

Policies for Low Carbon Growth

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List of acronyms

ADB	Asian Development Bank
AIDS	Acquired Immunodeficiency Syndrome
BCCSAP	Bangladesh Climate Change Strategy and Action Plan
BERR	UK Department for Business, Enterprise and Regulatory Reform
BPO	Business Process Outsourcing
CAIT	Climate Analysis Indicators Tool (WRI)
CAT	Cap and Trade
CC	Climate Change
CCA	Climate Change Agreement (UK)
CCFP	Conversion of Cropland to Forest Program (China)
CCL	Climate Change Levy (UK)
CCS	Carbon Capture and Storage
CDM	Clean Development Mechanism
CFC	Chlorofluorocarbon
CFL	Compact Fluorescent Lamp
CHP	Combined Heat and Power
CIM	Inter-ministerial Committee on Climate Change (Brazil)
CN Net	Climate Neutral Network
CNCCP	Chinese National Climate Change Programme
CNG	Compressed Natural Gas
CONUEE	National Commission for the Efficient Use of Energy
COP	Conference of the Parties
CSO	Civil Society Organisation
DECC	UK Department for Energy and Climate Change
DEFRA	UK Department for Environment, Food and Rural Affairs
DFID	UK Department for International Development
DIUS	UK Department for Innovation, Universities and Skills
DOE	Department of Environment (Bangladesh)
ECA	Enhanced Capital Allowance (UK)
EE	Energy Efficiency
ESMAP	Energy Sector Management Assistance Program
EU	European Union
EVN	Economic Value to the Nation
EVW	Economic Value to the World
FBMC	Brazilian Forum on Climate Change
FAO	Food and Agricultural Organization
FIDE	Trust Law for Electric Energy Savings (Mexico)
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GLCFA	Guyana Low Carbon Finance Authority
GNI	Gross National Income
GNVA	Gross National Value Added
GoUK	Government of the UK
GVA	Gross Value Added
HCFC	Hydrochlorofluorocarbon
HDR	Human Development Report
HIC	High-income Country
HVDC	High-voltage Direct Current
LC	Low Carbon
LCDS	Low Carbon Development Strategy
LIC	Low-income Country

MCP	Malaria Containment Programme
MELCA	Movement for Ecological Learning and Community Action (Ethiopia)
MIC	Middle-income Country
MoEF	Ministry of Environment and Forests (Bangladesh)
NAMA	Nationally Appropriate Mitigation Action
NAPA	National Adaptation Programme of Action
NAPCC	National Action Plan on Climate Change (India)
NDRC	National Development and Reform Commission (China)
NEAP	National Environment Action Plan (Malawi)
NFFP	Natural Forest Protection Program (China)
NGO	Non-governmental Organisation
NPCC	National Plan on Climate Change (Brazil)
NSCCC	National Steering Committee on Climate Change (Bangladesh)
NSREP	National Sustainable and Renewable Energy Programme (Malawi)
ODI	Overseas Development Institute
OECD	Organisation for Economic Co-operation and Development
PASDEP	Plan for Accelerated and Sustained Development to End Poverty (Ethiopia)
PAT	Perform, Achieve, Trade
PROINFA	Programme of Incentives for Alternative Sources of Electric Energy (Brazil)
PRSP	Poverty Reduction Strategy Paper
PSI	Pollution Standards Index
PV	Photovoltaic
R&D	Research and Development
REDD	Reduced Emissions from Deforestation and Degradation
SME	Small and Medium Enterprise
TWG	Technical Working Group
UK	United Kingdom
UN	United Nations
UNCTAD	UN Conference on Trade and Development
UNDP	UN Development Program
UNEP	UN Environment Programme
UNFCCC	UN Framework Convention on Climate Change
WDI	World Development Indicator
WRI	World Resources Institute
WTO	World Trade Organization
WWF	Worldwide Fund for Nature

Executive summary

The Overseas Development Institute (ODI) has reviewed the low carbon growth and climate change response strategies of a range of countries with differing economic characteristics to draw out the policy implications for developing countries at different stages of development (Ellis et al., 2009).

The study, financed by the UK Department for International Development (DFID), selected a cross-section of high-, middle- and low-income countries to conduct a balanced review of low carbon growth policies. High-income countries (HICs) included Germany and the United Kingdom. Middle-income countries (MICs) included China, Brazil, Guyana, Mexico and Nigeria.

Low-income countries included Bangladesh, and Ethiopia. Shorter 'snapshots' were also provided for South Korea, India, Malawi, Rwanda and South Africa. These countries were chosen because they indicate the range of activities being carried out. All have published official documents outlining their climate change policies, such as national strategy documents, National Adaptation Programme of Action (NAPA) reports to the UN Framework Convention on Climate Change (UNFCCC), and national communications to the UNFCCC.

Growth has been, historically, highly correlated with carbon emissions. In light of the impact that this has had on climate change, new, low carbon growth strategies are being sought, i.e. policymakers are now seeking to achieve growth pathways that are associated with relatively low increases in carbon emissions.

Many developing countries have struggled to achieve any kind of sustained growth however, and have contributed little to the problem of climate change. The question for them will be how to achieve growth at all, particularly in light of climate change and international mitigation policies and the impact these are having on their economies.

These countries will need to find climate resilient growth strategies (i.e. growth strategies which are achievable despite the impact of climate change), and identify and manage opportunities (such as new markets) and risks (such as trade barriers) that arise from international mitigation efforts, in order to achieve growth in future.

Having an appropriate policy framework in place (such as a NAPA or Nationally Appropriate Mitigation Actions (NAMA)), is likely to help countries secure public and private funding for adaptation and mitigation. Identification of future mitigation opportunities and low carbon growth trajectories could thus be important, even for countries that have achieved only low growth rates to date. This will allow such countries to position themselves to take maximum advantage of new opportunities that may arise. For this reason we have considered both low carbon and climate resilient growth strategies in this report, as well as strategies to maximise growth potential arising from international mitigation efforts going forward.

The report draws on the case studies and other relevant literature to identify possible policy lessons and discuss the extent to which low carbon growth challenges traditional growth theory and policies.

Achieving low carbon growth clearly has major implications for policy, and implies considerable adjustment of the traditional growth agenda. However, low carbon growth does not present a major challenge to traditional growth theory, it simply requires the internalisation of the environmental costs of growth through the appropriate pricing of goods and services. This can be achieved through a range of mitigation policies, such as taxes on the production or consumption of carbon intensive goods.

The potential impact of mitigation policies on growth is unclear. Constraints on emissions raise the cost of energy which, in turn, reduces the output that can be achieved with a given set of inputs. No consensus exists on the costs of mitigation however, which will depend on the efficiency and nature of the policies adopted, and the extent of technological innovation achieved. And mitigation could also generate new growth opportunities, which would offset those costs.

This could be the case if, for example, there is fast growth in demand for environmental goods and services. Significant co-benefits associated with mitigation could also occur if there are strong synergies between green technology change and industrial technological progress, which is a key source of growth. Policies designed to promote green technological innovation and technology transfer could thus also potentially increase growth. In addition, some mitigation policies generate revenues (e.g. carbon taxes) and provide opportunities to stimulate growth through the judicious use of the revenues raised.

Thus the design of national mitigation policies and the way incentive mechanisms for low carbon growth are created will determine overall growth effects. The literature on this is mixed however, and modelling results depend enormously on the particular assumptions that are used. While much of the literature on mitigation suggests an overall negative impact on growth, a recent report by The Climate Group finds that a global climate agreement could lead to an increase in global GDP of 0.8% by 2020 relative to projected GDP with no climate action.

In addition to the overall impact of mitigation on global growth, the distribution of mitigation efforts will be important in determining the growth impacts in different parts of the world. Rich countries may need to accept lower rates of growth in future, if developing countries are to have the necessary space to grow their way out of poverty. The way that revenues from international mitigation efforts are used will also be important. For example, if auction revenue raised from permit sales in carbon cap-and-trade schemes is then used to finance mitigation or adaptation in developing countries, this could generate significant gains for recipient countries.

Mitigation policies will affect different sectors in different ways and are likely to imply adjustments to the sectoral sources of growth enjoyed previously by some countries. For example, mitigation policies which drive down the price of oil will generate a net loss for oil exporting countries and net gain for oil importers.

Air transport taxes might reduce demand for tourism or for air freighted exports such as fruit and vegetables. Carbon taxes may generate carbon leakage (i.e. the shift of dirty industry to pollution havens) and reduce income associated with carbon intensive products. The impact of these policies will vary significantly by country, depending on their sectoral composition. The analysis of the potential impact of different kinds of mitigation policies is fairly limited to date and the subject of a forthcoming ODI study.

A key determinant of the impact of international efforts to mitigate climate change on developing countries' growth paths will be the policies adopted by developing countries to adapt, mitigate and strategically position themselves in order to benefit from these international mitigation responses. This is likely to include the pursuit of a low carbon growth path as a prerequisite for receiving finance either for mitigation or adaptation. Appropriate policies can help to position countries to take advantage of new economic opportunities that may arise and can also help protect countries from threats to their growth arising from climate change or its mitigation.

Identifying policy implications

To aid comparison across countries, and with conventional growth policies, the review has been structured around the following six key pillars:

1. Finance for mitigation and adaptation;
2. Human capital;
3. Technological progress in energy, infrastructure and transportation;
4. Investment in agriculture and forestry;
5. Trade and private investment opportunities;
6. Incentives and regulation for low carbon growth.

We have reviewed case studies and literature under each of these pillars and identified the following possible policy lessons. (A more detailed discussion of policy implications drawn from the country policy reviews is contained in the full version of this report.)

Finance for mitigation and adaptation

- For the international policy community, the achievement of an international agreement on emissions reductions is a priority to help unlock private finance for mitigation.
- Countries can be strategic in how they position themselves to attract finance for mitigation and adaptation. For example, the development of a 'Climate Change Fund'/multi-donor trust fund, and an appropriate policy framework e.g. a NAPA, NAMA, and/or a low carbon growth strategy, can help to convince donors that climate change is taken seriously in that country, and that any funding will be spent transparently and effectively.
- Developing countries need to continue to lobby for financial support for mitigation and adaptation, and for reform that will help them benefit more from carbon markets, including the Clean Development Mechanism (CDM).
- For countries with carbon assets, strategic positioning, policy development, and lobbying for financial support for mitigation and adaptation, may help to both influence the international agenda, and the development of international mitigation mechanisms, such as Reduced Emissions from Deforestation and Forest Degradation (REDD) and CDM, in their favour, both in terms of scope and scale.
- Widening the scope of carbon markets to enable more LICs to benefit, and improving the investment climate in developing countries may also help them to maximise financial inflows of private finance for mitigation.
- Not all developing countries will be able to obtain private finance for mitigation and adaptation. Increasing the availability of public finance will also be important in supporting developing countries' low carbon growth efforts.

Human capital

- Broad awareness-raising may help increase public understanding of climate change and its effects, and the implications for people's livelihoods and welfare going forward. This can be implemented formally, for example through schools, or informally, through public awareness campaigns.
- Training in skills relating to green technologies and industries can help position countries to take advantage of any new low carbon growth opportunities and markets.
- Targeted investments in health, water and sanitation may help increase climate resilience by protecting human capital from the potential negative health impacts of climate change.

Technological progress in energy, infrastructure and transportation

- Infrastructure improvements and the development of clean energy options should be made as soon as possible to reduce emissions as well as adapt to potential impacts. This will avoid locking in high-carbon technologies and processes as demand for energy rises. The development of decentralised grids may offer co-benefits between greener energy production, and increased access to energy.
- Strategic thinking and strong policy management of patterns of urbanisation may be required to increase climate resilience and facilitate low carbon growth.

- Government can play an important role in clarifying the future direction of policy and the key decisions that will be made on energy production and infrastructure development, to give business the confidence it needs to undertake low carbon investments.
- It is critical for low-income countries to receive international support and technology transfer to facilitate their transition to a low carbon economy. Greater efforts to promote international cooperation on research and development may help to promote technological diffusion. A re-examination of intellectual property provisions in the World Trade Organization (WTO) may also be needed.
- Countries should identify renewable resources that provide the greatest advantage in view of local conditions, resources, and state of development.
- The future development, demonstration and transfer of technology for carbon capture and storage will be very important for countries that continue to develop their large coal reserves.
- Governments in all countries can benefit from working with the private sector and civil society to scale up renewable technologies, from improved cook-stoves to large-scale wind and solar to hydropower.
- Transport is best approached holistically and should include public transport, clean, sustainable fuels, and efficient vehicles.
- Biofuels offer a potentially important new export opportunity for some developing countries, although major developed countries still impose protection on biofuel imports.

Investment in agriculture and forestry

- Greater understanding and awareness of the impact of climate change on agricultural productivity, and shifts in demand for agricultural produce will help developing countries to improve climate resilience and take advantage of possible new growth opportunities. Education of farmers will be an important component in this.
- Comprehensive approaches that include improved agronomic practices; climate-resistant crop varieties; water, soil and fertiliser management, and better livestock management are needed.
- Adaptation efforts in agriculture may be most important in poor countries that rely disproportionately on agriculture and are likely to be most affected by climate change.
- Forestry payments present a significant potential financing opportunity for some countries, if international mechanisms such as REDD can be successfully developed.
- Countries that develop a rigorous, comprehensive, transparent and inclusive process around sustainable forest management may be more likely to secure international investments and future CDM benefits and turn them into successful alternative growth strategies and conservation of forests.
- Agriculture offers considerable potential sequestration benefits though there are significant barriers to attracting carbon finance for this sector.

Trade and private investment opportunities

- Countries that identify, target and secure new green investment and growth opportunities stand to benefit more from the transition to a low carbon economy.
- There is a role for government leadership to identify low carbon growth sectors which may provide competitive advantage and employment growth.
- The development of new opportunities must be backed by sufficient support and funding from government and the international community. This includes the creation of an appropriate policy environment; provision of the necessary training/education; investment promotion and awareness raising; and collaborative partnerships between the public, private and NGO sectors.

Incentives and regulation for low carbon growth

- Internationally coordinated action to mitigate climate change can help reduce the risk of a 'race to the bottom' in relation to the taxation and regulation needed to stimulate low carbon growth.
- Donor support for low carbon regulation and taxation could help build developing countries' capacity to implement such policies effectively.
- An ongoing review of the efficacy and cost-effectiveness of measures by different countries to incentivise the necessary changes in behaviour and stimulate low carbon growth, could help improve policy-making in this area.
- Many of the barriers to low carbon growth, mitigation financing and technological transfer in developing countries are the same as the barriers to growth and investment generally i.e. a poor investment climate and uncompetitive markets. Policies to tackle these remain important.

Policy processes

In our review, we also looked at the policy processes adopted in each country. Possible lessons include:

- Policy statements should go beyond 'statements of intent' to provide a roadmap for specific measures and an implementation plan.
- Policy is strengthened by underpinning studies.
- Consultations help to obtain ideas and include various stakeholder viewpoints; promote coordination and collaboration, and enhance transparency and trust in the process.
- The inclusion of civil society helps build support for policies and thus aids in implementation. Consulting and partnering with the private sector can help increase the feasibility and market-friendliness of policies that are proposed. This can facilitate greater private sector engagement in achieving low carbon growth and improve the sustainability and scale-up of green investments.
- Training and education can help with coordinating different government departments and policies.
- Providing strong policy guidance is crucial to implementation.

Progress to date and lessons learned

The countries we have reviewed have already taken steps to develop a climate change or low carbon development strategy, and thus are, to a greater or lesser degree, ahead of other countries, within their income category at least. However, there are still a number of issues that most countries either did not address or could not resolve in their policy documents. These include:

- Specification of a (potential) funding source for climate mitigation and adaptation activities;
- An implementation roadmap with specific measures;
- Anti-corruption and pro-transparency measures governing the use of mitigation/adaptation funds;
- A framework for macro management and measures to combat Dutch Disease;
- Identification of new green growth opportunities and the policies needed to achieve them;
- A rigorous consultation process;
- The need for policy alignment and intra-governmental cooperation.

So, although many of these countries are, to some extent, ahead of the game in terms of policies to promote low carbon growth and climate resilience, it is clear that improvements can still be made.

Nonetheless, the policies they have set out and the processes they have pursued can provide valuable lessons for other countries only now beginning to think about how they will respond to climate change.

While it is too early to judge the efficacy of many of these policies (and indeed many of them are still only being planned), ongoing monitoring of their impact will be important in ensuring that lessons are learned globally, thus speeding up the effective response to this most pressing of problems.

1. Introduction

Developing countries as a group have contributed much less to the problem of climate change than developed countries, yet they are the most vulnerable to its negative impacts. Developing countries must have the opportunity to grow their way out of poverty, and the threats posed by climate change increase the urgency of promoting sustainable growth and development, which will help to increase the capacity of developing countries to manage a changing climate.

However, growth and development are usually associated with increases in carbon emissions, so are likely themselves to contribute to climate change. International pressure to control carbon emissions is growing, although the extent to which developing countries should bear the burden for mitigation remains highly controversial. The contribution to tackling climate change expected of large emitters like China and India is likely to be very different from that of low-income countries (LICs), as will be the policy requirements to achieve the necessary change.

Many developing countries have struggled to achieve sustained growth at all, and have thus contributed little to the problem of climate change. For them, the first question is how to achieve growth at all, particularly in light of the impact of climate change and international mitigation policies on their economies. They will need to find climate-resilient growth strategies (i.e. growth strategies which are achievable despite the impact of climate change), and to identify and manage opportunities (such as new markets) and risks (such as trade barriers) arising from international mitigation efforts, in order to achieve growth going forward. Having an appropriate policy framework in place (such as a NAMA (Nationally Appropriate Mitigation Action) or a NAPA (National Adaptation Programmes of Action)), is likely to help them secure public and private funding for adaptation and mitigation. Thus, identification of future low carbon growth trajectories will be important even for these countries, in order that they may position themselves to take maximum advantage of new opportunities that may arise. For this reason, we consider both low carbon and climate-resilient growth strategies in this report, as well as strategies to maximise growth potential arising from international mitigation efforts going forward.

At the same time, international mitigation efforts, and steps taken by developed countries to 'green' their gross domestic product (GDP), could have a significant impact on developing countries' economic prospects, generating both opportunities and threats, which developing countries need to factor into their own growth strategies and policy responses to climate change.

The objective of achieving low carbon growth – although increasingly a focus for policy debate – poses considerable challenges. As yet there is only a limited understanding of what low carbon growth will look like in a developing country context, the incentives for developing countries to pursue low carbon growth paths, the costs and benefits and the funding available. Of course, achieving any kind of sustained growth has by itself proved challenging for many developing countries.

Governments in both the developed and the developing world are only just beginning to think about how to develop a low carbon growth strategy. To date, most of the focus has been on policies for adaptation (to the effects of climate change), and mitigation (to constrain emissions and hence reduce climate change). But policymakers are now beginning to think also about what economic *opportunities* might arise in a new, carbon-constrained, global economy.

Thus, low carbon growth policies consist of two broad elements:

- Mitigation, to allow economic growth to continue while constraining any associated growth in carbon emissions. This includes policies designed to encourage greener energy sources, greater energy efficiency and reduced emissions from agriculture and forestry, and includes

strategic thinking about other issues, such as management of infrastructure development to support greener forms of the urbanisation that is likely to accompany economic growth.

- Adaptation, to both climate change itself and to international mitigation policies, to ensure that domestic growth strategies are consistent with the changing global environment and policy context. This includes both taking account of threats to the future growth of certain high carbon industries and trying to capitalise on new opportunities arising, perhaps from growing demand in certain markets (e.g. for environmental goods and services), changing patterns of international trade and investment or new sources of finance being made available through carbon markets (e.g. the Clean Development Mechanism (CDM)), for example.

The specific country context will determine both the threats and opportunities faced, the capacity to either address or capitalise on them and the policies they will imply.

In this report, we review low carbon development strategies (LCDSs) and other policy responses to climate change that have been produced, across a spectrum of high-income, middle-income and low-income countries (HICs, MICs and LICs) with differing economic characteristics, with a view to drawing out implications for policy which can be considered by developing countries, depending on their context and stage of development.

The objective of the study is to review the official policy response in the case study countries, and so we have focused only on documents produced by or for governments in those countries; we have not reviewed commentaries or proposals made by other organisations seeking to influence government.

The countries reviewed are: Bangladesh, Brazil, China, Ethiopia, Germany, Guyana, Mexico, Nigeria and the UK. (Shorter snapshots of climate change/low carbon policy developments have also been produced for a number of other countries: India, Malawi, Rwanda, South Africa and South Korea).

In each case, subject to the information available, we have endeavoured to describe:

- The country context (e.g. main industries, level and source of carbon emissions, etc);
- The policy context and process (e.g. nature of ministerial involvement, degree of consultation, timeframe for implementation, etc);
- Stated motivations for the climate change response/low carbon growth strategy;
- The policies that have been proposed or implemented as part of this strategy;
- The policy/strategy documents reviewed.

The review of policies has been based on the following six key pillars:

1. Finance for mitigation and adaptation;
2. Human capital;
3. Technological progress in energy, infrastructure and transportation;
4. Investment in agriculture and forestry;
5. Trade and private investment opportunities;
6. Incentives and regulation for low carbon growth.

Not all of the country policies tackle all of these six issues, and the degree of emphasis on different policies, and also on the balance between adaptation and mitigation, varies considerably between countries depending on their level of income and economic structure.

In the final section, we discuss how low carbon growth challenges traditional growth theory, and traditional growth policies, drawing on the case studies and other relevant literature to identify possible policy lessons.

2. Low carbon growth case studies

2.1 High-income countries

2.1.1 Germany

Country context

Services accounted for 29% of German GDP in 2008 (including financial services, retail and real estate), followed by the industrial sector at 26% of GDP (including energy production and manufacturing) and by trade, transport and communications (18%). Of lesser importance to the German economy are the construction and agriculture sectors (at 4% and 1% of GDP, respectively). The German economy is also one of the world's leading exporters of goods, worth an estimated €56 billion a year in exports and accounting for 16% of global trade.

Energy in Germany is produced mainly by the use of mineral oils (35%), coal (24%) and natural gas (23%), while renewable forms of energy production account for only 7% of all energy consumed. In terms of electricity consumption, the manufacturing sector accounts for the greatest share of electricity used (with 43% of total electricity consumption), followed by the service sector (27%), the residential sector (27%) and the transport sector (3%).

CO₂ emissions by sector in Germany (compiled from the 2009 Worldwide Fund for Nature (WWF)/Allianz G8 Climate Change Scorecard) show that the energy sector is the greatest source of CO₂ emissions in Germany, accounting for 42% of all CO₂ emissions, followed by the industrial sector (22%), transport (16%), households and services (14%) and agriculture (5%).

Policy motivations for low carbon growth

Energy security, secure job creation and reductions in greenhouse emissions are the main stimuli for low carbon growth in Germany. To this end, the German government has launched a series of initiatives (leading up to 2020) to move towards more sustainable energy production as well as to enhance the German economy through the use and production of green growth technologies.

In terms of energy security, the German government explains that the country needs to move forward towards a greater use of renewable energy in order to mitigate changes in fossil fuel prices and move away from nuclear-based energy. Investments in renewable energy and energy security would also allow the German economy to save €20 billion a year (by 2020) on energy imports alone. Nuclear power will be eliminated from the national grid by 2022, as stated in the 2002 Atomic Energy Act, as the German government believes the risks associated with the use of nuclear power are not offset by its benefits.

The 'green growth sector' in Germany is estimated already to provide employment for around 1.8 million people and to have earned the German economy €56 billion in exports in 2006, while the renewable energy sector is estimated to employ 250,000 people and to be worth around €26 billion a year. Germany is one of the top exporters globally for green growth technologies, accounting for 5% of total German exports in 2007, while nearly a quarter of all new green technology patents in the European Union (EU) in 2007 originated from Germany. Green growth is also important for the services sector in Germany, as in 2008 revenues of €123 billion were generated within the 'green services' sector, with growth estimates of around 8% per annum.

The German government estimates that the green growth sector is currently worth €1500 billion a year (globally) and predicts that this figure will double to €3000 billion by 2020. In order to take a greater share of this market as well as to provide economic stimuli in a period of financial crisis, the German government wishes to enhance Germany's role in the production of green growth

technologies, through further investments in research and development. According to the government, this would allow Germany to become a world leading exporter in the field and allow between 500,000 and 1 million new jobs to be created within the field by 2020.

In addition to the creation of new jobs and energy security, the German government aims to move Germany towards the achievement of the following key targets:

- Cut greenhouse emissions by 40% of 1990 levels by 2020;
- Increase energy efficiency by 3% per annum;
- Increase the share of renewable energy to:
 - 50% of primary energy consumption by 2020;
 - 30% of gross power consumption by 2020;
- Increased usage of biofuels in order to reduce greenhouse gas emissions by 7% by 2020;
- Double the contribution of combined heat and power (CHP) technologies to 25% of power generation in 2020.

