These include much greater public support for R&D in such things as clean coal, closed loop manufacturing and low carbon cars; a steady rise in taxes on carbon and tradeable permits; and some public action to orchestrate the more complex systems changes needed, for example to transform the infrastructures supporting cars. This direction is relatively easy for business at all levels to support, and for investors to commit to. Much of the groundwork has been laid by the production models promoted by firms like

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Toyota and BMW in manufacturing. This approach may see many current lifestyles preserved, or even extended, including; commuting, increasing international aviation and the use of private vehicles. It can combine incremental adaptation in many markets and large scale projects (e.g. large commuter rail networks) to maintain current systems of living. The big challenge is how far and how fast to push, and how to balance the risks of undermining competitiveness and raising costs.

- **II) Green jobs strategies.** A very different strategic approach emphasizes less the elimination of waste and more the environmentally positive ways of replacing capital and material inputs with labour. Its aim is to shift the character of the economy to more maintenance and reuse. In essence, this extends some of the principles of the care economy into other fields (the economy in health, child and eldercare is labour intensive, relatively resistant to productivity increases, and highly contextual in nature). Examples include: the promotion of urban agriculture; green roofs; and very high levels of recycling, all of which depend on significant expansions in employment in the green economy and high labour inputs to processes. The reclamation of urban land, as part of a restoration economy developed as land's environmental and economic value rises, also tends to entail higher levels of maintenance. This route to the green economy has prompted a focus on the potential for green jobs. Estimates for the Europe suggest that 1m jobs could be created from a 20% cut in present energy consumption¹⁰⁹ In India, it is estimated that biomass gasification could create 900,000 jobs by 2025¹¹⁰. In the US, a number of the major unions are campaigning on the issue. For example, the Apollo Alliance, which is made up of major unions, including the ALF-CIO and SEIU, UFCW, environmental organisations (e.g. Sierra Club), and a number of community, trade associations and business groups advocates "Clean Energy, Good Jobs, Freedom from Foreign Oil". The Alliance argues that an investment of \$300 billion would add more than 3.3 million jobs to the economy, stimulate \$1.4 trillion in new GDP and produce \$284 billion in net energy cost savings¹¹¹. Central to this argument is that renewable energy

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generation is more labour intensive and therefore job creating than non-renewable investment¹¹². This argument helped inform the Green Jobs Act 2007, which has been incorporated into the Energy Independence and Security Act (2007), and many of the commitments in the Obama campaign. However, as demonstrated by the Apollo report these jobs may require substantial investment by government and further research is needed into the extent to which these industries really are more labour intensive - and the cost-effectiveness of these investments relative to other possible investments¹¹³. There are, however, indications that there may already be a shortage of skills in green industries.¹¹⁴ A labour intensive route may also help deal with issues of transition and fairness.¹¹⁵

These two routes are not incompatible – but they involve distinct approaches and a very different ethos. There are also some other very different lenses through which the green economy may be approached. One is **security** – reducing dependence on imported fuel supplies and food. The recent sharp rise in food and energy prices has given a strong push to this way of thinking. Another is to link the green economy to **health and wellbeing**, emphasising the promotion of walking and cycling, changes to diet, less stressed lifestyles, lower commuting times. The WHO Healthy Cities programme provides one set of ideas; and its recent commission on the social determinants of health another, with a strong emphasis on the links between equality and health outcomes. Economic analysis points out that health is already much the largest economic sector in most developed economies – accounting for around 10 and 18% of GDP. This is certain to grow over the next few decades, particularly when different forms of care are included. Of course we could see combinations of these approaches or very different and perhaps more radical paths.

For China, the move towards a green economy will be important for ensuring that the use of natural resources helps, rather than hinders, efforts to achieve a harmonious society. China's choices will have a decisive impact on the rest of the world – just as changes in global regulations, laws and markets will affect China. It is estimated that

some 25% of China's carbon emissions arise from activities related to Western consumption.

The precise form that green economies take is impossible to predict. But it is now certain that all economic policy, and much policy around cities and social design, will increasingly be seen through a green lens.

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