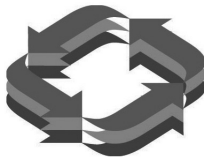


Cents and Sustainability

Securing Our Common Future by Decoupling Economic Growth from Environmental Pressures

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The Natural Edge
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earthscan

publishing for a sustainable future

London • Washington, DC

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Responding to the Complexity of Climate Change

The Overarching Moral, Economic, Scientific and Technological Challenge of Our Age

Will we stand by while drought and famine, storms and floods overtake our planet? Or will we look back at today and say that this was the moment when we took a stand? That this was the moment when we began to turn things around? The climate changes we are experiencing are already causing us harm. But in the end, it will not be us who deal with its most devastating effects. It will be our children and our grandchildren. Never has the failure to take on a single challenge so detrimentally affected nearly every aspect of our well being as a nation. And never have the possible solutions, had the potential to do so much good for so many generations to come. This is our generation's chance. It's a chance that will not last much longer, but if we work together and seize this moment, we can change the course of this nation (and world) forever.

Senator Barack Obama, 3 April 2006, Chicago, US¹

In his closing words to the Australia 2020 Summit in April 2008, the recently elected Prime Minister of Australia, Kevin Rudd, stated that 'Climate change is the overarching moral, economic, scientific and technological challenge of our age'.² This understanding is now being voiced by many of the world's political leaders, such as former US Vice President, Al Gore, in calling the situation nothing less than a 'planetary emergency'.³ The world's scientific

community is also making its voice heard, with the 2007 report from the Intergovernmental Panel on Climate Change (IPCC) finding that CO₂ equivalent levels were at 455ppm which is widely considered to be approaching the range where dangerous impacts could result.⁴ Dr Rajendra Pachauri, the chairman of the IPCC, states that 2015 will be ‘the last year in which the world could afford a net rise in greenhouse gas emissions, after which “very sharp reductions” are required’.⁵ UN Secretary-General Ban Ki-moon, when launching the Fourth Assessment Report of the IPCC,⁶ said that ‘slowing and even reversing the effects of climate change is the defining challenge of our age’.⁷

When considering the latest climate change science, and in light of the lack of progress at Copenhagen, it would be easy to despair. However, the stark reality of this situation is balanced by a growing realization that humanity has the capability to mitigate and adapt to climate change rapidly, and deliver strong economic growth as a result; the focus of the following chapters. The IPCC’s Working Group on Climate Change Mitigation for the Fourth Assessment Report showed that the world has the capability to achieve rapid reductions in greenhouse gas emissions by 2020 and even 50–80 per cent cuts by 2050,⁸ a position further supported by the 2009 update of the seminal book *Factor Four*, entitled *Factor Five: Transforming the Global Economy through 80% Improvements in Resource Productivity*.⁹ The IPCC also showed that the economic costs of meeting this target globally were minimal – a reduction of less than 0.12 per cent GDP per annum between now and 2050,¹⁰ hardly noticeable compared with the potentially devastating economic impacts of not acting. Discussing this with the authors, world-renowned sustainable development expert, Ernst von Weizsäcker reflected that, ‘Communism collapsed because it wouldn’t let prices tell the economic truth, Capitalism could collapse because we won’t let prices tell the ecological truth.’

Leading us away from despair is the partial reassurance that there are now a vast array of opportunities to harness the market and deliver significant change, such that ‘Creating the low-carbon economy will lead to the greatest economic boom in the U.S. since it mobilized for World War II’, according to former US President Bill Clinton in late 2007.¹¹ Further, there are many significant co-benefits of reducing greenhouse gas emissions that can lead to considerable cost savings. As *The Stern Review* stated, ‘... co-benefits can significantly reduce the overall cost to the economy of reducing greenhouse gas emissions. There may be tensions between climate change mitigation and other objectives, which need to be handled carefully, but as long as policies are well designed, the co-benefits will be more significant than the conflicts.’¹² Stern supports this position, finding that:

Analyses carried out under the Clean Air for Europe programme suggest cost savings as high as 40% of GHG mitigation costs are possible from the co-ordination of climate and air pollution policies. Mitigation through land-use reform has implications for social welfare (including enhanced food security and improved

*clean-water access), better environmental services (such as higher water quality and better soil retention), and greater economic welfare through the impact on output prices and production.*¹³

The European Environment Agency also showed that the additional benefits of acting to reduce global warming had the potential to deliver co-benefits related to mitigating air pollution in the order of €10 billion (US\$13 billion) per year in Europe, and additional avoided health costs of €16–46 billion per year (US\$20–58 billion).¹⁴ In short, as Al Gore outlined in his ‘A Generational Challenge to Repower America’ address in 2008: ‘When you connect the dots, it turns out that the real solutions to the climate crisis are the very same measures needed to renew our economy and escape the trap of ever-rising energy prices.’¹⁵

Despite growing evidence of both the challenges and opportunities over the last 30 years, there is still widespread hesitancy among some governments and business leaders resulting in a lack of action on a broad scale, and in some cases leading to efforts to block such progress. Much of this results from a lack of understanding, education and competency in the proven economic policies, scientific knowledge, business operations, and technological and design solutions now available – coupled with suitable economic structures for managing risk and rewarding action. Rather than seeking a ‘silver bullet’ solution – the one answer to save the world – it is becoming clear that what we need is more like what *Factor Four* and *Natural Capitalism* co-author Hunter Lovins calls a ‘silver buckshot’ approach: an integrated solutions-based portfolio of options, all travelling in the same direction and fixed on the same target and providing a range of complex and integrated challenges to be addressed within both the international and national context.

The OECD has argued that mitigating climate change is the most important of all environmental challenges because if humanity does not succeed then climate change will undermine and exacerbate all other environmental and social problems.¹⁶ These environmental issues include greater intensity of weather-related natural disasters, a decline in water availability and shifting rainfall patterns, the loss of biodiversity (both on land and in the ocean due to ocean acidification), rising sea temperatures bleaching coral reefs, and sea-level rise. Such impacts will particularly affect the developing world. As Stern points out:

*Climate change poses a real threat to the developing world. Unchecked it will become a major obstacle to continued poverty reduction. Developing countries are especially vulnerable to climate change because of their geographic exposure, low incomes, and greater reliance on climate sensitive sectors such as agriculture. For low-income countries, major natural disasters today can cost an average of 5% of GDP ... Millions of people will potentially be at risk of climate-driven heat stress, flooding, malnutrition, water related disease and vector borne diseases.*¹⁷

In light of the potential for massive development in China, Brazil, India and other rapidly emerging economies over the coming decades, the world is realizing that the current form of development that is ‘fossil fuel based, automobile-centred, and thrives on a throwaway economy’,¹⁸ as Lester Brown puts it, is not going to deliver solutions that will allow for this growth to be sustained environmentally forever. It is now widely accepted that raising living standards globally using such traditional development models will lead to significant increases in demand for resources, increases in the generation of waste and emissions, and increased risk of conflict over resource shortages.¹⁹ As discussed in previous chapters, there is compelling evidence that it is possible to significantly reduce poverty in our lifetime, and that such efforts are critical to enabling global population growth to stabilize this century. Earlier chapters have shown that the environmental, social and economic benefits of reducing global poverty and stabilizing global population levels this century are significant. However, should we be successful in achieving a substantial reduction in global poverty, serious consideration needs to be given to the potential this creates for an additional 2–3 billion people aspiring to consume to increasing levels of affluence, and contributing to increasing levels of greenhouse gas emissions and other environmental pressures. Already, ecological footprint studies show that humanity as a whole is using 40 per cent more resources than ecosystems of the earth can regenerate. Thus, if all developing nations achieved the current Western consumer lifestyle with current modes of development, this would rapidly push environmental pressures past ecological thresholds. Hence, while the levels of poverty reduction achieved in the last decade in Asian countries such as India and China are significant, there are also rising levels of demand for resources and environmental pressures right across the economy.

As Lester Brown explains:

*If, for example, each person in China consumes paper at the current American rate, then in 2030 China’s 1.46 billion people will need twice as much paper as is produced worldwide today. If we assume that in 2030 there are three cars for every four people in China, as there now are in the United States, China will have 1.1 billion cars. The world currently has 860 million cars. To provide the needed roads, highways, and parking lots, China would have to pave an area comparable to what it now plants in rice. By 2030 China would need 98 million barrels of oil a day. The world is currently producing 85 million barrels a day and experts from the International Energy Agency have warned in 2007 that we may never produce much more than that.*²⁰

Facing Unprecedented Challenges and Opportunities

Appreciating the wide array of 21st-century challenges, climate change is clearly an overarching and immediate threat to be addressed. From the proceeding chapters it is clear that a significant effort to decouple economic growth from greenhouse gas emissions will be required in the coming decades on a global scale, and also in a manner that supports the reduction of poverty. This will be one of the most complex and wide-reaching endeavours ever to face the human race,²¹ for a number of reasons:

Unprecedented speed

The speed of change needed across the world's economies to avoid dangerous climate change will require a massive effort. When considering the now common calls from climate scientists and policy analysts that the countries of the world must make significant reductions to emission levels in the coming decade, it is sobering to realize that according to the IPCC, carbon dioxide annual emissions grew by about 80 per cent between 1970 and 2004, and that the models predict an increase of global greenhouse gas emissions by 25 to 90 per cent (CO₂e) between 2000 and 2030.²² This is complicated by the fact that, according to UNEP, 'One of the reasons for the limited impact of policies is the long lifespan (40–50 years and longer) of energy infrastructure. This means that technology and investment decisions from decades ago have created a path dependency for today's production and consumption patterns.'²³ Hence, efforts need to be further accelerated to compensate for such infrastructure legacies.

Unprecedented scale

At present, fossil fuels provide at least 80 per cent of global energy requirements and are the basis of most of the industrial infrastructure and built environment the world has developed in the last 300 years.²⁴ In addition, greenhouse gas emissions arise from virtually all sectors of the economy in many different ways. Unlike other significant environmental issues – such as acid rain from sulphur dioxide pollution, which is relatively easy to respond to with a technical change in coal-fired power stations, or the reduction of the emissions of particular gases under the Montreal Protocol that were relatively easily replaceable – there is no one technical fix that can solve the climate change challenge. This is further complicated by the fact that, according to the New Economics Foundation, 'Implementation of environmental policies requiring substantial societal or cultural changes, such as a culture of environmental protection, or structural realignment, will meet with fierce resistance from sectors affected and from some parts of the public. Therefore, governments tend to buy time or defer decisions when such 'hard' structural changes in overall policies are required – often until it is too late.'²⁵

Unprecedented uncertainty

As the economic viability of a number of sectors of the economy – such as metal processing, cement and chemicals production, air transport and power stations – is currently tied to low energy costs, the future impacts from assigning a cost to greenhouse gas emissions through ecological tax reform or emissions trading schemes, present significant uncertainty. The fear of short-term losses has led to powerful vested interests forming blocking coalitions to prevent action on climate change since the early 1990s.²⁶ The *New York Times* editorialized in May 2007 that such a message ‘is a hugely important message to policy makers everywhere ... Many of them have been paralysed by fears ... that a full-scale attack on climate change could cripple the economy.’²⁷ However such uncertainty is being responded to by a number of works including the 2009 book *Factor Five*, where the authors of this volume worked with Ernst von Weizsäcker to chronicle the vast array of cost-effective energy productivity improvements that could be achieved in such sectors by taking a whole system approach, making it possible even for heavy industries and fossil fuel companies to significantly reduce their energy usage and greenhouse gas emissions.²⁸

Unprecedented need for education

As many countries have been blessed with access to cheap energy for so long, there has historically been relatively little attention given to reducing energy demand or generating renewable energy, accompanied by a lack of knowledge and skills in these areas. Abundant supplies of cheap energy have meant that when decision-makers have been faced with growth in energy demand they have usually just built more of the same form of supply infrastructure. Governments, keen to attract large industry, have often offered energy subsidies that have further made the price of energy artificially cheap. Hence many governments and companies now find themselves unprepared to focus on cost effectively reducing energy demand or generating onsite renewable energy. In Australia, recent surveys commissioned by the National Framework for Energy Efficiency (undertaken by Desha and Hargroves as discussed in Chapter 3), PriceWaterhouseCoopers,²⁹ Proudfoot Consulting,³⁰ Australia Industry Group³¹ and the Australian Research Institute in Education for Sustainability³² show that business leaders and key stakeholders like engineers and built environment professionals lack adequate education and training to ensure that Australia achieves cost-effective emissions reductions. These studies, which include discussions regarding similar global education challenges, highlight the unprecedented and urgent need for such capacity building.

Unprecedented need for collaboration

When facing the issues of climate change it is easy to become hypnotized by the complexity, and in order to meet this complexity with creativity and ingenuity

the professions need to work together to inform each others' efforts. For instance, consider the nexus between economics and engineering. The study of economics, if well informed by science, can provide valuable guidance as to the potential impact on an economy from a range of strategies for emissions reduction. Also, a study of science, engineering and design, informed by economics, can provide valuable guidance as to the potential for our industrial economies to achieve such reductions in light of best practices and balanced by the potential impacts on the environment. On its own, a study of economics needs to be informed by what is physically possible. Likewise a study of science and engineering on its own cannot provide all the answers without being informed by economics as to the impacts on the economy from a range of potential engineering and design options. The merger of these professions is in its very early stages, and governments struggling to come to grips with the reality of the climate change issue and how it will affect their economies need to seek advice from both these and a range of other professions to balance assumptions and recommendations (further discussed in Chapter 7). As Stern points out, 'The scientific and economic framework provides a structure for the discussions necessary to get to grips with the global challenge and guidance in setting rational and consistent national and international policies.'³³

Unprecedented need for cooperation

Responding to climate change requires unprecedented global cooperation and agreement. Ultimately a whole of global economy approach is needed, otherwise positive achievements in parts of the world may be offset by emissions growth in other parts. As *The Stern Review* points out, 'Because climate change is a global problem, the response to it must be international. It must be based on a shared vision of long-term goals and agreement on frameworks that will accelerate action over the next decade, and it must build on mutually reinforcing approaches at a national, regional and international level.'³⁴ Developing countries are understandably concerned about the fairness of any international agreements, and the levels of reductions required by each country need to be carefully considered as part of an overall global strategy, potentially on a per capita basis or a GDP-adjusted per capita basis.