The low carbon growth pillars

Finance for mitigation and adaptation

An Efficiency Fund, which will be used to pay for electricity saving projects in both the private and public sector, will be set up through revenues generated through the Emissions Trading Scheme from 2013; the fund is estimated to be able to generate around €1 billion per year.

The use of electrical vehicles will be encouraged through the National Development Plan for Electromobility. The plan involves a government investment of €115 million per year in order to encourage the use of electrical vehicles, both for personal transport and for freight.

A €500 million fund has been set up in order to implement the Renewable Energies Heat Act, which was implemented in January 2009. The act stipulates that a percentage of all energy used in all new buildings will come from renewable sources. The fund has been set up to ensure that all new buildings will be able to meet the requirements of the act.

Human capital

The reviewed policy documents call for improvements in education and qualifications to meet the demands of a rising 'green' sector; however, there are no specific strategies mentioned on how education levels (especially technical skills) can be improved within the German market.

Technological progress in energy/infrastructure/transportation

In terms of renewable energy, the German government introduced the Energy Sources Act in 2000, which was amended in 2009 to include new developments in renewables such as wind, photovoltaic and bioenergy, with the aim of further incentivising investment in these energy sources, with particular emphasis on the expansion of wind-powered energy sources and the replacement of old wind turbines with newer and more energy-efficient models.

The use of biomass as a source of energy has been promoted by the government; however, the roadmap acknowledges that there are certain associated problems, such as in land used to grow agricultural food products being converted into biomass production areas.

The German government wants to hasten the energy grid expansion, as it sees this as a long overdue project. The expansion falls under the Grid Expansion Act, which will allow new technologies to be introduced within the grid such as high-voltage direct current (HVDC) transmission cables, underground cabling and interconnections with neighbouring EU countries in order to trade energy between countries.

In 2009, the Combined Heat and Power Act¹ will be introduced in order to promote the investment and construction of new CHP power plants (which are far more efficient in the production of both heat and energy than traditional plants), as well as to increase CHP power and heat generation by 25% by 2020. The German government is also investing in further research into carbon capture and storage (CCS) facilities in order to increase its ability to further mitigate carbon emissions.

The roadmap highlights the need for an overhaul of the energy infrastructure within Germany, through an expansion of the electrical grid, the construction of new energy-efficient power stations, investment in HVDC electrical cables (which allow for far more efficient electrical distribution than conventional electrical cables) as well as investments in better energy storage facilities, renewable sources and better electrical load management.

Trade and private investment opportunities

The German government estimates that the green growth sector is currently worth €1500 billion a year (globally) and predicts that this figure will double to €3000 billion by 2020. In order to take a greater share of this market as well as to provide economic stimuli in a period of financial crisis, the German government wishes to enhance Germany's role in the production of green growth technologies, through further investments in research and development. According to the government, this would allow Germany to become a world leading exporter in the field and allow between 500,000 and 1 million new jobs to be created within the field by 2020.

Investment in agriculture and forestry

None of the reviewed documents calls for changes in the agriculture sector in terms of energy efficiency or resource management. As agriculture accounts for only 1% of GDP and 5% of CO₂ emissions, the German government may not regard it as strategically important in its green growth strategy.

Incentives and regulation for low carbon growth

The German government has already implemented the Integrated Energy and Climate Programme² in 2007, focused mainly on the promotion of renewables and CHP. The German government will continue to focus on the use of renewables as well as introducing the Efficiency Standards Act, aimed at increasing energy efficiency within the country.

The Energy Policy roadmap states that, by 2020, 40% of electricity generated will be produced in high energy efficiency coal power plants. The roadmap explains that the Emissions Trading Scheme set up in 2005 by the EU, by setting strict caps on CO₂ emissions by power plant, has already incentivised utility companies to move towards more energy-efficient power plants with lower carbon emissions. Current Emissions Trading Scheme caps will be decreased by 1.74% per annum from 2013, which should ensure a reduction in emissions by 21% as compared with 2005.

German electricity consumption will be reduced by 11% (based on 2005 levels) by 2020. The German government sees this as an important strategy towards carbon emission reductions, as electrical consumption accounts for nearly 50% of energy-related carbon emissions. The Integrated Energy and Climate Programme³ (fully implemented in May 2008) is an important step towards the reduction in electricity usage, as within the programme (among other reforms, including vehicle tax reforms that take into account carbon emissions per vehicle, clean power plants and increases in the use of biofuels) there are provisions for improvements in energy efficiency and reductions in electricity usage by domestic appliances.

According to the roadmap, more information about electricity consumption and electricity prices needs to be provided to consumers, especially for low-income households, which the roadmap

1 <http://www.dena.de/en/topics/energy-systems/projects/projekt/combined-heat-and-power-generation/>.

2 <http://www.erneuerbare-energien.de/inhalt/39945/42719/>.

3 <http://www.bmu.de/english/climate/downloads/doc/40589.php>.

identifies as particularly vulnerable to price fluctuations. Energy-efficient electrical appliances need to become more widespread through the economy through a proposed system of labelling which would exclude from German markets any appliances that do not meet the minimum energy efficiency requirements. An Efficiency Act should be introduced in order to promote energy efficiency by businesses and individual consumers. Efficiency will also be promoted through government investments aimed at incentivising the private sector towards investments in energy-efficient companies.

The German government envisions a much greater role for CHP and renewables for heat generation in Germany, as a large proportion of heat is currently generated through fossil fuels. The roadmap also plans to reduce greatly the amount of fossil fuels used in heating as well as increasing the efficiency of current heating systems, such as through improved building heat insulations. The German government implemented the Renewable Energies Heat Act⁴ in 2009. The act promotes the use of renewable energy sources (which meet approved standards) for new buildings.

A 20% reduction in carbon emissions generated by transport is also included in Germany's green growth strategy, as currently 20% of all carbon emissions generated in Germany have their source in the transport system. Road tax has been reformed in order to account for carbon emissions rather than engine size, as an incentive for consumers to purchase low carbon vehicles. In addition to the road tax, the EU will implement a CO₂ cap for vehicle emissions in 2012, which will be further reduced from 2020. The German government has introduced the Biofuel Quota Act, intended to reduce carbon emissions through the use of biofuels as well as regulating what biofuels are used.

Further action is also considered in order to reduce carbon emissions in the transport system, through increased taxes for luxury company cars, reduced taxes on the public transport system and decreased road speed limits in order to encourage fuel efficiency.

2.1.2 United Kingdom

Country context

The UK's economy is based largely on services. There has been significant growth in the financial sector, which went from 27% of the gross national value added (GNVA) in 2000 to 31.9% in 2007.⁵ In contrast, the manufacturing sector has seen a significant decline, from 17% of GNVA in 2000 to 12.4% in 2007. Other significant areas of the economy are the education and health sector (13% of GNVA in 2007) and the transport and communication sector (7% of GNVA in 2007).

The latest figures from the UK Climate Change Programme: Annual Report to Parliament 2008 (UK DEFRA, 2008) show that total greenhouse gas (GHG) emissions fell from 655.5 million tonnes in 2005 to 652.3 million tonnes in 2006, with an estimated fall to 639.5 million tonnes in 2007; CO₂ emissions in 2007 had fallen to 543.7 million tonnes, from 554.5 million tonnes in 2006.

2006 figures from the UK Climate Change Programme show that the business sector is the main source of greenhouse gas emissions in the UK, accounting for 32% of all emissions, followed by the transport sector (25%), the residential sector (24%) and the agriculture sector (8%). Industry and exports account for a much lower share of GHG emissions, at 2.8% and 1.8%, respectively. In terms of electricity generation, 2009 figures from the UK Low Carbon Transition Plan (GoUK, 2009) show that the majority of electricity used in the UK comes from gas (45%), followed by coal (32%) and nuclear energy (13%); renewables account for only 6% of electricity used.

4 http://www.bmu.de/english/renewable_energy/downloads/doc/42351.php.

5 <http://www.statistics.gov.uk/statbase/Product.asp?vlnk=1143>.

Policy motivations for low carbon growth

The government of the UK has pledged to move towards low carbon growth and sees it as a growing market in which the UK is already competitively placed. The policy motivation is thus twofold: first of all to reduce GHG emissions and mitigate carbon emissions, hence reducing the impact of the UK on climate change, but also to take advantage of this growing market and allow British firms to profit from high global demand for low carbon technologies.

In terms of its pledge to reduce GHG emissions, the government of the UK initially launched Climate Change: The UK Programme 2006 (DEFRA, 2006), as well as subsequent annual reports to Parliament on the state of progress as well as new initiatives to be introduced.⁶ The programme pledged a reduction of 20% in carbon emissions (based on 1990 levels) by 2010. Further to the 2006 programme, the UK government launched the UK Low Carbon Transition Plan in July 2009 (GoUK, 2009); the plan set out reviewed targets pledging a reduction of 18% in carbon emissions by 2020 on 2008 levels. In addition, the UK government is bound to meet Kyoto Protocol requirements (a 12.5% reduction in carbon emissions on 1990 levels in the 2008-2012 period) and a reduction of 60% (again on 1990 levels) by 2050.

The 2006 programme identifies a number of key areas (such as energy, the transportation system, business, public sector, residential, agriculture, etc) in which changes can be made in order to reduce carbon emissions, as well as looking into what actions the UK will take internationally in order to reduce global carbon emissions. The 2008 annual update specifies that the UK Climate Change Programme is based on three principles: 1) carbon pricing; 2) technology policy; and 3) removing barriers to behavioural change on energy efficiency.

The 2008 annual report to the government discusses the introduction of the Climate Change Act. The bill was made law in November 2008.⁷ The bill provides a framework and legally binding targets for carbon reduction and energy efficiency up to the year 2050; by statute a 60% reduction in carbon emissions (based on the 1990 level) must be achieved. The bill also introduces five-year carbon budgets, setting strict targets for carbon emissions for each five-year period. In addition, the Committee on Climate Change will be introduced. The committee will advise the government on the carbon budgets to be set for each five-year period as well as providing annual reports to Parliament on progress made. The bill will also allow the government to introduce further carbon trading schemes, should they be required, in order to meet carbon reduction targets.

In order to gain access to the low carbon growth market, the Investing in a Low Carbon Britain paper of April 2009 highlights the key areas in which the UK economy can compete effectively: CCS technologies, offshore wind farms, marine energy, nuclear power and low carbon vehicles (DECC et al., 2009).

Within the UK the low carbon growth stimulus is supported throughout the government. The UK's Departments for Energy and Climate Change (DECC), Business, Enterprise and Regulatory Reform (BERR), Innovation, Universities and Skills (DIUS) and Environment, Food and Rural Affairs (DEFRA) have been the most active in promoting low carbon growth within the UK.

The low carbon growth pillars

Finance for mitigation and adaptation

The UK government has set up a Low Carbon Investment Fund, which acts as an incentive for low carbon companies to set up or relocate to the UK. The fund will offer support for the research and development of low carbon technologies which can be applied to the market in general. The Environmental Transformation Fund has also been set up, with the aim of supporting the

⁶ <http://www.defra.gov.uk/environment/climatechange/uk/ukccp/>.

⁷ <http://www.defra.gov.uk/environment/climatechange/uk/legislation/>.

commercialisation of low carbon technologies and allowing their rapid introduction within the market.

Enhanced Capital Allowances (ECAs) have been introduced; these allow business to claim 100% capital allowances on qualifying energy-efficient investments and act as an incentive for businesses to invest in eco-friendly technology across a variety of sectors.⁸ To further help small and medium enterprises (SMEs), the Carbon Trust Scheme will include a loan package for around 3000 SMEs to purchase energy-efficient equipment, in order to allow firms to save on energy bills and at the same time reduce carbon emissions.

In addition to ECAs, the Climate Change Agreements (CCAs) were introduced in 2000, with two-year moving targets up to 2012.⁹ The CCAs are 12-year agreements between DEFRA and industry organisations. Industries that agree to the CCAs are given an 80% discount on the Climate Change Levy (CCL) in return for achieved (and agreed) additional cuts in carbon emissions. The CCAs have been joined by 10 major industries (including food and drink, chemicals, cement, paper and steel) and over 30 minor industries.

The UK government has also initiated the Low Carbon Building Programme, implemented in April 2006. The programme provides funds to support the reduction in carbon emissions from buildings by combining energy efficiency measures and micro-generation technologies together.¹⁰

Provisions are also being made to reduce carbon emissions within the public sector. A package of funding will be made available to the public sector in order to improve energy efficiency as well as incentivise local authorities (councils) to pay more attention and improve their commitment towards the environment.

Part of the low carbon development growth plan revolves around the automotive industry including planned government incentives for consumers to purchase electric vehicles as well as an investment package for vehicle manufacturers to research and produce low carbon vehicles (part of a wider stimulus plan for British automotive manufacturers). British households will also receive financial aid through a 'cash back' incentive set up by the UK government, which will give fiscal incentives through monetary payments to households that use renewable electricity.

The British government is also implementing carbon budgets for different government departments. The size of these will depend on both the emissions generated by these departments (including subordinate institutions such as schools and the National Health Service) as well as the ability of said departments to influence carbon mitigation in different economic sectors. These budgets will be used both to offset carbon produced by the departments and to allow departments to set up carbon mitigation programmes for the industries and economic sectors for which they are responsible.

Human capital

The UK government will set up a Skill Funding Agency with the aim of ensuring that the UK labour market will have the right skill sets to meet the high demand for low carbon technologies. The agency will collaborate with training organisations, universities, qualification schemes and apprenticeship schemes.

Technological progress in energy/infrastructure/transportation

The government will invest in the research and development of better carbon abatement technologies as well as investigating and reducing the barriers to the mass implementation of CCS technologies within Britain. CCS is a key area into which the UK government wishes to invest,

8 <http://www.eca.gov.uk/>.

9 http://www.carbontrust.co.uk/climatechange/policy/cc_agreements.htm.

10 <http://www.lowcarbonbuildings.org.uk/about/>.

predicting savings of up to £1-2 billion a year by 2020 for UK businesses (including energy generation) if CCS were to be used to its full potential within the UK market. To this end, the UK government will invest in CCS research and development, as well as building four CCS demonstration plants within the UK.

Investments have also been put in place to research low carbon electricity micro-generation technologies, in order to allow individual buildings (such as schools, public buildings, council houses, etc) to install their own electricity generators. In addition, the government established in 2007 the Energy Technologies Institute as a public–private initiative. This researches low carbon technologies, where private funding is matched by public funding.

Investment and support of renewable energy will be continued under the Renewables Obligation Act, which ensures that licensed energy providers within the UK generate a certain amount of energy through sustainable and renewable energy production¹¹ (from 5.5% in 2005/06 to 15.4% in 2015/16). It was introduced in April 2002, running until 2027. In order also to promote the growth of wind-powered energy and offshore wind farms, the government will ensure that wind farms receive better support from the Renewables Obligation Act through increased subsidisation of energy production.

The government will also invest in research on the use of wave and tidal stream technologies as a source of renewable energy for the UK. Further investment will also be undertaken in order to improve the infrastructure for the provision of renewable energy, such as better cabling to areas where proposed wind farms would be installed. Investments and support schemes to improve the provision of heat from biomass (wood stoves, etc) will also be undertaken. Further efforts will be made to allow the use of waste and hydrogen for heat and electricity generation as well as to increase national fuel security.

Investments will be undertaken in the research of advanced biofuel production techniques in order to further reduce carbon emissions. In addition to biofuels, the government will also engage in the research of other fuel sources, such as hydrogen cells. Grants will also be given towards a programme for the construction of an alternative refuelling infrastructure for fossil fuel alternatives. Overall government funds for all low carbon growth and carbon abatement research and development will total £405 million.

Investment in agriculture and forestry

The government will undertake a feasibility study of a carbon emission trading scheme for agriculture to assess the scope to extend the scheme to the sector. The government also aims to improve the management of agricultural activities in order to make them more energy efficient and reduce their impact on the environment.

Trade and private investment opportunities

In order to capitalise on opportunities in the new low carbon growth market, the Investing in a Low Carbon Britain paper of April 2009 (DECC et al., 2009) highlights the key areas in which the UK economy can compete effectively: CCS technologies, offshore wind farms, marine energy, nuclear power and low carbon vehicles.

The UK government will put in place a levy system in order to finance the construction of four CCS demonstration projects, with the aim of boosting CCS research and market deployment in the UK as well as ensuring British leadership in the production and commercialisation of CCS technologies worldwide. In addition, the UK government will promote the creation of CCS technologies production and research clusters within the UK in order to foster internal development as well as to attract foreign firms to research, invest in and produce CCS technologies in the UK.

¹¹ <http://www.ofgem.gov.uk/Sustainability/Environment/RenewablObl/Pages/RenewablObl.aspx>.

The UK government will spur continued research and development in offshore wind farms, as the UK is currently a global leader in the use of offshore wind technologies. The government wants to take advantage of this in order to export British offshore technologies and products as well as British expertise in the installation, use and production of offshore wind technologies, and sees this as a potentially large market, which could prove beneficial for the UK economy.

Investments will also be undertaken in marine energy technology, with potential internal growth estimated at 60% by 2016. The UK government sees this as an additional sector for economic growth, especially with regard to wave technology. To this end, the government is sponsoring a large-scale wave power project off the coast of Cornwall in order to spur further developments in marine energy technology and power plants.

Nuclear energy is also seen as beneficial for the UK economy, as the production of power plants within the UK will not only create jobs within the nuclear sector but also provide employment and growth for a large number of UK firms which can provide the materials and expertise needed in order to construct new nuclear power plants.

Low carbon vehicles are seen as a strategically important sector for investment in green technologies. The UK vehicles production market is already well established and the UK government believes that, with the right incentives, the industry could capitalise on future demand for low carbon vehicles by shifting production towards this particular sector.

Incentives and regulation for low carbon growth

Efforts to reduce carbon emissions within the business sector will focus on the EU Emissions Trading Scheme in order to fully involve the private sector in the carbon emission reduction process together with the provision of information for businesses. The CCL, a tax levied on non-residential energy users with the aim of incentivising the use of renewable energy supplies (which are tax exempt)¹² and also allowing businesses to become more efficient through the use of energy-efficient technologies, will be further used as instruments in order for business to reduce their carbon emissions and improve energy efficiency. The CCL is not applied to producers of CHP in order to encourage the use of CHP power plants (as they are deemed more energy efficient than conventional power or heat plants).

Changes to reduce carbon emissions within the transport sector include the introduction of the Renewable Transport Fuel Obligation Act in 2008, meant to ensure that at least 5% of all fuel used for road transportation comes from renewable sources (in practice, vehicles would use a mixture of biofuels (5%) together with more conventional fossil fuels (95%)) by 2010.¹³

The government will also further engage with the EU to make sure that aviation is included in the EU Emissions Trading Scheme as well as continued use of vehicle carbon emissions regulations. The government will make use of the vehicle excise duty in order to steer consumers towards the purchase of vehicles with lower carbon emissions, where the highest carbon-emitting vehicles will have to pay the highest tax band, and vehicles with emissions below a certain level will pay no tax. The government will continue funding the Low Carbon Vehicle Partnership, an action and advisory group set up in 2003 to accelerate the movement towards vehicles with low carbon emissions.¹⁴ The government will also continue to support the EU voluntary agreements on new car fuel efficiency, set up in 1999 between the EU and car manufacturers for the manufacture of vehicles with lower carbon emissions.¹⁵ Vehicle carbon emissions will be highlighted to the consumer through a colour-coded rating system that shows how high carbon emissions are for each vehicle. This will be linked to the vehicle excise duty classification scheme.

12 <http://www.defra.gov.uk/environment/climatechange/uk/business/cca/levy.htm>.

13 <http://www.dft.gov.uk/pgr/roads/environment/rtfo/aboutrtfo>.

14 <http://www.lowcvp.org.uk>.

15 <http://www.dft.gov.uk/consultations/archive/2006/reducingnewcarco2emissions/reducingnewcarco2emissionswh1748?page=4>.

In terms of residential housing, the programme pledges to update the Building Regulations Act implemented in 2006 (which include provisions for heat and energy conservation requirements within new and refurbished buildings) as well as introducing a new Code for Sustainable Homes, a voluntary environmental impact and sustainability rating system for residential property in England (the code was introduced in April 2008) aiming for a reduction in the environmental impact of residential property.¹⁶ The government aims also to subsidise between 150,000 and 250,000 home insulation installations by 2008 as a means of increasing heat retention within homes, thus reducing heating requirements, hence carbon emissions. The government has also sponsored a multi-million pound study in order to improve consumer information on energy usage through a pilot study on improved electricity, water and gas meter systems.

The government aims to ensure that manufacturers provide better information to consumers on the energy efficiency of products purchased as well as providing better standards for energy efficiency for such products through voluntary schemes at the national level and at the international level through the 2005 EU eco-design of energy using products directive. This is intended to make sure that disparities do not exist among EU Member States in terms of regulation of the environmental impact of consumer goods, in order to facilitate trade among EU countries and promote the manufacture of more environmentally friendly products.¹⁷

South Korea snapshot

In South Korea, services account for 58% of GDP, manufacturing for 28% of GDP, the remainder of industry for around 12% of GDP and agriculture for only 3% of GDP.

Energy in South Korea is derived mainly from coal (38% of total electricity produced) and nuclear power (37%), with additional energy provided by gas (18%), oil (5%) and hydroelectric power (1%). Data on 2004 emissions (by economic sector) show that the majority of greenhouse gas emissions stem from energy production (83%), followed by industry (12%) and agriculture (3%).

South Korea established a Low Carbon, Green Growth vision in 2008, although a concrete national strategy on low carbon growth has not been issued.

The ECOREA 2008 report (an annual report on the status of the South Korean environment: Ministry of Environment, 2009) contains a short description of South Korea's efforts on carbon mitigation and low carbon growth:

- Both decreased carbon emissions (through carbon intensity) as well as increased energy efficiency (through eco efficiency);
- Increased use of renewable energy sources, from 2.24% in 2006 to 11% in 2030;
- Increased investment in eco-friendly public transport and increased regulation of carbon emissions from motor vehicles;
- Introduction of a carbon tax;
- Implementation of new regulations and standards to monitor and manage carbon emissions.

In addition, the Ministry of Knowledge Economy has set up two national policies, the National Climate Change Plan and the Green Energy Industry Development Plan. Documentation on these is not currently available for review.

¹⁶ <http://www.planningportal.gov.uk/england/professionals/en/1115314116927.html>.

¹⁷ http://ec.europa.eu/enterprise/eco_design/index_en.htm.

2.2 Middle-income countries

2.2.1 Brazil

Country context

Brazil has large and well-developed agricultural, mining, manufacturing and services sectors and its economy overshadows that of all other South American countries. Brazil is rapidly expanding its presence in world markets. The economy is based on services (66%), industry (28.5%) and agriculture (5.5%). Around 66% of the population is employed in the services sector, 20% in agriculture and 14% in industry. Per capita income has reached \$10,000 (2008 estimate).¹⁸ Despite high levels of economic growth, roughly 30% of the population remains below the poverty line.

Brazil creates an estimated 2.3 billion tonnes of CO₂e per year – making the country the world's fifth-highest GHG emitter (de la Torre et al., 2009). Land use change and forestry, particularly the deforestation of the Amazon, is estimated to account for 60% of the country's total GHG emissions, 14% from the energy sector (5.4% from transport, 4.1% from manufacturing and 2.2% from electricity), and 24% from agriculture (World Resources Institute Climate Analysis Indicators Tool (WRI CAIT) database).

At present, 45.8% of the energy portfolio consists of renewable energy: the global average is 12.9%. In terms of the electricity sector, 77.3% comes from hydro, 3.6% from natural gas, 2.8% from oil, 2.5% from nuclear, 1.3% from coal, 3.5% from biomass and 1.0% from industrial gases, and imports are 7.9%.

Policy motivations for low carbon growth

Brazil is actively seeking to harness low carbon development to enhance competitiveness and open new markets, particularly for bioethanol. It also recognises that low carbon growth opportunities are in line with social development and poverty reduction objectives. Brazil was the first signatory of the Convention on Climate Change and has taken significant steps to show its commitment to reducing emissions. It recognises that protection of the Amazon rainforest is a critical issue and has made reducing deforestation a major long-term priority. On the other hand, Brazil's latest National Plan on Climate Change admits that there are significant barriers to the implementation and enforcement of its low carbon policies.

Because of deforestation, Brazil is one of the world's highest CO₂ emitters, but other sectors of its economy are already comparatively low in carbon. As one of the world's largest producers of hydroelectric power, CO₂ emissions from the Brazilian electricity sector are among the lowest in the world in relation to population and GDP. Additionally, Brazil's early investment in sugarcane-based ethanol has made it the world's most efficient ethanol producer, with ethanol providing about 40% of the automotive fuel in the country. Combined with domestic oil production, Brazil is essentially energy self-sufficient.

