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Climate change mitigation in emerging economies: From potentials to actions

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Climate change mitigation in emerging economies: From potentials to actions

by

Hanna Fekete[1)], Florian Mersmann[2)], Marion Vieweg[3)]

With contributions from:

Niklas Höhne[1)], Lina Li[1)], Nadine Braun[1)], Carmen Dienst[2)], Katharina Przybill[3)], Timon Wehnert[2)], Marcia Rocha[3)]

[1] Ecofys Germany GmbH, Köln
[2] Wuppertal Institute for Climate, Environment, Energy GmbH, Wuppertal
[3] Climate Analytics GmbH, Berlin

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Study performed by: Ecofys Germany GmbH, on Wassermann 65, 50829 Köln, Germany
Wuppertal Institute for Climate, Environment, Energy GmbH,
Döppersberg 19, 42103 Wuppertal, Germany
Climate Analytics GmbH, Friedrichstr 231 - Haus B, 10969 Berlin, Germany

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Publisher: Federal Environment Agency (Umweltbundesamt)
Wörlitzer Platz 1
06844 Dessau-Roßlau
Germany
Phone: +49-340-2103-0
Fax: +49-340-2103 2285
Email: info@umweltbundesamt.de
Internet: http://www.umweltbundesamt.de
http://fuer-mensch-und-umwelt.de/

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Abstract

Greenhouse gas emissions need to decrease substantially to hold global average temperature increase below 2°C warming above the preindustrial level. This requires emission reductions by all major emitting countries with developed countries taking the lead, but emerging economies are of increasing importance in this global effort.

This report provides an overview of current activities regarding climate change mitigation in six emerging economies: Brazil, China, India, Mexico, South Africa and South Korea. We cover the institutional set up, measurement, reporting and verification systems for greenhouse gases and mitigation policies and measures. The analysis also addresses existing barriers to mitigation and considers where the international community could provide support to remove these.

We find that all the countries analysed in the report have significantly improved their climate change institutions and MRV systems in the last years and have created mostly coherent frameworks for climate strategies and policies. Creating additional capacities on national and sub-national government levels and in the private sector as well as raising awareness among the population will be essential in the coming years to enable further improvements and enable those countries to reduce emissions further.

Kurzbeschreibung

Der Ausstoß von Treibhausgasen muss deutlich sinken, um den durchschnittlichen globalen Temperaturanstieg auf ein Maximum von 2°C über das vorindustrielle Niveau zu begrenzen. Dies verlangt Emissionsreduktionen von allen Ländern mit hohen Emissionen, angeführt von den entwickelten Ländern. Die Relevanz der Schwellenländer steigt in dieser globalen Anstrengung jedoch zunehmend.

Dieser Bericht gibt einen Überblick über derzeitige Aktivitäten zur Minderung des Klimawandels in sechs Schwellenländern: Brasilien, China, Indien, Mexiko, Südafrika und Südkorea. Wir betrachten institutionelle Strukturen im Bereich Klimawandel und untersuchen Systeme zur Messung, Berichterstattung und Verifizierung (MRV) von Treibhausgasemissionen, sowie politische Maßnahmen und andere Aktivitäten zur Vermeidung von Emissionen. Die Analyse stellt auch dar, wo noch Barrieren überwunden werden müssen und wie die internationale Gemeinschaft die Länder dabei unterstützen kann.

Die Ergebnisse zeigen, dass alle untersuchten Länder ihre institutionelle Struktur und ihre MRV Systeme in den letzten Jahren erheblich verbessert haben und meist kohärente Rahmenbedingungen für Klimastrategien und politische Maßnahmen geschaffen haben. Für weitere Verbesserung und um weitergehende Emissionsreduktionen zu erzielen, wird es in den nächsten Jahren essentiell sein, auf der nationalen und regionalen Regierungsebene und in der Privatwirtschaft zusätzliche Kapazitäten zu schaffen und in der Bevölkerung das Bewusstsein für die Thematik zu stärken.

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List of Abbreviations

ABC Plan	Low-Carbon Agriculture Plan
AC	Air Conditioning
ADB	Asian Development Bank
AFOLU	Agriculture, forestry and land use
ANIQ	Asociación Nacional de la Industria Química (National Association of Chemical Industry)
ANP	Áreas Naturales Protegidas (Protected Nature Areas)
ARPA	Amazon Region Protected Areas Program
BAU	Business as Usual
BEE	Bureau of Energy efficiency (India)
BMU	German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety
BNDES	Brazilian Development Bank
BNEF	Bloomberg New Energy Finance
BRT	Bus Rapid Transit System
CAAC	Civil Aviation Administration of China
CCC	Climate Change Council
CCS	Carbon capture and storage
CCTDA	China Coal Trade & Development Association
CDM	Clean Development Mechanism
CDSM	Chief Directorate of Surveys and Mapping (South Africa)
CEMDA	Centro Mexicano de Derecho Ambiental (Mexican Center of Environmental Right)
CESPEDES	Comisión de Estudios del Sector privado para el Desarrollo Sustentable (Commission of Private Sector Studies for Sustainable Development)
CETESB	Environmental Agency of São Paulo State
CEV	unified building code
CFE	Comisión Federal de Electricidad (Federal Electricity Commission)
CFLs	Compact fluorescent lamp
CGMC	General Coordination on Global Climate Change
CICC	Comisión Intersecretarial de Cambio Climático (Inter-ministerial Commission on Climate Change)
CIDES	Inter-ministerial Commission on Sustainable Development
CIM	Inter-ministerial Committee on Climate Change
CIMGC	Inter-ministerial Commission on Global Climate Change
CMA	China Meteorological Administration
CO_2	Carbon dioxide
Conabio	Comisión Nacional para el Conocimiento y Uso de la Biodiversidad (National Commission for the Knowledge and Use of Biodiversity)
CONAFOR	Comisión Nacional Forestal (National Forestry Commission)
Conagua	Comisión Nacional del Agua (National Water Commission)
CONAVI	Comisión Nacional de Vivienda
Conpet	National programme on the Rationalisation of the Use of Oil and Natural Gas Products
CONUEE	Comisión Nacional para el Uso Eficiente de la Energía (National Commission on the Efficient Use of Energy)
CRF	Common Reporting Format
DAFF	Department of Agriculture and Fisheries (South Africa)
DEA	Department of Environmental Affairs (South Africa)
DLA	Department of Land Affairs (South Africa)

DNA	Designated National Authority
DoE	Department of Energy (South Africa)
DTI	Department of Trade and Industry (South Africa)
DUIS	Desarrollo Urbano Integral Sustentable (Sustainable Urban Development Initiative)
DWAF	Department of Water Affairs and Forestry (South Africa)
EE	Energy efficiency
EE/DSM	Energy Efficiency and Demand Side Management of Energy
EMBARQ	WRI Center for Sustainable Transport
EMBRAPA	Brazilian Agricultural Research Corporation
EMC	Environment Management Corporation
ENARE DD+	Estrategia Nacional para la Reducción de Emisiones por Deforestación y Degradación de los Bosques (National Strategy for Reduction of emissions from Deforestation and Degradation of the forests)
EPE	Energy Planning Agency
ERC	Energy Research Centre
EREC	European Renewable Energy Council
ERI	Energy Research Institute (China)
ETS	Emissions Trading System
FIDE	Fideicomiso para el Ahorro de la Energía Eléctrica (Trust for Electric Energy Savings)
FIT	Feed-in Tariff
FNMC	National Fund for Climate Change
FSA	Forestry South Africa (dataset)
FUNCATE	Fundação de Ciência, Aplicações e Tecnologia Espaciais (Foundation for Space Science, Technology and Applications)
FYP	Five Year Plan
GCCRS	Gauteng Climate Change Response Strategy
GDARD	Gauteng Department of Agriculture and Rural Development
GDP	Gross Domestic Product
GEF	Global Environmental Fund
GEx	Executive Group on Climate Change
GGGI	Global Green Growth Institute
GHG	Greenhouse Gas
GIR	Greenhouse Gas Inventory and Research Center of Korea
GLCC	General Law on Climate Change
GWP	Global Warming Potential
HDI	Human Development Index
HVAC	Heating, Ventilation and Air Conditioning
IBAMA	Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis (federal environmental agency)
IBRD	International Bank for Reconstruction and Development
ICCC	Inter-secretary Committee on Climate Change
ICLEI	Local Governments for Sustainability
ICMBio	Instituto Chico Mendes de Conservação da Biodiversidade (governmental body for environment conservation)
IDLO	International Development Law Organization
IEA	International Energy Agency
IGCCC	Intergovernmental Committee on Climate Change

IMAZON	Instituto do Homem e Meio Ambiente da Amazônia (non-profit institute which aims to promote sustainable development in the Amazon)
INCCA	Indian Network on Climate Change Assessment
INECC	Instituto Nacional de Ecología y Cambio Climático (National Institute of Ecology and Climate Change)
Inegi	Instituto Nacional de Estadística y Geografía (National Institute for Statistics and Geography)
INPE	National Institute for Space Research
IPCC	Intergovernmental Panel on Climate Change
IPP	Independent Power Producer
IRP	Integrated Resource Plan
ISMO	Independent Systems and Market Operator
ISO	Interantional Organisation for Standardization
JSE	Johannesburg Stock Exchange
KECO	Korea Environment Corporation
KEEI	Korea Energy Economics Institute
KEMCO	Korea Energy Management Corporation
KEPCO	Korea Electric Power Corporation
KFRI	Korea forest Research Institute
KfW	Kreditanstalt für Wiederaufbau
KICT	Korea Institute of Construction Technology
KOSTAT	Statistics Korea
KOTSA	Korea Transportation Safety Authority
KRW	Korean Won
KVER	Korea Voluntary Emission Reduction Program
LAERFTE	Ley para el Aprovechamiento de las Energías Renovables y el Financiamiento de la Transición Energética (Law for the Use of Renewable Energy and Financing the Energy)
LASE	Ley para el Aprovechamiento Sustentable de la Energía (Law to promote the use of sustainable energy)
LCDS	Low Carbon Development Strategies
LPDB	Ley para la Promoción y Desarrollo de los Bioenergéticos (Law to promote development of bioenergy)
LTMS	Long-Term Mitigation Scenarios
LULUCF	Land use, land-use change, and forestry
M&E	Monitoring and Evaluation
MAPT	Measurement and Performance Tracking
MAs	Mitigation Actions
MCCC	Ministerial Council for Climate Change
MCT	Ministry of Science and Technology
MEPS	Minimum Energy Performance Standard
MFAFF	Ministry for Food, Agriculture, Forestry and Fisheries (South Korea)
MIIT	Ministry of Industry and Information Technology (China)
MKE	Ministry of Knowledge Economy (South Korea)
MLTM	Ministry of Land, Transport and Marine Affairs (South Korea)
MME	Ministry of Environment
MoC	Ministry of Commerce (China)
MoE	Ministry of Energy (South Africa)
MOE	Ministry of Environment (South Korea)

MoEF	Ministry of Environment and Forests (India)
MoF	Ministry of Finance (China)
MOHURD	Ministry of Housing and Urban-Rural Development (China)
MoR	Ministry of Railway (China)
MOST	Ministry of Science and Technology (China)
MoT	Ministry of Transportation (China)
MRV	Monitoring, Reporting and Verification
MTIOE	Ministry of Trade, Industry and Energy (South Korea)
NAFTA	North American Free Trade Agreement
NAMAs	Nationally Appropriate Mitigation Actions
NAMAs	Nationally Appropriated Mitigation Actions
NAPCC	National Action Plan on Climate Change (India)
NBS	National Bureau of Statistics
NCCC	National Coordination Committee on Climate Change (China)
NCCR	National Climate Change Response (White Paper)
NCPC	National Cleaner Production Centre of South Africa
NCs	National Communications
NCSP	National Communications Support Programme
NDP	National Development Plan
NDRC	National Development and Reform Commission (China)
NEA	National Energy Administration (China)
NEEA	National Energy Efficiency Agency
NEES	National Energy Efficiency Strategy
NERSA	National Energy Regulator of South Africa
NGIMA	National Greenhouse Gas Inventory Management Authority (India)
NGMS	National GHG Management System
NIAS	National Institute of Animal Science
NIAST	National Institute of Agricultural Sciences and Technology
NIGMS	National GHG Inventory Management System (India)
NLC	National Land Cover (dataset)
NOM	Normas Oficiales Mexicanas (efficiency standards)
NPC	National People's Congress (China)
NPCC	National Plan on Climate Change
NSC	National Steering Committee (India)
NSCC	National Strategy for Climate Change
NSSD	National Strategy for Sustainable Development and Action Plan
NSSF	National Sustainable Settlements Facility
OECD	Organisation for Economic Co-operation and Development
PACCM	Program of action for the City of Mexico
PACMUN	Planes de Acción Climática Municipal (action plans on climate change at municipal level)
PAMs	Policies and Measures
PAT	Perform, Achieve and Trade
PCGG	Presidential Committee on Green Growth
PDE	Ten-year Plan for Energy Expansion
PEACC	Programas Estatales de Acción ante el Cambio Climático (provincial level state programs on climate change)
PECC	Federal Government's Special Climate Change Program

PEE	Energy Efficiency Program
PEMEX	Petróleos Mexicanos (publicly owned oil company)
PMC	Project Management Cell (India)
PMCCC	Prime Minister's Council for Climate Change (India)
PNEf	National Energy Efficiency Plan
PNMC	National Policy on Climate Change
PPA	Purchasing Power Ageement
PPAs	Permanent Preservation Areas
PPCDAm	Action Plan to Prevent and Control Deforestation in the Legal Amazon
PPCerrado	Action Plan to Prevent and Control Deforestation in the Cerrado
PREVFOGO	National System for Preventing and Combating Forest Fires
Proarco	Program for the Prevention and Control of Burnings and Forest Fires in the Arc of Deforestation
PROCALSOL	Solar water heater promotion program
Procel	National Electric Energy Conservation Program
PROESCO	Energy- efficiency credit line
PROTRAM	Federal Mass Transit Programme
PSA	Esquema de Pago por Servicios Ambientales (Payment for environmental services)
PSAH	Pago por Servicios Ambientales Hidrológicos (Payment for hydrological environment services)
R	Rand
R&D	Research and Development
R&D	Research and Development
RBS	Revised Balanced Scenario
RE	Renewable energy
REBID	Renewable Energy Independent Power Producers Procurement Programme; other abbreviations: REIPPPP, RE4P
REC	Renewable Energy Certificate
RECs	Regional Environemntal Centers
REDD	Reducing Emissions from Deforestation and Degradation
REDD+	Reducing Emissions from Deforestation and Forest Degradation ("plus" conservation, sustainable management of forests and enhancement of forest carbon stocks)
REFIT	Renewable Energy Feed-In Tariff
RPO	Renewable Portfolio Obligation
RPS	Renewable Portfolio Standard
S.A. de C.V	Sociedad Anonima de Capital Variable (Variable Capital Company)
SAAQUIS	South African Air Quality Information System
Sagarpa	Secretaría de Agricultura, Ganadería, Desarrollo Rural, Pesca y Alimentación (Secretariat of Agriculture, Livestock, Rural Development, Fisheries and Food)
SAMI	South Africa's Mineral Industry
SANEDI	South African National Energy Development Institute
SANERI	South African National Energy Research Institute
SANS	South African National Standard
SAPIA	South African Petroleum Association
SARI	South African Renewables Initiative
SCT	Secretaría de Comunicaciones y Transportes (Secretary of Communication and Transportation)
SE	Secretaría de Economía (Ministry of Economy)
SEC	Specific Energy Consumption target
Sedesol	Secretaría de Desarrollo Social (Secretary of Social Development)

SEMARNAT	Secretaría de Medio Ambiente y Recursos Naturales (Environment Ministry)
SENER	Secretaría de Energía (Department of Energy)
SME	Statistics, Monitoring, and Examination System
SMEs	Small and Medium Enterprises
SNCC	Sistema Nacional de Cambio Climático (National System for Climate Change)
SNUC	National System of Protected Areas
TMS	Target Management Scheme
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nation Framework Convention for Climate Change
UNIDO	United Nations Industrial Development Organization
VSD	Variable Speed Drive
WRI	World Resource Institute
ZAE Cana	Agro-Ecological Sugar Cane Zoning law

Executive Summary

Greenhouse gas emissions need to decrease substantially to hold global average temperature increase below 2°C warming above the preindustrial level in 2100. This requires emission reductions by all major emitting countries with developed countries taking the lead, but emerging economies are of increasing importance in this global effort. Our assessment therefore includes six exemplary country case studies: Brazil, China, India, Mexico, South Africa and South Korea.

In a report published in May 2013, Fekete et al. (2013) analysed mitigation potentials of those countries. The assessment here goes one step further, in evaluating why some potentials lie idle.

1.1 Research question and approach

In this report, we first illustrate the institutional set up and national measurement, reporting and verification (MRV) systems related to climate policies. Both for institutions and MRV, it is essential to have sufficient capacities to build up a framework that supports embedding mitigation action in the policy activities of governments. In a second step, we analyse current strategies and on-going activities on the policy level in the area of climate change mitigation, in order to analyse linkages between overall mitigation targets, strategies and policies.

The guiding research questions this report tries to answer are:

- What are opportunities for and challenges to mitigation activities in emerging economies?
- What are good examples for institutional set-up, Monitoring, Reporting and Verification (MRV) systems or policy activities?
- Are there common challenges specific to emerging economies?
- How can the international community support these countries in increasing mitigation activities?

In order to assess how far countries are able to realise the identified mitigation potentials we look at a number of important elements: Some of these are concrete steps to allow for effective mitigation, like the implementation of projects, programmes, measures and policy frameworks and the removal of barriers to effective action. Others are supporting implementation and generate more or less favourable frameworks for action. These include the institutional setup for climate policy, the MRV system and the existence of comprehensive and ambitious climate strategies, for example low carbon development strategies (LCDS).

The assessment and report is based on desk research, complemented with insights from in-country experts from the research community.

1.2 Common opportunities for and challenges to mitigation

1.2.1 Overall set up of strategies and institutions for climate change mitigation

We find that all countries covered in this report have committed to emission reduction targets inscribed under the Copenhagen Accord. All have national strategies for low carbon development in place, customised to national circumstances. In various cases more detailed

sectoral and/or subnational plans support these strategies. Those plans are mostly aligned with other government priorities.

In all of the emerging economies analysed, economic development is the main focus of governmental action. Reductions of emissions are often seen as a positive side effect of actions driving development or creating other benefits for the population, rather than the ultimate target itself. Nevertheless, the countries have acknowledged the importance of mitigating climate change and understand mitigation activities as an opportunity to integrate cleaner development in their national planning. In that logic, climate change mitigation is a secondary political goal that nevertheless opens up new potentials to achieve other primary development goals of that country.

Additional to the strategies, institutional capacities in governments and in research have been built up in all emerging countries assessed in this analysis over the last years. In most cases, climate change related institutions are integrated in the overall political system and involve high level government representatives and different sector ministries. This demonstrates the recognition of the cross-cutting nature of climate change. There are different approaches to centralization, depending on the overall governance style of the respective country. We find that both centralised and decentralised systems have advantages and disadvantages. Centralization can create barriers by limiting the scope of action of sectoral or subnational levels while very decentralised approaches require high administrative efforts for aligning activities. In both cases, an overarching institution coordinating between sectors and government levels is essential. Many of the countries analysed have established such an institution in order to streamline activities.

All six countries have significantly improved their Monitoring, Reporting and Verification (MRV) systems for greenhouse gases in the last years, and have built in-country capacities to further fine-tune their systems. Comprehensive and consistent MRV is essential for those big countries, as uncertainty in data has a relatively high impact on global emission estimates. In a number of the countries, current emission estimates as well as projections are highly uncertain, in spite of recent improvements of the MRV systems. Often, the systems can profit from aligning already existing monitoring systems for example for energy savings.

1.2.2 Mitigation activities on the ground and common barriers

All countries engage in varied activities that contribute to greenhouse gas reductions. The focus of activities depends on national circumstances: For many countries, the energy sector is most important and provides the largest mitigation potential. For Brazil, however, agriculture, forestry and land use (AFOLU) are the key sectors for mitigation actions.

Good progress has been made in all countries in defining strategies for low carbon development. There are differences in how far these strategies are already implemented. While some countries, like China, are relatively advanced in translating plans to concrete actions, other countries are still in the process of doing so. Often some sectors are more advanced, like the strategies to reduce deforestation in Brazil where implementation is well advanced compared to other sectors where plans are still under development.

In many cases increased capacity and dissemination of knowledge on opportunities of low-carbon technologies is essential for more effective implementation. While awareness and

knowledge on options and technologies are high at the expert level in all countries, there is often a clear deficit in broad dissemination of information especially in sectors where a large number of stakeholders need to be involved. This is especially the case for mitigation measures around energy efficiency, housing, transport and in the agricultural sector.

Enhanced information dissemination could also improve coordination between different government and other stakeholders. Most countries covered in this report show considerable untapped energy efficiency potentials – common barriers include distorted energy prices and a lack of information on cost saving benefits. For renewable energy activities, common barriers in most countries are low quality renewable energy technologies or high import prices, insufficient grids, and limited technical capacities.

1.2.3 Opportunities for international support

Institutional and human capacities still present perhaps the most serious challenge across all sectors and countries covered within this report. Commitments made by high levels of governments do not necessarily translate into concrete actions, for example due to lacking a sense of urgency, limited problem awareness in institutions and general population, untrained personnel, and technical knowledge constraints.

Several options embedded in and surrounding the UNFCCC climate change regime can be used to strengthen international cooperation and support for capacities, technology needs and finance. These can be very helpful tools to foster collaborative efforts among all countries:

- Targeted expert training, knowledge networks and information clearing houses can help alleviate some of the identified challenges. With the current implementation of the Clean Technology Center and Network (CTCN) the international community has a potentially powerful tool to overcome technical capacity barriers.
- Many financial constraints for low-carbon technologies have their roots in limited knowledge by local financial institutions that are hesitant to invest in activities that they perceive as risky. Education of local investors and finance institutions can help to alter their perception. Financial instruments used by national and international climate and development financing institutions can further soften the investment risks, such as guarantees, low-interest loans etc.
- Best practices and in-depth knowledge of implementation opportunities may often be found within developing nations with comparable challenges. Developing countries have shown considerable innovative potential for tailor-made solutions to their circumstances on the ground. The International Partnership for Mitigation and MRV is a good example of how this can work. The platform has strong potential for collaborative efforts, and already provides a sizeable knowledge base.

Additional to capacity building of institutional levels, the education of private stakeholders and awareness raising among the population should play a central role. Pilot projects can provide valuable insights and lessons learned.

In line with the provisions of the Bali Action Plan, five out of the six countries based their commitments on the successful provision international technical, financial and capacity support – South Korea being the only exception. The international community could seize this

opportunity to strengthen cooperation with these countries in order to fully realise the mitigation potential. Especially in the area of sharing knowledge and sustainably developing capacities, emerging economies can benefit significantly.

Deutsche Zusammenfassung (German summary)

Der Ausstoß von Treibhausgasen muss deutlich sinken, um den durchschnittlichen globalen Temperaturanstieg im Jahre 2100 auf ein Maximum von 2°C über das vorindustrielle Niveau zu begrenzen. Dies verlangt Emissionsreduktionen von allen Ländern mit hohen Emissionen, angeführt von den entwickelten Ländern. Die Relevanz der Schwellenländer steigt in dieser globalen Anstrengung jedoch zunehmend. Unsere Untersuchung beinhaltet deshalb sechs beispielhafte Fallstudien: Brasilien, China, Indien, Mexiko, Südafrika und Südkorea.

In einem Bericht veröffentlicht im Mai 2013 analysierten Fekete et al. (2013) das Minderungspotenzial dieser Länder. Der nun vorliegende Bericht geht aufbauend darauf einen Schritt weiter und bewertet, weshalb Teile der Potenziale brachliegen.

1.1 Zentrale Fragen der Untersuchung und Herangehensweise

In diesem Bericht stellen wir zunächst die institutionellen Strukturen im Bereich Klimapolitik dar, weiterhin die nationalen Systeme zum Messen, Berichten und Verifizieren (MRV) von Emissionen. Ausreichende Kapazitäten sind im institutionellen Bereich und bei der Bereitstellung von Emissionsdaten essentiell um Rahmenbedingungen zu schaffen, die die Integration von Minderungsmaßnahmen in die politischen Aktivitäten zu unterstützen. In einem nächsten Schritt untersuchen wir vorhandene Strategien und derzeitige politische Maßnahmen im Bereich der Klimapolitik, um die Verknüpfungen zwischen Minderungszielen, -strategien und -politiken zu bewerten.

Die Fragen, die dieser Bericht zu beantworten versucht sind:

- Wo liegen Chancen und Herausforderungen für Minderungsaktivitäten in Schwellenländern?
- Was sind gute Beispiele für institutionelle Strukturen, MRV Systeme, oder politische Maßnahmen?
- Gibt es gemeinsame Herausforderungen, die besonders Schwellenländer betreffen?
- Wie kann die internationale Gemeinschaft diese Länder dabei unterstützen, ihre Minderungsaktivitäten zu steigern?

Um festzustellen, inwiefern Länder in der Lage sind die identifizierten Potenziale zu verwirklichen, betrachten wir verschiedene wichtige Elemente: Einige sind konkrete Schritte um eine effektive Minderung von Emissionen zu erreichen, zum Beispiel die Umsetzung von Projekten, Programmen oder Maßnahmen. Andere Elemente unterstützen die Umsetzung und beeinflussen die politischen Rahmenbedingungen entweder positiv oder negativ. Dazu gehören die Struktur und das Zusammenspiel relevanter Institutionen sowie die MRV Systeme und die Existenz von umfassenden und ehrgeizigen Klimastrategien.

Die Analyse basiert auf Literaturrecherche, ergänzt durch Einblicke von Experten in den jeweiligen Ländern.

1.2 Gemeinsame Chancen und Herausforderungen für Emissionsminderungen

1.2.1 Genereller Aufbau von Einrichtungen und Strategien zu Klimawandelvermeidung

Unsere Untersuchung ergibt, dass alle Länder die in diesem Bericht betrachtet werden Emissionsminderungen im Rahmen des "Copenhagen Accord" angeboten haben. Alle haben Entwicklungsstrategien zur Reduktion von Treibhausgasen entwickelt, die an die nationalen Umständen angepasst sind. In mehreren Fällen unterstützen sektorale oder regionale Pläne die nationalen Strategien. In den meisten Fällen sind diese Pläne vereinbar mit anderen Regierungsprioritäten.

In allen untersuchten Schwellenländern steht die wirtschaftliche Entwicklung im Fokus der Regierung. Emissionsreduktionen werden dabei oft eher als ein positiver Nebeneffekt gesehen, der die Wirtschaft fördert oder andere Verbesserungen für die Bevölkerung erwirkt, als als eigentliches Ziel. Nichtsdestotrotz haben die Schwellenländer die Relevanz der Vermeidung von Klimawandel anerkannt und verstehen diese als Möglichkeit um eine nachhaltigere Entwicklung in ihre Planung einzubeziehen. Gemäß dieser Logik ist Vermeidung von Klimawandel ein zweitrangiges politisches Ziel, welches jedoch neue Potenziale erschließt andere Entwicklungsziele zu erreicht.

Zusätzlich zu den Strategien, die entwickelt wurden, haben alle hier betrachteten Schwellenländer in den letzten Jahren ihre Kapazitäten in Regierungsinstitutionen und Forschungseinrichtungen ausgebaut. In den meisten Fällen sind Institutionen die sich mit Klimawandel beschäftigen in dem generellen politischen System integriert und beziehen hochrangige Regierungsmitglieder und Vertreter verschiedener Ministerien mit ein. Dies verdeutlicht die Anerkennung der themenübergreifenden Natur des Klimawandels.

Es gibt verschiedene Grade der Zentralisierung entsprechend des generellen Regierungsstils der jeweiligen Länder. Dabei haben sowohl zentralisierte als auch dezentralisierte Systeme ihr Vor- und Nachteile. Starke Zentralisierung kann den Handlungsspielraum auf sektoralem oder regionalem Niveau einschränken, während sehr dezentralisierte Ansätze einen hohen administrativen Aufwand verlangen um Aktivitäten zu koordinieren. In beiden Fällen ist übergeordnete Koordination durch eine verantwortliche Institution wichtig. Viele der untersuchten Länder haben solch eine Einrichtung um die Aktivitäten zu koordinieren.

Alle sechs untersuchten Länder haben ihre MRV Systeme in den letzten Jahren stark verbessert und haben Kapazitäten im Land aufgebaut um die Systeme weiter zu verfeinern. Umfassendes und konsistentes MRV ist unabdingbar für diese großen Länder, da Datenunsicherheit einen relativ großen Einfluss auf globale Emissionsschätzungen hat. In einigen der Länder sind derzeitige Abschätzungen des Emissionsniveaus extrem unsicher, trotz den bisherigen Verbesserungen des MRV Systems. Oft können die Systeme davon profitieren, mit anderen etablierten nationalen Systemen kombiniert zu werden, wie es sie z.B. zum Monitoring von Energieeinsparungen gibt.

1.2.2 Konkrete Minderungsaktivitäten und gemeinsame Barrieren

Alle untersuchten Länder haben Maßnahmen zur Emissionsreduktionen umgesetzt. Der Fokus hierbei hängt von nationalen Umständen ab. Für viele Länder ist der Energiesektor Priorität

und stellt auch das größte Minderungspotenzial. Für Brasilien jedoch sind Landwirtschaft, Forstwirtschaft und Landnutzung Schlüsselsektoren für Emissionsminderungen.

Es gab einigen Fortschritt in der Entwicklung von Niedrigemissionsstrategien. Es gibt Unterschiede in dem Grad der Umsetzung dieser Strategien. Während einige Länder wie zum Beispiel China ihre Strategien schon relativ weitgehend in konkrete Maßnahmen umwandeln konnten, befinden sich andere Ländern noch auf dem Weg dahin. Oft sind einzelne Sektoren weiter fortgeschritten als andere. So werden zum Beispiel in Brasilien die Strategien zur Verringerung der Rodung von Wäldern bereits umgesetzt, während in anderen Sektoren noch Strategien entwickelt werden.

In vielen Fällen ist die Steigerung von Kapazitäten und die Verbreitung von Wissen zu den Vorteilen emissionsarmer Technologien äußerst wichtig um wirkungsvolle Umsetzung der Strategien zu garantieren. Während Bewusstsein und Wissen zu Möglichkeiten und Technologien unter Experten in allen untersuchten Ländern bereits hoch ist, gibt es oft klare Defizite in der weiteren Verbreitung von Informationen, vor allem in Sektoren, wo eine Vielzahl von Akteuren involviert werden muss. Dies ist insbesondere für Minderungsmaßnahmen in Energieeffizienz, Gebäuden, Transport und im Landwirtschaftssektor wichtig.

Verbesserte Verbreitung von Informationen könnte auch die Koordination zwischen Regierungen und anderen Akteuren verbessern. Die meisten Länder, die in diesem Bericht betrachtet werden, zeigen wesentliches ungenutztes Potenzial im Bereich Energieeffizienz. Gemeinsame Hindernisse hierfür sind subventionierte Energiepreise und das Fehlen von Informationen zu Kosteneinsparungen. Für erneuerbare Energien sind übliche Hindernisse in vielen Ländern die schlechte Qualität der Technologien beziehungsweise hohe Preise für Importwaren, sowie unzureichende Elektrizitätsnetze und begrenzte technische Kapazitäten.

1.2.3 Chancen zur internationalen Unterstützung

Institutionelle Kapazitäten und fehlendes Fachwissen stellen über alle untersuchten Sektoren und Länder hinweg immer noch die vielleicht schwerwiegendste Herausforderung dar. Verpflichtungen auf hoher Regierungsebene werden so nicht immer in konkrete Aktivitäten umgesetzt. Oft wird das Problem und die Dringlichkeit einer Lösung durch verschiedene Akteure und die Bevölkerung aufgrund unzureichend ausgebildeten Personals und fehlenden technischen Fachwissens nicht unbedingt erkannt.

Verschiedene Mechanismen in und um die UNFCCC können genutzt werden, um internationale Unterstützung und den Aufbau von Kapazitäten, Technologien und Finanzierung möglich zu machen. Es gibt eine Reihe hilfreicher Instrumente um Zusammenarbeit zwischen allen Ländern zu fördern:

- Gezielte Weiterbildung von Experten, Netzwerke zum Wissensaustausch und zentrale Informationsstellen können helfen einige der identifizierten Herausforderungen zu beseitigen. Mit der Umsetzung des „Clean Technology Center and Network“ hat die internationale Gemeinschaft ein potentiell mächtiges Instrument, um technische Kapazitätshindernisse zu bewältigen.

- Viele finanzielle Einschränkungen für Niedrigemissionstechnologien haben ihre Wurzel in begrenztem Wissen regionaler Finanzinstitutionen, die nur zögerlich in Aktivitäten investieren, die sie als risikoreich empfinden. Die Weiterbildung von regionalen Investoren und Finanzinstitutionen kann dazu beitragen, diese Einschätzung zu ändern. Finanzielle Instrumente, die von nationalen und internationalen Entwicklungsinstitutionen genutzt werden, wie zum Beispiel Garantien oder Darlehen mit niedrigen Zinsen, können zusätzlich das Investitionsrisiko senken.
- "Best practice" und detaillierte Erfahrungen aus der Umsetzung können oft innerhalb von Entwicklungsländern gefunden werden, die mit ähnlichen Herausforderungen zu kämpfen haben. Entwicklungsländer haben beträchtliche Fähigkeiten bewiesen, an ihre Bedingungen angepasste, innovative Lösungen zu finden. Die „International Partnership for Mitigation and MRV" ist ein gutes Beispiel wie dies funktionieren kann. Diese Plattform hat ein hohes Potential zur gegenseitigen Unterstützung und Zusammenarbeit und stellt bereits eine breite Basis an Wissen zur Verfügung.

Zusätzlich zur Förderung von Kapazitäten auf institutioneller Ebene spielt die Ausbildung von privaten Akteuren und die Bewusstseinsbildung in der Bevölkerung eine zentrale Rolle. Hier können Pilotprojekte wertvolle Einblicke geben.

In Übereinstimmung mit den Forderungen des "Bali Action Plan", haben fünf der sechs hier untersuchten Länder ihre Minderungszusagen an die Bereitstellung von internationaler technischen, finanziellen und kapazitätsbezogenen Unterstützung geknüpft - die einzige Ausnahme bildet Südkorea. Die internationale Gemeinschaft sollte diese Möglichkeit wahrnehmen um die Zusammenarbeit mit den Ländern zu stärken und um deren volle Potenziale auszuschöpfen. Insbesondere beim Wissensaustausch und im nachhaltigen Ausbau von Kapazitäten können Schwellenländer stark profitieren.

1 Introduction

Greenhouse gas emissions need to decrease substantially to limit global average temperature to a maximum of 2°C warming above the preindustrial level in 2100. Emerging economies are of increasing importance in this global effort. Our assessment therefore includes six exemplary emerging countries which are Brazil, China, India, Mexico, South Africa and South Korea.

Much analysis has been published over the past years evaluating the appropriateness of commitments under the UNFCCC in this context (Climate Action Tracker 2012). This, however, provides only part of the picture. While commitments are important elements in the struggle to limit GHG emissions, they are only a first step, aiming to finally trigger concrete action on the ground.

In a first report of this research project published in February May (Fekete et al. 2013) we therefore on mitigation options: taking into account that action is most urgent where the largest mitigation options exist, the report assessed the available mitigation potential of the countries and how this relates to the pledges and respective efforts based on different equity principles.

We found that emerging economies not only have large influence on future emissions levels, but that large mitigation potentials are already available in the countries. Action needs to be taken soon to enable the full use of these potentials until 2020 as the remaining time for implementation is decreasing.

This report therefore builds on these findings and links mitigation potentials to political processes. It looks at the national climate policy landscape in emerging economies and tries to provide an overview how far this lends itself to realising the identified mitigation potentials.

2 From Low Carbon Development Strategies to unlocking mitigation potentials

To assess how far countries are likely ready to tap the identified mitigation potentials we look at a number of decisive political and institutional preconditions / structures. Some of these are essential to allow for effective mitigation, like the effectiveness of the implementation of projects, programmes, measures and the existing policy frameworks and remaining barriers to effective action. Others are supporting implementation and generate more or less favourable frameworks for action. These include the institutional setup for climate policy, the MRV system and the existence of comprehensive and ambitious climate strategies, for example low carbon development strategies (LCDS).

First we take a look at the institutional setup for climate related policy. The availability of institutional capacity, the degree of embedding of climate aspects in policy making and coordination of activities across departments and sectors can strongly influence the ability of a country to implement mitigation measures. We take a look at the most important institutions within the countries dealing with mitigation. This includes policy processes and efforts to coordinate activities at different levels. We don't provide a comprehensive picture of the political system, but focus on aspects related to climate policy. This can give a first indication on the preparedness of a country to tap identified potentials.

Another important aspect of this is furthermore the availability of basic emissions data, which is an essential element to the design and monitoring of policy measures. Most countries started

to collect such data mainly for external purposes, specifically the National Communications provided to the UNFCCC. Nevertheless it is just as relevant for the national policy process. We describe the existing MRV systems and their evolution to give an indication regarding the capability of these systems to support this purpose.

National strategies on low carbon development can provide a useful guidance for comprehensive climate action. These strategies can come in different forms and shapes, not necessarily being labelled as “Low Carbon Development Strategies”. The common feature is the effort to develop a more or less comprehensive plan of action across different sectors. We take a look at such strategies where they exist, also if not officially labelled as climate strategies, and outline main elements, their influence on national policy making and their relationship to the national targets.

Last but not least we take a look at measures implemented in the country and assess in a qualitative way how far they match with the identified mitigation potentials. Within this analysis we differentiate what a country has put forward as “Nationally Appropriate Mitigation Actions” (NAMAs) under the UNFCCC and nationally implemented policies and measures (irrespective of the funding sources for the activities). Officially communicated NAMAs often take the form of a commitment at national or targets at sectoral level rather than concrete activities. In these cases the NAMAs were assessed in Fekete et al. (2013) as part of the pledge analysis.

For other policies and measures we concentrated on the measures with the largest mitigation potential as identified in Fekete et al. (2013). For these we describe the most important policies in place and where possible indicate the degree of effectiveness to leverage the identified potential.

An important aspect in the implementation of effective mitigation policy is a careful analysis of existing barriers. These can be of institutional, financial or technical nature, but also include lack of capacity and other factors. For the high potential measures we describe the most prominent country specific barriers found during the review of the elements described above and through additional in literature review. Many of these barriers can finally only be overcome at the national level and we refrain from making any recommendations on how to do this. This would require an in-depth analysis including stakeholders which is beyond the scope of this report. Beyond the description of the political and institutional structures, our analysis focuses on potential support from the international community to help countries overcome barriers.

In total this provides a good overview of how well countries are prepared to tap the most important mitigation potentials available and what the international community could contribute to removing remaining barriers.

3 Brazil

3.1 Introduction

Brazil was the sixth largest greenhouse gases emitter in 2008 with around 1.5 $GtCO_2e$ (EDGAR 2011). With a population of approximately 195 million people in 2010 (UN 2011), Brazil has seen strong economic growth over the past 10 years, with an increase of 42% in GDP, and is expected to grow another 29% until 2017 (IMF 2012). Recent sources project that the population will increase by 14% by 2050 (UN 2011).

Brazil's target is to reduce GHG emissions by 36 to 39% below Business as Usual (BAU) by 2020. According to national BAU projections, Brazil's target translates in absolute terms into a reduction of approximately 1,210 to 1,260 $MtCO_2e/a$ and a resulting emission level of 1997 to 2023 $MtCO_2e/a$ in 2020 (Fekete et al. 2013). The target is voluntary and not conditional to other countries' mitigation efforts, but subject to the application of agreed Convention principles related to the provision of financial and technical support (Government of Brazil 2011).

Brazil differs from most countries due to its unusual emissions profile. Whilst globally the main source of GHG emissions is the use of energy, the largest share of Brazilian emissions comes from agriculture, forestry and land use (AFOLU). Even though deforestation rates have drastically decreased over the past 10 years in the country, such activities are still responsible for 70% of Brazil's current emissions. Methodologies to estimate future deforestation therefore have a huge influence on BAU projections. We find large differences in literature regarding future BAU development (Gouvello 2010), leading to large uncertainty in determining remaining emissions in 2020.

Most of the pledged reductions are expected to come from a drastic decrease in deforestation. In total the AFOLU sector would be responsible for a total of 28.6 to 30.8% reduction below BAU in national emissions according to the national plans.

Identified reduction potentials are very much in line with these plans. Activities to reduce deforestation alone have been estimated to deliver reductions of between 213 and 874 $MtCO_2e/a$ in 2020. Also other activities in the land use sector have been identified with substantial potential while other sectors remain small in comparison. Overall a potential between 440 and 1,310 $MtCO_2e/a$ has been found (Fekete et al. 2013).

This constitutes a substantial mitigation potential, which comes mainly at low cost or with substantial co-benefits. The question then is how far Brazil is set up to realise the possible reductions.

3.2 The institutional framework for climate policy

3.2.1 Institutional setup for climate regulation

The legislative power in Brazil lies with the bicameral National Congress (Congresso Nacional), which consists of the Federal Senate (Senado Federal) and the Chamber of Deputies (Câmara dos Deputados) (General Coordination on Global Climate Change 2010).

Both the Chamber of Deputies and the Federal Senate can present draft legislation to be revised and approved by the other part of the bicameral structure (National Congress). The process also includes the President who can sanction or veto legislation (Townshend et al. 2013).

On the executive side a number of ministries play an important role in climate change related matters. Most important are the Ministry of Science, Technology and Innovation (MCTI), the Ministry of the Environment, the Ministry of Mines and Energy, the Ministry of External Relations and the Brazilian Agency of Cooperation.

The General Coordination on Global Climate Change (CGMC) that is part of the MCTI is the technical focal point of the climate change issues in Brazil since 1994 (General Coordination on Global Climate Change 2010). It is responsible for the elaboration of the National Communications, Coordination of Funds, and technical assistance during the negotiations and capacity building in the country. Furthermore, it is responsible for the review of Intergovernmental Panel on Climate Change (IPCC) assessments and generally for providing and disseminating scientific information (General Coordination on Global Climate Change 2010). Overall, the CGMC plays an important role in promoting and tracking Brazilian progress towards meeting its voluntary target under the UNFCCC.

The Minister of Environment participates in international climate conferences (Townshend et al. 2013) and the ministry along with the IBAMA, the federal environmental agency, are responsible for the programme for monitoring deforestation activity in several Brazilian ecosystems by satellite imagery and hence for the GHG deforestation emissions inventory (General Coordination on Global Climate Change 2010). They are active in the combat of deforestation in form of punishment, fines and watchmen presence (Lèbre La Rovere 2011).

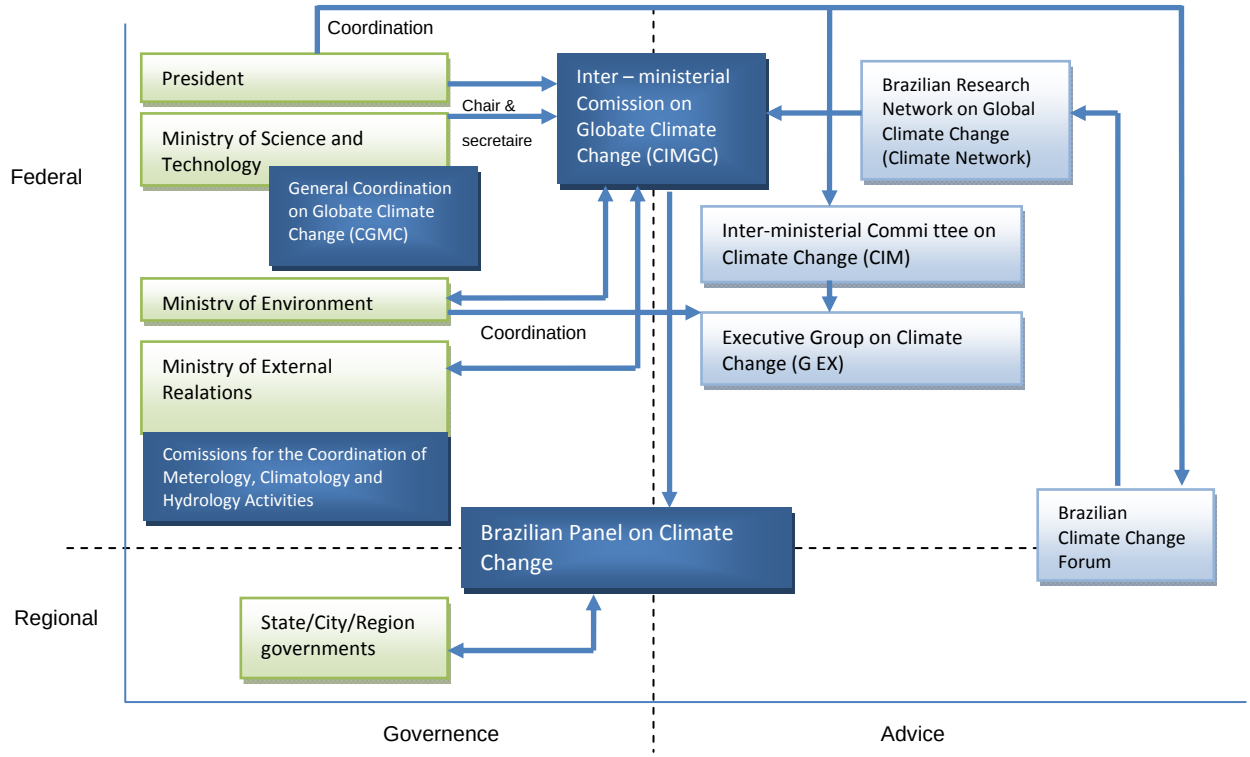
The Ministry of External Relations has the lead in international climate change debates and negotiations, such as the Conferences of the Parties (COP) or G-20 (Lèbre La Rovere 2011).

The Ministry of Mines and Energy has the responsibility to establish the energy policy of Brazil. They get technical information input from the Energy Planning Agency – EPE. The ministry is responsible for the most important energy policy instruments, the ten-year Energy Plan – PDE and the Long Term Energy Plan with a time horizon of about 25 years (Lèbre La Rovere 2011).

There are three institutions concerned with the support “of the development of clean and sustainable energy and biofuel”. These are the Ministry of Mines and Energy, the Ministry of External Relations and the Brazilian Agency of Cooperation (Governo Federal 2008).

From available documentation the relationship between different institutions is not fully clear. Fig. 1 tries to provide an overview of our understanding.

Fig. 1: Overview of institutional setup in Brazil



Source: own illustration based on (General Coordination on Global Climate Change 2010)

The most important coordinating bodies are the General Coordination on Global Climate Change described in the paragraphs above, the Inter-ministerial Committee on Climate Change (CIM), and the Inter-ministerial Commission on Global Climate Change (CIMGC). Additionally a National Fund for Climate Change (FNMC) and the Amazon Fund were established to finance studies and projects implementing mitigation and adaptation actions in Brazil.

The Inter-ministerial Commission on Global Climate Change – CIMGC

The CIMGC was created in 1999 as the Designated National Authority (DNA) of Brazil under the Clean Development Mechanism (CDM) (Lèbre La Rovere 2011). It also has the task to coordinate government actions in the area of climate change (General Coordination on Global Climate Change 2010).

The Inter-ministerial Committee on Climate Change – CIM

In 2007 the Federal Government established the CIM. Its mandate is to steer "*the development, implementation, monitoring and evaluation of the National Plan on Climate Change, among other functions*" (General Coordination on Global Climate Change 2010).

The Executive Office of the Presidency coordinates the CIM that includes representatives from seventeen ministries. CIM coordinates the Executive Group on Climate Change (GEx) that is responsible for drafting the National Plan on Climate Change and the National Policy on Climate Change (General Coordination on Global Climate Change 2010).

The National Fund on Climate Change – FNMC

The Fund, headed by the Ministry of Environment, has the goal of supporting *"projects and studies and to finance undertakings that aim at mitigating climate change and adapting to climate change and its effects"* (General Coordination on Global Climate Change 2010). 60% of the available funds come from oil proceedings. Other sources include the Federal Government's Annual Budget, donations from public and private entities as well as resources from bodies at state or municipal level (General Coordination on Global Climate Change 2010) (Provedello 2010).

The administration of the FNMC is steered by a Managing Committee which is composed of governmental representatives, scientists, entrepreneurs, workers and non-governmental organisations (Provedello 2010) (General Coordination on Global Climate Change 2010). Projects can be supported with grants or loans. Supported activities include education, empowerment and training, climate science or impact analyses, adaptation, and mitigation projects as well as investments in measures for reducing emissions from deforestation (General Coordination on Global Climate Change 2010).

Brazilian Development Bank – BNDES / Amazon Fund

BNDES manages the Amazon Fund since 2008. The main focus of this fund is to reduce deforestation and to preserve the Amazon biome. This includes preventing, monitoring and combating deforestation as well as the promotion of sustainability and preservation while using the Amazon forest. The governance of the fund includes representatives from the Federal Government, from the states in the Amazon and civil society. Funds come from foreign governments, multi-lateral institutions, non-governmental organisations and individuals (General Coordination on Global Climate Change 2010)(Secretariat for Social Communication of the Presidency of Brazil 2010).

Box 1: Conclusions on the institutional setup for climate legislation in Brazil

Coordination for climate policy exists through the General Coordination on Global Climate Change and the Inter-ministerial Commission on Global Climate Change. However, overall the division of tasks, reporting lines and responsibilities are not fully clear between the different institutions and Ministries involved in the formulation of strategies, plans and concrete laws and measures.

Brazil was a frontrunner in the setup of national finance institutions to support climate related activities. The existence of the two national funds is a useful setup and has large potential for enhanced mitigation action at national level, but also provides a good basis for international cooperation and support.

3.2.2 Institutional setup and activities for MRV of GHG emissions

Brazil has submitted two National Communications so far with a third being under preparation. The institutional setup to gather and process data is complex and involves a large number of experts and stakeholders.

MRV institutions

The General Coordination on Global Climate Change (CGMC) within the Ministry of Science and Technology (MCTI) coordinated both submitted National Communications. Already for the first inventory a large number of ministries, federal institutions and state institutions, trade associations and non-governmental organisations as well as universities and research centres were involved (General Coordination on Global Climate Change 2004) although there was no formal setup of the relationship between different actors (Gonzalez Miguez 2012).