Unprecedented interconnectivity

It may prove to be the case that the inherent complexities of responding to the climate crisis will also provide opportunities to assist other efforts. As negative impacts can be compounded in unpredictable ways through the planet's interconnected ecosystems, efforts to decouple greenhouse gas emissions can also be aligned with and positively reinforce efforts to decouple economic growth from a wide range of environmental pressures.

In Chapters 8–11 this concept is investigated for issues related to the loss of biodiversity and natural resources, water pollution and availability, waste production and air pollution. For instance:

- Countries that seek to contribute to their emissions reduction targets by investing in halting deforestation, improving soils to store carbon and assisting a shift to more appropriate forms of agriculture and forestry, particularly in developing countries, not only reduce emissions, but can also achieve improvements in the viability of forestry and agriculture, reduced risk from landslides, reduced loss of topsoil and reduced pressures on biodiversity (discussed in Chapter 8). This is especially viable, as reducing deforestation is a very cost-effective way to reduce greenhouse gas emissions globally, while investing in developing countries. As *The Stern Review* found, 'A study commissioned for the Review looking at 8 countries responsible for 70% of emissions from deforestation found that ... emission savings from avoided deforestation could yield reductions in CO₂ emissions for under \$5/tCO₂, and possibly for as little as \$1/tCO₂.'³⁵
- Many nations of the world will face severe water shortages this century due to changes in rainfall, melting of glacial reserves and increasing temperatures from climate change, together with over-extraction and inefficient use. Yet many are now finding that action to reduce water consumption can yield multiple benefits such as reducing energy demand and greenhouse gas emissions at a national and state level, by reducing the need for storage, purification and distribution of potable water, and at the household level through reductions in hot water requirements, a significant energy consumer. The potential to save energy this way is significant as shown by the fact that the Californian Energy Commission, in their 2005 report *California's Water-Energy Relationship*,^{35A} showed that water-related energy use makes up 19 per cent of all energy used in California, as discussed in Chapter 9.
- Another area of potential for reducing greenhouse gas emissions is through reducing waste production, such as reducing both the production of methane and the wastage of raw materials in municipal waste landfills. Efforts to reduce municipal waste, such as capturing the organic content for use in agriculture, recycling metals and plastics or shifting to biodegradable or minimal packaging, will not only reduce emissions but also reduce pressure on inorganic fertilizers and raw materials. This will lead to multiple benefits, as the mining and processing of non-renewable minerals and petrochemical resources is highly energy intensive compared to metal and plastics recycling (discussed in Chapter 10)
- Actions to reduce greenhouse gas emissions related to transport systems, urban planning, building regulations and energy generation will also have multiple benefits related to reductions in air pollution, such as reducing motor vehicle emissions.³⁶ Such benefits mostly relate to reducing damage to infrastructure and agriculture from acid rain from coal-fired power stations, and reduced impacts on human health, considering that there are approximately 800,000 deaths annually from ambient urban air pollution.³⁷ A study conducted by a leading Indian environmental NGO, the Centre for Science and Environment, revealed that about 10,000 people die prematurely in Delhi due to air pollution each year,³⁸ which is

equivalent to an average of one death every 52 minutes (discussed in Chapter 11). Air pollution is a significant cost to economies, considering that:

- In 1995, the UK government calculated total costs of damage from acid rain to be over £18 billion mainly from building damage.³⁹
- A European study found that tropospheric ozone causes measurable, regional-scale reductions on crop yields for 23 species of arable crops, costing Europe US\$5.72–12 billion a year in lost production.⁴⁰
- Particulate pollution under 10 microns (PM10) is predicted by the OECD to cause premature deaths and years of life lost of 3.1 million and 25.4 million respectively, by 2030.⁴¹
- A poll of tour guides found that one in ten tourists suffered pollution-linked health problems while visiting Hong Kong.⁴² In Kathmandu, 17 per cent of tourists interviewed indicated that they would avoid visiting Nepal again because of poor air quality.⁴³

Given these unprecedented challenges, and potential opportunities, in order to have a realistic chance of decoupling economic growth from greenhouse gas emissions and other environmental pressures on a global scale, business and governments around the world need to show considerable leadership. We next present an overview of evidence to date of such leadership from the business community and among national governments, particularly those with the ten largest economies, to demonstrate that in recent years significant progress has been made, providing a strong platform of experience to drive efforts in reducing greenhouse gas emissions while maintaining strong economic growth.

Signs of Change in the International Business Community

The global climate crisis will fundamentally reshape organisations and management. It will bring in new career paths ... and change the structure of organisations and the way they are run. It's early days, and no one in the world knows its final impact, but there are already signs of the ground shifting. It will force businesses and managers to live with uncertainty, a world shaped by forces still emerging.

The Age, 20 August 2008⁴⁴

Just over a decade ago many corporations were either supporting or participating in active lobbying against action on climate change. Since then, there has been a sea-change in attitudes in the business community. This transformation is occurring because of the increased certainty of the science of climate change, and a greater understanding of the risks and opportunities it presents for businesses and society, particularly after the publication of *The Stern Review* in 2006. These factors, combined with rapidly growing markets for clean-tech and renewable energy, have contributed to many leading businesses now seeing

climate change as a major business opportunity to improve their competitive advantage and reduce future risks. Companies are also increasingly facing new climate change-related regulations, whether at the state or national level, with which they need to comply. Hence, increasingly, chief executive officers and investors are realizing that the next major risk to the bottom line will be their reliance on generating greenhouse gases. As a result, investors are beginning to put pressure on companies to disclose climate-related risks and communicate their climate strategies. For example, during the US 2008 proxy season, investors filed a record 54 climate-related shareholder resolutions, twice as many as the previous season, most of which were seeking greater analysis and disclosure of business impacts related to climate change.⁴⁵ Furthermore, in 2008, organized by the Carbon Disclosure Project, an invitation to disclose greenhouse gas emissions performance and related strategies was sent to 3000 companies under the signature of 385 institutional investors with combined assets of US\$57 trillion, resulting in 1550 responses.⁴⁶

According to the FTSE Group, the UK equivalent of the US Dow Jones, there is growing awareness that ‘the impact of climate change is likely to have an increasing influence on the economic value of companies, both directly, and through new regulatory frameworks. Investors, governments and society in general expect companies to identify and reduce their climate change risks and impacts, and also to identify and develop related business opportunities.’⁴⁷ In this age of rising climate change issues, companies do not want to be targeted by NGOs or the media as being slow to act on climate change, especially as according to a 2004 survey by the World Economic Forum, responding leaders felt that corporate reputation was a more important measure of success than stock market performance, profitability and return on investment.⁴⁸ Understanding these trends, a number of companies internationally have taken leadership in developing and implementing cost-effective strategies to respond to climate change, with many finding that taking such action has turned out to be far more profitable than they first thought, through a combination of energy efficiency, renewable energy and carbon offsets. For example, since 2003, investigations by the Climate Group, as part of the Carbon Down, Profits Up programme,⁴⁹ have shown that six early-moving major firms – Dupont, IBM, British Telecom, Alcan, NorskeCanada and Bayer – collectively saved over US\$4 billion while reducing their carbon emissions by more than 60 per cent. Further investigations by the group showed that up to 2006, 43 large companies had significantly reduced their greenhouse gas emissions and saved a total of US\$15 billion.⁵⁰ Businesses are also using their marketing and salesmanship to promote genuinely greener, more energy-efficient products to consumers. Sir Terry Leahy, Chief Executive of Tesco, stated that ‘The key to success is to turn green consumption into a mass movement. By harnessing the buying power of millions of consumers we can drive change throughout the economy.’⁵¹

Other businesses are harnessing research and development opportunities to create new ‘green’ revenue streams. For example, in May 2005, General Electric, one of the oldest and largest corporations on the planet, announced

Ecomagination, a major new business driver that was expected to more than double revenues from cleaner technologies to US\$25 billion by 2010 (from US\$6.2 billion in 2004).⁵² In May 2006, the company had already reported revenues of US\$10.1 billion⁵³ from its energy-efficient and environmentally advanced products and services, and by 2008 this figure had grown to US\$17 billion. As of May 2009, the portfolio contains over 80 products, with the company aiming to invest US\$1.5 billion in researching cleaner technologies by 2010, having already invested over US\$1.4 billion in 2008.⁵⁴ GE Chief Executive Jeffrey Immelt believes that, ‘at some point in time, customers are going to say, “I don’t want anything but an environmentally friendly product.” It won’t be acceptable to have something that is cheap but dirty.’⁵⁵ To this end, GE developed plans that aimed to reduce emissions by 30 per cent by 2008 (which they surpassed in 2008), and to improve the energy efficiency of their operations by 30 per cent by 2012.⁵⁶

Global corporations are also beginning to address the implications and impacts of their products and services. For example, Wal-Mart announced in 2006 a US\$500 million climate change commitment, including initiatives to increase truck fleet fuel efficiency by 25 per cent in three years and double it in ten years.⁵⁷ By 2008 they met their target of their whole fleet being 25 per cent more efficient, with the US component of the fleet now 38 per cent more efficient than it was in 2005.⁵⁸ As Wal-Mart Chief Executive Lee Scott observed, ‘It will save money for our customers, make us a more efficient business, and help position us to compete effectively in a carbon-constrained world.’⁵⁹ The company also realized that changing the incandescent bulbs in its ceiling fan displays throughout its 3230 stores (40 bulbs per store) could save it US\$6 million a year.⁶⁰ Wal-Mart’s Chief Merchandising Officer John Fleming at a press conference at Merrill Lynch & Co.’s headquarters in New York said, ‘We don’t believe a person should have to choose between an environmentally friendly product and one they can afford to buy ... We want our merchandise to be both affordable and sustainable.’⁶¹ Wal-Mart is aiming to open a prototype store which is 25–30 per cent more efficient than the standard.⁶² In addition, Wal-Mart has developed a strategy to influence its 60,000 suppliers to produce lower carbon products.⁶³ Work is under way to develop a Sustainability Index, based on a 15-question survey which all of Wal-Mart’s suppliers will have to complete, and from life-cycle analyses undertaken by a consortium of universities in collaboration with manufacturers, retailers, NGOs and government organizations. It is hoped that this will enable customers to make more informed choices when shopping, and will create more incentive for the manufacture of sustainable products.⁶⁴

It will of course be easier for some sectors of the economy to decouple greenhouse gas emissions than others, but the opportunity to dramatically improve energy productivity exists in every sector. Companies such as General Electric and Wal-Mart are among the first to make significant commitments to emissions reductions, partly because the energy-saving initiatives related to buildings, appliances and transportation are well supported and proven.

However, in other sectors, particularly heavy industry, the precedent for such initiatives is only now emerging. Encouragingly, a range of options exist even for the heavy industries to significantly reduce energy consumption⁶⁵ and emissions of greenhouse gases,⁶⁶ including:

- Up to 50 per cent reductions in the energy intensity of zinc, tin, copper and lead smelting by using advanced furnace technology and co-generation.⁶⁷
- Up to 50 per cent reductions in the energy intensity of crushing and rock grinding in the mining sector.⁶⁸
- Up to 80 per cent reductions in the energy intensity of the steel industry by using innovative processes such as electric arc furnaces with high levels of recycled steel, and near net shape casting technologies.⁶⁹
- Between 30 and 80 per cent reductions in the energy intensity of the cement industry, by improving the current process to create Portland cement (30 per cent),⁷⁰ or by using innovations in geopolymers to replace Portland cement (80 per cent),⁷¹ which can be used for most major purposes for which Portland cement is currently used.⁷²
- Significant reductions in paper and pulp mills through investing in energy efficiency, co-generation and utilizing biomass as a source of energy. Paper and pulp mills can now even be retrofitted to become renewable electricity power generators through the use of black liquor gasification combined cycle technologies.⁷³

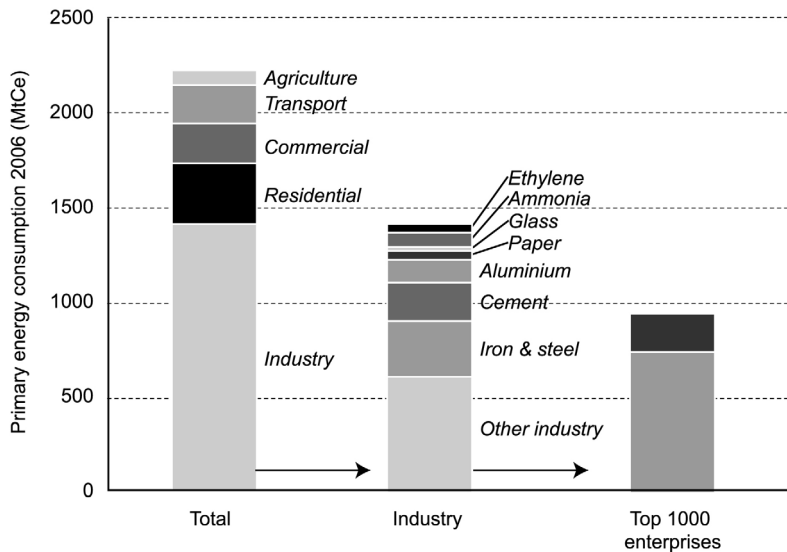
Investigating such options, the Australian National Framework for Energy Efficiency⁷⁴ found that 30 per cent more efficiency gains could be made with a four-year or less payback period, and up to 70 per cent with an eight-year or less payback period across industry in Australia. Given these and many other such opportunities, many governments around the world are entering into voluntary agreements with industry to meet specific energy-use or energy-efficiency targets.⁷⁵ A number of industrial sector agreements and target programmes around the world have led to significant energy efficiency improvements, including:

- Canada: Industry Programme for Energy Conservation;⁷⁶
- Denmark: Agreements on Industrial Energy Efficiency;⁷⁷
- Germany: Declaration of German Industry on Global Warming Prevention;⁷⁸
- Japan: Keidanren Voluntary Action Plan on the Environment;⁷⁹
- Australia: Energy Efficiency Opportunities Program⁸⁰ (*with the Victorian government the only state to place mandatory requirements on businesses above a certain size to identify and implement energy efficiency opportunities of three years or less.*)

In the UK, such voluntary agreements have been taken a step further with energy-intensive companies being able to apply to sign a Climate Change

Agreement (CCA)⁸¹ whereby the company agrees to commit to achieving a certain carbon reduction target or improving their energy efficiency, and in return receives exemption from 80 per cent of the carbon tax.⁸² Overall, the signatories to the CCA programme exceeded their targets by the equivalent of 1 million tonnes of carbon (MtC) per year up to the first target period (2002), by 1.4 MtC a year up to the second target period (2004),⁸³ and by around 1.9 MtC⁸⁴ a year up to the third target period (2006). Through this process these businesses in the UK are saving over US\$650 million from reducing greenhouse gas emissions.⁸⁵ Such progress in the UK business sector also strengthened bipartisan support for the 2008 energy bill, allowing the UK government to pass laws that make it the first country in the world to introduce legally binding legislation to cut greenhouse gas emissions by 80 per cent by 2050. The Netherlands government has also run since 1989 a major national programme to encourage energy efficiency in industry with negotiated formal binding agreements. The first Dutch long-term agreement scheme with industry had quantitative targets, to increase energy efficiency by 20 per cent by the year 2000 (compared to 1989), and for the whole of Dutch industry this target has been achieved.⁸⁶

The UK and Netherlands experience has helped to inspire the Chinese government to adopt a similar programme with the 1000 largest heavy industry companies in China, with an estimated combined energy consumption of



Note: Top-1000 program energy consumption is typically reported in final energy units (bottom segment). The shaded area at the top provides the MtCe equivalent of electricity generation, transmission, and distribution losses.

Figure 6.1 Energy consumption of China, China's industrial sector and the top 1000 energy-consuming enterprises, 2005

Source: LBNL (2009)⁸⁷

around 33 per cent of national energy consumption,⁸⁸ as shown in Figure 6.1. After visiting the UK and Netherlands programmes in 2003, the Chinese government has worked with industry since 2006 to create China's Top 1000 Energy-Consuming Enterprises Program.⁸⁹ The goal of the programme is to contribute up to 25 per cent of the savings required to achieve the overall Chinese government target of a 20 per cent reduction in energy use per unit of GDP by 2010.⁹⁰ Such a target is unprecedented, with no other country having such strong mandatory energy efficiency targets for its heavy industries. Subsequently, the Chinese steel industry (responsible for over half of global production) experienced a decrease in overall energy consumption of 8.8 per cent between 2005 and 2006.⁹¹ Such reductions by heavy industry are contributing to the nation's overall reductions in energy intensity of 3.7 per cent in 2007 and 4.6 per cent in 2008.⁹² An initial review in 2008 by the Lawrence Berkeley National Laboratory showed that the programme is proceeding well and could even achieve 50 per cent more savings than planned in 2010.⁹³ Further investigations showed that in the first quarter of 2009 the programme was contributing significantly to assisting China achieve an overall 20 per cent cut in energy intensity by 2010.⁹⁴

There are also significant potential reduction opportunities for light industry and the service sector – media, finance and banking, professional services, education, health and tourism – a sector that in OECD countries generates the majority of GDP and is responsible for as much as 70–80 per cent of employment.⁹⁵ However, in these sectors, energy costs are a small percentage of total costs, leading in the past to a minimal focus on reducing consumption.⁹⁶ As Amory and Hunter Lovins wrote in 1997, 'the average business spends (just) 1–2 per cent of their total costs on energy'.⁹⁷ Thus significant opportunities exist now in the service sector to firstly capitalize on the 'low hanging fruit', or easily realized reductions in energy usage, of up to 30–50 per cent of demand, and then to invest in energy from low-carbon sources, to become 'climate neutral' in regard to energy use. For example, in the UK, leading companies in the services sector such as Barclays Bank, Marks & Spencer, BSI, HSBC, Simmons & Simmons, Bradford and Bingley, Radio Taxis and BSkyB are a part of a growing wave of top British companies that claim to have achieved the net climate neutral status.⁹⁸ Throughout Europe many companies are committing to, and becoming, net climate neutral, such as Dutch multinational banking and insurance company ING which is reported to have been climate neutral since 2007. The UNEP Climate Neutral Network lists many other European companies that have committed to becoming climate neutral.⁹⁹ For instance, 20 Swedish companies have become net climate neutral and joined the UN Global Compact Caring for Climate Programme,¹⁰⁰ and in Australia numerous companies have now committed to becoming climate neutral from sectors that represent 70 per cent of the Australian economy and contribute significantly to Australia's GDP and employment.¹⁰¹ News Corporation, for example, the global media empire headed by Rupert Murdoch, has committed to become climate neutral by 2010.¹⁰² Furthermore, a number of other large companies –

PriceWaterhouseCoopers,¹⁰³ KPMG,¹⁰⁴ Energetics,¹⁰⁵ Bunnings Warehouse,¹⁰⁶ Fuji Xerox Australia, Westpac, National Australia Bank, ANZ, Insurance Australia Group and Swiss Re – have also committed to becoming climate neutral.¹⁰⁷

In the US, there are now numerous government and NGO energy efficiency programmes working collectively with thousands of companies who are meeting their greenhouse gas reductions targets ahead of schedule and making money. For example, nearly 100 case studies charted by the Center for Energy & Climate Solutions for the Cool Companies Project demonstrate how businesses are earning the equivalent of 40–50 per cent returns on energy-saving investments.¹⁰⁸ Savings bring not only lower costs, but also measurable, documented productivity gains through improved product quality, working conditions and employee morale. The US Pew Center for Global Climate Change partner companies are also finding similar success,¹⁰⁹ as are the US EPA's Climate Leaders.¹¹⁰ Leading US companies that are committed to (or already have) become climate neutral include Dell (computer manufacturer),¹¹¹ Google (internet search engine), Microsoft (computer software), The Cliff House (restaurant), Shaklee Corporation (pharmaceuticals, health goods), the Saunders Hotel Group (hotels and accommodation), Interface (carpet), Organic Bouquet (flowers), TripleE Better World Travel, (travel service provider), FedEx (hybrid delivery truck service), and PG&E (Californian energy supply company), to name a few.¹¹² Other major US Fortune 500 companies like PepsiCo and Whole Foods Supermarkets are now purchasing 100 per cent of their energy from low-carbon renewable sources, as are other US companies such as Mohawk Fine Papers, Inc. (Printing), the Dannon Company, Inc. (food and beverage), and the WhiteWave Foods Company (food and beverage).¹¹³

Considering such advances around the world, Hunter Lovins wrote in her contribution to the *Plan for Presidential Action for the First 100 Days in Office for the Next President of the United States*, (by the Presidential Climate Action Project), 'regardless of how severe the impact of climate change proves to be, and regardless of how drastically and how soon GHG come to be regulated at the federal level, these companies will be in a leadership position because by taking early action to deal responsibly with it, they cut their costs and got ahead of their competitors'.¹¹⁴ Understanding this, companies such as DuPont, GE, Alcoa, Caterpillar, PG&E, Lehman Brothers and others, acting as members of the US Climate Action Partnership, or USCAP,¹¹⁵ called for national legislation on carbon emissions in 2007, stating, 'In our view, the climate change challenge will create more economic opportunities than risks for the U.S. economy.'¹¹⁶ Such calls for leadership were clearly answered then by President Elect Obama with the release of the Obama/Biden Energy Plan in 2008, which, among other targets, called for 80 per cent reductions in emissions over 1990 levels by 2050.¹¹⁷ Clearly, with such strong signs of change in the international business community, the time to act is now. Indeed, as both Amory Lovins and Hunter Lovins have long been advocating, businesses who do not have ambitious strate-

gies to respond to climate change will face significant future risks, including losing business opportunities, export opportunities, reputation and the goodwill of both the local and global community.

The international business community is increasingly calling on governments to take action through a number of significant communications, including the 2007 Bali Communiqué,¹¹⁸ the 2008 Poznam Communiqué¹¹⁹ and the 2009 Copenhagen Call,¹²⁰ issued collectively by the chief executives of over 150 major global businesses. The first of these, issued in November 2007 in the lead-up to UN climate change negotiations in Bali, called for a comprehensive and legally binding UN framework to tackle climate change to underpin rapid reductions of greenhouse gas emissions in line with scientifically based targets, and was supported by corporations including ANB AMRO, Philips, Sun Microsystems, Volkswagen, Johnson & Johnson, Tesco, Coco-Cola, Unilever and Vodaphone. The process, led by the Prince of Wales' UK and EU Corporate Leaders Groups on Climate Change, resulted in a business communiqué to government that was based on an appreciation of the science rather than what is considered politically palatable or 'reasonable'.

The Bali Communiqué states that:¹²¹

The scientific evidence is now overwhelming. Climate change presents very serious global social, environmental and economic risks and it demands an urgent global response. As business leaders, it is our belief that the benefits of strong, early action on climate change outweigh the costs of not acting:

- *The economic and geopolitical costs of unabated climate change could be very severe and globally disruptive. All countries and economies will be affected, but it will be the poorest countries that will suffer earliest and the most,*
- *The costs of action to reduce greenhouse gas emissions in order to avoid the worst impacts of climate change are manageable, especially if guided by a common international vision,*
- *Each year we delay action to control global emissions increases the risk of unavoidable consequences that will likely necessitate even steeper reductions in the future, causing potentially greater economic, environmental and social disruption, and*
- *The shift to a low-carbon economy will create significant business opportunities. New markets for low carbon technologies and products, worth billions of dollars, will be created if the world acts on the scale required.*

This message, again clearly put forward in the Poznam Communiqué in 2008, and the Copenhagen Call in 2009, is forming a clear and consistent call for action to national governments, one that is being strengthened by the success of businesses around the world as outlined above.

Signs of Change within Regulations and Policies

In the lead-up to the Copenhagen Summit, in July 2009, the leaders of the G-8 countries US, Japan, China, Germany, France, UK, Russia and Canada agreed to a non-binding target of 80 per cent reductions in greenhouse gas emissions by 2050, with the intention of enabling the world as a whole to achieve a 50 per cent reduction by 2050.¹²² Such targets, although non-binding, sent a strong signal that world leaders recognized the need to undertake purposeful policy and regulatory changes to achieve significant levels of decoupling. Whilst overall the Copenhagen Summit did not fulfil expectations during the lead-up and in the months afterwards, many nations made new commitments to stronger reduction targets with some bringing in new policies. For instance, the Brazilian government has committed to 36–38 per cent cuts in greenhouse gas emissions by 2020 below business as usual. This and other important developments, largely missed by the media post-Copenhagen, are well summarized in Deutsche Bank's 2010 report *The Green Economy: The Race is On*.^{122A} This report shows that there were 154 new policies for help to drive action on climate change in nations around the world between September 2009 and March 2010. This is a significant increase on comparative periods, indicating that policy momentum is gathering rather than diminishing on climate change at the local and national level in many countries post-Copenhagen, contrary to the popular media perception.

We now provide a summary of leading policy changes by nations around the world on a range of topics, and then overview related efforts by the ten largest economies on the planet (Table 6.1). The world economy for the last 200 years has achieved remarkable economic growth partly because of access to cheap fossil fuels. It will take time to transition to a low-carbon economy, and there are significant barriers to change, not just from vested interests, but from a wide range of market, informational and institutional failures, together with the inherent complexity of the issues. Thus, in addition to policies to create a financial value for carbon emissions, such as emission trading schemes or carbon taxes implemented now in over 30 nations and 10 US states, effective decoupling of economic growth from greenhouse gas emissions is most likely to be achieved if countries also implement a range of related complementary policy measures and programmes.¹²³ Business, as explained above, is increasingly looking for clear and consistent leadership from government on climate change policy. The following pages briefly highlight how leading governments around the world are targeting mitigation opportunities with ambitious goals and policies. We then overview efforts in these areas by the 10 largest economies in the world, namely the US, Japan, China, Germany, France, the UK, India, Italy, the Russian Federation and Brazil.

The following examples of policy reform provide real-world examples from which others can learn and, we hope, inform the development of a suite of policy options suitable to each nation.

Climate neutral nations and cities

Nine nations – Norway, Portugal, Iceland, Pakistan, Costa Rica, the Maldives, Monaco, Ethiopia and Niue – have now committed to becoming very low carbon and even net climate neutral by 2050, if not before, and have joined the UNEP Climate Neutral Global Network.¹²⁴ Fifteen cities – Arendal, Norway; Rizhao, China; Vancouver, Canada; Växjö, Sweden; Aguascalientes, Mexico; Brisbane, Australia; Cape Town, South Africa; Cascais, Portugal; Copenhagen, Denmark; Curitiba, Brazil; Daejeon, South Korea; Niteroi, Brazil; Slough, England; Sydney, Australia; and Waitakere, New Zealand, have also signed up to the UNEP network. Hundreds of businesses and civil society organizations, who have committed to becoming climate neutral, have also joined. The network, a web-based project, is seeking to federate the small but growing wave of nations, local authorities, companies and civil society organizations who are pledging to significantly reduce emissions over time to develop zero-emission economies, communities and businesses.