Brazil's hallmark *Proalcool* programme was set up in 1974 to reduce dependency on foreign oil and used subsidies and tax breaks in order to encourage farmers to plant more sugarcane, to incentivise investment in distilleries and to encourage car manufacturers to design their vehicles based on bioethanol fuel production.¹⁹ Brazilian bioethanol production uses the waste material from sugarcane as fuel for the distillery process. It is also price competitive, with production costs

¹⁸ <https://www.cia.gov/library/publications/the-world-factbook/geos/br.html>.

¹⁹ The Social Fuel Stamp Policy is part of the Lula administration's drive to encourage and reward biodiesel production by smallholders. The fuel stamp is granted to producers who purchase from family agriculture, sign contracts with family producers and provide family farmers with training. The benefits include: tax exemption from federal taxes according to the amount purchased; low rate loans; and overseas trade facilities.

well below that of oil, with a break-even point of \$35 a barrel.²⁰ The period from 1990 to the present is known as Phase II of the *Proalcool* policy and is more flexible in terms of catering to market demands,²¹ but is still meeting policy objectives: by 2002, 35% of all new cars in Brazil were running on 100% ethanol. By 2004, 26% of all new cars were flex-fuel.²²

Brazil's new major offshore oil discoveries bring into question how robustly Brazil will continue to promote bioethanol. Today, Brazil is a net exporter of oil but recent statements from President Luiz da Silva indicate that Brazil has no plans to boost its export of crude from new fields but rather intends to use the oil to create value-added products, such as gasoline and petro-chemical products and use the profits to fund anti-poverty programmes. The government has recently taken steps to exert more state control over offshore oil finds to be able to funnel revenues into social spending (Associated Press, 2009).

In recent years, Brazil has also set out to create a more comprehensive national plan on climate change to direct sustainable development objectives and low carbon growth. Efforts to develop and implement such a plan show there is a high level of government support across multiple ministries for aggressive action on climate change. President Luiz da Silva has endorsed the national action plan on climate change.

The Brazilian National Plan on Climate Change (CIM, 2008) is an important milestone both in terms of outlining a set of programmes for low carbon growth and also for the integration and harmonisation of public policies. In 2007, the government created the Inter-ministerial Committee on Climate Change (CIM), charged with preparing the National Policy on Climate Change and the National Climate Change Plan. CIM is coordinated by the Office of the President of the Republic, and consists of 17 federal bodies and ministries and the Brazilian Forum on Climate Change (FBMC).

In 2008, the government launched the National Climate Change Plan (NPCC). In addition to members of CIM, the plan was developed in collaboration with other fora and institutions, including the National Conference on the Environment, the State Fora on Climate Change and a variety of civil society organisations (CSOs). The plan is to be delivered in phases, with most interim targets set between 2018 and 2020.

Targets will be met by promoting sustainable development in the industrial and agriculture sectors, maintaining a high proportion of renewable energy in electricity production, encouraging the use of biofuels in the transportation sector and reducing deforestation. The plan's recommendations are organised into four lines of action:

1. Mitigation;
2. Vulnerability, impact and adaptation;
3. Research and development;
4. Enhancement of skills and dissemination.

The NPCC states that, to ensure success, it will be implemented in successive phases, as a way to ensure constant evaluation of intended objectives, as well as to include other measures which may be identified and considered feasible, in later stages. The following phases will include mechanisms to evaluate the performance of ongoing actions and their respective results. Additional actions and instruments will also be presented, including pacts with Brazilian states in order to guarantee that the objectives stipulated here can be fully met. In this sense, studies

20 Production costs of ethanol average at around \$0.18-0.25 a litre, with an average export price of \$0.23 a litre. This compares with the US cost of bioethanol production of \$1.14/gallon.

21 In terms of the price incentives for consumers to use either oil or ethanol.

22 This is shown by the difference between anhydrous and hydrous levels of ethanol production and total ethanol production.

related to new economic mechanisms for sustainable development will be carried out, also covering fiscal and tax incentives, among others.

The plan presents ambitious targets but lacks specific carbon emission targets, deadlines and implementation measures, stating that the specific implementation measures will be designed through ongoing consultations. Questions remain around, for example, cogeneration, which currently supplies only about 0.5% of Brazil's domestic energy, although the government's plan is to increase this to one-fifth of all domestic energy (it does not specify incentives or deadlines). The plan has received other criticisms from non-governmental organisations (NGOs), saying that inputs given during the initial consultation phase were not included in the plan. There may also be other clean energy opportunities missed by focusing only on biofuels, hydropower, cogeneration and nuclear for clean energy generation.

Brazil has made an attempt to harmonise its national strategy for low carbon growth with growth and poverty reduction strategies, stating that a key goal is to identify the most vulnerable groups and target adaptation assistance, education and infrastructure development in these areas. However, the NPCC does not specify how its proposals will be integrated across government departments or with local governments, leaving that again to future consultations. Another challenge will be to maintain momentum and emphasis on clean energy sources, given rising demand. Although the Brazilian energy sector is relatively clean – at present 45.8% of the energy matrix consists of renewable energy, while the global average is 12.9% – new targets are steep and newly discovered offshore oil could hamper efforts to meet renewable energy goals.

Low carbon growth pillars

Finance for mitigation and adaptation

Brazil has taken the stance that market mechanisms to fund reduced deforestation efforts are not sufficient. Therefore, securing public finance for forestry programmes is considered a priority. Brazil has created the Amazon Fund to fight deforestation in the Amazon rainforest, which aims to raise \$21 billion by 2021. Norway has pledged up to \$1 billion. Brazil has also proposed a Climate Fund to the National Congress as part of the NPCC. This would aim to finance actions concerned with preventing deforestation, among other things. In addition, the NPCC is expected to be funded by the National Bank for Social and Economic Development.

Human capital

The NPCC, in recognising that there is a strong need for increased capacity and education to deal with health and adaptation issues, particularly in vulnerable communities, sets out goals to strengthen measures to enhance communication and environmental education. Specific provisions related to education and health include: strengthening sanitation systems; providing incentives for studies, research and training on the impacts of climate change on human health, including developing indicators for monitoring impacts on health; strengthening environmental education; identifying threats, vulnerabilities and resources (financial, logistics, material, human, etc) to set up prevention, preparation and response plans for public health emergencies; expanding the technical capacity of professionals in the public health system; creating alert systems for harm and damage related to climatic events; and implementing dedicated climate change educational programmes in schools and universities that reach management, teachers and students.

Stimulating technological progress in energy/infrastructure/transportation

The NPCC sets out a number of ambitious goals to mitigate emissions by increasing renewable energy generation, especially hydro, to promote new sources of clean energy (nuclear and cogeneration) and to substantially expand the use of biofuels nationwide. More than 7000 MW of renewable sources will be brought online by 2010 in accordance with the Programme of Incentives for Alternative Sources of Electric Energy (PROINFA).

Several renewable energy provisions include: 1) increasing the electricity supply from cogeneration, mainly from sugarcane bagasse, to 11.4% of the total supply in the country in 2030, corresponding to 136 TWh; 2) encouraging energy generation from wind and biomass, particularly sugarcane bagasse; 3) expanding the national photovoltaic industry, predominantly in systems that are isolated and connected to the grid; and 4) reducing the non-technical losses – estimated to average 22,000 GWh per year – by a rate of 1000 GWh per year over the next 10 years.

Hydropower also emerges as one of the government's preferred solutions. The draft plan seeks to enlarge Brazil's hydropower network by 34,460 MW by the end of the next 10-year Energy Plan (2007-2016). Hydro already accounts for around 35% of the country's total energy consumption and 84% of its electricity generation. However, hydro projects are controversial in Brazil and civil society has expressed concern about the extent to which hydro will be expanded. Also controversial is the plan's endorsement of nuclear energy projects.

Biofuels figure prominently in the plan, given the country's longstanding policy on biofuels development. The NPCC anticipates increasing Brazil's biofuel production from its present rate of around 25.6 billion litres per year to 53.2 billion litres in 2017. Specifically, the plan prohibits the conversion of agricultural land for food production and forests, instead encouraging the use of degraded lands. The plan encourages industry to achieve an average annual consumption increase of 11% in the next 10 years by displacing fossil fuels. The NPCC suggests that a 5% biodiesel target may be added in the future. Research and development in agro-energy is ongoing.

Trade and investment opportunities

The subject of encouraging private sector finance is a sensitive one because Brazil does not want to encourage foreign investments that could compromise state sovereignty. Brazil sees strong value in the CDM as the main economic instrument existing for the promotion of voluntary measures to mitigate GHGs, but has been a strong proponent of the public fund approach rather than private finance for new CDM mechanisms such as REDD. However, the Brazilian government supports expansion of CDM projects in principle, given that there is still great potential to be harvested within the country.

In addition to trade of emissions reductions through the CDM, opportunities for bilateral trade of emissions offsets are being explored. There are talks of a potential Brazil–US agreement in which Brazil could sell offsets directly into the proposed future US Emissions Trading Scheme. Specifically, trading forestry credits are seen to be a major opportunity. According to McKinsey & Co. (2009), 85% of Brazil's abatement potential lies in deforestation and the agriculture sector. McKinsey & Co. found in its Brazilian GHG abatement cost curve that eliminating deforestation by 2030 accounts for 72% of all abatement opportunities, at a cost of less than €10/tCO₂e. The cost to reduce deforestation emissions is estimated at €5.7 billion annually, but a significant portion of this could be funded using international carbon credits.

Brazil hopes that biofuels will be its primary opportunity to enhance trade and investment. It is working to stimulate an international ethanol market, in part by engaging in technical cooperation with other countries possessing agricultural potential to increase sugarcane-based ethanol, with the aim of expanding and stabilising the supply of ethanol in the international market. The government is also currently engaged in talks at the World Trade Organization (WTO) to get bioethanol classified as an 'environmental good'²³ in order to enhance trade. There is also a memorandum of understanding between the US and Brazil to advance cooperation on biofuels. Brazil is seeking to expand South–South trade opportunities in flex-fuel vehicles. For example,

23 See Dufey (2007), who notes that the current lack of a clear classification of biofuels within the multilateral trading system constrains effective trade. At present, there is no agreement on whether biofuels are industrial or agricultural goods. This means a lack of agreement as to what constitutes Green Box non-actionable subsidies or an environmental good.

Sudan and Brazil have discussed signing an agreement on technology transfer and trade in flex-fuel vehicles.

Investment in agriculture and forestry

Reducing emissions from deforestation is a cornerstone of the Brazilian plan since it is estimated that at least 60% of the country's emissions come from deforestation. The NPCC sets out a goal to reduce deforestation in the Amazon by 70% by 2018, along with abolishing illegal logging by 2015.

There are also plans to double the area of reforestation from 5.5 to 11 million ha in 2020, including in indigenous areas. The objective is to promote territorial and land organisation, monitoring and control through high-precision satellite monitoring and incentives for sustainable activities and environmental enforcement, involving partnerships between federal bodies, state governments, city governments, CSOs and the private sector. Efforts will be made to mobilise instruments that can contribute to the achievement of this objective, including the reforestation and afforestation carried out in Brazil under the CDM. Furthermore, lines of credit adapted to forestry activity, technical assistance and technological research will be expanded.

Other elements include a moratorium on the selling of soybeans that come from deforested areas of the Brazilian Amazon, the creation of a National Forest Inventory to provide information about carbon stocks and a revision of current banking requirements to make forest management and reforestation activities more attractive.

To ensure the provisions on illegal logging are successful, the government will require certification of wood and forest products and attempt to strengthen forest management. Nevertheless, this provision has attracted scrutiny, because the new strategy calls for greater penalties for unlicensed loggers although, under the current system, state and municipal authorities are responsible for curbing deforestation in their respective jurisdictions, and there are no recommendations to centralise these efforts nationally.

Brazil recognises that agriculture and cattle raising are integrated systems and plans to provide incentives for sustainable practices concerned with: the recovering of a large part of the current 100 million ha of degraded pasture; carbon sinks via crop livestock integration; agro-forestry; adoption of a zero-tillage system and reduction in the use of nitrogenous fertilisers; and the organic enrichment of pasture to reduce methane emissions by cattle raising.

Incentives and regulation for low carbon growth

Brazil is taking a multi-pronged approach to developing a low carbon economy, including establishing programmes and incentives to reduce deforestation emissions, reduce emissions in the agriculture sector and encourage renewable power generation, as well as pursuing new trade opportunities in biofuels and offsets, as discussed above. Brazil sees improving energy efficiency as a key method to reduce the carbon content of Brazilian GDP, improving the competitiveness of Brazilian products in the international market, increasing income and generating an economic surplus that can lead to higher social welfare. The following are the main actions outlined in the NPCC specific to setting a low carbon plan, although they do not specify the measures that will be used to reach targets.

- **Energy efficiency:** Implementation of the National Policy for Energy Efficiency, which will result in a gradual energy saving up to 106 TWh/year to be reached in 2030, avoiding emissions of around 30 million tons of CO₂;
- **Charcoal:** Substitution of charcoal for coal in steel plants, through the encouragement of reforestation in degraded areas;
- **Fridges:** Replacement of 1 million old fridges per year, for 10 years, with the collection of 3 million tCO₂eq/year of chlorofluorocarbons (CFCs);
- **Replacement of refrigerant gases:** It is estimated that emissions of 1078 billion tCO₂eq of hydrochlorofluorocarbons (HCFCs) will be avoided in the period 2008-2040;

- **Solar heating:** Encouragement of the use of water solar power heating systems, reducing electricity consumption in 2200 GWh per year by 2015;
- **Urban solid waste:** 20% increase in recycling by 2015;
- **Sugarcane:** Phasing out of the use of fire for clearing and cutting of sugarcane in areas where harvesting mechanisation can take place; mechanisation to be adopted in at least 25% of each agro-industrial unit, for each five-year period, as determined by Decree 2.661/98;
- **Incentives for research and training related studies,** to expand knowledge about the impacts of climate change on human health.

Further demonstrating its interest in low carbon development, Brazil is also part of the Energy Sector Management Assistance Program (ESMAP) Low Carbon Growth Country Studies Program, a six-country programme in which each country government undertakes local studies to assess its development goals and priorities, in conjunction with GHG mitigation opportunities, and examines the additional costs and benefits of lower carbon growth. The Brazilian study focuses on land use and land use change models, including deforestation, energy sector options, transport, waste management and cross-sector issues. To provide more options and information to the Brazilian government, the study will produce a GHG cost abatement curve; a municipal and interstate transport model; reference points and low carbon scenarios for 2030; a simulation of GHG emissions owing to deforestation and agriculture; potential GHG mitigation opportunities; and policy options. These studies will be used to inform and design future low carbon incentives and regulation.

2.2.2 China

Country context

The Chinese economy is based mainly on manufacturing and services (WDI 2006 data). Industry in general accounted for nearly 49% of GDP in 2006, the services sector accounts for 39% of GDP and agriculture accounts for 11% of GDP.

The Chinese government estimates that total greenhouse gas emissions in 2004 were around 5600 million equivalent tons of CO₂. In 2005, coal-fuelled electricity accounted for 68.9% of primary energy consumption, oil for 21% and combined gas, nuclear and renewable energy for 10%.

According to the 2009 WWF/Allianz G8 Climate Change Scorecard, the major source of carbon emissions in China comes from energy production (accounting for 39% of all CO₂ emissions), followed by the industrial sector (with 33% of all CO₂ emissions), the agriculture sector (14%), the residential and services sector (7%) and finally the transport sector (5%).

Energy in China stems mainly from coal (80%) and hydroelectric power (15%), with the remainder (5%) coming from nuclear, oil and gas.

Policy motivations for low carbon growth

The Chinese National Climate Change Programme (CNCCP) was announced in June 2007, with the aim of reducing energy consumption per unit of GDP by 20% from its 2005 level by 2010. In addition the 11th Five-year Plan for National Economic and Social Development (2006-2010) considers it a major strategic task for China to build an energy-conserving and environmentally friendly society. In addition, China has signed both the Kyoto Protocol (as a non-Annex 1 country) and the UN Framework Convention on Climate Change (UNFCCC) as part of its international obligations to mitigate climate change. The Chinese strategy for mitigation and adaptation to climate change is based wholly on the ideal of mitigation and adaptation through economic development, hence economic growth and climate change mitigation are not seen as mutually exclusive by the government but rather as a way to promote sustainable economic development.

The CNCCP has four major objectives:

- Control greenhouse gas emissions;
- Enhance China's capacity to adapt to climate change;
- Improve research and development of green growth technologies;
- Raise public awareness of climate change and improve climate change management systems.

The major aim of the CNCCP is to achieve the target of a reduction of 20% in energy use per unit GDP by 2010, thus also reducing CO₂ emissions. To do so, the Chinese government aims to use a variety of tools, such as strengthened regulation on energy conservation and efficiency, and introduce market mechanisms for energy conservation, increased use of renewable and nuclear energy and increased research into better energy conservation procedures. Additional tools to be used include better natural resource management techniques, enhanced eco-friendly agricultural techniques and the dissemination of information on climate change adaptation and mitigation through modern communication systems.

Possibly the main impetus for Chinese low carbon growth, beyond the need to conform to international standards and expectations, is the need to achieve the highest efficiency possible from what resources are available, as the Chinese themselves state that China has a very high population but is low on natural resources, hence a sustainable development path is absolutely necessary for development. To further this aim, the Chinese government intends to restructure its industrial base in order to promote high-tech industries which require low inputs (such as energy and materials) and curb or reduce high consumption industries, while at the same time incentivising, promoting and helping current high consumption industries to adopt new techniques and technologies in order to reduce consumption levels.

Chinese low carbon growth is supported at the national level by the National Coordination Committee on Climate Change, which is part of the People's Republic of China's National Development and Reform Commission, whose main aim is to develop and implement mid- and long-term economic and social development plans in China. Working together with the NDRC are the Ministry of Science and Technology and the Ministry of Finance.

Low carbon growth pillars

Finance for mitigation and adaptation

China has been one of the main recipients of funds under the CDM, with considerable financing of large energy-related industrial projects.

The Chinese government has not set up any general funds for carbon mitigation or low carbon growth, but rather is incentivising the use of green growth technology on a sector-by-sector level, with funds usually attached to promote specific regulations or laws. Hence, these specific funds are placed in the categories below into which they best fit.

Human capital

China's Mid- and Long-term Development Plan for Science and Technology was established in 2006 with the aim of prioritising the research and development of energy efficiency and conservation and green growth technologies. In addition, the Science and Technology Program on Climate Change, implemented in 2007, established a set of timed goals for developments in green growth technologies to be achieved during the 11th Five-year Plan period (2006-2010) as well as more long-term goals leading up to 2020.

China also aims to enhance its pool of climate change research specialists in order to allow China to better mitigate and adapt to climate change. The government has set up national research institutes such as the National Climate Monitoring Network, in order to increase the number of

climate change specialists within the country as well as to strengthen the research and development of green growth technologies, so as to hasten their introduction and application within the Chinese market.

Stimulating technological progress in energy/infrastructure/transportation

Financial support has been extended towards the research and development of green growth technologies, through both stable government funds as well as private investment, which the Chinese government is trying to attract more of in the coming years. The government has invested more than 9.5 billion yuan in the research and development of green growth technologies through programmes like the National Key Technologies R&D Program, the National High-Tech R&D Program and the National Basic Research Program.

The Chinese government will focus on energy saving and efficiency technology, research into better and more efficient forms of renewable energy, technology focused on the reduction of GHG, CCS technology, efficient use of coal and fossil fuels and more efficient nuclear energy production. The government is also promoting further research, development and construction of hydroelectric power generators (although construction locations will be decided based on their social and environmental opportunity costs) as well as the construction of wind-powered electricity generators and biomass-powered electricity generators.

Investment in agriculture and forestry

The Chinese government wishes to improve and enhance agricultural and forestry laws and regulations in order to promote more efficient agricultural production, protect and manage (in a sustainable manner) current agricultural land, reduce the use of harmful fertilisers and enhance CCS through agricultural procedures. The government is looking to promote the research and development of special high-yield and low GHG emission rice varieties together with methane reduction technologies to apply to both agricultural produce and livestock in order to reduce GHG emissions further. In terms of agricultural equipment, the government will try to phase out old agricultural machinery with high fuel consumption and encourage their replacement with energy-efficient, low carbon vehicles and equipment.

In addition to agriculture, the Chinese government is looking to further strengthen forestry laws in order to consolidate the protection of existing forests and promote the sustainable management of forest lands. In addition, regulations are being looked at in order to promote the voluntary reforestation of land for CSS, as well as to reduce the rate of desertification of land in China.

Key projects include the Natural Forest Protection Program (NFPP), the Conversion of Cropland to Forest Program (CCFP), the Sandification Control Program for Areas in the Vicinity of Beijing & Tianjin, etc.

Trade and private investment opportunities

Foreign investment in green growth technologies, especially energy generation, is being promoted by the Chinese government. The government is looking for foreign investors in order both to build cleaner energy production facilities and to promote technology transfer of cleaner and more advanced green growth technologies, with the aim of introducing (and possibly also producing) them in the Chinese market.

The Chinese government also wants to restructure the Chinese economy, not just by promoting low consumption industry, but also by promoting investments in high-tech and services sector enterprises in order to lower GHG emissions and decrease energy and product consumption, but also to encourage Chinese global competitiveness. China is already the world's largest producer of photovoltaic cells; its market share could grow considerably as global demand for alternative energy sources increases.

Chinese low carbon growth market opportunities will be based on three pillars: vehicles, renewable energy and biofuels.

In terms of vehicles, China is a world leader in the production of electrical vehicles such as bicycles and motorbikes, and could thus extend its industrial capacity and research towards the wider production of electrical vehicles. In addition, China has successfully experimented with electrical vehicles through the production of its first fully electrical vehicle, the S18, produced by the company Chery (brand recognition and market awareness still remains a problem, however). Internally, the market value of the automotive industry has exceeded the market value of the motor industry within the US, hence there is great scope to serve electrical and low carbon emission vehicles to the internal market, as well as meeting any future external demand.

China is the world's leading producer of photovoltaics, hence the country is in a key position to capitalise on both external and internal demand for photovoltaics. In addition, renewable energy efforts will be focused on upscaling production of wind-powered electricity generators. Initial government efforts focused on photovoltaics include the promotion of internal use by various government ministries (including the Ministry of Finance and the Ministry of Housing and Rural-Urban Development), while the wind sector has been boosted through laws that require that 70% of wind-powered technology be produced internally, as well as offering tax breaks and tax havens to firms producing wind-powered technologies.

The Chinese government has also promoted the internal production of biofuels (as long as non-food crops are used in order to maintain food security) and aims to further enhance their commercialisation.

Incentives and regulation for low carbon growth

Energy conservation campaigns have been launched aimed at private sector enterprises with the objective of reducing energy consumption through voluntary energy audits, the creation of energy saving plans and the disclosure of energy being used within companies. In addition, the Chinese government has set out to make sure that private enterprises are conforming to energy efficiency standards set out by the government.

In 2005, the Renewable Energy Law was enacted in order to prioritise the use of and investment in renewable energy. The law forces the Chinese electrical grid operator to purchase all electricity generated through renewable sources at a competitive price, thus encouraging investment in the production of renewable energy. In addition, the law gives renewable energy users significant discounts on electricity prices. It also creates a fund to promote private sector investments into renewable energy production. Further, the law commits the Chinese economy to a renewable energy target whereby 15% of all energy must come from renewable sources. The Chinese government wishes to further strengthen the Renewable Energy Law through additional legislation and policies, together with further incentives to promote use of and investment in renewable energy.

The Chinese government launched the Cleaner Production Promotion Law in 2002. The aim of the law is to encourage (through funds and regulation) the use of cleaner production processes in private enterprise. Companies need to audit their production process and make results public; those which are deemed to be too polluting or are using toxic materials not approved by the government will have to change their production process in order to meet government regulation; other companies will be encouraged to use cleaner production mechanisms through the use of incentives, guidebooks and a special fund created to support the law.

In addition, a number of policies aimed at reducing GHG emissions have been, or are in the process of being, either implemented or strengthened. These laws include the Energy Law of the People's Republic of China, the Coal Industry Law and the Electric Power of the People's Republic

of China Law. The Chinese government sees the implementation or amendment of these laws as a legitimate way of increasing carbon mitigation and energy efficiency in China.

The Chinese government is also trying to reduce GHG emissions coming from the transport sector. The government has set carbon emission standards for vehicles both built in and imported into China, setting a ban (together with a monitoring system) on the import or construction of vehicles that exceed government regulation on CO₂ emissions. The government is encouraging the production and use of low carbon or zero carbon emission vehicles as well as the use of rail transport and electrical vehicles in public transport systems. Vehicle emission policies will be supplemented by reforms in fuel taxes in order to encourage the purchase and use of more fuel-efficient and low carbon-emitting vehicles.

Within the construction and residential sector, the Chinese government will promote the construction of new environmentally friendly energy-efficient buildings and the use of sustainable materials for their construction. Offices and homes are also targeted in order to improve their energy efficiency and to reduce carbon emissions through the implementation of an energy efficiency label set up by the government to promote the use and commercialisation of energy-efficient products within the Chinese market.