The preparation of the Second National Communication was divided between a large number of partners, combined in a network with coordinating institutions for the different sectors (see Tab. 1). The network started with 150 institutions and 700 specialists and has grown up to 600 institutions and 1,200 experts. They come from the public and private sectors, as well as from the research and university sector (General Coordination on Global Climate Change 2010). Given the large number of institutions and experts involved it became clear during the preparation of the first inventory that clear and detailed terms of reference are required to manage the process and ensure deadlines are met.

Funding is a critical element for the Brazilian greenhouse gas inventory. As the largest share of emissions stems from deforestation, monitoring this has highest priority. Acquiring and processing satellite images required for this task represents the largest cost item. The Initial National Communication was funded from a number of different sources, including the GEF, funds from the national budget (through INPE), ELECTROBRAS, INBAMA and by some of the participating organisations through in-kind contributions. For the Second National Communication more funds were made available from the GEF, although problems with the appreciation of the Brazilian Real also lead to the need to supplement with national funds and limited activities (Gonzalez Miguez 2012).

The technical coordination as well as the analysis and approval of the results from the sector specific entities of the inventory were given to a small office, created for this task. For methodology and definition discussions periodical meetings were held (Paciornik 2012).

The MCT is responsible for quality control of the inventory. They established a small team of experts and involved institutions with respective experience to task the quality assurance and control of the report (Osório & Piva 2011; Gonzalez Miguez 2012). Until 2011 continuity in the core expert team in the MCT was successfully ensured despite some challenges. After a change in government the team was dissolved (Gonzalez Miguez 2012).

Important institutions for data collection in the land use sector are the National Institute for Space Research (INPE) and the Foundation for Aerospace Science, Applications and Technologies (FUNCATE), a foundation managed by MCT/INPE, providing land use activity data based on satellite images (General Coordination on Global Climate Change 2010). Data for the livestock and agriculture sector was collected by the Brazilian Agricultural Research Corporation EMBRAPA. For underground biomass, data is used from academic literature (Osório & Piva 2011).

Energy data is managed by the Ministry of Mines and Energy. The way of getting the data is through energy balance sheets (Osório & Piva 2011). The "Alberto Luiz Coimbra Institute Graduate School and Research in Engineering in the Federal University of Rio de Janeiro"

(COPPE/UFRJ) plays an important role for the collection of energy data (Gonzalez Miguez 2012). The Environmental Company of São Paulo State (CETESB) is the coordinator of data collection of the waste sector. As the initiator of a national inventory network for the waste sector, CETESB manages the information provided by the different states (Osório & Piva 2011).

For the industry sector Brazil has not installed a responsible organisation so far. The different industrial sectors offer their accompanying data sources (Osório & Piva 2011).

Tab. 1: Institutions involved in Brazil's GHG inventories data collection.

Land-use change and Forestry	Foundation for Aerospace Science, Applications and Technologies (FUNCATE)
Energy	Alberto Luiz Coimbra Institute Graduate School and Research in Engineering in the Federal University of Rio de Janeiro (COPPE/UFRJ) Economy & Energy NGO
Livestock and agriculture	Brazilian Agricultural Research Corporation (EMBRAPA)
Waste	Environmental Company of São Paulo State (CETESB)
Industry	Overall responsibility not defined: Input from: Brazilian Aluminum Association - ABAL, National Cement Industry Union - SNIC, Brazilian Steel Institute - IABr, Brazilian Chemical Industry Association - ABIQUIM and Brazilian Coal Association - ABCM as well as individual experts from various sectors

Sources: (General Coordination on Global Climate Change 2010; Gonzalez Miguez 2012; Osório & Piva 2011)

Overall a large number of highly qualified experts is available within the country together with the tools and methodologies required. However, a fixed framework structure for establishing the inventories that is able to collect all information and knowledge over time ensuring continuity is still missing. This includes staff continuity as well as appropriate archiving and knowledge management systems that allow an institutional memory. For the third inventory a more structured approach and better organization is planned with the aim to establish more regularity. How this fits with plans to outsource coordination to the Brazilian Climate Change Research Network is not yet clear (Osório & Piva 2011; Paciornik 2012; Cerri et al. 2009).

Overview on MRV activities

Brazil has published two National Communications under the UNFCCC: The Initial National Communication in 2004 (General Coordination on Global Climate Change 2004), the second in 2010 (General Coordination on Global Climate Change 2010). A third report is under preparation since November 2011 (Paciornik 2012).

The process for the establishment of an inventory for the initial communication already started in 1995. There was little expertise available at the time and even the allocation of funds to different sectors was difficult as there was no experience in how large the shares in emissions were. The different organisations also had to first develop some methodologies that were not covered by the 1996 IPCC Guidelines, like vehicles running on ethanol, and determine national emission factors, e.g. charcoal used in the iron and steel sector, due to the specific situation in Brazil (Gonzalez Miguez 2012).

The second Brazilian GHG inventory covers additional 10 inventory years compared to the first. For both inventories Brazil did not adopt the method of using the global warming potential (GWP) for a period of 100 years for transferring the emissions into carbon dioxide equivalent units. Brazil transformed its emissions in units of mass for the individual greenhouse gases in the initial and second inventory submission (General Coordination on Global Climate Change 2010).

LULUCF data are processed through a database due to the large number of entries. For all other data spreadsheets are used for ease of use. LULUCF results are transferred to the main spreadsheets for consolidation. Quality controls were put in place to minimise errors in the spreadsheets (Paciornik 2012).

The National Policy on Climate Change (see section 3.3.1) notes the need for annual GHG reporting and tasks the MCT to provide this. It is not yet clear how this is to be implemented (Paciornik 2012).

Box 2: Conclusions on MRV for climate legislation in Brazil.

There is ample expertise on mitigation options and MRV of GHG emissions within science and research institutions in Brazil. The institutional structure with the main coordination team at the MCT allowed to make constructive use of this expertise. Tools and methodologies are available and there is sufficient experience to improve and enhance these over time.

Funding is critical for the Brazilian inventory due to the high cost associated with the acquisition and processing of LULUCF data. In the past, inventory activities were only partly covered by international funds.

A fixed framework structure for establishing the inventories that is able to collect all information and knowledge over time ensuring continuity is still missing. This includes staff continuity as well as appropriate archiving and knowledge management systems that allow an institutional memory.

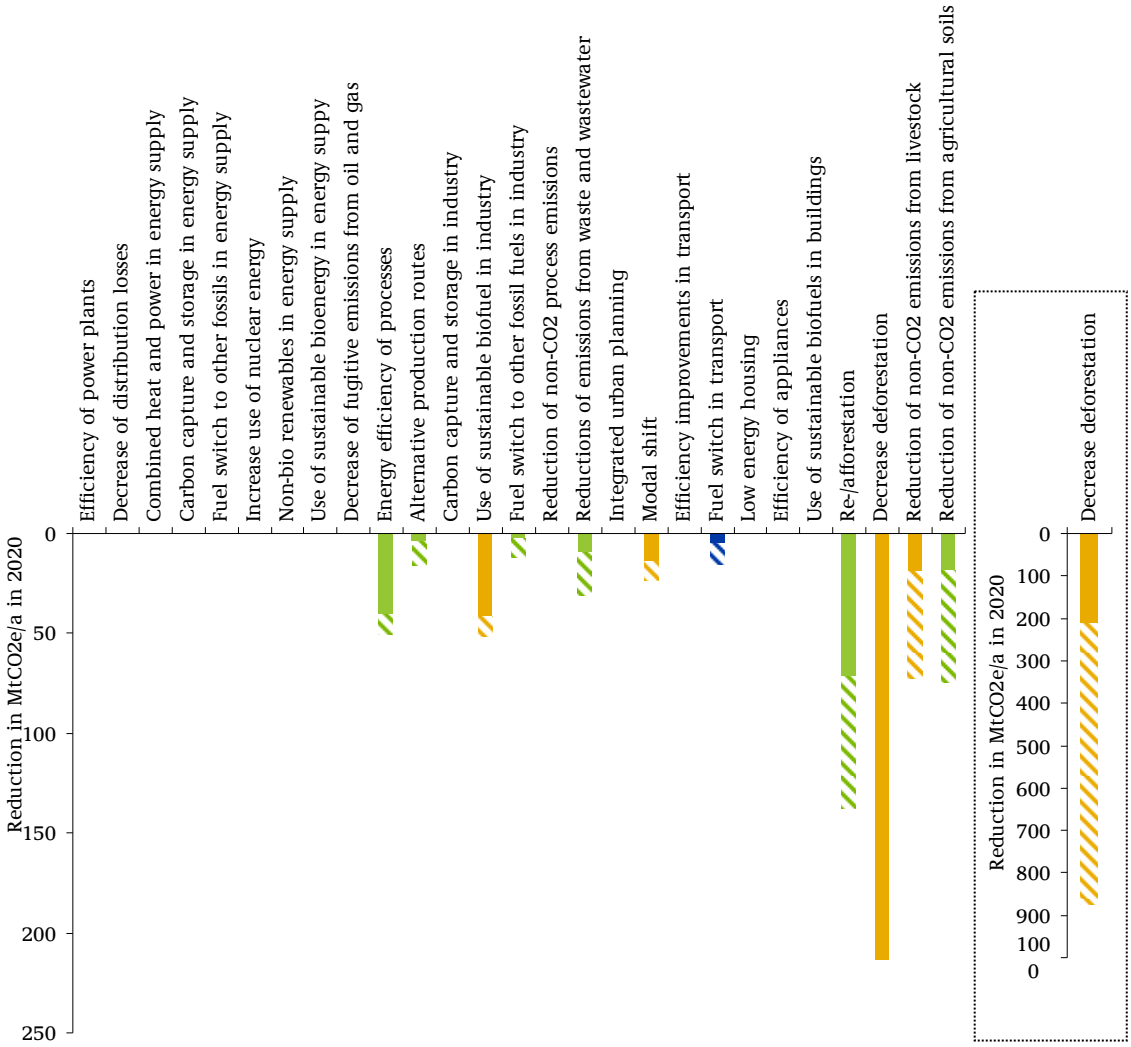
For the third inventory a more structured approach and better organisation is planned with the aim to establish more regularity. How this fits with plans to outsource coordination to the Brazilian Climate Change Research Network is not yet clear.

3.3 Mitigation potentials, strategies and activities

Emissions projections and mitigation potentials are strongly influenced by the emissions profile with the large share of AFOLU and its related high uncertainty. BAU projections for 2020 vary between around 1.5 $GtCO_2e$ and 3.2 $GtCO_2e$, i.e. by a factor of more than 2 (Fekete et al. 2013). Since most of the uncertainty is related to estimates of future deforestation, the evaluation of existing potentials is difficult and highly depends on the assumptions made under the BAU scenario.

Fekete et al. (2013) identify a total mitigation potential of between 0.4 and 1.3 GtCO2e. Of this total most comes from the AFOLU sector for which a potential of 0.3 to 1.2 GtCO2e was identified.

Fig. 2: Brazil: Ranges of mitigation potential by standard measures found in different sources



Note 1: Due to the large range of potential estimates for deforestation we have depicted the full range for this measure in the additional graph on the side of the page. Otherwise the individual potential for the other measures are difficult to identify. Be aware of the different scale of the two graphs.

Note 2: green bars represent no-regret measures, orange bars co-benefit measures and blue bars ambitious measures.

Source: (Fekete et al. 2013)

The assessment of Brazil's mitigation potential shows:

- Brazil's mitigation potential lies mainly in the land-use sector, reflecting its emissions profile. Both emission projections as well as reduction potentials in this area are characterised by a high level of uncertainty and estimates vary significantly depending on the assumptions made.

- The literature on Brazil identifies only limited potential for the energy sector. The main reduction potential outside the land-use sector is in the industrial sector and is based on improvements through increasing efficiency and on the use of sustainable biofuels, mainly replacing unsustainable biomass use.

3.3.1 Low-carbon development strategies

National Policy on Climate Change (PNMC)

The National Policy on Climate Change (Politica Nacional sobre Mudanca do Clima - PNMC) can be seen as Brazil's overarching legal instrument and - even though not labelled as such by Brazil - as its low carbon development strategy. The PNMC (Law No. 12.187), following a presidential decree, was passed in 2009, and signed by President Luiz Inácio Lula da Silva (Robinson 2010, Secretariat for Social Communication of the Presidency of Brazil 2010).

A decree, implemented and enacted into law in December 2010 (Decree No. 7.390/2010) details the mitigation actions considered practicable to reach Brazil's emission reduction goal. These actions represent Brazil's NAMAs – although not labelled in the Decree text as such (Presidência da República 2010) . These actions are provided in Tab. 2.

The PNMC includes the voluntary emission reduction target of 36.1% to 38.9% below BAU emissions and focuses on four areas: deforestation, agriculture and livestock, energy, and the steel sector. The Regulating Decree also determines that total national emissions should remain under 2 $GtCO_2e$ per year by 2020. Compared to 2005 levels, this would represent a 5.8% reduction (Townshend et al., 2013) and that the federal government's budgeting instruments incorporate the expected cost of the mitigation actions (Lèbre La Rovere 2011)(Presidência da República 2010).

Main instruments of the PNMC are the National Plan on Climate Change (NPCC), the National Fund for Climate Change, Action Plans for the prevention and control of deforestation in the biomes, and the National Communication (Presidência da República 2009) and mandatory sector plans for key economic sectors. The coordination of the Sector Plans lies in the responsibility of the Inter-ministerial Commission on Global Climate Change (General Coordination on Global Climate Change 2010; Seroa da Motta et al. 2011).

The next sections provide more detail on the most important elements and

Fig. 2 provides an overview of how the different instruments are linked.

Tab. 2: Nationally Appropriate Mitigation Actions (NAMAs) announced by Brazil to support implementation of the National Policy on Climate Change

Nationally Appropriate Mitigation Actions NAMAs	2020 (Projected) ($MtCO_2e$)	Range of estimated reduction ($MtCO_2e$)		Reduction in percent regarding projected emissions in 2020		Implementation Instruments
		Lower range	Upper range	Lower range	Upper range	
LAND USE	1084	669	669	24,7%	24,7%	
Red. deforestation - Amazon (80%)		564	564	20,9%	20,9%	Action Plan for the Prevention and Control of Deforestation in the Amazon
Red. deforestation - 'Cerrado' (40%)		104	104	3,9%	3,9%	Action Plan for the Prevention and Control of Deforestation and Fires in the "Cerrado"
AGRICULTURE	627	33	166	4,9%	6,1%	
Restoration of grazing land		83	104	3,1%	3,8%	Action Plan for Mitigation and Adaptation in Agriculture
Integrated crop–livestock system		18	22	0,7%	0,8%	
No-till farming		16	20	0,6%	0,7%	
Biological nitrogen fixation		16	20	0,6%	0,7%	
ENERGY	901	166	207	6,1%	7,7%	
Energy efficiency		12	15	0,4%	0,6%	Ten Year Plan for Energy Expansion
Increase in the use of biofuels		48	60	1,8%	2,2%	
Increase from hydroelectric power supply		79	99	2,9%	3,7%	
Alternative energy sources		26	33	1,0%	1,2%	
OTHERS	92	8	10	0,3%	0,4%	
Iron and steel – replacing coal from deforestation to planted forests		8	10	0,3%	0,4%	Plan for the Reduction of Steel Industry Emissions
TOTAL	2703	975	1052	36,1%	38,9%	

Source: (General Coordination on Global Climate Change 2010; Piva 2011; Odenbreit Carvalho & Oliveira 2012)

National Plan on Climate Change (NPCC)

The National Plan on Climate Change (Decree No. 6263) was elaborated by the Executive Group on Climate Change under supervision of the Inter-ministerial Committee on Climate Change (CIM) and was enacted in 2008. As implementing instrument of the National Policy on Climate

Change (PNMC), it was updated after the PNMC came into force and is subject to further annual updates (General Coordination on Global Climate Change 2010; Governo Federal 2008).

The NPCC focuses on actions to decrease deforestation with some actions addressing energy efficiency and renewable energy. The plan foresees that actions should be quantifiable and verifiable by international experts (Townshend et al. 2013; Robinson 2010).

Sector Plans

The National Policy on Climate Change mandated the development of sector plans which had to include (Lèbre La Rovere 2011):

- Expected emission reductions in 2020, with milestones for every three year period;
- Mitigation actions to be implemented;
- Indicators for monitoring of performance and assessment of effectiveness;
- Proposal of tools and incentives to be adopted in the implementation of the plans;
- Sectoral studies of cost estimates and implications for competitiveness

The coordination of actions under the sectoral plans lies with the CIMGC, while the Brazilian Climate Change Forum (FBMC) is responsible for follow up on implementation (Lèbre La Rovere 2011). The latter was also involved in the preparation of the plans in close cooperation with civil society (Government of Brazil 2012).

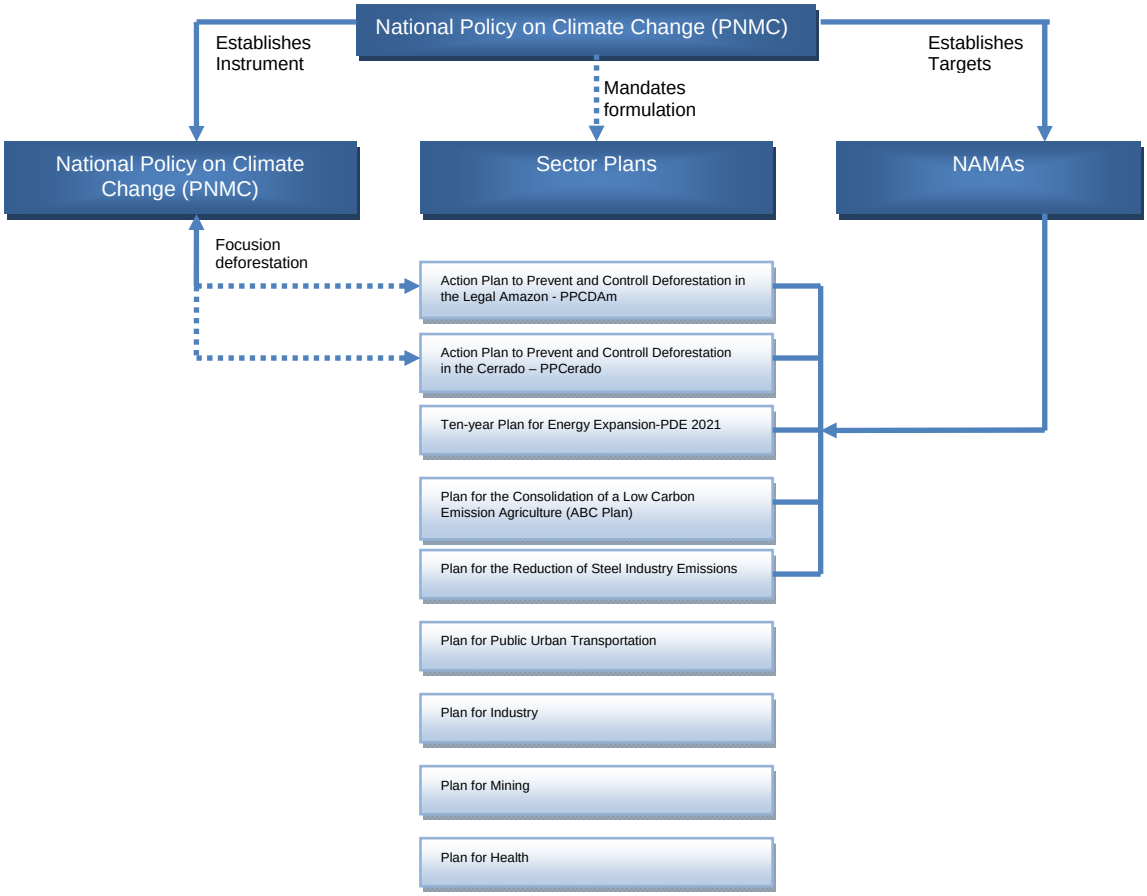
The most advanced Sector Plans are: the Action Plan to Prevent and Control Deforestation in the Legal Amazon - PPCDAm, the Action Plan to Prevent and Control Deforestation in the Cerrado - PPCerrado, one for Energy, the Ten-year Plan for Energy Expansion – PDE, and the Plan for the Consolidation of a Low Carbon Emission Agriculture Economy (General Coordination on Global Climate Change 2010; Townshend et al. 2013; Provedello 2010; Osório & Piva 2011). Tab. 3 provides an overview of all existing sector plans to date.

Tab. 3: Overview of sector plans elaborated for Brazil under the PNMC.

Sector	Plan	Status of elaboration	Status of implementation
Forest	Action Plan to Prevent and Control Deforestation in the Legal Amazon - PPCDAm	Finished 2004	Implemented
Forest	Action Plan to Prevent and Control Deforestation in the Cerrado - PPCerrado	Finished 2010	In implementation
Energy	Ten-year Plan for Energy Expansion – PDE 2021	Finished 2010	In implementation
Agriculture	Plan for the Consolidation of a Low Carbon Emission Agriculture Economy (ABC Plan)	Finished 2010	In implementation
Iron and Steel	Plan for the Reduction of Steel Industry Emissions	Finished 2010	In implementation
Public urban transportation	Plan for Public Urban Transportation	Finished 2012	In implementation
Industry	Plan for Industry	Finished 2012	In implementation
Mining	Plan for Mining	Finished 2012	In implementation
Health	Plan for Health	Finished 2012	In implementation

Source: (Ministério do Meio Ambiente 2013) (Silverwood-Cope 2012)

Fig. 3: Relationship between PNMC, NPCC, Sector Plans and NAMAs in Brazil.



Source: own illustration based on (General Coordination on Global Climate Change 2010)

Box 3: Conclusions on low carbon development strategies in Brazil

The National Policy on Climate Change implements Brazil's pledge under the UNFCCC of reducing emissions by 36.1-38.9 % below BAU into nationally binding legislation. It also adds an absolute emission cap at 2 $GtCO_2e$ per year emissions by 2020.

The National Policy on Climate Change with the various plans and strategies to further detail activities form a consistent system of strategies. While the sector plans aim to identify concrete mitigation actions, it is not clear in how far they will be effectively implemented and will form an integral part of mainstream decision-making, or remain as 'environmental activities' at the fringes of policy making.

Key to successful emission reductions will be the land use sector and agriculture. In both areas action plans were established, for the Amazon even as early as 2004, and are under implementation.

3.3.2 Mitigation actions

Nationally appropriate mitigation actions (NAMAs)

Brazil is of the view that NAMAs for developing countries should be voluntary, non-quantified and supported by developed countries according to the Convention principles. Brazil considers actions that result directly in emission reductions as NAMAs.

Brazil's voluntary NAMAs reported to the UNFCCC are summarised in Tab. 2 in chapter 3.3.1, based on the actions defined in the PNMC, regulated through Decree 7.390/2010 (Townshend et al. 2013) and are included in the sector plans (Lèbre La Rovere 2011). Additional NAMAs are being explored by non-governmental organisations (Ecofys 2013).

Mitigation policies and measures

Decreasing deforestation

The Forest Code (Federal Law 4771/1965), is the most important regulation in the area and has regulated minimum forest cover on private land holdings since 1965. The Forest Code regulates land use in forests and other Protected Area with the aim to establish clearer rules for the agricultural sector using the Amazon Forest. A set of changes to the law entered into force in October 2012 (Townshend et al. 2013; Boadle 2012). The most critically discussed change being the amnesty introduced for illegal deforestation activities that started before 22 June 2008. This not only prevents these areas from being replanted, but could also encourage future illegal activity as an amnesty becomes a realistic option (Höhne et al. 2012).

Box 4: The Forest Code (Brazil)

Main features of the revised Forest Code are:

- Definition of a share of forest reserve that needs to be preserved within areas with native vegetation. The share varies by region: 80% in the 'Legal Amazon', 35% in Cerrado, 20% in all other regions.
- Rules for mandatory restoration of deforested areas, with exceptions to smallholders.
- Establishment of a "Rural Environmental Register" to enable detailed tracking of activities.
- Amnesty to landowners for deforestation activities that started before 22 July 2008
- Mandatory reforestation of riverbanks, depending on the width of the river and the size of the property
- Protection of mangrove swamps, but legalization of some economic activities at the peripheral regions

(Townshend et al. 2013; Presidência da República 2012)

A programme for payments for ecosystem services known as "Green Allowances" entered into force in 2011 and aims to incentivize conservation while providing income for the poor and promoting capacity building (Townshend et al. 2013).

Further important instruments to reduce deforestation are the sectoral plans defined for the Amazon (PPCDAm) and Cerrado (PPCerrado) biomes. Since their launch in 2004 (PPCDAm) and 2005 (PPCerrado) their implementation resulted in the creation of large conservation areas and improved monitoring of activities and enforcement of law (Ywata et al. 2012)(Ministério do Meio Ambiente 2012)

Since 2006 law no. 22184 establishes principles for the management of public forests, including regular audits. It includes institutional arrangements for control and environmental inspection and creates the Brazilian Forest Service (BFS) to manage public forests. The law also established the National Fund for Forest Development (NFFD), with the purpose to promote sustainable forestry activities and technological innovation (Townshend et al. 2013).

In 2009 Brazil approved the Agro-Ecological Sugar Cane Zoning law (ZAE Cana) as well as the Agro-Ecological Palm Oil Zoning law, for protection of the Amazon, the Pantanal and other protected areas against cultivation of sugar cane and support growth of palm oil plants in degraded areas and no longer on regions with native plants (Secretariat for Social Communication of the Presidency of Brazil 2010).

A number of other regulations and programs address important aspects related to deforestation. These include:

- The National System of Protected Areas (SNUC): aimed to protect Brazil's flora and fauna at federal, state and municipal level, and to harmonize legislation in this field (General Coordination on Global Climate Change 2010). This includes the Amazon Region Protected Areas (ARPA). The goal of the programme, to protect 50 million hectares of Amazon forest until 2014, has already been reached (Secretariat for Social Communication of the Presidency of Brazil 2010).
- Prevention and Control of Burnings and Forest Fires: since 1998 the 'Proarco' programme aimed at decreasing forest burning with a focus on large scale fires in the Legal Amazon. Since 2001 the National System for Preventing and Combating Forest Fires (PREVFOGO) is in place with the establishment of dedicated fire brigades, access pathways and provision of training to fire fighters (General Coordination on Global Climate Change 2010).

Brazil published a 'REDD strategy' in 2009 (Federative Republic of Brazil 2009) that however focused more on describing the status quo than develop a forward looking strategy. Legislation to implement the required framework has been under development since 2010, but activities at regional level have progressed despite the absence of a national strategy (Townshend et al. 2013).

An important element in addressing deforestation was the establishment of the Amazon Fund in 2007. By 2012 there were 36 projects running financed through the Amazon Fund (Teixeira & Coutinho 2013). The existence and functioning of the fund is also an important element for increased international cooperation in the sector in the context of REDD+.

Re-/afforestation

Reforestation activities are mainly regulated through the forest code (see above). They include the reforestation of cut areas as well as riverbanks.

Afforestation is mainly targeted at National Forests. The intention is to increase the area under State control, reserving it for afforestation purposes and promoting sustainable use. Between 2002 and 2009 the number of National Forests was increased from 59 to 77 with an increase in area from 16 to 23 million hectares (General Coordination on Global Climate Change 2010).

Private actors also engage in voluntary afforestation activity. As an example, it is planned to plant 1200 hectares of forest to compensate for the carbon footprint of the Olympic games in Rio 2016 (Watts 2012).

Use of sustainable biofuel in industry

The main instrument for the promotion of sustainable biofuel in industry is represented by the Plan for the Reduction of Steel Industry Emissions (Plano Setorial de Redução de Emissões da Siderurgia). The Plan foresees two main fields of measures: expansion of forest plantations and improvement of efficiency in charcoal production processes. The aim is to substitute the production of charcoal from native forests through production from plantations. Currently technical norms for the production of charcoal are under discussion together with the Brazilian Steel Association (IABr) (Ministério do Desenvolvimento Indústria e Comércio Exterior 2011).

As the main instrument for the implementation of activities, public-private partnerships are foreseen to make use of experiences of the private sector through the CDM. Approved methodologies used under the CDM are to be used to ensure measurability, reporting and verification.

The modernization of the charcoal production chain is to be implemented by the Brazilian Micro and Small Business Support Service (SEBRAE). Overall implementation is to be decentralised under the coordination of CIM (Ministério do Meio Ambiente 2010).

Energy efficiency of processes

The Ten-Year Plan for Energy Expansion (PDE 2021), details energy programmes and projects to be implemented in this time frame, including energy efficiency in industry (Lèbre La Rovere 2011) (Ministério de Minas e Energia 2012). By 2021 the industry sector is expected to reduce energy use by almost 18 TWh, a 5.9% reduction below BAU (Ministério de Minas e Energia 2012).

Much earlier the 'Procel Indústria' Industrial Energy Efficiency programme was installed. The focus of the programme is to minimize losses in motor-driven systems already installed in the Brazilian industry, increasing the market penetration of high-efficient three-phase induction motors and efficient motor loads and strengthening the technical support in this area. The programme's goal of the 1st phase until 2007 was nearly achieved. Other focuses are efficient industrial processes, monitoring and electric losses (Alves Soares 2008; International Partnership for Energy Efficiency Cooperation 2012).

Tab. 4: Energy Efficiency programs in industry in Brazil

Program	Objectives	Results
National Programme for Electricity Conservation - PROCEL (1985) in especial PROCEL Indústria	Promotion of high efficiency motors Decrease losses in installed motor systems (Ministério de Minas e Energia 2010)	2700 technical agents were trained at the end of 2008 (Ministério de Minas e Energia 2010)
Energy- efficiency credit line PROESCO (BNDES)	Support of Energy Service Companies through provision of credit lines Finance studies, installations, new equipment, technical service, monitoring and information systems (BNDES 2013)	In 2011 16.5 million US Dollar of financing was approved (Nielsen 2012)
National Energy Efficiency Plan – PNEf (published 2011)	Guidelines to introduce energy efficiency to support implementation of the PNE (Moss 2012)	Not yet visible

Non-CO_2 emissions from soils and livestock

While deforestation rates have been decreasing substantially over the last decade, agricultural production has increased over the same period. Grain production for example increased by 65% between 2001-02 and 2010-11 and the planted area increased by 25% (IPAM 2012). This shows the increasing importance of the sector, which is also reflected by the large potentials identified in the sector by various studies (see Fekete et al. 2013).

The main instrument in the sector is the Sectoral Plan for agriculture. The "Plan for the Consolidation of a Low Carbon Emission Agriculture" (ABC Plan) which was launched in 2010. The objective of the plan is to promote best agricultural practices in six areas (Ministério da Agricultura 2013):

- Renovation of degraded pastures
- Integrated crop-livestock-forestry systems
- No-tillage systems
- Biological nitrogen fixation
- Plantation forests
- Animal waste treatment
- Adaptation to Climate Change

These objectives are to be achieved through a mix of activities, including research, education and training, technical assistance, regulation and provision of inputs, material and credit. The largest part of funding provided for the implementation of activities is earmarked for the rural credit scheme (Ministério da Agricultura 2013). The overall amount available for the programme, however, is relatively small with only around 6% of total funding within the "agriculture and livestock plan" for 2011-12 going to the ABC programme (IPAM 2012).

Uptake of the credit programme was slow in the first year. Insufficient information and marketing as well as the high environmental standards are claimed as main reasons for this. After more efforts into marketing of the funds and a relaxation of environmental standards uptake increased in 2012, but overall performance on GHG emissions is yet unclear due to the fact that also projects that have no impact on GHG emissions or even negative (e.g. rice paddies) (Angelo 2012).

3.3.3 Coherence of strategies, activities and potentials

Does Brazil consistently translate strategies into actions?

The process to translate the National Policy on Climate Change into action is still under way. The general provisions and goals formulated in the National Policy have been translated to more concrete sectoral plans of which most are now in the first years of implementation. For most sectors, especially in deforestation, the developed sector plans seem to adequately translate the set targets into actions. A weak but important area is the agricultural sector, where the current plan with its relaxed environmental standards does not seem to be able to achieve the envisaged emissions reductions.

The Brazilian growth strategy collides with climate policy measures in some areas, especially regarding the expansion of large scale agriculture. This includes the cultivation of sugarcane for biofuel, but also soy driving cattle breeding into forest areas. Plans in the energy and transport sector also not always match with envisaged climate policy (Scholz 2010; Zanella & Cardoso 2011).

The plans of the Ministry of Mines and Energy for 2008-2017 for example involve the expansion of fossil fuel based thermal power stations. This is contradictory to the aim of using more renewable energy (Townshend et al. 2013).

Do strategies and activities support the use of identified potentials?

In line with the identified potentials, Brazilian strategies and activities mainly target the prevention of deforestation. Sectoral planning covers most of the relevant potentials identified, with the exception of re-/afforestation measures. Additionally there are shortcomings in the effective implementation of measures in the agricultural sector. Tab. 5 provides a comparison between the measures identified with the largest potentials to the targets identified as NAMAs.

Tab. 5: Comparison of identified highest potentials with sectoral targets for Brazil's National Policy on Climate Change

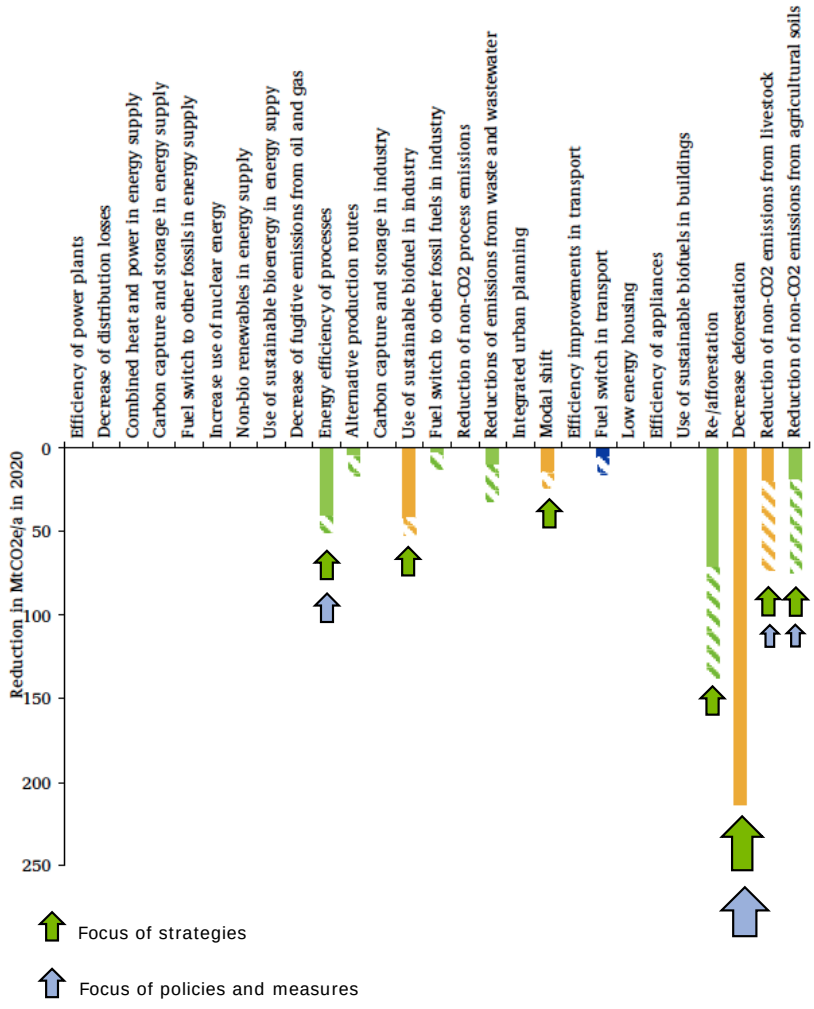
Measure (categories from this report)	Identified potential ($MtCO_2e/a$)	Sector target ($MtCO_2e/a$)	Measures (categories from NAMAs)
Decrease deforestation	213-874	669	Land use
Re-/afforestation	72-138		
Reduction on non-CO_2 emissions from livestock	19-73	18-22	Integrated crop-livestock system
Reduction of non-CO_2 emissions from agricultural soils	18-75	115-144	Restoration of grazing land No-till farming Biological nitrogen fixation
Energy efficiency of processes	40	12-15	Energy efficiency (not only industry)
Use of sustainable biofuel in industry	42	8-10	Iron and steel – replacing coal from deforestation to planted forests

As described in the sections above we see most activity in combating deforestation and increasing energy efficiency, especially in industry. The sector plans address most important activities required for effective implementation of GHG emission reductions.

The voluntary commitment to reduce deforestation by 80% compared to the officially defined baseline by 2020[1], is on a good way to be reached, if the current pace of decrease in deforestation is maintained (Townshend et al. 2013; Robinson 2010; Secretariat for Social Communication of the Presidency of Brazil 2010).

We see clear gaps in implementation in the agricultural sector where the existing ABC plan has not been able to tap the identified potential. It remains to be seen how far the new sectoral plan for the sector will be able to improve this.

Fig. 4: Brazil: Ranges of mitigation potential compared to strategies and policies and measures implemented.



(Source: (Fekete et al. 2013)). Additional arrows: Areas with relevant policy activities.

[1] For a critical discussion of this baseline see (Fekete et al. 2013).

Box 5: Conclusions on coherence of mitigation potentials, strategies and measures in Brazil

With the National Policy on Climate Change and the related national and sectoral plans Brazil is in a good position to implement large parts of the identified potentials. As can be expected from its GHG emissions profile the focus of strategies and activities has been in the area of reducing deforestation. This is in line with the large identified potential.

For other measures the picture is mixed. Afforestation is partly addressed within the Forest Code and the sectoral plan for agriculture, but given the large potential a dedicated strategy and related instruments and actions would seem appropriate. The potentials identified for the reduction on non-CO_2 emissions from soils and livestock are adequately addressed on the strategic level within the ABC plan, but implementation seems to lack behind the ambition set by the strategy.

For energy efficiency in industry and the use of sustainable biomass in industry strategies and measures seem adequate to achieve the stated goals, although these fall short of the identified potentials.

3.4 Remaining barriers to unlocking identified potentials

3.4.1 Nation-wide barriers

With Brazil's inclusive approach to legislation including intensive stakeholder consultation as well as scientific and expert input into the process there are few barriers on the legislative side. A key issue arises from enforcement of environmental legislation rather than from lack of instruments (Townshend et al. 2013).

Conflicting goals between growth strategies and environmental plans in different sectors also constitute a barrier to effective implementation of measures. This is most prominent in the land use and agricultural sector, but also applies to other areas of the economy (Scholz 2010; Zanella & Cardoso 2011).

3.4.2 Measure-specific barriers

Tab. 6 provides an overview of the barriers that were found in literature for the measures with the largest identified mitigation potential. Especially in the area of energy efficiency in industry and in the agricultural sector lack of information and capacity is dominant. Financial and economic barriers are found across all measures while institutional and political barriers only play an important role for reducing deforestation.

Tab. 6: Overview of type of barriers to most important mitigation measures in Brazil.

	Decrease Deforestation	Re-/afforestation	Energy efficiency of processes	Livestock and Agricultural soils
Share of total potential	49%-67%	11%-16%	3%-9%	8%-12%
Barriers				
Institutional/political	X	x		x
Financial/economic	X	x	X	X
Technical	X			
Informational/capacities			X	X
Others	x			x

Note: if x, then barrier is relevant to measure. Size indicates importance of the barrier. Blue colour bar illustrates the importance of the potential as a share of total potential in steps of 10% points.

Decrease deforestation

The main institutional and political barriers relate to the ability to effectively enforce existing legislation to prevent deforestation. A norm implemented in December 2011 defines that only the authority that issues logging permits is allowed to punish illegal logging (Presidência da República 2011). These authorities are usually local or state agencies. Before the change the federal Brazilian Institute of Environment and Renewable Natural Resources (IBAMA) was successfully engaged in environmental law enforcement. The change in responsibility together with the recent amnesty granted for illegal logging activities before 2008 could pose a significant barrier to the successful implementation of existing legislation (Brindis 2011; Höhne et al. 2012).

On the financial and economic side the large increase in demand for agricultural products could threaten past successes in reducing deforestation by increasing the profitability of clear cutting for agricultural purposes (IPAM 2012).

To monitor and control deforestation Brazil uses a satellite monitoring system. Illegal loggers have learned to adapt to the observation methods and know how to avoid being detected. They cut only sparse small areas, which are hardly detectable. INPE is aware of this problem and the improvement of monitoring technology is under evaluation (Faleiros 2011).

Another problem with the satellite monitoring system is cloud cover. This circumstance allows that only a small percentage of the forest can be assessed at a given time (in average 30% of the Amazon) and so deforestation actions can stay undetected (Faleiros 2011) (Martins et al. 2013).

Brazil has many protected areas, but their creation alone does not guarantee the maintenance of biodiversity. The implementation of the protected areas is confronted with problems of enforcement due to lack of funds, means of transport, equipment and staff. Additionally the

areas are sometimes extremely hard to access (General Coordination on Global Climate Change 2010).

The farm lobby in Brazil is very strong with influence on legislators from a widespread political spectrum (Boadle 2012). Especially in the Congress, which is pivotal for the approval of a law or decree, the agricultural lobby is strongly represented (Peplow 2012).

Tab. 7: Most relevant barriers to deforestation reduction in Brazil.

Institutional/ political	Responsibility for enforcement with local authorities undermines effectiveness (Brindis 2011) Revised Forest Code with amnesty to illegal logging before 2008 could encourage future illegal logging activities (Höhne et al. 2012)
Financial/ economic	High demand and high prices for agricultural products increase profitability of deforestation for agricultural activities (IPAM 2012) Lack of finance, equipment and staff for protected areas (General Coordination on Global Climate Change 2010)
Technical	Illegal loggers have learned to adapt to satellite observation (Faleiros 2011) Cloud cover while satellite monitoring (Faleiros 2011)
Others	Strong agricultural lobby (Boadle 2012)

Re-/afforestation

The New Forest Code does not provide sufficient economic incentives for farmers to reforest their land or to cultivate it in a sustainable way (Tollefson 2012) outside the legal requirements for reforestation (Boadle 2012).

Overall the lack of a dedicated strategy to promote re-/afforestation can be seen as a barrier to tap the identified mitigation potential from the measure.

Energy efficiency in industry

Financial restrictions and lack of know how pose the most important barriers for implementation of energy efficiency measures in industry. 65% of the budget of the programme for acceleration of economic growth is foreseen for the expansion of infrastructure measures for natural gas and oil. The amount for renewable energy and for energy efficiency is very small (Scholz 2010)

There is low know-how about new technologies to save energy and to improve the energy efficiency. There are not many training consultants (Bundesministerium für Wirtschaft und Technologie 2010).

Tab. 8: Most relevant barriers in energy efficiency in Brazil.

Financial/ economic	Budget of the programme for acceleration of economic growth mostly foreseen for expansion of infrastructure measurements for natural gas and oil (Scholz 2010)
Informational/ capacities	Lack of know-how on new technologies, lack of training capacity (Bundesministerium für Wirtschaft und Technologie 2010)

Non-CO_2 emissions from soils and livestock

The two largest areas of challenges in the agricultural sector are the lack of financial resources and incentives to implement more sustainable practices and a large information and capacity deficit.

High demand and prices for agricultural commodities make the exploitation of resources highly profitable. At the same time funding for more sustainable farming practices is still only a minimal share of total funds provided to the sector (IPAM 2012; Angelo 2012). Combined with low levels of information available to farmers, lack of resources for technical assistance and restrictions for many small-scale farmers to access available funds for sustainable practices, this provides a major barrier to the adoption of low emissions farming practices (IPAM 2012; Faleiros 2011).

Tab. 9: Most relevant barriers to agricultural soils in Brazil.

Institutional/ political	Unclarity on federal and state legislation motivates farmers to wait to move to more sustainable farming practices (IPAM 2012)
Financial/ economic	High demand and high prices for agricultural products make production highly interesting and reduce incentives for environmentally sustainable practices which reduce profit (IPAM 2012; Kaimowitz et al. 2004) Funding for sustainable agriculture through the ABC plan is still small relative to funding provided to traditional agriculture (IPAM 2012; Angelo 2012)
Informational/ capacities	Difficulty of access to low-interest credit by farmers due to credit history, information deficits on availability, lack of capacity to apply and inability to prove land ownership (IPAM 2012) Lack of capacity of producers to get required 'rural environmental registration' (CAR) to be able to access funding (IPAM 2012) Lack of information and technical assistance combined with traditionally conservative and low-risk mentality prevents adoption of new technologies/techniques (IPAM 2012; Faleiros 2011)
Others	Strong agricultural lobby (Boadle 2012)

3.5 Conclusions

Brazil has a comprehensive legal framework that not only enshrines the pledge made to the UNFCCC into national legislation, but also provides for a set of tools for implementation. While the sector plans aim to identify concrete mitigation actions, it is not clear in how far they will be effectively implemented and will form an integral part of mainstream decision-making, or remain as 'environmental activities' at the fringes of policy making.

The technical and analytical capacity to provide information for planning of strategies and measures is large and a wide range of institutions are involved in the processes leading to the definition

Highlights
- National Policy on Climate Change translates pledge to domestic legislation
- Two national funds to support climate related activities: Amazon Fund and National Fund on Climate Change
- High national technical and analytical capacity to support policy processes
- Most advanced strategies and measures have addressed deforestation in the Amazon successfully in the past decade

Possible improvements
- Enhanced enforcement of legislation
- Technical assistance, capacity building and information in the agricultural sector and in industry
- Dedicated strategy for afforestation

of plans and programs. The large number of involved experts requires substantial coordination capacity. This also shows in the MRV system that provides the required GHG emissions inventory data. The institutional structure with the main coordination team at the MCT allowed to make constructive use of the extensive expertise available. Tools and methodologies are available and there is sufficient experience to improve and enhance these over time.

However, a fixed framework structure for establishing the inventories that is able to collect all information and knowledge over time ensuring continuity is still missing. This includes staff continuity as well as appropriate archiving and knowledge management systems that allow an institutional memory.

A number of coordinating bodies take this role outside the MRV system. Coordination for climate policy exists through the General Coordination on Global Climate Change and the Inter-ministerial Commission on Global Climate Change. However, overall the division of tasks, reporting lines and responsibilities are not fully clear between the different institutions and Ministries involved in the formulation of strategies, plans and concrete laws and measures.

Brazil has been a frontrunner in the setup of national finance institutions to support climate related activities. The existence of the two national funds is a useful setup and has large potential for enhanced mitigation action at national level, but also provides a good basis for international cooperation and support.

Brazil's aim to reduce GHG emissions mostly through a decrease in deforestation is largely in line with governmental policies and the identified mitigation potential in this area.

For other measures the picture is mixed. Afforestation is partly addressed within the Forest Code and the sectoral plan for agriculture, but given the large potential a dedicated strategy and related instruments and actions would seem appropriate. The potentials identified for the reduction on non-CO_2 emissions from soils and livestock are adequately addressed on the strategic level within the ABC plan, but implementation seems to lack behind the ambition set by the strategy.

For energy efficiency in industry and the use of sustainable biomass in industry strategies and measures seem adequate to achieve the stated goals, although these fall short of the identified potentials.

Tab. 10 summarized some important elements of the report for Brazil. It illustrates the potentials of different measures and related activities to tap these as well as remaining barriers. Additionally, we present ideas on how the international community can support Brazil in overcoming some of these remaining barriers.

Tab. 10: Overview of potentials, actions and remaining barriers for most important mitigation measures in Brazil

Potential	Coverage as priority in national strategy and targets	Implemented policies to tap potential	Remaining barriers	Opportunities for international support
Decrease Deforestation Total potential in 2020: 213 and 874 $MtCO_2e/a$	Action Plan to Prevent and Control Deforestation in the Legal Amazon - PPCDAm; Action Plan to Prevent and Control Deforestation in the Cerrado - PPCerrado	Amazon Fund; Forest Code; Protected Areas; Prevention and Control of Burnings and Forest Fires Programs; Payment for environmental services	Law enforcement problems due to institutional issues and lack of resources; Economic incentives high to cut forest; Technical problems with satellite surveillance	Additional funds to improve satellite surveillance
Re-/afforestation Total potential in 2020: 71.6 and 137.5 $MtCO_2e/a$	No dedicated strategy	Partly through Forest Code and ABC programs	Lack of economic incentives; Lack of a dedicated strategy	Support public-private partnerships for afforestation activities
Energy efficiency of processes Total potential in 2020: 40.1 $MtCO_2e/a$	Ten-year Plan for Energy Expansion; National Energy Efficiency Plan – PNEf	'Procel Indústria' Industrial Energy Efficiency Program; Energy efficiency credit line PROESCO	Lack of financial resources; Lack of know-how on new technologies, lack of training capacity	Support in information campaigns and with training of local capacity
Livestock and Agricultural soils Total potential in 2020: 36.8 and 72.6 $MtCO_2e/a$ 18.4 to 74.7 $MtCO_2e/a$	"Low-Carbon Agriculture" Plan (ABC)	ABC rural credit program Capacity building Technical assistance	Lack of information and technical assistance; Difficulty of access to low-interest credit by farmers; Low levels of funding compared to 'traditional agriculture';	Support in information campaigns and with training of local capacity

4 China

4.1 Introduction

China has grown to be one the world's most important economies and is experiencing significant growth. With a population of 1.3 billion in 2011 and a Gross Domestic product (GDP) of 9.94 trillion US$ (PPP constant 2005), it holds first and second place, respectively, in country rankings according to population and GDP (World Bank 2012). Its contributions to climate change have become increasingly important; both in terms of absolute GHG emissions driving climate change as the largest emitter globally and its input at international climate change negotiations.

Under the Copenhagen Accord, China has pledged to reduce CO_2 emission intensity by 40 to 45% below 2005 levels by 2020. Previous analysis explored China's climate change mitigation potential in different areas and compared it to the business as usual development of emissions, the country's pledge and efforts needed according to different equity principles (Fekete et al. 2013). As elaborated in that report, China's mitigation potential goes beyond the pledged reductions. Also, their "fair share" of emission reductions according to most equity principles is bigger than the reductions implied by the pledge. Even with technical measures with negative costs or significant co-benefits, China can already go beyond their pledge. At the same time, projections including national policies show that China will achieve its pledge but not go much beyond it (Höhne et al. 2012).