2020 Greenhouse gas reductions regional targets (summarized in Table 6.1)

Leading the way is Costa Rica, which has committed to becoming net climate neutral by 2021. Following them is Norway, which has committed to 40 per cent greenhouse gas reductions by 2020 as part of their goal to become climate neutral by 2030. The EU has committed to a minimum 20 per cent reduction in greenhouse gas emissions (from 1990 levels) by 2020 and is pushing in international meetings for a global agreement of 30 per cent reductions by 2020. If the world will agree to the 30 per cent target by 2020 then the EU will adopt this stronger target.¹²⁵ Many other countries around the world have committed to strong 2020 greenhouse gas reduction targets, including Canada (17 per cent on 2005 levels), Japan (25 per cent from 1990 levels), South Korea (30 per cent below business as usual (BAU)), Russia (25 per cent from 1990 levels), Brazil (36.1 per cent to 38.9 per cent below BAU), India (20–25 per cent reduction in energy intensity on 2005 levels), Indonesia (26 per cent relative to BAU and by up to 41 per cent with international support), South Africa (34 per cent below BAU), Mexico (30 per cent below BAU levels), Thailand (22.5 per cent reduction in energy emissions), Israel (20 per cent below BAU), and Singapore (16 per cent below BAU levels).

China has committed to a 40–45 per cent reduction in carbon dioxide emissions per unit of GDP by 2020 compared to 2005 levels. The 11th Chinese Five-Year Plan calls for 20 per cent reductions in energy usage per unit of GDP from 2005 to 2010,¹²⁶ with early evidence showing that China is on target to achieve this.¹²⁷

Energy efficiency targets

The EU currently has a non-binding target of 20 per cent energy efficiency improvement by 2020.¹²⁸ As noted above, in the UK the biggest 10,000

energy-using companies have to, by law, sign up to and achieve energy efficiency targets to receive an 80 per cent exception from the UK carbon tax.¹²⁹ Most of these companies have exceeded their energy efficiency targets ahead of time and overall saved £650 million (approximately US\$1020 million) in the process. According to the British Prime Minister Gordon Brown, this will ‘have committed our continent to a low carbon trajectory, demonstrating how Europe can provide the platform for Britain to achieve its aims nationally and internationally’.¹³⁰

Of the rapidly growing transition economies in the world, China has the most impressive record for setting and achieving ambitious energy performance targets. In 1980, Chinese President Deng Xiaoping adopted the goal to quadruple GDP while only doubling energy consumption over the 20-year period between 1980 and 2000.¹³¹ Investigations by the Lawrence Berkeley National Laboratory show that during this time China achieved greater than a sixfold increase in GDP, with a corresponding increase in energy use of a little over double.¹³² This remarkable achievement not only affected Chinese industry and business, but affected the entire global economy, as estimates by the Lawrence Berkeley National Laboratory show that if this level of reduction in energy intensity had not been achieved, China would today be consuming two to three times more energy, making it by far the largest energy consumer in the world.¹³³ Again in 2000, Chinese officials committed China to a fourfold increase in GDP by 2020 with only a doubling in energy usage. To ensure this is achieved the Chinese government has committed to the ambitious energy efficiency goal of achieving a 20 per cent reduction in energy intensity by 2010. This ambitious goal is underpinned by numerous new policy initiatives and programmes, as outlined in Table 6.1.

Energy standards for buildings

Numerous efforts in the US, Europe, Australia, China and Japan are all working to improve building standards.¹³⁴ The UK Government’s Code for Sustainable Homes legislates binding regulations for energy reduction with staggered targets – 25 per cent more efficient by 2010, 44 per cent by 2013, and 100 per cent or zero emissions by 2016. Now passed into law, the code sets minimum standards for both energy and water efficiency. In addition, the UK government has agreed that any home achieving a Level 6 sustainability rating will be exempt from stamp duty.¹³⁵ In France, the government has committed to ensuring that all new buildings should ‘produce more energy than they consume’ by 2020.¹³⁶ In Freiburg, Germany, a progressive energy-efficient housing standard has resulted in reductions of up to 80 per cent in energy use for space heating, by requiring energy consumption for heating purposes in households to be limited to 65kWh/m² per annum for all construction under the Council’s jurisdiction since 1992 (including construction on land bought from the Council and in projects funded by the Council). This is approximately a 70 per cent improvement on typical older European homes of 220kWh/m² per annum.¹³⁷

In 2008, the California Public Utilities Commission adopted the California Long-Term Energy Efficiency Strategic Plan, which includes the following commitments:

- All new residential construction will be zero net energy by 2020.
- All new commercial construction will be zero net energy by 2030.
- The heating, ventilation and air-conditioning industry will be re-shaped to deliver maximum performance systems.
- All eligible low-income customers will have an opportunity to participate in the Low Income Energy Efficiency Program and will be provided all cost-effective energy efficiency measures in their residences by 2020.¹³⁸

To encourage the transition to zero net energy buildings, the Californian government has also passed laws that create two voluntary building energy efficiency codes that achieve 15 and 25 per cent higher energy efficiency/renewable energy standards than the current mandatory energy efficiency Californian building code standard.¹³⁹ The Californian government has also passed regulation that allows local government in California to choose to make these voluntary standards mandatory for new buildings in their county. This important policy initiative allows industry to learn from the leaders and build momentum for higher standards. Rapidly growing economies, such as China and India are also setting stronger energy efficiency and renewable energy requirements in building codes. According to the IPCC 'On 1 January, 2006, China introduced a new building construction statute that includes clauses on a mandatory energy efficiency standard for buildings ... [and] requires construction contractors to use energy efficient building materials and to adopt energy-saving technology in heating, air conditioning, ventilation and lighting systems in civil buildings.'¹⁴⁰

Energy-efficient products and services

In the EU, energy demand in households accounts for 25 per cent of the final energy needs, with electricity used for domestic appliances in households showing the sharpest increase. The EU is responding to this issue by requiring energy labelling of household appliances demanding minimum efficiency requirements.¹⁴¹ In America since 1978, California's energy-efficient appliance standards, combined with their energy-efficient building standards, (mentioned above) have saved more than US\$56 billion in electricity and natural gas costs. While the US has increased per capita electricity consumption by nearly 50 per cent over the past 30 years, California's per capita electricity use has remained relatively flat.¹⁴² In Japan the government has set strict energy-saving targets, focusing on 18 types of consumer and business electronics. Home and office air-conditioners, for instance, had to be redesigned to use 63 per cent less power by 2008.¹⁴³

Since the late 1990s, China has developed a comprehensive programme of energy efficiency standards and labelling for household appliances, working

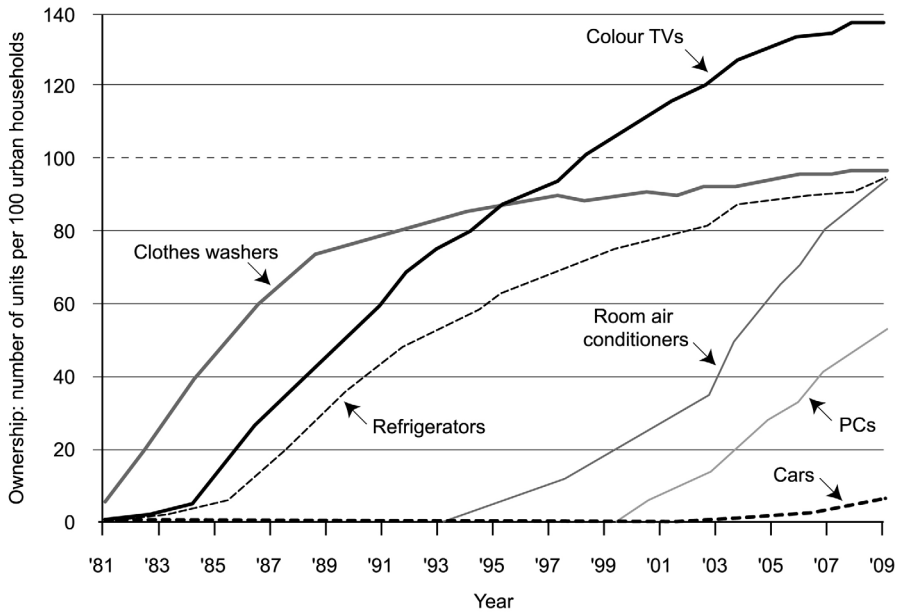


Figure 6.2 Chinese urban appliance ownership

Source: LBNL (2009)¹⁴⁴

with Lawrence Berkeley National Laboratory’s China Energy Group in an effort to respond to the rapid increase in the uptake of appliances by Chinese citizens¹⁴⁵ (see Figure 6.2). According to Lawrence Berkeley National Laboratory’s, ‘Standards enacted in China between 1999 (when the first new standard went into effect) and 2007 are expected to reduce growth of electricity consumption nationally by 110 TWh by 2020, saving consumers more than \$100 billion cumulatively over this period.’¹⁴⁶ This work to improve Chinese appliance standards is very important because China is the largest global producer of major appliances and consumer electronics, providing over 50 per cent of the global supply for some products. By 2007, China was producing over 44 million refrigerators, 80 million air-conditioners and 85 million televisions annually. Hence, improving Chinese appliance standards has significant flow-on effects to reduce energy consumption and greenhouse gas emissions globally while increasing economic growth within China. An example of this is in the market of compact fluorescent lamps. China is already the world’s largest manufacturer of this energy-efficient product, accounting for an estimated 80 per cent of global output, an industry with exports now worth around the US\$2 billion mark.¹⁴⁷

Disconnecting electricity utility profits from energy sales

A significant barrier to the uptake of energy efficiency has been the fact that, until recently, electricity and gas utilities increased their profits through gener-

ating greater sales.¹⁴⁸ Thus in the past there was little financial incentive for utilities to encourage their customers to take up energy efficiency opportunities and use less electricity and gas. The report *Aligning Utility Interests with Energy Efficiency Objectives: A Recent Review of Efforts at Decoupling and Performance Incentives*¹⁴⁹ shows that at least 25 states in the US have utility rate-payer-funded energy efficiency programmes in operation, all with very positive results. In short, all of these states have addressed traditional disincentives by introducing some type of cost recovery or savings sharing mechanism within these energy efficiency programmes for the electric utility.

Differential tariffs and smart meters

Several OECD countries have undertaken national roll-outs of smart meters to allow customers to monitor their energy consumption, and hence cost, in an effort to reduce consumption.¹⁵⁰ Such a mechanism is particularly successful when combined with differential tariffs to allow utilities to charge a greater cost during peak times. In Italy, the energy utility Enel Distribuzione SpA has installed more than 30 million electronic meters.¹⁵¹ In 2004, Paolo Scaroni, Enel's Chief Executive, stated: 'Enel's 2 billion euro investment, including R&D costs and roll-out, will be paid back in 4 years in Italy alone.'¹⁵² In 2003, Sweden announced that monthly readings would be required of all electricity meters by 2009. In September 2007, the Dutch government proposed that all 7 million households of the country should have a smart meter by 2013, as part of a national energy reduction plan.¹⁵³ Roll-outs are also under way in California and Pennsylvania in the US. According to John Hutton, the UK Secretary of State for Business, Enterprise and Regulatory Reform, smart energy meters should be brought in under an accelerated programme, as ten years is just simply, 'too long'.¹⁵⁴ In Australia, the Victoria government has committed to rolling out smart meters to 2.2 million homes and 300,000 businesses.¹⁵⁵

Increasing the role of renewable energy

At least a third of the world's countries now have renewable energy targets,¹⁵⁶ with the level of renewable electricity generation capacity reaching an estimated 240 gigawatts (GW) worldwide in 2007; a 50 per cent rise over 2004, but still representing only 3.4 per cent of global power generation.¹⁵⁷ By setting bold targets for the amount of the country's electricity that will be sourced by renewable sources, national governments around the world are signalling to the market that innovation in renewable energy will be rewarded. Where countries and regions may not have bold targets, often states and cities are making strong commitments, thus signalling their support for greater national and global leadership on this issue. For instance, in November 2008, the Governor of California, Arnold Schwarzenegger, issued an executive order establishing the Renewable Portfolio Standard target for California that 'requires all retail sellers of electricity to serve 33% of their load with renew-

able energy by 2020. This builds on Million Solar Roofs Initiative which was adopted by the California Public Utilities Commission (CPUC) in 2005, and expanded by legislation Governor Schwarzenegger signed in 2006'.¹⁵⁸

Increasing the use of feed-in tariffs (FITs)

FITs place a legal obligation on utilities to purchase electricity from renewable energy installations, whereby the tariff rate is guaranteed (in the best examples for a long period of up to 20 years), and is determined for each technology to ensure profitable operation of the installation. In 2008 it was established that as many as 36 countries (including 12 developing nations) and 10 states/provinces had brought in feed-in tariffs to encourage and support the renewable energy sector.¹⁵⁹ For instance, in the EU, FITs are widely used, with Germany, Denmark and Spain considered model countries achieving significant results. For Germany, where FITs have been in place and supported politically since 1990, its law has made it a world leader in renewable energy, generating billions of euros a year in exports, creating in the region of a quarter of a million jobs, saving nearly 100 million tonnes of carbon dioxide annually in recent years, and setting records for installed capacity across many technologies – all at the cost of around US\$1.80 per household per month.¹⁶⁰ California has committed to and will soon be the largest US state to have implemented a FIT.¹⁶¹ Among developing countries, India was the first to establish a FIT, followed by Sri Lanka and Thailand (for small power producers only), Brazil, Indonesia and Nicaragua. In the first half of 2005, feed-in policies were enacted in China, Ireland, Turkey and the US state of Washington. China's feed-in policy was part of a renewable energy promotion law enacted in February 2005.¹⁶²