2.2.3 Guyana

Country context

The Guyanese economy has exhibited moderate economic growth in recent years and is based largely on agriculture and extractive industries. The economy is heavily dependent on the export of six commodities: sugar, gold, bauxite, shrimp, timber and rice. Agriculture is 32% of GDP, services 47% and industry 21%. Economic recovery since the 2005 flood-related contraction has been buoyed by increases in remittances and foreign direct investment in the sugar and rice industries as well as the mining sector.

According to Guyana's Initial National Communication to the UNFCCC, emissions are just 4 million tonnes CO₂e, because the country is a net sink for CO₂ emissions. Net CO₂ emissions were estimated at 1.4 million tonnes in 1994 but removals totalled 26 million tonnes. The WRI CAIT database similarly estimated total CO₂e emissions at 1.5 million tonnes in 2005. The National Communication states that the agriculture sector was the major source of CH₄ and N₂O emissions, with emissions totalling 51,000 tonnes and 1000 tonnes, respectively, in 1994. Under this sector, rice cultivation and enteric fermentation in animals are the main sources of CH₄; that of N₂O emissions is from the use of synthetic nitrogen fertiliser on agricultural soils. There is a perceived need for better data collection for future inventories, particularly in the energy sector.

Policy motivations for low carbon growth

Over the past two decades, Guyana has transitioned to a multiparty democracy and market-based economy. Most of Guyana's population of less than 800,000 are located on a coastal strip 1.4 metres below sea level. In 2006, floods caused major economic losses. In order to upgrade sea defences, Guyana needs financial resources; it views carbon assets as a way to provide this.

With the release of its LCDS in June 2009, the government outlined how Guyana can work with the international community to provide a model on how to create a low deforestation, low carbon, climate-resilient economy. Its proposal centres on payments for preserving its rainforest through the mechanism known as REDD Plus. The government asserts that payments for avoided deforestation can provide a platform to enable Guyana's economy to be realigned with a low carbon development trajectory. The government has stated that its top development priorities are to further stimulate investment, economic growth and job creation, as well as to improve security and social services, protect vulnerable groups and deal with increased climate change-induced flooding.

In the LCDS, Guyana views its forests as its most valuable asset. The majority of the 16-18 million ha rainforest (depending on estimates) is suitable for timber extraction and agriculture, and significant mineral deposits exist below its surface. The Guiana Shield, which comprises southern Venezuela, Guyana, Suriname, French Guiana and northern Brazil's Amapa and Para states, has one of the world's highest percentages of primary forest cover: over 90% of the region is tropical forest.

If the forest were harvested and the land put to its highest-value subsequent use, the value of this rainforest²⁴ – known as the Economic Value to the Nation (EVN) – is estimated by McKinsey & Co. (Office of the President, Republic of Guyana, 2008) to be between \$4.3 billion and \$23.4 billion.²⁵ This translates into a likely average annual annuity payment of \$580 million. Conservative valuations of the Economic Value to the World (EVW) provided by Guyana's forests suggest that, left standing, they contribute \$40 billion to the global economy each year.²⁶ Payments between the EVN and EVW are to be considered sufficient to disincentivise deforestation (see Finance for Mitigation and Adaptation, below).

Guyana plans to use REDD Plus payments as the basis for funding priority investments in clean energy (predominantly hydropower), adaptation (flood defence), development of village economies and health care and education. The plan sets a four-phase timeline for implementation from 2009-2020. The initial phases are to attract 'transition' donor grants that will be used to ramp up the country's REDD Plus programme and make initial low carbon investments. The latter phases transition to market-based funding from avoided deforestation credits through REDD Plus.

Guyana sees its low carbon strategy as providing long-term benefits in terms of:

- Promoting a low carbon economic infrastructure;
- Facilitating investment and employment in low carbon economic sectors;
- Generally enhancing the nation's human capital and creating new opportunities for forest-dependent and other indigenous communities.

The governments of Norway and Guyana have worked together to implement Guyana's LCDS, providing a model of how to quickly implement policies to avoid deforestation. The partnership aims to support the creation of low carbon employment and investment opportunities in Guyana, sustained efforts to avoid deforestation and forest degradation, strengthening transparent forest governance, and establishing an international monitoring, reporting, and verification system for Guyana's forests.

To further support its strategy, Guyana has pledged to institute a number of new organisational units and systems, including an Office of Climate Change to coordinate all climate-related activities for the nation, a Low Carbon Strategy Project Management Office to drive major low carbon programme priorities and a Guyana Low Carbon Finance Authority to manage forest payments and related investment flows into the country and to promote investment efficiency, although the precise logistics behind which ministry or department will manage received money has yet to be finalised.

In addition, safeguards and systems will be developed to ensure avoided deforestation credits are globally verified and other land use governance standards are transparent and accountable.

24 This estimate includes the State Forest Estate, and excludes lands under the jurisdiction of indigenous peoples, who will be able to 'opt in' to the forest protection programme through the national consultation process.

25 Amerindian lands were omitted from the calculation of EVN because they are not legally obligated to protect the forest. The decision to participate will likely be based on whether participation will lead to improved access to opportunities and services for forest-dependent communities.

26 Based on 2030 marginal abatement cost from McKinsey & Co (2007).

The government was advised by a multi-stakeholder steering committee, which comprised governmental agencies and NGOs, to hold a three-month period of countrywide consultations and awareness building on Guyana's draft LCDS. A principal stakeholder group consisted of the country's forest-based Amerindians, who make up 9.1% of the population. Amerindian communities with titled lands were given time to decide whether to opt in to a forest payment scheme for avoided deforestation as set out in the LCDS. Initial consultations were planned for summer 2009, along with awareness and outreach activities utilising the local media and internet. An updated version of the LCDS will be published, incorporating feedback.

The draft strategy is supported by Guyana's R-Plan, a document produced for the World Bank's Carbon Partnership Facility, which sets out more details on Guyana's participation in the REDD Plus process. Guyana's R-Plan, produced by the REDD Secretariat at the Guyana Forestry Commission, sets out detail on how the forest's carbon stocks will continue to be managed, to ensure that the forests are managed in a way that is as close as is reasonable to carbon neutral over time.

Guyana's strategy is one of the most comprehensive and ambitious plans yet prepared by a developing country. It tries to achieve a high level of collaboration internationally, while building strong domestic support through consultations and outreach, and directly ties prioritised projects with a funding source. However, the plan rests entirely on the premise that the country will receive payments for preserving their vast tracts of rainforest, which at present is far from certain. In terms of policy coordination, the LCDS contains a provision which aims to align all land use policies with the LCDS, most importantly forestry and mining policies, but there is little clarity about how the government will go about this. The strategy aligns well with development goals set out in Guyana's (now several years old) poverty reduction strategy paper (PRSP) and goals outlined in its 2002 Initial National Communication.

Low carbon growth pillars

Finance for mitigation and adaptation

Guyana will establish the Guyana Low Carbon Finance Authority (GLCFA) to fulfil two functions: to collect, manage and monitor forestry payments; and to work with the Guyana Office for Investment to address the challenge in attracting investors to Guyana who are willing to underwrite their investments in low carbon sectors.

The GLCFA will seek to address investment barriers and help improve investment returns. Owing to lack of capacity to promote investment in Guyana, the GLCFA will likely require a reputable international services provider in the near term. At a later point, the GLCFA will build its own staff capability.

Guyana, as mentioned, plans to obtain financing for its low carbon growth through payments for avoided deforestation, scaled up in four phases. Phase I in 2009 is to launch the local carbon strategy and attract donors to initially fund its deforestation efforts. In Phase II (2010-2012), Guyana will receive increased payments from partners (starting with Norway and scaling to additional global partners). Phase III (2013-2020) is integrating the economy with a global climate deal. During this phase, interim forest payments should gradually increase to approach the level of EVN. In parallel, REDD Plus payments from carbon compliance markets should ramp up. During these years, Guyana will continue to invest in infrastructure and adaptation priorities, combined with capacity building and expanded education and health programmes, expecting to start to see transformations toward a low carbon, services-centred economy. Phase IV (post-2020) focuses on operating 'at scale' with a full REDD Plus regime in place and payments at or exceeding EVN, with no requirement for fund-based payments.

Human capital

Guyana recognises that, in transforming its economy, it will require a balance between attracting large, long-term private investments and making significant investments in human capital and social services to provide the population with the capacity to take advantage of the new economy. Guyana will invest a significant share of the forest protection funds it receives in initiatives aimed at developing jobs, diversifying the jobs base and improving the general standards of living including: investing in targeted education initiatives to fuel economic growth, potentially including specialised vocational training and supporting social services such as basic infrastructure (road maintenance, reliable supplies of potable water) and health and education services through discrete projects funded by forestry payments.

Stimulating technological progress in energy/infrastructure/transportation

Guyana has identified more than \$1 billion in essential capital projects that can be fully or partially funded through private investment, assisted by an in-country infrastructure investment fund built from forest compensation payments. These targeted low carbon infrastructure projects include:

Hydropower (\$400-600 million): Guyana currently relies on expensive and carbon-intensive imports for its electricity generation (in 2008 the fuel import bill was 35% of GDP). Guyana has identified a site at Amaila Falls and completed the technical design for a hydropower dam which could deliver energy security by meeting all of the country's domestic power needs for the 'foreseeable future'.

Draining, irrigation and road development to improve access to unused, non-forested land (\$300-500 million): By developing infrastructure into these parts of the country, economic activity and employment can be oriented away from areas which put pressure on the forest.

Fibre optic cables/technology park (\$10-30 million): According to estimates by Accenture (Office of the President, Republic of Guyana, nd), Guyana's outsourcing industry has the potential to more than double the number employed by 2013. Guyana is competitive in all inputs to cost per seat (the key industry metric), with the exception of the cost of telecommunications bandwidth.

In terms of adaptation infrastructure, total estimated near-term adaptation costs for Guyana are projected to exceed \$1 billion. By 2030, the annual loss as a result of flooding in Guyana is projected to be \$150 million (~10% of current GDP). Therefore, immediate priority investments include:

- Upgrading infrastructure and assets to protect against immediate flooding concerns;
- Addressing systematic and behavioural concerns – strengthening building codes and expanding the early warning system;
- Developing financial and risk/insurance measures to boost resiliency post-flooding – these are contingent funds to provide immediate financial assistance following flooding;
- Switching to flood-resistant crops;
- Establishing the climate change adaptation needs of Guyana's inaccessible regions, including forest communities.

Trade and investment opportunities

The government's goal is to make non-forested parts of the country accessible to private investors, who can catalyse low carbon economic development and employment (largely in high-end agriculture and aquaculture). Guyana is concerned that it is not well known to major investors outside of its traditional industries. Attracting large-scale investors to Guyana will require incentives to finance industry-specific infrastructure and overcome perceived country investment risk.

Guyana has identified six priority low carbon economic sectors: fruits and vegetables, aquaculture, sustainable forestry and wood processing, business process outsourcing, ecotourism and possibly

bioethanol. Initially, Guyana will focus on three sectors: fruits and vegetables, aquaculture and sustainable forestry.

Fruits and vegetables: Based on a global assessment, Guyana will need to provide significant financing incentives, offer a substantial land area to attract leading operators and improve its investment support to new investors.

Aquaculture: Guyana will work to attract potential investors to help it establish its aquaculture industry, which will entail developing a system of pond excavation, drainage and irrigation pipes and predation defence measures.

Sustainable forestry and wood processing: In order to ensure that its forestry practices are in accordance with global sustainable forest management practices, Guyana has begun to establish a framework for national-level environmental certification, with the long-term goal of achieving Forest Stewardship Council certification.

Other potential investment opportunities (business process outsourcing (BPO), ecotourism and possibly bioethanol): By investing in its infrastructure, workforce, business environment and marketing, Guyana can expand its nascent business process outsourcing industry, providing a variety of services and employment opportunities. Guyana has the potential to develop its ecotourism industry, although tourism development requires a gradual build-up of capabilities, infrastructure and brand over time. Guyana could enter the clean energy market by becoming a bioethanol producer. The 142,000 ha tentatively set aside for biofuel production at the Canje Basin would allow it to produce bioethanol at commercial scale.

Investment in agriculture and forestry

The government of Guyana is playing a leading role in developing strategies to implement REDD. Its proposals move away from the idea of narrow payments contingent solely on a baseline of deforestation, towards a broader, more inclusive view that provides low carbon development investments to keep what remains of forests intact.

Guyana proposes that, with the right low deforestation economic incentives, it will avoid 1.5 gigatons of CO₂e by 2020, which would have been produced by an otherwise economically rational development path. These incentives are to be generated through interim forestry payments from Guyana's partnership with the Norwegian government, other sources and the REDD programme.

To actually generate these funds over the long term, Guyana recognises that the forestry sector must be part of a global carbon trading system or a series of linked regional trading systems. The Eliasch Review (UK Office of Climate Change, 2008) estimates that including REDD and sustainable forestry management in a global carbon market could generate incentives to reduce deforestation by up to 75% by 2030. In the near term, the LCDS proposes that these funds be allocated through bilateral partners and other transitional mechanisms, and in the longer term through REDD. However, Guyana is also willing to turn over rights to its forests to foreign holders if necessary, as indicated in a recent deal in which an investment company, Canopy Capital, based in London, bought the rights to create a financial deal for the forest's services.²⁷

Incentives and regulation for low carbon growth

Guyana's LCDS states that payments for preserving its forests will allow it to follow a low carbon development path. Key initiatives to set Guyana on a low carbon trajectory have been described above, but can be summarised as follows:

²⁷ <http://blogs.tampabay.com/energy/2009/05/when-money-does-grow-on-trees-think-carbon.html>.

- Investment in strategic low carbon economic infrastructure, such as hydro; improved access to unused, non-forested land; and improved fibre optic bandwidth to facilitate the development of low-carbon business activities;
- Investment in low carbon sectors with high potential, such as fruits and vegetables, aquaculture and sustainable forestry and wood processing;
- Investment in other low carbon business development opportunities, such as BPO and ecotourism;
- The expansion of access to services and new economic opportunities for indigenous peoples through improved social services (including health and education), low carbon energy sources, clean water and employment which does not threaten the forest;
- Improved services to the broader Guyana citizenry, including improving and expanding job prospects, promoting private sector entrepreneurship and improving social services with a particular focus on health and education;
- Investments in priority climate adaptation infrastructure, which could reduce the 10% of current GDP estimated to be lost each year as a result of flooding.

India snapshot

India's economy consists of services (53.7%), industry (29.1%) and agriculture (17.2%). Services account for more than half of India's output, although 60% of the population is dependent on agriculture. With a rapidly expanding number of middle-class consumers, India's economy has one of the fastest-rising energy demands in the world.

India's largest sources of emissions are from energy (67%) and agriculture (24%), with more than 50% of total energy demand met through coal, 6% from hydroelectric power plants, 1% by nuclear power plants and less than 1% from renewables. India's GHG emissions were estimated at 1.55 billion tonnes in 2000 (WRI CAIT database).

Concerns over energy security and scarcity are a high priority for the government. The Prime Minister, Manmohan Singh, has a Council on Climate Change which has recently launched a National Mission to Green India. The Prime Minister released India's first National Action Plan on Climate Change (NAPCC) in 2008, outlining existing and future policies and programmes addressing climate mitigation and adaptation. The plan identifies eight core 'national missions' running through 2017 and directs ministries to submit detailed implementation plans to the Prime Minister's Council on Climate Change. At the end of August 2009, India announced its intention to implement mitigation targets in the form of 'perform, achieve, trade (PAT)' targets for the most energy-intensive industries, as a contribution to international pressures to address climate change.

The country has invested heavily in recent years in renewable sources of energy, including wind, solar, biomass and hydro energy. As of 2008, India's installed wind power generation capacity stood at 9655 MW, making it the fourth-largest in the world. Through a variety of programmes and policies, India is encouraging low carbon energy generation, including:

- A strengthened policy framework and subsidies to reduce upfront costs to wind power investors;
- Capital subsidies, sales incentives and reimbursement of fees for solar thermal projects and automatic approval for foreign direct investments. Solar water heating systems are required for some building types in New Delhi. In July 2009, India unveiled a \$19 billion plan to produce 20,000 MW of solar power by 2020;
- Accelerated deployment plans and incentives for hydro and nuclear;
- Incentives for biomass power generation, biofuels for transport and compact fluorescent lamps;
- Retirement of inefficient coal power plants and plans for coalbed methane power generation;
- Reforestation programmes to increase forest cover by 1% a year until 2012. The Green India programme aims to reforest 6 million ha of degraded forest lands;
- Mandatory (E5) ethanol blending nationwide by April 2008 and fixed purchase prices for biodiesel.

2.2.4 Mexico

Country context

Mexico's economy is based mostly on the services and industrial sectors. In terms of gross value added (as a percentage of GDP) in 2006 (Organisation for Economic Co-operation and Development (OECD) data), the most important sectors in Mexico were industry (with 29% of GVA) followed by services (with 28% of GVA) and the financial sector, including real estate and retail (20% of GVA). The public sector accounted for 12% of GVA and construction for 7%; agriculture accounted for only 3% of GVA in 2006.

Trade is an important aspect of Mexico's economy, accounting for nearly a third of Mexico's GDP in 2006 (OECD data). However, the country is a net importer of both goods and services, and is also a net receiver of foreign direct investment.

The 2006 CO₂ emissions data provided within the Special Climate Change Program report shows that total CO₂ emissions for 2006 added up to 715 metric tonnes, the majority stemming from energy producers (28% of total CO₂ emissions) and the transport sector (20%); agriculture is the third-largest CO₂ emitter, with 18% of all emissions, followed by industry, with 8%.

Policy motivations for low carbon growth

The Federal Government of Mexico, through the Ministry of the Environment and Natural Resources, has launched the Special Climate Change Program²⁸ for the period 2008-2012. Within the programme and in conjunction with the National Climate Change Strategy of 2007, a number of carbon abatement and low carbon growth initiatives are specified. The programme plans a reduction of 50% on carbon emissions (based on 2000 levels) and an average production of 2.8 tons of CO₂ per inhabitant by 2050. The focus is to allow economic development to occur within the country without compromising the environment, as well as to give the initial push towards a reduction (or removal) of carbon emissions from the Mexican economy.

The programme is divided into three major stages. The first (between 2008 and 2012) will be an evaluation of the greatest risks the country is facing as well as an identification of the economic priorities to tackle, during which an executive progressive framework for adaptation and mitigation will be introduced. The second stage (2013-2030) will consist in reinforcing the strategic capacities to adapt and mitigate, through a strategic evaluation of the balance between deforestation and reforestation, the introduction of sustainable agricultural procedures, the introduction of carbon mitigation procedures, the removal of procedures and incentives that lead towards environmentally degrading procedures as well the introduction of public policies to incentivise a sustainable and eco-friendly economic climate. The third stage (2031-2050) will be the consolidation of the mitigation procedures created during the previous two stages, leading to a positive balance between deforestation and reforestation, implementation of sustainable economic development procedures and a reduction in environmental risks.

Carbon mitigation and low carbon growth in Mexico will be based on changes in energy supply, in management and production, in consumer habits, in manufacturing production procedures, in natural resource management and in the way the national territory is occupied and used.

The programme includes carbon reduction targets across economic activities, with the greatest reductions found in energy production (from 196 metric tonnes of CO₂ in 2006 to 24 in 2012) and energy consumption (an aggregate of industry, transportation, commercial, residential and government sectors).

²⁸ <http://www.semarnat.gob.mx/queesemarnat/consultaspublicas/Pages/peccconsultacomplementaria.aspx>.

The low carbon growth pillars

Finance for mitigation and adaptation

The Mexican government wants to make sure that carbon emissions and low carbon growth are integral parts of private sector investment decisions and not treated just as externalities. To this end, it wants to implement a number of funds to incentivise private sector companies to invest in low carbon technologies as well as to create economic instruments aimed at blocking, or redirecting, private sector and residential development in areas deemed at high risk in terms of negative environmental impact.

The Mexican government also refers to the \$500 million World Bank Clean Technology Fund as a source of funding to assist in the implementation of its low carbon growth programme, and has also set up the Mexican Carbon Fund to promote carbon abatement investments.

Within the energy sector, the Mexican government has identified a number of measures to reduce carbon emissions. In terms of oil and gas electrical production, 47 projects are identified, in which \$1.5 billion will be invested to increase energy efficiency and reduce carbon emissions, together with a \$1.4 gas recovery project. The main objective is to allow PEMEX²⁹ to reduce carbon emissions and increase its energy efficiency as well as to reduce gas leaks and improve the gas distribution infrastructure. The programme identifies the use of both biomass as a combustible fuel and photovoltaic technologies as good alternatives to traditional fossil fuels in generating heat.

Human capital

In terms of human capital, the Mexican approach to low carbon growth is based on increased education on climate change in both the formal educational system (at all levels) and for the population as a whole as well, strengthening the technical knowledge of public sector workers in order to better implement the low carbon growth plan through distance learning and specialised workshops within individual administrative regions. The government also wishes to strengthen its technical capacity to investigate the causes and consequences of climate change in Mexico through integrated climate change control and monitoring systems and enhanced research on carbon mitigation and GHG emissions.

Technological progress in energy/infrastructure/transportation

The Mexican government is developing a strategy for carbon mitigation, including the identification of innovative green growth technologies, the enhancement of currently available carbon abatement techniques as well as increased availability of green growth technologies within the Mexican market through the right incentives to promote the research and diffusion of such technologies.

The Mexican government recognises that the use of renewables for electricity production is beneficial both for the Mexican economy and for the environment, by reducing pollutants as well as improving national energy security. The use of renewable energy sources will be promoted and boosted by 2012. Currently, renewable energy sources represent 24% of total energy production; through investment, the programme foresees an increase to 26% by 2012. Electricity generation through renewable sources will be based on social, environmental and economically viable forms of wind, solar, geothermal and hydroelectric technologies. Investment in renewable energy will be undertaken by both the government and the private sector with government incentives.

The Mexican government is looking at increased investments in the transport infrastructure in order to reduce the use of fossil fuels and increase the use of public transport as, currently, the transport sector accounts for 20% of all carbon emissions, of which automobiles account for the highest proportion. The programme sets out to make sure that new fossil fuel-powered vehicles from 2010 will have generate lower carbon emissions and that there will be reduced carbon emissions from cargo and passenger carriers through the Clean Transport Program. The transport infrastructure

29 The Mexican state-owned petrol and gas company, <http://www.pemex.com/index.cfm>.

will also be modernised in order both to facilitate connections between different regions within the country and to make road transport more energy efficient. Public transport and state-owned vehicles will be replaced with more modern, energy-efficient, low carbon vehicles. The rail network infrastructure will also be modernised in order to introduce energy-efficient trains.

CCS technologies will also be considered. The government also considers nuclear energy a viable alternative to carbon energy sources, owing to the volatile price of combustible materials as compared with electricity produced through nuclear power plants.

Investment in agriculture and forestry

The agriculture sector is seen as a key component for low carbon growth in Mexico, as it accounted for 19% of national carbon emissions in 2006. The government wants to reclaim land with low productivity potential into sustainable land (including the conversion from grazing to crop growing) and to introduce sustainable agricultural practices. The government is pursuing means to use its forests as a form of carbon offsetting through REDD and is trying to increase the carbon sink capacity of forests through reforestation programmes. Government is participating in the World Bank's Carbon Partnership Facility to prepare for a potential international REDD programme in which Mexico would receive payments to conserve its forests. The government also plans to establish clear frontiers between forests and agricultural land in order to further strengthen the preservation of forests and reduce illegal deforestation.

Trade and private investment opportunities

In terms of electricity production, the objective is to stimulate private investment in low carbon, high efficiency electricity plants together with a reduction in electrical loss across the supply infrastructure. The private sector is seen as an important partner in reducing carbon emissions and thus the government is aiming to promote investment in carbon-reducing technologies, as the private sector represented 28% of carbon emissions in 2006. The climate change programme also recognises the importance of regulatory frameworks and legislation to promote greater reductions in carbon emissions within the private sector, and notes the importance of dialogue with representatives of the private sector in order to engage business in the carbon emissions reduction initiative.

Incentives and regulation for low carbon growth

The programme looks at the use of energy in Mexico as a way to increase energy efficiency. It highlights the use of the official Mexican regulation for energy efficiency as the main tool to increase the energy efficiency of appliances used within the Mexican economy.

The promotion of eco-friendly and energy-efficient residential homes is considered. Energy efficiency within households will be promoted through the Trust Law for Electric Energy Savings (FIDE³⁰) and will involve the use of more energy-efficient air conditioners, replacing old refrigerators with modern eco-friendly models and the insulation of households for heat retention. The To Live Better³¹ programme will be implemented to save energy through the substitution of electrical equipment with more energy-efficient models. The programme also highlights the use of national regulation to reinforce energy efficiency and looks at energy efficiency and carbon reduction in the construction sector. The government will promote the construction of energy-efficient buildings through public financing schemes, and a specific programme to develop sustainable households.