The main possibilities for GHG mitigation in China lie in the energy supply sector, specifically in the area of renewable energy. Other important areas of mitigation are in the building sector, which is subject to rapid changes due to increasing economic wealth, and in the industrial sector, specifically in the area of energy efficiency. Measures with substantial potential also exist in the transport sector. Data is only available for efficiency improvements in this area, although a modal shift might also lead to relevant emission reductions (Fekete et al. 2013).

4.2 The institutional framework for climate policy

This chapter illustrates the current situation in China in terms of its institutional setup and Monitoring, Reporting and Verification (MRV) activities related to climate change mitigation. More specifically, we analyse the setup of government institutions responsible for climate change issues and the systems for MRV of GHG.

4.2.1 Institutional setup for climate regulation

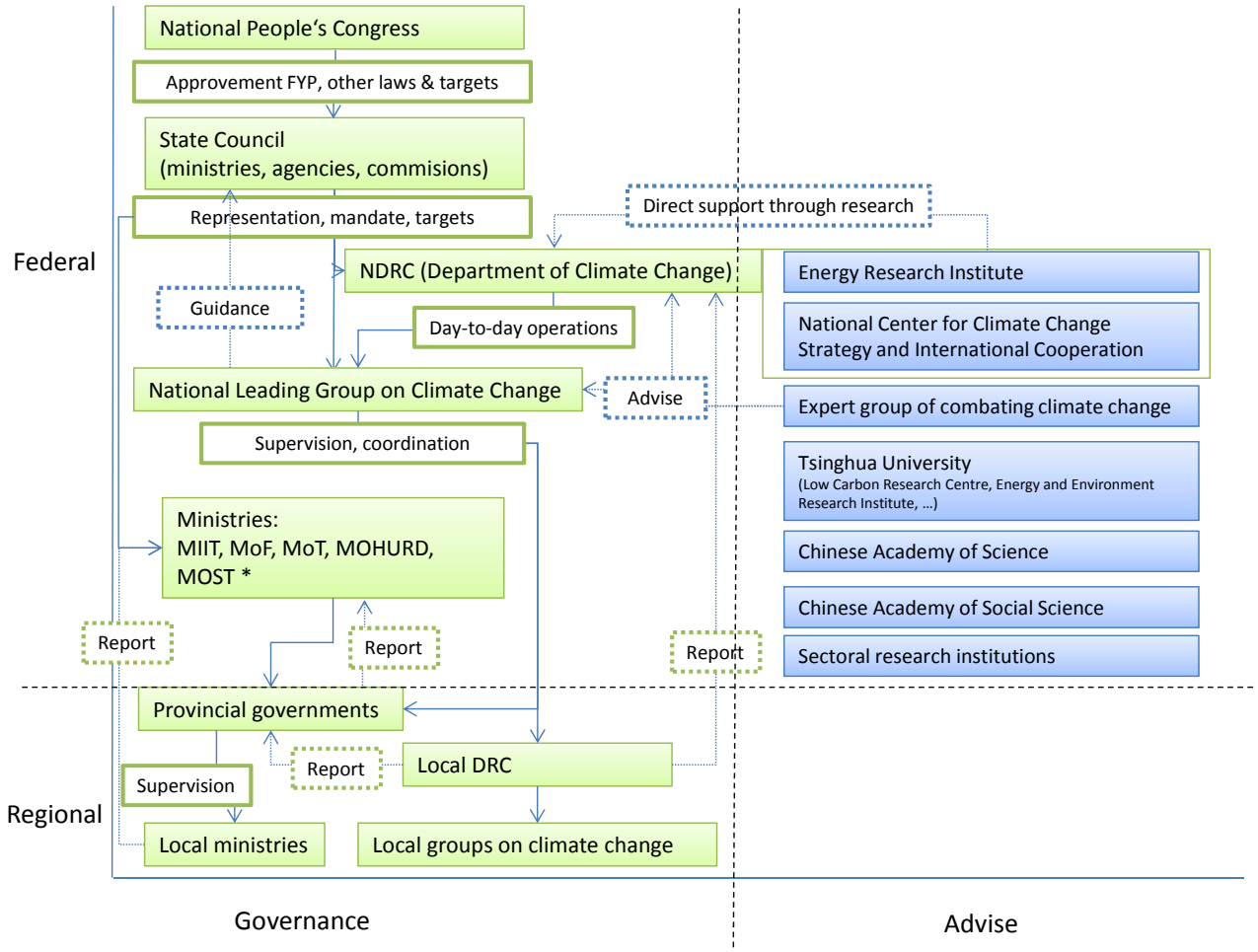
Climate change has been on the national agenda for some decades, since China joined in the United Nation Framework Convention for Climate Change (UNFCCC) in the early 1990s. The international involvement in the topic gradually triggered down to the national strategic level. The development of the institutional setup demonstrates this.

Fig. 5 and Tab. 11 illustrate the current setup of government institutions and supporting advisory bodies and their responsibilities for climate change regulation. The subsequent paragraphs explain the different levels further.

Legislative and framework level

The Constitution states that the National People's Congress (NPC) and its Standing Committee are empowered to exercise legislative power of the State, amending and introducing new laws. The NPC has issued decisions on climate change mitigation, giving the mandate to the government to integrate mitigation targets into the Five Year Plans (FYPs). Its endorsement of the 2020 climate change target for China also makes it formally legally binding at the national level. Energy saving and low carbon (GHG mitigation) are strongly interlinked in China's climate related administration, and a series of new laws or amendments of laws on renewable energy, energy saving, circular economy, clean production etc. have been launched by NPC.

Fig. 5: Overview of institutional setup in China



* MIIT: Ministry of Industry and Information Technology; MoF: Ministry of Finance; MoT: Ministry of Transport, MOHURD: Ministry of Housing and Urban Rural Development; MOST: Ministry of Science and Technology

Source: own illustration

The Executive Branch of government is led by the State Council where 29 ministries and state commissions are represented. The State Council also oversees the work of government in each of China's 34 province-level administrations. Decisions and orders of the State Council, most notably the FYPs provide the basic framework for all key policies and measures, including those on climate and energy. They are binding on the ministries and provincial agencies responsible

for their implementation. The State Council also oversees various agencies and commissions related to climate change, such as for example the China Meteorological Administration (CMA), the National Energy Administration (NEA) and the National Bureau of Statistics (NBS) (Government of China 2012).

Tab. 11: Overview of government institutions and their responsibilities for climate regulation in China

Level	Government institution	Role and Responsibilities
Legislative and framework level	National People's Congress	China's highest legislative body
	State Council	China's highest executive and administrative body
Programmatic level	National Leading Group on Climate Change	The highest administrative body overseeing mitigation policies and actions
	National Development and Reform Commission: Department of Climate change	Lead ministry on coordinating climate and energy strategy and actions
	Relevant ministries: NEA MIIT MoF MoT MOHURD NBS MOST	Respective responsibilities: Energy sector Industry and communication sector Management of state budget and financial policies Transportation sector Building sector Data and statistics S&T development
Provincial level	Local DRC Leading group on climate change	Overseeing and coordinating provincial mitigation policies and actions
	Relevant bodies: Regional bodies for MIIT, MOST, MoF etc.	Developing and implementing sectoral or supporting policies and actions at regional level

Programmatic level

Climate change policy was under the responsibility of the CMA until the late 1990's. This responsibility was transferred to the National Development and Reform Commission (NDRC) in 1998, shifting climate change from a scientific issue to a significant development issue. In the same year the National Coordination Committee on Climate Change (NCCC) formed under the Climate Change Department of the NDRC, headed by the Premier and including more than 20 ministries and agencies as members.

In 2007, the State Council decided to transform the NCCC and established the National Leading Group on Climate Change. It is the highest administrative body overseeing mitigation policies and actions, responsible for taking the lead in the formulation and coordination of China's climate change-related policies and measures, providing guidance for central and local governments' response to climate change, and organising for international negotiations (Qi et al., 2007). The leading and cross-ministerial role of NDRC has been classified as a good example

of National Designated Agencies (Project Catalyst, 2009). It assigns individual energy and carbon intensity targets to each province, monitors their progress and develops and supervises national-level programmes. A National Climate Change Expert Committee was also set up to support decision making.

Relevant ministries are in charge of specific sectoral climate regulations, including but not limited to: National Energy Administration (NEA), Ministry of Industry and Information Technology (MIIT), Ministry of Finance (MoF), Ministry of Transportation (MoT), Ministry of Housing and Urban-Rural Development (MOHURD), National Bureau of Statistics (NBS).

Provincial level

In 2007, the State Council requested each province to establish coordination mechanisms and leading groups. These are responsible for overseeing and coordinating provincial mitigation policies and actions. In general they follow the set up at the national level, i.e., they are led by the local Development Reform Commission, but either the Ministry of Science and Technology (MOST) or China Meteorological Administration (CMA) have also taken coordination roles. With support of the World Bank, the provinces Hubei, Jilin, Shaanxi, and Yunnan completed climate change action plans in 2007 (NDRC 2007b). By 2009, all 34 provinces had completed climate change plans, mostly drawn up by expert assessment and consultation with provincial government agencies.

Box 6: Conclusions on the institutional setup for climate legislation in China

Climate legislation is centralised on the national level, giving only little responsibilities to the provinces who mainly execute decisions taken by the national government. As regional interests may not necessarily include a decrease of GHG emissions, a lack of implementation can result from this.

Climate legislation in China involves various ministries, all responsible for their specific topic areas. The NDRC serves as an important central hub for the coordination of all matters related to climate change. It also establishes a close link to scientific institutions.

4.2.2 Institutional setup and activities for MRV

The national climate change commitment of China follows growing international MRV requirements and highlights the importance of developing and maintaining strong GHG emission tracking systems. These efforts are already underway: in early 2010, the NDRC requested all provinces to prepare the first provincial GHG inventories for the year of 2005; and the 12th FYP (2011-2015) explicitly requires the establishment and improvement of the statistical and monitoring systems for GHG emissions. While China's early MRV efforts were largely in response to international drivers, its systems are increasingly oriented to supporting domestic policies and programmes.

MRV institutions

China prepared its GHG inventories and National Communications on a project basis. Thus, the institutions involved in the processes varied in the past.

For the Initial National Communication that was submitted in 2004, the NCCCC delegated oversight over the preparation of the document and inventory to the NDRC and also established an expert Project Steering Committee to ensure overall guidance and a Project Management Office to strengthen the unified management and implementation of the project (PRC, 2004). The Energy Research Institute (ERI, part of the NDRC) and a number of scientific bodies, including institutes of the Chinese Academy of Sciences (Atmospheric Physics, Forest Ecology and Environment, Agrometeorology), also participated in the development of the inventory (Climate Policy Initiative, 2012).

For the Second National Communication, the Department of Climate Change of the NDRC delegated the inventory preparation by sector to institutions with relevant expertise (Tab. 12). The ERI had overall responsibility for developing the inventory database. This included defining the basic requirements of the database, collecting information, and maintaining the inventory.

Tab. 12: Institutions involved in China's national GHG inventory preparation since 2007

Sector	Institution
Energy	Energy Research Institute of NDRC
Industrial processes	Low Carbon Research Centre, Tsinghua University
Cropland	Institute of Physics, Chinese Academy of Sciences
Livestock	China Academy of Agricultural Sciences
Land use change and Forestry	Research Institute of Forest Ecological Environment Protection
Wastewater/sewage treatment	Chinese Environmental Science Research Institute

Source: The People's Republic of China 2012

China's institutional capacity to monitor emissions has developed substantially since its Initial National Communication. To facilitate inventory preparation in the future, the ERI is tasked with developing an Emissions Forecast Methodology. While the ERI develops general criteria for the collection and analysis of information, specific methodologies are developed by the contracted institutions. A database system is also developed. We can expect this setup to be further developed for future reporting requirements internationally and on a national level.

Where the government requires MRV on a provincial level, the local Development and Reform Commissions are in charge for collecting and reporting inventory data. They seek support from research institutions (e.g. Guangdong Technology and Economy Research Development Centre, Hubei Energy Saving Supervision Centre, Liaoning DRC Economy Research Institute, Yunnan Academy of Environmental Sciences, Zhejiang Development and Planning Research Institute, etc.). The central government provides financial support, guiding documentation and capacity building involving the ERI and national experts.

MRV activities

China has submitted two National Communications, including GHG inventories for the years 1994 and 2005. The following paragraphs give a short evaluation of the documents. The annex

in section 11.2 includes more details on approaches to the National Communications and the inventories.

Research for the Initial National Communication started in 2001 and the final document was released and submitted in both Chinese and English in 2004. The document includes its first GHG inventory for 1994 and three gases, CO_2, CH_4 and N_2O (The People's Republic of China 2004).

The process for the Second National Communication began in 2007, when the UNDP (as implementing agency for the Global Environmental Facility (GEF)) approved US$5.35 million in support for its development (GEF 2010). China released the document in 2012, including a more developed inventory covering 2005 emissions of all six relevant GHG and expanding to also cover Hong Kong and Macau. Furthermore, the Second National Communication contains emission projections under a reference scenario and various scenarios including policies (The People's Republic of China 2012).

In terms of methodologies used for developing the inventory, the Second National Communication is more advanced, oriented closer to the Intergovernmental Panel on Climate Change (IPCC) approaches. It uses more detailed methodologies and reporting principles, indicating a higher accuracy of the outcomes. It also contains a more detailed breakdown of sectoral data by subsector and gas. The data for the two inventory years cannot directly be compared because of the different scopes and approaches.

Although the documents include an explanation of the methodologies used, we cannot trace back the exact origin of the data and the ways of processing it. Especially for the emission projections, assumptions are unclear, making it difficult to evaluate the results. According to the uncertainty analysis provided in both documents, lack or inaccuracy of activity data is a huge problem. National statistical data does not always fulfil the requirements of international recommendations for GHG inventories.

To gather experience and enhance capacity at regional level, NDRC assigned seven provinces and cities (Guangdong, Hubei, Liaoning, Yunnan, Zhejiang, Shaanxi, and Tianjin) to be pilots for regional GHG inventory development. They were required to develop the inventory draft by mid of 2011 and submit the final version by end of 2011. Five sectors are covered: energy activities, industry process, agriculture, land use change and forestry, as well as urban waste disposal. The central government provided 0.5 million RMB support (about 80 000 USD). ERI developed the guiding document "Provincial Level GHG Inventory Guideline". Capacity-building activities involving national experts accompanied the activities (NDRC 2011b).

With the Statistics, Monitoring, and Examination Systems (SME), China established a tool to monitor its goals under the 11^{th} FYP, mainly focusing on energy intensity. Section 11.2 includes additional information on the SME. In the past years, energy statistics have shown deviations between data reported on the local level and on the national level. Calculating CO_2 emissions based on these energy data sets, emissions summed up from subnational level were 1.4 $GtCO_2e$ in 2010 higher, the difference mostly related to different results for coal combustion (Guan et al. 2012).

Guan et al. identified three main reasons for this: First, the national level does not well cover small coal producers, of which some were closed due to inefficiency but reopened elsewhere.

Second, the performance of the local authorities is measured in economic growth, incentivising over-reporting of GDP. To match energy data to the overrated GDP, authorities adapt energy consumption to the higher level as well. Third, with the national strategies and international commitments to reduce energy consumption and emission intensity, there is an incentive to under-report at the national level.

Box 7: Conclusions on MRV for climate legislation in China

UNFCCC reporting requirements and processes have been the main driver to the capacity development of MRV of GHG in China in the past. Quality and detail of inventories have improved significantly with the second National Communication. However, the processes are not yet institutionalized and integrated with the overall governance structure.

In parallel to international GHG reporting, a Statistics Indicators, Monitoring, and Examination system is in place to support tracking of energy saving targets and measures. Energy use accounts for the majority of GHG emissions in China, and the infrastructure to collect energy statistics can be easily adapted towards an MRV system for emissions, which is expected to be set up in the coming years.

For China, there are clear benefits to advance the inter-connection between the UNFCCC and non-UNFCCC MRV processes, both on informing development and evaluation of domestic policies and on enhancing trust building at the international level. Furthermore, the pilot projects for provinces to monitor and report emissions are an important step to streamline reporting methods and verify results.

4.3 Mitigation potentials, strategies and activities

China does not have a national document that is explicitly called “low carbon development strategy”. Elements closely related to those of an LCDS are included in its national plans: On one hand, China’s internationally communicated emission reduction targets are anchored on the national level. On the other hand, the 11th and the 12th FYP contain important low carbon aspects, and the topic is present in many parts of governmental planning. In the context of China we therefore use a broad definition of LCDS, including national plans that only partly refer to climate change. The following paragraphs provide an overview on strategies related to low carbon development and their relation to national policy making and target setting.

4.3.1 Low-carbon development strategies

Due to increasing pressures of resource and environment constraints, sustainable development requests, and international pressure, the Chinese government recognized the significance of green and low carbon development. This development is furthermore backed by its concept of scientific development and ecological civilization. In various international arenas, including APEC, G20, and Rio+20 conferences, national leaders announced that developing a low carbon economy is China’s national strategy. The 12th FYP confirmed that China would take a low carbon transformation pathway, characterized by developing energy savings, emission reductions, resource conservation and an environmental friendly society. In spring 2011 China also started to develop its national climate change legislation designing China’s climate change law, which is still at drafting stage and coordinated by NDRC.

The Chinese low-carbon development policy framework

The low-carbon development policy framework in China has been developed in a gradual and comprehensive manner for a decade. Between 2002 and 2006, China developed its first National Climate Change Assessment (MOST et al. 2006), followed by the National Climate Change Programme (NCCP) released in June 2007. The NCCP outlined objectives, basic principles, key areas of actions, as well as policies and measures to address climate change for the period up to 2010. It was China's first comprehensive policy document on response to climate change, as well as one of the first of its kind in developing countries.

A National Science and Technology Plan for Climate Change was released (MOST 2007) which specified areas and measures for addressing key capacity gaps of climate change mitigation, impacts and adaptation. In 2008, China released a White Paper called "China's Policies & Actions for Addressing Climate Change", outlining the basic principles for addressing climate change, highlighting strategic areas of action and listing specific targets and actions. Since 2009, annual progress reports have been released. Since the launching of 12th FYP in early 2011, implementing regulations, work programmes as well as sectoral/regional specific programmes and actions have been put in place. Section 11.2 contains a more detailed overview of the low-carbon development policy framework in China.

Bindingness of targets in China's LCDS

Targets related to climate change are well anchored on the national level. The endorsement of the 2020 climate change target for China (40-45% carbon intensity reduction comparing to 2005) by NPC in fall 2009 made it legally binding. FYPs embrace the targets into consecutive 5-year periods in a legally binding manner and integrate it into the macro economic and social development framework.

Over the 2005 – 2010 period, the overarching target was to reduce energy intensity by 20% from 2005 level, and 19.1% was achieved according to official communication (National Bureau of Statistics of China 2011). Continuing the green path set by the 11th FYP, a greater emphasis was given in 12th FYP on energy efficiency and clean energies, together with plans to gradually implement a carbon-market mechanism. Key targets include:

- Energy consumption per unit of GDP to be cut by 16% (compared to 2010);
- Carbon dioxide emission per unit of GDP to be cut by 17% (compared to 2010);
- Non-fossil fuel to account for 11.4 % (vs. 8.3% of 2010) of primary energy consumption;
- Forest coverage rate to rise to 21.66% and forest stock to increase by 600 Mm^3;

The Chinese government has broken down the nationally binding energy and carbon intensity reduction targets to provincial levels via domestic regulations.

4.3.2 Nationally appropriate mitigation actions and other relevant policies and measures and coherence with strategies

This chapter gives insights into current activities for mitigation activities, including NAMAs and other policies for reduction of GHG. We first introduce the Chinese definition of NAMAs. The description of other policies focuses on areas for which we have identified large mitigation potentials, but also includes other relevant policy areas.

Nationally Appropriate Mitigation Actions in China

China emphasizes, that NAMAs are country driven and voluntary activities by developing countries. Its definition of NAMAs excludes unilaterally funded projects (Asselt et al. 2010).

China's emission intensity target, the increase of the non-fossil share and the increase in forest coverage was proposed in November 2009 and submitted to the Copenhagen Accord on 28 January 2010 as its voluntary pledge on an international level. Later on, this overarching pledge was submitted formally by NDRC to become a Chinese NAMA (UNFCCC LCA 2011). The target is integrated in the Chinese national planning and in its strategic documents, so the NAMA as communicated to the UNFCCC is in close relation with the LCDS.

Besides the overall targets, China has not defined any mitigation projects or sectoral activities as NAMAs yet. However, there are some non-governmental activities related to NAMAs in China, such as the Project "Identifying NAMAs in selected countries" led by TERI and supported by Tsingua University and other research organisations from emerging economies. There are also two NAMA ideas under consideration under the International Partnership on Mitigation and MRV (one on urban transport, and one on cement sector (International Partnership on Mitigation and MRV 2013). However, as the government is not involved with those activities, it is unclear to what extent they will continue (with the label "NAMA" or under a different format). China also participates in the MAIN dialogue, a multinational initiative to support the design and implementation of LEDS and NAMAs through regionally based dialogues and sustainable practitioner networks (CCAP 2011), showing interest in and openness to the topic .

Other relevant GHG mitigation policies

Carbon Emission Trading System Pilot programme (2011)

Emission Trading Schemes (ETS), as market-based policy tools, are to promote the emission reductions in a cost effective manner. In October 2011, NDRC designated seven provinces and cities (Beijing, Shanghai, Tianjin, Chongqing, Guangdong, Hubei and Shenzhen) as pilots (National Development and Reform Commission 2012). The participating regions are expected to start trading locally by 2013 and cross-regionally or even nationally by 2015. So far, only Shenzhen has started its first trading period.

Under the oversight of NDRC and local Development and Reform Commissions (DRCs), various implementation bodies started the preparations as early as 2010, but face a tough timeline to deliver. These implementation bodies include local exchanges, research institutes, government associations and academics. Challenges they have in common include data availability, measuring capacity of potential ETS participants, cap setting and allocation methodologies, trading modality development and institutional capacity (Point Carbon 2012).

Up to now, Beijing, Shanghai, Guangdong and Tianjin have adopted and published their ETS pilot implementation guidelines, outlining general framework on the scope, cap setting, allocation, MRV and trading modalities. Shenzhen is the only one that has passed a local bill on its ETS and started trading. The city launched the first phase of its local ETS on 18 June 2013. The scheme sets an absolute emissions cap for the participating industries of 21% below 2010 levels (Xueqing und Hong 29.07.2013). The effectiveness of the carbon market is yet to be seen,

which will then influence the pace and prospects of a China-wide ETS and the debate around carbon pricing.

Low Carbon Province/City Pilot programme (2010)

The NDRC launched a national low carbon province and city experimental project in August 2010. The project covers five provinces: Guangdong, Liaoning, Hubei, Shaanxi and Yunnan, and eight cities: Tianjin, Chongqing, Shenzhen, Xiamen, Hangzhou, Nanchang, Guiyang and Baoding. These provinces and regions are required to include work on climate change in the local 12th FYPs and formulate low-carbon development plans (National Development and Reform Commission 2010).

Relevant policies and coordination should set out a development path suitable for China's low-carbon economy. Tasks include development plans, supporting policies, a low carbon industry system, establishment of a statistics and management system of greenhouse gas emissions and promotion of low carbon lifestyles and consumption patterns. They submitted their low carbon pilot work plans submitted by mid-2011. In addition, NDRC announced the second round of low carbon city/province pilots December 2012, including Hainan province, Beijing, Shanghai and 26 other cities, which adds to total of six provinces and 36 cities, covering most provinces in China (National Development and Reform Commission 2012). Those pilots will be the pioneers on low carbon urbanization.

Renewable energy support policies

China has been a frontrunner in Asia in the recent years in promoting Renewable energy (RE) development. The 12th FYP sets a target for renewable energy sources to reach 9.5% of total energy consumption, and 20% of annual electricity production by 2015 (National Energy Administration of China 2012). In 2012 the targets were detailed further: 100 GW wind (including 5 GW offshore wind), 21 GW solar (now increased to 37 GW), and 290 GW hydro by 2015.

Feed-in Tariffs (FIT) are a key policy instrument to support RE in China. A fixed FIT was introduced by NDRC in 2009 for onshore wind, superseding the “government-guided prices” authorised by a 2005 law, which used to evolve year-on-year depending on the results of the annual competitive bidding procedures for wind capacity. The current fixed FIT for onshore wind is differentiated into four tariff levels, according to the resource availability of the site. Between RMB 0.51/kWh (0.08 USD/kWh) and RMB 0.61/kWh (0.10 USD/kWh) are paid, with the best sites receiving the lowest FIT[2]. For comparison, coal-fired plants receive an average price of RMB 0.35/kWh (0.06 USD/kWh) (Cheung, 2011).

The NDRC also announced a unified FIT for grid-connected PV plants in July 2011, which will be reviewed regularly (NDRC, 2011). The new FIT scheme started with a price of 1.15 RMB/kWh (0.19 USD/kWh) being paid to installations, which were approved for construction before 1 July 2011, or started generation before 31 December 2011. Afterwards it was reduced to

[2] Exchange rate: 1 RMB = 0,16 USD.

1 RMB/kWh (0.16 USD/kWh). The Golden Sun Programme, an investment subsidy scheme for solar installations introduced in 2009, remains in force.

Biomass, an abundant resource especially in rural China, is also used for electricity production and receives a feed-in premium of 0.35 RMB/kWh (0.06 USD/kWh) on top of the generation price for coal-fuelled generators, which differs in every province.

Additional support schemes for RE include: corporate income tax reduction, rebate on value-added tax, government funding for research, standardisation processes, renewable energy supply projects in rural areas and remote areas, creation of RE surveys and information systems, and localisation of RE manufacturing facilities, etc. (Su et al. 2010).

Energy efficiency in industrial processes

As an overarching plan, the Chinese Ministry of Industry and Information Technology published the Climate Action Plan of the Industrial Field (2012-2020). This includes targets for the industrial sector for mitigation of GHG. The targets are further broken down to sub-sectors, such as for example steel, cement, and other emission intensive industries.

In order to accomplish the energy conservation target of a 20% reduction in energy intensity during the 11th FYP, the NDRC distributed the energy conservation target of 100 Mtce[3] to the Top-1000 Enterprises in 2006. The Top-1000 Enterprises covered 1 008[4] enterprises with comprehensive energy consumption of 180 ktce (or above) from nine important sectors. It also requires them to "establish an energy conservation organisation, formulate energy efficiency goals, establish an energy utilisation reporting system, conduct energy audits, conduct training, formulate an energy conservation plan, adopt energy conservation incentives, and invest in energy efficiency improvement options" (Price 2010). There are several energy efficiency funds at national and provincial level, which participating enterprises can draw on (ibid.). This was considered one of the most effective energy saving policies in the 11th FYP. According to the NDRC, the target of achieving savings of 100 Mtce was achieved already in 2009 (Price et al. 2011).

In 2012, NDRC assigned the energy conservation target of 250 Mtce by 2015 to 10 000 enterprises, as a follow up of the Top-1 000 Enterprises Programme. The programme in fact covered about 17 000 enterprises due to the energy consumption limits defined (comprehensive energy consumption of 10 ktce (or above) and 5 ktce (or above, appointed by relative departments)). Enterprises were requested to complete their energy audit in 2012 and draft the energy conservation plan of the five years based on it. Every year the enterprise-level verification will generate input for provincial verification. The local DRCs are responsible for the verification of the accomplishment of Top-10 000 Enterprises' energy conservation targets in March, and then report to NDRC.

[3] 1 Mtce (Mega ton coal equivalent) = 29.29 GJ.

[4] Of this initial participants, eventually 998 enterprises signed their energy-saving target contracts with local authorizes. The remaining companies dropped out of the programme for different reasons.

Low-energy housing

In the 1990s, China first introduced Minimum Energy Performance Standards (MEPS) for both new and existing residential and commercial buildings. The standards include design parameters, thermal performance of the building envelope, lighting and Heating, Ventilation and Air Conditioning (HVAC). The compliance with these MEPSs of new buildings at designing phase is high already: China has recently managed to reach almost 100% (Wuppertal Institute for Climate, Environment and Energy 2013).

However, compliance during construction is not necessarily given (World Business Council for Sustainable Development 2009) and the standards could be more ambitious to reflect current technical possibilities. In comparison to other countries, they are rather low: A building would, with the Chinese building code, consume about twice as much energy as the same building with the Swedish building code (Li et al. 2009).

To support the standards and provide additional incentives, China has established an investment scheme for heating metering, retrofit of existing buildings, energy management systems and "green buildings" (ibid.).

Energy efficient appliances

The improvement of electric appliances is approached via efficiency labels and minimum efficiency standards in China. Labels are mandatory for a few appliances (air conditioning, refrigerators, washing machines), but producers of appliances self-report the level they reach, making the effectiveness of the programme difficult to judge. Minimum efficiency standards cover more than appliances (Zhou 2008).

Efficiency improvements in transport

Principally driven by pollution of urban centres through chemical and particle emissions from fuel driven vehicles, Chinese government has implemented various emission standards for light duty vehicles for various pollutants, similar to the EU standards. Beijing recently introduced even stricter standards than the national level, because of the high pressure to decrease smog in the capital (China.org 24.01.2013). Although these policies do not refer to GHG but to other pollutants, they may be an incentive to move towards a cleaner car fleet.

For GHG emissions, China has the target to reduce emission intensity of the total vehicle fleet for passenger transport to 117 gCO_2/km in 2020 from 180 gCO_2/km in 2010 (The International Council on Clean Transportation 2012, 2012). In 2009, the MIIT had introduced a standard for new passenger vehicles of 7 l/100km (167 gCO_2e/km) by 2015, which is the third phase of a series of standards started in 2005 (Wagner et al. 2009).

The standards the MIIT has introduced however seem too weak to reach the overall fuel economy target in 2020, if it is to be reached merely by efficiency improvements: Even if by 2015 all new passenger vehicles comply with the standard, the overall vehicle fleet will not be at that stage because the car stock does not change instantly. And, as those vehicles purchased between today and 2015 likely will be around in 2020 still, new vehicles between 2015 and 2020 would have to be drastically better in their fuel efficiency to reach the overall target. However, the use of sustainable biofuels and modal shift could also contribute to lowering emission intensity of transport.

Supporting the targets further, China's taxation favours more efficient cars and a labelling system for fuel economy aims at increasing the consumers' awareness. For heavy duty vehicles, a standard is under discussion (Wagner et al. 2009). The current status is unclear at the point of finalisation of this report.

4.3.3 Coherence of strategies, activities and potentials

Does China consistently translate strategies into actions?

China has a large number of programmes supporting low carbon development in implementation. Many of the targets from the FYP also translate into measures that impact GHG emissions, such as for example the Top-1000 programme and renewable energy capacity targets, which are further described below. A drawback is that, according to past experience, supportive policies like capacity building or economic support have lagged behind the publishing of targets. This was for instance the case during the introduction of the Top-1000 programme: The targets were imposed on industry stakeholders. However, no economic support or information accompanied the targets, leading to some frustration among stakeholders (Price 2010). This problem specifically occurs when introducing new targets and mechanisms.

Another problem is the contradiction of policies in some areas to achieve different targets. This is mostly due to a lack of communication between the different policy making institutions on the executing level. Especially in rural areas, there is little coordination between the government players responsible for different areas of improvement (Long Sen To 2007).

In terms of coherence of overall targets, strategies, and the focus policy areas, China's climate legislation is well developed. The targets submitted as a NAMA are well integrated in national policy making: With the legally binding FYP for 2011-2015 and its targets to reduce CO_2-intensity by 17% in comparison to 2010, to increase the share of non-fossil fuels to 11.4% and to increase forest coverage, the country is already heading into the direction of the 2020 target and, if it continues this trend beyond 2015, is likely to achieve that milestone as well.

Do strategies and activities support the use of identified potentials?

Fig. 6 gives an overview of mitigation potential of various technical measures. The main possibilities for GHG mitigation in China lie in the energy supply sector, specifically in the area of renewable energy. Other important areas of mitigation are in the building sector, which is subject to rapid changes due to increasing economic wealth, and in the industrial sector, specifically in the area of energy efficiency. Measures with substantial potential also exist in the transport sector. Data for mitigation potential is only available for efficiency improvements in this area, although a modal shift might also lead to relevant emission reductions (Fekete et al. 2013).

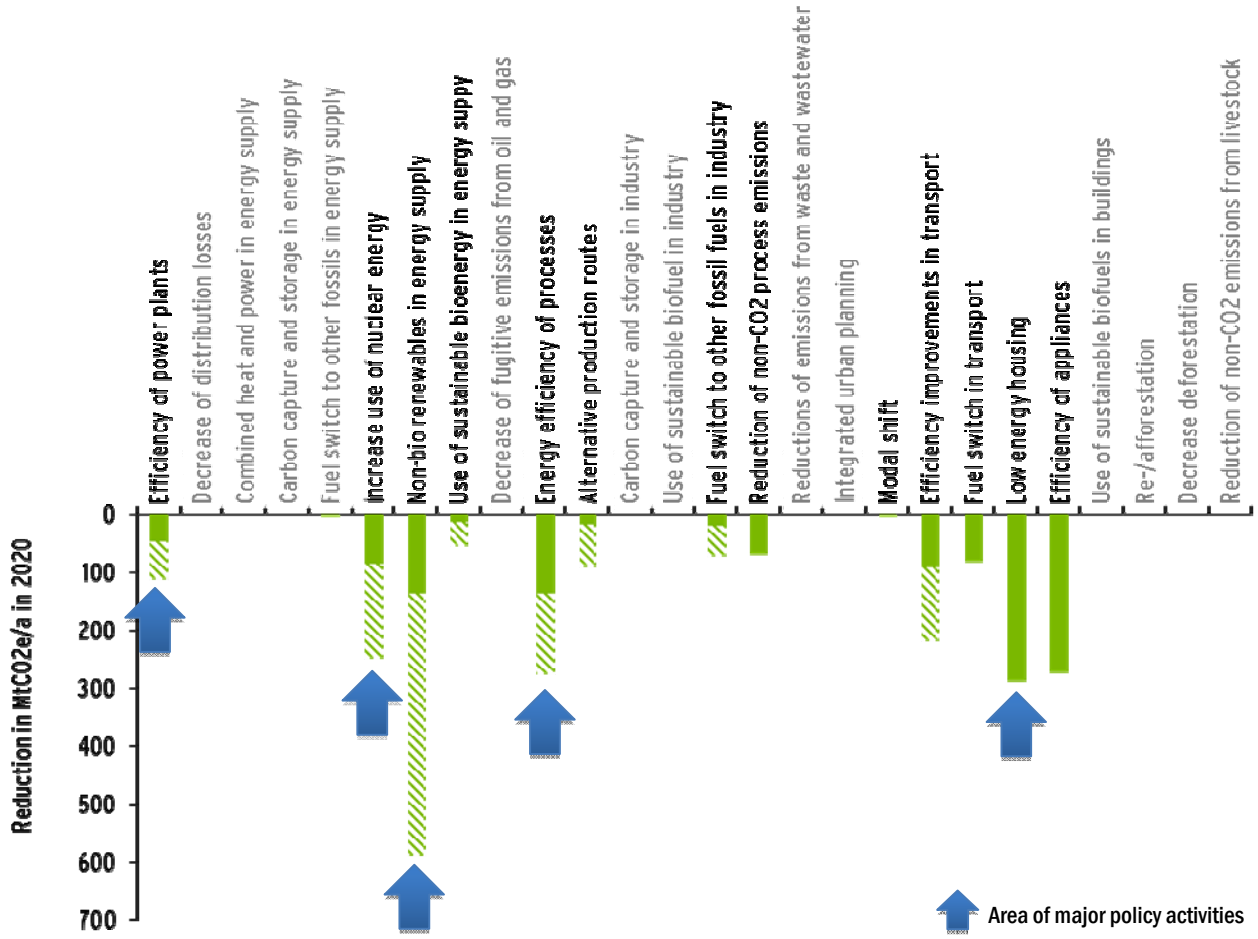


Fig. 6: Mitigation potential of different technical measures in China in 2020. Solid area: Low end of potential, shaded area: high end of potential.

Source: (Fekete et al. 2013). Additional arrows: Areas with relevant policy activities.

Additionally to the technical potentials, Fig. 6 illustrates where major policy activities are ongoing in China. What we can see is that China is already targeting some of the most important areas to mitigate GHG (e.g. renewable energy, energy efficiency of power plants and industry, low energy housing). However, other areas with relevant potentials are not yet addressed to a big extent (e.g. efficiency of appliances or transport).

Renewable energy technologies reveal the highest mitigation potential of all measures assessed. The Chinese government is aware of the importance of RE for energy security and environmental reasons but also as an economic factor. It has integrated RE in its internationally pledged targets, its national planning and the regulatory framework and has targets to increase RE capacity significantly. China supports those targets with various financial incentives for project developers, budgets for Research and Development (R&D), and pilot projects in rural areas, besides others. Various big programmes exist to support different RE technologies. According to our own calculations based on the WEO 2012, the most important targets (capacity increase for solar and wind) could lead to emission reductions of about 80 $MtCO_2e/a$ in 2020. In spite of strong policy support, the current activities may thus reduce much less emissions than the potential identified.

Energy reductions from industry is another main focus of Chinese policy making. With the Climate Action Plan of the Industrial Field (2012-2020), the industrial sector is furthermore the first one to obtain a sectoral emission reduction target, contributing to the FYP's targets for 2015 and the internationally communicated targets for 2020 (China Ministry of Industry and Information Technology 2013). With the Top-1 000/Top-10 000 Programme and supporting policies, China additionally has an instrument to pass on a share of the targeted reductions to the operational level. The Top-10 000 programme's target to save 250 Mtce by 2015 translates into accumulated emission reductions of approximately 430 $MtCO_2e$. Distributed over 5 years, this means less than 100 $MtCO_2e/a$, which is below the potential identified for 2020. However, the numbers are not comparable directly due to the different time horizons. Concluding, the activities in the area of industrial energy efficiency are substantial, but could be up-scaled further to tap the full potential.

Other measures with high potential are low-energy housing, efficiency of appliances and of transport. In the 12th FYP for Energy Conservation, energy efficiency of buildings are one of the points which are described in less detail and complemented with a smaller number of measures than for example the industrial sector (State Council 2012).The existing level of ambition of efficiency standards do not yet tap the full potential available.

Box 8: Conclusions on coherence of mitigation potentials, strategies and measures in China

China's international targets are in line with the high level national planning. With the targets anchored in the 12th Five Year Plan, China is moving in the right directions to meet its international pledge, which it has defined as a NAMA under the UNFCCC.

Sector specific activities also reflect high level priorities, to mention especially the industrial sector for which the "Climate Action Plan of the Industrial field (2011-2020)" defines sub-sectoral targets and measures (China Ministry of Industry and Information Technology 2013).

The priority areas from international and high level national targets also trickle down to the policy level. The planned ETS is an overarching policy that, if implemented effectively, can help steer the economy to reach the desired emission level in the target years. The TOP 1000 programme and its supporting measures can be a powerful tool to reach targets in the industrial sector and the capacity targets for renewable energy are likely to go beyond internationally communicated targets for renewable energy (Höhne et al. 2012).

In terms of coherence with the potential, China is in general moving into the right direction, focusing on renewable energy and industrial energy efficiency. According to our assessment, China would need to put more effort into the buildings and transport sector to also exploit the big potentials in those areas.

4.4 Remaining barriers to unlocking identified potentials

The mitigation potential identified in previous analysis is larger than the level China pledged internationally and the pledge is likely to be achieved (Fekete et al. 2013). In this chapter we analyse barriers to implement further mitigation activities in China.

4.4.1 Nation-wide barriers

Little awareness on climate change issues: Although climate policies have become an important factor of national policy making, the Chinese public is not yet very aware of the topic and the opportunities which climate friendly activities offer. This results in consumption patterns driving emissions up and little pressure on policy makers or on the industry from the public. The last point gives room to lobbyism of big industry association, which have increased their influence on policy making substantially (Deng und Kennedy 2010). Lobbying can especially effect policy makers' decisions on climate change whenever their own knowledge and awareness of the topic is low. In China, we see this as a potential problem especially for public servants at lower government levels and in remote areas.

Structural issues with MRV: China is making big efforts to establish a consistent MRV framework for energy and GHG emissions. However, there are still some drawbacks to their system. One example is the mismatch between national and provincial data (Guan et al. 2012). Furthermore, the current system does not include MRV of co-benefits (Long Sen To 2007), which play an essential role in low carbon development and NAMAs. Another issue is lack in transparency regarding the origin of data and methodologies for emission scenarios. China's second National Communication for example contains emission projections but only includes the most basic assumptions (see (The People's Republic of China 2012)).

Centralised approach to climate policy: China is a large country with a many different regions, in terms of climate, and economic and social development. The specific local needs are not necessarily addressed by the centralised policy setup (Peidong et al. 2009). The central government also breaks down overall energy consumption or emission reduction targets to the sectors in a top-down manner (specifically to industry), which does not necessarily reflect the possibilities of the diverse industrial players. This furthermore limits the scope of regional policy making: An example is the limited scope for Chinese provinces implementing pilot ETS, which does not allow them to punish noncompliance. This would need to be done by the central government (Davidson 2013a).

4.4.2 Measure-specific barriers

Besides those barriers affecting all or the majority of mitigation areas, there are also specific barriers to implementation of individual measures. We only assess those measures, which reveal significant mitigation potential and where barriers can reasonably be overcome with concrete political action. The extension of nuclear energy is a relevant source for mitigation potential. However, existing barriers such as severe safety risks and difficult waste disposal are unsolved problems, which we cannot expect a LCDS or a NAMA to solve. We therefore do not assess this area of mitigation further.Tab. 13 illustrates the type of barriers found for the most important measures assessed in this context. The specific barriers are then discussed further in the following paragraphs.

Tab. 13: Overview of type of barriers to most important mitigation measures in China

	Non-bio Renewable energy	Low energy housing	Efficiency of appliances	Efficiency of industrial processes	Efficiency improvements in transport

Share of total potential	11 – 25%	12-23%	12-22%	11-12%	7-9%
Barriers					
Institutional/political	x	X		X	
Financial/economic	X		x	X	
Technical	X				
Informational/capacities	X	X	X	X	X
Others		X	x		

Note: if x, then barrier is relevant to measure. Size indicates importance of the barrier. Blue colour bar illustrates the importance of the potential as a share of total potential in steps of 10% points.

Non-bio renewable energy supply

In terms of the institutional set up, the main barrier to renewable energy in China is a very centralised policy making. As a result, support does not always comprehensively address the different needs of stakeholders. This way of policy making limits the effectiveness of RE policies, as regional advantages, potentials and specific problems are not always regarded (Long Sen To 2007).

Although there are various financial incentives and other programmes, there is uncertainty because the instruments are not aligned and in some cases not enforced: Through the "Regulation on the Administration of Power Generation from Renewable Energy" there is an obligation for grid operators to purchase electricity from renewable sources. However, there is lack of clarity in the regulation. RE project developers need to negotiate with grid operators. This leaves space for interpretation and enforcement of the obligation to purchase the electricity is not necessarily given (Su et al. 2010).

Despite the strong top-down set up of the Chinese government, responsibilities for policy making affecting RE is spread over various governmental institutions. Regulations originating from departments pursuing different aims have led to contradictory incentives. An example is the cancelation of an import tax on wind turbines in order to reduce costs for wind energy, while at the same time there was a programme to support local wind equipment manufacturers (Peidong et al. 2009).

The main economic barriers are the higher costs in comparison to coal and insufficient financial incentives for the installation of RE: While wind energy is already close to grid parity in China, solar energy can still not compete with the cheap domestic coal in terms of generation costs (Wang 2010). Even if financial incentives for renewable energy resulting from the different programmes can sometimes make up for this difference, the taxation for other energy carriers interferes with these programmes and partly leaves renewable energy generation costs at disadvantage (Peidong et al. 2009).

The most important technical barriers in China are the lack of quality of RE installations and the need for grid integration. Low quality is related to missing technical standards and the trade of a high share of renewable technologies on black markets, leading to mistrust in the

technologies and in the case of the residential sector to house owners denial of permission to install RE on their buildings (Dianshu et al. 2010).

Limited electricity transmissions lines limit especially the expansion of wind capacities. Many RE projects are developed in remote areas with little electricity demand and underdeveloped grids and can therefore not be integrated well (Su et al. 2010). With the elaboration of the "Guidance on Development and Construction of Decentralised Access Wind Power Projects", the National Energy Administration has taken a first step towards decentralised wind energy (Global Wind Energy Council 2012). However, a major share of the capacity is still dependent on transmission lines because major potentials are found in the north west of the country or offshore, while the demand concentrates in the south east (Wang 2010).

Capacities for RE manufacturing, installation and maintenance are improving as the industry is growing but some gaps remain, especially when technologies are imported but knowledge on installation and maintenance is not (Jun Feng no year). Currently, roughly 50% of high-added-value parts such as converters, controllers etc. are still imported (Global Wind Energy Council 2012).

Tab. 14: Most relevant barriers to renewable energy in China

Institutional/ political	Lack of coordination between various departments (Peidong et al. 2009) Very centralised policy making does not reflect needs and potentials of regions (Dianshu et al. 2010) Little standards assuring quality of RE installations ((IEA und ERI 2011),(Dianshu et al. 2010)) No common standards for dimensioning of wind parks (IEA und ERI 2011)
Financial/ economic	Cheap competition in electricity grid (mainly coal) (Wang 2010) Incomprehensive taxation for renewable energy (Peidong et al. 2009) Strong increase of capacity requires large funds for feed-in tariffs (Davidson 2013b)
Technical	Grid access (especially for wind energy) (Wang 2010) Bad quality of technologies and planning processes (Dianshu et al. 2010) No comprehensive database containing necessary information on potentials (IEA und ERI 2011)
Informational /capacities	Low share of R&D (Peidong et al. 2009) Lack of capacities for installation and maintenance of RE power installations (Jun Feng no year)

Low energy housing

Inadequate enforcement of building codes and the poor metering and billing system for heat are main barriers in the sector. While the compliance with the MEPS of new buildings during the designing phase is at almost 100% (Wuppertal Institute for Climate, Environment and Energy 2013), there is no systematic enforcement of those standards during the construction or afterwards leading to non-compliance in many cases (World Business Council for Sustainable Development 2009). This applies especially to rural areas and to the residential sector (Dunnett et al. 2010).

Existing building codes are rather weak and not adapted to regional circumstances of the different climatic zones (ibid.). The billing system for heat does not reflect real consumption of energy. Heat energy in China is subsidised and priced at a fixed rate irrespective of

consumption and at levels which do not reflect the actual costs of supply (World Business Council for Sustainable Development 2009).

Additionally, lack of capacities leads to a weak monitoring system of activities in the sector. Other barriers in the area include a lack of experience with low energy housing in the construction sector and little awareness of opportunities and co-benefits of energy efficient housing.

An important economic barrier is a lack of capital for investments. This especially affects the retrofitting of existing buildings (Richerzhagen et al. 2009).

Tab. 15: Most relevant barriers to low energy housing in China

Institutional/ political	Weak and unsystematic enforcement of building codes (esp. in rural areas) (World Business Council for Sustainable Development 2009). Codes are not adapted to regional climate circumstances (Dunnett et al. 2010) Heat billing does not reflect the actual costs of energy consumption (World Business Council for Sustainable Development 2009)
Financial/ economic	No economic incentives to invest in low energy housing (Richerzhagen et al. 2009) Subsidies for energy distort the real price (Richerzhagen et al. 2009) Lack of capital for investments in retrofitting older buildings (Richerzhagen et al. 2009)
Technical	Current construction practices inadequate building envelopes (World Business Council for Sustainable Development 2009)
Informational/ capacities	Lack of capacities and experience on low energy buildings in the building sector (Richerzhagen et al. 2009); (World Business Council for Sustainable Development 2009) Lack of capacities for building or retrofitting low energy housing (World Business Council for Sustainable Development 2009) Weak monitoring mechanisms due to lack of financial and human resources Lack of information on the consumer side about financial advantages and increased life quality of low energy houses (Richerzhagen et al. 2009)
Others	Importance of house as a status symbol might contradict the implications of low energy housing (i.e. in size) (Richerzhagen et al. 2009)

Efficiency of appliances

Limits to implementation arise from inconsistencies in the standard setting and labelling programmes and their relationship to other purchase incentives for appliances to stimulate growth, which are not coupled to energy efficiency (Dianshu et al. 2010). There are various energy efficiency labels for appliances, of which one is mandatory for some appliances. Under this label, manufacturers self-report the energy consumption of each model, which has led to underreporting of the energy consumption levels in some cases (Zhou 2008). There is little trust in the existing labelling systems within the population, as manufacturers are perceived to sell incorrectly labelled products and the government is perceived to mismanage the labelling schemes (Dianshu et al. 2010).

On the economic side, electricity in China is relatively cheap, creating no incentive to households to worry about energy savings (Dianshu et al. 2010). Informational barriers result

mainly from the demand side, as awareness of energy efficiency is very low (Dunnett et al. 2010). Another barrier to energy efficient appliances is the diversity in products of manufacturers which are difficult to cover with single policies or programmes (ibid.).

Tab. 16: Most relevant barriers to efficiency of appliances in the residential sector in China

Institutional/ political	Self- reporting on energy consumption for energy efficiency standards has led to underreporting (Zhou 2008) Labelling programmes for energy efficient appliances are in conflict with incentives for economic growth (Dianshu et al. 2010)
Financial/ economic	Low price of energy does not encourage energy savings in the households (Dianshu et al. 2010)
Informational/ capacities	Low awareness of energy efficiency and energy consumption on demand side(Dunnett et al. 2010), (Dianshu et al. 2010)
Others	Dispersion of manufacturers are difficult to include in single policies or programmes (Dunnett et al. 2010) Little trust in the existing labelling systems within the population (Dianshu et al. 2010)

Efficiency of processes in industry

Although industrial energy consumption is in the spotlight of national and regional policy making, still some barriers exist to making use of the full potential in China. In general, barriers to energy efficiency in the industrial sector are more severe for SMEs than for bigger companies.