Reducing private vehicle transport greenhouse gas emissions

Much can be done to reduce the emissions from vehicles, as detailed in *Factor Five*.¹⁶³ New Zealand has committed to halving per capita transport emissions by 2040 by introducing electric cars and a requirement to use biofuels.¹⁶⁴ As of 2006, vehicles with low emissions already accounted for almost 11 million cars (21 per cent) on Japan's roads.¹⁶⁵ In Sweden, between 2007–2009, private car buyers have received a subsidy of SEK10,000 (around US\$1300) for zero- or low-emission vehicles, with the initiative becoming regarded as a success. While SEK250 million (around US\$32 million) was set aside for the scheme over three years, sales of 'eco-cars' are soaring with 45,000 vehicles sold in the nine months the scheme was operative in 2007 (44 per cent private sales).¹⁶⁶

Improving freight and rail transport

Much can also be done to reduce the emissions from freight and rail transport through vehicle design, and improvements in operations, mode selection and logistics, as detailed in *Factor Five*.¹⁶⁷ In 2007 France committed to invest

heavily in rail infrastructure to take freight transport off the roads and onto rail as part of France's 'Green Revolution'.¹⁶⁸ This is part of a more general trend in Europe that is seeking to reduce congestion on roads and reduce greenhouse gas emissions by making it more cost effective to transport freight by rail and sea. The EU Commission is promoting this transition.¹⁶⁹ China has committed to undertaking the world's most significant railway expansion since the US built its transcontinental line in the 1860s. Beijing plans to spend US\$248 billion between now and 2020 on approximately 120,000 kilometres of new track, for freight and high-speed passenger transportation.¹⁷⁰

Reducing traffic congestion and encouraging modal shifts

Over 15 cities in OECD countries have successfully implemented a congestion tax. London still stands out as an example, using revenue from its congestion tax to spend over €300 million (US\$440 million) in improving and building safe bike paths and cycle lanes.¹⁷¹ Hybrid cars have been made exempt from the congestion tax. Another interesting and cost-effective strategy to reduce congestion is to enable staff of government and business to work 10-hour days four days a week, instead of 8-hour days five days a week. The Utah government has instituted a four-day week affecting 17,000 government workers and saving the government around US\$4 million a year through reduced electricity usage.¹⁷² Marion County, Florida recently switched to a four-day working week for county workers and expects to save US\$250,000 in the first year alone.¹⁷³ Employers are considering this to help staff cope with high oil prices and boost morale through maximizing their time with family.

Reducing growth in air transport greenhouse gas emissions

Unlike many other industries, although there are some promising options, there are few available technological or design options for reducing aviation's contribution to climate change significantly. Therefore, mandatory measures need to be introduced globally which apply fairly to all airlines, such as ensuring that all domestic aircraft emissions are included in emissions trading schemes, thus applying an international aviation emission charge to complement national and regional emissions trading schemes, with the funds raised to be invested in high-speed rail transport and telecommunications infrastructure to encourage the substitution of air travel with less emission-intensive alternatives.¹⁷⁴ The EU has also imposed tougher pollution limits on airlines from 2012,¹⁷⁵ stating that all airlines operating in or out of the EU will have to limit carbon dioxide emissions to 97 per cent of 2005 levels. From 2013, that figure will be reduced to 95 per cent.¹⁷⁶

Reducing oil dependence

A number of countries have committed to significantly reducing their nation's oil dependency. Sweden, which was badly hit by the oil price rises in the 1970s,

has committed to getting off oil by 2020. The country relies on fossil fuels mainly for transport, with only 32 per cent of the energy coming from oil in 2003, down from 77 per cent in 1970. Almost all of the country's heating was converted in the past decade to schemes that distribute steam or hot water generated by geothermal energy or waste heat. Iceland hopes by 2050 to power all its cars and boats with hydrogen made from electricity drawn from renewable resources. Brazil intends to power 80 per cent of its transport fleet with ethanol derived mainly from sugar cane by 2012.¹⁷⁷ Japan, the world's second largest economy with no domestic sources of fossil fuel has kept its oil consumption level since 1975, while world consumption has risen steadily, by dramatically diversifying its power sources over the years, becoming far less dependent on oil and cultivating a culture of conservation.¹⁷⁸ These plans are a part of broader sustainability plans like Hawaii's 2050 sustainability project, which has created a citizen-driven blueprint for the state's next half-century. The Hawaii 2050 strategy documents outline how the state can handle a tourist economy, a swelling population, friction between cultures, and a changing climate and environment.¹⁷⁹

Further to these examples of policy reform, Table 6.1 presents a snapshot of specific government commitments and initiatives from the ten largest economies in the world to reduce energy consumption and increase levels of renewable energy generation. Such leadership illustrates the wealth of experience countries can now learn from to underpin efforts to achieve ambitious short- and long-term targets in these areas. These examples show that there is no longer any serious political risk in adopting such ambitious targets, and perhaps that the real risk is in not acting.

To conclude, climate change is now becoming a central part of government policy-making around the world. The ultimate goal of many of these targets and supporting policies is to cost effectively achieve significant reductions in greenhouse gas emissions in the order of 20–40 per cent by 2020 and 60–80 per cent by 2050.¹⁸⁰ Such examples of significant commitments by some of the world's largest economies provide clear direction for other economies, in both developed and developing countries, to accelerate their progress towards significant greenhouse gas emissions reductions. The main barrier traditionally to national governments making such commitments has been their fear that it would harm economic growth and jobs, and we now consider this in the next chapter.

Table 6.1 *Energy consumption reduction and renewable energy targets set by the ten largest economies (ordered from largest to smallest)*

Country	Energy reduction and renewable energy targets
United States	<ul style="list-style-type: none">• President Obama in 2009 committed to taking a global leadership role on climate change, announcing the formation of the Major Economies Forum on Energy and Climate.• In 2009, the Obama administration also announced that fuel consumption standards for US vehicles would be raised to 35.5 miles per gallon (15.44 kilometres per litre) by 2016 from the current 25 miles per gallon, which is four years earlier than previous US law.• In 2009 the American Clean Energy and Security Act of 2009, an energy bill that would establish a cap-and-trade scheme for greenhouse gases was approved by the House of Representatives by a vote of 219 to 212. While by the end of 2009 the bill had not yet been approved by the Senate it lists the goals of the US administration. If passed by the Senate, this bill commits the US to:<ul style="list-style-type: none">– a 17% emissions reduction from 2005 levels by 2020 and about 80% by 2050;– a renewable electricity standard which requires each electricity provider supplying over 4 million MWh, to produce 20% of its electricity from renewable sources by 2020;– a new set of energy efficiency standards for lighting products, commercial furnaces and other appliances, requiring buildings to have 30% energy efficiency improvement by 2010 and 50% by 2016.• US State governments and city mayors have made strong commitments, including:<ul style="list-style-type: none">– California has an executive order to reduce CO₂ emissions by 80% on 1990 levels by 2050. California has committed by law to sourcing 33% of all energy from renewables by 2020 achieving 20% by 2010. For instance, California aims to have a million solar roofs by 2017.¹⁸¹ The new Solar Initiative calls for 3GW of solar photovoltaics by 2017 for homes, schools, businesses and farms. California leads the US and the world in many aspects of climate change policy and mitigation targets. These are outlined in detail by the annual California Energy Commission's Integrated Energy Policy reports.¹⁸² States in the northeast and mid-Atlantic have set up the Regional Greenhouse Gas Initiative to cut emissions to 2005 levels between 2009 and 2015, and by a further 10% between 2015 and 2018.– As of October 2007 almost 750 American mayors had pledged their cities to meet the goals set forth in the Kyoto Protocol or reduce their emissions of greenhouse gases by at least 7% by 2012. Some have already met even more aggressive targets, ranging from a goal of 20% reduction by Portland to a goal of 42% reduction over the same timeframe by Sebastopol, California.¹⁸³
Japan	<ul style="list-style-type: none">• Japan's Kyoto Protocol commitment is to reduce greenhouse gas emissions by 6% on 1990 levels by the period 2008–2012.• As part of the Copenhagen Accord process, Japan has committed to achieve a 25% reduction in GHG emissions from 1990 levels by 2020.• The 2008 Action Plan for Achieving a Low-Carbon Society sets a long-term target of reducing Japan's current level of greenhouse gas emissions by 60–80% by 2050.¹⁸⁴ In October 2008, Japan introduced on a trial basis an Integrated Domestic Market for Emissions Trading, consisting of a Trial Emissions Trading Scheme, and options for procuring additional tradable credits.¹⁸⁵• In 2009 the incoming prime minister of Japan, Yukio Hatoyama, announced a commitment of 25% reductions in greenhouse gas emissions over 1990 levels by 2020.¹⁸⁶

Country	<i>Energy reduction and renewable energy targets</i>
China	<ul style="list-style-type: none"> • The Japanese National Energy Strategy aims for: <ul style="list-style-type: none"> – 30% improvement of energy efficiency by 2030; – overall oil dependence reduced to lower than 40% by 2030 with an 80% target specifically for the transport sector. • Tokyo aims to reach a 20% share of renewables in primary energy consumption by 2020. Japan implemented a nationwide feed-in tariff system in late 2009.¹⁸⁷ <p>As part of the Copenhagen Accord process, the Chinese government formally committed to a 40–45% reduction in carbon dioxide emissions per unit of GDP by 2020 compared to 2005 levels. China has also committed to ambitious short-term energy efficiency targets, such as reducing energy intensity 20% by 2010 from 2005 levels.¹⁸⁸ The Chinese government has brought in a comprehensive range of policies¹⁸⁹ to enable such targets to be achieved, including:</p> <ul style="list-style-type: none"> • Requiring the top 1000 largest businesses to achieve ambitious energy efficiency improvements per annum between 2005 and 2010.¹⁹⁰ • Implementing fuel consumption standards for passenger cars that are significantly higher than the US. • Implementing comprehensive energy efficiency standards for appliances.¹⁹¹ • Implementing the National Energy Efficient Design Standard for Public/Commercial Buildings. • China's Renewable Energy Law aims to achieve: <ul style="list-style-type: none"> – 16% of primary energy from renewables by 2020;¹⁹² – an increase in biofuel production to 15 billion litres by 2020;¹⁹³ – solar hot water coverage of 300 million square metres by 2020.¹⁹⁴ • Technology targets to be achieved by 2020 include generating 300GW of hydroelectric power, 30GW of wind power, 30GW of biomass power, 1.8GW of solar photovoltaics, and smaller amounts of solar thermal power and geothermal.¹⁹⁵ • By 2010, the emissions of nitrous oxide from industrial processes will remain stable at 2005 levels¹⁹⁶ (with a global warming potential of around 290 times CO₂). • Power producers with capacity greater than 5GW must increase power capacity from non-hydro renewables to 3% by 2010 and 8% by 2020.¹⁹⁷
Germany	<ul style="list-style-type: none"> • As a member of EU15, Germany aims to fulfil the Kyoto Protocol commitment to reduce greenhouse gas emissions by 8% on 1990 levels by the period 2008–2012. • As a member of the G-8, Germany committed to 80% cuts by 2050 in July 2009. • As a member state of the EU in 2007 Germany committed to 20% reduction in greenhouse gas emissions by 2020 (increasing to a 30% reduction if international agreement is reached) and halving of 1990 levels by 2050.¹⁹⁸ • Energy productivity is to double from 1990 levels by 2020.¹⁹⁹ • Offered to set a target of 40% reduction below 1990 levels by 2020 if EU accepts a 30% greenhouse gas emissions reduction target. • National objective to supply 20% of electricity from renewable sources by 2020.²⁰⁰
France	<ul style="list-style-type: none"> • Aims to fulfil the Kyoto Protocol commitment to reduce greenhouse gas emissions by 8% on 1990 levels by the period 2008–2012, as member of EU15. • As a member of the G-8, France committed in principle to 80% cuts by 2050 in July 2009. • Member state of the EU's commitment for 20% reduction in greenhouse gas emissions by 2020 (increasing to a 30% reduction if international agreement is reached) and halving of 1990 levels by 2050.²⁰¹

Table 6.1 *continued*

Country	<i>Energy reduction and renewable energy targets</i>
	<ul style="list-style-type: none"> • Policy targets for 7% of energy used to be provided by renewable sources by 2010, and 10% by 2015.²⁰² Tax credits, subsidies and grants are used to meet these targets, and fines or tax penalties are enforced to penalize non-compliance.²⁰³ • The National Energy Efficiency Action Plan sets targets and actions to reduce greenhouse gas emissions by 25% from 1990 levels by 2020, and further targets to achieve this include: <ul style="list-style-type: none"> – minimum of 9% energy savings over the period 2008–2016; – decreasing energy intensity by 2% per year by 2015 and by 2.5% per year by 2030; – reducing energy consumption in the construction industry by more than a third by 2020; – lowering greenhouse gas emissions by 20% in the transport industry by 2020.²⁰⁴
United Kingdom	<ul style="list-style-type: none"> • Aims to fulfil the Kyoto Protocol commitment to reduce greenhouse gas emissions by 8% on 1990 levels by the period 2008–2012 as a member of the EU15. • As a member of the G-8, the UK committed in principle to 80 per cent cuts by 2050 in July 2009. • Member state of the EU's commitment for 20% reduction in greenhouse gas emissions by 2020 (increasing to a 30% reduction if international agreement is reached) and halving of 1990 levels by 2050.²⁰⁵ • National objectives to reduce CO₂ emissions by 20% on 1990 levels by 2010 and by 80% on 2000 levels by 2050.²⁰⁶ • London policy targets aim to reduce CO₂ emissions by 20% by 2010, relative to 1990 levels, and by 60% by 2050.²⁰⁷
India	<ul style="list-style-type: none"> • As part of the Copenhagen Accord process, the Indian government has formally committed to 20–25% reduction in emissions intensity of GDP by 2020 in comparison to the 2005 level. • The National Action Plan on Climate Change released in June 2008 sets targets to establish an effective, cooperative and equitable global approach based on the principle of common but differentiated responsibilities and relative capabilities enshrined in the UN Framework Convention on Climate Change (UNFCCC).²⁰⁸ • In November, 2009 India announced an industry energy efficiency programme. A new law will outline average current energy usage for companies spanning major sectors, including cement, steel and power. • Industries will be required to meet energy efficiency standards and those who fail to do so will be able to purchase energy efficiency certificates from successful industries. • Under the National Action Plan, the National Solar Mission aims to develop a solar energy industry in India that can compete with the fossil fuel industries.²⁰⁹ India is implementing a solar feed-in tariff in 2010. • The 11th Five-Year Plan contains mandatory and voluntary measures to increase efficiency in power generation and distribution, increase the use of renewable energy and encourage mass transit programmes. • Long-term targets by the year 2032 include renewable energy accounting for 15% of power; 20GW of solar capacity by 2022; 10% of oil consumption substituted by biofuels, synthetic fuels and hydrogen; and 100% use of solar hot water in all possible applications.²¹⁰ • Short-term targets by 2012 include full use of co-generation in the sugar and other biomass-based industries.²¹¹