The Mexican government wishes to implement a national carbon trading mechanism (by 2012) based on its previous experience with a virtual carbon trading scheme developed by PEMEX in 2004. The carbon trading scheme is seen as an integral part of 'internalising' carbon emissions

30 <http://www.fide.org.mx/>.

31 <http://www.presidencia.gob.mx/vivirmejor/>.

and will be an important stimulus for companies to invest in low carbon growth technologies and reduce carbon emissions.

Industry will also be targeted, as the industrial manufacturing and construction sector accounted for 15% of national carbon emissions in 2006. FIDE will be extended to industry as well as to SMEs. Carbon emissions will be reduced through the implementation of the National Commission for the Efficient Use of Energy (CONUEE).³² New energy-efficient lighting systems and generators for industrial buildings will be installed. A study will also be undertaken in order to assess the feasibility of combined heat and electricity generation within the country.

The energy efficiency of the tourism sector is considered within the low carbon growth programme. The programme highlights the fact that the majority of carbon emissions from the tourism sector stem from transport and hotels. The program aims to reduce demand for energy in the tourism sector by issuing compliance certificates to industry members, funding a feasibility study on carbon reduction in the industry and informing industry representatives through conventions and other public events how they can reduce carbon emissions and the benefits of energy efficiency.

2.2.5 Nigeria

Country context

Nigeria's economy is heavily dependent on the production and export of petroleum, which provides 95% of foreign exchange earnings and about 80% of budgetary revenues. Industry accounted for 41% of GDP value added in 2006, agriculture for 31% and services for 28%.

Data from WRI's CAIT database from 2000 show that most CO₂ emissions in Nigeria stem from the land use change and forestry sector, accounting for 44%. This is followed by the energy sector at 28%, of which fugitive emissions are at 16.4%, manufacturing and construction 9%, transport 4.7% and electricity 2.8%. Agriculture is responsible for about 23% of all CO₂ emissions, with the remainder from waste and industrial processes. Nigeria's submission to the UNFCCC shows that energy and land use change sectors were the main contributor to CO₂ emissions (40%), followed by gas flaring (30%). Energy production data from the World Development Indicators (WDIs) show that the majority of electricity produced in Nigeria comes from gas-powered electricity plants (58%), followed by hydroelectric power (33%) and oil-fuelled power plants (9%).

Motivations for low carbon growth

The government of Nigeria advocates low carbon growth because of the negative effects that climate change will have on the world's poorest people, including those living in Nigeria. Nigeria is suffering from a number of environmental problems, such as sand storms, flooding and desertification, the causes of which need to be mitigated to avoid further increases in poverty within its territory. As such, the government is ready to increase its efforts in order to reduce GHG emissions down to an acceptable level to which the country may be able to adapt.

Moving towards a low carbon economy not only brings positive environmental effects but also will allow developing countries such as Nigeria to take an active part in the low carbon growth market, giving the country a good opportunity to participate in the production of goods and services that are currently in high demand. The government believes that any losses accrued to traditional industry and industrial methods owing to a move towards a low carbon economy will be offset by the advantages of participating in the low carbon growth market.

The government thus wishes to move its economy towards low carbon growth and, through incentives and regulations, allow its businesses to become ecologically friendly, thus helping them

³² http://www.conae.gob.mx/wb/CONAE/Que_es_conae.

not only to become sustainable in the long run but also to increase their efficiency levels (in terms of both energy use and production), improving their competitiveness and growth possibilities.

In order to move forwards, the Nigerian government, especially supported by Nigeria's Prime Minister, Umaru Musa Yar'Adua, has set up the Vision 2020 initiative, with the ultimate aim of transforming Nigeria into one of the world's top 20 economies by 2020. Within its strategy (which has yet to be fully formulated), the government will include both sustainable development and energy efficiency strategies. As the strategy has yet to be enacted or completed, the low carbon growth pillars discussed below represent the suggested national strategies that the Nigerian government could adopt in order to reach its goals. These all stem from Vision 2020 Technical Working Groups (TWGs) set up within the Nigerian government.

Some of the recommendations given by the TWGs relate to the strengthening of national institutes and ministries in order to allow them to effectively manage the nation's sustainable development. The TWGs recommend that the Federal Ministry for the Environment be reinforced in its capacity to make policy and enforce green growth laws. The National Council on the Environment should also be strengthened, as this would promote cross-governmental linkages pertaining to environmental protection and sustainable development. A policy framework should be created to harmonise green growth laws and allow for greater enforcement of such laws by the relevant national institutions.

The low carbon growth pillars

Finance for mitigation and adaptation

The TWG on Energy recommends the introduction of fiscal incentives (such as tax rebates) to incentivise companies to comply with pollution standards, through a rewards system for compliant industries and companies. The TWGs also recommend that special funds be set up to finance sustainability advocacy groups, to allow them to grow and increase their authority and outreach across the country.

Fiscal packages will be provided to promote private investment into renewable energy sources, such as wind farms, hydroelectric power, solar power and biomass. Fiscal incentives proposed to increase private sector investment in renewable forms of energy include import exemption duties, tax holidays and investment grants. These fiscal incentives not only will be applied to national investors but also would be extended to foreign investors in order to facilitate foreign investment in green growth technology within the country.

Human capital

The TWGs recommend the government begin a national campaign aimed at creating awareness within Nigeria on climate change and its effects. This should be implemented through both informal education (i.e. through public communication channels) and the formal education system.

The TWGs also recommend the government promote capacity building in environmental management techniques across all levels of academia and within professional institutions, in order to increase the number of qualified professionals within Nigeria's labour pool. Such professionals should also be hired across all levels of government, in order to give the sustainable development perspective on all policy options.

Technological progress in energy/infrastructure/transportation

Informational and technical knowledge sharing is seen as critical by the TWGs and, as such, an important recommendation is to set up internal information-sharing networks on best practices, techniques and technologies aimed at the facilitation of low carbon growth within Nigeria. The TWGs recommend Nigeria set up a system like the Global System for Sustainable Development, using modern telecommunication technologies (such as the internet) to facilitate information sharing across the country.

In addition to imported techniques and technology, the TWGs consider indigenous knowledge particularly important to create sustainable green growth technology that is not reliant on (potentially expensive) imports from abroad and can thus be perpetuated within the country through locally available resources. In addition, local knowledge of the environment should be used to promote sustainable development, especially in rural communities. The TWGs believe that rural communities often have a large amount of informal (but nonetheless valid) information on their local ecosystem and often have valuable traditional techniques to conserve it. Hence, the TWGs believe these techniques should also play an integral part in the Vision 2020's goal of a sustainable economy.

Research and development of renewable energy sources are also considered important. Although Nigeria's main sources of energy are fossil fuels (on which most of the TWG on Energy report is focused), and are likely to remain so by 2020, the TWGs consider the development of renewable energy sources important for reasons of national energy security. To this end, the TWGs recommend the Nigerian government promote research and development into renewable energy sources, such as hydroelectric power, wind farms and tidal energy facilities. The TWG also consider the local development of nuclear power plants viable alternatives to fossil fuels in order to attain national energy security.

Although fossil fuels (mainly gas, and through a substantially increased capacity for electricity generated by coal) will still be the primary energy sources in 2020, hydroelectric power is still seen as an important renewable energy source (and in fact currently accounts for a third of all electricity produced in Nigeria). Thus, one of the main targets in the TWG on Energy report is to increase the amount of electricity produced in this way and to make good use of all viable hydroelectric power generation sources, especially in rural areas. This will be promoted through the establishment of a national coordinating agency for alternative energy development as well as through the promotion of energy micro-generation in rural areas.

Investment in agriculture and forestry

The TWGs believe it is necessary to increase the forested area of Nigeria from the current 6% of national land, to 15% in 2020. To do so, they propose the use of large-scale reforestation and afforestation programmes, as well as the promotion of the reforestation of degraded agricultural land through agro-forestry and incentive schemes aimed at farmers in potentially suitable areas.

In addition, the TWGs propose a strengthening of national laws and regulations in order to preserve existing national parks, including all wildlife within the parks. Biodiversity will also be conserved through the creation of local small-scale enterprises that can harness local flora and fauna to produce commercially viable (but sustainable) products.

Green technologies will also be used to facilitate sustainable agricultural production. Sustainable agricultural development will be linked to the use of renewable forms of energy, especially small-scale energy generation in rural areas using wind, solar and hydroelectric power. Organic farming techniques as well as enhanced controls and regulations on soil and water quality levels will also be promoted in order to improve the sustainability of the agriculture sector.

Trade and private investment opportunities

In terms of private sector growth opportunities, as the Vision 2020 process has not been completed yet, no real green sectors of growth have been identified by the Nigerian government or the TWGs. On the other hand, the TWG on Energy has been focused mostly on innovations and efficiency gains within the fuel and carbon industries within Nigeria, for which the government sees real growth opportunities in terms of internal and external fossil fuel supplies.

Incentives and regulation for low carbon growth

The TWGs recommend that the government strengthen pollution controls through a national Pollution Standards Index (air, water and earth pollution), the establishment of pollution monitoring stations and guidelines and standards for vehicle pollution levels based on the PSI, in order to promote the use of low emission vehicles as well as curb the use of vehicles with high pollutant levels (this will also be achieved by setting age limits on vehicles imported into the country) and enforce the Environmental Assessment Law. The PSI will also be applied to industry through the enforcement of pollutant guidelines by 2012 as well as incentives to retrofit old manufacturing plants in order that they may comply with pollution standards.

Industry compliance with the pollutant guidelines and laws will be assessed through the implementation of a national database showing compliance levels across all industrial sectors. Industries will also be encouraged to reduce industrial wastes and adapt to environmental standards through agencies such as the National Environmental Standards and Regulations Enforcement Agency (in charge of the enforcement of sustainable development policies).³³

Gas flaring is a major source of pollution within Nigeria (as is stated in Nigeria's latest submission to the UNFCCC in 2003), thus the TWGs recommend the practice be stopped immediately. In addition, the TWGs recommend a monitoring system be set up to prevent oil and gas leaks, and a clean-up of all areas affected by oil leaks be completed by 2015. In order to eliminate CO₂ emissions from gas flaring, the government is currently passing the Gas Flare Prohibition Bill,³⁴ as well as considering reinforcing current laws that penalise companies undertaking gas flaring.

The TWG on Energy recommends that energy efficiency be promoted throughout the economy, through national campaigns aimed at the promotion of energy efficiency, increased tariffs on electricity consumption, both for large-scale electricity users as well as for the residential sector, and promotion of the use of energy-efficient appliances.

South Africa snapshot

In South Africa, the services sector accounted for 65% of GDP in 2007 (WDI data), industry for 31% and agriculture for just 3%. Electricity production is nearly wholly based on coal, with 94% of total electricity produced coming from coal, with the remaining 5% coming mainly from nuclear energy and in small part from hydroelectric power. South African carbon emissions stem mainly from electricity production (44%), industry (15%) and transport (11%), and currently account for nearly 50% of all CO₂ emissions in Africa.

In July 2008, the South African government launched People – Planet – Prosperity: A National Framework for Sustainable Development in South Africa. However, the framework provides only a general outline in relation to the achievement of reductions in carbon emissions. In 2006, the Long-term Mitigation Scenario strategy paper was launched looking at carbon abatement opportunities in South Africa. The strategy paper shows a number of scenarios for carbon abatement, from 'no action' up to scenarios whereby all carbon abatement opportunities are implemented. Economic growth outcomes for each scenario are analysed and key recommendations relate to:

- Increased energy efficiency;
- Investment in renewable energy;
- Cleaner electricity supplied by coal-powered plants and better CCS facilities;
- Cleaner transport vehicles.

The South African government does not currently have a specific green growth/low carbon economy national strategy; however, the government is currently in the process of creating such a strategy based on the papers outlined above.

³³ <http://www.nesrea.org/about.php>.

³⁴ <http://allafrica.com/stories/200906090507.html>.

2.3 Low-income countries

2.3.1 Bangladesh

Country context

Since Bangladesh achieved independence in 1971, GDP has grown fivefold, GDP per capita has doubled, food production has increased threefold and the population growth rate has declined from around 2.9% per annum in 1974 to 1.4% in 2006. The economy has grown at over 6% for the past three years and the country could become a MIC by 2020. Between 1991 and 2005, the percentage of people living in poverty declined from 59% to 40%. Despite much progress, however, some 56 million people still live in poverty (MoEF, 2008).

More than half of GDP is generated through the services sector; industry contributes close to 28% and agriculture makes up about 19% of GDP (WDI). Nearly two-thirds of Bangladeshis are employed in agriculture. Garment exports and remittances from Bangladeshis working overseas also fuel economic growth. Garment exports account for around 84% of total manufactured exports; the industry employs approximately 3 million workers (of a total estimated labour force of 70 million), 90% of whom are female migrant workers. According to Hussain (2009), revenues from remittances now exceed various types of foreign exchange inflows, particularly official development assistance and net earnings from exports.

Bangladesh emitted only 142 million tonnes of CO₂e (excluding land use change and forestry) in 2005 (WRI CAIT database). The largest source of CO₂e emissions is agriculture (66%) followed by energy, of which 8.7% came from fuel combustion, 8% from electricity generation, 7.5% from manufacturing and 2.7% from transport. Land use change and forestry resulted in net removals of 9.3 million tonnes of CO₂e (-8%) according to the country's UNFCCC submission. The country's energy consumption in 2004-2005 was just 89kg per capita (MoEF, 2002).

Policy motivations for low carbon growth

Bangladesh is already one of the most vulnerable countries in the world to weather and natural disasters. Floods, tropical cyclones, storm surges and droughts are predicted to become more frequent and severe in the coming years. The government thus recognises that climate change is a development as well as an environmental priority, and is committed to developing and incorporating potential response measures that reduce the impacts of climate change into the overall development planning process. Bangladesh is focusing primarily on building a platform for climate-resilient growth through adaptation measures, but is also taking steps to pave the way for mitigation and low carbon growth.

Given that Bangladesh has very low levels of GHG emissions, its climate change strategies are couched within the government's long-term vision to eradicate poverty and to achieve national economic and social wellbeing. The immediate goal to halve poverty by 2015 is a key target set out in its PRSP, finalised in 2005. Recognising the threat climate change poses to poverty alleviation goals, adaptation has become the foremost priority for Bangladesh. Low carbon growth has not been an explicit policy priority to date, as Bangladesh has low levels of industry and is struggling to extend energy services to much of its population.

On the adaptation side, with the support of development partners, over the past 35 years the government has invested over \$10 billion (constant \$ 2007) to make the country less vulnerable to natural disasters. These investments include flood management schemes, coastal polders, cyclone and flood shelters and the raising of roads and highways above flood level. The government has also developed state-of-the-art warning systems for floods, cyclones and storm surges, is expanding community-based disaster preparedness and has research centres developing climate-resistant varieties of rice and other crops (ADB, 2009).

In addition to adaptation efforts, the government has expressed a commitment to doing its part to reduce emissions and has made low carbon growth one of the pillars of its Climate Change Strategy and Action Plan (BCCSAP). Programmes to reduce emissions from the agriculture and energy sectors have been proposed, and the government emphasises sustainable development as the guiding paradigm for future development. Other planned programmes tackle social, health and food security issues, enhancing infrastructure and disaster preparedness.

Bangladesh's low carbon growth strategies are in the beginning stages, and much of the government's 10-year climate change strategy focuses on strengthening building blocks for good policy, including institutional capacity, awareness building and education, mainstreaming of climate change policies in national and sector development programmes and coordinating policies between ministries. However, the programmes generally lack detail on how specific measures will be carried out, with further implementation details, particularly on mitigation actions, not yet provided. Funding for programmes remains unclear and depends on whether there is HIC commitment to fund adaptation and mitigation activities in developing countries. For example, the series of detailed adaptation projects proposed as part of the 2005 NAPA remain unfunded.

The Ministry of Environment and Forests (MoEF) has been designated the focal ministry for all work on climate change, including international negotiations. The Department of Environment (DOE), under the MoEF, has also set up a Climate Change Cell to act as Secretariat for the recently established National Environment Committee, which ensures a strategic overview of environmental issues. Immediately after the COP13 Bali Conference, the government formed the National Steering Committee on Climate Change (NSCCC). This comprises secretaries of all relevant ministries and civil society representatives and is tasked with developing and overseeing implementation of the national BCCSAP. There are also five TWGs, on Adaptation, Mitigation, Technology Transfer, Finance and Public Awareness.

Four primary documents outline the government's approach to climate change and its strategy for adaptation and mitigation: the 2002 Initial National Communication to the UNFCCC, the 2005 PRSP, the 2005 NAPA and the 2008 BCCSAP. The government's Initial National Communication to the UNFCCC in 2002 set forth future policy priorities, including: protection of arable lands; improved water management; improving agro-technology research; formulating land use policies; coastal zone management; food security; strengthening disaster warning and disaster preparedness systems; trans-boundary cooperation; GHG emissions reductions; a sustainable development programme (integrated with poverty reduction activities); a unified, internally consistent climate change policy; formulation of a NAPA; national capacity building; and the institutional creation of a climate cell. Reflecting on progress made since the first UNFCCC submission, Bangladesh has taken significant steps to follow through with these priorities.

The government has also made climate change an integral part of the latest PRSP, which identified key future policy priorities, including the need to integrate climate change into existing policies and strengthen programmes for resilience in agriculture and water management, disaster reduction and health, with a focus on coastal areas.

The Bangladesh NAPA identified vulnerabilities and impacts and outlined 15 priority activities to combat climate change impacts, including general awareness raising, technical capacity building and implementation of projects in vulnerable regions, with a special focus on agriculture and water resources. Because little has been done to implement proposed NAPA projects, it remains to be seen whether a strong framework for evaluation of activities develops.

Bangladesh's NAPA was prepared by MoEF, guided by the Project Steering Committee and members from other key ministries, departments and agencies, including the Ministry of Finance and Planning. The NAPA reflected strong government participation and diverse consultations, including contributions from government policymakers, local government representatives, scientists

from various research institutes, researchers, academicians, teachers, lawyers, doctors, ethnic groups, media, NGO representatives and indigenous women (MoEF, 2005).

In 2008, the government launched the BCCSAP, a 10-year programme (2009-2018) built on the country's 2005 NAPA to increase capacity and resilience, with a strong focus on adaptation and disaster risk reduction. The BCCSAP was developed by the government in consultation with civil society, including NGOs, research organisations, development partners and the private sector. The first five-year programme (2009-2013) of the BCCSAP concentrates on six thematic pillars:

1. Food security, social protection and health;
2. Comprehensive disaster management;
3. Infrastructural development;
4. Research and knowledge management;
5. Mitigation and low carbon development;
6. Capacity building and institutional strengthening.

The six themes encompass 37 programmes to be implemented over the next 10 years, with further implementation details to be worked out in consultations with stakeholders. The needs of the poor and vulnerable, including women and children, will be prioritised in all activities implemented under the BCCSAP. Programmes funded under the BCCSAP will be implemented by relevant ministries or line agencies, under the guidance of the National Environment Committee, with overall coordination provided by MoEF. BCCSAP aims to involve civil society and the private sector as appropriate. Bangladesh is currently receiving technical assistance to implement BCCSAP programmes from the Asian Development Bank (ADB).

There was strong collaboration between government ministries to produce the NAPA and the BCCSAP, but both documents emphasise that there is a need for much greater coordination and integration of climate change into the policy agendas of different Ministries. The BCCSAP specifically called for a complete review of national policies to revise and enhance consideration of climate change issues. The NAPA presented adaptation activities as a set of measures complementary both to national goals and to the objectives of other multilateral environmental agreements to which Bangladesh is a signatory.

A number of national policies have addressed climate change concerns, including the National Water Policy, the National Action Plan on Biodiversity, the National Water Management Plan and the Disaster Management Plan, but other policies, such as the National Energy Policy, the National Environmental Action Plan, the Environment Conservation Rules and the Environmental Conservation Acts, would benefit from greater coordination.

Low carbon growth pillars

Finance for mitigation and adaptation

The government has established the National Climate Change Fund by allocating about \$45 million to it in the FY2009 budget. A Multi-donor Trust Fund was also established to pool funds from development partners to implement a long-term strategy to mitigate the adverse effects of climate change. The UK launched a £75 million (\$130 million) grant-funded programme, to be administered by the World Bank, to support the creation of the Multi-donor Trust Fund (ADB, 2009). However, an estimated \$500 million is needed over the next one to two years to support immediate action initiatives in Bangladesh. The total cost of programmes in the first five years of the plan could reach \$5 billion. Because of this significant shortfall, Bangladesh has been actively pushing for strong funding commitments by industrialised nations in international negotiations.

Human capital

Bangladesh has recognised that one of the first steps in dealing with climate change is to develop institutional and human resources capacity. The BCCSAP outlines specific programmes over the

next years to address issues of capacity, education and health. Education and awareness raising are recognised as key, both within the government and also for the public. Within government, the aim is to strengthen human resources capacity and institutions for climate change management, particularly to handle natural disasters. Bangladesh will establish a centre for knowledge management and training on climate change and create programmes to raise public awareness and education on climate resilience, including mainstreaming climate change issues in the media.

In terms of health and social needs, adaptation programmes have been created to improve water and sanitation, particularly in vulnerable areas, and to implement a surveillance systems for existing and new disease risks to ensure health systems are prepared to meet future demands.

Programmes are also outlined on livelihood protection in ecologically fragile areas, particularly for vulnerable groups and women.

Stimulating technological progress in energy/infrastructure/transportation

Bangladesh recognises that there are mitigation opportunities in raising efficiency in the production and consumption of energy. A detailed assessment of mitigation options has not been done since a preliminary assessment was prepared as part of Bangladesh's 2002 Initial National Communication, which identified possible measures for the energy, land use/forestry and agriculture sectors. The UNFCCC submission outlined current abatement activities underway, including: fuel switching to gas-based power generation, dissemination of improved cooking stoves, phasing-out of two-stroke engines, conversion of vehicles to compressed natural gas (CNG), installing home photovoltaic systems, switching to compact fluorescent lamps, switching brick making from wood based to natural gas based and promotion of environmental management systems in industry. The National Energy Policy also places emphasis on energy efficiency as well as renewable energy development, particularly on solar homes and biogas plants. The extent of the impact from these efforts is unclear.

In terms of adaptation infrastructure, the BCCSAP outlines programmes to: repair and rehabilitate existing coastal embankments, river embankments and drainage systems and ensure effective operation and maintenance systems; plan, design and construct urgently needed new infrastructure (e.g. cyclone shelters, coastal and river embankments and water management systems; urban drainage systems, river erosion control works and flood shelters); and undertake strategic planning of future infrastructure needs, taking into account the likely future patterns of urbanisation and socioeconomic development and the changing hydrology of the country. The BCCSAP and the PRSP also urge preparatory studies on impacts of rising sea levels, including modelling climate change impacts at the national and sub-national levels on a variety of sectors.

Trade and investment opportunities

In public documents there has not been a great deal of focus on encouraging private investment and pursuing new opportunities for trade. Most discussions have centred on enhancing access to the CDM, given that the country only has two projects, on solar energy and waste management. The BCCSAP states that the goal is to increase the number of CDM 'programmes' and to experiment with new instruments to generate carbon credits and facilitate carbon market financing in future. For example, under a proposed programme to manage urban waste, the BCCSAP proposes using the CDM to set up small power plants by capturing methane from waste dumps.

Investment in agriculture and forestry

Bangladesh has expressed a great concern over the potential effects of climate change on its agriculture sector and has also identified opportunities in agriculture and forestry to reduce emissions. The BCCSAP focuses on lowering emissions from agricultural land through improvement in agronomic practices and by developing an expanded afforestation and reforestation programme. On the adaptation side, programmes are being developed to enhance institutional capacity for research and dissemination on climate-resilient cultivars, development of

climate-resilient crop systems and promotion of adaptation measures in the fisheries and livestock sectors.

Aquaculture, in particular, could be significantly affected. It contributes around 5% to GDP³⁵ and provides a valuable source of protein as well as export income. Increasing salinity, storm surges and flooding, along with changes in ocean currents and sea level rises, present the most significant risks. The BCCSAP encourages developing greater research and prediction capabilities for climate change risks in general, and specifically calls for more research into potential threats to fish spawning and impacts from increasing salinity and increased water temperatures.

Incentives and regulation for low carbon growth

Under the BCCSAP pillar dedicated to mitigation and low carbon development, the government has pledged to undertake a number of activities to lower emissions and facilitate technology transfer, including to:

1. Develop a strategic energy plan and investment portfolio to ensure national energy security and lower greenhouse gas emissions;
2. Expand social forestry on government and community lands throughout the country;
3. Expand the 'greenbelt' coastal afforestation programme with mangrove planting along the shoreline;
4. Seek the transfer of state-of-the-art technologies from developed countries to ensure that we follow a low carbon growth path (e.g. 'clean coal' and other technologies);
5. Review energy and technology policies and incentives and revise these, where necessary, to promote efficient production, consumption, distribution and use of energy.