The most relevant institutional and political barrier is the *top-down manner* with which measures are implemented. This refers specifically to the TOP-1 000/10 000 programme. The allocation of targets in many cases disregards differences in technical potentials among the installations, where for example a benchmark approach could provide better insights. Policies implied by the central government furthermore in some cases contradict social priorities of local authorities, e.g. when closing smaller inefficient plants (Dunnett et al. 2010). Also, enforcement of environmental regulations in the industrial sector is weak (UNIDO 2011).

To support the top-down targets sufficiently, the existing framework of financial incentives needs to be strengthened ((UNIDO 2011), (Price 2010)). Investment costs are relatively high even if investment in energy efficiency pays back over time (UNIDO 2011). Especially for small and medium businesses, access to capital may be a challenge, as they do not have a credit history and risk perception of new technologies of financial institutions leads to high interest rates (Romankiewicz et al. 2012).

Tab. 17: Most relevant barriers to industrial energy efficiency in China

Institutional/ political	Reduction targets under the Top-1 000 programme are set top-down and not according to benchmarks and not adapted to individual circumstances of the entities (Dunnett et al. 2010) Limited scope of TOP-1 000 programme (Dunnett et al. 2010) Increase of energy efficiency through closure of small plants contradicts social and economic priorities and is opposed by local authorities (Dunnett et al. 2010) Lack of enforcement for environmental regulations in the industrial sector (UNIDO 2011)
Financial/ economic	Lack of consistent incentive policies in the industrial sector (UNIDO 2011) Support policies can often not keep pace with the target setting(Price 2010) High initial investment costs of technologies (UNIDO 2011) In some cases poor financial performance of energy efficiency and resulting bad reputation (UNIDO 2011) Lack of credit history esp. among SMEs (Romankiewicz et al. 2012) Risk perception of financial institutions leads to high interest rates (Romankiewicz et al. 2012)
Informational/ capacities	Knowledge on best practice technology is limited especially in smaller firms. (Dunnett et al. 2010) Plant operators often unaware of existing opportunities and there is little technical expertise for implementation of energy efficiency projects (Romankiewicz et al. 2012) Low awareness and therefore low social pressure for environmental friendly behaviour from public (UNIDO 2011)
Others	Fragmented structure of the Chinese industry sector (Dunnett et al. 2010) Increasing consumption levels might encourage the re-opening of inefficient and old plants (Dunnett et al. 2010)

Energy efficiency improvements in transport

We have found little information on barriers to efficiency of vehicles in China. McKinsey reports a lack of awareness of customers on mid- to long-term savings, so the willingness to invest additionally for energy efficiency is low (McKinsey & Company 2009).

Another barrier might be a similar cultural issue as for low carbon housing: Increasing income can imply the desire to express this wealth in form of bigger cars, which generally use more energy than smaller ones. (Wang et al. 2013) suggest that sales of SUVs in China will increase by 13% annually until 2020, with this segment of the car market growing significantly faster than those of smaller personal vehicles.

Box 9: Conclusions on barriers to GHG mitigation in China

While China has large potentials in various areas of GHG mitigation, various targets related to emission reductions and a relatively stringent policy framework in order to implement high level targets, some barriers to implementation of activities remain. The top-down manner of policy making leaves potentials untapped as the central government sometimes lacks insights in local circumstances of industrial installations or renewable energy sites.

Stakeholder involvement and coordination is low, along with little awareness of the climate change topic in the public and in some governmental levels.

Distributed responsibilities especially for the renewable energy sector over various governmental agencies and commissions lead in some cases to contradictory policies And although China's RE technology industry has grown immensely in the past years, some technical issues also remain. To tap the vast wind energy potential, more grid integration is needed. Solar industry lacks comprehensive standardisation which would guarantee high quality.

4.5 Conclusions

Highlights
- Climate change strategies are legally binding and usually imply concrete activities
- Rapid development of renewable energy and energy efficiency and increasing relevance in policy making

Possible improvements
- Enhance awareness on climate change in public and involvement of independent stakeholders in policy making
- Improve MRV system for emissions by linking to energy monitoring system
- Increase focus on efficiency in transport and buildings

China already taps some of the most important potentials. Reflecting the centralised policy making the country is consistent in its general strategy and most relevant policies. In the last decade China has made important and strong steps towards a more environmentally friendly economy and improved its performance drastically, for example related to energy efficiency.

Further potentials for policy actions exist in building a more comprehensive policy framework covering all relevant areas of GHG mitigation and increase ambition in those. In terms of MRV of emissions, additional transparency and a system with continuous MRV activities can help monitor progress and identify most effective policies. Linking the MRV of emissions to the monitoring system for energy presents important opportunities.

While some of the barriers to climate change mitigation can only be removed through activities at a national level, international support can provide substantial opportunities for others. Especially in the building of further human resources, international support can help China enhance its activities on GHG mitigation. Capacity building along the complete value chain of renewable energy and for low-energy housing can effectively remove important barriers in these areas. For all policy areas and technological measures, expert networks can help to efficiently transfer knowledge.

Increased ambition at the international level, especially by developed countries and other emerging economies, could incentivise the Chinese government to undertake more ambitious mitigation actions and to eventually trigger down to the Chinese public and create awareness for the climate change topic. This is valid for overall economy wide targets, but also for individual sectoral regulations, for example in the case of fuel standards for passenger vehicles.

Opportunities for China at a national level can emerge from improving transparency and from the involvement of stakeholders, as well as the support of R&D and capacity building, and awareness raising on benefits of energy savings amongst the population. The policy areas of efficiency improvements in transport and in buildings (building envelope as well as appliances) should also be strengthened in the national policy framework.

Tab. 18 illustrates a summary of the findings of this report on Chinese policy making. Additionally, we present ideas on how the international community can support China in overcoming remaining barriers.

Tab. 18: Overview of potentials, actions and remaining barriers for most important mitigation measures in China

Potential	Coverage as priority in national strategy and targets	Implemented policies to tap potential	Remaining Barriers	Opportunities for international support
Renewable energies Total potential in 2020: 120- 570 $MtCO_2e/a$	Target in Copenhagen pledge and 12th FYP	• Feed-in tariff • Tax incentives for enterprises • Renewable Energy Law • Amendments, supporting grid integration	• Grid integration • Feed-in tariff rates to low • Contradictory tax incentives • Quality of installations • Lack of capacity for dimensioning and maintenance	• Capacity building for complete RE supply chain • Sharing of best-practice RE policies
Low energy buildings Total potential in 2020: 290 $MtCO_2e/a$		• Minimum Energy Performance Standards	• Distorted energy prices, issues with metering of heat • Lack of capacity in building sector	• Capacity building in low-energy housing for construction sector
Energy efficient appliances Total potential in 2020: 270 $MtCO_2e/a$		• Various labelling programmes (partly mandatory)	• Consumer awareness • Inconsistent setup of programmes • Low energy prices	•
Efficiency of industrial processes Total potential in 2020: 140- 270 $MtCO_2e/a$	Focus in FYP, Climate action plan of the industrial field	• Top-1 000/ TOP-10 000 programme, • Closure of small, inefficient plants, • ETS pilots	• Top-down setting of targets • Lack of enforcement • Lack of capacity and access to capital especially in small companies • Opposition to plant closure due to social reasons	• Sharing of best-practice regarding benchmarking in industry
Efficiency in transport Total potential in 2020: 90-220 $MtCO_2e/a$		• Fuel standards for passenger vehicles	• Lack of consumer awareness on benefits	• Increase ambition of own fuel standards

5 India

5.1 Introduction

India is the second biggest emerging economy in terms of population. Although the population growth rate has decreased steadily since the 1980s, the rate as of 2011 was still at almost 1.5% per year (2011). In spite of strong economic growth, India belongs to the poorest countries in the world with a low Human Development Index (HDI), a relatively low adult literacy rate and a current per capita income of 3 550 US$ PPP (GIZ 2012).

The main possibilities for greenhouse gas (GHG) mitigation in India lie in the energy supply sector, specifically in the area of renewable energy. Other important areas of mitigation are in the industry sector, which is subject to rapid changes due to increasing economic wealth, and in the transport sector, specifically in the area of modal shift.

Under the Copenhagen Accord, India has pledged to reduce carbon intensity by 20 to 25% below 2005 levels by 2020. India's pledge does not exploit the full technical mitigation potential, but is in line with what most effort sharing approaches suggest. The average of the pledge lies at about the same level as the average BAU level, meaning that no reduction below BAU would be achieved. The large mitigation potential can reduce emissions further than the pledge. We assessed that the most optimistic scenario can lead to halving India's current emissions in 2020 by implementing the identified measures.

5.2 The institutional framework for climate policy

5.2.1 Institutional setup for climate regulation

India is one of the largest democracies in the world. It has developed a very comprehensive participative approach by establishing various levels of regional administration with different degrees of autonomy.

On the federal level, 28 ministries are responsible for designing new laws (and proposing them to the parliament), and implementing them on the various sub-regional levels. 28 states and seven union territories with own regional governance structures form another important government level. Below the state government level, there are municipal governments, which are responsible for local administration, as well as city level departments. The heads of ministries, the state ministers and the prime minister form the "Union Council of Ministers of India" - the decision-making body of the government of India (Ministry for law and justice India 1954).

Responsibilities for specific topic areas are clearly regulated in the Indian constitution (Government of India 1949). Some of the sectors subjected to climate change policy such as electricity are under the responsibility of federal and state level (Government of India 2012). Some regulations, e.g. all related to agriculture, are exclusively subject of state governments.

India developed most of the institutional arrangements concerning climate policy during the last 10 years. In 2007, the government established the Prime Minister's Council for Climate Change (PMCCC), which then released the National Action Plan on Climate Change (NAPCC) in 2008 forming the legal basis for climate policy in India.

The Ministry of Environment and Forests (MoEF) is responsible for planning, promoting, coordinating and overseeing the implementation of environmental and forestry policies and programmes that cover climate policy. The MoEF involves additional resorts, such as the ministry for power or water, for sector specific questions. The National Action Plan on Climate Change defines targets and actions for eight priority areas (see also section 5.3.1). Depending on the responsibility of a thematic area as laid down in the constitution, additional state or regional departments mirror the federal departments. The MoEF coordinates different intergovernmental working groups that advise the government on climate policy related issues.

The PMCCC is chaired by the Prime Minister and regularly brings together experts from relevant ministries and institutions to review and update the NAPCC. The PMCCC is supported by the Executive Committee on Climate Change. It develops coordinated responses to issues related to climate change at the national level, regularly monitors the implementation of climate policy and coordinates with various agencies (Government of India 2013).

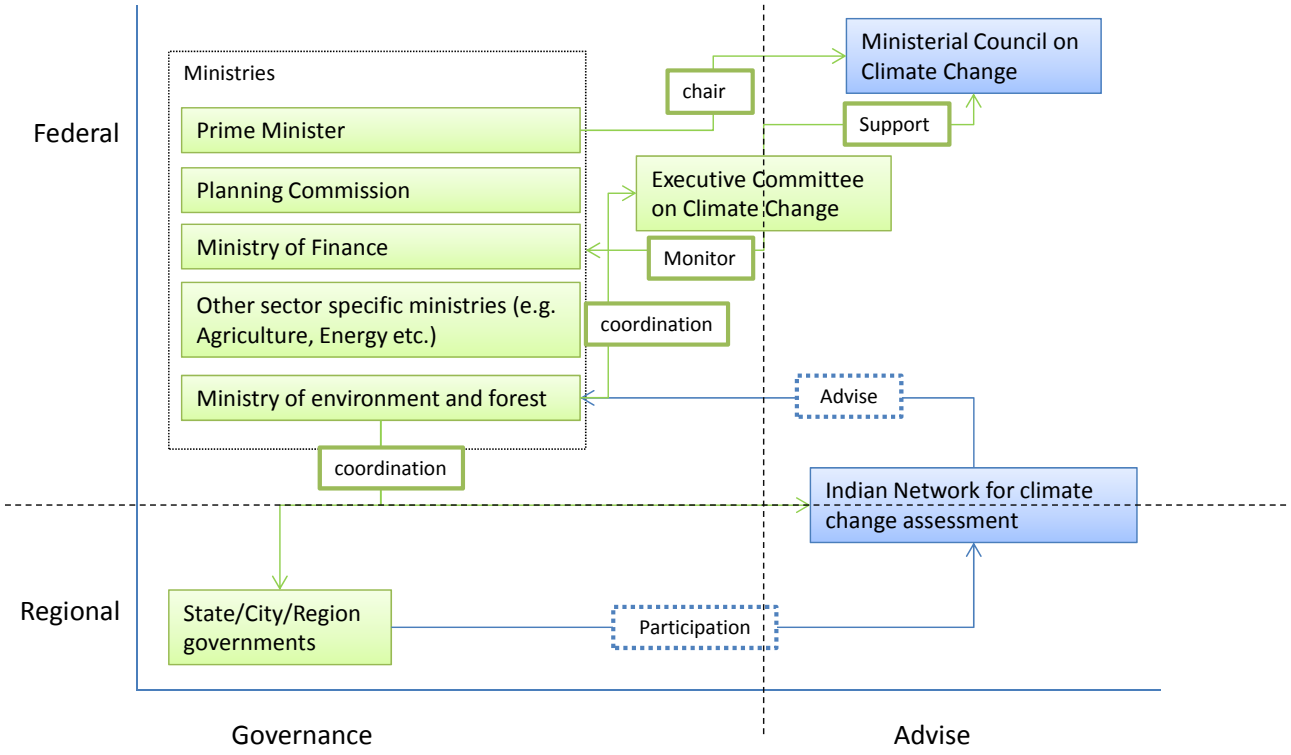
The Expert group on Low Carbon Strategy for inclusive Growth was established in 2009 aiming to align climate change with the broader national objectives such as poverty eradication and social development. It has not yet developed the strategy itself yet, but has published an interim report in 2011 (Planning Commission Government of India 2011b). Its members represent stakeholders from all groups in society and politics. This expert group does not give direct input to other government institutions, but provides options of a broader strategy to the public as well as to policy makers.

The Indian Network on Climate Change Assessment (INCCA) was established in 2009 to coordinate research institutions and is responsible for inventory estimations and climate research. The INCCA works under the MoEF and receives financial support from the Global Environmental Fund (GEF) through United Nations Development programme (UNDP). The group is split into two clusters: one involves about 60 institutions to estimate GHG emissions for national inventories. The other (67 institutions) work on impact, vulnerability and adaptation assessments.

India's Planning Commission plays a mediatory and facilitating role between the different government bodies involved. It is responsible to formulate a plan that reviews progress and allocates budget to the different political priority areas and institutions as regulated in the Five Year Plan. With these functions it plays an important role although it does not directly affect climate policy making.

Fig. 7 gives an overview of the relevant institutions and their interactions, their exact functions are described in the Annex in Tab. 60.

Fig. 7: Overview of institutional setup in India



Source: own illustration

5.2.2 Institutional setup and activities for MRV

MRV institutions

The central body responsible for developing national GHG inventories is the INCCA, which coordinates different research institutions in collecting and processing data. On a higher level, a defined process within the MoEF ensures not only the conformity of the inventory with the updated UNFCCC reporting guidelines, but also the integrity of inventory, communication of data and information exchange with all partners. The Project Management Cell (PMC) under the guidance of the National Project Director coordinates the process in a project-based approach (Government of India 2012).

During the development of inventories, a GHG Inventory Working Group (within the MoEF) comprising all the members involved in the preparation of GHG inventory processes meets at least twice a year to take stock of the state of the inventory and discuss priorities in the inventory development process (Government of India 2012).

Once the inventory is prepared, it goes through a peer review by members of the GHG Inventory Working Group. The revised inventory is then subjected to a final review through technical consultations. These technical consultations comprise expert meetings and extensive reviews. The inventory is additionally reviewed by the National Steering Committee (NSC), which comprises members from relevant ministries (Government of India 2012).

MRV activities

India has published two National Communications, the initial one in 2004 including inventory data for the year 1994, and the second one in 2012 with data for the years 2000 and 2007. More detailed information on India's submissions can be found in Tab. 59.

Estimations of anthropogenic GHG emission inventories in India began on a limited scale in 1991 and resulted in a first report in 1992, evaluating emissions for 1990. The first inventory used the Intergovernmental Panel on Climate Change (IPCC) 1996 guidelines and covered emissions from CO_2, CH_4 and N_20 by main sources. It was published in India's Initial National Communication in the year 2004 with data for the year 1994 (Government of India 2004).

However, India's activities towards a more structured data collection of all types of emission sources first started during the preparation of the Initial National Communication published in 2004. This document covers all sectors, but the level of detail in the methodology is rather low. The only operational setup for collecting data from different sources and sectors is the one that was used to prepare the National Communications (MAPT 2011).

After the INCCA (compare section 5.2) was established in 2009, an inventory for the year 2007 was successfully set up and published in 2010 (Ministry of Environment and Forests Government of India 2010). The elaboration of the inventory involved 17 institutions, and it contributed to the Second National Communication published in 2012. It included major improvements in the level of detail of chosen approaches and using country specific emission factors compared to the Initial National Communication (Ministry of Environment and Forests Government of India 2010).

Box 10: Conclusions on institutional setup and MRV for climate legislation in India

Climate legislation in India is well integrated in the general policy making set-up. Especially noticeable is the direct involvement of high-level politicians in this area via the Ministers' Council on Climate Change. Another noticeable feature of India's set-up for climate legislation is the distribution of power to the state and local level and the involvement of civil society via the Expert group on Low Carbon Strategy for inclusive Growth and the INCCA. On the one hand, this allows a connection to the diverse needs of different regions and stakeholders in India. On the other hand, the huge structures and processes for decision making slow down policy making significantly.

In terms of MRV institutions, India possesses of a clearly responsible body, the INCCA, which includes stakeholders from various ministries and research institutions. However, MRV under the UNFCCC takes place irregularly and generates data on few past years only. To support climate policy making and track mitigation activities on a national level, a more robust system would be needed. The Planning Commission of the Government of India suggests to create a National Greenhouse Gas Inventory Management Authority (NGIMA) and a National GHG Inventory Management System (NIGMS) advancing current activities significantly and leading to annual GHG inventories (Planning Commission Government of India 2011a). Such a system would also support the monitoring of progress towards the internationally pledged emission reductions.

5.3 Mitigation potential, strategies and activities

In this chapter, we evaluate to what extent national strategies and activities in India are coherent to the potentials. We first give an introduction to Low Carbon Development Strategies (LCDS) in the country and an overview on NAMAs and other mitigation activities, which might affect the use of the potentials identified in the previous report. Then we compare these potentials to the priority areas of activities.

5.3.1 Low-carbon development strategies

On the national policy level, India establishes Five Year Plans (FYP) to support the short and mid-term targets of the country and to translate general aims into more concrete planning. The primary objective of Indian policy interventions is poverty eradication and sustainable social development. The 12th FYP for the period from 2013-2017 therefore focuses on economic growth and sets a target GDP growth rate of 8.2% per year until 2017 to overcome poverty and to meet the millennium development goals. For the first time a chapter dedicated to sustainable development has been introduced in the FYP. The plan outlines that growth requires substantial growth in the energy sector and that the Indian government must take steps to reduce energy intensity in production processes as well as increase domestic energy supply (Planning Commission Government of India 2012).

Although there is no official plan yet in place to be considered as a Low Carbon Strategy, recommendations from the Expert Group on Low Carbon Strategy for Inclusive Growth are a central component of the 12th FYP. The Expert Group's interim report published in 2011 discusses options that are in line with the growth strategy and that reduce emissions covering all sectors. While the FYP does not include any emission reduction targets, the Expert Group's report presents GHG emissions projections. However, these projections provide a scientific basis for the development of GHG action in India, not a political target.

The National Action Plan on Climate Change is the major pillar of climate policy in India. The Prime Minister's Council for Climate Change released the document in 2008. It contains targets and strategies for eight priority areas, the "missions", covering the time period up to 2022. These eight missions focus on long-term and integrated strategies to address key national goals such as sustainable development and poverty eradication from the climate change perspective. For each mission, the concerned ministries were assigned to prepare a detailed plan of action for the implementation of each mission. Under the directive of the NAPCC, each state within the country also has to outline the actions it will undertake in each of the sectors in their state climate change action plans. Delhi became the first state to finalise and launch their action plan, and most other states are about to finalise their action plans. (GLOBE International 2013; Government of India 2008). Detailed information on the missions of the NAPCC and relating sub-targets is listed in Tab. 61 in the Annex.

While most of the missions focus on adaptation, three of them cover mitigation measures: the National Solar Mission, the National Mission for Enhanced Energy Efficiency and the National Mission on Strategic Knowledge for Climate Change.

The missions all have a different status of implementation and their inclusion in the Action Plan does not necessarily lead to activities already. The missions are further translated into policies, as chapter 5.3.2 illustrates. The 12th FYP in this sense also plays a role, making several

suggestions which result in more specific targets and changing the focus of some policy areas (Planning Commission Government of India 2012).

The 12th FYP also gives insights in the allocation of resources to climate change policy and other relevant topics. While the 11th FYP allocated 10 billion Rs to the MoEF for all climate change topics, (Planning Commission 2008), the 12th FYP allocates budget per priority sector (or "mission") under the NAPCC.

5.3.2 Nationally appropriate mitigation actions and other relevant policies and measures

This chapter gives insights into current activities for mitigation activities, including Nationally Appropriate Mitigation Actions (NAMAs) and other policies for reduction of GHG. The paragraphs first introduce the Indian definition of NAMAs. The description of other policies focuses on those areas for which we have identified big mitigation potentials, but also illustrates other relevant policy areas, if any.

Nationally Appropriate Mitigation Actions in India

India officially communicated its commitment to reduce the emissions intensity of the economy by 20 to 25% by 2020 compared to the 2005 levels (excluding emissions from agriculture) as a NAMA (UNFCCC 2011). It has the clear position that NAMAs are voluntary actions and require financial support from Annex I countries to be successfully be implemented in developing countries (Asselt et al. 2010).

India is one the countries emphasising strongly the responsibilities of developed countries to mitigate climate change. Although they do implement policies and strategies related to climate change, they do not see those as an obligation in the international context but as their voluntary choice. This understanding also leads to the idea that India's domestic actions do not need to be reported internationally or towards donors as would likely be the case with NAMAs. As a result, India is very hesitant to engage in the development of NAMAs.

Other relevant GHG mitigation policies

Although India objects to develop NAMAs, it has implemented a number of policies related to climate change mitigation. The following paragraphs analyse some of them, focusing on the areas for which we identified relevant mitigation potentials.

Energy supply – Renewable Energy

Energy supply has been one of the key focus areas in policy making on federal level in India during the last two decades. The Solar Mission is the most advanced measure in terms of implementation status. It has a clear focus on introducing solar energy by setting targets until 2022 and introducing Renewable Purchase Obligations (RPO) and transparent auctioning processes to support the targets. The targets have been established over three phases: from 2010-2013, from 2013-2017 and from 2017-2022.

Tab. 19: Targets of National Solar Missions from 2010 to 2022.

Solar Technology	Phase I (2010-2013)	Phase II (2013 – 2017)	Phase III (2017 – 2022)
Grid-connected/ rooftop	1 000 -2 000 GW	4 000 -10 000 GW	20 000 GW
Off-grid applications	200MW	1 000 MW	2 000 MW
Solar hot water heaters	7 million m^2	15 million m^2	20 million m^2
Rural solar lanterns/lighting	n.a.	n.a.	20 million systems

Source: Adapted from (Council on Energy, Environment and Water 2012)

Beside the overarching targets as decided in the NAPCC, the sector is addressed by several policies (Government of India 2008). One important example is a feed-in tariff for renewable energy. It guarantees a higher electricity price to projects, chosen based on a reverse bidding process. A few other measures introduced are bundling scheme for grid connected projects and capital and interest rate subsidy for off-grid projects (Council on Energy, Environment and Water 2012), (Ministry of New and Renewable Energy 2013b).

The Integrated Energy Policy 2006 addresses all aspects of energy and relating sectors, including pricing, safety, access, efficiency and the interaction with the environment. Its objectives referring to GHG mitigation actions are the phase-out of capital subsidies, the creation of renewable grid connectivity, the requirement for power regulators to mandate feed-in laws for renewable energy as provided under other relevant legislation (see Electricity Act 2003) and the encouragement of utilities to integrate renewable energy technologies into their systems. The Energy Coordination Committee oversees the implementation. A number of states have already introduced RPOs and feed-in schemes for solar energy (Bridge to India 2013).

The Electricity Act 2003 seeks to promote efficient and environmental policies in the energy sector in India. As a supplement to this Act, the National Tariff Policy 2006 requires the State Electricity Regulatory Commissions to fix a minimum RPO, taking into account regional conditions (Ministry of New and Renewable Energy 2013a). In order to combine the National Tariff Policy with the National Solar Mission, in 2011 the cabinet amended the Policy and decided to require the state regulators to purchase a fixed percentage of solar power – 0.25% by 2013, and up to 3% in 2022 (Ministry of New and Renewable Energy 2013c). Tab. 20 lists other relevant policies.

Tab. 20 Overview of policies for energy supply in India

Policy	Description	Status
National Solar Mission (2008)	See section **Fehler! Verweisquelle konnte nicht gefunden werden.**	Approved and partly still to be implemented
Levy on coal	In 2010 India announced to introduce a levy at the rate of Rs. 50 (1 US$) per tonne domestically produced or imported coal	Implemented
Integrated Energy Policy (2006)	See section **Fehler! Verweisquelle konnte nicht gefunden werden.**	Implemented
Electricity Act 2003	Key provisions on Renewable Energy	Implemented

National Tariff Policy (2006)	Stipulates purchase of minimum percentage of power from REN	Implemented
National Electricity Plan (2012)	Plan on rural development of access to energy (incl. REN); obligation under Electricity Act 2003	Implemented
Subsidy for Wind Power (2009)	Generation based scheme to promote wind power; provided Rs. 0.50 (US$ 0.10) per kWh and capped at around US$ 120 000 per MW, spread over a minimum of four years	2009 introduced, ceased 2012, again introduced in 2013 budget
State Energy Policy Plans/ Other RE support policies	Action plans on financing and regulations on state specific feed-in tariffs and other instruments	n.a.
National Clean Energy Fund	Tax on carbon of 50 Rs per tonne generate fund for renewable energy support	Implemented

Source: (GLOBE International 2013), updated by information from in-country experts

Energy efficiency – Industrial processes

Energy efficiency is another key policy area addressed by the NAPCC and national legislation. The Perform, Achieve and Trade (PAT) scheme, a market based mechanism to improve energy efficiency in industry, is the most prominent and advanced policy under the National Mission for Enhanced Energy Efficiency. The scheme was launched in 2012 and covers 478 facilities that are responsible for a significant share of India's primary energy consumption (Ministry of Power 2012). Operators that are part of the scheme have to reach a Specific Energy Consumption target (SEC; energy consumed per unit of production) by 2015. The sectoral targets are based on sector's contribution in energy consumption. Each facility is then assigned a target based on their energy consumption within the sector. If they surpass the target, they receive tradable certificates that they can sell to others that have failed to achieve their target. As a result of the implementation, the Indian government estimates to save 23 Mtco in coal, gas and petroleum products every year until 2015 (Ministry of Power 2012). The Bureau of Energy efficiency (BEE) is the implementing institution.

Energy efficiency of appliances

Under the Energy Conservation Act (2001) that is used as basis for the measures under the NAPCC, large energy consumers are required to adhere to energy norms (Ministry of Law, Justice and Company Affairs 01.10.2001). That includes regular energy audits to improve efficiency of production processes, but also participation in energy labelling programmes for appliances. With the introduction of the Standards and Labelling Programme in 2006, energy labels became mandatory for various electricity consuming appliances. The government extended the programme further over the years, to cover most important appliances. The label includes a rating model on their energy efficiency, starting from one star, implying low energy efficiency, to a five star grade for the most energy efficient model(Bureau of Energy Efficiency 2012).

Modal shift in transport

With increasing motorisation of moving goods and people, the transport sector is becoming an increasingly important emitter in India and also on the policy side. One example for large scale activities on the central government's level is the creation of the Inland Waterway Authority

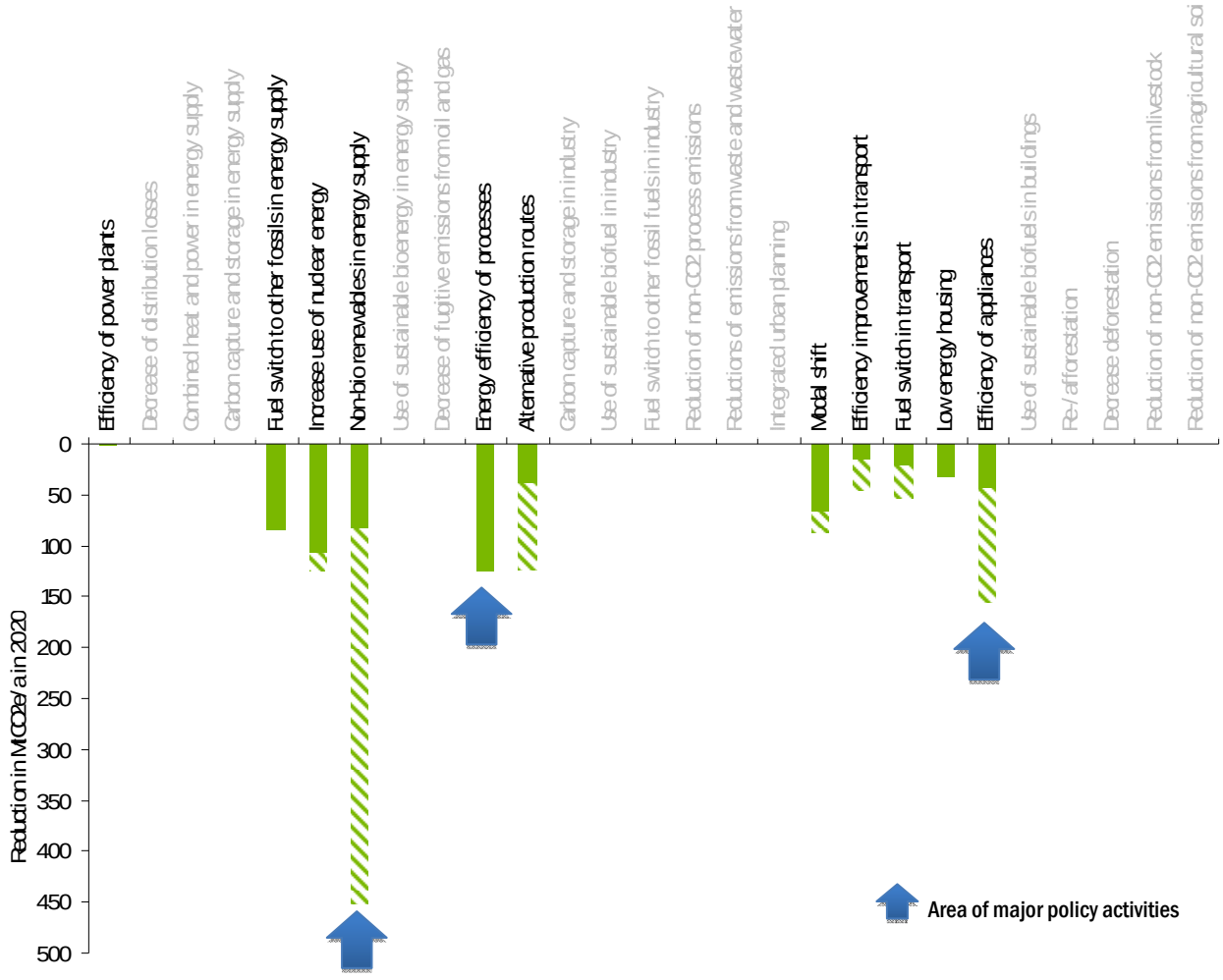
which has the task to develop the national waterways further. The authority has prepared a development plan, including improvements along the major rivers in India, which however is not being implemented yet due to lack of funding (Ecorys 2010).

On the subnational level, governments are for example active in the development of Bus Rapid Transit (BRT) systems. The most advanced system is the Ahmedabad BRT system with 45 km installed in 2012 and still expanding (UNEP Risø Center 2012).

5.3.3 Coherence of strategies, activities and potentials

Fig. 8 gives an overview of mitigation potential of various technical measures, as assessed in previous analysis (Fekete et al. 2013). The main possibilities for greenhouse gas (GHG) mitigation in India lie in the energy supply sector, specifically in the area of renewable energy. Other important areas of mitigation are in the industry sector, which is subject to rapid changes due to increasing economic wealth, and in the transport sector, specifically in the area of modal shift. Measures with substantial potential also exist in the area of appliances.

Fig. 8: Mitigation potential of different technical measures in India in 2020. Solid area: Low end of potential, shaded area: high end of potential.



Source: (Fekete et al. 2013). Additional arrows: Areas with relevant policy activities.

Does India consistently translate strategies into actions?

The extent to which strategies are converted into actual policies varies by strategy and by content area. The NAPCC is the most important strategy related to climate change in India. Its solar mission is a good example for setting concrete, focused targets and converting those into actual activities on the ground (Byravan und Rajan 2012). Also, according to Byravan and Rajan, it implied increase of ambition on state and federal level, led to the improvement of financial support for renewable energy and has supported the setting-up of a solar industry.

In some cases, implementation of the NAPCCC lags behind and is not as fast as expected, and for some missions, the document is rather a mid-term vision than a planning document (ibid.). Other strategic documents, such as the FYP, are more concrete and we can expect most of the planned activities to turn into concrete action.

Do LCDS and activities support the use of identified potentials?

The area of improvements with biggest potentials, non-bio renewable energy, is also one of the focus areas of India's energy policy making. The NAPCC as well as the supporting policies have all considered the required framework in their design, and a great number of policies has been introduced down to state level to support high level targets. Some further improvements could be done by supporting Research and Development (R&D) further, and implementing pilot projects in rural areas, besides others.

To enhance efficiency of appliances, the mandatory labelling for air condition technologies and other high energy consuming appliances was introduced in 2007. BEE has strongly improved the coverage of appliances with efficiency labels. To effectively exploit potentials available, stronger dissemination of information on the standards and their benefits as well as binding efficiency standards can contribute positively. In terms of energy efficiency in industry, the degree to which potentials are tapped will depend highly on how the PAT scheme will be continued after 2015, which is unclear at the moment (Höhne et al. 2012).

Box 11: Conclusions on coherence of potentials, strategies and measures in India

With the NAPCC established, India's national planning is likely to be more ambitious than the international target, which it has labelled a NAMA. The NAPCC does not refer to the emission intensity reduction target pledged under the UNFCCC, and India's pledge is already close to the business as usual development, not including the NAPCC.

Sector specific activities partly reflect high level priorities, as defined in the NAPCC's missions. One very good example is the Solar Mission, which has translated into policy activities down to province level. However, implementation of measures to reach some of the targets in the missions is not secured. The strategies are not always consistently translated into actions on the ground, mainly because of a lack of resources in the area of climate change policy or unclarity of availability of funding.

A number of programmes imply steps ahead in important areas of mitigation, such as the PAT scheme improving energy efficiency in the industrial sector. The Indian climate policy framework still can profit from further improvements to effectively transform high level targets to actual measures and exploit larger shares of potentials.

5.4 Remaining barriers to unlocking identified potentials

The mitigation potential identified in this report is larger than the mitigation ambition India submitted internationally as its pledge. In this chapter we analyse, where barriers to exploiting this potentials are.

5.4.1 Nation-wide barriers

Various barriers exist in India which prevent the realisation of mitigation potential in all areas:

Dispersed institutional set up: India has established structures allowing for engagement of a broad range of stakeholders and involving many levels of society. Law making is relatively decentralised and many activities on state level are not necessarily in line with national plans. This system leads to two major drawbacks: First, policy making takes much time. Second, activities at state level are usually not coordinated on a federal level.

Lack of knowledge on new technologies: Integrating new technologies in processes can be a difficult task. This is especially the case for small and medium enterprises (SME), where knowledge about new technologies and capacities to use and maintain them are rather low. The financial sector also perceives new technologies as more risky and thus demands higher interest rates. Additionally, databases providing information on potentials still have to be built up.

Lack of financial resources on government level: For India it is a challenge to supply sufficient resources for implementing targets and policies related to climate change. The focus of policy making is rather on economic growth and there is little budget for environmental matters. The same is the case for monitoring of activities and development of GHG inventories.

5.4.2 Measure-specific barriers

Tab. 21 illustrates the type of barriers to each of the measures assessed in this context. The specific barriers are then discussed further in the following paragraphs.

Tab. 21: Overview of type of barriers to most important mitigation measures in India

	Non-bio Renewable energy	Efficiency of appliances	Efficiency of industrial processes	Alternative production routes	Modal shift
Share of total potential	13-35%	7-12%	10-20%	6-10%	7-11%
Barriers					
Institutional/political	X	x		x	X
Financial/economic	X		X	x	X
Technical	x	x			
Informational/capacities	x	X	x	X	x

Note: if x, then barrier is relevant to measure. Size indicates importance of the barrier. Blue colour bar illustrates the importance of the potential as a share of total potential in steps of 10% points.

Non-bio renewable energy supply

The main institutional barrier to renewable energy in India is a lack of capacity and resources of governmental institutions. There are insufficient and uncoordinated support policies on different government levels and e.g. Renewable Portfolio Standards (RPS) are not always enforced (Infrastructure Development Finance Company Ltd. 2010). On the other hand, there are perverse tax incentives for the construction of wind energy, which resulted in construction of wind farms in low-wind areas, leading to a bad reputation of the technology in some parts.

The main economic barriers are the high financing costs for installation of RE. In spite of rapid decreases in costs of renewable energy technologies and low labour costs, high interest rates bring RE at a competitive disadvantage and still pose a significant barrier to capacity increase (Council on Energy, Environment and Water 2012).

The most important technical barrier in India is that some renewable energy technologies are still imported and capacities as well as spare parts for maintenance are rare. For technologies produced in India there are little standards, so high quality is not always granted (Infrastructure Development Finance Company Ltd. 2010). Especially solar industry has very harsh competition from China (Council on Energy, Environment and Water 2012). Also, access to wind data and solar irradiation is scarce (ibid.).

Tab. 22: Most relevant barriers to renewable energy in India

Institutional/ political	Lack of comprehensive policy statement for RE (Infrastructure Development Finance Company Ltd. 2010)
	Land acquisition issues (Council on Energy, Environment and Water 2012)
	Income tax reductions for national wind energy developers: Caused construction of wind energy in low wind areas. No incentive for foreign investors (Infrastructure Development Finance Company Ltd. 2010)
	Little penalties for non-achievement of RPO and less enforcement(Infrastructure Development Finance Company Ltd. 2010)
	Lack of coordination and cooperation within and between various ministries, agencies, institutes and other stakeholders delays and restricts the progress in RE development.(Infrastructure Development Finance Company Ltd. 2010)
	Unregulated manufacturing industry (Council on Energy, Environment and Water 2012)
Financial/economic	High interest rates as result from market conditions in India (Nelson et al. 2012)
	High financing costs outrun lower labour costs and excellent natural resources (Nelson et al. 2012)
Technical	Challenge of grid integration (Infrastructure Development Finance Company Ltd. 2010)
	No standardisation (Infrastructure Development Finance Company Ltd. 2010)
	Lack of data bases for wind and solar irradiation
Informational/capacities	Little capacities for maintenance (Infrastructure Development Finance Company Ltd. 2010)
	Little awareness on RE technologies and lack of experience with practical problems (Infrastructure Development Finance Company Ltd. 2010)

Efficiency of appliances

The coverage of appliances with efficiency labels has increased. However, the lack of comprehensive incentives to promote energy efficient products and lack of coordination of different measures on the government level, still impedes efficient products to be applied as

swiftly as technically and economically feasible. Both aspects are related to the low institutional capacity to implement and coordinate those programmes (CUTS International 2012).

Manufacturers of appliances are uncertain if the market for efficient products is big enough and therefore tend to fall back on existing solutions, given the high price sensitivity of the appliance market (CUTS International 2012).

Tab. 23: Barriers to energy efficient appliances in India

Institutional/ political	Lack of institutional capacity to implement energy efficiency programmes in the end use sector (CUTS International 2012) Lack of associated financial incentives and mechanisms to promote wider availability of energy efficient products (CUTS International 2012) Lack of integrated inter-departmental/government support (CUTS International 2012) Principle-agent problems in rental markets (Bhattacharya und Maureen L. Cropper 2010) Labelling programmes not necessarily mandatory (Bhattacharya und Maureen L. Cropper 2010)
Financial/ economic	Price sensitivity of the appliance market results in little willingness for manufacturers to invest in energy efficiency (CUTS International 2012) Lack of resources for design development and testing especially amongst small scale manufacturers (CUTS International 2012)
Technical	Lack of access to the state of the art energy efficiency technology and opportunities for R&D (CUTS International 2012)
Informational/capacities	Uncertainty about market demand of high efficiency models (CUTS International 2012) Lack of information especially amongst small scale manufacturers and informal assemblers (CUTS International 2012) Lack of awareness about opportunities in residential energy end-use both at the consumer (e.g. on long-term cost effectiveness) as well as government level (CUTS International 2012)

Industrial energy efficiency

Because of high risk of black out, many industrial plants run their own on-site electricity plant. As prices for electricity from the grid in this sector are relatively high, it may be of economic benefit for the company to also use own electricity when the grid is available. The generation systems are small and in most cases less efficient than central plants (Bhattacharya und Maureen L. Cropper 2010). It is important to note that the high prices for industrial clients are not intended as a policy instrument for decreasing electricity consumption, but partly result from legal requirements for cheap electricity for the low income households and agriculture (UNIDO 2011).

Posing another important financial barrier, there is only limited access to capital for EE projects, especially in SME. This relates to risk perception and lack of capacity on EE projects in the finance sector (Limaye et al. 2012). Therefore, even if the investment would pay back over time, it becomes difficult to develop EE projects.

Tab. 24: Barriers to industrial energy efficiency in India

Institutional /political	High electricity prices charged to industry, stimulating self-generation using inefficient diesel-powered generators (Bhattacharya und Maureen L. Cropper 2010). Lack of communication between project developers and bankers (Limaye et al. 2012)
Financial / economic	Limited availability of funds for investing in EE projects, especially for SME (Limaye et al. 2012) High project development and transaction costs (Limaye et al. 2012) Unclear risk assessment and management (Limaye et al. 2012) Lack of capacity in finance sector for EE projects (Limaye et al. 2012)
Informational/capacities	Information, awareness, and communication: lack of information on new EE technologies (Limaye et al. 2012)

Alternative production routes

The most important barriers to improving production routes, particularly in the cement industry where information is most available, are related to institutional or political issues. More regulations on the combustion of waste and introduction of standards for clinker and final products of the processes can give guidance and thus security to plant administrators.

Tab. 25: Most relevant barriers to alternative production routes in India

Institutional/ political	Lack of standards in cement industry for clinker and final products Need for adaptation of waste legislation for combustion of waste for process energy
Technical	Geographical distance of alternative materials to plants and lack in infrastructure
Informational/capacities	Lack of resources for R&D for advanced technologies and processes

Source: (WBCSD und IEA 2013). Mainly information on barriers for improvements in cement industry found.

Modal shift transport

While modal shift of transport does not present any relevant technical issues in India, several political and financial barriers remain: One example is the lack of long-term commitment on the city level to implement more sustainable transport modes replacing private motorised transport. For bigger infrastructural projects, e.g. for the improvement of inland waterways, funding is scarce although development plans already exist.

Tab. 26: Most relevant barriers to modal shift in India

Institutional/ political	Indecisiveness on preferable transport mode (metro or BRT system) (UNEP Risø Center 2012) Need for long term commitment to implement transformation processes of transport systems (ibid.)
Financial/ economic	Lack of funding for inland waterways development (Ecorys 2010)
Others	Competition of private vehicles for use of road space (UNEP Risø Center 2012)

Box 12: Conclusions on barriers to GHG mitigation in India

While India has large potentials in various areas of GHG mitigation and a number of instruments in place in order to implement targets, some barriers to implementation of activities remain. Barriers specific to certain measures are for example the high interest rates for renewable energy investments, but there are also more global, systematic barriers, which affect most measures to a certain extent: One reappearing issue is the dispersed institutional setup and lack of resources on the government level, slowing down policy making. This sometimes impedes consequent transformation of high level targets to actual measures.

5.5 Conclusions

Highlights
- Involvement of high government institution (Prime Minister) in climate change matters
- Strong targets and focus on supporting policies for RE, especially solar energy

Possible improvements
- Capacity building for government institutions
- Increase focus on low-carbon transport

We find that India has a relatively complex institutional setup related to climate change issues, involving different levels of stakeholders and allowing for bottom-up suggestions from state levels. The involvement of different levels and a large number of non-governmental review processes aims to guarantee democratic processes and consider different local and sectoral needs. The downside of the setup and bureaucratic processes behind it is that policy making becomes a complex, time intensive and sometimes inefficient matter.

On the MRV of GHG emissions, India has improved substantially over the years. Further streamlining of processes and the establishment of an on-going MRV process could help increasing the quality of data. This requires additional resources for governmental and research institutions in this area.

Analysing coherence of policies, national targets and the international pledge, and keeping in mind that India's pledge is at a similar level as the BAU, this report finds that with the NAPCC India's national planning is likely to be more ambitious than the international target. For renewable energy and particularly for solar energy, India has ambitious targets which go beyond BAU.

In terms of coherence of activities and potentials, sector specific activities partly reflect high level priorities, as defined in the NAPCC's missions. This is specifically the case for the Solar Mission. However, implementation of measures to reach the targets in the missions is sometimes difficult, partly because the targets are quite ambitious.

While India has large potentials in various areas of GHG mitigation and a number of instruments in place in order to implement targets, some barriers to implementation of activities remain. Barriers specific to certain measures are for example the high investment costs for renewable energy investments and the high cost sensitivity of consumers of electric appliances. There are also more global, systematic barriers, which affect most measures to a certain extent: One reappearing issue is the dispersed institutional setup and lack of resources on the government level, slowing down policy making. This sometimes impedes consequent

transformation of high level targets to actual measures and leads to inconsistent policy framework.

Opportunities for India can emerge from increasing capacities on the governmental level in order to streamline policy making processes, as well as the support of capacity building and awareness raising in the financial sector in order to enable investments in the low-carbon area. There are also possibilities to address consumer side barriers: Additional information on opportunities from energy efficiency and RE, consistent standardisation and labelling schemes to increase quality and transparency and support for initial investments in technologies can all play a major role in India. As national capacities in India are limited to some extent, international support can play an important role in enhancing the climate policy setup.

Tab. 27 illustrates a summary of the finding of this report on Indian climate policy making. The first column recaps the potentials identified during previous analysis. The second column names most relevant actions in these areas, both in terms of strategies as well as measures, followed by the third column depicting remaining barriers.

Tab. 27: Overview of potentials, actions and remaining barriers for most important mitigation measures in India

Potential	Coverage as priority in national strategy and targets	Implemented policies to tap potential	Remaining Barriers	Opportunities for international cooperation
Renewable energies Total potential in 2020: 80-450 $MtCO_2e/a$	Solar mission	RE feed-in tariffs with revers bidding, RPOs, Clean Energy Future (tax on coal)	High interest rates for RE investments Grid integration Low quality (lack of standards)	Capacity building of financing sectors Provision of guaranties Exchange of experience on grid integration and standards
Energy efficient appliances Total potential in 2020: 40-160 $MtCO_2e/a$	National Mission for Enhanced Energy Efficiency	Super-efficient appliances programme Labelling schemes	Lack of information on consumer and manufacturer side (small companies)	
Efficiency of industrial Processes Total potential in 2020: 120 $MtCO_2e/a$	National Mission for Enhanced Energy Efficiency	PAT scheme	Difficult access to information and capital for small firms	
Alternative production routes Total potential in 2020: 40-120 $MtCO_2e/a$	-	-	Lack of regulatory clarity	Exchange on best-practice in international forums
Modal Shift Total potential in 2020: 70-90 $MtCO_2e/a$	Plans for development of inland waterway transport	BRT systems on city level	Lack of long-term commitment and funding in big infrastructural projects	Provision of finance Show casing best-practice activities

6 Mexico

6.1 Introduction

Mexico has been an important player in international climate policy over the last years. With 604 $MtCO_2e$ in 2008 its emissions are comparable to those of Australia and the UK and only slightly higher than South Korea, taking rank 13 globally (European Commission & Joint Research Centre (JRC), Netherlands Environmental Assessment Agency (PBL) 2011). Mexico is a member of the OECD and NAFTA and is economically closely linked to the US (Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT) 2009).

Over the last decade Mexico has seen a moderate GDP growth with a slightly larger growth in energy consumption (IEA 2012), leading to increased energy intensity. With 113 million inhabitants in 2010 it represents the 11th largest population globally. UN estimates population to grow a further 13% until 2020 (United Nations Department of Economic and Social Affairs Population & Division 2011).

Mexico pledged to reduce its GHG emissions by 30%, compared to a BAU scenario by 2020. In May 2012, the country presented the baseline related to the pledge with emissions of 882 $MtCO_2e/a$ by 2020. Remaining emissions after the proposed reduction would be 618 $MtCO_2e/a$ in 2020. Additionally it set a national long-term target of reducing emissions by 50% below 2000 levels by 2050. With the publication of the new climate strategy in June 2013 the baseline was revised to include all policies up to the end of 2009. The new baseline corrects emissions trends upward to 960 $MtCO_2e/a$ by 2020, translating into remaining emissions of 672 $MtCO_2e/a$ (Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT) 2013b). According to most effort sharing principles this pledge can be seen as ambitious.

Various studies estimated mitigation potential for Mexico. A meta-study published in May 2013 analysed these and estimated an overall GHG mitigation potential between 184 and 362 $MtCO_2e/a$ in 2020. The potential covers different measures for 2020. Reduced deforestation represents the largest potential, directly followed by the deployment of non-bio renewable electricity generation technologies, efficiency in power plants, efficiency in transport and modal shift (Fekete et al. 2013). New analysis published in June 2013 is already based on the revised baseline and estimates a mitigation potential of 320 $MtCO_2e/a$ in 2020, so well within the range of previous studies. On average this would come at a negative cost of 36 $US\$/tCO_2e$ (USAID 2013). Both studies come to the conclusion that there is sufficient potential available to meet the pledge.

Given the ambitious goals set and the availability of sufficient mitigation potential at negative or low costs we assess how far the institutions, strategies and policies in the country are set to enable the goals to be met and the potentials to be tapped.