Country	Energy reduction and renewable energy targets
	<ul style="list-style-type: none"> Introduced mandatory labels for refrigerators, transformers, air-conditioners and tube lights in January 2010.
Italy	<ul style="list-style-type: none"> Aims to fulfil the Kyoto Protocol commitment to reduce greenhouse gas emissions by 8% on 1990 levels by the period 2008–2012 as a member of the EU15. As a member of the G-8, Italy committed in principle to 80% cuts by 2050 in July 2009. Member state of the EU's commitment for 20% reduction in greenhouse gas emissions by 2020 (increasing to a 30% reduction if international agreement is reached) and halving of 1990 levels by 2050.²¹² Feed-in tariff targets 3000MW of solar photovoltaics by 2016, which equates to almost 1 million homes if used for residential installations.²¹³ National objective and commitment to EU targets to increase share of electricity from renewable resources to 25% by 2010.²¹⁴ Mandates for 1% blending for both ethanol and biodiesel.²¹⁵
Russian Federation	<ul style="list-style-type: none"> Aims to fulfil the Kyoto Protocol commitment to meeting the same 1990 greenhouse gas emissions levels by the period 2008–2012 as a member of the EU15. As part of the Copenhagen Accord process, the Russian government has formally committed to a target of 22–25% reduction in emissions below 1990 levels by 2020. As member of the G-8, Russia committed in principle to 60–80 per cent cuts by 2050 in July 2009.
Brazil	<ul style="list-style-type: none"> As part of the Copenhagen Accord process, the Brazilian government has committed to 36.1–38.9 per cent cuts in greenhouse gas emissions by 2020 relative to business as usual by 2020. Brazil's Energy Matrix Program sets mandatory requirements for: <ul style="list-style-type: none"> at least 5% addition of biodiesel to fossil diesel by 2013;²¹⁶ 10% of annual electricity consumption provided by alternative sources by 2020.²¹⁷ Brazil's National Climate Change Plan aims to reduce annual deforestation rates by 40% from average 1996–2005 levels during 2006–2009, with a total decrease of over 70% by 2014–2017.²¹⁸ The Amazon Protected Area programme aims to consolidate 600,000km² in new and existing protected areas by 2012. The Coalition of Developing Nations provides funds from the International Carbon Trading Scheme to assist this programme.²¹⁹

Source: Based on *The Stern Review* (2006)²²⁰ and updated by The Natural Edge Project, with references added.

Notes

- 1 The Australian 2020 Summit was a 'by invitation' event and involved 1000 representatives from across the Australian community and Cheryl Desha was invited to represent the work of The Natural Edge Project.
- 2 For further information on Prime Minister Kevin Rudd's views on climate change see www.pm.gov.au/topics/climate.cfm, accessed 11 August 2008.
- 3 Barringer, F. and Revkin, A. C. (2007) 'Gore warns Congress of 'planetary emergency'', *New York Times*, 22 March.

- 4 IPCC (2007) *Climate Change 2007: Synthesis Report*, Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge.
- 5 Milmo, C. (2007) 'Too late to avoid global warming', *Independent* (UK), 19 September.
- 6 IPCC (2007) *Climate Change 2007: Synthesis Report*, Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge.
- 7 UN (2007) 'Ban Ki-moon urges climate change breakthrough in Bali after dire report released', *UN News Centre*, 17 November.
- 8 IPCC (2007) *Climate Change 2007: Synthesis Report*, Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge, p104.
- 9 von Weizsäcker, E., Hargroves, K., Smith, M., Desha, C. and Stasinopoulos, P. (2009) *Factor Five: Transforming the Global Economy through 80% Improvements in Resource Productivity*, Earthscan, London.
- 10 IPCC (2007) *Climate Change 2007: Synthesis Report*, Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge, p104.
- 11 Reuters (2007) 'Bill Clinton: "Green" economy offers great rewards', *Reuters*, 2 November.
- 12 Stern, N. (2006) *The Stern Review: The Economics of Climate Change*, Cambridge University Press, Cambridge, p302.
- 13 Stern, N. (2006) *The Stern Review: The Economics of Climate Change*, Cambridge University Press, Cambridge, p278.
- 14 EEA (2006) *Air Quality and Ancillary Benefits of Climate Change*, Technical Report no 4, European Environment Agency, Copenhagen.
- 15 Gore, A. (2008) 'Al Gore: A generational challenge to repower America', Transcript, 17 July, www.wecansolveit.org/pages/al_gore_a_generational_challenge_to_repower_america/, accessed 12 July 2009.
- 16 Mellgren, D. (2008) 'OECD issues warning on climate change action or else half the world will suffer', *The Associated Press*.
- 17 Stern, N. (2006) *The Stern Review: The Economics of Climate Change*, Cambridge University Press, Cambridge, pp104–105.
- 18 Brown, L. (2008) *Plan B 3.0: Mobilizing to Save Civilization*, W. W. Norton & Company, New York, p14.
- 19 Klare, M. (2001) *Resource Wars – The New Landscape of Global Conflict*, Metropolitan Books, New York.
- 20 Brown, L. (2008) *Plan B 3.0: Mobilizing to Save Civilization*, W. W. Norton & Company, New York, p13.
- 21 Stern, N. (2006) *The Stern Review: The Economics of Climate Change*, Cambridge University Press, Cambridge, see 'Summary of conclusions'.
- 22 IPCC (2007) *Climate Change 2007: Mitigation of Climate Change*, Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge, see 'Summary for policymakers'.
- 23 UNEP (2007) *Global Environment Outlook: Environment for Development (GEO-4) Report*, UNEP, p332.
- 24 Schneider, S. and Azar, C. (2002) 'Are the costs of stabilising the atmosphere prohibitive?', *Ecological Economics*, vol 42, pp73–80.

- 25 NEF (2006) *The UK Interdependence Report: How the World Sustains the Nation's Lifestyles and the Price it Pays*, New Economics Foundation, London, cited in UNEP (2007) *Global Environment Outlook: Environment for Development (GEO-4) Report*, UNEP, p467.
- 26 Obama, B. (2006) 'Oil & alternative fuels – Energy independence and the safety of our planet', 3 April 2006.
- 27 Editorial (2007) 'The warming challenge', *New York Times*, 5 May, cited in Lovins, H. 'The economic case for climate action', in PCAP (2008) *Plan for Presidential Action for the First 100 Days in Office for the Next President of the United States*, Presidential Climate Action Project, US.
- 28 von Weizsäcker, E., Hargroves, K., Smith, M., Desha, C. and Stasinopoulos, P. (2009) *Factor Five: Transforming the Global Economy through 80% Improvements in Resource Productivity*, Earthscan, London.
- 29 PWC (2008) *Carbon Countdown: A Survey of Executive Opinion on Climate Change in the Countdown to a Carbon Economy*, PriceWaterHouseCoopers, Australia.
- 30 Proudfoot Consulting (2007) *Meeting the Corporate Energy Challenge: Are Companies Walking the Talk on Energy Efficiency?*, Proudfoot Consulting, Australia.
- 31 Australia Industry Group (2007) *Environmental Sustainability and Industry, Road to a Sustainable Future*, AIG, Australia.
- 32 Lyth, A., Nichols, S. and Tilbury, D. (2007) *Shifting Towards Sustainability: Education for Climate Change Adaptation in the Built Environment Sector*, a report prepared by the Australian Research Institute in Education for Sustainability.
- 33 Stern, N. (2006) *The Stern Review: The Economics of Climate Change*, Cambridge University Press, Cambridge, p319.
- 34 Stern, N. (2006) *The Stern Review: The Economics of Climate Change*, Cambridge University Press, Cambridge, see 'Summary of conclusions'.
- 35 Stern, N. (2006) *The Stern Review: The Economics of Climate Change*, Cambridge University Press, Cambridge, pp244–247.
- 35A Californian Energy Commission (2005) California's Water–Energy Relationship, Californian Energy Commission, www.energy.ca.gov/2005publications/CEC-700-2005-011/CEC-700-2005-011-SF.PDF.
- 36 Mellgren, D. (2008) 'OECD issues warning on climate change action or else half the world will suffer', *The Associated Press*.
- 37 Campbell-Lendrum, D. and Corvalán, C. (2007) 'Climate change and developing-country cities: Implications for environmental health and equity', *Journal of Urban Health*, vol 84, no 1, pp109–117.
- 38 CSE (1999) 'Sick of air pollution', Press Release, Centre for Science and Environment, 5 June, Delhi, India.
- 39 Farmer, A. (1997) *Managing Environmental Pollution*, Routledge Publishing, New York.
- 40 Holland, M., Kinghorn, S., Emberson, L., Cinderby, S., Ashmore, M., Mills, G. and Harmens, H. (2006) *Development of a Framework for Probabilistic Assessment of the Economic Losses Caused by Ozone Damage to Crops in Europe*, Centre for Ecology and Hydrology, Natural Environment Research Council, Bangor, Wales.
- 41 UNEP (2007) *Global Environment Outlook: Environment for Development (GEO-4) Report*, UNEP.
- 42 Agence France-Presse (2006) *Hong Kong Pollution Leaves Tourists Choking*, Agence France-Presse.

- 43 Clean Air Initiative for Asian Cities Centre (2007) *2007 Annual Report: Clean Air Initiative for Asian Cities Centre*, Clean Air Initiative for Asian Cities Centre, Manila, the Philippines.
- 44 Gettler, L. (2008) 'Company structures and career paths shift with global warming', *The Age*, 20 August.
- 45 Rauber, C. (2008) 'Investors file flurry of global-warming resolutions', *San Francisco Business Times*, 6 March.
- 46 Carbon Disclosure Project (undated) Homepage, www.cdproject.net/, accessed 22 August 2009.
- 47 FTSE4Good Index Series (2006) *Market Consultation on the FTSE4Good Climate Change Criteria*, FTSE Group, cited in Lovins, H. (2007) 'The economic case for climate action', in PCAP (2008) *Plan for Presidential Action for the First 100 Days in Office for the Next President of the United States*, Presidential Climate Action Project.
- 48 Sosnowchik, K. (2004) 'Between blue and yellow: What's in a name?', *Green@work*, May/June.
- 49 The Climate Group (2004) *Carbon Down, Profits Up*, the Climate Group, London; the Climate Group (2005) *Carbon Down, Profits Up*, the Climate Group.
- 50 The Climate Group (2004) *Carbon Down, Profits Up*, the Climate Group.
- 51 Lean, G. (2007) 'Green giants join forces to fight carbon emissions', *Independent (UK)*, 25 March.
- 52 Environmental Leader (2008) 'GE reports on progress of Ecomagination, sets new goals', *EL Daily*, 29 May.
- 53 The Climate Group (2007) *Carbon Down, Profits Up* (third edition), the Climate Group.
- 54 General Electric Company (2009) 'Ecomagination: Our commitments', <http://ge.ecomagination.com/our-commitments/index.html>, accessed 12 September 2009.
- 55 Environmental Leader (2008) 'GE reports on progress of Ecomagination, sets new goals', *EL Daily*, 29 May.
- 56 General Electric Company (2009) 'Ecomagination: Our Commitments', <http://ge.ecomagination.com/our-commitments/index.html>, accessed 12 September 2009.
- 57 Roner, L. (2005) 'Wal-Mart – An environmental epiphany?' *Climate Change Corp.Com*, 7 December.
- 58 Alliance to Save Energy (undated) 'Wal-Mart is serious about sustainability', <http://ase.org/content/article/detail/5740>, accessed 25 August 2009.
- 59 Lash, J. and Wellington, F. (2007) 'Competitive advantage on a warming planet', *Harvard Business Review*, March.
- 60 Fishman, C. (2006) 'How many lightbulbs does it take to change the world? One. And you're looking at it', *Fast Company Magazine*, no 108, p74.
- 61 Gogoi, P. and Herbst, M. (2007) 'Wal-Mart: Measuring just how green; the retailing giant launched a potentially groundbreaking initiative to measure suppliers' energy use – how hard will it push for change?', *Business Week Online*, 26 September.
- 62 Alliance to Save Energy (undated) 'Wal-Mart is serious about sustainability', <http://ase.org/content/article/detail/5740>, accessed 25 August 2009.
- 63 The Climate Group (2007) *Carbon Down, Profits Up* (third edition), the Climate Group.
- 64 Wal-Mart (2009) 'Sustainability Index', <http://walmartstores.com/Sustainability/9292.aspx>, accessed 12 September 2009.