The plan describes actions that will be taken under specific programmes that will be developed to further the mitigation and low carbon development pillar. These are as follows.

Low carbon development programme	Proposed actions
Improved energy efficiency in production and consumption of energy	<ul style="list-style-type: none"> • Study least cost energy supply path that satisfies future energy needs • Raise energy efficiency in power production, transmission and distribution, agricultural and industrial processes, domestic and service sectors and transport sector
Gas exploration and reservoir management	<ul style="list-style-type: none"> • Invest in gas exploration • Invest in reservoir management
Development of coal mines and coal-fired power stations that use clean technology	<ul style="list-style-type: none"> • Review coal mining methods and undertake a feasibility for new coals plants • Potentially invest in coal mining and clean coal-fired power generation plants
Lower emissions from agricultural land	<ul style="list-style-type: none"> • Support to research and on-farm trials of new water management technologies for rice • Support to agricultural extension service for new water management techniques for rice
Renewable energy development	<ul style="list-style-type: none"> • Investments to scale up solar programmes • Research and investment to harness wind • Feasibility studies for tidal and wave energy • Study potential for improved biomass stoves
Afforestation and reforestation programmes	<ul style="list-style-type: none"> • Support afforestation programmes • Develop wetland afforestation programme • Study scope for carbon credits under REDD • Provide support to existing and new homestead and social forestry programmes

³⁵ http://www.fao.org/fishery/countrysector/naso_bangladesh/en.

	<ul style="list-style-type: none"> • Research the suitability of various tree species for reforestation programmes
Management of urban waste	<ul style="list-style-type: none"> • Design of urban waste dumps so that methane can be captured in all major urban areas • Use the CDM to set up small power plants that capture methane from waste dumps

Beyond listing the targeted areas above, the BCCSAP does not provide further guidance on how these objectives will be achieved. The stated focus of the above activities is to 'play our part in reducing emissions now and in the future'. It is clear that Bangladesh sees the value of pursuing low carbon development but its climate strategy document does not make it a specific goal to seek out and harness new opportunities for economic development and trade, develop new industries or foster in-country technological innovation. Rather, the goals focus on pursuing best practices, technology transfer, energy security and undertaking programmes that foster poverty reduction.

2.3.2 Ethiopia

Country context

Ethiopia's economy is based to a large degree on agriculture, accounting for almost half of GDP, 90% of export earnings and 85% of total employment. Services make up 41% and industry 12%. Agriculture suffers from frequent drought and poor cultivation practices. Coffee is critical to the economy, with exports of some \$350 million in 2006, but historically low prices have caused many farmers to switch to other crops to supplement income. Under Ethiopia's Constitution, the state owns all land and provides long-term leases to tenants. A major drought struck late in 2002, leading to a 3.3% decline in GDP. Normal weather patterns helped agricultural and GDP growth recover during 2004-2008. GDP grew by 8.5% in 2008. With a growth rate of 2.8% per year, the country's population is expected to reach 129 million by 2030, from almost 80 million today.

According to the WRI CAIT database, Ethiopia's total GHG emissions were 73.5 million tonnes in 2005. 67% was from agriculture, almost 12% from land use change and forestry and 12% from energy, including 8% from fuel combustion, 2.4% from transport and 1.2% from manufacturing. Total emissions are about 1 tonne per capita, one of the lowest rates in the world. Biomass fuels account for nearly 95% of total national energy consumption, with the balance from petroleum (4%) and hydro (1%).

Policy motivations for low carbon growth

Ethiopia's heavy dependence on agriculture, coupled with a high population growth rate, makes the country particularly susceptible to the adverse effects of climate change. Negative climatic impacts on crop and livestock production could exacerbate nationwide food shortages, increase poverty and slow economic growth. Ethiopia has taken steps to address climate change but is also broadly representative of the limited level of integration of climate change policies into the national agenda and the lack of strategic planning on climate change across many African countries. The country's objectives are not so much to achieve low carbon growth, but rather to strengthen climate resilience through adaptation, and to enhance food and energy security.

Ethiopia's Plan for Accelerated and Sustained Development to End Poverty (PASDEP) for 2005-2010 emphasises that the country's immediate socioeconomic priorities are adequate food production, basic health services, capacity building, primary education, containing AIDS and reducing environmental degradation, but does not make an explicit connection between development needs and climate change mitigation and adaptation.

However, the 2001 Initial National Communication to the UNFCCC (by the Ministry of Water and Natural Resources) states that a number of options to mitigate emissions and adapt to climate change could combine twin objectives: sustainable economic development and GHG mitigation.

Options identified include energy efficiency improvements, renewable energy generation, ethanol blending, forest preservation, reforestation and afforestation and waste composting.

In its 2007 NAPA,³⁶ Ethiopia aims to increase climate change resilience by developing programmes and projects that ameliorate worsening natural resource depletion and environmental deterioration while securing energy supplies, reducing poverty and improving basic services. The NAPA also developed criteria for prioritising potential adaptation projects that would meet these goals, although a comprehensive strategy for implementation has not been developed. Projects that are included relate mainly to physical adaptation measures – to early warning systems for drought and floods, agricultural improvement, irrigation and water systems, capacity building, research and development and carbon sequestration. One project relates to health – strengthening malaria containment. There is no mention of programmes to encourage behavioural change and very little progress has been made to date on implementing any of these projects. A variety of ministries are charged with leading on implementation for many of the adaptation projects, most commonly the National Meteorological Agency.

Expansion of hydro power and biofuels are currently the mainstays of national energy policy, with a major dam project proposed and expansions planned in molasses-based bioethanol and jatropha-based biodiesel. The 2007 Biofuels Development and Utilisation Strategy established biofuels as a priority for the government as a means to improve agricultural revitalisation, access to alternative energy sources, employment and energy security, as Ethiopia is a net importer of oil. NGOs and other civil society groups have criticised the government's plan as premature, lacking environmental safeguards and a threat to biodiversity. However, the government expects Ethiopia to benefit from bioenergy technologies to grow more food, rejuvenate its vast land resources and further strengthen its economy through 'home-grown energy sources'. Ethiopia is also promoting energy efficiency and conservation measures, as well as utilising blended ethanol (E5) in the Addis Ababa transport system. However, these measures fall short of aspiring to an economy-wide transition to clean energy sources.

Meles Zenawi, Prime Minister of Ethiopia, has emerged as a strong champion of the climate change agenda and has underlined the need to transform the relationship between agriculture and bioenergy in Africa in general as a primary means of adjusting the continent's economy to the challenges of climate change. Mr. Zenawi has also promoted the idea that the new bioenergy technologies have the potential to drive growth in the region, from transport fuels to green electricity. Concerns relating to the potential for increased GHG emissions because of land clearance for biofuels production – given carbon sequestration in soils – may need to be given greater consideration and appropriate regulation and certification measures devised.

Ethiopia has thus taken initial steps to address climate change, but coordination and implementation of policies proposed to date has remained disjointed. While the mitigation options submitted to the UNFCCC in 2001 are linked to growth and poverty reduction strategies, little progress has been made in implementing them. Similarly, the NAPA links criteria for prioritised projects to their ability to continue to reap sustainability benefits and contribute to poverty reduction. But it is not clear how integrated proposals will be in practice across ministries and the extent to which mitigation options will be verified and linked to mitigation finance options. Ethiopia's PASDEP does not integrate mitigation and adaptation measures within its growth and poverty reduction strategies to any extent. Ethiopia is currently developing a national climate change strategy with assistance from the World Bank – the document will need to be more comprehensive and provide clearer operational guidance if it is to progress the agenda.

³⁶ Preparation of the NAPA was initiated and coordinated by the National Meteorological Agency, with a Steering Committee made up of 10 government ministries/agencies, university and NGO representatives. The NAPA was guided by a participatory process involving stakeholders and a multidisciplinary and complementary approach building on existing plans and programmes, including national action plans under the UN Convention to Combat Desertification, National Biodiversity Strategies and Action Plans, the Convention on Biological Diversity and national sectoral policies on climate change and air pollution. Consultants were used to prepare technical reports used as inputs into the NAPA.

In sum, Ethiopia has shown interest in climate-resilient growth and taken some initial steps, but it does not have a clear institutional lead nor has it developed a national climate change strategy with a long-term vision for dealing with climate risks to growth and poverty reduction, or a plan to harness emerging opportunities. There is some recognition in the policy documents that climate change presents major risks to the development agenda but its policy documents are fragmented and inconsistent. Mention of emissions mitigation activities are restricted to expanding hydro and biofuels to improve energy access, supporting an efficient and revitalised agriculture sector and reforestation and protecting existing forests.

Low carbon growth pillars

Finance for mitigation and adaptation

There appears to be a lack of funding for activities proposed in both the National Communication and the NAPA. Ethiopia is urging developed nations to provide funding for its NAPA projects through grants rather than loan programmes. The National Biofuels Strategy also states that part of the aim of a national biofuels programme is to take advantage of additional finance available through the CDM. However, there is no approved CDM methodology for biofuels derived from other crops or plants, such as sugarcane, since land may have been cleared to produce the biofuel crop, and this issue remains controversial. Thus, development of appropriate national certification infrastructure that meets an internationally accepted methodology is likely to be necessary prerequisite before Ethiopia effectively taps into the CDM.

Human capital

Ethiopia's NAPA recognises that capacity building for climate change adaptation at all levels, particularly at federal level and regional levels, is important to achieving its climate change goals. The NAPA prioritises the establishment of a National Research and Development Centre for Climate Change and the establishment of a National Environmental Education programme.

In terms of moderating health impacts, the NAPA contains a Malaria Containment Programme (MCP) in selected areas of Ethiopia-Gambella, the Ethiopian Rift Valley and Somali. The government hopes to enhance community capacity building to initiate and implement environmental health programmes and projects in regional states.

Stimulating technological progress in energy/infrastructure/transportation

With the financial help of developed countries, Ethiopia aims to exploit its significant hydro, solar, wind, biomass and geothermal energy resources, although the motives are as much to improve access to energy and energy security as they are about mitigation. The government is currently looking at developing renewable energy projects that would supply both Ethiopia and its neighbours, including the recently launched Ashegoda Wind Power Project, the country's first wind farm, which will have an installed capacity of 120 MW and will generate annual energy production of 400 GWH to 450 GWH. With support from Germany's Solar Energy Foundation, about 2000 solar systems have been installed in the rural village of Rema and in nearby Rema ena Dire, making it the largest solar power project in East Africa. The project has brought power to roughly 5500 residents (only about 1% of people in rural areas have access to electricity in Ethiopia).

Given that the vast majority of households rely on biomass sources for energy and cooking needs, the government sees harvesting bioenergy efficiently as a cornerstone strategy. The Initial National Communication highlights the need to expand the use of improved cook stoves and of biofuels for transport. The 2007 National Biofuels Strategy calls for the production of 128 million litres of ethanol by 2013. The government has also allocated 24 million hectares for jatropha plantations, asserting it will not affect food production. Currently, there are more than 50 developers (many of whom are foreign) registered for the cultivation of biodiesel crops for biodiesel, of which 14 had begun operations in 2008 (MELCA, 2008). For bioethanol, however, there are only six projects in the country, of which four are government-owned sugar estates. Over 300,000 ha of land have

been dedicated to bioethanol production and over 80% of these developments are happening in arable lands, forest lands and woodlands (ibid).

Through the Ethiopian Electric Power Corporation, the government is distributing 5.4 million compact fluorescent lamps country wide to help electricity consumers save money on their electricity bills and cut carbon emissions. To improve climate resilient infrastructure, the NAPA prioritises strengthening and enhancing drought and flood early warning systems, although little progress has been made on this front.

Trade and investment opportunities

Policy documents do not specifically propose the development of new low carbon growth industries or technologies, although the government is currently looking at developing renewable energy projects that would supply both Ethiopia and its neighbours, as noted above.

Ethiopia is looking to expand its participation in the CDM by assessing potential for projects and programmes, particularly in agriculture. A World Bank study (Gouvello et al., 2008) on CDM opportunities across sub-Saharan Africa's energy sector found an estimated technical potential of more than 3200 clean energy projects, including 361 large programmes of activities. In Ethiopia, potential projects to generate power from agricultural residues, roundwood residues, wood-processing residues and jatropha biodiesel were found to total over 25 million tonnes of CO₂e reductions, generating 39,200 gigawatt hours per year. The Initial National Communication and NAPA do not specify how this potential may be harvested and no specific policies were proposed to try to encourage the CDM but Ethiopia is supportive of a reformed CDM that expands programmes of activities and provides special incentives for small-scale projects. It also recognises that, to take advantage of potential projects, it must build up training and technical expertise in project design and preparation. The need to create a good investment climate for such projects is not specifically mentioned in policy documents.

Investment in agriculture and forestry

As the mainstay of Ethiopia's economy, agriculture has been the central target for climate adaptation efforts. Changing rainfall patterns and drought are the largest risks to agricultural productivity from climate change. The NAPA proposed a number of projects related to irrigation and water and crop management to help adapt to these risks. Six out of 11 NAPA projects relate to agriculture, including:

- Promoting a drought/crop insurance programme;
- Development of small-scale irrigation and water harvesting schemes in arid, semi-arid and dry sub-humid areas;
- Improving/enhancing rangeland resource management practices in pastoral areas;
- Community-based sustainable utilisation and management of wetlands in selected regions;
- Enhancing food security through a multi-purpose, large-scale water development project in Genale-Dawa Basin;
- Promotion of on-farm and homestead forestry and agro-forestry practices in arid, semi-arid and dry-sub humid parts of Ethiopia.

Some have argued that the NAPA priorities in agriculture fall short of long-term needs. Crop insurance, for example, may reduce short-term vulnerability by mitigating the risk of severe fluctuations in rainfall from year to year. However, it does not build resilience to the long-term fundamental impacts of climate change that will alter production systems, such as cultivation moving higher into the hills as temperatures rise or changing rainfall patterns that will affect where and how agriculture activities take place. Similarly, as climate modelling cannot accurately predict how rainfall patterns will change, developing new irrigation systems and reservoirs does not advance a more flexible approach that can adapt as a greater understanding of national-level impacts emerges.

On the mitigation side, agricultural measures discussed include: increasing livestock productivity through improved nutrition with supplementation and treatment of forages to improve digestibility and through improved genetic characteristics; promoting sustainable agriculture; promoting mixed crop livestock farming practices where appropriate; promoting the use of manure management system facilities; adopting appropriate fertiliser application; promoting conservation tillage techniques to sequester carbon in cultivated soils; rehabilitation of overgrazed watering points and long-term settlement areas; and redistribution of manure that is accumulated near these settlements. These activities are targeted more at adopting best practices to improve productivity but do also contribute to the country's mitigation actions.

In forestry, Ethiopia's UNFCCC submission found that protecting existing carbon reserves and enhancing carbon sequestration through reforestation had significant potential for reducing emissions. Ethiopia has already been active in reforestation, including contributing more trees than any other nation – over 1 billion – towards the UN Environment Programme (UNEP) Billion Tree Campaign global target of planting 7 billion trees by December 2009. Reforestation has been a major target for proposed programmes as well, including a NAPA project on community-based carbon sequestration in the Rift Valley to rehabilitate the acacia woodlands. The UNFCCC national submission set the goal to reforest 21,000 ha over the following 30 years. Ethiopia also aims to improve forest management practices, promote agro-forestry and develop and restore gallery forests along river banks.

Incentives and regulation for low carbon growth

Beyond encouraging renewable energy generation, other pillars of a mitigation and low carbon growth strategy are noted as:

- Promoting the use of fuels with low carbon content (fuel switching), e.g. exploiting the Ogaden natural gas reserve;
- Promoting the use of smaller cars through tax differentiation based on engine size, expansion of public transport infrastructure, improving the efficiency of operating vehicles by carrying out maintenance, inspections and training, improving urban traffic, promoting environmentally friendly transport modes such as bicycles;
- Integrated waste management, composting solid waste of Addis Ababa city and landfill gas recovery from solid waste site of Addis Ababa city.

Ethiopia was also the first African nation to join the Climate Neutral Network (CN Net)³⁷ – an initiative led by UNEP to promote global action to decarbonise national economies and societies.

Malawi snapshot

Based on WRI CAIT data from 2000, Malawi is a small net emitter of GHG. Last estimates for annual per capita emissions were in the region of 3.0 tonnes of CO₂e. The greatest contribution of emissions arises from the land use change and forestry sector (99.7%) and industrial processes (0.3%). Although Malawi is not obligated to meet emissions reductions targets, the government recognises that its reduction and use of carbon sinks provides opportunities as well as challenges for the socioeconomic development of the country. The domestic energy system is dominated by biomass.

Malawi's 1994 National Environment Action Plan (NEAP), its Vision 2020 launched in 1998 and its 2002 PRSP outline measures and priorities to promote sustainable use of the environment, including following priority development pillars: rapid sustainable pro-poor economic growth and structural transformation; human capital development; improving the quality of life of the most vulnerable; and good governance. The NAPA, developed by the Ministry of Lands and Natural Resources, built on these priorities by providing

³⁷ Based on a free of charge, interactive website, CN Net gives participants a platform to present their strategies in climate neutrality to network members. It functions as a network for information exchange and sharing of practical experiences, making the best practices on climate neutrality widely available.

concrete measures to tackle effects of climate change and prioritises the creation of buffers for the most vulnerable from the socioeconomic implications of climate shocks.

Malawi's energy resources include biomass, coal, hydropower, solar and wind. The government has established a National Sustainable and Renewable Energy Programme (NSREP) to increase access to and coordinate implementation of renewable energy technologies. To this end, Malawi's Initial National Communication to the UNFCCC targets the following mitigation options in agriculture, energy and forestry:

1. Use of briquettes instead of firewood;
2. Improved mud and ceramic stoves;
3. Use of biogas for lighting and cooking;
4. Rural electrification through grid extension, mini/micro hydropower and solar photovoltaic heaters and cookers which would reduce demand for biomass energy;
5. Increased use of public transport and catalytic converters to reduce GHG emissions;
6. Wind water pumping instead of diesel and petrol engines;
7. Promote re-vegetation and natural regeneration, forest protection and agro-forestry;
8. Improved nutrient management in livestock and rice fields and better water management.

The market-based mitigation options considered in the National Communication include energy pricing, fiscal incentives, regulation and demand-side management. The submission also recommends the removal of duty and sur-taxes on renewable energy technologies. Mitigation options in its 2002 communication to the UNFCCC did not include alternatives to petrol and diesel for transport. Lack of funding continues to be a fundamental barrier to implementation of these programmes.

Rwanda snapshot

Rwanda's largest source of CO₂e emissions, mostly from methane, is the energy sector, followed by agriculture, according to 2002 data in its Initial National Communication to the UNFCCC. It has negative net CO₂ emissions owing to the sequestration capacity of its forests. Rwanda has demonstrated commitment to low carbon energy growth, with a focus on the development of indigenous and renewable energies.

Rwanda is working to increase access to electricity under its sector-wide approach, which aims to increase electricity access from 6% of the population to at least 35% by 2020. Access in rural and off-grid areas will be supported by solar and micro-hydro power solutions. Rwanda also has a model methane project at Lake Kivu, which extracts methane to produce large amounts of electricity which could potentially be exported.

The government has defined additional policies and measures in its national submission to the UNFCCC to encourage low carbon development in energy, forestry, agriculture and waste. Key measures are:

Sector	Activity
Energy	<ul style="list-style-type: none"> • Promote and extend use of biogas, solar photovoltaic, solar water heaters and micro-hydro • Intensify regional collaboration in electricity generation and integration of supply network and promote energy commerce at regional level • Promote power generation from waste and algae in small-scale industries • Promote low consumption lamps and efficient cooking stoves • Introduce efficient wood charcoal-making technologies
Forestry	<ul style="list-style-type: none"> • Support programmes involved in reforestation, forest preservation, such as in Nyungwe, and sustainable forest management, such as in Bugurama • Wetland preservation and management
Agriculture	<ul style="list-style-type: none"> • Nitrogen runoff management and use of organic fertilisers • Management of manure and enteric fermentation • Controlled burning of savannah and on-site burning of farm residues • Intensification of agriculture and animal husbandry
Waste and waste disposal	<ul style="list-style-type: none"> • Banning wastewater flows on public roads and areas • Banning use of cesspools for disposal of residuary urban waters • Imposition of a water treatment tax • Extension of lagoon purification technology

Rwanda has identified the tools needed to achieve expected results including training, education, tax exemption, low interest loans and other financial incentives. Rwanda has stressed that it is critical for the

country to receive financial support from developed countries and international institutions beyond conventional forms of aid to support its goals to transform the energy sector. It sees supporting the energy sector in developing countries as an investment opportunity for energy companies, as it can create employment and will encourage the sector to develop along a sustainable, low carbon path.

Summary table of low carbon growth and resilience policies and measures proposed by selected countries

	Base of economy/ largest emission source	GNI/ capita (\$, 2008) (WDI)	Finance Sources	Human capital	Infrastructure	Transport	Clean energy	Agriculture and forestry	Trade and investment opportunities	Incentives for low carbon growth	Policy documents
Germany	Services/ energy	\$42,440	Efficiency Fund, sector funding	Education	Smart grid	Electro- mobility	Wind, PV and bioenergy/ CHP, CCS	NA	Technology exports, green services sector, jobs	EE, CAT, consumption taxes, biofuel quota	Energy roadmap, LC growth strategy
UK	Services (finance)/ services	\$45,390	LC Investment Fund, Environment Transformation Fund, ECAs, CCA, LC building funds	Behavioural change, training, Skill Funding Agency	Low carbon building programme	Low carbon vehicle partnership, increase fuel efficiency standards	Renewables, nuclear, wave/tidal, R&D (CCS, biofuels, fuel cells)	Feasibility study on CAT for agriculture	Green technology and services sector, job growth	CC Levy, LC fuel quota, LC Vehicle Partnership, Code for Sustainable Homes	Climate Programme, LC Industry Strategy, LC Transition
Brazil	Services/ deforestation	\$7350	National Climate Fund, Amazon Fund	CC education, health and sanitation, studies, alert systems	Biofuels stations	Bio ethanol and flex-fuel vehicles	Hydro, cogeneration, nuclear, off-grid solar	Grant-based REDD, cattle management, organic fertilisers	Flex-fuel vehicles, ethanol trade, forestry offsets	EE, appliances, solar heating, recycling, research and training	National Plan on Climate Change
China	Industry, services / energy and industry	\$2770	CDM	Training of climate specialists for R&D	Building standards	Efficient vehicles and public transport	Efficient use of coal/ nuclear, hydro, wind and biomass	Reforestation, less fertiliser, new rice crops, sustainable forest management	Wind, PV, electric vehicles, technology transfer, restructured economy	Lower energy intensity/EE, clean power and transport, green buildings, R&D	China's National Climate Change Program
Mexico	Services, industry/ energy	\$9990	Mexican Carbon Fund, World Bank Clean Technology Fund, sector funding	CC education –all levels, CC monitoring systems	More efficient plants, lower losses	Low carbon vehicles, clean transport program	CCS, nuclear, wind, solar, hydro, geothermal	Sustainable agriculture practices, REDD, combat illegal deforest.	Ecotourism	EE, CAT, efficient appliances	Special Climate Change Program
Bangladesh	Services/ Agriculture	\$520	National Climate Change Fund, Multi-donor Trust Fund	Awareness, health surveillance, institutional capacity building, livelihoods protection	Flood and disaster defence, preparatory studies	Efficiency, conversion to CNG, phasing out two-stroke engines	Clean coal, EE, fuel switching, biogas, cook stoves, studies for other types including tidal	Climate-resilient crops, improved cultivation practices, reforestation, protection for aquaculture	CDM	Technology transfer, impact and feasibility studies, EE, cleaner coal, renewables, reforestation, waste management	Climate Change Strategy and Action Plan, NAPA, PRSP, UNFCCC submission
Ethiopia	Agriculture/ Agriculture	\$280	International grants	R&D Centre, malaria containment	NA	Biofuels, smaller cars	Hydro, demo renewables projects, CFLs	Reforestation, irrigation, rangeland and agro-forestry management, crop insurance	CDM – agriculture projects	Fuel switching, LC vehicles, waste management	NAPA, UNFCCC submission, PASDEP
Guyana	Agriculture, industry/land use change and forestry	\$1420	Low Carbon Finance Authority, REDD	Education and job training	Roads, fibre optic cables, flood defence, alert system	NA	Hydro	Irrigation systems, flood- resistant crops, REDD	REDD, aquaculture, fruits/vegetables, sustainable forest prods, BPO ethanol, ecotourism	Investments in low carbon sectors, new social services, REDD readiness	Low Carbon Development Strategy, PRSP, UNFCCC submission
Nigeria	Industry (oil)/land use change and forestry	\$1160	Tax holiday, investment grants, rebates for pollution standards compliance	National awareness campaign, capacity bldg in government	Low emission vehicles	NA	Hydro, wind, PV, biomass and tidal & nuclear R&D	Reforestation, organic farming, use of traditional knowledge	Technology transfer, EE in fossil fuel industry	Pollution controls, EE, halt gas flaring	Vision 2020

Summary table of low carbon policies and measures in snapshot countries

	Base of economy/ largest emission source	GNI/ capita (\$, 2008) (WDI)	Transport	Agriculture and forestry	Incentives for low carbon growth	Policy documents
India	Services/energy	\$1070	Biofuels	Reforestation	Wind, PV, solar thermal, CFLs, retire old coal plants, nuclear, biofuels, reforestation, PAT system	
Malawi	Agriculture/land use change and forestry	\$290	Catalytic converters, public transport	Reforestation/forest protection, improved nutrient management, water management	Biogas, improved cook stoves, micro-hydro, PV, solar thermal, demand-side management, removal of duties on renewable techs	NAPA, UNFCCC submission
Rwanda	Agriculture/energy	\$410		Reforestation, agricultural management, fertiliser management, better waste handling	Bioenergy, solar, micro-hydro, EE, regional clean electricity grid	NAPA, PRSP, UNFCCC submission
South Africa	Services/energy	\$5820	Cleaner vehicles		Renewables and EE, CCS and clean coal	People – Planet – Prosperity: A National Framework for Sustainable Development in South Africa, Department of Environmental Affairs & Tourism, South Africa – the paper highlights only the need to implement a national strategy to combat climate change, but has no actual strategies
South Korea	Services/ energy	\$21,530	Public transport and regulation of vehicles		Lower carbon intensity and EE, carbon tax, renewables	ECOREA 2008 – (document contains only a few brief non-specific paragraphs on carbon abatement), Ministry of Environment, Republic of Korea The Ministry of Knowledge Economy has set up two national policies, the National Climate Change Plan and the Green Energy Industry Development Plan, but documentation for both is not available

Table acronyms: BPO = Business Process Outsourcing; CAT = Cap and Trade; CC = Climate Change; CCA = Climate Change Agreement; CCS= Carbon Capture and Storage; CDM = Clean Development Mechanism; CFL = Compact Fluorescent Lamp; CHP = Combined Heat and Power; CNG = Compressed Natural Gas; ECA = Enhanced Capital Allowance; EE = Energy Efficiency; GNI = Gross National Income; LC = Low Carbon; NAPA = National Adaptation Programme of Action; PASDEP = Plan for Accelerated and Sustained Development to End Poverty; PAT = Perform, Achieve, Trade; PRSP = Poverty Reduction Strategy Paper; PV = Photovoltaic; R&D = Research and Development; REDD = Reduced Emissions from Deforestation and Degradation; UNFCCC = United Nations Framework Convention on Climate Change.