6.2 The institutional framework for climate policy

6.2.1 Institutional setup for climate regulation

In Mexico the legislative power lies largely with two bodies - the Chamber of Deputies and the Senate. There is a defined distribution of responsibilities, with the Senate for example being responsible for international agreements, and the Chamber of Deputies dealing with budget

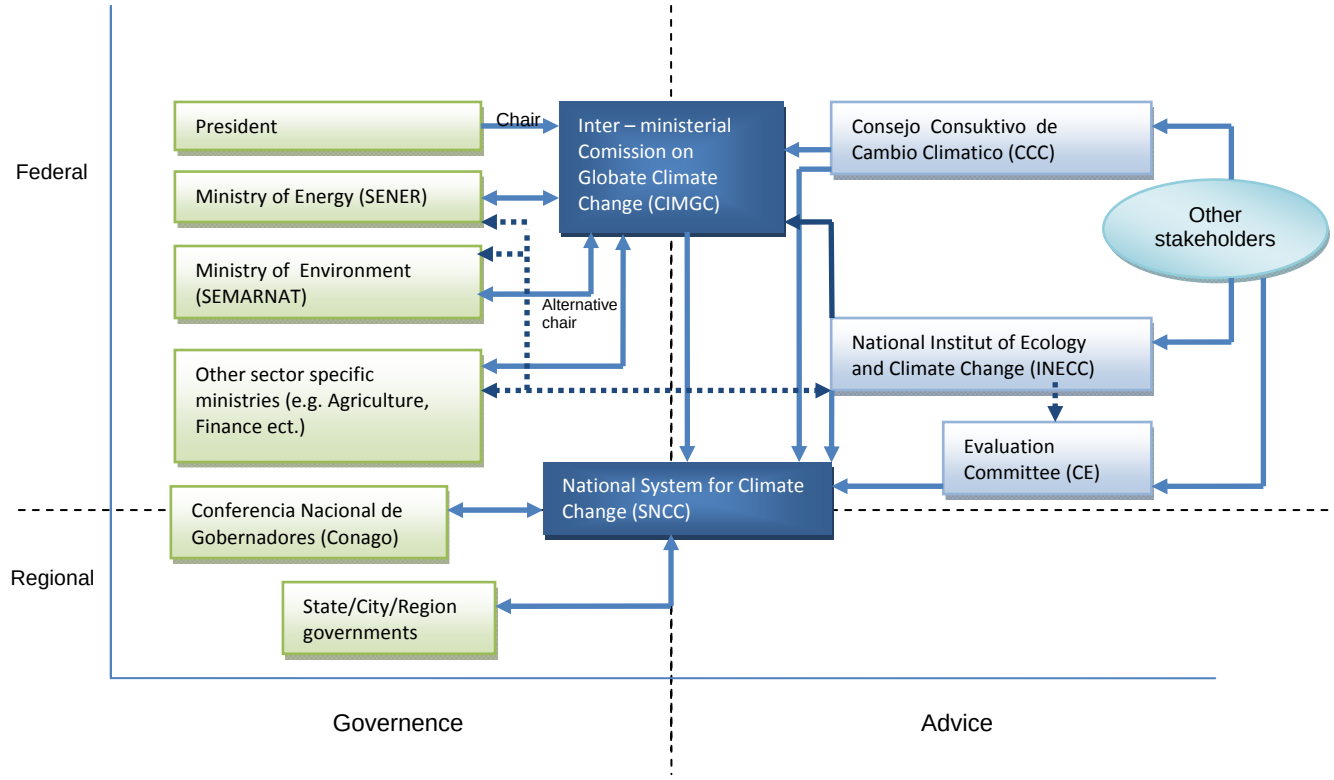
and expenditures (GLOBE International 2013). The Executive has a constitutional right to veto new legislation. Through this veto, the right to initiate bills and its role in enforcing legislation (Morgenstern & Nacif 2002), the Executive plays an important role in climate change policies.

On the Executive side the most important ministries for climate related activities are the Department of Energy ("*Secretaría de Energía*", SENER) and the Environment Ministry (*"Secretaría de Medio Ambiente y Recursos Naturales"*, SEMARNAT) although other ministries also play an important role in their respective sectors. Early, Mexico recognised the cross-cutting nature of climate change policy. This already showed in 1997 through the creation of the Inter-secretary Committee on Climate Change (ICCC) within SEMARNAT to coordinate work on climate change at federal level (Álvarez 2013). In 2005 this was transformed to the Inter-ministerial Commission on Climate Change ("*Comisión Intersecretarial de Cambio Climático*", CICC) (Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT) n.d.).

Apart from the Ministries, the Federal Electricity Commission (*Comisión Federal de Electricidad - CFE*) and the state owned oil company (*Petróleos Mexicanos – PEMEX*) play a special role in Mexico's institutional setup. The federal government's monopoly on electric utilities is enshrined in the federal Constitution; gasoline and diesel prices are determined by the federal government and implemented through PEMEX (Höhne et al. 2012). A major reform of the energy sector is currently under discussion that could change this situation considerably. President Peña presented his proposed reform plans in August 2013 which could in fact reduce the monopoly structure of the two sectors (México Presidencia de la República 2013; Meacham 2013). Other important institutions mandated with activities relevant to GHG mitigation are the National Forestry Commission (*Comisión Nacional Forestal* - CONAFOR) and the Commission for the Efficient Use of Energy (*Comisión Nacional para el uso eficiente de Energia* - CONUEE).

Fig. 1 provides an overview of the institutional setup for climate change policy in Mexico as defined in the General Law on Climate Change (Estados Unidos Mexicanos 2012). Large parts of this structure were already in place before the new legislation entered into force, but the law added a number of institutions, as well as strengthening the coordination both at federal level and between activities at federal and state, municipal and city level. It also aims at the inclusion of a wide range of non-governmental stakeholders, including academia, civil society and the private sector.

Fig. 9: Overview of institutional setup in Mexico



Source: own illustration based on (Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT) 2012a; Centro Mexicano de Derecho Ambiental (CEMDA) 2012b)

The most important institutions in this setup are the CICC and the newly formed National System for Climate Change (*Sistema Nacional de Cambio Climático* - SNCC).

Inter-ministerial Commission on Climate Change (CICC)

In the past the main task of the CICC was to coordinate the development and implementation of the strategy on climate change mitigation and adaptation, which started with an initial document in 2006 and developed towards the Federal Government's Special Climate Change Programme (PECC), published 2009. It also coordinates Mexico's participation in the international negotiations (particularly UNFCCC) and the Clean Development Mechanism (CDM) (Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT) n.d.).

The new General Law on Climate Change (see

Box 15 in section 4.2.1) has broadened the mandate. The CICC now takes on a central role in developing and implementing climate-related mitigation and adaptation policies. It also takes a leading role in mainstreaming climate aspects into all areas of the political process, and to execute activities under the national policy (Centro Mexicano de Derecho Ambiental (CEMDA) 2012b).

National System for Climate Change (SNCC)

The SNCC is a new institution established to coordinate activities between the three levels of government: federal, provincial and municipal. The objective of the SNCC is to facilitate the

collaboration and coordination of different levels and to ensure communication and consistency of actions at different levels and with the National Strategy (International Development Law Organization (IDLO) 2012).

Box 13: Conclusions on the institutional setup for climate legislation in Mexico

Mexico is well set to implement comprehensive and ambitious climate policy. The coordination between ministries at the federal level and between federal, provincial and municipality levels as well as the expertise built up over time both within Government institutions and in research institutes and universities provide a good basis for future action.

The coordination mechanisms and supporting institutions set up in Mexico are likely some of the most advanced institutional settings globally. The main question for successful implementation will be how much political clout these institutions will finally have when it comes to taking sometimes tough decisions balancing different interests.

The new administration that came into power just after the General Law on Climate Change was passed has started to implement the requested institutional changes. How far the new Government will in fact implement the envisaged embedding of activities at all levels and within all departments will remain to be seen.

4.1.1 Institutional setup and activities for MRV

Mexico has the most advanced reporting system in the developing world. It is the only developing country that has already submitted five National Communications to the UNFCCC and has an elaborate national setup to prepare regular reporting.

MRV institutions

The main institution responsible for emissions inventories and reporting under the UNFCCC is the National Institute of Ecology and Climate Change (*Instituto Nacional de Ecología y Cambio Climático, INECC*)[5]. The work of the institute is supervised by SEMARNAT in its function as president of the CICC. The institute was established in 1992 after Mexico signed the UNFCCC, and has been responsible for the preparation of the National Communications and GHG inventories ever since (Álvarez 2013).

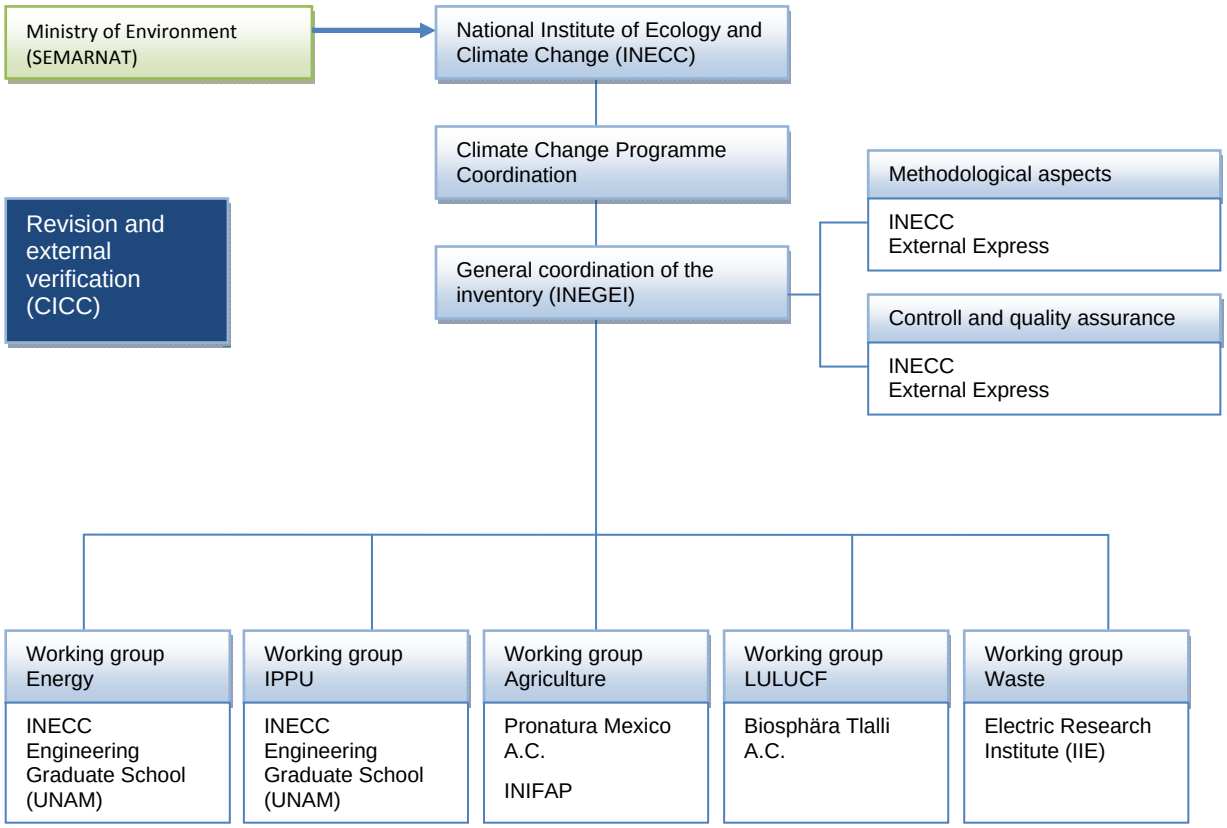
At the beginning INECC only had a general coordination role, largely relying on external consultants and on the Atmospheric Science Centre of the University of Mexico (UNAM). The actual technical work in gathering and compiling data as well as methodology development and quality control were outsourced to consultants and research institutes (Salas Cisneros 2013).

Over time INECC developed more internal capacity, and staff members are incorporated into almost all technical working groups of the inventory process. The number of specialists within INECC has constantly increased. Continuous training and the fact that there is low turnover of

[5] The General Law on Climate Change in 2012 renamed the institute to include climate change.

personnel has considerably improved human capacity within the institute (Salas Cisneros 2013). INECC is also taking a more active role in methodology development and quality control while still being supported by external consultants (see Fig. 10).

Fig. 10: Institutional structure for the elaboration of the national inventory – Mexico



Source: own illustration based on (Salas Cisneros 2013) based on (Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT) 2012c)

In addition to the direct working group members for the individual sectors, further institutions and private sector experts are involved in the preparation of the national inventory (see Tab. 12).

Tab. 28: Institutions involved in Mexico's national GHG inventory preparation 2012

Sector	Institution	English translation
Energy and industrial processes	Comisión Federal de Electricidad (CFE) Instituto Nacional de Estadística y Geografía (INEGI) Petróleos Mexicanos (Pemex) Secretaría de Comunicaciones y Transportes (SCT) Secretaría de Economía (SE) Secretaría de Energía (SENER) Asociación Nacional de la Industria Química (ANIQ) DUPONT México, S.A. de C.V. Quimobásicos S.A. de C.V	Federal Electricity Commission (CFE) National Institute for Statistics and Geography (INEGI) Petróleos Mexicanos (Pemex) Ministry for Communication and Transport (SCT) Ministry of Economy (SE) Ministry of Energy (SENER) National Chemical Industry Association (ANIQ) DUPONT México, S.A. de C.V. Quimobásicos S.A. de C.V
Agriculture and land use change and Forestry	Comisión Nacional para el Conocimiento y Uso de la Biodiversidad (CONABIO) Comisión Nacional Forestal (CONAFOR) Instituto Nacional de Estadística y Geografía (INEGI) Secretaría de Agricultura, Ganadería, Desarrollo Rural, Pesca y Alimentación (SAGARPA)	National Commission for the Knowledge and Use of Biodiversity (CONABIO) National Forest Commission (CONAFOR) National Institute for Statistics and Geography (INEGI) Ministry for Agriculture, Livestock, Rural Development, Fisheries and Food (SAGARPA)
Wastewater/ sewage treatment	Comisión Nacional del Agua (CONAGUA) Secretaría de Desarrollo Social (SEDESOL) Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT)	National Water Commission (CONAGUA) Ministry for Social Development (SEDESOL) Ministry of Environment (SEMARNAT)

Source: (Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT) 2012c)

Funding for the first three National Communications was project based from international donors. UNEP and the National Communications Support Programme (NCSP) funded the first, the Global Environment Facility (GEF) the second and third National Communication. Since 2006 and the start of preparations for the fourth National Communication funding is also partly provided by federal funds through SEMARNAT (Salas Cisneros 2013).

The relationships between INECC and other participating institutions and experts are long-standing and many of the people involved have been part of the process since the start, including some of the INECC staff. However, the project-based nature of the process often leads to delays in schedule and requires repeated contractual agreements with partners (Álvarez 2013; Salas Cisneros 2013).

INECC also supports capacity building for the development of state and municipal GHG inventories through workshops, material and online tools (Álvarez 2013).

Overview of MRV activities

Mexico is the only non-Annex I country that has submitted five National Communications to the UNFCCC so far, while most other countries have submitted a maximum of two NCs, with two countries (Korea and Uruguay) submitting three. The latest National Communication of Mexico was submitted 6 December 2012. The reporting has been submitted every 3 to 5 years(UNFCCC 2013).

The inventory uses the IPCC guidelines of 1996 for all sectors except waste, which uses 2006 guidelines.

In addition to activities at the federal level, most of the states in Mexico have prepared or are in the process of preparing state-level inventories. Currently Mexico has already started preparation of the first biennial report due in 2014 and the next National Communication for 2016, as required by the decisions taken in Durban and Doha (Álvarez 2013).

The project-based process in the past involved six steps, starting each inventory cycle with planning workshops. Then the different sector working groups collect the data. INECC compiles and checks the information and prepares the full document, including editing and publication (Salas Cisneros 2013).

In line with international requirements the new General Law on Climate Change mandates regular emissions reporting (Centro Mexicano de Derecho Ambiental (CEMDA) 2012b):

- Emissions from combustion of fossil fuels: annually
- Non-fossil emissions: every two years
- LULUCF emissions: every four years

These results will be part of the national GHG emissions registry[6].

This will in the future further improve the availability of data, which is already good compared to many other developing countries. The need for regular reporting may also influence the currently still more project-based nature of the reporting towards a permanent setup with permanently dedicated staff and allocated budget. (Gómez et al. 2013) also see a need to improve capacity of verification officers and additional assistance of international verification bodies.

Mexico also has a voluntary emission reporting initiative that was established in 2004 as a cooperation between SEMARNAT, CESPEDES, the World Resources Institute and the World Business Council for Sustainable Development. Participation in the programme has grown from 15 companies reporting emissions in 2004 to 115 entities reporting in 2012, representing 120 $MtCO_2e/a$ or 16% of the 2006 national inventory. This voluntary initiative has contributed to capacity building regarding GHG reporting in the participating companies, has increased awareness of the problem and is now moving towards encouraging voluntary mitigation actions (SEMARNAT et al. 2013).

[6] A registry for environmental pollutants already exists since 2006. It includes emissions of 109 substances, including greenhouse gases (Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT) 2013c). The law does not make clear reference to this, but it could be assumed that the existing registry would be adjusted to meet the requirements specified in the new legislation.

Box 14: Conclusions on MRV in Mexico

GHG reporting is already very advanced in Mexico. This is clearly demonstrated by the frequency of submitted National Communications, which is as high (even though not as regular) as that of developed Annex I Parties. The country has acquired substantial experience in the field within government institutions, research institutions and the private sector.

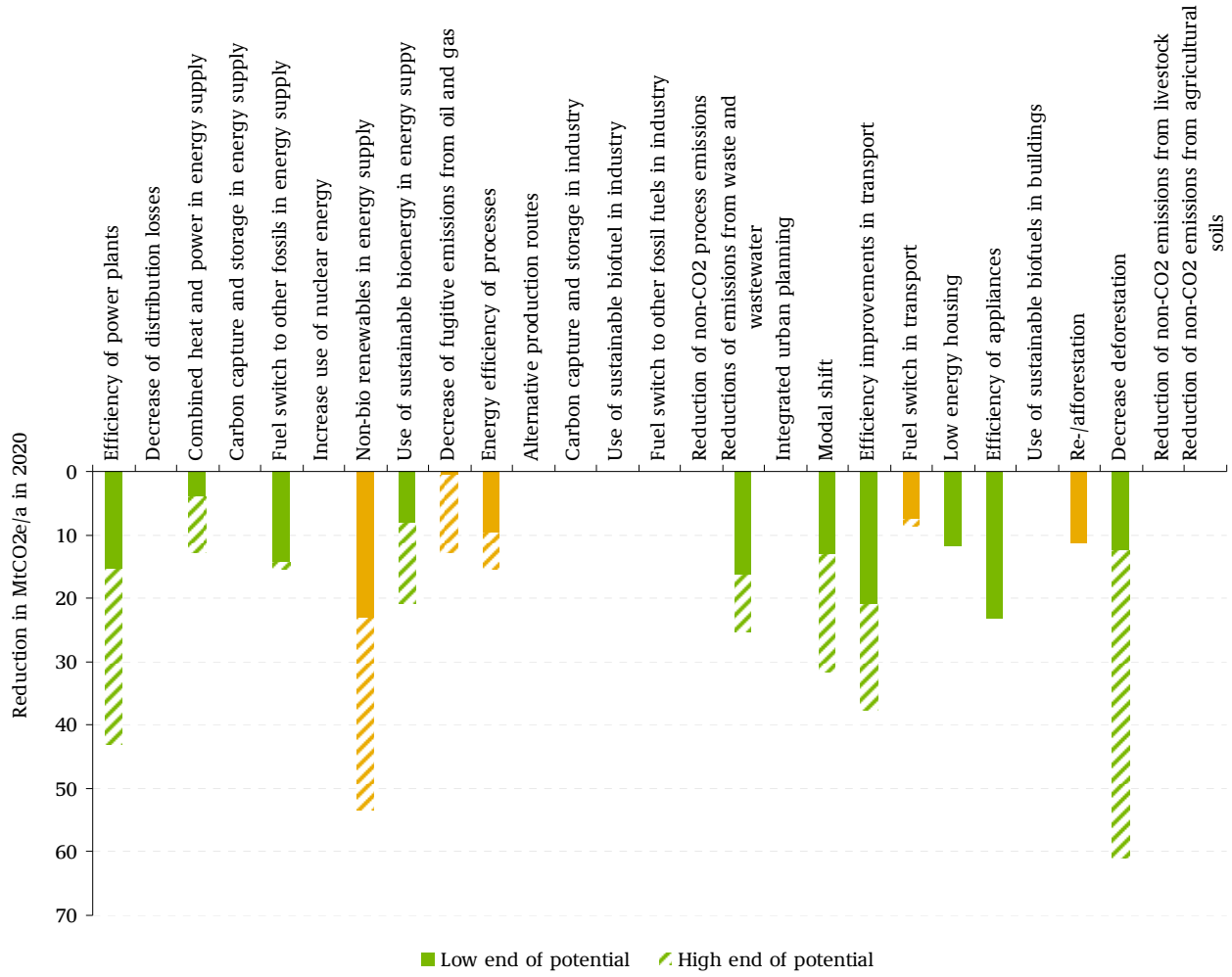
The next step is to move from a project-based - especially project funded - activity to a more institutionalized process. The current setup provides a solid basis to do so and the legal requirements set up in the General Law on Climate Change will likely promote this development.

4.2 Mitigation potentials, strategies and activities

Mexico could achieve its pledge at no or moderate cost if it fully implemented all measures identified in various studies (Fekete et al. 2013; USAID 2013).

Large differences in the estimated baseline development and regarding available potentials point to an uncertainty connected with the underlying data so results need to be assessed with care. Fekete et al. (2013) find a total minimum potential representing the lowest common denominator between the studies of 124 $MtCO_2e/a$ in 2020. The high end of the potential is given at 322 $MtCO_2e/a$. The total range is almost three times as large as the minimum potential. Fig. 11 provides an overview of identified potentials for different measures.

Fig. 11: Mexico: Ranges of mitigation potential by standard measures found in different sources.



Note: green bars represent no-regret measures, orange bars co-benefit measures

Source: (Fekete et al. 2013)

The assessment of Mexico's mitigation potential shows:

- Mexico has a wide portfolio of mitigation potential in all sectors. There are some measures that draw immediate attention, like reducing deforestation and increasing renewable energy production, but no single measure has the potential to deliver the required reductions for Mexico to achieve their target.
- A wealth of information and thorough assessment from various sources exists on potential activities, technological choices and economic considerations to guide decision-making.
- Many of the potentials come at negative or very moderate cost and are connected with substantial co-benefits, for example in the transport sector, where measures could lead to improved air quality and thus reduced health problems as well as reduced time required for commuting to work, thus increasing quality of life and overall productivity.

The next sections provide an overview whether strategies, policies and actions are in place or under way that are likely to tap the identified potential.

4.2.1 Low-carbon development strategies

General Law on Climate Change

The General Law on Climate Change (GLCC), which entered into force on 6 June 2012, mandates the development of a strategy covering both mitigation and adaptation (Estados Unidos Mexicanos 2012). The law sets some important framework conditions both institutionally and strategically as summarized in

Box 15 and described in section 6.2.1.

Box 15: The General Law on Climate Change: providing a framework

The General Law on Climate Change itself does not constitute a climate strategy, but lays some important foundations for the future development of a LCDS. It not only mandates the development of such a strategy, but also further improves the institutional setup and the information basis for the design and implementation of a national climate strategy. The main pillars of the Law are:

Institutions - Establishment of a National System for Climate change

- ✓ Establishment of an overall cooperation platform coordinated by the President, including institutional structures responsible for planning and implementing activities, including the Inter-ministerial Commission for Climate Change (CICC), the Climate Change Council (CCC), and INECC.

Planning instruments - Mandating a long-term strategy and related policies and programs

- ✓ Implementation of a national strategy for climate change, covering mitigation and adaptation with a 40 year horizon and regular revisions (every 10 years the latest).
- ✓ Mandates the development of a national policy that defines goals and activities in the different sectors in line with the defined strategy (this is similar to the recent PECC, but based on the national strategy).

Information tools

- ✓ Requirement for mandatory emissions reporting
- ✓ Creation of a public emissions registry for all sectors (Generation and use of energy, transport, agriculture, forestry and land use, waste, industrial processes, and others as required).

Evaluation

- ✓ Creation of an evaluation committee that is responsible for the periodic evaluation of policies and measures with the national strategy and subsequently defined strategies and policies.

Funding and economic instruments

- ✓ Setup of a Climate Change Fund aimed at attracting and channelling funds from public and private sectors from national and international sources.
- ✓ The General Law authorizes the CICC to establish a voluntary emissions market, including the establishment of a regulating entity. This provides the basis for the gradual establishment of market-based instruments to encourage the implementation of the National Policy on Climate Change.
- ✓ Reform of subsidies by 2020 in a way that promotes advantages from energy efficiency, non-fossil fuels and sustainable public transport. Incentives for renewable electricity generation.

Other important framework conditions included in the law are:

- A set of aspirational national targets in different sectors:
  - The overall national emissions goal line with international commitments of 30% below BAU by 2020 and 50 percent below 2000 emissions by 2050.
  - Share of electricity produced from clean sources of 35% by 2024.
  - 0 percent rate of loss of carbon in the original ecosystems.
  - No methane emissions from solid waste by 2018 for municipalities with more than 50.000 inhabitants.

  All goals stated in the law are aspirational, but provide guidance and a benchmark for future strategies and activities.
- Reporting and verification system with subsequent sanctions

(Centro Mexicano de Derecho Ambiental (CEMDA) 2012b; International Development Law Organization (IDLO) 2012)

National Strategy for Climate Change

Based on the mandate from the GLCC, the National Strategy for Climate Change (NSCC) was published in June 2013. It is independent from previous strategies and for the first time takes a long-term approach. Its main task is to define mid- and long-term goals for the national policy in three priority action fields: overarching institutional climate change issues, adaptation and mitigation (see Box 16).

A first step in the process to define the new strategy was the publication of a background analysis on the baseline scenario, mitigation options, and economic and institutional questions related to mitigation by INECC in November 2012 (Instituto Nacional de Ecología y Cambio Climático (INECC) 2012).

The action propositions are not mandatory, and serve as orientation only. For each area the strategy provides a short analysis of the current situation and a number of actions (líneas de acción). The Strategy includes a vision that identifies milestones in the form of mostly qualitative and relatively general indicators to be achieved in 10, 20, and 40 years. While thus the aspirations are put in a timeline, the proposed actions are not yet prioritized or provided with guidance on their concrete implementation. Instead, the strategy provides criteria to help prioritization, including the mitigation potential, cost, co-benefits, impact on productivity and existence of barriers (Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT) 2013a).

The General Law on Climate Change mandates the development of programmes to define goals and activities in the different sectors in line with the defined strategy. Translation of the strategy into concrete action will be the task of the new Special Programme on Climate Change (*Programa Especial de Cambio Climático* - PECC) 2013-2018 which is currently being developed and should be published later this year (Centro Mexicano de Derecho Ambiental (CEMDA) 2012b).

Box 16: The National Strategy for Climate Change: long term policy orientation

The National Strategy for Climate Change is one of the planning instruments inherent of the General Law on Climate Change and giving pioneering action fields and suggestions for national policy. The Inter-ministerial Commission for Climate Change (CICC), the environment ministry (SEMARNAT), the Climate Change Council (CCC), and INECC developed the strategy. The main focus lies on the three following themes, their actual situation and the strategic axis with possible actions.

Pillars of the National Climate Change Policy

P1: Focus on climate policies and actions which are cross-cutting, coordinated and integrative (18 actions)

P2: Develop fiscal policies and economic instruments with a climate focus, including a reform of energy subsidies and economic instruments to avoid deforestation and promote REDD+ (18actions)

P3: Implement a research platform for the development and improvement of climate technologies and strengthening institutional capacities (20actions)

P4: Promote the development of a "climate culture" (7actions)

P5: Implement mechanisms for MRV and Monitoring & Evaluation (12actions)

P6: Strengthening strategic cooperation and the international leadership (8actions)

Adaptation to Climate Change effects

A1: Reduce the vulnerability of society and increase the resilience to climate change effects (13 actions)

A2: Reduce the vulnerability and increase the resilience of strategic infrastructure and productivity systems to climate change effects (12 actions)

A3: Conserve and use ecosystems in a sustainable way and maintain the environment services (16 actions)

Low Carbon Development/Mitigation

M1: Accelerate the energy transition to renewable sources (14 actions)

M2: Reduce energy intensity through efficiency and responsible consumption (14 actions)

M3: Change to sustainable urban models including mobility systems, integrated waste management and low carbon buildings (13 actions)

M4: Promote better agribusiness and forestry practices to preserve natural carbon sinks (15 actions)

M5: Reduce emissions of short-lived climate pollutants (19 actions)

Evaluation

An evaluation of activities in the different fields will be carried out by SEMARNAT and the CICC:

- Mitigation: every ten years
- Adaptation: every six years

Past efforts in integrated climate planning

Over the past years the Special Program on Climate Change (PECC 2009-2012) was the main instrument for climate change policy in Mexico. It included objectives, strategies, lines of action and goals during the period 2009-2012. All these activities constituted unilateral measures, independent of additional international support. Although it also included a national target for 2050, the strategic usefulness of the PECC was limited by the short time horizon and a lack of

concrete policy instruments to operationalize the envisaged goals (Höhne et al. 2012). Actions resulting from the PECC were estimated to deliver around 51 $MtCO_2e/a$ of emissions reductions by 2012, a reduction of around 6.5% compared to BAU (Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT) 2012b).

Measures in the PECC constituted a mix of very concrete projects, involving for example improvements in individual installations (e.g. goals M1; M11), to more general aspirations, for example to increase rail freight (goal M31) (Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT) 2012b).

According to the latest official progress report, the PECC achieved a reduction of almost 41 $MtCO_2e/a$ in 2011, which would constitute 80% of the envisaged goal for 2012 (Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT) 2012a). These numbers need to be assessed with caution. The report does not provide details of the methodology used to assess the individual measures. Reductions are also shown in relation to the baseline provided with the original PECC in 2008, based on the 2006 GHG inventory, and does not adjust for changes in overall economic activity, especially the economic crisis in 2008/2009.

A document published in 2011 identified 17 additional actions that were aimed at reducing emissions by almost 47 $MtCO_2e/a$ by 2020. The activities can be seen as a proposal for the upcoming new climate plan, the PECC 2012-2020 (Instituto Mexicano para la Competitividad A.C. 2011).

Sub-national activities

At provincial level state programmes on climate change (Programas Estatales de Acción ante el Cambio Climático - PEACC) have been used for integrating climate change aspects. At the end of 2012 there were eight completed programmes, 22 under development and two in planning. The existing programmes vary strongly in the time horizon they cover. The programme of action for the City of Mexico (PACCM) covers the period from 2008 - 2012, in line with the PECC's timeline. Other states, like Chiapas or Hidalgo take a longer term approach (Instituto Nacional de Ecología y Cambio Climático (INECC) 2012). Under the General Law on Climate Change it can be expected that these efforts would in the future be closely linked to the development of the national strategy.

In March 2012 a new programme started to formulate action plans on climate change at municipal level (Planes de Acción Climática Municipal - PACMUN) (Instituto Nacional de Ecología y Cambio Climático (INECC) 2012). So far 30 plans were completed and over 200 more are in preparation or planning (ICLEI 2013).

Energy sector strategy

Apart from efforts to design an integrated strategy on climate change, the most important sectoral strategy influencing GHG emissions is the energy strategy formulated by SENER on an annual bases. The most recent strategy was released in March 2013. It confirms the goal from the GLCC to increase the share of electricity from clean sources to 35% by 2024. The strategy to achieve this includes the increase in nuclear capacity as well as a number of action points that are aimed at providing financial incentives to make renewable technologies competitive as well as removing administrative hurdles (Secretaría de Energía (SENER) 2013).

Box 17: Conclusions on low carbon development strategies in Mexico

Mexico has been very active in developing programmes and plans on climate action. In the past these were designed with too short time horizons to effectively serve as strategic guidance to policy making. While the PECC 2008-2012 for example included activities from all sectors, there was little analysis on cross-sectoral effects and needs. Measures ranged from individual installation level to rather vague aspirations, making implementation and evaluation more or less difficult depending on the individual measure. Previous action plans did also little to embed climate change aspects more deeply within the overall goals, work plans and budgets of the individual ministries.

With the General Law on Climate Change (GLCC) and the newly published National Strategy on Climate Change (NSCC) this piecemeal approach could be overcome. The frameworks have been put in place and the legal basis set to enable a more strategic approach to climate policy across all sectors.

The NSCC finally is designed towards a long-term strategic development, but only provides very general guidance. It remains to be seen how this strategy will be translated to more concrete actions and how far it will be successful in not only delivering individual projects and programmes, but influence decision-making at all levels of Government and across departments and sectors.

4.2.2 Mitigation actions

Nationally appropriate mitigation actions (NAMAs)

Mexico has fully embraced the concept of NAMAs under the UNFCCC. Although their initial submission regarding NAMAs only contained their nationwide emissions reduction pledge of 30% below business-as-usual, conditional to international support (UNFCCC 2011), Mexico has continuously advanced NAMA development since.

The latest National communication contains a list of 12 NAMAs in different states - from mere concepts to implementation. In Tab. 29 we provide an overview of these:

Tab. 29: NAMAs in process - Mexico

Name	Status	Corresponds to measure	Objectives / Comments
NAMA for sustainable housing	Implementation	Low energy housing	Promotion of ambitious energy performance standards for new residential buildings. Funding secured through NAMA facility and the Climate Investment Fund
Household services in the urban residential sector	Design	Efficiency of appliances	Enhance opportunities for mitigation and its co-benefits in services for households (lighting, water supply, waste). Crediting NAMA
NAMA based on the Federal Mass Transit programme	Design	Modal shift	Stage 1: capacity building for project development

Name	Status	Corresponds to measure	Objectives / Comments
(PROTRAM)			Stage 2: funding for activities beyond 2016 Crediting NAMA
Increase efficiency of appliances and replacement of refrigerants	Design	Efficiency of appliances	Efficiency increase and phase-out of HFCs in the sector. Crediting NAMA
Energy efficiency of washing machines and household water saving	Concept and funding negotiations	Efficiency of appliances	Increase energy and water efficiency.
Freight transport NAMA	Design	Efficiency in transport	Renovation of freight transport fleet.
Small and medium business (SME) NAMA	Concept	Energy efficiency of processes?	Promote energy efficiency through equipment solutions. GIZ technical support / part of German Mexican NAMA programme
Mitigation actions in cement production	Implementation design	Fuel switch in industry	Replace fuels by solid waste in cement production and increase clinker ratio of the final product.
Energy efficiency and development of a mitigation strategy in the chemical industry	Design	Energy efficiency of processes	Define a strategy and implement energy efficiency and monitoring systems in the sector. Sub-sector: detergents and resins/synthetic waxes
Energy efficiency and development of a mitigation strategy in the mining sector	Design	Energy efficiency of processes	Define a strategy and implement energy efficiency and monitoring systems in the sector.
Oil and gas sector NAMA	Design	Decrease of fugitive emissions from oil and gas	Reduction of fugitive gases and baseline development for the oil and gas sector.
Solar energy generation	Concept	Non-bio renewables in energy supply	Increase generation of solar electricity.

Source: (Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT) 2012c; Ecofys 2013; Climate Investment Fund 2013)

There is only limited information available on most of the NAMAs and their mitigation potential. Detailed information is only available for the sustainable housing NAMA, which is already in its implementation phase. The action aims to promote the construction of new residential buildings with high energy performance standards, with a particular focus on low-income households (Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT) 2011a).

The real mitigation achieved from the activity will highly depend on the amount of funding that can be attracted. Outer limits of the potential were calculated to be roughly between 10 and 17 $MtCO_2e/a$ by 2020, assuming a 100% penetration of the building standards for new buildings. The high end of this range assumes that current existing actions, like the Green Mortgage programme would be stopped in the baseline case, while 100% penetration of passive house standards would be achieved (Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT) 2011a). The provided range is even larger than the mitigation potential identified

in previous studies, which is due to the very high and unrealistic penetration rates. Reality would likely deliver much lower although potentially still substantial reductions.

In addition to the NAMAs included in the National Communication, a number of feasibility studies were conducted for potential further NAMAs (Ecofys 2013):

- Enhancing vehicle renovation;
- Optimization of the conventional bus system in Mexico City;
- NAMA for the sustainable use and disposal of the biomass in Mexico, turning it into renewable energy.

Mitigation policies and measures

Apart from activities that are specifically designed as NAMAs, Mexico has a range of policies and measures in place that are directed towards reducing GHG emissions. Some of these are complemented by the above listed NAMAs.

Renewable energy supply

There are currently three main bills that are aimed at promoting renewable energy generation. They were all implemented at the start of the last administration in 2008/09 (Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT) 2012c; Höhne et al. 2012):

- Law to promote development of bioenergy (Ley para la Promoción y Desarrollo de los Bioenergéticos - LPDB): provides general support for bioenergy, for example through the nomination of the Inter-secretarial Bioenergy Commission.
- Law to promote the use of sustainable energy (Ley para el Aprovechamiento Sustentable de la Energía - LASE): aims to increase the availability of information on renewable energy, develop a national inventory and a catalogue of pilot and demonstration alternative energy projects for rural communities and to develop policy, regulatory and financing mechanisms to better take advantage of renewable sources.
- Law for the Use of Renewable Energy and Financing the Energy Transition (Ley para el Aprovechamiento de las Energías Renovables y el Financiamiento de la Transición Energética - LAERFTE): provides the basis for the framework to promote and regulate renewable energy and cogeneration.

Recent reform proposals to the latter two laws aim at increasing their impact (Camara de Diputados 2013). The cornerstone for future measures in this area will be the target envisaged in the GLCC to increase the share of renewables from currently around 19% of electricity generation to 35% by 2014. In the baseline scenario this share is projected to drop to 16% due to the large increase in demand, which under BAU is assumed to be satisfied entirely through gas.

Although the new energy strategy 2013 - 2027 adopts the goal from the GLCC, it is not yet clear how this will be implemented. SENER developed three possible scenarios to achieve the goal and is currently developing a more detailed roadmap, including a revision of the renewable energy programme which should be published early 2014 (Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT) 2012c):

- Wind scenario: focus on wind power with 28% share of backup capacity from gas
- Nuclear: 7 to 8 plants with 1,400 MW each of nuclear capacity and 20,900 MW wind capacity
- Mixed: 2 plants with 1,400 MW each of nuclear capacity and 20,900 MW wind capacity

The share of wind capacity in the mixed scenario is based on the evaluation of the economically competitive potential in Mexico. This potential has been estimated to be between 10 and 20 GW by 2020 (Secretaría de Energía (SENER) 2012).

The currently discussed reform of the energy sector relating to the special position of Pemex and CFE will likely have substantial impact on the sector and the instruments available to promote renewable energy sources (see section on barriers below). The reform could potentially remove the monopoly for the oil and gas sector and for electricity generation (México Presidencia de la República 2013). The tax reform currently under discussion would likely influence renewable energy in a number of ways in both directions so the final impact on renewable energy and other measures is not yet clear (Mexico Gobierno de la República 2013).

Efficiency of appliances

To improve energy efficiency, Mexico has created two important institutions concentrating exclusively on this topic: The National Commission on the Efficient Use of Energy (Comisión Nacional para el Uso Eficiente de la Energía- CONUEE) is the agency under the Energy Ministry responsible for technical support, information generation and dissemination and policy advice on all matters related to energy efficiency (Comisión Nacional para el Uso Eficiente de la Energía - Conuee 2013). The Trust for Electric Energy Savings (Fideicomiso para el Ahorro de la Energía Eléctrica- FIDE) is a private, non-profit entity initiated by the Federal Electricity Commission in 1990 with the goal to implement electricity saving activities, promote the development of efficient technology and disseminate information (Fideicomiso para el Ahorro de la Energía Eléctrica 2013).

Both entities are engaged in a number of activities that implement efficiency measures. Apart from education and a labelling system, FIDE also provides low-interest credits to electricity efficiency projects, including the replacement of domestic appliances and for measures to reduce electricity use in industry and commerce.

Conuee is directly involved in the design of efficiency standards. Over the last years a number of efficiency standards (Normas Oficiales Mexicanas - NOM) were adopted or revised, including for general lighting, room air conditioners, residential refrigerators and freezers, residential clothes washers, water heaters, thermal insulation of buildings, energy efficiency of the building envelope of residential buildings[7],tortilla manufacturing equipment, and electric motors (Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT) 2012c).

The minimum performance standards (and their corresponding test procedures) for refrigerators and air conditioning units have been harmonised with those of the US and

[7]A standard for non-residential buildings already existed earlier.

Canada (De Buen 2007; De Buen 2009). How far energy efficiency standards really reduce GHG emissions also depends on behavioural changes. A study in Mexico found that the replacement of inefficient air conditioners increased electricity consumption. The lower operating cost led to increased use (Davis et al. 2012). This points to the need for complementary measures, like for example information campaigns to address rebound effects.

Low energy housing

Although standards for the building envelope and for thermal insulation exist, there is no unified national building code. The setting of building codes is within the responsibility of the states and municipalities. In 2007, the Comisión Nacional de Vivienda (CONAVI) developed such a unified building code (CEV), which was updated in 2010 and serves as a voluntary model (Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT) 2011a).

The PECC 2009 - 2012 also included measures to promote low energy housing. These include:

- *Green mortgages programme (Hipoteca Verde)*: provides loans for new dwellings or remodelling (refurbishment), e.g. solar water heater, thermal insulation, CFLs, high efficient A/C, low-flow showers (Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT) 2011b). While this programme is listed within the PECC 2009-2012, it continues under the new administration (INVONAVIT 2013).
- *"Esta tu casa" programme*: run by CONAVI, the programme offers the same services as the green mortgages programme with a focus on low-income households (Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT) 2011b). This programme is also continued beyond the PECC (Secretaría de Desarrollo Agrario Territorial y Urbano (SEDATU) 2013).
- *Solar water heater promotion programme (PROCALSOL)*: the program run by CONUEE had the goal to achieve the installation of 1.7 million m^2 of installed solar water heaters between 2008 and 2012 (Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT) 2011b). In 2011 alone almost 1 million m^2 were installed (PROCALSOL 2013).

Another measure is the Sustainable Urban Development Initiative (Desarrollo Urbano Integral Sustentable - DUIS), implemented by CONAVI in cooperation with 13 other organisations. The goal is to support infrastructure development and housing construction through the coordination of all levels of government in developing holistic urban planning concepts (Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT) 2011a).

Waste

The PECC included a number of goals for the waste sector for the period of 2009 - 2012. For solid waste the aim was to develop 29 projects, mainly as CDM projects, to reduce emissions through controlled combustion or energy use of methane from landfills. Only part of the projects were realised within the time frame under the CDM, and they delivered less reductions than envisaged (Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT) 2012c). There were also a number of goals related to the treatment of wastewater, but none of these were realised within the operational phase of the PECC (Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT) 2012a).

Efficiency improvements in transport

The most important new development in Mexican transport legislation is the adoption of a vehicle standard for GHG emissions (norm: PRO Y-NOM -163-Semarnat-ENER -SC FI-2012). It applies to new vehicles and aims at harmonising emissions standards with the US by 2016 (Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT) 2012c).

In the past a strong focus was given to the replacement of old vehicle stock. The average vehicle fleet in Mexico is old and inefficient (Secretaría de Comunicaciones y Transportes (SCT) 2012) and there have been various programs that provided incentives to replace old vehicles with new ones. The impact of these has been limited, although the number of scrapped vehicles was overachieved in most years. Over the period 2004 - 2011 just over 2 $MtCO_2e$ were reduced according to official calculations (Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT) 2012c). Also newer measures, like the obligatory replacement of taxis 10 years or older in Mexico City (Gobierno del Distrito Federal 2013a) still target this area, as well as changes to legislation under discussion which would limit the age of freight vehicles to 20 years (Aguilar 2013).

The Clean Transport Programme (Programa de Transporte Limpio) aims to decrease the fuel consumption of freight vehicles and passenger buses that have a federal plate. Between 2009 and 2011 almost 11,000 vehicles were evaluated with a total emission saving of around 2 $MtCO_2e$ over the period (Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT) 2012c). To reduce emissions and improve air quality Mexico City also established restrictions on driving within the city limits, depending on the last number on the licence plate (Gobierno del Distrito Federal 2013b).

Modal shift

There are a number of efforts to support cities in addressing the increasing transport problems in a sustainable way. The Social Development Ministry (Secretaría de Desarollo Social - SEDESOL) supported a number of cities in restructuring their transport systems (Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT) 2012c).

In 2009 the Federal Mass Transport Programme (PROTRAM) was established with financial support from the World Bank to support the development and implementation of sustainable urban transport projects (Fondo Nacional de Infrastructura 2010). The concept is now being further developed, with the target to turn the programme into a credited NAMA.

The PECC also included a goal to increase freight transport via rail. There were no concrete measures defined how to implement this, and the PECC progress report does not provide any further information(Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT) 2012a).

Decrease deforestation

Mexico developed a national REDD plan, and a number of strategies, plans and laws directly support the REDD strategy (Climate Focus 2013). With the information available it is difficult to evaluate their effectiveness.

The main legislation related to avoiding deforestation activities is the General Law of Sustainable Forest Development (Ley General de Desarrollo Forestal Sustentable). It is targeted

at the conservation of forests and introduces the concept of environmental services as a "public utility", including carbon storage as an explicitly mentioned service (Climate Focus 2013).

Other measures, like the 'Law on Sustainable Rural Development' include "payment for environmental services" schemes (*Esquema de Pago por Servicios Ambientales - PSA).* Here the protection of the environment is to be achieved through payments to forest owners for conservation measures (for example reforestation, sustainable management, fire prevention) (Instituto Nacional de Ecología y Cambio Climático (INECC) 2012). In the forest sector the most important scheme is ProArbol, which was established in 2006 and focuses on conservation and restoration actions in communities, especially marginalized communities (Climate Focus 2013). It includes 12 sub-programmes to achieve emission reductions from actions aimed at protecting, conserving, restoring and sustainably using the resources of temperate and tropical forests and vegetation of arid zones (Höhne et al. 2012).

A specific project (Proyecto Los Bosques de México y el Cambio Climático) aims at consolidating the different programs of incentives for the forest services, establishing sustainable management of the forests, and helping rural communities besides (Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT) 2012c)(Instituto Nacional de Ecología y Cambio Climático (INECC) 2012).

Recent changes to the Environmental Law and the Sustainable Forest Development Law in April 2012 aimed at definition of key terms, development of economic instruments and safeguards for REDD+ (Townshend et al. 2013).

4.2.3 Coherence of strategies, activities and potentials

Does Mexico consistently translate strategies into actions?

It is too early to evaluate the effective translation of the GLCC and NSCC into action. The actions defined in the NSCC are too broad and not yet translated to concrete policy measures or programmes. How far these activities will finally translate to action will strongly depend on the National Policy (PECC 2013-2018) which is currently under development.

In the past the programmes and plans on climate change had been mainly a collection of targets and activities at various levels of detail, from individual projects to general targets or aspirations for sectors or sub-sectors. Many of these activities were already incorporated into the budgets and planning of the respective ministries when the climate change plans were published. So it is unclear if actions implemented are the result of a strategy, or the strategy was the result of already defined measures.

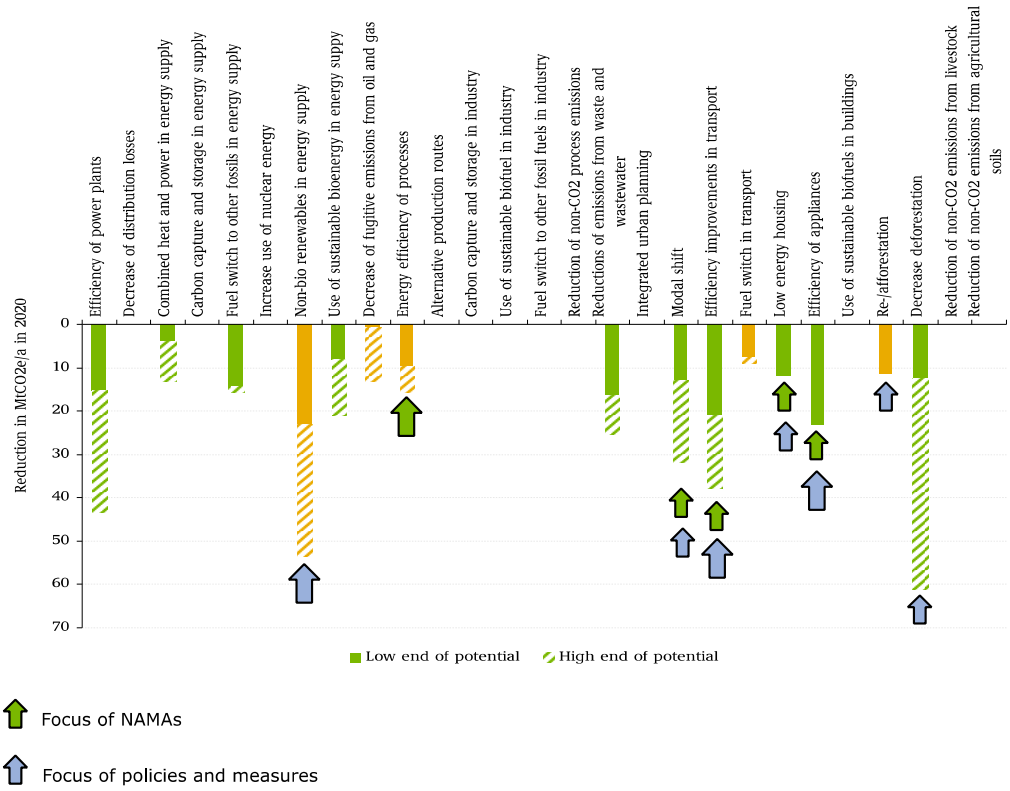
The renewable energy goal of 35% by 2024 established in the GLCC was subsequently incorporated into the energy sector strategy. The translation into concrete actions to achieve the goal is currently under way and it remains to be seen how stringent the set targets will be supported by policies and measures (Secretaría de Energía (SENER) 2013).