- 65 von Weizsäcker, E., Hargroves, K., Smith, M., Desha, C. and Stasinopoulos, P. (2009) *Factor Five: Transforming the Global Economy through 80% Improvements in Resource Productivity*, Earthscan, London.
- 66 Smith, M., Hargroves, K., Stasinopoulos, P., Stephens, R., Desha, C. and Hargroves, S. (2007) *Energy Transformed: Sustainable Energy Solutions for Climate Change Mitigation*, The Natural Edge Project, Australia.
- 67 Ausmelt Technologies (undated) Homepage, www.ausmelt.com.au/home.htm, accessed 12 July 2009.
- 68 Pokrajic, Z. and Morrison, R (2009) 'A simulation methodology for the design of eco-efficient comminution circuits', Proceedings of the XXIV International Mineral Processing Congress, Beijing.
- 69 Weizsäcker, E., Hargroves, K., Smith, M., Desha, C. and Stasinopoulos, P. (2009) *Factor Five: Transforming the Global Economy through 80% Improvements in Resource Productivity*, Earthscan, London.
- 70 Humphreys, K. and Mahasenan, M. (2002) *Towards a Sustainable Cement Industry*, World Business Council for Sustainable Development, Geneva, see 'Substudy 8: Climate change'; Kim, Y. and Worrell, E. (2002) 'CO₂ emission trends in the cement industry: An international comparison', *Mitigation and Adaptation Strategies for Global Change*, vol 7, no 2, pp115–133.
- 71 Smith, M., Hargroves, K., Desha, C. and Stasinopoulos, P. (2009) 'Factor 5 in eco-cements', ECOS, CSIRO, no 149.
- 72 CSIRO (undated) 'Geopolymers: Building blocks of the future', www.csiro.au/science/ps19e.html, accessed 4 September 2008.
- 73 Worrell, E. and Galitsky, C. (2004) *Emerging Energy-Efficient Technologies in Industry: Case Studies of Selected Technologies*, Ernest Orlando Lawrence Berkeley National Laboratory, Environmental Energy Technologies Division, US.
- 74 Energy Efficiency and Greenhouse Working Group (2003) *Towards a National Framework for Energy Efficiency – Issues and Challenges Discussion Paper*, Energy Efficiency and Greenhouse Working Group, Australia.
- 75 Price, L. et al (2003) *Voluntary Agreements for Increasing Energy-Efficiency in Industry: Case Study of a Pilot Project with the Steel Industry in Shandong Province, China*, Lawrence Berkeley National Laboratory, US.
- 76 McKenzie, R., (1994) 'Canada's National Partnership Strategy for Industrial Energy Efficiency', International Energy Agency Conference Proceedings – Industrial Energy Efficiency: Policies and Programs, Washington, DC, 26–27 May.
- 77 Togeby, M., Johannsen, K., Ingerslev, C., Thingvad, K. and Madsen, J. (1999) 'Evaluations of the Danish Agreement System', Proceedings of the 1999 American Council for an Energy-Efficient Economy Summer Study on Energy Efficiency in Industry, Washington, DC.
- 78 Ramesohl, S. and Kristof, K. (1999) 'What is the role of energy-related voluntary approaches in the Post-Kyoto climate policy? A process oriented analysis of the "Declaration of German Industry on Global Warming Prevention"', in *Energy Efficiency and CO₂ Reduction: The Dimensions of Social Change: 1999 European Council for an Energy-Efficient Economy Summer Study*, 31 May–4 June, Mandelieu, France.
- 79 Worrell, E. and Price, L. (2001) *Barriers and Opportunities: A Review of Selected Successful Energy-Efficiency Programs*, Lawrence Berkeley National Laboratory, US.
- 80 Department of Resources, Energy and Tourism (formerly the Department of Industry, Tourism and Resources) (undated) Homepage, www.energyefficiencyopportunities.gov.au/, accessed 10 April 2008.

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- 81 House of Commons Environment, Food and Rural Affairs Committee (2004–2005) *Climate Change: Looking Forward*, Ninth Report of Session, House of Commons Environment, Food and Rural Affairs Committee, UK
- 82 Kirby, A. (undated) ‘UK industry succeeding: UK beats greenhouse gas targets’, *BBC News Online*, 7 April 2003.
- 83 UK Government (2006) *Explanatory Memorandum to the Climate Change Agreement*, Office of Public Sector Information (OPSI), UK.
- 84 DEFRA (2007) *Climate Change Agreements: Results of the Third Target Period Assessment*, Department for Environment, Food and Rural Affairs, London.
- 85 Kirby, A. (undated) ‘UK industry succeeding: UK beats greenhouse gas targets’, *BBC News Online*, 7 April 2003.
- 86 *Novem* (2002) ‘Voluntary agreements on energy efficiency in industry in the Netherlands: The second generation’, *Novem*, August.
- 87 Lawrence Berkeley National Laboratory (2009) *China Energy Group: Sustainable Development Through Energy Efficiency*, Lawrence Berkeley National Laboratory, Berkeley, CA.
- 88 Wang, X. (2006) ‘Top-1000 Enterprises Energy Efficiency Program: Policy design and implementation’, Supporting documentation for the Energy Foundation’s Forum on Implementing China’s 2010 20-Percent Energy Efficiency Target, 9–10 November 2006.
- 89 Price, L. and Wang, X. et al (2008) *China’s Top-1000 Energy-Consuming Enterprises Program: Reducing Energy Consumption of the 1000 Largest Industrial Enterprises in China*, Lawrence Berkeley National Laboratory, Berkeley, CA.
- 90 Lawrence Berkeley National Laboratory (2009) *China Energy Group: Sustainable Development through Energy Efficiency*, Lawrence Berkeley National Laboratory, Berkeley, CA.
- 91 Gao, Y. (2007) ‘Energy consumption of China’s steel industry down 8.8%’, *China Daily*, 18 February.
- 92 Zhou, N., Levine, M. and Price, L. (2009) ‘Overview of current energy efficiency policies in China’, submitted to *Energy Policy* (in press).
- 93 Price, L. and Wang, X. et al (2008) *China’s Top-1000 Energy-Consuming Enterprises Program: Reducing Energy Consumption of the 1000 Largest Industrial Enterprises in China*, Lawrence Berkeley National Laboratory, Berkeley, CA.
- 94 Levine, M., Zhou, N. and Price, L. (2009) *The Greening of the Middle Kingdom: The Story of Energy Efficiency in China*, Lawrence Berkeley National Laboratory, Berkeley, CA.
- 95 Ahmad, N., Lequiller, F., Marianna, P., Pilat, D., Schreyer, P. and Wölfl, A. (2003) *Statistics Brief: Comparing Growth in GDP and Labour Productivity: Measurement Issues*, OECD.
- 96 Lovins, A. and Lovins, H. (1997) *Climate: Making Money, Making Sense*, Rocky Mountain Institute, Colorado.
- 97 Lovins, A. and Lovins, H. (1997) *Climate: Making Money, Making Sense*, Rocky Mountain Institute, Colorado.
- 98 Business for Social Responsibility (2008) *Who’s Going ‘Carbon Neutral’? A Compilation by Business for Social Responsibility*, Business for Social Responsibility, San Francisco, CA.
- 99 UNEP Climate Neutral Network (undated) Homepage, www.grida.no/, accessed 7 March 2008.
- 100 UN Global Compact (2009) *Twenty Climate-Neutral Frontrunners Join Caring for Climate*, United Nations Global Compact, New York.



- 101 Grady, K. (2003) 'Climate change and the Australian economy', Conference Presentation, Business Council of Australia.
- 102 News Corporation (2007) 'News Corporation launches global energy initiative: Commits to become carbon neutral by 2010 and engage audiences around the world on issue', Press Release, 5 May.
- 103 Gettler, L. (2006) 'PwC plans to become carbon neutral', *The Age*, 16 December.
- 104 KPMG (2008) *KPMG's Journey to Climate Neutrality*, KPMG, Australia.
- 105 Australian Greenhouse Office (undated) 'Greenhouse friendly', www.climatechange.gov.au/greenhousefriendly/products/index.html#energetics, accessed 4 November 2008.
- 106 Bunnings (undated) 'Bunnings and sustainability', www.bunnings.com.au/contact-us_bunnings-sustainability.aspx, accessed 12 July 2009.
- 107 WWF (2007) 'WWF welcomes ANZ commitment to become climate neutral by end of 2009', Media Release, 3 May.
- 108 Center for Energy & Climate Solutions (undated) 'Energy and climate', www.energyandclimate.org/, accessed 4 December 2008; Cool-Companies.com (undated) 'Hype about hydrogen', www.cool-companies.org, accessed 4 December 2008; Capital E (undated) Homepage, www.cap-e.com, accessed 4 December 2008.
- 109 Pew Center for Global Climate Centre (undated) 'Global warming: Emission reduction targets of companies', www.pewclimate.org/companies_leading_the_way_belc/targets/, accessed 4 December 2008.
- 110 Climate Leaders is an EPA industry–government partnership that works with companies to develop comprehensive climate change strategies, see www.epa.gov/stateply/, accessed 12 July 2009.
- 111 Gross, G. (2007) 'Dell to go "carbon neutral" by late 2008', *Washington Post*, 26 September.
- 112 Business for Social Responsibility (2008) *Who's Going 'Carbon Neutral'? A Compilation by Business for Social Responsibility*, Business for Social Responsibility.
- 113 US EPA (2009) 'US EPA 2009 Green Power Partnership: Top 50 company list', www.epa.gov/grnpower/toplists/top50.htm, accessed 12 September 2009.
- 114 Lovins, H. (2007) 'The economic case for climate action', in PCAP (2008) *Plan for Presidential Action for the First 100 Days in Office for the Next President of the United States*, Presidential Climate Action Project, US.
- 115 As of May 2007, USCAP members included: Alcan Inc.; Alcoa; American International Group, Inc. (AIG); Boston Scientific Corporation; BP America Inc.; Caterpillar Inc.; ConocoPhillips; Deere & Company; the Dow Chemical Company; Duke Energy; DuPont; Environmental Defense; FPL Group, Inc.; General Electric; General Motors Corp.; Johnson & Johnson; Marsh, Inc.; National Wildlife Federation; Natural Resources Defense Council; the Nature Conservancy; PepsiCo; Pew Center for Global Climate Change; PG&E Corporation; PNM Resources; Shell; Siemens Corporation; and World Resources Institute.
- 116 USCAP (2007) *A Call for Action – Consensus Principles and Recommendations from the U.S. Climate Action Partnership: A Business and NGO Partnership*, USCAP.
- 117 Obama and Biden (2008) 'Barack Obama and Joe Biden: New energy for America', www.barackobama.com/pdf/factsheet_energy_speech_080308.pdf, accessed 12 July 2009.

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- 118 Prince of Wales Corporate Leaders Group on Climate Change (2007) 'The Bali Communiqué', www.balicommunique.com/communique.html, accessed 13 February 2008.
- 119 Prince of Wales Corporate Leaders Group on Climate Change (2008) 'The Poznam Communiqué', www.copenhagencommunique.com/the-communique/previous-communications, accessed 19 August 2009.
- 120 Prince of Wales Corporate Leaders Group on Climate Change (2008) 'The Copenhagen Call', www.copenhagencommunique.com, accessed 19 August 2009.
- 121 Prince of Wales Corporate Leaders Group on Climate Change (2007) 'The Bali Communiqué', www.princeofwales.gov.uk/content/documents/Bali%20Communique.pdf, accessed 7 June 2010.
- 122 CBC News (2009) 'Recession slows climate change progress: Obama', *CBC News*, 9 July.
- 122A Deutsche Bank Climate Change Advisors (2010) *Global Climate Change Policy Tracker – The Green Economy, The Race is On*, Deutsche Bank Group, www.dbcca.com/dbcca/EN/investment-research/investment_research_2296.jsp
- 123 Centre for International Economics (2008) 'Discussion paper for the 9th National Business Leaders Forum for Sustainable Development', reports commissioned by the Property Council and the Australian Sustainable Built Environment Council.
- 124 UNEP (undated) 'Climate Neutral Network', www.climateneutral.unep.org, accessed 7 March 2008.
- 125 *Environment News Service* (2007) 'Europe to cut greenhouse gases 20 percent by 2020', *Environment News Service*, 8 March.
- 126 Levine, M., Zhou, N. and Price, L. (2009) *The Greening of the Middle Kingdom: The Story of Energy Efficiency in China*, Lawrence Berkeley National Laboratory, Berkeley, CA.
- 127 Levine, M., Zhou, N. and Price, L. (2009) *The Greening of the Middle Kingdom: The Story of Energy Efficiency in China*, Lawrence Berkeley National Laboratory, Berkeley, CA.
- 128 EurActiv (2008) 'Commission: Binding energy efficiency targets not excluded', Euractiv.com, 25 February.
- 129 House of Commons Environment, Food and Rural Affairs Committee (2004–2005) *Climate Change: Looking Forward*, Ninth Report of Session, House of Commons Environment, Food and Rural Affairs Committee; Kirby, A. (2003) 'UK industry succeeding: UK beats greenhouse gas targets', *BBC News Online*, 7 April; UK government (2006) *Explanatory Memorandum to the Climate Change Agreements (Eligible Facilities) (Amendment) Regulations*, UK government.
- 130 Number10.gov.uk (2007) 'Prime Minister calls for global action on climate change', Number10.gov.uk, 19 November 2007.
- 131 Levine, M., Zhou, N. and Price, L. (2009) *The Greening of the Middle Kingdom: The Story of Energy Efficiency in China*, Lawrence Berkeley National Laboratory, Berkeley, CA.
- 132 Lawrence Berkeley National Laboratory (2009) *China Energy Group: Sustainable Development through Energy Efficiency*, Lawrence Berkeley National Laboratory, Berkeley, CA.
- 133 Levine, M., Zhou, N. and Price, L. (2009) *The Greening of the Middle Kingdom: The Story of Energy Efficiency in China*, Lawrence Berkeley National Laboratory, Berkeley, CA.
- 134 The Insulation Council of Australia and New Zealand (2006) 'ICANZ applauds ACT 5-Star decision', Press Release, 20 February.