3. How does low carbon growth challenge the traditional growth agenda?

3.1 How does low carbon growth challenge traditional growth theory, and how might it affect the global rate of growth?

Achieving low carbon growth clearly has major implications for policy, and implies considerable adjustment of the traditional growth agenda. Having said that, low carbon growth does not actually present a major challenge to traditional growth *theory* - it simply requires the internalisation of the environmental costs of production of goods and services. Because the impact of carbon emissions on climate change has not been captured in the prices of goods and services to date (more specifically, because the cost of energy has been sub-optimally low, having not factored in the impact on climate change), growth and development have occurred in a way that undervalues carbon, and hence results in a greater use of energy than would be the case if energy was properly priced. In practical terms, examples might include the development of sprawling modern cities that rely heavily on travel by car, or the intensification of food production in a way that relies on the use of machinery and fertilisers that consume high levels of fossil fuels, or the growth of a 'throw-away culture', rather than the reuse or recycling of existing materials.

In theory, it is simple to resolve this problem through the appropriate pricing of carbon emissions, which would incentivise producers and consumers to take into account the environmental costs associated with the carbon emissions created in producing or consuming goods and services. Thus, the main requirement to establish the right conditions and incentives to achieve a low carbon growth path is to establish an appropriate carbon price.

(While establishing a carbon price internalises the necessary environmental externalities, some have argued that a transition to a low carbon economy also requires a broader altering of what is counted on national balance sheets. Conventional measures of GDP do not take into account the depletion of natural resources, or the environmental consequences (e.g. pollution) of production. Thus, Joseph Stiglitz and Amartya Sen conclude as part of the Commission on the Measurement of Economic Performance and Social Progress (2008)³⁸ that GDP is an insufficient metric by itself and that additional measures of sustainability and human wellbeing should be included when assessing economic progress.)

An international agreement which sets an overall global ceiling on emissions, and allocates emissions allowances to every country in the world, would effectively set a carbon price. But in order to achieve this (and, indeed, in the absence of such an agreement), countries will need to implement national policies that will facilitate the achievement of the necessary emissions reductions or constraints on emissions growth. These policies could include fiscal incentives (through taxes or subsidies), regulation (through standards or labelling), an emissions permit trading scheme or government support for research and development.

However, the potential impact of mitigation policies on growth is rather unclear. While much of the literature suggests a negative impact from mitigation on growth, a recent report by The Climate Group finds that a global climate agreement could lead to an increase in global GDP by 0.8% by 2020 relative to projected GDP with no climate action. The literature on this issue is very mixed, and modelling results often depend enormously on the assumptions used.

On the one hand, emissions constraints raise the cost of energy, which reduces the output that can be achieved with a given set of inputs. However, there is no consensus on the costs of mitigation in

38 The Commission was created by French President, Nicholas Sarkozy, to review the adequacy of GDP.

the literature. Some studies argue that the costs of mitigation could be lower than expected. This could be because of the discovery of new, cheap technologies which can facilitate a low-cost switch from fossil fuel to fossil-free sources of energy (Gerlagh, 2006), or because of international spillover effects (Buonanno et al., 2003) or because of synergies between green research and development investments and general output-increasing research and development investments (Cantore, 2006). The cost of mitigation will also depend on the nature and efficiency of the mitigation policies adopted. Emissions trading schemes, for example, are seen as a way of minimising mitigation costs by allowing flexibility in where emissions reductions are made, thus providing opportunities and incentives to keep down the cost of mitigation.

Mitigation policies will affect different sectors differently, and are likely to imply adjustments to the sectoral sources of growth previously enjoyed by some countries. For example, mitigation policies which drive down the cost of oil will generate a net loss for oil-exporting countries, and a net gain for oil importers. Air transport taxes might reduce demand for tourism, or for air-freighted exports such as fruit and vegetables. Carbon taxes may generate carbon leakage (i.e. the shift of dirty industry to pollution havens), and reduce income associated with carbon-intensive products. Thus, the impact of these policies will vary significantly by country, depending on their sectoral composition. Analysis of the potential impact of different kinds of mitigation policies on growth has been fairly limited to date, and is the subject of a forthcoming Overseas Development Institute (ODI) study.

Notwithstanding the costs that are bound to be associated with mitigation, there are also opportunities associated with mitigation that some argue could potentially outweigh the costs (e.g. UNCTAD, 2009). In other words, the growth stimulus deriving from policies devoted to enhancing environmental technological progress could outweigh the growth-reducing effect associated with a higher cost of carbon. This could be the case if there is fast growth in the demand for environmental goods and services, for example. Moreover, there may be major co-benefits associated with mitigation. If – as noted above – there are strong synergies between green technological change and general, industrial technological progress (a key source of growth), then policies designed to promote green technological innovation and technology transfer could potentially also increase growth. In addition, efforts to restore forests or avoid deforestation or land degradation in some countries may also have beneficial economic effects, if they help improve flood controls in watersheds.

Some mitigation policies generate revenues (e.g. carbon taxes) and thus provide opportunities to stimulate growth through the judicious use of the revenues raised. For example, a recent paper from Tol et al. (2008) shows that, if revenues from a carbon tax are spent on health and education, the overall impact of a carbon tax would be positive.

Thus, the way national mitigation policies are designed will have a significant impact on the overall growth effects. At an international level, if revenues raised from international mitigation policies (e.g. auction revenue from the sale of carbon permits in CAT schemes) are then spent in developing countries, this could generate significant gains for recipient countries.

Regardless of the overall impact of mitigation on global growth, the distribution of mitigation efforts will also affect growth prospects. Some have argued that rich countries may need to reconsider their pursuit of continued economic growth, if developing countries are to have the space to grow their way out of poverty.

There are also significant practical uncertainties and constraints associated with mitigation in both developed and developing countries, including:

- The potential success of future innovation in energy production technologies in driving down the price of low carbon energy;

- The ease with which countries can switch to green energy, which depends on the extent to which they are locked into existing technologies. The adoption of low carbon energy sources will depend on their relative price and convenience as compared with fossil fuels. If the upfront costs of switching to a greener energy infrastructure are high, this could reduce uptake, even if energy costs would be lower in the long run;
- Constraints to technology transfer, as a result of barriers to foreign direct investment, limited capacity to adopt and learn from new technologies, intellectual property rights, or behavioural inertia;
- Constraints to innovation arising from uncertainty about the future carbon price/return on investment, potential to free ride on the back of other country's innovation and the possibility that public investment in research and development activities could 'crowd out' private investments, i.e. entrepreneurs could be discouraged from innovating if they have the perception that they could 'free ride' by exploiting technological knowledge generated by public authorities, or if they think they will not be allowed to keep the rents associated with green innovation;
- Informational constraints relating to technology availability and associated benefits and costs, including uncertainty about future energy prices;
- Financial constraints associated with lack of access to capital, and asymmetric information problems in the credit market;
- Political constraints e.g. political instability and political economy problems associated with removing subsidies to fossil fuels;
- Institutional constraints relating to the slow development of markets (including issues such as the difficulties associated with measuring, reporting and verification), and potential transactions costs associated with trading mechanisms such as the CDM and Joint Implementation;
- Knowledge constraints, e.g. there are some significant gaps in understanding about the impact of certain reforms on emissions (such as the role of land use in carbon sequestration, and the impact of different types of agricultural production practices).

A key determinant of the impact of mitigation on developing countries, and their ability to achieve sustained, low carbon growth, depends on the policies they adopt in order to mitigate and adapt to climate change, to develop the necessary institutional arrangements to manage reform and to position themselves strategically in order to benefit from international mitigation responses.

Appropriate policies can help to position countries to take advantage of new economic opportunities that may arise which will help to increase their growth rate, such as new sources of finance for mitigation or adaptation, or new export opportunities in environmental goods and services. Appropriate policies can also help to protect countries from *threats* to their growth arising from climate change or its mitigation, e.g. the loss in agricultural productivity arising from changing weather patterns, or the reduction in demand for the exports of dirty industries.

3.2 How does low carbon growth challenge conventional growth policies?

In this section we consider each of the growth pillars in turn, assessing what adjustments are required in order to ensure that they will facilitate low carbon growth, and then describing the range of policy options discussed in the policy documents reviewed. At the end of each section, we list possible policy lessons that can be drawn for both developing countries, and for donors and international policymakers.

3.2.1 Finance for mitigation and adaptation

Investment underpins growth, but requires access to finance, which is something many developing countries lack. Adaptation and mitigation will clearly require huge amounts of investment (e.g. in flood-resistant walls, or in the conversion of fossil fuel energy production into green energy

sources, etc). The Human Development Report 2007/08 estimates adaptation funding needs for the developing world to be \$86 billion per year by 2015 (UNDP, 2007).³⁹ The HDR also presents an estimate for the investments in low carbon technology needed to transition to a sustainable emissions pathway at an additional \$25-50 billion per annum in developing countries.⁴⁰

Developing countries will clearly need external sources of finance for adaptation and mitigation, whether it is through public funds or through private capital which can be incentivised to move to developing countries through mechanisms such as carbon markets. There is currently a debate about how much of the required finance will actually be attainable through private markets. The achievement of an international agreement which establishes a clear international price for carbon will help to create greater certainty about the value of green investments, and hence should help to unlock greater private finance for mitigation.

The negotiations have generally emphasised that private finance is expected to kick-start low carbon investments and public finance will close the gap. But this is a large assumption and may be relevant mostly for HICs and MICs. MICs have been more successful in attracting private finance (e.g. through the CDM), in part because they are larger emitters with more 'low hanging' mitigation options; LICs have struggled to attract private finance at the best of times, given their often poor investment climates. With the lack of international public funding commitments and low domestic budgets, LICs cannot rely exclusively on public monies to fund their adaptation and mitigation actions. They will also need to strengthen their national investment climates (e.g. by investing in infrastructure to tackle the high costs of doing business, undertaking regulatory reform and reducing policy and regulatory uncertainty) to attract greater levels of private finance for green investments, including through the CDM. Without such reforms, it remains unclear how much private finance will in fact be forthcoming in LICs.

Some countries with major carbon assets (such as forests) could expect increased sources of private finance arising from carbon markets in the longer term, but others will not, and will have to rely more heavily on sources of public funding, which may or may not turn out to be additional to conventional development aid. Some of the countries reviewed say that they will be unable to implement the low carbon growth strategies they are developing without additional resources from the developed world. If countries are perceived to be particularly vulnerable to climate change, they may even face reduced access to private capital, as their growth prospects are expected to deteriorate. If public funding is used to plug gaps in finance left by private markets, this could suggest that a reallocation of funding is needed, towards developing countries with fewer carbon assets. Currently, mitigation projects qualifying under the CDM are quite narrowly defined, and thus most of the financial benefits it generates are going to a small number of countries, i.e. China and India. In order to facilitate a much wider impact, the carbon market will need to be reformed and widened in scope quite considerably, e.g. to cover forestry/reduced deforestation, for example. There are a range of proposals on the table for discussion about how carbon market flows can be scaled up going forward to provide a much wider set of countries with increased finance for mitigation. Proposals to expand and scale up the carbon market include:

1. **Reforms** to the rules governing what activities can be carried out under the CDM (for example expanding the scope to cover a broader range of project types, such as agriculture, forestry, nuclear power, etc) and the methodologies that are used (for example simplified methodologies to increase access by LICs and expanded programmatic CDM);
2. **Sectoral mechanisms**, in which emissions reductions from whole sectors (as opposed to individual projects) can generate carbon credits. Other sector-based approaches include

³⁹ \$44 billion for climate-resilient investments, \$40 billion for poverty reduction and \$2 billion for disaster relief. This would be in addition to official development assistance.

⁴⁰ A new reviewed study published by the International Institute for Environment and Development and the Grantham Institute for Climate Change at Imperial College London suggested that real costs of adaptation are likely to be two to three times greater than estimates made by the UNFCCC, which were put at \$40-170 billion annually.

'no lose targets' for developing countries, and mechanisms to focus on technology transfer and avoided deforestation (REDD).

Proposed NAMAs would expand the scope and scale of participation by developing countries further. Countries would implement a suite of policies and measures covering multiple sectors and using multiple instruments to achieve reductions. Certain activities under NAMAs could be supported with instruments such as the CDM applied either to projects or sectors. NAMA activities could also potentially qualify for emissions credits issued directly by the Conference of the Parties (COP). NAMAs would offer the most potential for expanded access and participation, since a variety of mechanisms would be included, but sectoral crediting and expanded programmatic approaches to the CDM would also provide greater opportunities for LICs.

The low carbon growth strategies reviewed in this paper show that finance is fundamental to implementation and is linked to all proposals made under countries' low carbon development plans, yet it remains scarce, particularly for LICs. In policy documents, countries have specified financing to come through dedicated climate change funds, government earmarks, the CDM and requests for international support. Some of the countries studied have implemented a climate change fund, including Bangladesh, Germany, Guyana, Mexico and the UK.

Bangladesh is trying to position itself well for receiving international support by establishing a Multi-donor Trust Fund, and Brazil has its Amazon Fund for deforestation funding. Bangladesh and Ethiopia have expressly stated that they hope to expand CDM opportunities but other LICs do not target CDM specifically in their policy documents. Guyana has been the most aggressive of LICs in terms of pursuing financing options, working with McKinsey & Co and other international institutions to develop support for its plan to finance low carbon growth through REDD payments.

Significant questions remain over how and to what extent funding will be provided for the mitigation and adaptation agendas in developing countries. NAMAs have yet to be developed but will need to be funded along with adaptation plans (e.g. NAPAs) that some LICs have already prepared. For example, Bangladesh, Ethiopia, Rwanda and Malawi have stated they cannot move forward with their NAPAs without international funding, but it remains to be seen what level of developed country support for both mitigation and adaptation is agreed in Copenhagen. For example, the EU Commission in its Global Finance Blueprint for Ambitious Action by Developing Nations has proposed contributing some €2-15 billion⁴¹ a year by 2020 to mitigation and adaptation in developing countries, contingent on reaching a robust agreement in Copenhagen, but other nations, including the US, have not yet committed funds.

There is also a question as to what extent existing aid budgets will or should be diverted towards adaptation and mitigation activities. This could result in significant reallocations of aid spending across countries and sectors which, particularly in a climate of reduced public expenditure generally (coming out of the financial crisis), could have significant implications – positive or negative – for many highly aid-dependent developing countries.

Adaptation and mitigation activities planned in low carbon strategies are directly dependent on available finance, but LICs like Ethiopia, Malawi, Nigeria and Rwanda have no specified funding source if CDM financing or international adaptation funding does not materialise. Similarly, Bangladesh and Guyana are in danger of falling short of funding if the Multi-donor Trust Fund and the Low Carbon Finance Authority, respectively, fail to attract sufficient international donors. Industrialised countries, including the UK and Germany, tend to have more mitigation financing available, but even these countries face budget constraints for energy investments, even more so in the wake of the global financial crisis.

41 The EU Commission estimates that €100 billion will be needed annually to fund adaptation and mitigation activities in developing countries http://ec.europa.eu/ireland/press_office/news_of_the_day/climate-change-developing-countries_en.htm.

All of this suggests the following possible policy lessons:

- For the international policy community, the achievement of an international agreement on emissions reductions is a priority to help unlock private finance for mitigation.
- Countries can be strategic in how they position themselves to attract finance for mitigation and adaptation. For example, the development of a 'Climate Change Fund'/multi-donor trust fund, and an appropriate policy framework e.g. a NAPA, NAMA, and/or a low carbon growth strategy, can help to convince donors that climate change is taken seriously in that country, and that any funding will be spent transparently and effectively.
- Developing countries need to continue to lobby for financial support for mitigation and adaptation, and for reform that will help them benefit more from carbon markets, including the Clean Development Mechanism (CDM).
- For countries with carbon assets, strategic positioning, policy development, and lobbying for financial support for mitigation and adaptation, may help to both influence the international agenda, and the development of international mitigation mechanisms, such as Reduced Emissions from Deforestation and Forest Degradation (REDD) and CDM, in their favour, both in terms of scope and scale.
- Widening the scope of carbon markets to enable more LICs to benefit, and improving the investment climate in developing countries may also help them to maximise financial inflows of private finance for mitigation.
- Not all developing countries will be able to obtain private finance for mitigation and adaptation. Increasing the availability of public finance will also be important in supporting developing countries' low carbon growth efforts.

3.2.2 Human capital

The development of human capital, through investment in education, training and health services for example, is an important underpinning of growth. Educating the population about the impact of climate change, and giving them the skills and knowledge to adapt to it, to understand the changing global policy environment and hence the potential impact on their livelihoods and to capitalise on any new opportunities will help to improve countries' growth prospects. A number of the countries reviewed here have proposed or implemented policies to raise awareness on these issues.

The development of skills to design and implement new, green technologies will also be crucial to facilitating low carbon growth internationally. It is likely that a relatively high proportion of technological innovation will take place in HICs, where education levels and investment in research and development are higher.

Measures to protect the health and wellbeing of the population in light of future threats from climate change, such as natural disasters and disease, will also be important in order to preserve human capital.

The reviewed policies show that most countries recognise the importance of awareness building, education and training in order to underpin and provide public support for both mitigation and adaptation. Bangladesh, China and Nigeria focus broadly on awareness building; Brazil, Ethiopia, Germany, Guyana and Mexico focus on integrating climate change into the education system; Mexico and Ethiopia specify incorporating education at all levels. Bangladesh hopes to establish a knowledge centre to conduct training, awareness raising and education on climate change, and is the only country specifically to target women in this effort. However, few countries specifically acknowledge the link between awareness raising, education and behavioural change in their policy documents; rather, it seems to be implied that they expect to build public support for action and encourage behavioural change. No countries, except the UK and Guyana, even mention behavioural changes or discuss how they plan to go about encouraging these changes.

Bangladesh, Brazil and Ethiopia focus on addressing health concerns arising from climate change through surveillance, research and water and sanitation programmes. Both MICs and LICs included programmes to study the causes and impacts of climate change further.

Germany's strategy document calls for new growth and job opportunities within the green services and technology sectors but makes no mention of how training and skills can be improved. The UK does propose to develop a Skill Funding Agency to provide training in anticipation of high demand for low carbon technologies, and targets behavioural change. Guyana is the only LIC specifically to pledge to make significant investments in job development and training in a new economy.

Apart from Guyana's ambitious LCDS, developing human capital is approached in a piecemeal fashion, with no country proposing a full suite of measures to address education, training, job creation and health across the board. Developing and developed countries alike provide few details on how new education curricula and awareness campaigns will be implemented or how widespread these measure will be.

Possible policy lessons:

- Broad awareness raising may help increase public understanding of climate change and its effects, and the implications for people's livelihoods and welfare going forward. This can be implemented formally, for example through schools, or informally, through public awareness campaigns.
- Training in skills relating to green technologies and industries can help position countries to take advantage of any new low carbon growth opportunities and markets.
- Targeted investments in health, water and sanitation may help increase climate resilience by protecting human capital from the potential negative health impacts of climate change.

3.2.3 Technological progress in energy, infrastructure and transportation

Technological progress is a key driver of economic growth, and energy, infrastructure and transportation all play an important role in underpinning economic growth.

Energy demands are growing fast in the developing world, as a result of rising populations and economic growth. Growth policy has traditionally focused on increasing access to energy at the lowest possible price, but this may now need to change in light of the need for mitigation. Cleaner, greener sources of energy are currently more expensive than fossil fuel-based energy sources, so utilising these new technologies will impose a cost on developing countries, at least in the short term. Developing countries may argue they should not bear this cost themselves, and there may well be considerable private finance available to help fund this switch in developing countries, as a result of offsetting through the CDM and other mechanisms going forward.

Given that many developing countries still have relatively low access to electricity, and that the development of new power plants is happening much faster than in developed countries, this represents a significant opportunity to ensure that the high carbon development trajectories of developed countries are not replicated in developing countries going forward, e.g. by prioritising donor funds on investment in green energy sources in the developing world. This will require more joined-up donor engagement than currently exists, as there are still significant investments being made in fossil fuel-based energy generation projects in many developing countries.

This may have significant co-benefits for developing countries, for example if green micro-generation technologies facilitate improved access to energy in rural areas that are not connected to the national electricity grid, for example. It can also help to contribute to energy security in the longer term, and reduced costs for net oil importers.

Developing countries are also calling for greater efforts to be made to facilitate technological diffusion, given that much technological innovation takes place in the developed world. However, increasing technological diffusion may not always be in the interests of private companies, who wish to protect their innovations in order to profit from their efforts. Some developing countries have argued that intellectual property provisions in the WTO should be re-examined in light of these kinds of considerations. Greater efforts to promote international cooperation on research and development may help to promote technological diffusion.

Strategic thinking and strong policy management of patterns of urbanisation may also be required, to increase climate resilience and prevent high carbon development trajectories, e.g. by preventing the growth of new towns and cities in areas vulnerable to climate change, such as coastal areas, and preventing urban development patterns which are heavily reliant on individual transportation rather than public transport.

From the policy documents reviewed in this paper, it is clear that provisions related to energy, infrastructure and transportation form the backbone of many countries' climate change plans, largely because energy and transportation are the largest sources of emissions for most countries, and infrastructure development is critical both for setting a low carbon growth trajectory and for building climate resilience. Government can play an important role in clarifying the future direction of policy and the key decisions that will be made on energy production and infrastructure development, to give business the confidence it needs to undertake low carbon investments. Energy security is a primary objective for all countries but low carbon energy is not the only factor in achieving energy security, as all countries are simultaneously developing domestic oil, gas and coal reserves.

In the energy sector, aspirations for lower carbon and renewable sources of energy are largely tied to income levels. Lower-income countries focus on off-grid PV, solar heating, modest amounts of wind power, wind pumping, micro-hydro, various types of bioenergy⁴² and 'clean coal' technology transfer. The lowest-income countries – Ethiopia, Malawi and Rwanda – also focus on expanding usage of efficient cook stoves. Nigeria is exploring options for nuclear as well, for energy security reasons, but would need significant international support and technology transfer. In general, LICs are more vocal in their plans to harness co-benefits through increased access to clean, smoke-free forms of energy and off-grid applications that avoid costly transmission lines. The co-benefit of job creation is not a primary focus.