Do strategies and activities support the use of identified potentials?

Comparing the NAMAs under development and implemented policies and measures with the identified potentials we find that overall many of the measures bearing high potential are addressed by NAMAs, policies or other measures.

A large focus of activities seems to be in the transport and building sectors, with multiple measures and NAMAs developed to address different activities. The energy supply side and the important land use sector are covered by policies and measures, but are no focus for NAMAs at the moment.

Fig. 12: Mexico: Ranges of mitigation potential compared to NAMA activities and policies and measures implemented.



Source: (Fekete et al. 2013). Additional arrows: Areas with relevant policy activities.

Measures in the energy sector were not assessed within the scope of this study. The switch to gas is part of the energy strategy and driven by cost considerations rather than specific mitigation policies. Apart from the waste sector where we have found only very limited activity within the CDM, all other measures are supported through NAMAs and/or policies. The scale of activities for all measures is yet not sufficient to tap the full potential as identified (UNEP 2011).

Box 18: Conclusions on coherence of mitigation potentials, strategies and measures in Mexico

With the new General Law on Climate Change Mexico will have a well worked out system of translating the overarching targets into strategies and plans. At the moment existing policies mainly pre-date the new climate legislation, but in large parts already address the right areas, both in terms of matching the newly defined climate strategy as well as targeting the areas with the largest identified potentials. This is likely due to the fact that extensive analysis was conducted on potentials and potential activities prior to the definition of the climate strategy.

Measures exist in most of the areas where high potentials were identified, except in the waste sector. The legislative reforms currently under discussion, especially the proposed energy reform, and the finalisation of the National REDD strategy are likely to pave the way for further action.

4.3 Remaining barriers to unlocking identified potentials

4.3.1 Nation-wide barriers

One of the most prominent barriers common to most developing countries is the fact that diverging priorities exist. Between the need to deliver basic public services and infrastructure, combat poverty and reduce inequality within the society there is often limit appetite for action on climate change mitigation (Lara-Valencia & Brazel 2012).

The need for mitigation and the negative impact of non-action through the impacts of climate change is well understood within some departments, mainly at the federal level. However, relevant information on climate change, potential mitigation measures and related benefits is not always available to all actors, especially at the local level (Lara-Valencia & Brazel 2012).

Regular changes in Government, which usually include a full exchange of personnel in the administration, hinder continuity in political priorities and add risk especially to longer term and large scale projects, for example in the energy sector. At federal level the administration changes every 6 years, at local level every 3 years. There is no re-election possible (Centro Mexicano de Derecho Ambiental (CEMDA), 2009), but also influence other measures that benefit from long-term predictability, like for example investments in public transport infrastructure or industrial investments.

4.3.2 Measure-specific barriers

Tab. 30 provides an overview of the barriers for the measures with the largest identified mitigation potential. It provides a clear message that the most barriers are found institutionally, politically and in the financial/economic area. For two measures - renewables and low energy housing - barriers exist in almost all fields, making implementation a complex challenge.

Tab. 30: Overview of type of barriers to most important mitigation measures in Mexico .

	Non-bio renewables in energy supply	Efficiency of appliances	Low energy housing	Efficiency improvements in transport	Waste	Deforestation
Share of total potential	13%-29%	6%-13%	3%-7%	10%-12%	7%-9%	7%-17%
Barriers						
Institutional/political	X	x	X	X	X	
Financial/economic	X	x	X	x	X	
Technical	X		x			
Informational/ capacities	x		X			
Others	x			x		

Note: if x, then barrier is relevant to measure. Size indicates importance of the barrier. Blue colour bar illustrates the importance of the potential as a share of total potential in steps of 10% points.

Renewable energy supply

One of the biggest challenges in promoting renewable energy in Mexico is the need for harmonisation of legislation and tools across the different levels of Government and different institutions and actors. This includes adjustments required to the Mexican Constitution and the law on public electricity production (Ley Del Servicio Público De Energía Eléctrica). The least cost requirement that directed decision-making especially in the electricity sector for the last decades does not allow for the deployment of higher cost production technologies for the supply to the public. According changes to the Constitution have been proposed and approved but not yet published. An additional obstacle at the political level is the frequent changes in Government with subsequent changes in priorities, providing low confidence for long-term investments(Centro Mexicano de Derecho Ambiental (CEMDA) 2012a).

On the financial side the most important barriers are the high up-front investment costs for renewable technologies. This is linked to the low national production capacity for such technologies. Low national demand has so far prevented the development of national production capacity for renewables technologies, while investment in research and technical development remain also at low levels (Centro Mexicano de Derecho Ambiental (CEMDA) 2012a).

Tab. 31: Most relevant barriers for non-bio renewables in energy supply in Mexico

Institutional/ political	Frequent government change with change of priorities thus missing continuity in large scale projects (Centro Mexicano de Derecho Ambiental (CEMDA) 2012a) Constitutional requirement for energy companies to produce low cost energy for the public (Centro Mexicano de Derecho Ambiental (CEMDA) 2012a) Difficulties in obtaining local and federal licenses for installation of renewable capacity(Instituto Nacional de Ecología 2009) Land use rights related to the use of solar and wind technologies (Centro Mexicano de Derecho Ambiental (CEMDA) 2012a)
Financial/ economic	High up-front investment cost (Instituto Nacional de Ecología 2009) Price of electricity is controlled and supposed to be low, renewables are expensive (Garrison 2010) Non constant financial supply (Instituto Nacional de Ecología 2009) Lack of incentives (Garrison 2010)
Technical	Power sector designed to operate with current conventional technologies (Instituto Nacional de Ecología, 2009) Lack of storage systems and smart grid technologies to address high intermittency of renewable electricity production (Secretaría de Energía (SENER) 2013)
Informational/ capacities	Limited number of experts (Centro Mexicano de Derecho Ambiental (CEMDA) 2012a) Investments in research and science of new energy as well as technical development are limited and small (Centro Mexicano de Derecho Ambiental (CEMDA) 2012a)
Others	Environmental damage/harm (Garrison 2010)

Efficiency of appliances

Electricity subsidies for residential consumers discourage many energy efficiency investments in appliances and lighting (Instituto Nacional de Ecología 2009; Centro Mexicano de Derecho

Ambiental (CEMDA) 2012a). In addition to the perverse incentive provided through cheap electricity, there are no economic incentives available to compensate for the higher up-front cost of efficient appliances. Existing institutions and legal frameworks are not designed to implement integrated plans that cover all aspects needed to promote efficient appliances, each only covering a distinct part (Centro Mexicano de Derecho Ambiental (CEMDA) 2012a).

Tab. 32: Most relevant barriers for efficiency in appliances in Mexico

Institutional/ political	Missing legal framework for economic incentives (Centro Mexicano de Derecho Ambiental (CEMDA) 2012a) Lack of institutional capacity with regard to implementation of integral plans (Centro Mexicano de Derecho Ambiental (CEMDA) 2012a)
Financial/ economic	Subsidized electricity prices provide a disincentive (Instituto Nacional de Ecología 2009) Needed investments and support are missing (Centro Mexicano de Derecho Ambiental (CEMDA) 2012a)

Low energy housing

A number of barriers make it challenging to tap the full potential available in this sector. First and foremost, there is a clear lack of comprehensive energy efficiency norms with a robust enforcement system (Instituto Nacional de Ecología 2009). The voluntary building code developed by CONAVI is only a model. CONAVI as a federal agency cannot enforce its adoption and implementation. Existing norms do not cover all aspects of construction and building equipment and are not yet fully included in the relevant building codes. Furthermore, the implementation of energy efficiency standards in housing remains weak (Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT) 2011a).

But norms can only provide the incentive for action. The lack of knowledge and experience with energy efficiency in construction of all actors - home-owners, developers, planners, building professionals and local administrations - poses a very practical barrier to action. This includes lack of information on the availability of technologies, how to implement them and the benefits from their implementation. There is no formal certification for craftsmen or builders that would ensure minimum standards and would help to disseminate information on low carbon technologies(Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT) 2011a).

Higher up-front cost also provides an obstacle to implementation of efficiency measures (Instituto Nacional de Ecología 2009). This is especially problematic since there is a high turnover of ownership. The ones building and buying the property often do not intend to use the building beyond the payback time of low carbon investments. Thus the overall economic argument of energy saving investment is often not convincing. This very short-term approach by investors and buyers is a main obstacle to enhanced investment. Subsidised energy prices provide further disincentives for low-carbon solutions and extend payback times of investments (Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT) 2011a).

Tab. 33: Most relevant barriers to low carbon housing in Mexico

Institutional/ political	No comprehensive and formal regulations for energy efficiency in housing Delay in the adoption of energy efficiency norms (Instituto Nacional de Ecología 2009) Relatively little involvement of energy companies, and underdevelopment of the energy services market (OECD/IEA 2013)
Financial/ economic	Subsidized energy prices (LPG and electricity) High cost of energy efficient building materials and technical equipment due to lack of economies of scale (limited demand) Short-term perspectives of buyers (Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT) 2011a) Lack of financing for equipment and project development (OECD/IEA 2013)
Technical	Lack of practical experience with energy efficiency in construction Lack of quality of the products due to lack of regulation and supervision (Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT) 2011a)
Informational/ capacities	Lack of knowledge about technical solutions for building professionals and administration officials Lack of knowledge about related benefits for home owners/buyers Too few demonstration projects of low energy houses (Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT) 2011a) Lack of technical personnel (OECD/IEA 2013)

Waste

Institutionally the largest challenge is to establish the overall legal framework at all three levels of Government (federal, state and municipal) that enables the responsible municipalities to address the issue while taking into consideration the local circumstances (Centro Mexicano de Derecho Ambiental (CEMDA) 2012a). In addition to the lack of adequate regulation at many levels, the lack of enforcement of existing regulation constitutes another obstacle to successful implementation of activities (Instituto Nacional de Ecología 2009).

High up-front investment cost for activities such as recycling and gas capture pose an important financial barrier to implementation (Instituto Nacional de Ecología 2009).

Tab. 34: Most relevant barriers in the waste sector in Mexico

Institutional/ political	Lack of waste management programs in all states and municipalities (Instituto Nacional de Ecología 2009)(Centro Mexicano de Derecho Ambiental (CEMDA) 2012a) Legal federal framework for handling waste challenges is missing (Centro Mexicano de Derecho Ambiental (CEMDA) 2012a)
Financial/ economic	Capital investment required for action as recycling or gas capture is high (Instituto Nacional de Ecología 2009) Lack of markets for waste management (Instituto Nacional de Ecología 2009)

Efficiency improvements in transport

Emissions from transport are traditionally regulated at the local level as they are generally treated as local air pollutants. With respect to a national approach to GHG emissions, this creates a legal and political barrier. Since climate change is - unlike many of the other pollutants from vehicle exhaust - not a local but a global problem, the responsibility needs to be taken up also at the national level, and all levels of government need to act in a concerted manner (Centro Mexicano de Derecho Ambiental (CEMDA) 2012a).

Tab. 35: Most relevant barriers to efficiency improvements in transport in Mexico

Institutional/ political	Lack of responsibility for transport emissions at federal level (Centro Mexicano de Derecho Ambiental (CEMDA) 2012a) Uncertainty about future fuel efficiency standards and norms (Instituto Nacional de Ecología 2009) Lack of verification programs and enforcement resources (Instituto Nacional de Ecología 2009)
Financial/ economic	Cost of new vehicles (Instituto Nacional de Ecología 2009)
Others	Resistance of the stakeholders of the current transport system (Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT) 2012c)

Deforestation

Activities in the forest sector in general go in the right direction. Conflicting interests from other sectors, which are often given priority over forest protection, inhibit effectiveness. An integrated approach would need to address demands on forest lands for preservation as well as from agriculture, oil and mining.

Large parts of the population that live in the highly forested areas still largely depend on economic activities which entail deforestation or degradation of forests. The payment for environmental services approach aims to address this, but may need to be further embedded in an overall strategy for the economic development of the region that ensures sustainable forest management.

Tab. 36: Most relevant barriers for the reduction of deforestation in Mexico

Institutional/ political	Goals and legislation in the forest sector are potentially domineered by priorities in the agricultural, oil & gas or mining sectors (Climate Focus 2013), for example the 'Progran' programme that incentivises livestock through direct payments which results in an incentive for deforestation (Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT) & Instituto Nacional de Ecología 2010) Coherence among Federal and State policies and laws has been highlighted as a main challenge (Climate Focus 2013) Legal framework for mangrove protection is weak, implementation of existing protection rules is not very effective (Centro Mexicano de Derecho Ambiental (CEMDA) 2012a) Limited action for the protection of the forests at municipal level (Chapela 2012) Non-compliance and enforcement related to illegal deforestation (Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT) & Instituto Nacional de Ecología 2010)
Financial/ economic	High dependence of the local population on economic activities that lead to deforestation (Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT) & Instituto Nacional de Ecología 2010)

Technical	High fragmentation of community land (tierras ejidales) makes monitoring more complex (Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT) & Instituto Nacional de Ecología 2010) Lack of surveillance technology, i.e. satellite capacity (Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT) & Instituto Nacional de Ecología 2010)

4.4 Conclusions

Mexico has a highly developed comprehensive climate policy system. It has been very active in developing programs and plans on climate action for the past years. The General Law on Climate change builds on these experiences and creates a well-designed framework for effective climate policy that spans all levels of government - national, provincial and municipal.

The coordination mechanisms and supporting institutions set up in Mexico are likely some of the most advanced institutional settings globally. The main question for successful implementation will be how much political clout these institutions will finally have when it comes to taking sometimes tough decisions balancing different interests.

Highlights
- The General Law on Climate Change passed in 2012 sets a comprehensive overall framework
- The institutional setup and the system of strategic planning, information and monitoring is exemplary
- High national MRV capacity: 5 National Communications submitted

Possible improvements
- Energy sector is still dominated by the two state-owned entities
- Energy subsidies provide perverse incentives
- Technical in-country capacity in the renewables sector and for low-carbon buildings remains low
- Address waste management

Strategies in the past were designed with too short time horizons to effectively serve as strategic guidance to policy making. Previous action plans did also little to embed climate change aspects more deeply within the overall goals, work plans and budgets of the individual ministries.

With the General Law on Climate Change (GLCC) and the newly published National Strategy on Climate Change (NSCC) this piecemeal approach could be overcome. The NSCC finally is designed towards a long-term strategic development, but only provides very general guidance. It remains to be seen how this strategy will be translated to more concrete actions by the Special Programme on Climate Change (PECC 2013-2018) currently under development, and how far it will be successful in not only delivering individual projects and programs, but influence decision-making at all levels of Government and across departments and sectors.

This could also remedy some of the barriers in different sectors where lack of coordination between national, provincial and national level or across sectors hamper effectiveness of measures. This is especially important in combating deforestation, but also applies to many measures in the transport sector. The waste sector is currently not adequately covered by measures, which in the past have remained at project level. More integration across the levels of government could help address this important potential at a broader political level.

Other barriers, such as lack of technical capacity, technology or high upfront investment cost could be tackled with the help of international support. Supporting the set up of incentive schemes to address higher investment cost, like the NAMA on sustainable housing, could be expanded. Intensive capacity building activities especially in the building sector and for renewable energy generation technologies would provide valuable support.

Other barriers need to be overcome at a national level, and Mexico is on a good path to tackle these. The currently planned energy reform could address the largest stumbling blocks to renewables deployment in energy supply. The energy subsidy reform that forms part of the National Strategy on Climate Change has the potential to remove many of the economic barriers in the different sectors.

Tab. 37 summarized some important elements of the report. It illustrates the potentials of different measures and related activities to tap these as well as remaining barriers. Additionally, we present ideas on how the international community can support Mexico in overcoming some of these remaining barriers.

Tab. 37: Overview of potentials, actions and remaining barriers for most important mitigation measures in Mexico

Potential	Coverage as priority in national strategy and targets	Implemented policies to tap potential	Remaining Barriers	Opportunities for international support
Renewable energies Total potential in 2020: 23-53 $MtCO_2e/a$	National non-fossil energy target: 35% share by 2024	Various laws to promote renewable energy Under development: Renewable strategy Energy reform Tax reform	Monopoly in the electricity sector and least cost requirement High up front cost	Support financial incentive schemes to cover up front cost
Low energy buildings Total potential in 2020: 12 $MtCO_2e/a$	NAMA for sustainable housing	Green mortgages Sustainable urban development initiative	No comprehensive energy efficiency norms with enforcement High up front cost In-country expertise	Support financial incentive schemes to cover up front cost Capacity building in low-energy housing for construction sector
Energy efficient appliances Total potential in 2020: 23 $MtCO_2e/a$		Labelling Efficiency standards	Distorted energy prices (subsidy reform is part of the national strategy) High up front cost	Financial support
Efficiency in transport Total potential in 2020: 21-37 $MtCO_2e/a$		Emissions standard for new vehicles Scrapping of old vehicles Information / education	Responsibility at local level together with other pollutants Lack of enforcement resources Cost of new vehicles Resistance of stakeholders	Increase ambition of own fuel standards Support in information campaigns Support enforcement
Waste Total potential in 2020: 16-27 $MtCO_2e/a$		Activities mainly project based (mainly CDM)	Coordination between levels of government High up front investment Lack of markets	Exchange on best-practice in international forums
Deforestation Total potential in 2020: 13-61 $MtCO_2e/a$	Specific mention in the National Strategy	Payment for environmental services schemes	Coordination between sector priorities Dependence of local population on economic activities that result in deforestation or degradation Lack of surveillance technology	Technical support for MRV Continue/expand existing support for REDD+

7 South Africa

7.1 Introduction

South Africa is the largest economy and the largest GHG emitter on the African continent. On a global scale South Africa ranks at number 15 in terms of GHG emissions. Beyond total emissions, it is important to note that the carbon intensity in South Africa is very high, both in terms of per capita (9.2tCO_2e /person) and per GDP unit (2.4 ktCO_2e/million 2000 US$) (World Bank 2012).

South Africa's economy relies heavily on mining and heavy industry. Energy consumption in the industrial and buildings sectors relies largely on electricity, which is produced with high carbon content by the use of domestic coal. Overall it is estimated that 75% of South Africa's emissions are due to coal use (Marquard et al. 2011). Within a 2020 time horizon emission growth mainly stems from growth in industry and the increased electrification and electricity use of households (Fekete et al 2013).

In 2008 the country was facing a power supply crisis. Energy generation capacity could not meet demand. Black-outs and load-shedding had to be imposed for over six months (IEA 2013). In this crisis situation, energy efficiency measures and renewables gained popularity. However, with the economic downturn of 2009 security of supply was stabilised again and a major focus of South Africa's energy policy is again on building new coal fired power plants.

Climate issues have dramatically gained momentum in the country in recent years. The country has pledged to reduce emissions by 34% below BAU in 2020 and 42% below BAU in 2025 in Copenhagen. During COP 17 in Durban the climate debate has reached out into relevant institutions in South Africa.

7.2 The institutional framework for climate policy

7.2.1 Institutional setup for climate regulation

Legislative and executive branches of government: The South African Parliament, the main legislative body of the country, consists of two houses: the National Assembly and the National Council of Provinces. However, legislation on climate change in South Africa has been scarce in the past. Instead, the country has relied mainly on less binding policies, strategies and regulations issued by the executive branches of government, i.e. the Cabinet of South Africa, consisting of the President and Deputy President, the Ministers of all government departments and their deputies. The Cabinet commissioned the Energy Research Centre ERC) to outline Long-Term Mitigation Scenario Analysis (LTMS) in 2006, which provided policy recommendations for a long-term strategy for climate change (see Winkler 2007). The LTMS still forms the heart of South Africa's approach to climate change (GLOBE 2013).

Climate change mitigation and adaptation, and related strategy formulation, are part of the South African President's list of service delivery agreements with the Ministers of the Cabinet. Ministers have to regularly report on progress achieved on the agreed climate change outputs (DEA 2011b). In order to further integrate this process, *the Intergovernmental Committee on Climate Change* (IGCCC) was established in 2008. It is responsible for South Africa's international stance on climate change as well as the coordination of South Africa's domestic

climate change policy. It also serves as "a *de facto* steering committee for climate change-related projects that impact on, or require the active involvement of, more than one of the IGCCC members" (DEA 2011a). Members of the IGCCC are all ministerial departments relevant for climate change regulation, and all provincial environmental departments.

Main responsible ministries and departments: The Ministry heading the country's approach to climate change is the Ministry of Water and Environmental Affairs, with the Department of Environmental Affairs (DEA) as the main responsible entity. The DEA presented South Africa's Vision, Strategic Direction and Framework for Climate Policy in 2008, after two and a half years of public consultations. This framework has now been replaced by the National Climate Change Response Policy White Paper (NCCR), adopted by the Cabinet in late 2011 after extensive public consultations (DEA 2011a, GLOBE 2013). The NCCR addresses both mitigation and adaptation, and provides planning goals for the short- (5 years), medium- (20 years), and long-term (up to 2050).

The Department of Energy (DoE)[8], a department of the Ministry of Energy (MoE), is in charge of South Africa's energy policy. As emissions from energy generation are the highest source of greenhouse gases in the country, decisions on energy are highly relevant for the country's overall approach to mitigating climate change. The most relevant overall energy strategy is contained in the Integrated Resource Plan (IRP), which in its revised form was published in 2011, after a public consultation process that *inter alia* led to a strengthening of the goal for renewable energy in South Africa's future energy mix (DoE 2011).[9]

Currently, a special focus lies on South Africa's National Treasury, a department of the Ministry of Finance. The Treasury has announced the introduction of a carbon tax starting 2015 as part of the country's overall budget. The draft legislation for the tax was open for public comment until the beginning of August 2013 (Ensor 2013), and will need approval by the Parliament. A final draft is planned to be published late 2013 or early 2014 (Creamer 2013). As part of the budget, the Treasury is also in charge of taxation of motor vehicles.

Public entities: Another important institution in the field of energy is the National Energy Regulator of South Africa (NERSA), tasked with the regulation of the electricity, piped-gas and petroleum pipeline industries (www.nersa.org.za).

Electricity in South Africa is mainly generated by the state-owned supplier Eskom. Eskom according to its own figures produces 95% of South Africa's electricity (www.eskom.za), but also handles electricity distribution. Eskom plays a strong role in energy policy formulation in South Africa (Koen 2012). In 2011, the DoE issued a draft bill for the establishment of an independent Systems and Market Operator (ISMO) that would take responsibility for generation capacity planning, and electricity market coordination as well as handling power purchase agreement with independent electricity producers (IPPs) (Pegels 2011), but the bill has not been passed yet.

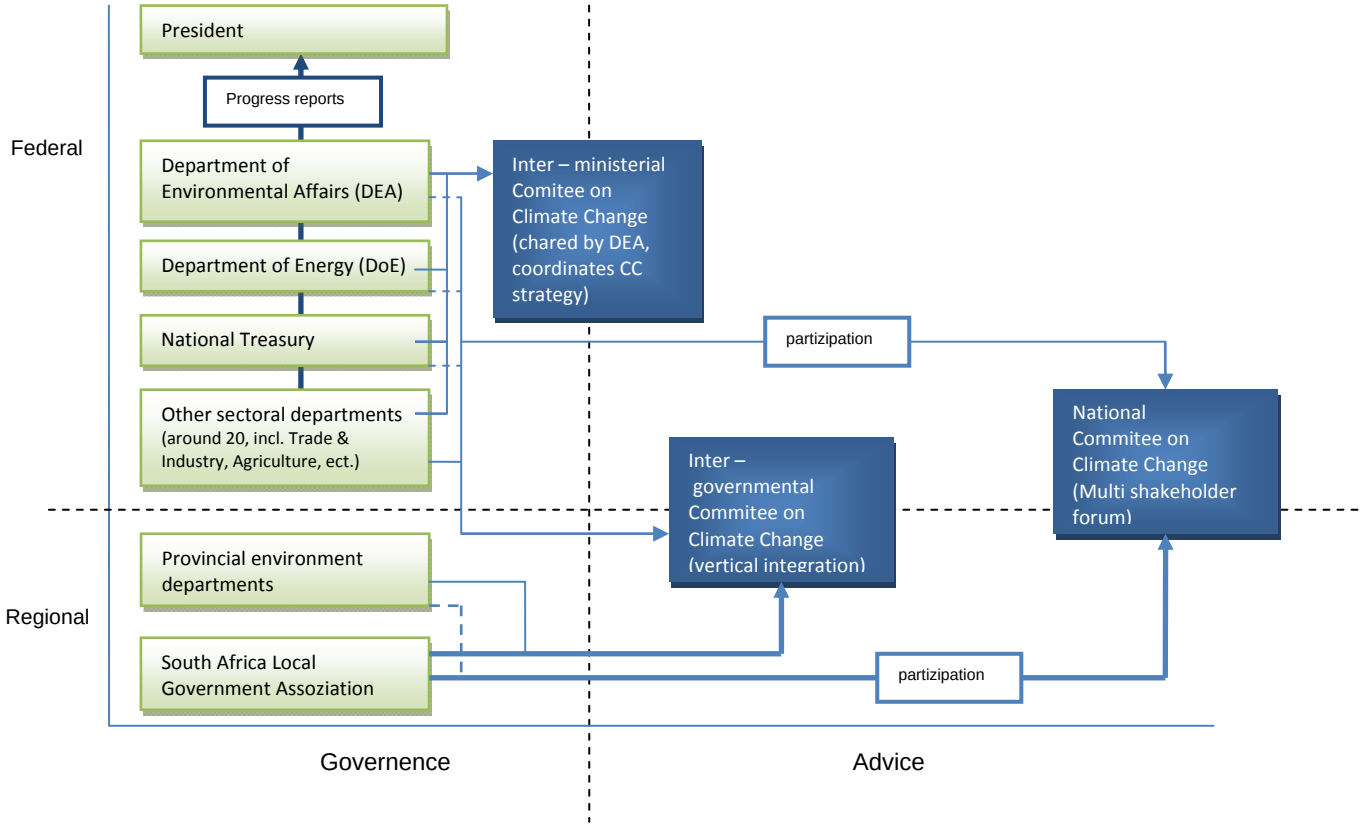
[8] The Department of Energy is formerly known as Department of Minerals and Energy. For consistence, we use the abbreviation "DoE" throughout this report.

[9] A draft Integrated Energy Plan was recently released for public comment by the Department of Energy (DoE 2013), but could not be considered for this report at the time of publication.

In 2011, the two public research agencies South African National Energy Research Institute (SANERI) and National Energy Efficiency Agency (NEEA) were merged into the new South African National Energy Development Institute (SANEDI). SANEDI is an implementing agency of the South African government, in particular of the DoE, created to assist the country to reach its energy goals (SANEDI 2012). It focuses on awareness-raising and increased uptake of "green" energy. Its portfolio includes data and knowledge management on energy, energy efficiency, fuel technology, low-carbon energy and transport, CCS, as well as energy end use and infrastructure (www.sanedi.org.za).

South Africa strongly advocates involvement of stakeholders in the policy process. It has set up a National Committee on Climate Change, with multi-stakeholder participation from key sectors and civil society. Participating stakeholders include business and industry representatives, national government departments, provincial environmental departments, local governments, public entities and NGOs (DEA 2010). Unfortunately, no information on the current work of the Committee is publicly available.

Fig. 13: Main actors and institutions for climate regulation in South Africa



Source: own illustration

7.2.2 Institutional setup and activities for MRV

The National Climate Change Response Policy (DEA 2011a) specifies objectives and gives details in regard to future activities on MRV in South Africa. Reporting requirements for developing countries were further developed at the COP17 in Durban. These two developments laid the foundation for current developments on MRV activities in South Africa. However, as the changes in reporting requirements are not yet in place or reported, main findings of a study

carried out by the Energy Research Centre (ERC) (2011) are still valid and thus the main source for the following assessment.

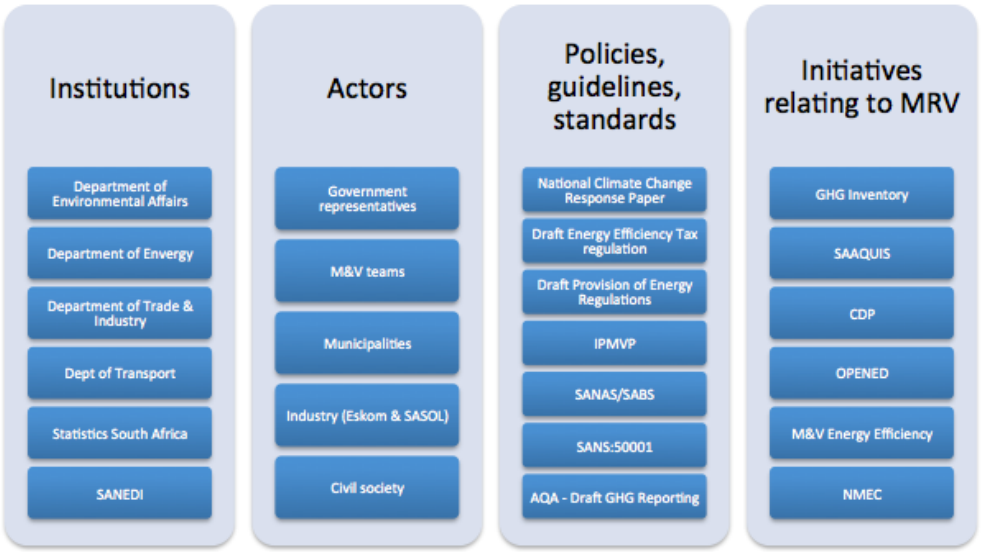
MRV institutions

Most important and responsible institution for the National Communication, GHG inventory and other related tasks is the Department of Environmental Affairs (DEA). The DEA also drafted the National Climate Change Response (DEA 2011), where details are given on how the Monitoring & Evaluation of climate change actions should be carried out in the future (in Section 6 and 12 of the White Paper).

Although the DEA has the mandate to carry out the National Communications and reporting to the UNFCCC, they depend on the cooperation with other ministries/departments and the provision of data from various sources. Energy data, for example, was provided by the Department of Energy (DOE), Eskom and other institutions for the three GHG inventories reported.

Next to the DEA, several actors, institutions and initiatives are linked to MRV in South Africa, which can be seen in Fig. 14.

Fig. 14: MRV in South Africa: Existing initiatives, data base, actors, regulations and institutions



Source: Boyd 2011

Not only public institutions, like government entities or governmental agencies (e.g. Statistics South Africa or SANEDI) are involved, but also public enterprises (Eskom) and the private sector (like SASOL), partly through unofficial or only partial reporting.

The challenges of this grown and decentralised information flow is the lack of formalised coordination mechanism, duplicated efforts and in parts only limited access to the basic data by DEA (ERC 2011). Due to scattered data collection and preparation of results by external consultants, there is also the danger to lose track of data and documents (Netgen 2011).

The industry of South Africa so far has had no compulsory reporting structure. However, high emitting industries – such as SASOL – report their emissions to the DEA for the GHG inventory

or/and to the Carbon Development Project, where the top 100 companies listed in the Johannesburg Stock Exchange (JSE) are supported to monitor report and verify their emission data (up to now 5 reports published, latest in 2012).

As stated in the NCCR, for entities with emissions of above 0.1 Mt CO_2e per year (or comparable electricity use) reporting of emissions data shall be made mandatory (DEA 2011a).

According to the DEA, a "*System for the monitoring and evaluation of climate change in South Africa*" shall be developed in response to the NCCR White Paper with the "*purpose to help analyse the impacts of mitigation actions and to gather information and report progress on the implementation of adaptation actions [….]. The first component is to* ***design and publish an M&E framework****, which will address the scopes, objectives, principles, roles and responsibilities of the different institutional structures which are to take part in South Africa's M&E system. The second component is the* ***development of the national M&E system****.*" (Mitigation Partnership 2013)

The tasks lined out in the White paper shall be implemented within two years (by end of 2013). Thus, the processes to establish the M&E framework and system are currently under way (DEA 2011a, Mitigation Partnership 2013).

For the preparation of the latest GHG inventory presented in the Second National Communication, the institutions lined out in Tab. 38 had been involved for the different sectors.

Tab. 38: Institutions involved in South African national GHG inventory preparation (for 2NC 2010)

Sector	Institution
Energy	Department of Energy (DoE); South African Petroleum Association (SAPIA) and Chamber of Mines; Eskom
Industrial processes	Industry associations (e.g. ACMP), Department of Energy (DoE), South Africa's Mineral Industry publication (SAMI) and Statistics South Africa
Agriculture	Department of Agriculture, Forestry and Fisheries (DAFF) and other affiliate institutes including the CSIR and ARC.
Land use change and Forestry	Forestry South Africa (FSA); National Land Cover (NLC) datasets; Department of Land Affairs (DLA) Chief Directorate of Surveys and Mapping (CDSM) and the Department of Water Affairs and Forestry (DWAF)
Waste	Annual South Africa population statistics (adopted from the United Nations Statistics)

MRV activities

South Africa has so far published two National Communications, in 1998 and 2011, including data of three national GHG inventories (for the years 1990, 1994 and 2000), for more detail see the Annex in section 11.5.

According to the NCCR White Paper of 2011 (DEA 2011a), "*…a national system of data collection to provide detailed, complete, accurate and up-to-date emissions data in the form of a Greenhouse Gas Inventory and a Measurement and Evaluation System to support the analysis of the impact of mitigation measures…*" shall be established. In future the annual inventory is supposed to be carried out by the DEA in partnership with the South African Weather Service,

the host of the South African Air Quality Information System (SAAQIS), conforming to the IPCC's 2006 guidelines within two years after NCCR White Paper publication. The inventory shall be a web-based reporting system and linked to the SAAQIS.

Recent activities/developments

The fourth GHG inventory is under way as the DEA launched a tender in spring 2013 for a consultancy on an independent review of the 4th Annual GHG inventory (SA tenders 2013).

Regarding the improvement of database and transparency, the web-based *Eco Inventory* is already online (see http: //ei.netgen.co.za/) developed by Netgen (who developed SAAQIS) and in cooperation with the University of the Witwatersrand, the Department of Agriculture, Forestry and Fisheries, funded by the British High Commission. The Eco Inventory is divided into the AFOLU, the Transport and the LULUCF inventory, as the database is mainly developed for the optimisation of inventory preparation of the Department of Agriculture. In addition to background information also details on the methodology and data base[10] are presented online.

Box 19: Conclusions on institutional setup and MRV in South Africa

Climate regulation in South Africa is part of the delivery agreements of the President with the Ministries, and as such has been given a high priority within the country's government. Leadership of climate policies lies within the Department of Environmental Affairs, but the Department of Energy also plays a strong role due to the particular importance of the energy sector for greenhouse gas mitigation in South Africa.

Overall, the ownership of climate-relevant regulations is more dispersed in South Africa than in other countries within this report. The Intergovernmental Committee on Climate Change and the National Committee on Climate Change seek to integrate and coordinate the various public and private stakeholders involved in climate change policies and measures.

South Africa has so far had a decentralised system for reporting under UNFCCC. The will to improve the current conditions, develop a M&E framework and implement a sound monitoring and evaluation system (for GHG emissions as well as for mitigation and adaptation actions) is expressed in the NCCR White Paper. South Africa has recognised the need for a more structured approach, standardization, bundled coordination, improved data collection and data quality assurance as well as on verification. It needs to be seen how the objectives addressed in the White paper will be implemented in the next years.

7.3 Mitigation potentials, strategies and activities

7.3.1 Low-carbon development strategies

South Africa does not explicitly name any of its domestic strategies a low-carbon development strategy (LCDS). In 2011, two strategic approaches to development were published: The *National Development Plan* (National Planning Commission 2011), and the *National Strategy*

[10] Details on the status are not available online without password, thus not accessed by author.

for Sustainable Development and Action Plan (NSSD) (DEA 2011a). Both allude to the transition to a low-carbon (or "green") economy. Climate change is not the main focus of these strategies but they touch upon certain aspects of climate change. For instance, the NSSD defines the reaction to climate change as one of the country's development goals.

A third strategy with direct impact on low carbon development, the *Integrated Resource Plan* (IRP) by the MoE, was developed in 2010 and revised in 2011 (MoE 2011). The IRP is a sectoral strategy for the future energy mix in South Africa[11]. The MoE devised an independent scenario for the IRP. After public consultations and a subsequent revision, the scenario is now called *Revised Balanced Scenario* (RBS). The RBS was adjusted according to further price scenarios and policies already in place, leading to a differentiated strategy for the development of the energy sector in South Africa up to 2030. The IRP is subject to revision every two years. However, the IRP's revision for 2012/2013 is not publicly available yet.

The *National Climate Change Response White Paper* (NCCR), also adopted in 2011 (DEA 2011a) can be best viewed as a low carbon development strategy in the sense of this report. Previous iterations of the NCCR have been referred to as LCDS in the literature (see Project Catalyst 2009, van Tilburg 2011). As mitigation target, it contains the 'Peak, Plateau, Decline scenario that was first put forward as a NAMA by South Africa after Copenhagen (see below).

The NCCR contains two major goals: First of all, it focuses on areas relevant to adaptation (such as water, land use change, food security, biodiversity, settlements and early warning systems). A subcommittee of the IGCCC is tasked to develop sectoral plans, e.g. the *National Water Strategy, Strategic Plan for South African Agriculture* (DEA 2011a).

Secondly, the NCCR develops a national strategy for mitigation in the context of sustainable development. The NCCR reiterates South Africa's pledge to reduce emissions by 34% below BAU in 2020 and 42% below BAU in 2025, conditional to international support. The emissions trajectory of "Peak, Plateau, Decline", as included in South Africa's NAMA submission, is adopted in the NCCR. The strategy contains a number of general measures and activities that serve to reach the country's reduction goal (see Box 20). In particular, the NCCR calls for the development of carbon budgets for each sector.

Box 20: Principal elements for mitigation in South Africa's National Climate Change Response

South Africa's NCCR seeks to integrate mitigation with sustainable development in order to contribute to global greenhouse gas reductions and at the same time to add to national development goals. The NCCR reiterates South Africa's international emissions reduction pledge under the condition of international support. The country's emissions are to follow the "Peak, Plateau, and Decline" trajectory. The following elements serve to reach this goal:

Setting performance benchmarks: The National GHG Emissions Trajectory Range sets the benchmark for the success of all mitigation activities. Comparing them with the trajectory range can show if the output is sufficient - if not,

[11] The IRP is included here because of the significance of the energy sector for South Africa's low carbon development path, and its use of a scenario differing from the LTMS. Other sectoral strategies such the National Energy Efficiency Strategy are covered in sections below.

the activities can be optimised accordingly. The Trajectory Range will be adapted according to new data and technologies.

Identifying desired sectoral mitigation contributions: All sectors of the economy have to develop strategies for greenhouse gas reductions, and provide options for their review, in order to reap their maximum reduction potential. Provisions such as the Air Quality Management Act have to be taken into account.

Defining carbon budgets: For specific sectors, in particular energy supply, mining, industry and transport, emission caps will be set. A system to determine these budgets will be developed that will also provide low-cost measures for greenhouse gas reductions.

Developing mitigation plans: Sectors or entities with carbon budgets have to develop and submit plans for greenhouse gas reduction outlining strategies to implement the set targets.

Using an optimal mix of different instruments: As there is a great variety of instruments for mitigation, an optimal mix of mitigation approaches, policies, measures and actions for each sector is to be developed that maximises mitigation as well as job creation and sustainable development.

Using the market: The use of economic incentives as well as putting a price on carbon is desired. For sectors or entities under a carbon budget, a market based instrument may be put in place.

Monitoring and evaluation: A national greenhouse gas inventory as well as a monitoring and evaluation system are to be developed in line with international MRV requirements. Under this Climate Change Response Monitoring and Evaluation System, entities emitting more than 0.1Mt of greenhouse gases annually, or that consume electricity produced emitting the same amount, are required to submit emissions data reports.

(adapted from DEA 2011a)

An important part of South Africa's mitigation strategy is increased use of low- or zero-emission energy technologies for electricity generation, heightened energy efficiency and energy demand management.

Job creation in the context of both adaptation and mitigation is another important aspect. The NCCR further makes reference to the creation of a green economy, which would serve both the reduction of emissions and the fight against poverty.

The NCCR further highlights the need for an integrated planning approach on all levels of government in the fight against climate change in order to ensure sustainable and climate-resilient development.

As short-term actions within two years of publication of the strategy, the NCCR proposes so-called *Flagship Programmes* that should show immediate results in various sectors, such as water protection and demand management, transport, waste management, or CCS. The relevant ministries are tasked to develop framework concepts in their respective areas. In 2012, a mapping exercise for the flagship programmes was underway (DEA 2012). Further information on the implementation status of the flagship programmes could not be obtained.

Coherence of strategy

The National Climate Change Response and the two development strategies are mainly aligned. One identifiable area of conflict may be the prioritisation of mining and energy-intensive industries for job creation and economic development in the National Development Plan. This, however, may be due to differing areas of focus within the strategies.

However, some incoherence can be identified between the NCCR and the Integrated Resource Plan:

South Africa's NAMA submission, the basis for the mitigation target contained in the NCCR, included an appended document quantifying the envisaged "Peak, Plateau, Decline" trajectory. Up to and 2025, South Africa's emissions are to peak between 398 and 614 Mt CO_2e/a, and to remain at that level up to 2035. After 2035, South Africa's emissions are to decline so they reach a level of 212 to 428 Mt CO_2e/a in 2050. This level is calculated as a range of plus/minus 108 Mt CO_2e/a around the LTMS "Required by Science" scenario endpoint of 320 Mt CO_2e/a in 2050 (DEA 2011b).

With energy generation from fuel combustion as South Africa's single largest emissions source (Burton and Coetzee 2012), a significant decline of emissions from the energy sector is needed in order to reach the envisaged decline of emissions after 2035 (see also Fekete et al 2013). While the IRP envisages a decline from 90% to 65% of coal use for electricity generation in 2030, it also allows for a build-up of new coal-fired power plants. Existing coal-fired power plants would run at lower load in order to accommodate newly built plants as long as emissions constraints posed by the IRP apply (DoE 2011, Burton and Coetzee 2012). CCS is seen as a means to continue and strengthen the use of coal as the country's main energy source (DoE 2011). In contrast, the CCS *Flagship Programme* contained in the NCCR aims at concrete emissions reductions instead of allowing an increase in coal use (DEA 2011a).

Admittedly, without sectoral quantifications given in the National Climate Change Response, this incoherence is implicit. A further expansion of the country' coal-fired electricity capacities, however, runs contrary to the needs of a decarbonisation that is required to meet South Africa's emissions target in 2050[12].

In conclusion, South Africa currently holds two strategies that vary significantly in ambition. The IRP is the more specific sector strategy and has a long-standing history of serving as a planning guideline for both government and the utility Eskom. In contrast, the more ambitious NCCR has the character of a general White Paper, which still needs to be underpinned by strong legislation. The robustness of South Africa’s climate policy, will strongly depend on to which degree the next revision of the IRP will integrate the emission reduction goals set out in the NCCR, especially for the period after 2030.

[12] This assessment is underscored by the findings in Fekete et al. (2013): In order to meet its reduction target, "South Africa will have to address all available mitigation options simultaneously, including more costly options" (Fekete et al. 2013).

7.3.2 Nationally appropriate mitigation actions and other relevant policies and measures

Nationally Appropriate Mitigation Actions in South Africa

In the international negotiations, South Africa held the position that NAMAs should be voluntary and include unilateral actions. The country was among the first to propose a registry where countries could seek support for their NAMAs, and to also include MRV elements in such a registry (Asselt 2010).

South Africa has inscribed its target of reaching deviation of 34% below the BAU trajectory in 2020 and 42% in 2025, subject to international support in the form of financial resources, transfer of technologies and capacity support as Nationally Appropriate Mitigation Action under the Copenhagen Accord in 2009. South Africa's emissions pathway is to follow the 'Peak, Plateau, Decline' trajectory outlined above.(South Africa 2009).

Tyler et al. (2013) assert that South Africa has been seen as a very active country in the international NAMA context, however, "the term 'Nationally Appropriate Mitigation Action' (NAMA) is not extensively used in domestic climate policy dialogue" (Tyler et al. 2013).

South Africa has not inscribed any NAMAs in the registry prototype provided by the UNFCCC, but the Ecofys NAMA database (www.nama-database.org) lists one NAMA in the implementation phase, and two feasibility studies. The next section briefly outlines these.

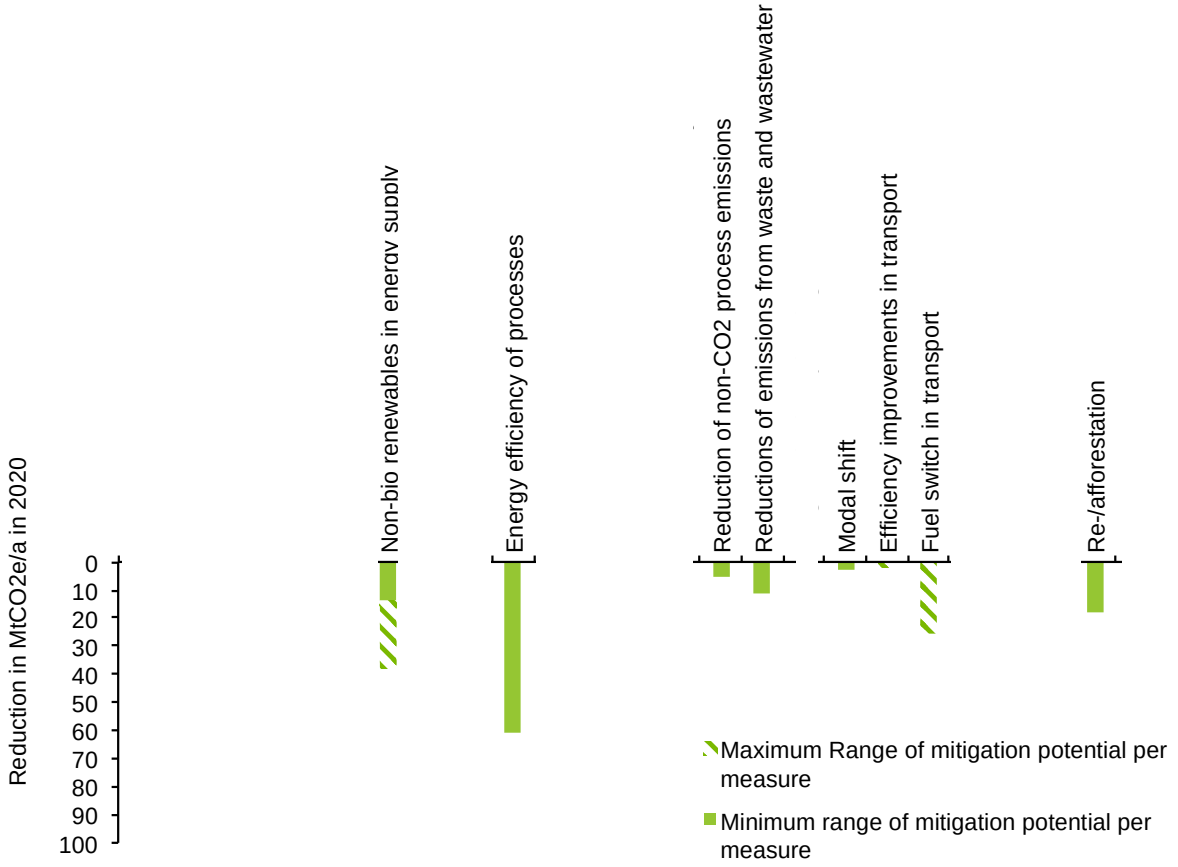
South African Renewables Initiative (SARI) SARI aims at the development of the renewables sector in South Africa, and to mobilise international and national support for accelerated renewables deployment. It was launched in 2011 during COP17 in Durban as a collaborative project of South Africa, the European Investment Bank, Denmark, Germany, Norway, and the United Kingdom. The Department of Energy and the Department of Trade and Industry chair the initiative (Tyler et al 2013). SARI has not started working yet, but if implemented fully, could lead to a relative saving of up to 1.2 billion tonnes on CO_2e (ibid.).

Feasibility studies have been undertaken by the ERC for the rollout of electric passenger vehicles and financing upgraded energy specifications of new low-income housing (Winkler 2010), but no further information is available if the concepts have been taken beyond the feasibility stage.

Other relevant GHG mitigation policies

South Africa has a host of policies, strategies and individual measures to mitigate climate change in place. The following presents a non-exhaustive list of the most prominent strategies, policies and measures in the country, broadly following the areas that were identified as having a strong mitigation potential (Fekete et al. 2013, see also Winkler 2007). Some areas that were identified as high potential measures in Fekete et al. (2013) are not assessed in this study due to lack of publicly available information.

Fig. 15: Mitigation potential of different technical measures in South Africa



Source: Fekete et al 2013

Introduction of a carbon tax

The NCCR lists the introduction of a carbon pricing system as part of South Africa's mitigation policies (DEA 2011). Already in 2010, the treasury released a discussion document broadly outlining the rationale behind the tax, but giving few details on its actual design. Following the release of the document, a stakeholder consultation on design and economic implications was held (Tyler et al. 2013). In early 2013, the National Treasury announced its intent to introduce a general carbon tax in 2015, and released a policy paper outlining the proposed design of the tax in May 2013 (Treasury 2013).

According to the proposed design, the carbon tax will only cover direct greenhouse gas emissions from stationary sources resulting from fuel combustion and gasification, and from industrial processes. As a complimentary measure, tax incentives for energy savings will be introduced before roll-out of the carbon tax (Treasury 2013).

The proposed tax will be gradually phased in. The tax rate is set at 120 R/tCO_2e (ca. 12 USD) above the tax-free threshold, and will increase by 10% each year until 2019. After that the tax rate will be revised (Parker / Gilder 2013).

From 2015 to 2019, 60% of emissions will be tax-free across all covered sectors[13]. Trade-exposed sectors receive an additional allowance of 10%, and some sectors receive additional allowances for process emissions. 10% of emissions (5% for sectors with process emissions allowances) may be offset through carbon credits. The threshold will be reduced in the next phase until 2025, after which an absolute emissions threshold may be introduced (Treasury 2013).

The introduction of the carbon tax to the general budget will require legislation to be passed by Parliament. A proposal will be published in late 2013 or early 2014, and will take into account stakeholder comments (Creamer 2013).

The use of revenues accrued from the tax has not been decided yet. Clear earmarking is apparently not planned. Instead, the Treasury may consider tax cuts or incentive schemes to balance out the revenues (Creamer 2013).