- 135 BBC (2006) 'Zero carbon homes plan unveiled', *BBC News*, 13 December.
- 136 Deutsche Well (2007) *Sarkozy Promises Green Revolution for France*, Deutsche Well, Germany.
- 137 Clinton Climate Initiative (2008) 'C40 Cities: Buildings, Freiburg, Germany', Clinton Climate Initiative.
- 138 The Climate Group (2007) 'Top Actions by States and Regions – California', www.theclimategroup.org/what_we_do/states_and_regions/california, accessed 12 July 2009.
- 139 California Energy Commission (2007) *Integrated Energy Policy Report*, California Energy Commission, CA.
- 140 IPCC (2007) *Climate Change 2007: Mitigation of Climate Change*, Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge, see 'Policies, instruments and co-operative arrangements'.
- 141 European Commission (undated) 'Energy efficiency', http://ec.europa.eu/energy/efficiency/index_en.htm, accessed 12 July 2009.
- 142 The Climate Group (2007) 'Top actions by states and regions – California', www.theclimategroup.org/what_we_do/states_and_regions/california, accessed 12 July 2009.
- 143 Faiola, A. (2006) 'Turn off the heat – how Japan made energy saving an art form', *Guardian* (UK), 17 February.
- 144 Lawrence Berkeley National Laboratory (2009) *China Energy Group: Sustainable Development Through Energy Efficiency*, Lawrence Berkeley National Laboratory, Berkeley, CA.
- 145 Lawrence Berkeley National Laboratory (2009) *China Energy Group: Sustainable Development through Energy Efficiency*, Lawrence Berkeley National Laboratory, Berkeley, CA.
- 146 Lawrence Berkeley National Laboratory (2009) *China Energy Group: Sustainable Development Through Energy Efficiency*, Lawrence Berkeley National Laboratory, Berkeley, CA.
- 147 China Sourcing Reports (2006) *Compact Fluorescent Lamps*, China Sourcing Reports, Global Sources, Singapore
- 148 Smith, M., Hargroves, K., Stasinopoulos, P., Stephens, R., Desha, C. and Hargroves, S. (2007) *Energy Transformed: Sustainable Energy Solutions for Climate Change Mitigation*, Griffith University, ANU and The Natural Edge Project, Australia, see Lecture 4.4.
- 149 Kushler, M. (2006) *Aligning Utility Interests with Energy Efficiency Objectives: A Recent Review of Efforts at Decoupling and Performance Incentives*, American Council for an Energy-Efficient Economy, p5; Smith, M. and Hargroves, K. (2007) 'Smart approaches to electricity use', *CSIRO ECOS Magazine*, no 135, p12.
- 150 Smith, M. and Hargroves, K. (2007) 'Smart approaches to electricity use', *CSIRO ECOS Magazine*, no 135, p12.
- 151 Enel SpA (2008) 'ENEL Energia offers fixed price for electricity and gas', Press Release, 30 January.
- 152 Enel SpA (2004) 'IBM and ENEL will team to offer automated metering solution world wide', Press Release, 18 March.
- 153 Parliamentary Office of Science and Technology (2008) 'Smart metering of electricity and gas', *Postnote*, no 301.
- 154 Davies, J. (2007) 'Smart meters win minister's backing: John Hutton says 10 years is too long to wait for smart energy meters to be rolled out', *Computing*, 12 November.

- 155 Department of Primary Industries (2009) 'Smart meters: Advanced metering infrastructure for Victoria', www.dpi.vic.gov.au/dpi/dpinenergy.nsf/LinkView/4EC2E4EA42B821FCCA2572B10079A930A8BAF6E4E66C900FCA2572B20004C403, accessed 19 August 2009.
- 156 REN21 (2007) *Renewables Global Status Report*, REN21 Renewable Energy Policy Network for the 21st Century, Paris.
- 157 Renewable Energy Network for the 21st Century and Worldwatch Institute (2007) cited in Editorial (2008) 'Renewable energy surges forward', *The Japan Times Online*, 16 March.
- 158 The Climate Group (2007) 'Top Actions by States and Regions – California', www.theclimategroup.org/what_we_do/states_and_regions/california, accessed 12 July 2009.
- 159 REN21 (2007) *Renewables Global Status Report*, REN21, Paris Renewable Energy Policy Network for the 21st Century, Paris.
- 160 Mendonca, M. (2007) 'Energy, ethics and feed-in tariffs', *Renewable Energy World.Com*, 30 April.
- 161 California Energy Commission (2007) *Integrated Energy Policy Report*, California Energy Commission.
- 162 REN21 (2008) *Global Status Report: Policy Landscape / Power Generation Promotion Policies*, Renewable Energy Policy Network for the 21st Century, Paris.
- 163 von Weizsäcker, E., Hargroves, K., Smith, M., Desha, C. and Stasinopoulos, P. (2009) *Factor Five: Transforming the Global Economy through 80% Improvements in Resource Productivity*, Earthscan, London.
- 164 UNEP (undated) 'Climate Neutral Network', www.climateneutral.unep.org/cnn_contentdetail.aspx?m=175&amid=666, accessed 7 March 2008.
- 165 Faiola, A. (2006) 'Japanese putting all their energy into saving fuel', *Washington Post Foreign Service*, 16 February 2006.
- 166 Vidal, J. (2006) 'Sweden plans to be the world's first oil-free economy', *Guardian* (UK), 2 February; Simpson, P. V. (2008) 'Eco-car subsidy could break budget', *The Local*, 1 March.
- 167 von Weizsäcker, E., Hargroves, K., Smith, M., Desha, C. and Stasinopoulos, P. (2009) *Factor Five: Transforming the Global Economy through 80% Improvements in Resource Productivity*, Earthscan, London.
- 168 Chrisafis, A. (2007) 'Sarkozy puts France on green track', *Guardian* (UK), 26 October.
- 169 EU Commission (2007) *EU Seeks To Shift Freight to Rail and Shipping*, EU Commission.
- 170 *BusinessWeek* (2008) 'China's Great Railway Expansion', *BusinessWeek*, 23 October.
- 171 Taylor, M. (2008) 'City's two-wheel transformation', *Guardian* (UK), 9 February.
- 172 *Associated Press* (2008) 'Utah is going to a 4-day workweek. In an effort to save energy, state employees will get Friday off', *Associated Press*, 3 July.
- 173 *Earth First* (2008) 'Some rural students get 4-day school week due to high fuel costs', *Earth First*, 25 July.
- 174 von Weizsäcker, E., Hargroves, K., Smith, M., Desha, C. and Stasinopoulos, P. (2009) *Factor Five: Transforming the Global Economy through 80% Improvements in Resource Productivity*, Earthscan, London.
- 175 IPCC (1999) *Special Report – Aviation and the Global Atmosphere, Summary for Policymakers*, Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge.

- 176 *EU Business News* (2008) 'European Union forces CO₂ caps on airlines', *EU Business News*, 25 October.
- 177 Vidal, J. (2006) 'Sweden plans to be the world's first oil-free economy', *Guardian* (UK), 2 February.
- 178 Faiola, A. (2006) 'Turn off the heat – how Japan made energy saving an art form', *Guardian*, UK, 17 February.
- 179 Hawaii 2050 Sustainability Task Force (2008) 'Hawaii 2050 Sustainability Plan sets direction for state's future', *PR Newswire*.
- 180 Smith, M., Hargroves, K., Stasinopoulos, P., and Desha, C. (2008) 'Analysis of the costs of inaction versus the costs of action on climate change for Australia', Submission to the Garnaut Review, The Natural Edge Project and Griffith University Business School, www.naturaledgeproject.net/Documents/TNEPSubmission.pdf, accessed 12 July 2009.
- 181 REN21 (2006) *Renewables Global Status Report 2006 Update*, Renewable Energy Policy Network for the 21st Century, Paris.
- 182 California Energy Commission (2007) *Integrated Energy Policy Report*, California Energy Commission.
- 183 Wilson, S. (2007) 'US Grassroots Tackle Climate Change', *BBC News*, 11 July.
- 184 Mori, Y., Kikuyama, Y. and Day, J. (2009) 'Japan implements integrated market for emissions trading linked to Kyoto mechanisms on trial basis', Martindale-Hubbell, Tokyo.
- 185 Young, T. (2008) '500 businesses join Japan's emissions trading scheme', *BusinessGreen.com*, 17 December.
- 186 McCurry, J. (2009) 'Japan's new prime minister promises ambitious greenhouse gas cuts: Yukio Hatoyama seeks to reduce CO₂ emissions by 25% below 1990 levels by 2020', *Guardian* (UK), 7 September.
- 187 REN21 (2006) *Renewables Global Status Report 2006 Update*, Renewable Energy Policy Network for the 21st Century, Paris.
- 188 Levine, M., Zhou, N. and Price, L. (2009) *The Greening of the Middle Kingdom: The Story of Energy Efficiency in China*, Lawrence Berkeley National Laboratory, Berkeley, CA.
- 189 Levine, M., Zhou, N. and Price, L. (2009) *The Greening of the Middle Kingdom: The Story of Energy Efficiency in China*, Lawrence Berkeley National Laboratory, Berkeley, CA.
- 190 Price, L. and Wang, X. et al (2008) *China's Top 1000 Energy-Consuming Enterprises Program: Reducing Energy Consumption of the 1000 Largest Industrial Enterprises in China*, Lawrence Berkeley National Laboratory, Berkeley, CA.
- 191 Levine, M., Zhou, N. and Price, L. (2009) *The Greening of the Middle Kingdom: The Story of Energy Efficiency in China*, Lawrence Berkeley National Laboratory, Berkeley, CA.
- 192 NDRC (2007) *National Climate Change Program*, National Development and Reform Commission, China.
- 193 REN21 (2006) *Renewables Global Status Report 2006 Update*, Renewable Energy Policy Network for the 21st Century, Paris.
- 194 Liu, Y. (2005) 'Shanghai embarks on 100,000 solar roofs initiative', *China Watch*, 10 November, Worldwatch Institute, Washington, DC.
- 195 NDRC (2007) *National Climate Change Program*, National Development and Reform Commission, China.
- 196 NDRC (2007) *National Climate Change Program*, National Development and Reform Commission, China.

- 197 REN21 (2006) *Renewables Global Status Report 2006 Update*, Renewable Energy Policy Network for the 21st Century, Paris.
- 198 European Commission (2007) *Combating Climate Change: The EU Leads the Way* (2008 edition), European Union.
- 199 German Federal Ministry of Economic Affairs and Technology (2007) *National Energy Efficiency Action Plan (EEAP) of the Federal Republic of Germany*, European Commission.
- 200 German Federal Ministry of Economic Affairs and Technology (2007) *National Energy Efficiency Action Plan (EEAP) of the Federal Republic of Germany*, European Commission.
- 201 European Commission (2007) *Combating Climate Change: The EU Leads the Way*, European Union.
- 202 REN21 (2006) *Renewables Global Status Report 2006 Update*, Renewable Energy Policy Network for the 21st Century, Paris.
- 203 EU (2007) *France – Renewable Energy Fact Sheet*, European Union.
- 204 French Republic (2008) *Energy Efficiency Action Plan for France*, European Commission.
- 205 European Commission (2007) *Combating Climate Change: The EU Leads the Way*, European Union.
- 206 DEFRA (2006) *Climate Change: The UK Programme 2006*, UK Department of State for the Environment, Food and Rural Affairs, London.
- 207 REN21 (2006) *Renewables Global Status Report 2006 Update*, Renewable Energy Policy Network for the 21st Century, Paris.
- 208 Sabha, L. (2008) 'Impact of climate change and National Action Plan on Climate Change', Press Release, Ministry of Environment and Forests.
- 209 Government of India (2008) *National Action Plan on Climate Change*, Government of India.
- 210 REN21 (2006) *Renewables Global Status Report 2006 Update*, Renewable Energy Policy Network for the 21st Century, Paris.
- 211 REN21 (2006) *Renewables Global Status Report 2006 Update*, Renewable Energy Policy Network for the 21st Century, Paris.
- 212 European Commission (2007) *Combating Climate Change: The EU Leads the Way*, European Union.
- 213 REN21 (2006) *Renewables Global Status Report 2006 Update*, Renewable Energy Policy Network for the 21st Century, Paris.
- 214 European Union (2007) *Italy – Renewable Energy Fact Sheet*, European Union.
- 215 European Union (2007) *Italy – Renewable Energy Fact Sheet*, European Union.
- 216 Nass, L. L., Pereira, P. A. and Ellis, D. (2007) 'Biofuels in Brazil: An overview', *Crop Science*, vol 47, pp2228–2237.
- 217 Dutra, R. M. and Szkloa, A. S. (2008) 'Incentive policies for promoting wind power production in Brazil: Scenarios for the Alternative Energy Sources Incentive Program (PROINFA) under the new Brazilian electric power sector regulation', *Renewable Energy*, vol 33, no 1, pp65–76.
- 218 WWF (2008) 'Brazil falls short with forest emission reduction ambitions', WWF, 3 December.
- 219 Laurance, W. F. (2007) 'A new initiative to use carbon trading for tropical forest conservation', *Biotropica*, vol 39, no 1, pp20–24.
- 220 Stern, N. (2006) *The Stern Review: The Economics of Climate Change*, Cambridge University Press, Cambridge, Table 21.1.