MICs and HICs have included large-scale hydro and wind, grid and off-grid PV, cogeneration, CCS and nuclear in their plans. China, the UK, Nigeria and Bangladesh have included research and feasibility studies for tidal and/or wave energy. For Nigeria and Bangladesh, again, these energy sources would only be possible to develop with international assistance. Germany, the UK, Mexico and China have included programmes to promote energy-efficient appliances as well. The UK and Germany are the only countries specifically to target low carbon energy technologies as a source of employment growth, although Guyana alludes to this as well.

Countries where coal is the primary source of energy – chiefly, Bangladesh, China, India and South Africa – are pursuing cleaner fossil fuels, including advanced coal plants, CCS, coal mine methane capture, fuel switching and development of gas fields. Others, like Ethiopia, Malawi and Rwanda, are promoting charcoal in cooking and power generation. Most countries intend to pursue a portfolio of low carbon technologies, although Guyana noticeably focuses only on tapping its hydro resources. Energy efficiency is factored into plans of all income groups to some degree.

Infrastructure improvements aimed at lowering emissions take a variety of forms. A number of HICs and MICs aim to strengthen building codes, and Germany is advancing its smart grid. Mexico and Brazil hope to build more efficient power plants and reduce technical losses. Guyana plans to

⁴² Bioenergy includes biomass gasification, cogeneration and digesters.

capitalise on new growth opportunities in BPO by installing more than \$10 million worth of fibre optic cables. Brazil aims to expand ethanol service stations. Specific infrastructure plans for adaptation tend to be in coastal countries, including Bangladesh, Guyana and the UK, which plan to build flood and seawall defences and boost disaster preparedness.

Transportation measures focus on mitigation from biofuels, promoting public transport and encouraging smaller and/or more efficient vehicles, although only the UK and Germany propose to work on all of these areas. China, Brazil, Ethiopia and potentially Guyana plan to expand biofuels for transport. Brazil clearly has an advantage in bioethanol production efficiency and it is willing to export its technology to other Southern countries to enhance opportunities for global trade. Lower-income countries tend to focus only on encouraging public transport, although Ethiopia wants to impose a tax on large vehicles. China has programmes for both public transport and efficient vehicles. Despite the fact that some countries are already using other cleaner-burning transport fuels such as CNG in cities, policy documents reviewed for this study do not mention fuels other than biofuels as an option.

Possible policy lessons:

- Infrastructure improvements and the development of clean energy options should be made as soon as possible to reduce emissions as well as adapt to potential impacts. This will avoid locking in high-carbon technologies and processes as demand for energy rises. The development of decentralised grids may offer co-benefits between greener energy production, and increased access to energy.
- Strategic thinking and strong policy management of patterns of urbanisation may be required to increase climate resilience and facilitate low carbon growth.
- Government can play an important role in clarifying the future direction of policy and the key decisions that will be made on energy production and infrastructure development, to give business the confidence it needs to undertake low carbon investments.
- It is critical for low-income countries to receive international support and technology transfer to facilitate their transition to a low carbon economy. Greater efforts to promote international cooperation on research and development may help to promote technological diffusion. A re-examination of intellectual property provisions in the World Trade Organization (WTO) may also be needed.
- Countries should identify renewable resources that provide the greatest advantage in view of local conditions, resources, and state of development.
- The future development, demonstration and transfer of technology for carbon capture and storage will be very important for countries that continue to develop their large coal reserves.
- Governments in all countries can benefit from working with the private sector and civil society to scale up renewable technologies, from improved cook-stoves to large-scale wind and solar to hydropower.
- Transport is best approached holistically and should include public transport, clean, sustainable fuels, and efficient vehicles.
- Biofuels offer a potentially important new export opportunity for some developing countries, although major developed countries still impose protection on biofuel imports.

3.2.4 Investment in agriculture and forestry

Growth in LICs is often heavily agriculture based initially, and such growth can be strongly pro-poor. The donor community has put considerable effort into promoting increased agricultural productivity in developing countries. However, this has sometimes resulted in increased intensification of production and reliance on fertilisers etc, which is now seen as less desirable, given the higher carbon emissions associated with such production. Thus, agricultural development projects may need to be re-examined in light of new priorities for low carbon growth. It may be that more extensive methods of agricultural production that are utilised by small farmers

in the developed world may become a source of comparative advantage, given increasing global demand for low carbon and organic agricultural produce.

At the same time, climate change is expected to reduce agricultural productivity and may also affect patterns of comparative advantage across countries. Shifting patterns of demand will also affect agricultural growth strategies; for example, biofuels represent one possible growth area for some countries. The demand for some exports may decline, such as for air-freighted fresh fruit and vegetables.

Forestry has been a major source of income for some developing countries, and given the great importance of forests as a carbon sink, the potential value of avoided deforestation and reforestation could be a significant source of finance for those countries through mechanisms such as the CDM and REDD, although considerable progress still needs to be made in developing these mechanisms. The extent to which these potential flows of funds actually result in alternative livelihoods and sources of growth being successfully developed will depend crucially on how those funds are spent. For some such countries, alternative livelihood options and sources of growth are not easy to identify.

The limited participation of sub-Saharan Africa in the first commitment period of the CDM is to some extent to be expected: large developing country emitters, such as China, have benefited the most from the CDM to date because they emit more and therefore have emissions ready to be offset.⁴³ But the recognition of avoided emissions in both the forestry *and* the agriculture sector may, in the future, increase the level of participation towards primarily agricultural societies.⁴⁴ Should some of the issues of monitoring and verifying the increased storage and permanence of carbon sequestration be resolved, investing in the agriculture sector in non-Annex 1 countries and offsetting emissions produced elsewhere could become increasingly attractive.

There is an ongoing debate about whether REDD payments should be fund based or provided through carbon markets. Brazil and some LICs are firmly on the side of a fund or grant-based mechanism because it feels foreign investments in its forest resources compromise national sovereignty. Many others feel that the only way to attract and sustain the level of funding required to conserve the world's forests is through the carbon market. It is not clear which form REDD will take in upcoming international negotiations, if an agreement is reached at all. Guyana has taken a proactive approach to establishing an interim fund for international support while it improves governance and transparency mechanisms to support a monitored and verified source of emissions reduction credits from forests.

All countries reviewed specified policy measures to improve practices and reduce emissions from forestry and agriculture. These activities figure more prominently in countries with a large dependence on agriculture, such as Ethiopia and Malawi, or countries with large forest reserves, like Brazil and Guyana. Measures for agriculture are seen as a way to increase productive efficiency while protecting against climate change impacts. For countries with forest reserves, standing forests present a potential source of finance.

Countries with heavy dependence on agriculture, including Bangladesh, Brazil, China, Ethiopia, Mexico and Rwanda, are targeting a variety of agriculture activities: from improved soil management and improved agronomic practices through management of fertilisers and nitrogen runoff, to use of climate-resistant crop varieties and improved irrigation and water management for adaptation. Water management, irrigation and reservoirs are seen as especially key by Ethiopia,

43 As of August 2008, over half of all registered projects were based in either India (30%) or China (22%), with only 2% located in sub-Saharan Africa (ODI, 2008). This bias towards MICs has also been highlighted in the recently published World Development Report 2010 (World Bank, 2009).

44 A recent policy brief produced by the Food and Agricultural Organization (FAO, 2009) also makes this point: it states that inclusion of agriculture in developing country NAMAs may also help to balance the exclusion of most forms of agricultural mitigation from the CDM of the Kyoto Protocol.

but these are not explicitly targeted in the policy documents of other African states, including Malawi, Rwanda and South Africa, which may potentially face severe water shortages. These practices require programmes to educate farmers and that the right kind of support and incentives are provided to maintain implementation. Use of climate-resistant crop varieties may be more successful with dedicated research and development programmes, such as that proposed by Bangladesh.

Nigeria and Brazil are the only countries to specifically promote organic fertilisers, although Nigeria is interested in it partially as a cost-saving measure. Brazil and Ethiopia, both large livestock producers, target improved management of grazing lands, and China, Brazil and Ethiopia include measures to reduce methane emissions from livestock. Rwanda proposes agricultural intensification as a measure to reduce emissions. The UK is exploring options for a CAT system for agriculture; Ethiopia is the only country to mention a drought/crop insurance programme.

Nearly all developing countries – Bangladesh, China, India, Brazil, Ethiopia, Mexico, Nigeria and Rwanda – have specified plans for reforestation. Countries with significant forest stocks, such as Brazil, Guyana and Mexico, are also actively involved in developing and promoting a REDD system of payments, although Brazil favours a fund-based approach while Mexico and Guyana prefer a crediting mechanism in the long run and are part of the World Bank's REDD readiness programme. For Guyana, other parts of its plan to transition to a low carbon economy rest on whether it obtains financing through REDD. However, other countries with forest reserves, including India, China and Rwanda, are not so actively pursuing REDD finance. Brazil, Ethiopia, and Guyana also state that sustainable forest management will be promoted; Guyana in particular sees sustainably sourced forest products as a major new industry. Other than a common emphasis on reforestation for all developing countries, Guyana and Brazil come closest to a comprehensive forestry approach in terms of promoting reforestation, conservation, sustainable forest management and efforts to combat illegal logging through certification. Incentives for sustainable forest management and forest conservation are crucial to these efforts, as are government programmes in reforestation.

Possible policy lessons:

- Greater understanding and awareness of the impact of climate change on agricultural productivity, and shifts in demand for agricultural produce will help developing countries to improve climate resilience and take advantage of possible new growth opportunities. Education of farmers will be an important component in this.
- Comprehensive approaches that include improved agronomic practices; climate-resistant crop varieties; water, soil and fertiliser management, and better livestock management are needed.
- Adaptation efforts in agriculture may be most important in poor countries that rely disproportionately on agriculture and are likely to be most affected by climate change.
- Forestry payments present a significant potential financing opportunity for some countries, if international mechanisms such as REDD can be successfully developed.
- Countries that develop a rigorous, comprehensive, transparent and inclusive process around sustainable forest management may be more likely to secure international investments and future CDM benefits and turn them into successful alternative growth strategies and conservation of forests.
- Agriculture offers considerable potential sequestration benefits though there are significant barriers to attracting carbon finance for this sector.

3.2.5 Trade and private investment opportunities

Integration into global markets has been seen as a necessary prerequisite for growth, and will continue to be key if countries are to benefit from new private flows of finance through mechanisms such as the CDM, and new export opportunities, e.g. of environmental goods and services. Trade

and foreign direct investment will also be key in facilitating the diffusion of new, clean technologies. However, international mitigation policy is likely to result in shifts in comparative advantage, and new export opportunities and risks, to which the developing world will need to adapt. For example, emissions caps could create incentives for relatively 'dirty' industries to move to countries without emissions caps. This represents an opportunity for increased foreign direct investment into developing countries, albeit of a rather environmentally unfriendly kind. However, border tax adjustments are being considered in part by some developed countries to prevent this carbon leakage, which could have consequences for access to other export markets that were previously open to developing countries.⁴⁵

The introduction of carbon taxes, carbon labelling and associated regulation or changes in consumer behaviour could also shift comparative advantage, and could damage prospects for the growth of markets such as air-freighted fruit and vegetables, or tourism. If fuel taxes are introduced which significantly push up the costs of freight, it is also possible that more goods will be sourced locally, to reduce transportation costs. In these sorts of scenarios, export-based growth strategies may need to be reconsidered.

The increased cost of energy, which is likely in a carbon-constrained world, may incentivise more local production and consumption of goods. This may mean that it is more carbon efficient to process some raw materials close to their site of production. However, in other cases, it may mean that some export-orientated growth strategies need to be reconsidered. The country strategies reviewed generally have very tailored perspectives on where opportunities lie in the future with respect to climate change. Countries with the most proactive plans to harness new opportunities, all of which are seen to generate job growth and provide competitive advantage, include:

- Brazil – trade in ethanol fuel and technology and flex-fuel vehicles;
- China – production and export of PV technology;
- Guyana – new industries in aquaculture, forest products, BPO, ecotourism, ethanol and export of fruits/vegetables;
- Mexico – ecotourism;
- UK and Germany – new high-tech energy industries and green services sector with opportunities in export and expertise.

LICs, particularly Bangladesh, Ethiopia and Nigeria, are hoping for new investment opportunities through the CDM. Rwanda is also interested in developing regional cooperation on clean electricity generation. Generally, there is much less vision for 'new growth' industries and opportunities in these countries, as they are severely constrained by lack of financing and capacity. Collaboration between the private sector, NGOs and the government is important to be able to identify and act on new opportunities, but this is generally weak in LICs.

Possible policy lessons:

- Countries that identify, target and secure new green investment and growth opportunities stand to benefit more from the transition to a low carbon economy.
- There is a role for government leadership to identify low carbon growth sectors which may provide competitive advantage and employment growth.
- The development of new opportunities must be backed by sufficient support and funding from government and the international community. This includes the creation of an appropriate policy environment; provision of the necessary training/education; investment promotion and awareness raising; and collaborative partnerships between the public, private and NGO sectors.

⁴⁵ The EU, for instance, is considering the use of border tax adjustments as a way to prevent European businesses from relocating to countries that do not have a carbon tax or other mitigation policies in place.

3.2.6 Incentives and regulation for low carbon growth

The achievement of low carbon growth is likely to require increased regulation and taxation, which will inevitably increase the cost of doing business to some extent. Where regulatory action is not coordinated internationally, there is also a risk of a race to the bottom, where countries compete for investment by minimising the regulatory burden they impose. Evidence from reviewing the impact of other regulatory policies suggests that this outcome is unlikely, however, given that such regulatory costs are fairly small compared with other factors affecting market entry. However, it is possible that the implementation of regulation and taxes or subsidies to achieve low carbon growth objectives could affect trade and investment flows at the margin, vis-à-vis a country's neighbours, or other similar nations.

LICs have relatively limited regulatory capacity, so a new set of low carbon growth policies and regulations may well create considerable challenges for developing countries to implement effectively, particularly in this new, relatively untried area. Thus, donor support for policymaking and regulation could help. These countries similarly lack capacity to participate in climate change negotiations at the international level. Here, again, donor and NGO assistance can be useful to facilitate developing countries' ability to participate in and shape an international climate agreement. There are efforts already underway, for example, in the area of REDD negotiations, with a number of civil society initiatives helping to provide a voice for developing country parties in REDD negotiations, particularly in the area of indigenous peoples' rights, such as the Coalition for Rainforest Nations. Strong capacity-building support across mitigation and adaptation activities can help improve the likelihood that an international climate regime will not disadvantage developing countries and that countries have the ability to adapt to and mitigate climate change in an effective, equitable and transparent way.

Having a good overall investment climate and competitive market environment should enable developing countries to take advantage of any new financing, export or inward investment opportunities that arise as a result of international mitigation policies. Having dynamic, competitive markets, which respond effectively to price signals, should also help countries to adapt their production more quickly in response to the new policy environment associated with low carbon growth.

The policy documents reviewed show that the measures used to promote low carbon growth are as diverse as their objectives. The following is a collection of financial incentives and regulatory measures proposed by various countries in their reviewed policy documents:

Financial incentives:

- Low-interest loans for clean energy installations (India and Germany);
- Feed-in tariffs for renewable energy (UK and Germany);
- Subsidies (India);
- Capital subsidies, sales incentives, and reimbursement of fees for renewables projects, and automatic approval for foreign direct investments (India);
- CAT (UK, Germany, Mexico, South Korea);
- PAT system (India);
- Taxes (road tax, Germany and UK), reduced taxes for public transport (Germany), tax differentiation based on engine size to promote the use of smaller cars (Ethiopia);
- Fund to promote private sector investments into renewable energy production (India).

Regulation:

- Decreased speed limits – Germany;
- Quotas – biofuels (Brazil, Germany);
- Fuel – efficiency standards (UK, Germany, China);

- Pollution controls (China);
- Regulation to promote renewables, e.g. the Renewable Energy Law in China forces the Chinese electrical grid operators to purchase all electricity generated through renewable sources.

These incentives and regulations are clearly crucial to the successful implementation of low carbon policies, as they represent the means through which the necessary change is brought about. However, in LICs specifically, there is little discussion of the financial incentives or regulation with which their planned policies will be implemented, reflecting the early stage they are at in developing low carbon policies.

Possible policy lessons:

- Internationally coordinated action to mitigate climate change can help reduce the risk of a 'race to the bottom' in relation to the taxation and regulation needed to stimulate low carbon growth.
- Donor support for low carbon regulation and taxation could help build developing countries' capacity to implement such policies effectively.
- An ongoing review of the efficacy and cost-effectiveness of measures by different countries to incentivise the necessary changes in behaviour and stimulate low carbon growth, could help improve policy-making in this area.
- Many of the barriers to low carbon growth, mitigation financing and technological transfer in developing countries are the same as the barriers to growth and investment generally i.e. a poor investment climate and uncompetitive markets. Policies to tackle these remain important.

3.2.7 Macroeconomic stability

Good macro policy which is able to avoid instability and mitigate the impact of adverse shocks promotes economic growth. Although macroeconomic stability has not been an issue highlighted in the low carbon growth policies reviewed, there are justifiable concerns as to the potential impact of significant flows of new financial resources into countries with sizeable carbon assets. Countries with significant carbon assets may experience Dutch Disease if they are unable to absorb and effectively use significantly increased flows of funds for mitigation.⁴⁶

The negative effects of Dutch Disease can be avoided through judicious economic management that focuses on diversifying the economy, investing in human and physical capital and a certain amount of capital 'sterilisation' through the use of funds. Unfortunately, many emerging economies experiencing major windfall gains from the discovery and subsequent export of 'new' resources have economic management systems that are too weak to mitigate the negative effects of Dutch Disease. In such cases, the discovery of such 'new' resources becomes more of a curse than a blessing.⁴⁷

This suggests that particular attention should be paid to the development of mechanisms for accountability and transparency in the use of funds along with a sound macroeconomic and public expenditure framework for countries which are likely to benefit from these kinds of large inflows. As formalised by Levy (2007), increased public investments can help mitigate the potential negative effects of Dutch Disease on other sectors of the economy.

46 Typically, countries that start to export a 'new' resource face upwards pressure on their exchange rate. As the real exchange rate appreciates, imports become relatively cheaper, which crowds out domestically produced goods. There is a risk that the non-oil economy declines as domestic production falls, and with it employment. As a result, economic growth may slow and become unbalanced. This model is known as Dutch Disease, named after the experience of the Netherlands in 1959 and formalised by Corden and Neary (1982).

47 Weeks (2008) points out that a 'resource curse' is not necessarily cast by inexorable forces but by seriously misguided economic policies.

To the extent that climate change results in increased volatility of weather patterns, and climatic shocks on the agriculture sector (but not exclusively), it may also result in greater macroeconomic instability. This suggests that countries should be considering increasing their reserves or other kinds of fiscal buffers that may be used to smooth economic shocks, in addition to their access to other international mechanisms designed to cope with exogenous adverse shocks (such as compensatory finance mechanisms). Weather-based insurance (mentioned in policy documents from Ethiopia and Guyana) and better access to capital markets can also help countries to manage such risks more effectively.

3.2.8 Security and protection from predation

The institutional framework in a country should also provide a reasonable degree of certainty that investors will be able to reap the rewards of their investment. Political instability, corruption, crime and weak contract enforcement can all threaten potential returns and make investment unattractive. This is another area rarely addressed explicitly in the low carbon growth strategies reviewed. However, there may be concerns relating to the potential impact of large financial flows from carbon markets and public finance for mitigation and adaptation. Such large flows can generate strong incentives for rent-seeking behaviour, resulting in corruption and undermining growth prospects. This can also result in very inequitable outcomes, which can exacerbate political instability and conflict. Climate change can also contribute to conflict, as people are displaced or fight for increasingly scarce resources. This suggests that emphasis should be placed on mechanisms to maximise the accountability of governments and other bodies in relation to the management of climate change policies, and particularly in relation to the management of finance for mitigation and adaptation.

3.2.9 Policy processes and barriers

Next, we consider the policy processes that the reviewed countries have adopted in developing their low carbon development and climate change response strategies. Countries have developed their plans and proposals in different ways, but most have tried to: 1) involve a number of ministries/departments; 2) hold a consultation phase and obtain recommendations from external experts; and 3) promoted an open and transparent process.

First, most countries involved multiple ministries in both drafting and implementing proposed plans. However, coordination between those ministries remains an issue. Lack of policy coordination is a significant barrier, and several policy documents (Bangladesh, Brazil, and Guyana) recognise the need for harmonisation across policies. For example, PRSPs may lack linkages to poverty impacts from climate change (e.g. Ethiopia), or ministries might have competing priorities (e.g. Brazil). Furthermore, across the board, policy proposals tend to lack specific targets, timelines and implementation guidelines. This affects all countries, as even the UK and Germany could have implementation problems owing to lack of policy guidance. Guyana plans to work out implementation guidelines through a consultation phase but others, particularly Ethiopia and Bangladesh, have no clear road to implementation.

Second, many countries seem to have conducted consultation phases between the public sector and civil society. Bangladesh, for example, included a very broad range of people in its consultations for both its NAPA and its BCCSAP. Brazil involved a variety of CSOs in the development of its NCCP, although there were criticisms that their inputs were ignored. There seemed to be a lower level of involvement by civil society in China. For countries participating in REDD, consultations are a required component of draft readiness plans, but there has been controversy over whom to include and how. Guyana has been praised for developing a robust consultation process which, while not perfect, provides a good framework for other countries to follow.

If the private sector was involved in the process, it was generally by way of contracting external experts, but it is not evident that the private sector was included in most developing country proposals.

One key exception is Guyana, which seems to have benefited by working closely with DFID, the management consultancy McKinsey & Co and other donors, private sector partners and experts to develop its comprehensive proposal. Nigeria used TWGs in its Vision 2020 to recommend specific target technologies and strategies.

Third, countries with consultation processes generally have the most transparent process overall, including Bangladesh, Brazil and Guyana. These countries also specify that implementation guidelines will be worked out in ongoing consultations. Guyana, for example, specifically aims to develop transparent forest governance and to ensure that avoided deforestation credits are globally verified and other land use governance standards are transparent and accountable.

By and large, a considerable shortcoming in most of the policy documents is that they do not spell out specific actions that will be taken or specific implementation plans. Countries such as Guyana have specified the actions they will take in a certain timeframe, but other plans, such as those for Brazil or Ethiopia, offer few details on how they intend to carry out their plans. A few countries suggest that they will work out guidelines in future consultations, and others delegate certain ministries to be in charge of future implementation. Most of the policy documents are more statements of intent than plans of action.

Overall, capacity in LICs presents the most significant barrier to implementation, including lack of training and expertise in climate change issues and weak enforcement and oversight. Therefore, a key prerequisite for developing countries to successfully implement their plans is to build training and awareness, enhance coordination between ministries and provide adequate finance to enable enforcement.

In MICs, the biggest issue seems to be a lack of coordination between implementing bodies, unaligned policies and weak enforcement at the local level. Brazil and Guyana recognise that they need to conduct an assessment of policies and promote alignment, but other countries do not mention policy alignment in their policy documents. HICs also suffer from implementation issues, largely because of a lack of policy guidance.

Possible policy lessons from reviewed countries:

- Policy statements should go beyond 'statements of intent' to provide a roadmap for specific measures and an implementation plan.
- Policy is strengthened by underpinning studies.
- Consultations help to obtain ideas and include various stakeholder viewpoints; promote coordination and collaboration, and enhance transparency and trust in the process.
- The inclusion of civil society helps build support for policies and thus aids in implementation. Consulting and partnering with the private sector can help increase the feasibility and market-friendliness of policies that are proposed. This can facilitate greater private sector engagement in achieving low carbon growth and improve the sustainability and scale-up of green investments.
- Training and education can help with coordinating different government departments and policies.
- Providing strong policy guidance is crucial to implementation.

3.2.10 Assessing progress to date, and learning lessons

The countries we have reviewed have already taken steps to develop a climate change or low carbon development strategy, and thus are already ahead of most other countries (within their

income category, at least). However, there are still a number of issues that most countries either have not addressed, or could not resolve, in their policy documents, including:

- Specification of a (potential) funding source for climate mitigation and adaptation activities;
- An implementation roadmap with specific measures;
- Anti-corruption and pro-transparency measures governing the use of mitigation/adaptation funds;
- A framework for macro management and measures to combat Dutch Disease;
- Identification of new green growth opportunities and the policies needed to achieve them;
- A rigorous consultation process;
- The need for policy alignment and intra-governmental cooperation.

Thus, although many of these countries are ahead of the game in terms of policies to promote low carbon growth and climate resilience, it is clear that improvements could still be made.

Nonetheless, the policies they have set out, and the processes they have pursued to arrive at them, can provide valuable lessons for other countries, which are only now beginning to think about how they will respond to climate change. While it is too early to judge the efficacy of many of the policies that have been set out (and indeed many of them are still only being planned at this stage), ongoing monitoring of the efficacy of these policies will be important in ensuring that lessons are learned globally, thus speeding up the effective response to this most pressing of problems.

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