Renewable energy support policies

South Africa has an excellent resource base for renewable energy. Especially solar energy could potentially be applied on a very large scale, as South Africa encompasses some of the world's best solar resource areas (Pegels 2011). However, the current share of renewable energy is low. In 2003, the White Paper on Renewable Energy (DoE 2003) set a target of 10,000 GWh/a of renewable energy by 2013. The DoE's Annual Report 2011-2012 report (DoE 2012) lists the actual output from renewable energies at 2,000 GWh in 2010/2011.

South Africa has switched from a renewable energies feed-in tariff (REFIT, 2009-2011) to a competitive procurement process (REBID) for independent power producers (IPPs) in 2011 after problems with implementation and questions about the schemes compatibility with constitutional requirements for competitiveness in sales to a public entity[14] (Pegels 2011). REBID is hosted by the South African Treasury (Greenwell Consulting 2012).

REBID[15], an auctioning process to win a long-term purchasing power agreement (PPA) with Eskom (Fritz 2012), requires project developers of renewable energy projects to pass two sets of evaluation criteria. First, proposals are weighed against economic development, legal issues, land use and acquisition, as well as environmental, financial and technical elements. After the first phase, project proposals undergo a second assessment on feasibility and price (Greenwell Consulting 2012). Bidders have to pay a fee of 20,000 Rand (2,000 USD) in order to obtain documentation (Fritz 2012).

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[13] Sectoral coverage includes a category "other". It is not clear what will be covered under this: "Much will depend on how widely or narrowly the word "other" is interpreted" (Parker / Gilder 2013).

[14] The quasi-monopolistic energy company Eskom is state-owned, and the only buyer of renewable energy produced by IPPs. South Africa's treasury argued that because of this, procurement requirements for organs of state apply (Pegels 2011).

[15] REBID is also known as REIPPPP or REI4P: Renewable Energy Independent Power Producers Procurement Programme (Fritz 2012).

The auctioning process has led to considerable competition from international project developers, and PPAs for 1,415 MW of renewable energy had been awarded in the first round up to 2012 (DoE 2012a). The second and third phase of the bidding process was to be held in 2013 (GLOBE 2013), but no information on outcomes could be obtained.

At the end of 2012, the European Investment Bank reported additional funding 50 million EUR (65 million USD) for South Africa's first solar tower project (50MW), "and one of the first private sector renewable energy projects in the country" (EIB 2012). The project was agreed under the first REBID phase (ibid.).

Energy efficiency in industrial processes

South Africa's Energy Efficiency Strategy (DoE 2005) includes a target to reduce final energy demand in the industry and mining sectors by 15% in 2015. Industry and mining are the largest consumers of energy in South Africa, with a total end-user energy demand of 38% in 2009 (DoE 2012b). Because of the existence of no- to medium cost savings potential in these sectors, the strategy paper concluded "that the target of 15% is realistic and achievable" (DoE 2005).

In 2006, the South African government introduced the Energy Efficiency Accord, a voluntary agreement with businesses, mainly targeted at the industry and mining sector, that had the goal of contributing to the stated goal of the 15% reduction target until 2015 outlined in the Energy Efficiency Strategy (DoE 2006). According to the Accord's 2008 Assessment Report (DoE 2008), 36 companies and eight business associations signed the Accord. 21 companies responded to the assessment questionnaire. The assessment report assumes a target of 7% for the assessed year (2007) against the baseline year 2000, which was achieved by only seven of the reporting companies. The report cautions that only measuring the absolute reduction of final energy demand may be misleading, as it does not capture relative reductions in energy intensity, especially if productive output increased over the same time.

The National Energy Efficiency Strategy is currently undergoing a public commentary process, and a National Energy Efficiency Action Plan that will contain concrete actions for the sectors covered under the Strategy (industry and mining, transport, residential sector, commercial and public buildings, and power generation) (DEA 2013).

While the review of the strategy (DoE 2012b) does not list any compulsory efficiency measures to be applied in industrial policies, it does mention the adoption of two new standards that can be applied voluntarily for industrial processes: SANS 50001, equivalent to ISO 500001, introduces energy management systems for industrial and commercial applications. The standard includes monitoring, evaluation and targeted actions as well as capacity building for organisations and individual behaviour (DoE 2012b). At least 10 companies are in the process of implementing the energy management system, or have shown strong interest. However, adoption of the standard itself seems to be slow-going (UK 2012).

In order to claim tax savings on the basis of energy efficiency, entities have to comply with SANS 50010, a domestic measurement and verification standard. Efficiency savings need to be certified (DoE 2012b). This incentive programme is applicable to any person's taxed income - it is not exclusive to the industrial sector (GLOBE 2013).

In order to incentivise energy efficiency and demand side management of energy (EE/DSM) not only in the industrial sector, but also for the commercial, residential and public sector, South Africa put in place an EE/DSM fund with a total volume of 5,445 million Rand (555 USD) from 2011 - 2015, administered by energy provider Eskom. Under the Standard Offer Programme, Eskom offers a standard rate per verified kWh saved, with variable rates depending among others on technology used and time of day, e.g. 0.55 R/kWh ((0.05 USD) during peak times, 0.1 R/kWh off peak and weekends for industrial and large commercial customers that save more than 5MW. The programme focuses on energy efficient lighting systems, building management, electrical hot water, process optimisation, solar water heaters, and renewable energy (ESKOM 2011).

Since 2010, the National Cleaner Production Centre of South Africa (NCPC) hosts the Industrial Energy Improvement Project (UK 2012). Co-funded by the South African Government, Switzerland and the UK, the project is implemented by UNIDO. It aims at

- increasing Eskom's energy margin by 9.2%,
- reducing energy consumption by at least 23 000 GWh per year,
- 10% reduction of energy demand of the 138 largest electricity consumers (40% of total energy demand), and 7% by the next-largest 40 000,
- greenhouse gas emissions reductions of about 22 $MtCO_2e$ per year.

The project focuses on the design of the South African framework of policies and regulations for implementation and monitoring of industrial energy efficiency, supports South Africa's energy efficiency standard-setting for industries (in line with the standards mentioned above), trains energy efficiency experts and sets up demonstration projects for energy management systems and energy systems optimisation (UNIDO 2011).

The project has contributed to the review of South Africa's National Energy Efficiency Strategy through the commission of a consultant (UK 2012). The project has also been very successful in training experts for energy management and optimisation experts.

The NCPC's goal to foster the use of an energy management system by at least 25 companies until March 2012 was not met (UK 2012). Under the project, a number of energy audits have been performed in small and medium enterprises, but the review of the project (UK 2012) found it unlikely that the target of 500 audits by 2014 will be met.

Reductions of emissions from waste and wastewater

The NCCR White Paper (DEA 2011) includes a Waste Management Flagship Programme which was set to explore the waste sector’s mitigation potential, and possibilities for waste-to-energy projects in South Africa. No information on the status of implementation could be acquired.

Currently, mitigation of greenhouse gases from the waste sector seems to be realised mainly through CDM projects, with an over-all slow uptake of projects. Urban EARTH reported five landfill gas-to energy CDM projects in South Africa, with eight more in the application process (Botes 2013).

Modal shift and efficiency improvements in transport

Since the end of 2010, South Africa has put in place an additional value-added tax for the purchase of new passenger cars based on CO_2 emissions. The rate of the tax is 75 Rand (7.5 USD) per gram of carbon dioxide for cars with output in excess of 120 g/km. In contrast to most other political instruments relevant for mitigation in South Africa, this is a concrete legal instrument (GLOBE 2013). The tax was recently extended to double cabs, and a tax rate of 100 Rand (10 USD) per gram CO_2 for emissions beyond 175g/km was added (DoE 2012b).

As part of the country's National Public Transport Strategy and Action Plan (DoT 2007), a Bus Rapid Travel System is being implemented in Cape Town. The implementation phase will run for the next 25 years. The project is primarily funded through South Africa's Public Transport Infrastructure and System Grant (Tyler et al. 2013). According to Tyler et al. (2013), it is the first large scale integrated public transport system in South Africa.

The Energy Efficiency Strategy (DoE 2005) includes a voluntary target of 9% energy efficiency improvement in the transport sector by 2015. The review of the strategy published by the DoE in 2012 (DoE 2012b) does not touch upon the status of delivery of this goal. It mentions strategic objectives for the coming years, including modal shift in passenger transport from mini-bus taxis and private cars to higher efficiency bus- and rail systems, enhanced travel management (less drives), higher efficiency of freight transport, higher efficiency vehicle technology and alternative fuels and propulsion systems.

Since 2008, new light motor vehicles have to be labelled according to their fuel efficiency (DoE 2012b).

Some of the measures are marked in the review as "ongoing", but no information is provided on the status of implementation. The NCCR includes a Transport Flagship Programme that tasks the Department of Transport to develop an Efficient Vehicles Programme (DEA 2011), but no further information on its status could be obtained.

Low energy housing and efficiency of appliances

Under the Energy Efficiency and Energy Demand Flagship Programme, the NCCR includes a residential energy efficiency programme including the development of energy specifications for low-income housing to be determined by the National Sustainable Settlements Facility, and "regulation of commercial and residential building standards to enforce green building practices" (DEA 2011).

The National Sustainable Settlements Facility (NSSF), originally conceived as a CDM project on low-cost housing energy upgrades in Kuyasa, Cape Town by Cape Town NGO SouthSouthNorth in 2005 (UNFCCC 2005), is an initiative that will deliver incremental finance for low-income housing projects to adhere to low-energy specifications, including solar water heaters, but also design specifications such as orientation, roof design and insulation. It is financed by domestic funding through the Development Bank of Southern Africa and international support by the German KfW. The NSSF is still in the development phase, but could deliver emissions reductions of at least 25 $MtCO_2$ over the first ten years (Tyler 2013). It is planned that the NSSF will be able to generate income through international financing mechanisms such as CDM or

other carbon market mechanisms (southsouthnorth.org). At the moment, it is still in the pilot phase (see Garibaldi et al. 2013).

In 2011, the Department of Trade and Industry (DTI) amended the National Building Regulations and Building Standards Act to foster greenhouse gas reductions caused by buildings (www.buildingregulations.co.za). Among others, the Act requires at least 50% of water heating by means of various possible renewable sources. New buildings have to be designed according to South African standard SANS 10400XA, which makes detailed provisions on building envelope, hot water supply, and energy usage of the building design, depending on use and geographical location of the building (ibid.).

In order to improve awareness of consumers for energy efficient appliances, DoE and DTI are developing a labelling system similar to the European energy efficiency label, as part of the revised Energy Efficiency Strategy. The Strategy calls for a 10% reduction of energy demand in the residential sector by 2015 (DoE 2012b). An earlier voluntary labelling scheme for refrigerators (2005) failed because of limited public outreach and insufficient funding (www.25dgrees.net).

The Standard Offer Programme (see above) also applies to the residential sector (ESMAP 2011). Eligible technologies are energy efficient lighting, building management, hot water systems and solar water heaters, but may also extend to air conditioners, heat pumps, and shower heads (ESMAP 2011, Eskom 2011).

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South Africa does not have any programmes in place that are explicitly targeted at greenhouse gas mitigation from the forestry or agriculture sectors (Rahlao 2012a). South Africa is in the process of formulating a national REDD+ Strategy, and could benefit from an expansion of the current Public Works Programmes that have so far focused on ecosystems management (Rahlao 2012b).

7.3.3 Coherence of strategies, activities and potentials

Does South Africa consistently translate strategies into actions?

South Africa has put in place a wide array of mitigation strategies. The National Climate Change Response is certainly at the forefront of these, but considering the country's high energy intensity, especially for electricity, strategies such as the Integrated Resource Plan and the National Energy Efficiency Strategy play a similarly important role for South Africa's future low-carbon development. The NCCR has been in place for a mere three years, and IRP and NEES are still subject to revision, so an evaluation of the strategies' effectiveness is not possible at this point in time.

However, South Africa's implementation speed of concrete policies and measures has not matched its ambitious goals set in its strategies in the past. In its recommendations for the development of the National Climate Change Response White Paper in 2011, the Development Bank of Southern Africa posited: "*South Africa has adopted a stance whereby its international pledge is ambitious, while implementation remains limited*" (DBSA 2011).

Judging from the limited up-to-date information that could be obtained on the status of implementation, this trend seems to continue. The Flagship Programmes envisaged in the National Climate Change Response have not yet taken a publicly visible stage. Comparably few programmes and projects are actually undergoing implementation, many have been in the design or demonstration phase for a long time (e.g NSSF, see Tyler et al. 2013). Of the four mitigation actions that were analysed by Tyler et al. (2013), only one (BRT in Cape Town) was already being implemented. Reasons for this may be lack of political ownership, fragmented institutional landscapes and limited institutional capacities, additional financing requirements and vested interest opposition (Tyler et al. 2013, Never 2011). Barriers to implementation will be analysed in more detail in chapter 7.4.

While South Africa stresses the need for international support in order to reach its greenhouse gas reduction goal, Tyler et al. (2013) found that a strategic approach to secure funding for a comprehensive approach to mitigation actions is not visible: "*Some donor activity supporting activities to mitigate emissions are evident in the country, with a focus on pilots and capacity-building; however, to date (August 2012) there has been no concerted or coherent effort by government, business or civil society*" (Tyler et al 2013).

Do strategies and activities support the use of identified potentials?

In Fekete et al. 2013, we assessed South Africa's mitigation potential until 2020 across various technical measures, using the LTMS (Winkler 2007) as the main, albeit not only, source of potential data. Because potentials were scaled to fit realistic chances of implementation from the perspective of 2012, some measures that were estimated as having large potentials in the LTMS were omitted, e.g CCS (marginal technical short term potential, but up to 11 and 35 $MtCO_2e/a$ in 2030), or nuclear energy (no new nuclear reactors foreseen before 2024 at the earliest).

In the following, the strategies and activities described above are briefly and qualitatively assessed against their mitigation potential as identified in Fekete et al. (2013). The assessment is based on the available information on South Africa's strategies, policies and measures on the sectors covered within this report. Because of the limited availability of up-to date sources, the assessment may not cover South Africa's current state of implementation of its strategies, policies and measures in full accuracy.

Carbon tax

The introduction of a carbon tax in itself does not reduce emissions, but it sets price incentives to invest more strongly in low-carbon technologies. Thus, the carbon tax can be a significant driver for mitigation actions, and stimulate the development of low carbon industries, products and processes in covered sectors (Tyler et al. 2013).

Winkler (2007) assessed the impact of different tax levels on CO_2 reduction, and found significant impacts starting from 100 Rand, with the strongest increase of impacts at around 140 Rand, and slower gains in impact up to 400 Rand. The proposed tax rate of 120 Rand (plus the annual 10% increase) can therefore be expected to have a significant impact on South Africa's CO_2 emissions from this perspective.

On the other hand, South Africa's carbon tax model does include strong discounts of at least 60% for every covered sector in the first phase, which means that the real rate of the tax will initially be closer to 50 Rand. Winkler (2007) found that a 50 Rand carbon tax had negligible impacts.

Thus, it can be expected that the tax's full impacts will only show in the mid-term. Real savings that can be accounted to the tax may only be reaped in its second phase. It will, however, present an incentive for companies to adapt, as it gives a clear signal with a steadily and dependably rising carbon price. If it passes the legislative process in the form it is currently proposed, it represents an ambitious overarching policy instrument that has a high mitigation potential (Tyler et al. 2013).

Non-bio renewable energy

Despite some ambitious goals set for the promulgation of renewable energy in various strategies and plans, the uptake of renewable energy generation in South Africa has so far remained limited, especially considering the country's good suitability for solar power generation. Aligning the goals set in energy planning (IRP) and climate policy (NCCR) could be a strong opportunity to establish a coherent policy framework. Growth rates of renewable energies would need to rise considerably in order to match the country's mitigation potential of approx. 35-38 $MtCO_2e/a$ in 2020.

Substituting the country's feed-in tariff with the REBID system may represent a "second-best" solution to its challenges in feeding in electricity produced by IPPs: "In international comparison, bidding processes and quotas have a less positive track record than renewable energy feed-in tariffs" (Pegels 2011). However, REBID may be the more suited solution to South Africa's legal and institutional circumstances. The interest created by the first bidding phase is a very positive signal. It may be hoped that the second and third bidding phases show equally or even more positive results, and lead to fast-tracked development of renewable energy projects by IPPs.

In order to complement this process, South Africa should strive for a fast full implementation of SARi. The initiative has the potential to concentrate South Africa's renewable energy strategies "within an relatively crowded but largely uncoordinated policy space" (Tyler et al. 2013), and thus be able to boost renewable energy generation from its currently negligible state (Tyler et al. 2013, IEA 2013), but seems to have been mostly dormant since its introduction in 2011.

Energy efficiency in industrial processes

Because of the high energy intensity and comparably low energy efficiency of South Africa's industry, reducing emissions by enhancing the energy efficiency of industrial processes is identified as having the largest mitigation potential within the LTMS and Fekete et al. (2013), who estimated about 61 $MtCO_2e/a$ in 2020. Recognising this large potential and its cost effectiveness, the South African Government has sought to enhance the industry sector's energy efficiency through a host of strategies, policies and measures from an early date (DoE 2005), independently of the LTMS.

The Energy Efficiency Accord between businesses and the South African government has led to greater awareness of the benefits of increased energy efficiency, but at least in the short term did not lead to strong reductions in energy demand (DoE 2008).

South Africa has put in place a host of programmes and incentive schemes in order to boost its industry's energy efficiency, but the uptake by businesses seems to be comparably slow. It remains to be seen if the revision of the country's Energy Efficiency Strategy will contain a stronger set of compulsory measures in order to reap the high potential for reducing emissions through energy efficiency measures that South Africa's industry can implement at comparably low cost.

Waste

The NCCR recognised that reducing emissions from waste could have a strong mitigation potential in South Africa, and introduced a flagship programme to explore the possibilities for this sector. However, more information on the status of the flagship programme could not be obtained, and a concrete strategy by the government does not seem to exist.

Considering the significant potential of 11 $MtCO_2e/a$ in 2020 identified by Fekete et al. (2013), the reliance on (a small number of) CDM projects does not seem adequate to realise the sector's full potential.

Transport

South Africa's short term potential to reduce emissions from modal shift and energy efficiency in transport is comparably small at about 5 $MtCO_2e/a$ in 2020, because many underlying and intervening factors such as social constraints and the need for integrated infrastructure planning (see Winkler 2010, Fekete et al. 2013). South Africa has taken some concrete steps in order to strengthen the energy efficiency of the vehicle fleet, including a carbon tax levied on the purchase of new vehicles.

While the concrete impact of the tax could not be assessed within the scope of this study, it certainly represents a strong incentive for buying more efficient vehicles. Expanding it to commercial vehicles will even strengthen its impact. An expanded efficiency labelling system will further raise awareness of buyers.

The expansion of South Africa's public transportation system, envisaged in the review of the National Energy Efficiency Strategy, has a high long-term potential, if it leads to a reduction of private cars on the roads. With Cape Town's BRT system, South Africa has a valuable demonstration project in place.

Low energy housing and efficiency of appliances

With about 13 $MtCO_2e/a$ in 2020 for private and public buildings combined, the sector has some considerable mitigation potential (Fekete et al. 2013). With the introduction of new standards for low-energy housing, South Africa has put in place a strong base for significant emissions reductions from new buildings.

The National Sustainable Settlements Facility could play a considerable role in this context. However, this depends on resolute steps to fast-track its implementation.

The labelling system for energy-efficient appliances may heighten consumer awareness, but may have limited outreach if it is not complemented by efficiency standards. Information on such a standard could not be obtained.

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Rahlao (2012a) found that South Africa does not have any explicit strategies for greenhouse gas reduction from the land use and forestry sectors. For these sectors, Winkler (2007) identified a maximum mitigation potential of 18 $MtCO_2e/a$ in 2020. While the current Public Works Programmes in these sectors may also contribute to greenhouse gas reductions, their focus lies on ecosystems management (Rahlao 2012b). An assessment of their mitigation potential was not possible within the scope of this study.

The introduction of a REDD+ Strategy may lead to significant emissions reductions in the sector. However, no current information on the state of its formulation could be obtained.

Box 21: Conclusions on coherence of mitigation potentials, strategies and measures in South Africa

South Africa has put in place a large variety of strategies, policies and measures to mitigate climate change, addressing most of the country's mitigation potential. Their effectiveness may be strengthened through stronger coherence of high-level strategies and plans, and fast-tracked implementation of the policies and measures that are currently in the design phase. In doing so, South Africa could achieve greenhouse gas reductions that are yet unrealised.

The design of the carbon tax sends an especially positive signal, as it cuts across most sectors and has a large potential to lead to low carbon development in the medium term if is adopted as timely as currently envisaged, and if the reductions on the tax given in its first period are phased out as foreseen.

In order to reap shorter term benefits in climate protection, South Africa should strive to implement the Flagship Programmes laid out in the National Climate Change Response. These projects can showcase the country's ambition, and may serve to attract international funding that is necessary to fulfil South Africa's mitigation goal inscribed as a NAMA under the UNFCCC.

7.4 Remaining barriers to unlocking identified potentials

Judging from the available data, South Africa does not realise its full mitigation potential. The following chapter seeks to explain some factors that keep the country from larger steps toward full implementation of possible measures.

7.4.1 Nation-wide barriers

Limited translation from high to low tiers of administration: A strong barrier to implementation of mitigation measures in South Africa seems to be the translation of high-level political targets to lower tiers of the administration. Even if political will is apparent on the level of the national government, local governments are slow to adopt, as Never (2011) found from interviews with business and government representatives in 2011. Tyler et al. (2013) lament "the present bias against implementation overall" (Tyler et al. 2013).

Uncertainty over climate threat: Never (2011) further found that there was still considerable uncertainty over the threat of climate change fuelled "by the vocal presence of groups of climate change sceptics and denialists" (Never 2011) within the country. While she found no fundamental questioning of science, the presence of these groups and attention by the media may lead to a diminished sense of urgency for implementing activities amongst political stakeholders.

Challenges in policy coordination: Within the South African government, there is an apparent lack of policy coordination and collaboration between the various departments that formulate strategies and policies for mitigation actions, especially the DEA and DoE (Never 2011). For measures that concern both or more departments, this may also leads to weak mandates and limited ownership for these measures (Tyler et al. 2013). For successful implementation of mitigation activities, Tyler et al. (29013) suggest "*close alignment of the MA [Mitigation Actions] with the core business of the owner or implementer*" (Tyler et al. 2013), i.e. as little spreading of responsibilities across departments and agencies as possible.

Low institutional capacities: Limited knowledge and institutional capacities combined with weak government institutions were also identified as significant barriers (Never 2011, Tyler et al. 2013). However, Tyler et al. (2013) found that barriers resulting from capacities varied strongly, depending on different measures and government levels. Generally, measures closer to mainstream solution presented less challenges for capacities, but local innovation for implementation seems to overcome capacity problems in various cases (Tyler et al. 2013).

7.4.2 Measure-specific barriers

Tab. 39: Overview of type of barriers to most important mitigation measures in South Africa

	Carbon Tax (share not determined)	Energy efficiency of industrial processes	Non-bio renewable energy	Transport	Low-energy housing
Share of total potential		37-54%	12-23%	15-22%	n.a
Barriers					
Institutional/political	X	X	X		
Financial/economic			X		x
Technical	X		x		
Informational/capacities					x
Others	X			x	

Note: if x, then barrier is relevant to measure. Size indicates importance of the barrier. Blue colour bar illustrates the importance of the potential as a share of total potential in steps of 10% points.

Carbon tax

Assessing the barriers to the carbon tax is not possible in detail as it is still in the design phase. However, the industry representatives have already voiced their *opposition against the*

introduction of the tax (Creamer 2013a). The political opposition has taken up the criticism of the industry (Ensor 2013).

South Africa's plans of finalising the proposed legislation in late 2013 or early 2014 may face problems if opposition against the tax grows (Creamer 2013b). Also, strong opposition may lead to a *weakening of the provisions* set in the policy paper by the treasury. If the bill has to be subjected to another review process, it may face *delays* because there is too little time to implement it in 2015. *Delays* are also possible because the needed *infrastructure for data collection and processing* fundamental to the carbon tax is not in place yet.

Tab. 40: Most relevant barriers to the carbon tax

Institutional/ political	Timeframes may be too short Proposal may be weakened Opposition parties take up criticism from industry (Ensor 2013)
Technical	Data infrastructure not yet in place
Others	Opposition by industry (Creamer 2013a)

Energy efficiency of industrial processes

In principle, there are no strong barriers to energy efficiency in industrial processes in South Africa. Most measures are beneficial technically and financially, at least in the mid-term. Barriers thus are not specific to South Africa, but apply to industries worldwide, such as aversion to risks arising from switching fuels, focus on product outputs instead of process optimisation, lack of knowledge and capacities of both consumers and producers as well as regulating institutions, and many others (see e.g. IEA 2011).

In South Africa, comparably cheap electricity prices (Never 2011) combined with the mostly voluntary nature of the measures may further contribute to keep businesses from investing more heavily into a reduction of their energy demand.

Tab. 41: Most relevant barriers to energy efficiency

Institutional/ political	Mostly voluntary measures, little enforcement possible Low knowledge and capacities for energy efficiency
Financial/ economic	Cheap electricity (Never 2011)

Renewable energy

The main political barrier to renewable energy in South Africa is *the fragmented policy space* surrounding renewable energy development in the country. DEA and DoE have split ownership in renewable energy policies, which may create uncertainty for investors in renewables (Never 2011).

Investments in renewable energy in general have *high initial costs* which may need to be buffered by public finance and international support. Through REIPPP, South Africa is already leveraging private financing for renewable energies (www.ipprenewables.co.za). South Africa has not adopted a coherent strategy to garner international support, but this may change with the implementation of SARi (Tyler et al 2013). However, the initiative needs strong political commitment in order to reach the implementation stage fast (Tyler et al. 2013).

A challenge may also be the *integration of renewable energy* into the South African grid. The areas with the strongest potential for solar energy lie in the north of the country, relatively far from population centres. South Africa will therefore have to invest heavily into grid expansion and optimisation in order to be able to cope with the specific challenges of introducing high volumes of renewable energy into the national grid (Gets 2013).

The largely *centralised electricity provision and distribution* through public provider Eskom presents another barrier for increased uptake of renewable energy. Eskom has in the past relied almost exclusively on the provision of relatively cheap electricity through large coal-fired power plants, and has only recently started to scale up its commitment to renewable energy sources. Because Eskom also handles access by IPPs to the grid, it has had the ability to block stronger independent production that would have been detrimental to its own position (see Never 2011).

Tab. 42: Most relevant barriers to renewable energy

Institutional/ political	Fragmented policy space with split ownership across departments (Never 2011)
Financial/ economic	High initial cost of technologies needs to be buffered (see Tyler et al. 2013)
Technical	Grid integration of renewable energy (Gets 2013) Centralised electricity provision and distribution detrimental to decentralised renewable energy generation (Koen 2012) Slow uptake of renewable energy generation by state provider Eskom (Newmarch 2013)

Transport

Efficiency improvements in the public transport sector face a specific social constraint in South Africa: While public transportation (e.g. trains and minibuses) for the low-income population is already moderately efficient, the number of private cars is growing rapidly. However, *large urban sprawls* and accompanying high crime rates make public transportation unattractive to higher-income people in the country (Fekete et al, 2013, see also Winkler 2010). Increases in energy efficiency of transportation systems will therefore heavily depend strongly on social policies.

Tab. 43: Most relevant barriers to transport

Others	Large urban sprawls and high crime rate deter from attractiveness of public transportation systems (Fekete et al. 2013, Winkler 2010)

Low energy housing

Possibly the strongest barrier to large-scale implementation of low-energy housing programmes are the *high initial costs* for energy efficient technologies (Ziuku / Meyer 2012). Given that many programmes in South Africa focus on the low-income sector, this means large-scale subsidies are needed for large-scale roll-outs. The NSSF could play a highly beneficial role in this regard (Tyler et al. 2013)

Adding to the cost is the *limited domestic capacity* for the production of energy-efficient residential technologies (Tyler et al. 2013). However, the production capacity for certain technologies such as solar water heaters, is growing (Ziuku / Meyer 2012).

While *electricity prices* have in the past been very low, leading to reduced incentives to apply energy-efficient technologies (Ziuku / Meyer 2012), prices for electricity are rising now, which could lead to a stronger uptake in the future.

Tyler et al. (2013) further mention corruption issues in the delivery of low-income housing. It is not yet clear if the introduction of the new building standards will lead to stronger enforcement.

Tab. 44: Most relevant barriers to low-energy housing

Financial/ economic	High initial cost of technologies call for significant subsidies (Tyler et al. 2013) Low electricity prices have not provided strong enough incentives (yet) (Ziuku / Meyer 2012)
Technical	Limited domestic production capacities (Ziuku / Meyer 2012)
Others	Corruption issues (Tyler et al. 2013)

Box 22: Conclusions on barriers to GHG mitigation in South Africa

South Africa faces a number of barriers that inhibit the realisation of its full mitigation potential. On a nation-wide level, translating high level political goals and strategies to local levels of administration tasked with implementation seems challenging. Limited institutional capacities and weak government institutions tasked with climate change issues may further aggravate this barrier. By strengthening political institutions and policy coordination as well as adopting a strong synergistic view of climate, energy and development policies, South Africa has a strong opportunity to translate its national goals into stronger implementation.

This may also serve to overcome some of the measure-specific barriers, especially in the field of energy efficiency and renewable energy. Some of the barriers above will have to be tackled domestically, such as incentivising low carbon energy and efficient transport technologies. Others, such as grid integration of renewable energy, overcoming high initial cost for low-carbon infrastructures, issues of energy and market regulation, or challenges in technical capacity and know-how in some sectors, present South Africa with important opportunities for international cooperation and learning.

7.5 Conclusions

South Africa has taken on ambitious goals for climate change mitigation on a high political level. As part of the service delivery agreements with the President, he or she has to be made aware of progress made in the area of climate change. The National Climate Change Response White Paper constitutes a broad and highly ambitious political framework which presents multiple opportunities for substantiating more concrete policies and measures.

Highlights

- Climate change policy has been given high political priority
- Proposed carbon tax could lead to low carbon development across all sectors

Possible improvements

- Expand efforts to coordinate strategies across ministries
- Fast-track implementation of Flagship Programmes
- Strengthen institutional, technical and human capacities

While climate change falls mainly into the Department of Environmental Affairs area of responsibility, especially the Department of Energy has a strong stake in policy formulation due to the high importance of the energy sector for the nation's greenhouse gas output. South Africa is taking steps to better integrate and coordinate its policies through the Intergovernmental Committee on Climate Change and the National Committee on Climate Change. For measurement, reporting and verification of greenhouse gas emissions, a more streamlined approach including standardisation, improved data collection and data quality assurance is already underway.

For the large variety of strategies, policies and measures that cover almost every sector within the country, South Africa would strongly benefit from further expanding its efforts for strengthened political coordination, and fast-tracking of policies and measures that are currently in the design phase. In doing so, South Africa could achieve greenhouse gas reductions that are yet unrealised.

The design of the carbon tax sends an especially positive signal, as it cuts across most sectors and has a large potential to lead to low carbon development in the medium term, given the effective tax is raised for the following period.

In order to reap shorter term benefits in climate protection, South Africa should strive to implement the Flagship Programmes laid out in the National Climate Change Response. These projects can showcase the country's ambition, and may serve to attract international funding that is necessary to fulfil South Africa's mitigation goal inscribed as a NAMA under the UNFCCC.

South Africa faces a number of barriers that inhibit the realisation of its full mitigation potential. On a nation-wide level, translating high level political goals and strategies to local levels of administration tasked with implementation seems challenging. Limited institutional capacities and weak government institutions tasked with climate change issues may further aggravate this barrier. By strengthening political institutions and policy coordination, South Africa has a strong opportunity to translate its national goals into stronger implementation.

This may also serve to overcome some of the measure-specific barriers, especially in the field of energy efficiency and renewable energy. Some of the barriers above will have to be tackled domestically, such as incentivising low carbon energy and efficient transport technologies. Others, such as grid integration of renewable energy, and challenges in technical capacity and know-how in some sectors, present South Africa with significant opportunities for international cooperation and learning. An overview of possible supportive actions is given in the overview table below.

As a founding member of the International Partnership on Mitigation and MRV, South Africa has demonstrated its interest in international exchange of lessons learned and best practices in these fields. As a non-formalised institution consisting of more than forty developed and developing country members, the Partnership provides an important platform for cross-country learning and capacity development.

Tab. 45: Overview of potentials, actions and remaining barriers for most important mitigation measures

Potential	Coverage as priority in national strategy and targets	Implemented policies to tap potential	Remaining Barriers	Opportunities for international support
Energy efficiency in industrial processes Total potential in 2020: 61 $MtCO_2e/a$ in 2020	Specific mention in National Climate Change Response, Flagship Programme proposed Energy Efficiency Strategy: energy demand reduction of 15% by 2015	covered by proposed Carbon Tax New standards Standard Offer Programme	Mostly voluntary measures, little enforcement possible Low knowledge and capacities of producers, consumers and regulating institutions Low electricity prices Carbon Tax: short time to implementation Data infrastructure not yet in place may be weakened due to oposition (industry and political)	Support in information campaigns Continued and enlarged capacity building for producers and regulators Support financial incentive schemes to cover up front cost
Renewable energies Total potential in 2020: 35-38 $MtCO_2e/a$	Specific mention in National Climate Change Response, Flagship Programme proposed Since 2003: target of 10,000 GWh of RE by 2013	Renewable Energy Independent Power Producers Procurement Programme South African Renewables Initiative	Fragmented policy space with split ownership across departments High initial cost of technologies needs to be buffered Grid integration of renewable energy Centralised electricity provision and distribution detrimental to decentralised renewable energy generation Slow uptake of renewable energy generation by state provider Eskom	Technical assistance for grid renovation Support financial incentive schemes to cover up front cost Capacity building Information exchange through international forums
Waste Total potential in 2020: 11 $MtCO_2e/a$	Specific mention in National Climate Change Response, Flagship Programme proposed	in principle covered by proposed Carbon Tax currently only in project form (CDM)	need for overarching policy approach for mitigating GHG from waste	Provision of best practice examples through international forums
Modal shift and efficiency in transport Total potential in 2020: 5 $MtCO_2e/a$	Specific mention in National Climate Change Response, Flagship Programme proposed Energy Efficiency Strategy: voluntary target of 9% efficiency improvement	Taxation of vehicle purchase based on emissions implementation of BRT in Cape Town Labelling system for light motor vehicles	Large urban sprawls and high crime rate deter from attractiveness of public transportation systems	Provision of best practice examples through international forums Technical and financial support
Low energy housing and efficiency of appliances Total potential in 2020: 13 $MtCO_2e/a$	Specific mention in National Climate Change Response, Flagship Programme proposed	National Sustainable Settlements Facility Building Standard Standard Offer Programme	High initial cost of technologies Low electricity prices Limited domestic production capacities Corruption issues	Support financial incentive schemes to cover up front cost Capacity building Provision of information on best practices through international forums

AFOLU Total potential in 2020: 18 $MtCO_2e/a$ in 2020	Specific mention in National Climate Change Response	in principle covered by proposed Carbon Tax	need for overarching policy approach for mitigating GHG	Provision of information and best practice for REDD strategy Provision of best practice examples through international forums

8 South Korea

8.1 Introduction

The Democratic Republic of Korea (South Korea), OECD member since 1996, is among the fastest-growing countries in the world. Its GDP has increased by 3-5% annually in the last 20 years, making South Korea No. 13 in GDP globally in 2010 (World Bank 2012). South Korea's emissions have doubled from 1990 - 2008, putting it well over the OECD average increase of 27%. While Korea's energy intensity has been slowly declining, it is still very high, and will foreseeably remain above OECD average in the coming years (OECD/IEA 2012). Korea has a high share (31%) of nuclear energy in its electricity used in the country (Borowiec 2012), with a strong political commitment to further expansion. Korea is highly dependent on energy imports, notably coal, oil and natural gas. Almost half of the country's current power generation depends on coal (OECD/IEA 2012).

Former President (2008 - 2013) Lee Myung-bak declared "Low Carbon, Green Growth" a national vision in his address on the country's 60th anniversary in 2008. Low carbon growth was thus made a national priority.

South Korea has put forward an unconditional pledge to reduce greenhouse gas emissions by 30% versus BAU in 2020, which, using national emissions projections, translates roughly into a 4% reduction versus 2005 emission levels. Anyhow, as South Korea's pledge represents a relative target, actual emission reductions depend on BAU projections. For its 3rd National Report, Korea has lowered its emissions forecast, and consequently its reduction target.

South Korea places high value on its international standing on climate change and low-carbon development. Since 2012, the country has been hosting the Green Climate Fund of the UNFCCC, and has put in place the Global Green Growth Institute (GGGI), which was recognised as an official international organisation after approval by nine independent countries in October 2012 (Kim 2013).

A comparison of Korea's pledge with realistic mitigation potentials is inconclusive due to limited data availability (Fekete et al. 2013).[16] A preliminary assessment by the Asian Development Bank (ADB) (Hanaoka 2012) indicates that Korea's pledge is highly ambitious, whereas data by Greenpeace and the European Renewable Energy Council (EREC) (Short / Crispin 2012) show a high and as yet untapped potential for renewable energy. Because of Korea's high energy intensity, strengthening energy efficiency across all sectors could yield high potential for greenhouse gas reductions. Also, the transport sector could have a high abatement potential, as indicated by ADB data. Finally, as a means to reduce emissions across a whole variety of sectors, Korea plans to introduce an emissions trading system in 2015 that has been heralded as possibly the most ambitious in the world (Reklev 2013a).

[16] Due to limited data availability, Fekete et al. (2013) did not analyse South Korea's mitigation potential quantitatively, but assessed promising areas for GHG mitigation. This led to a different structuring of measures, which we keep here for coherence. Therefore, the analysis in this chapter differs from the analysis elsewhere in this report.

8.2 The institutional framework for climate policy

8.2.1 Institutional setup for climate regulation

Climate change is identified as a national security issue in South Korea's Third National Communication, which *"would require efforts from every aspect of society, especially when dealing with GHG emissions"* (MOE 2012). In consequence, combating climate change has been mainstreamed throughout the country's political structure. GLOBE International names South Korea as one of the countries that "have prioritised tackling climate change" (GLOBE 2012).

In 2009 the "Presidential Committee on Green Growth" (PCGG) was established through the Framework Act on Low Carbon, Green Growth. The PCGG was designed to be Korea's main institution for deliberations on low-carbon, green growth strategies and their alignment with Koreas national strategy. It was established as a high-level committee chaired by the Prime Minister and a civilian appointee of the President, with appointees of the President with expert knowledge and experience in low carbon, green growth, including climate change, energy and resources, green technology, green industries, or sustainable development as members (Republic of Korea 2009). Furthermore, the Enforcement Decree to the Framework Act named high officials from all relevant ministries as Commissioners to the PCGG[17] (Republic of Korea 2010).

A recent report by Bloomberg New Energy Finance indicates that the PCGG has been subsumed into other government departments (BNEF 2013). Similarly, an article by the Korea times reports that the PCGG "has been demoted to an affiliated body of the Prime Minister's Office, and various departments dedicated to green growth have been absorbed into others or abolished" (Kim 2013). At the writing of this report, there was no official information on its future role . The Committee's own website has not been updated since the end of 2012 (www.greengrowth.go.kr). As an effect, Korea's current institutional set-up and administrative structure in the climate change field is not clear.

Following the Framework Act on Low Carbon, Green Growth, the government has to establish comprehensive Five Year Plans for the implementation of the national strategy, to be deliberated in the State Council and the PCGG. All ministries also have to establish five year plans, so-called "central action plans", for their jurisdiction, in alignment with the government's

[17] i.e. the Minister of Strategy and Finance, Minister of Education, Science and Technology, Minister of Foreign Affairs and Trade, Minister of Public Administration and Security, Minister of Culture, Sports and Tourism, Minister for Food, Agriculture, Forestry and Fisheries, Minister of Knowledge Economy, Minister of Environment, Minister of Gender Equality and Family, Minister of Land, Transport and Maritime Affairs, Chairman of the Korea Communications Commission, Chairman of the Financial Services Commission, and the Minister of the Prime Minister's Office.

Five-Year Plans.[18] Similarly, mayors and governors have to formulate local action plans for their jurisdiction (Republic of Korea 2009).

The Ministry of Environment (MOE) has a special role in South Korea's GHG mitigation strategy, as it is responsible for the overarching framework of the GHG and Energy Target Management Scheme, and coordination among the relevant Ministries (UNESCAP 2012a). On a sectoral it is in charge of the waste sector within the country. Furthermore, the MOE issues guidelines for MRV measures and methods.

Other important ministries are the Ministry of Knowledge Economy (MKE) (in charge of the energy and industrial sector), the Ministry for Food, Agriculture, Forestry and Fisheries (MFAFF) (in charge of agriculture and livestock), and the Ministry of Land, Transport and Marine Affairs (MLTM) (in charge of buildings and transport).

Tab. 46: Overview of government institutions and their responsibilities for climate regulation in Korea in 2012

Level	Government institution	Role and Responsibilities
Legislative and framework level	National Assembly	enacts Acts
	President (executive, head of state)	can issue Presidential Decrees
Programmatic level	PCGG	mandated to coordinate work on Low-Carbon, Green Growth
	MOE	main responsible ministry for climate- and environment-related issues, drafts bills coordinates domestic five-year plan on Low-Carbon, Green Growth responsible for policy coordination in the waste sector
	Relevant ministries: MKE MFAFF MLTM	Respectively: responsible for policy coordination in the following sectors energy and industrial sector agriculture and livestock buildings and transport
Provincial level	city mayors provincial governors	Overseeing and coordinating provincial mitigation policies and actions write local five-year plans

8.2.2 Institutional setup and activities for MRV

South Korea is one out of three Non-Annex I countries that has already submitted three national communications under the UNFCCC. A detailed look at these three communications, their preparation and responsibilities reflects the development of the institutional setup, GHG reporting and other MRV activities in Korea in the last 15 years.

While the Initial National Communication (NatCom) published in 1998, was developed based on a number of research projects by the Ministry of Trade, Industry and Energy (MTIOE) and the second NatCom was published by the Ministry of Knowledge Economy (MKE), the third national communication has been prepared by the *Greenhouse Gas Inventory and Research*

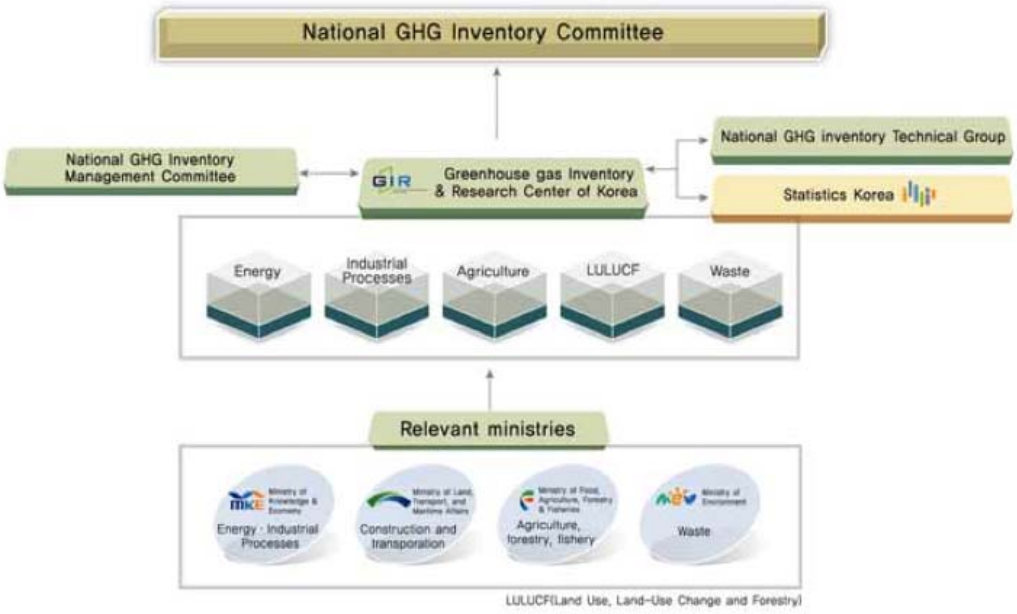
[18] The Enforcement Decree mandated the PCGG to formulate guidelines. According to the Decree, the PCGG also had to be made aware of any change in a central action plan, and give guidance as to the alignment with the national strategy.

Center of Korea (GIR) and published by the MOE (Ministry of Environment) (see Annex in section 11.6). Details on the MRV activities and institutions involved are outlined in the following paragraphs.

MRV institutions

The official institutions and key organisations currently involved in the preparation of the GHG inventory and linked to MRV activities are listed in the 3rd National Communication. Their cooperation and interplay is illustrated in Fig. 16.

Fig. 16: National GHG inventory management system according to 3rd Nat.Com.



Source: MOE 2012

The National GHG inventory committee is the approving authority for the national GHG inventory and has the purpose to adjust, review and approve all related documents and information (country-specific emission factors, national inventory reports (NIR), common reporting format (CRF), reports and guidelines). The committee is led by the Vice Minister for the Environment and consists of 15 members from related ministries and highly qualified experts). The final review of the NIR and CRF includes the results of the technical groups and the management committee (see below).

The Greenhouse Gas Inventory and Research Center of Korea (GIR) is the key coordinating implementing organisation for the national GHG inventory. It was founded in June 2010 as an affiliate of the MoE with the specific purpose to act as a GHG inventory hub and mitigation research think tank based on the Framework Act on Low Carbon, Green Growth. This is the result of the overall aim to establish a sound national inventory system. The GIR provides the *National Greenhouse Gas Measurement/Reporting/Verification Guidelines"* and *"National and*

Corporate Greenhouse Gas Emissions Factor Development/Verification Guidelines". The team of the GIR also establishes and publishes the *National GHG inventory Management Plan*, manages the QA/QC, prepares the NIR and CRF[19], verify the country-specific factors, operates and manages the *National GHG Management System* (NGMS) and organizes the inventory committee.

A national GHG Inventory Management committee is responsible for the coordination of MRV for the national GHG inventory, especially for the development and verification of country-specific emission and removal factors.

The MOE (Ministry of Environment) is the representative body in charge of the national GHG inventory and publishes the NIR, which is prepared by the GIR (see below).

A national GHG technical group is responsible for technical review of NIR and verification reports, as well as for the review of the MRV guidelines and guidelines for the country-specific emission and removal factors.

The four involved ministries (MFAFF, MKE, MOE, MLTM)[20] are responsible for the sectoral inventory data, which they gather from their agencies and submit to the GIR. In total, eight agencies, designated by the relevant ministries, provide the inventory data for the related sectors: Korea Energy Economics institute (KEEI), Korea Institute of Construction Technology (KICT), Korea Transportation Safety Authority (KOTSA), Korea Energy Management Corporation (KEMCO), National Agricultural Research Institute (NIAST), National Institute of Animal Science (NIAS), Korea Forest Research Institute (KFRI), and Korea Environment Corporation (KECO).

As can be seen in the illustration, next to the organisations listed in the National Communication, also the Statistics Korea (KOSTAT) is a relevant organisation and provides data to the agencies and GIR for the preparation of the inventory. Since the foundation of the GIR in 2010, the process of inventory preparation is institutionalized and sustained from the national budget.

MRV activities

National Level

South Korea has published three national communications. According to GIR (2013), national inventories are one of their five priority activities and planned to be carried out on a yearly basis. This is more ambitious than UNFCCC requirements of biennial reporting for non-Annex I countries. In general the approach to establish and operate a Greenhouse Gas Inventory and Research center with activities ranging from the proposing of reduction measurements to

[19] QA/QC = Quality assurance/Quality control; NIR = National Inventory Report; CRF = Common Reporting Format

[20] Under President Park's administration, various ministries received new names. The Ministry for Knowledge Economy (MKE) is now named Ministry of Trade, Industry and Energy (MOTIE). The Ministry of Food, Agriculture, Forestry and Fisheries (MFAFF) was changed to Ministry of Agriculture, Food and Rural Affairs (MAFRA). The former Ministry of Land, Transport and Maritime Affairs (MLTM) is now named Ministry of Land, Infrastructure and Transport (MOLIT).

develop a global green growth network and provide expert trainings for developing countries is quite straightforward for a non-Annex I country. The inventory data and information provided in Korean's national communications is summarized in the Annex in section 11.6.

Since 2010, a comprehensive institutional and data management system has been developed to ensure a detailed and accurate annual national GHG inventory, including development of country-specific emission and removal factors, verification of used data and methods (see above and GIR 2013).

However, the inventory information given in the recent (and former) national communication is only summarized and quite limited in regard to the transparency of data and methods used. So far NIRs and connected background information are only available in Korean language, which poses a barrier to international review. There is no indication that this information will be translated to English any time soon (Sang Won Lee 2012).

South Korea has enacted and implemented a GHG and Energy Target Management Scheme for which Korea built a system allowing Measurement, Reporting, and Verification (MRV) for the GHG emissions and energy consumption (see MOE 2012; GIR 2013b). The controlled entities must provide GHG and energy receipts that are certified by third-party verifying agencies. These receipts are submitted to the relevant ministries.

The MOE is responsible for the general organization of the target management system and also responsible for the specification and management of the verifying agencies. These specialized agencies must have expertise in verification and independence. Since 2011, the training of auditors has been intensified and by fall 2011 more than 200 auditors/verifiers had been certified.

GHG inventories for local governments

Within the Framework Act on Low Carbon Green Growth, the local governments are required to implement their "Plan for Local Government Green Growth", which shall be harmonized with the National Green Growth strategy. In order to accomplish that, the MOE initiated the establishment of local governmental GHG inventories and the Korea Environment Corporation (KECO) performs a local government GHG Inventory project (Miheyon Lee 2011).

According to Jang-Won Lee (2009), the MOE developed an inventory plan as early as 2009 and offered financial support. Coordinating Agency was (in 2009) the Environment Management Corporation (EMC), which developed a "Local Government Inventory Protocol", i.e. reporting formats and data archiving methodologies based on IPCC 2006 Guidelines and the Protocol for city inventories by the organization ICLEI. Technical support was given to the local study groups (linked to the Regional Environmental Centers (RECs)), providing an internship programme for 68 people and reviewing the local inventories. The RECs were responsible for the data collection and inventory compilation (based on the protocol provided by EMC). In addition they were supposed to improve the activity data and apply – if possible – regional specific emission factors (highest tier method as possible). The educated 68 interns, mainly students from the region, supported the RECs in their data collection and inventory preparation.

In the original time schedule, the inventories of the 16 large local governments were to be finalised by end of 2009, while for the 230 small local governments, the inventories were be implemented by February 2011.

Since 2010, KECO has taken over the responsibility as EMC's successor and performs quality control of the local inventories (Mihyeon Lee, 2011). It completed implementation of the 16 large governments' inventories and 175 local governments' inventories, with the remaining to follow in 2012, as well as evaluation and verification of the data (KECO 2012). How the local inventories relate to the national inventory is not made clear from public sources. Information obtained from personal communication indicates that local and national greenhouse gas inventories are not fully compatible.

Development of expertise and capacity building

Since 2003, the Japan Ministry of the Environment supports and organises annual *Workshops on Greenhouse Gas Inventories in Asia* with the aim to offer a platform to share experiences and enable mutual learning related to the development of GHG inventories. Korean experts have participated since the first event and presented their experiences, e.g. in 2011 approaches for emission calculation on waste and QA/QC (Baek, 2011, Lee, 2011).

In addition to this, Korea has a bi-national exchange with Japan. Since 2008, annual *Korea-Japan national greenhouse gas inventory review meetings* have been held to discuss experiences and specific barriers in the inventory development and verification.

Interestingly, South Korea has 81 nominated (and updated)[21] inventory review experts in the UNFCCC roster of experts. This is remarkable as no other country (including all Annex I countries) has as many experts in the roster of the UNFCCC and less than 15 countries have more than 20 experts in the list (UNFCC 2013a). In 2012, three experts of South Korea participated in the reviews of NCs by the UNFCCC in 2012 (2012 review cycle).

Next to the above mentioned internships for local experts of the REC's in 2009, KECO provides trainings on GHG control to cover the demand of specialists (at local government and company level) "*to prepare for greenhouse gas reduction after 2020 and post-Kyoto system [...] in order to establish and implement greenhouse gas emission management and reduction strategy*" (KECO 2013).

Box 23: Conclusions on MRV and institutional setup for climate legislation

South Korea has adopted a strong and comprehensive top-down approach for the institutional implementation of its Low Carbon, Green Growth national strategy. The strategy has been streamlined into all public agencies that may have an impact on activities for greenhouse gas reductions. The national framework and strategy on were set up to be coordinated by a high-level body - the 'Presidential Committee on Low Carbon, Green Growth' - and implemented through five-year plans by all relevant ministries as well as the provincial level. However, it is

[21] Number of experts in the Roster of Experts that updated their profile according to the new application form created by SBSTA http://unfccc.int/parties_and_observers/roster_of_experts/items/534.php.

not yet clear if the ambitious pace set by the previous administration will be held by the new President, Park Geun-hye, who has come into office early in 2013. Publicly available information on the new administration's climate policy is scarce.

The efforts of the Korean government to develop a sound inventory and MRV systems are quite high, which can be seen in the establishment of the GIR and comprehensive institutional structure to ensure annual NIRs with country-specific and verified data. In addition, the activities on capacity building – on provincial level and on national expertise – are remarkable (e.g. number of roster experts, international exchanges and mutual learning, national trainings for local Korean demand). On the other hand, the reporting of the NIR is solely done in Korean language, which is why it is little transparent for external experts. To ensure transparency and allow mutual learning for other Non-Annex I parties, it would be preferable to have more information publicly available in English.

8.3 Mitigation potentials, strategies and activities

Discerning Korea's mitigation potential has proven a daunting exercise because of a distinct lack of data beyond official Korean sources detailing the country's mitigation pledge of 30% below BAU until 2020 (Fekete et al. 2013). South Korea's pledge amounts to an abatement of about 232 Mt CO_2e/a in 2020 versus projected BAU emissions of 776 Mt CO_2e/a in 2020. Notably, South Korea's target is not conditional on international support, which sets it apart from most other developing countries. In a presentation on the ADB's forthcoming report on "Economics of Climate Change and Low Carbon Growth Strategies in Northeast Asia" (Hanaoka 2012) in May 2012, the authors estimated a maximum mitigation potential of 186 MtCO_2e/a in 2020, presuming a maximum carbon price of 200 USD/tCO_2. They identified high mitigation potentials in strengthened energy efficiency across all sectors, as well as low-cost mitigation opportunities for the transport sector. On the other hand, a study carried out by Greenpeace and EREC (Short / Crispin 2012) found significant potential in renewable energies. The authors estimated a strong possible increase of renewable sources (10.4 - 13.8%). At the same time, they assumed a phase-out of nuclear energy, as opposed to a significant increase of this energy source as envisaged by Korea's Third National Communication (MoE 2012).

8.3.1 Low-carbon development strategies

While Korea does not officially name the Framework Act on Low-Carbon, Green Growth and its accompanying five-year plan and national strategy a low-carbon development strategy, it has been often used as an example for LEDS, low carbon growth plans etc. in various studies (e.g. Sang et al. 2012, Tilburg et al. 2011). In an official presentation to the UNFCCC by the Korea Environment Institute, the 'Low Carbon, Green Growth' paradigm has been stated as *"adopted as a Low Emission Development Strategy for Korea"* (Yong-gun Kim 2012). The five-year plan and national strategy set general targets for green growth throughout society and all sectors in the country.

Objectives and policy directions

The framework act itself touches nearly every aspect of the economy that is relevant for GHG emissions - from the administrative aspects (international negotiations, MRV, meetings of the

PCGG); activities like recycling of resources and research, to green transformation support and access to finance, grants and loans. Embedded in the framework act is South Korea's National Strategy on Green Growth.

The framework act itself did not include specific targets. Anyhow, it was supplemented by an enforcement decree in 2010. This decree includes an emissions reduction target of 30% vs. BAU in 2020. The decree further specifies the establishment of the national and local Five Year Plans, as well as matters relating to financial support for green industries, and MRV of greenhouse gases and energy consumption.

The framework and its accompanying decree are part of the national legislative framework of the country and can thus be considered binding on the domestic level.

South Korea's Green Growth Strategy comprises three main objectives leading to a number of policy directions to take (see Box 24). These are substantiated through a wide range of concrete policies, a number of which will be explained further below. The strategy is explicitly set up to be a comprehensive national growth agenda for fostering transformational change throughout Korean society (Kaudia, Yang, and Yu 2012). The Five Year Plans developed by the relevant ministries and regional administrations provide milestones on the implementation of the Green Growth Strategy.

Since its inception in 2009, integration and accomplishment of the goals defined in the National Strategy have been monitored by the Presidential Committee on Green Growth (PCGG). South Korea's third National Communication includes milestones that have been reached in the pursuance of low carbon green growth. These include the institutional foundation of the emissions trading system, increased investment in "green" research and development, modal shifts in transport, and strengthened resilience to climate change (MOE 2012). However, the description of the milestones remains rather vague.

Box 24: Objectives and Policy Directions of South Korea's Green Growth Strategy

The first objective, "Mitigation of climate change and improvement of energy independence", directly focuses on combating climate change in the Republic of Korea. Following the objective, three main policy directions were identified (Jones / Yoo 2011):

- Mitigation of greenhouse gas emissions: mitigation of GHG emissions for buildings, transport, industry, strengthened MRV, promotion of forestation
- Reduction in the use of fossil fuels and enhancement of energy independence: reduction of energy intensity to OECD average, increased use of renewable and nuclear energy
- Improvement of the capability to adapt to climate change: Four Major Rivers Restoration Project, 18% of environment friendly agricultural products by 2020

The second objective, "Creation of new growth engines", identifies policy directions that are to foster economic growth in an ecological fashion:

- Development of green technologies and creation of new growth engines: expand share of world market in green tech industry to 8% within five years
- Greening of existing industries and nurturing of emerging green industries: raise export of green goods from

10% (2009) to 22% in 2020, help further development of small and medium enterprises

- Advancement of the industrial infrastructure: increased development of services in health care, education, finance, contents industry, software, tourism
- Laying the institutional foundation for a green economy: development of emissions trading, greening of taxes, public credit guarantees for green industries.

The third main objective, "Improvement in the quality of life and enhancement of international standing", aims at initialising a "green shift" in Korea's society, as well as advancing Korea's international reputation as a "green" nation. This goal includes three further policy directions:

- Creation of a green homeland and green transportation system: raise share of rail travel from 18% (2009) to 26% in 2020, metropolitan mass transit to rise from 50% (2009) to 65% in 2020
- Bringing green revolution into daily life: carbon footprint labelling, increased mandatory procurement of green goods, better education on green growth
- Becoming a role model for the international community as a green leader: active engagement in climate negotiations, increased share of ODA (from 11% to 30% in 2020)

In order to reach the objectives laid out in the national strategy, South Korea has committed to annually invest about 2% of its GDP on the implementation of the objectives laid out in its Green Growth Strategy over the duration of the Five-Year Plan.

(adapted from Jones /Yoo 2011)

Coherence of strategy

Whilst the act 'speaks' to and is supported by other legal instruments (such as the "Act on Encouragement of Purchase of Green Products" (2011) and "Sustainable Development Act" (2011)), Article 8 (1) states that the act shall take precedence over all other acts in application to low carbon, green growth.

As a cross-sectoral, nation-wide strategy developed top-down, the framework act can thus be considered a very coherent approach to combating climate change and green growth, covering all areas relevant to climate change. The Presidential Committee on Green Growth was designed to have an oversight function for all relevant legislation.

However, with the new administration in place, there are reports that South Korea is starting to weaken its strong emphasis on the 'Low Carbon, Green Growth' paradigm (see above). At the writing of this study, it was not clear if this shift would have implications on the coherence of South Korea's strategic approach.

8.3.2 Nationally appropriate mitigation actions and other relevant policies and measures

Nationally Appropriate Mitigation Actions in Korea

South Korea has been especially vocal in the debate under UNFCCC concerning MRV of NAMAs since the first deliberations on the subject, holding that there should be a differentiation between domestically and internationally supported NAMAs, and promoting the NAMA registry (UNFCCC 2009). Registered NAMAs "*should be specific and focused actions that have direct*

linkage with mitigation. [...] The scope and extent of NAMAs could range from economy-wide mitigation targets to specific policies and measures in certain sectors or areas" (ibid.).

South Korea further promotes the concept of credited NAMAs established as part of the proposed new market mechanisms, provided there is appropriate MRV of credited actions (UNFCCC 2013b). There is no decision by the UNFCCC COP on the inclusion of credited NAMAs under the proposed new market mechanism, or in fact how such a mechanism would be set up at all.

South Korea has formally defined its goal of 30% nation-wide GHG reduction below BAU as an unconditional, domestic NAMA under the UNFCCC. It has not defined individual measures under the UNFCCC.

Other relevant GHG mitigation policies

While there are no NAMAs explicitly named as such in Korea, the 'Framework Act on Low-Carbon, Green Growth' together with its Enforcement Decree provides a frame for policies and measures (PAMs) on climate change, energy and sustainable development in 64 articles under 7 chapters, covering all sectors of the economy. Korea's third National Communication lists 38 policies and measures for GHG reduction of various types, ranging from recommendations by the ministries to hard regulation (MOE 2012).

In the following, we take a closer look at some of the policies and measures. As outlined, South Korea has devised a comprehensive set of PAMs which this report cannot analyse in full. We therefore concentrate on areas that have shown the most promise in our previous potential analysis.

Development of a carbon market

GHG and Energy Target Management Scheme: The most prominent of Korea's measures for GHG mitigation is the GHG and Energy Target Management Scheme (TMS), which serves as the precursor of the forthcoming emissions trading system that is set out to start from 2015. Under the TMS, about 70% of the total national GHG output are managed. More than 450 companies from the power, industry, waste and agricultural sectors are covered by the scheme. Companies with over 125 $ktCO_2e$ output and an energy consumption of over 500 TJ, or individual facilities outputting more than 5 $ktCO_2e$ and consuming more than 100 TJ receive reduction targets. The reduction targets are derived from sectoral goals set by the relevant ministries, but provide for a degree of flexibility as companies are able to negotiate their targets to a certain extent (UNESCAP 2012a). Compliance with the reduction targets is verified by specialised agencies. If the target is exceeded, companies face a maximum fine of ca. 8,800 USD (UNESCAP 2012a). Every covered company must provide the government with data on emissions and energy consumption annually, on the basis of which individual reduction targets are set. The main emitter covered by the scheme is KEPCO, the state-owned utility company. In all, only 10 companies were responsible for 76% of total covered emissions in 2011 (BNEF 2013).

In addition to the TMS, Korea put in place a voluntary emissions reduction system in 2005, the Korea Voluntary Emission Reduction programme (KVER). The programme, operated by the Korea Energy Management Corporation (KEMCO) on behalf of the Ministry for Knowledge and Economy (MKE), aims at raising low-carbon investment by small and medium-sized enterprises,

which are not part of the TMS. Currently, credits from this programme (K-CERs) are mainly bought by the Korean government as a means to subsidize smaller-scale investment in energy efficiency, renewables and other low-carbon technologies (BNEF 2013).

Emissions trading system: From 2015 onwards, Korea will implement an emissions trading system (ETS), which will likely cover the same entities as the current Target Management Scheme. The Korean government passed legislation for the ETS in the end of 2012, outlining general rules and governance for the system. Responsibility for operation lies within the South Korean Environment Ministry (MOE). After consultation with industry and the designation of a trading exchange, a so-called ETS Master Plan is to be developed, which includes legal aspects as well as a general plan of operation over 10 years. Planned publication date of the Master Plan is December 2013. The plan will be revised every five years (BNEF 213).

Allocation of allowances will follow an allocation plan to be developed until June 2014. Until the end of the first phase in 2017, all allowances will be handed out free. Free allocation will drop to 97% in the second phase (2018-2020), and to less than 90% in the third phase. Only 10% of the total compliance obligation may be covered by offsets. Offsetting through international carbon trading is not allowed for the first two phases, but may be used for up to 50% of the total offset limit in later phases. Usable national offsets will most likely include K-CERs and domestic CDM credits (BNEF 2013).

If an entity does not submit required allowances, it faces fines of three times the market prices, up 100,000 KRW per ton (ca. 90 USD/t). It is not yet clear if non-compliant entities will only be fined, or will still need to submit missing allowances. Without the need to submit these allowances, the 90 USD/t penalty will effectively act as a price ceiling in the system (BNEF 2013).

Energy efficiency

Korea has a very high energy intensity, mostly due to the predominance of heavy and energy-intensive industry (steel, petro-chemicals, cement) in the country. The industrial sector in total accounts for 52% of total energy consumption (OECD/IEA 2012). South Korea's energy intensity has fallen by 11.4% since 2000, but with 0.19 toe/1000 USD of primary energy still remains well above OECD average (0.15). Strengthening energy efficiency is thus one of the most promising strategies to reduce emissions in the country (OECD/IEA 2012).

Already in 2008, the Korean government passed the First National Energy Plan and the Fourth Energy Use Rationalization Plan in order to decrease energy intensity of the whole economy by 46% until 2030. From 2008 to 2012, the plan envisages a decrease of 11.3% or 34.2 Mtoe from a BAU level of 299.3 Mtoe in energy demand, with accompanying investments of 18.3 trillion KRW (16.2 billion USD) (MKE 2010, OECD/IEA 2012). Korea strives to implement IEA's energy efficiency recommendations adopted at summits in 2006, 2007 and 2008. In 2010, the country ranked 15th of the 28 OECD member states in the implementation of IEA's recommendations (KEMCO, n.d.).

The Korean government has also enacted an energy audit system for industry and the buildings sector in 2007, targeted at businesses with more than 2000 toe of energy consumption per year. Through the audits, about 2.2 Mtoe of energy savings potential has been identified

between 2007 and 2010, which led to a significant increase in investment in energy savings (OECD/IEA 2012).

Other policies enacted by the South Korean government for fostering energy efficiency in general include voluntary agreements for energy savings and GHG reduction with industries, investment support for energy efficient facilities, revised building codes, and consultations on energy use plans of the public and private sector (OECD/IEA 2012).

To increase energy efficiency of appliances, three large programs are in place: an Energy Labelling and Standard programme (since 1992, mandatory for 35 products including refrigerators, various types of lighting, TVs, and automobiles). It was expanded in 2012 to include the Energy Frontier Program, which similarly to the Japanese Top Runner Programme applies the highest energy efficiency of a product type as efficiency target for all models (KEMCO, n.d., OECD/IEA 2012). Certain products with an especially high efficiency can also gain a special certificate under the High-Efficiency Equipment Certification Program. The programme was introduced in 1996 and covers 34 products, including LEDs. Finally, the mandatory Stand-by programme (established 1999) aims at reducing power consumption in stand-by mode in 22 products, including computers and home audio products. If criteria are not met, a warning label must be applied (KEMCO, n.d.).

Renewable energy

With just 1.6% of total primary energy supply in 2011, Korea's share of renewable energy is very low. In 2011 about two thirds of renewable energy supply stemmed from biofuels and waste, and 21.6% from hydropower. Wind and photovoltaic energy contributed only very small amounts, their share has been growing (OECD/IEA 2012).The Third National Basic Plan for New and Renewable Energy and Deployment (2008) foresees an increase of "new and renewable" energy in total primary energy supply from 2.4% in 2008 to 6.1% and 11% in 2020 and 2030 respectively. The higher percentage given in the Basic Plan stems from South Korea's definition of "new and renewable", which includes classical renewable energy sources, but also non-renewable sources (coal and gas liquefaction) as well as fuel cell technology (Lee 2010). A presentation by the National Research Foundation of Korea (Han 2012) breaks down the 11% goal for the different technologies from 2010 to 2030 as

- PV: 166 to 1,364 ktoe (8-fold increase, 0.5% in 2030)
- Wind: 176 to 4,155 ktoe (24-fold increase, 1.4% in 2030)
- Biofuels: 755 to 10,357 ktoe (14-fold increase, 3.4% in 2030
- Geothermal energy: 33 to 1,261 ktoe (38-fold increase, 0.4% in 2030

Other sources listed include Waste (3.7% in 2030), solar-thermal energy (0.6%), hydropower (0.5%), and tidal energy (0.5%).

In order to promote an increase in renewable energies, South Korea has implemented a variety of support policies. The government plans to invest 9 trillion KRW (ca. 8 billion USD) under the Offshore Wind Power Top-Three Roadmap in order to boost the country's offshore wind capacity, with a goal set at 7.3 GW wind power capacity (6.9 GW) offshore in 2030, up from 406 MW purely onshore in 2011 (IEA Wind 2012). However, construction of offshore wind

generators has been relatively slow, with only one 30MW wind park actually under construction (Han 2012).

The government further aims at expanding supply and demand of wood pellets by providing financial support to wood pellet manufacturers. While production capacity of wood pellets is at 200.000 tonnes per year, only 6.000 have actually been produced due to low demand. The government has reacted by distributing wood pellet boilers to remote villages, as well as greenhouse heaters for horticulture (OECD/IEA 2012).

Korea implemented feed-in tariffs (FITs) for renewable energy generators in 2002, guaranteeing support over 15 years, or even 20 years in the case of photovoltaic power generation (OECD/IEA 2012).

As of 2012, Korea's FITs are being replaced with a Renewable Portfolio Standard (RPS). This standard requires energy suppliers operating power stations with more than 500 MW capacity (currently 13) to provide 2% from new and renewable power portfolios. This percentage is set to rise by 0.5% every year until 2016, and 1% until 2022, when it will reach 10%. Until 2016, part of the required renewable energy supply must come from photovoltaic sources. Facilities generating renewable energy can be certified and then awarded tradable renewable energy certificates on a weighted basis, depending on type of generation. If energy generating entities fail to meet their requirement under the RPS, a fine of 150% of the weighted market price of shortage is issued (Kim 2012).

Nuclear energy

The expansion of nuclear energy in South Korea has been ongoing since the 1970s, and the government keeps to its strong commitment to nuclear energy generation. Currently, 23 nuclear power plants are operational, with up to five more under construction (OECD/IEA 2012). All nuclear power plants are operated by subsidiaries of state-owned utility company KEPCO.

South Korea's Fifth Basic Plan of Electricity Supply and Demand (MKE 2010) foresees a strong increase of nuclear capacity, with 34 reactors producing 49% of the country's electricity, and a further increase to 59% by 2030. Despite growing public concern over nuclear safety following recent reports over fraudulent certification of reactor parts, the government remains committed to its nuclear expansion plan. (BBC 2013, Choe 2013).

Transport

The transport sector in South Korea accounted for more than 15% of emissions from fuel combustion in 2010. The government strives to lower emissions by devising policies targeted both at public transportation, transport infrastructure and individual vehicles.

Public transportation systems are being expanded across the country. South Korea has made progress in the enhancement of Bus Rapid Transit Systems (BRT) and other metropolitan buses in its metropolitan areas, and has implemented public transport exclusive in a pilot project in Daegu. Korea's 3rd National Communication further foresees the development of a Transit Master Plan in order to plan such measures more systematically and to give guidelines (MOE 2012).

Korea makes efforts to enhance the efficiency of its road systems by installing IT-based traffic information and guidance systems as well as "smart roads" that integrate IT-based traffic flows with automotive technology. Also, pilot projects with roundabouts have been initialized which have had positive effects on waiting times, fuel efficiency and traffic flow (MOE 2012).

From 2015, South Korea mandates all new vehicles below 3.5 tonnes to meet a fuel efficiency of 17km/l (140gCO_2/km) on average of the manufacturer's fleet (OECD/IEA 2012). Through provision of tax incentives and subsidies as well as the installation of charging stations for electric cars, the government's Green Car Promotion Strategy provides support to customers of low-emission cars. Starting with the public sector and expanding support to the private sector in 2013, Korea aims at one million electric cars and 2.2 million chargers by 2020 (OECD/IEA 2012, MOE 2012).

The Republic of Korea levies a driving (mileage) tax in addition to regular fuel taxes on gasoline and diesel. Revenues mostly flow back into road construction (OECD/IEA 2012).

8.3.3 Coherence of strategies, activities and potentials

Does South Korea consistently translate strategies into actions?

As the measures outlined above have to be in line with South Korea's national strategy by design, we assume a high coherence of the measures with the strategy. However, with only 4 years since the former administration announced "Low Carbon, Green Growth" as a national paradigm, an evaluation of an effective translation of the strategy into concrete actions is too early.

As for instance in Mexico, a range of policies and measures predates the framework act. Actions contained in South Korea's Plans for energy efficiency and renewable energy stem from 2008, at least one year before the new paradigm was announced. It is not clear if these actions were strengthened or expedited with the introduction of South Korea's Green Growth Strategy.

Do strategies and activities support the use of identified potentials?

Korea's target to reduce GHG emissions by 30% below BAU in 2020, also reiterated as a NAMA under the UNFCCC, is considered as highly ambitious by various studies: Preliminary data by the ADB on South Korea's mitigation potential indicated that the set target is only reachable under the condition of a very high carbon price (Hanaoka 2012, see also Fekete et al. 2013). A recent study by Bloomberg New Energy Finance (BNEF) comes to a similar conclusion (BNEF 2013). In the following we seek to analyse if the policies and measures adopted by the Republic of Korea tap the sectors' full potential. Due to missing data on potentials per measure, the analysis provided here differs from chapters elsewhere in this report.

Development of a carbon market

The development of Korea's emissions trading system constitutes the most important policy instrument for economically efficient greenhouse gas abatement. The ETS may give strong incentives for the industrial sectors covered to realise their mitigation potential, especially considering the high energy intensity of some.

It is difficult to assess the scheme's potential, as many rules have not fully been developed yet. At the writing of this study, only Bloomberg New Energy Finance has attempted to quantitatively compare probable mitigation potentials of the covered sectors with the Korean government's abatement goal, and to make assumptions on resulting prices of carbon. The study concludes the possible price ceiling of 90 USD/t, which would represent the highest carbon price yet worldwide, will not suffice to reach South Korea's mitigation target, as the need for abatement in the traded sectors may exceed lower-cost abatement potential. BNEF therefore expects the carbon price to rise beyond 200 USD/tCO_2e if it is not capped (BNEF 2013). Preliminary data by the ADB (Hanaoka 2012) supports this finding. The ADB expects South Korea to reach its reduction goal only at the highest modelled price scenario of 200 USD/t CO_2e.

Despite some lack of clarity on the scheme's design, South Korea's ETS has a high potential and shows the country's commitment to greenhouse gas mitigation. Anyhow, mere dependence on abatement through the ETS will not be enough to reach South Korea's ambitious goal. It therefore needs to be complimented by a comprehensive approach for the whole economy. We therefore welcome the South Korea's integrated approach under the Framework for Low-Carbon Green Growth.

Energy efficiency

Korea's energy intensity ranks among the highest world-wide because of the prevalence of its unusually large industrial sector. Increasing the energy efficiency across all sectors is therefore urgently needed. The Korean government has responded to this by implementing wide-ranging efficiency targets and measures of how to reach them.

The target of lowering energy intensity by 46% up to 2030 can be regarded as ambitious. Anyhow, many of the measures are voluntary. While these measures have undoubtedly had many positive effects, it is not clear if they have led to all possible improvements.

A very positive step could be the implementation of the Energy Frontier Program. A similar programme in Japan, the so-called Top Runner Program, has led to a progressive improvement in efficiency for appliances (UNESCAP 2012b). Labelling programs have positive effects on consumer awareness, but their effectiveness for behavioral change are hard to assess.

Renewable energy

South Korea has taken some significant political steps to enhance their share of renewable energy in the national energy mix, and has committed to invest in the build-up of its offshore wind capacity, among others (OECD/IEA 2012). The country's main energy sources, anyhow, remain coal and nuclear energy.

The energy (r)evolution study on South Korea by Greenpeace and EREC suggested that the country's renewable energy potential may in fact be higher than envisaged by the Korean government, and may even be attainable at lower cost because of a decrease in nuclear expansion, which according to the authors would come at a higher cost than a similar increase in generation capacity through renewable energies (Short/Crispin 2012, see also Fekete et al. 2013).

The target set for the RPS could be strengthened significantly. The goal of 10% renewable energy in 2022 seems to be aiming low, and does not correspond well with the country's overall commitment to a low carbon development path.

The Republic of Korea could therefore increase their commitment to renewable energy, and strengthen the implementation of its existing plans in this field. Instead, the budget allocated to the renewable energy sector for 2013 has apparently been reduced by 12%, and achievements in fostering renewable energy by measures of the government have shown poor results so far (Suk 2013, Yoon/Kim 2013).

Nuclear energy

South Korea has adopted a strong stance towards nuclear expansion. Within this study, we cannot assess if the country's plans reflect its nuclear potential, as commitment to nuclear energy most commonly has its grounds in energy security deliberations rather than combating climate change.

Transport

Emissions from transport in Korea are high, and also have a high mitigation potential. Preliminary data by the ADB at the same time indicated that especially increased vehicle efficiency has a high mitigation potential at negative cost (Hanaoka 2012).

Korea has adopted a whole range of policies geared towards the transport sector, and plans on further expanding public transport. New fuel efficiency standards and pilot projects on electrification of vehicles and enhanced traffic guidance have the potential to lower emissions from this sector. Especially the country's fuel efficiency standard could be strengthened even further to reflect evolving standards that have to be met for vehicle export, e.g. to the European Union.

The country's mileage tax provides an incentive to consumers for buying more efficient cars, or to make use of the evolving public transport system. However, its use for road construction may in part contradict Korea's efforts to lower transport emissions. Past experiences show that enhanced supply of road networks also increases the number of vehicles and vehicular traffic. In order to fully tap into the sector's mitigation potential, Korea may consider to instead use the funds levied from the mileage tax to further strengthen public transport systems instead (OECD/IEA 2012).

Box 25: Conclusions on coherence of mitigation potentials, strategies and measures

Korea has adopted a highly ambitious non-conditional target that may only be reachable with high-cost abatement measures. The 30% vs. BAU target has been inscribed as the country's NAMA under the UNFCCC. In order to reach its goal, Korea's 'Low Carbon, Green Growth' framework encompasses a very wide range of policies and measures, covering the energy and industrial sector, buildings, transport, agriculture and livestock, forestry and waste.

The most outstanding measure to be adopted by Korea is its future emissions trading system that, if resulting prices as indicated by Bloomberg New Energy Finance prove correct, has the potential to become the most ambitious scheme worldwide. Anyhow, the possible price cap of

90 USD/t CO_2 may still not be enough to reach the country's mitigation target by market-based measures alone.

It is therefore essential that Korea also takes decisive steps on a sectoral level. Especially for energy efficiency, the majority of measures have a strong voluntary component that limit effectiveness. Korea could also significantly strengthen its renewable energy commitment, which in its current form does not reflect the country's low carbon commitment. With a new administration in place since the beginning of 2013, continued high level political commitment is needed.

8.4 Remaining barriers to unlocking identified potentials

8.4.1 Nation-wide barriers

With its top-down coordinated approach, the Republic of Korea has put in place a comprehensive and coherent set of policies and measures to limit GHG output and foster green growth, including wide-ranging stakeholder involvement. In principle the nation does not face any significant overarching barriers to implement its goal. The strides Korea has taken under its former president will have to be maintained under its new president Park Geun-Hye. The ambitious goal that South Korea has set for itself under the former administration requires strong political commitment at a high level in order to be successfully implemented in the longer term.

At the writing of this study, official reports are inconclusive on how president Park Geun-Hye will go forward on the 'Low Carbon, Green Growth' strategy. She has however introduced a new paradigm, "creative economy", focusing more on science and information technology rather than low carbon growth. The Korea Times reports *"waning interest in green growth"* in Korea, further pointing out that *"interest in green growth evaporated instantly with the change of administration"* in the country (Kim 2013).

8.4.2 Measure-specific barriers

Apart from potentially limited political commitment, some further barriers exist on a sectoral level. Unfortunately, only sparse information on barriers that limit deployment is available.

Tab. 47: Overview of type of barriers to most important mitigation measures in Korea

	Emissions trading	Energy efficiency	Renewable energy	Nuclear energy	Transport
Share of total potential (not analysed)	n.a.	n.a.	n.a.	n.a.	n.a.
Barriers					
Institutional/political	X	X	X		X
Financial/economic	x	X	X	X	X
Technical				X	X
Informational/capacities		x			x
Others	X			x	

Note: if x, then barrier is relevant to measure. Size indicates importance of the barrier.

Emissions trading

The main political barrier to a successful implementation of Korea's emissions trading system is the remaining *uncertainty about the actual rules of the system*. While the government seems to be set on introducing the ETS by 2015, many cornerstones are not fully developed, including an answer to the question if the imposed fine will act as a price cap or not, but also questions of allocation of allowances are not yet addressed. The planned publication of the allocation plan in June 2014 leaves little time before the projected start of the ETS, so a delay in publication can easily lead to a delayed start of the system as whole. It also provides little time for participants to prepare.

Even with current information on the planned ETS, the *carbon price* can be expected to be very high if compared to other current systems (BNEF 2013). This has already led to strongly voiced *opposition by targeted industries*, concerned that the ETS will harm the competitiveness of domestic industries on the global market. It can be expected that these concerns will be voiced strongly in industry consultations to be held by the taskforce on the ETS that was formed in early 2013 (Reklev 2013b, BNEF 2013). Furthermore, a major part of the covered entities are in fact state-owned, and may thus be able to exert more direct influence. Continuing opposition may very well lead to delays in its implementation, and to lower ambition than foreseen at the moment.

Tab. 48: Most relevant barriers to emissions trading

Institutional/ political	Rules not set: possible price cap, allocation of permits (BNEF 2012) Late development of allocation plan may delay implementation (BNEF 2013)
Financial/ economic	System may lead to a high carbon price that may hurt Korean economy (BNEF 2013)
Others	Strong and continuous opposition by industry, seeking to water down scheme (BNEF 2013)

Energy efficiency

Because of the many actors involved in specifying and implementing the different measures on energy efficiency, the IEA calls for greater *coordination between Korean ministries and agencies* in order to further harmonise the approaches (OECD/IEA 2012).

Another effect of the great variety of programmes and measures on energy efficiency is a lack of consistent *measurement and reporting* on the effectiveness of these measures on the targeted sectors, which may limit their overall effectiveness (OECD/IEA 2012).

Finally, the *price structure* especially for electricity in South Korea does not lend itself to more efficient energy use: Despite the government's efforts to introduce a more realistic pricing system, electricity prices both for consumers and industry remain below generation cost, at about 90% of recovery across consumers. A new pricing system that better reflects commodity prices and allows state-owned company KEPCO to adapt end-use pricing on has not been implemented. Tariffs therefore remain subject to government policy, with varying prices for different sectors leading to cross-subsidisation between different consumers. (OECD/IEA 2012).

Tab. 49: Most relevant barriers to energy efficiency

Institutional/ political	Greater coordination between Korean ministries and agencies needed (OECD/IEA 2012)
Financial/ economic	Very low, cross-subsidised price for electricity does not provide enough incentive to limit electricity use (OECD/IEA 2012)
Informational /capacities	Need for enhanced measurement and reporting on effectiveness of measures (OECD/IEA 2012)

Renewable energy

Possibly as a result of the waning overall political commitment, recent reports indicate that the new administration has cut the *renewable energy support budget* (Suk 2013, Yoon/Kim 2013). This may lead to a considerable economic barrier to further implement renewable energy in the country, as developers are often faced with high up-front cost.

Given the low price for electricity in the country, moving from a feed-in tariff system to a mandatory renewable portfolio may help to overcome low deployment rates due to higher costs for renewables. It remains to be seen how possible additional costs will be distributed, and how effective the system will be in fostering investment in renewable energy in Korea. However, the envisaged share of 10% in 2022 may be too low to spur significant investment in renewable energy as a result of the RPS. A stronger goal may foster higher investment in renewable energy by the private sector.

Tab. 50: Most relevant barriers to renewable energy

Institutional/ political	Budget cuts for renewable energy in 2013 (Suk 2013, Yoon/Kim 2013) Renewable Portfolio Standard may give better incentives for investment in RE, but too early to judge (OECD/IEA 2012)

Nuclear energy

The main barrier for the deployment of nuclear energy lies within the *high cost for installation and maintenance* of nuclear reactors, which is dependent on governmental support. In general, nuclear plant construction calls for very high investments, has long payback times, and projected construction costs are highly uncertain, which makes such plans economically challenging (Schlissel /Biewald 2008).

In the wake of the Fukushima incident, there seems to be *growing opposition* against increased nuclear energy within the population, so the government may choose to halt the planned rapid expansion of renewable energy (Borowiec 2012).

Another barrier to rapid nuclear deployment may be the recent reports of *fraudulent certificates for reactor parts*, which have led to a shut-down of up to four reactors in Korea. Reports such as these have led to growing public concern for nuclear energy safety (Choe 2013).

Tab. 51: Most relevant barriers to nuclear energy

Financial/ economic	High cost for installation and maintainance depends on support by government
Technical	Recent discoveries of fraudulent certificates for reactor parts have led to shutdown of nuclear plants (BBC 2013, Choe 2013)
Others	Opposition to nuclear technology by public (Borowiec 2013, Choe 2013)

Transport

According to a study carried out by the Korea environment Institute in 2009, Korea faces a variety of inter-related technical, financial, political and social barriers barriers that prevent a full-scale realisation of the country's mitigation potential in the transport sector (KEI 2009).[22]

On the technical level, raising fuel efficiency standards and emissions standards for vehicles as well as requiring manufacurers to switch to bio-fuelled or electrical vehicles requires vehicle manufacturers to adopt and implement *new technologies that may not be available* to them yet. While certainly possible, this may produce *time lag in the implementation of policies*, and *added cost* for producers and consumers.

Especially expanding biofuels and electrification of vehicles may therefor be only possible by governmental subsidies. This again leads to a *need for stronger intra-governmental coordination and increased fiscal spending*. Countering added governmental cost through a carbon tax on fuels meets *resistance by tax payers*. Abolishing current subsidies for oil also meets *resistance by the beneficiaries of subsidised oil* (KEI 2009). Politicians have thus been reluctant to make such decisions in the past.

Tab. 52: Most relevant barriers to transport

Institutional/politi cal	Need for increased intragovernmental coordination (KEI 2009) Politicians reluctant to make unpopular decisions (KEI 2009)
Financial/ economic	Added cost of new technologies (KEI 2009) Need for increased fiscal spending (KEI 2009)
Technical	Vehicle manufacturers missing need technologies Need for increased fiscal spending (KEI 2009)
Others	Resistance by public against tax raises (KEI 2009) Opposition of beneficiaries against abolishion of subsidies (Kei 2009)

[22] It bears to be noted that some of the barriers may not apply any longer, as the quoted study dates from 2009. However, no more recent information could be obtained.

Box 26: Conclusions on barriers to GHG mitigation in South Korea

There is only very limited information available on implementation barriers in the Republic of Korea.

The main barrier to full implementation of the country's low-carbon development target may well be political, as new President Park Geun-Hye has introduced a new paradigm for Korea's economic growth, and interest in a future low-carbon economy seems to be waning within South Korea.

This may also be the cause for recent cuts in funding for renewable energy projects, which will potentially hinder the implementation of renewables to the extent that is foreseen in the government's plans. Furthermore, strengthening the goal for the share of renewable energy could lead to further investment in renewable energy by the private sector in the country.

The late finalisation of the rules of South Korea's emissions trading system may lead to problems for a timely implementation of the system. There is considerable uncertainty about a possible price cap and the allocation of permits, and strong opposition by the industry.

The pricing structure for electricity in South Korea does not lend itself well to spurring more efficient energy use, as prices are lower than the actual generation cost. Also, according to recommendations by the IEA, better measurement and reporting on the great variety of measures may be needed to strengthen their overall effectiveness.

8.5 Conclusions

Highlights
- Comprehensive approach to low-carbon development
- Ambitious target
- Emissions trading system

Possible improvements
- Sustained commitment by new government
- Strengthen goal of renewable energy share
- Provision of information in English

Korea has adopted a comprehensive top-down approach for the implementation of its 'Low-carbon, Green Growth' national strategy. The strategy has been streamlined into all public agencies that may have an impact on greenhouse gas emissions. Korea's 'Low Carbon, Green Growth' framework encompasses a wide range of policies and measures, covering all sectors.

The efforts of the Korean government to develop a sound inventory and MRV systems are high. This can be seen in the establishment of the GIR and comprehensive institutional structure to ensure annual NIRs with country-specific and verified data. To ensure transparency and allow mutual learning for other Non-Annex I parties, it would be preferable to have more publicly available information in English.

The most outstanding measure to be implemented by Korea is its future emissions trading system that, if preliminary assessments on the resulting price of carbon prove correct, has the potential to become the most ambitious scheme worldwide. Anyhow, the possible price cap of 90 USD/t CO_2 may still not be enough to reach the country's mitigation target by market-based measures alone.

It is therefore essential that Korea not only takes decisive steps in the implementation of the future ETS, but also strengthens actions that are not directly attributable to carbon pricing. Especially for energy efficiency, the majority of measures have a strong voluntary component that may limit effectiveness. Korea could also significantly strengthen its renewable energy commitment.

The main barrier to full implementation of the country's low-carbon development target may well be a political one, as new President Park Geun-Hye has introduced a new paradigm for Korea's economic growth, and interest in a future low-carbon economy seems to be waning within Korea.

This may also be the cause for Korea's recent cuts in funding for renewable energy projects, which will potentially hinder the implementation of renewables to the extent that is foreseen in the country's plans. Furthermore, strengthening the goal for the share of renewable energy could lead to further investment in renewable energy by the private sector in the country.

The late finalisation of the rules of South Korea's emissions trading system may lead to problems for a timely implementation of the system. There is considerable uncertainty about a possible price cap and the allocation of permits, and strong opposition by the industry.

The pricing structure for electricity in South Korea does not lend itself well to spurring more efficient energy use, as prices are lower than the actual generation cost. Also, according to recommendations by the IEA, better measurement and reporting on the great variety of measures may be needed to strengthen their overall effectiveness.

With only four years since former President Lee's declaration of ‘Low-Carbon, Green Growth’ as paradigm for Korea, it is still early to judge the long-term effectiveness of the approach. If the country continues its pace and transforms its political commitment to low carbon development into further action, Korea could be on a good way to reach its 30% vs. BAU target that has been inscribed as the country's NAMA under the UNFCCC. However, it is not yet clear if the ambitious goals set by the previous administration will be held up by the new President, Park Geun-hye, who has come into office early in 2013.

South Korea's pledge to reduce its emissions 30% below business as usual in 2020 is independent of international support. In the international dialogue on green growth and low carbon development, the country has been very vocal in the past.

As an example, former President Lee founded the Global Green Growth Institute (GGGI) in 2010. The organisation offers advice to developing countries in devising green growth strategies, seeks to provide relevant research in the field of green growth, and promotes the practical implementation of green growth plans in developing countries. Since 2012, the GGGI has been converted to an international organisation by its member governments.

Together with Germany, South Korea is also a founding member of the International Partnership on Mitigation and MRV. The Partnership is an informal institution consisting of 40 member countries, aiming at practical exchange in the field of low carbon development, NAMAs and MRV activities.

These initiatives have met with very positive feedback, and have continuously expanded their knowledge base and dialogue. They have a strong potential to provide a feedback to South

Korea, and further the implementation of its own climate strategies. The current administration under President Park can thus profit from cooperation and advice from a host of countries that may face similar barriers as South Korea.

Tab. 53: Overview of focus areas, actions and remaining barriers to tap mitigation potential

Focus area	Action undertaken to tap potential	Remaining barriers	Opportunities for international cooperation
Carbon market development	GHG Target Management Scheme in place Development of ETS, to start in 2015	 ETS rules unclear, may be weakened due to industry opposition	Further cooperation e.g. through Partnership on Mitigation and MRV, GGGI to strengthen low carbon strategies and overcome remaining barriers
Energy efficiency	Energy audits Voluntary agreements with industries Investment support Revised building codes Labelling and certification programmes	many measures voluntary lack of coordination between ministries and agencies subsidised electricity price	
Renewable energy	Offshore Wind Power Top-Three Roadmap: Investment support Renewable Portfolio Standard (RPS)	Budget cuts Effectiveness of RPS not yet clear	
Nuclear energy	Increase of nuclear energy (59% of electricity by 2030)	High cost for installation and maintenance Opposition by public Problems with security certificates	
Transport	Expansion of public transport, including public transport exclusive areas Traffic information and guidance systems Fuel efficiency standard Tax incentives, subsidies for eco-friendly cars Build-up of electric car fleet Driving tax	Need for technical expertise Opposition by public against tax raises (carbon tax, need for increased fiscal spending) Opposition against abolition of oil subsidies by beneficiaries	

9 Conclusions

9.1 Many solutions to one challenge: mitigation strategies and activities in emerging economies

Our analysis has shown that all six countries examined are taking substantial steps to mitigate greenhouse gases, and are showing considerable commitment that was thought infeasible only a few years back. By now, some are at the forefront of climate action in different respects: Mexico has one of the most comprehensive institutional and strategic settings for climate policy globally, Brazil was a frontrunner in establishing national climate funds, China has embedded it's activities fully within 'mainstream' policy making and Korea will be the first developing country with an economy wide emissions trading system.

Yet, there is no single ‘silver-bullet’ solution - the approaches for mitigation strongly reflect different national circumstances and specific challenges faced by China, India, Mexico, Brazil, South Africa and South Korea. It is challenging to devise a common conclusion from this broad selection of countries and the substantial number and variety of actions taken. Below, we summarise common themes identified and provide ideas for cooperative solutions, mutual learning, and potential for international support.

9.1.1 Strategies and high level targets

All six countries committed to pledges that have been inscribed under the Copenhagen Accord and in all countries, national strategies for low carbon development are in place, customised to national circumstances. Further results are:

- Most of the countries have developed detailed sectoral and/or subnational plans based on the national strategies. In most cases, these strategies are at least partially aligned with other government priorities or plans.
- The strategies usually focus on development, stressing additional benefits, such as the creation of national industries and social benefits for the population. Low-carbon activities are often seen as one way to progress towards these objectives.
- Adaptation strategies are often at least as important in the national plans, but are not the focus of this report.
- In line with the provisions of the Bali Action Plan, five out of the six countries based their commitments on the provision of international technical, financial and capacity support. The international community could seize this opportunity to strengthen cooperation with these countries in order to fully realise the mitigation potential available in the countries. Countries that do not explicitly seek support can still benefit from supportive measures, e.g. knowledge and capacity sharing.

9.1.2 Institutional capacities

All countries analysed have built-up institutions for climate regulation and/or coordination, often involving high level government representatives and different sector ministries, recognising the cross-cutting nature of climate change. Most countries have integrated their

climate strategies into their national policy. Some cases would benefit from further aligning climate and energy policy across the various institutions involved.

- Because climate change is a cross-cutting issue, the many public agencies/ministries with differing focuses involved can make policy coordination difficult. Vested interests by the private sector also may make it difficult to find common solutions (see also Garibaldi et al. 2013). To help address this issue, many countries have set up inter-ministerial committees to coordinate policies, which is beyond average in developing but also in developed countries.
- Institutional and human capacities present perhaps the most serious challenge across all sectors and countries covered within this report. Commitments made by high levels of governments do not necessarily translate into concrete actions, for example, due to lacking a sense of urgency, limited problem awareness in institutions and general population, untrained personnel, and technical knowledge constraints.

9.1.3 MRV of greenhouse gas emissions

All six countries have significantly improved their MRV systems for greenhouse gases in the last years, and have built-up capacities to further fine-tune their systems. MRV systems are, in many cases, under further development in scope and depth.

- On MRV, countries have strategies to address future reporting requirements under the UNFCCC; yet there is still room to further increase capacities to significantly enhance activities. Benefits can also arise from extending MRV systems that exist to monitor energy use to also cover GHG emissions.
- For the creation of inventories, different approaches are used: some countries use highly centralised systems by appointed government agencies, others contract out data gathering and processing to the research and/or private sectors.
- The countries examined all participate in international exchange on low-carbon activities: South Korea and South Africa are founding members of the International Partnership for Mitigation and MRV, all countries analysed here participate.

9.1.4 Activities on the ground

Only a few explicitly labelled 'Low Carbon Development Strategies (LCDS)' and NAMAs have been developed so far. Why this is the case may have very country specific reasons and assessing the reasoning for this was not part of this report. Yet we have identified substantial activities in every country that contribute significantly to greenhouse gas reductions.

- All countries have defined strategies that may not be necessarily labelled as low carbon strategies, but that in content represent LCDS. Most of them also cover adaptation.
- The focus of activities is highly dependent on national circumstances: For many countries, the energy sector is most important, for Brazil, for example, AFOLU is the key sector for mitigation actions.
- Good progress has been made, yet, in many cases, capacity needs exist to guarantee stronger implementation and sound coordination between different government actors and other stakeholders.

- Most countries covered in this report show considerable untapped potential from energy efficiency measures – common barriers include lack of information on cost saving benefits and distorted energy prices.
- For renewable energy activities, various barriers were identified relevant for most countries, such as low quality renewable energy technologies, insufficient grids, and limited technical capacities.

9.2 Scope for international cooperation and support

There is significant commitment to supporting low-carbon development in all target countries, yet some barriers to emissions reductions remain. The barriers that are mainly domestic in nature will have to be tackled within the national context, yet countries can take advantage of international sharing of experiences, knowledge and best practices to help to overcome these barriers. There is considerable scope for South-South learning, as countries that are successfully tackling similar domestic challenges can provide valuable lessons learned from their experience. Examples for barriers which are mainly domestic in nature and can profit from exchange are institutional constraints.

Other barriers such as capacity, technical or some financial constraints are good candidates for cooperative efforts between countries, as well as for solutions within the international climate change regime.

Several options embedded in and surrounding the UNFCCC climate change regime can be used to strengthen international cooperation and support for capacities, technology needs and finance. These can be very helpful tools to foster collaborative efforts among all countries:

- Targeted expert training, knowledge networks and information clearing houses can help alleviate some of the identified challenges. Enhancing knowledge and understanding of processes and technologies on the ground will help to successfully implement actions that are decided on the national level. With the current implementation of the Clean Technology Center and Network (CTCN) within the UNFCCC, the international community has a potentially powerful tool to overcome technical capacity barriers. The CTCN is set to share technical knowledge and to provide training for experts.
- Many financial constraints for low-carbon technologies have their roots in limited knowledge by local financial institutions that are hesitant to invest in activities that they perceive as risky. Education of local investors and finance institutions can help to alter their perception. Financial instruments used by national and international climate and development financing institutions can further soften the investment risks, such as guarantees, low-interest loans etc.

Best practices and in-depth knowledge of implementation opportunities may often be found within developing nations with comparable challenges. While in-depth knowledge of new technologies may have to be provided by developed countries, developing countries have shown considerable innovative potential for tailor-made solutions to their circumstances on the ground. The International Partnership for Mitigation and MRV is a good example of how this can work. The platform has strong potential for collaborative efforts, and already provides a sizeable knowledge base.

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10.1 Non-country specific references

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11 Annex

11.1 Additional information on Brazil

Tab. 54: Overview of UNFCCC reporting in Brazil

Reporting frequency	Initial National Communication	Completed in 2004, including inventory for 1990-1994
	Second National Communication	Completed in 2010, including inventory for 1990-2005
Scope	Initial National Communication	*Gases*: CO_2, CH_4, N_2O, HFCs, CF_4, C_2F_6, SF_6 Sectors: Energy, industrial, forestry, agricultural and livestock and waste treatment sectors
	Second National Communication	*Gases*: CO_2, CH_4, N_2O, HFCs, PFCs, SF_6 Sectors: Energy, industrial processes, solvent and other product use, agriculture, land use change and forestry (LUCF), waste
Methods used	Initial National Communication	1996 IPCC Guidelines
	Second National Communication	Revised 1996 IPCC Guidelines, Good Practice Guidance 2000, Good Practice Guidance LULUCF 2003, some estimate following 2006 IPCC Guidelines
Transparency of reporting	Initial National Communication	Available in Portuguese, English, Spanish, French Text, inventory data and underlying data on LULUCF are available online
	Second National Communication	Portuguese, English, Spanish Text, inventory data and underlying data on LULUCF are available online

Sources: (General Coordination on Global Climate Change, 2010), (Osório & Piva, 2011), (Paciornik, 2012)

11.2 Additional information on China

11.2.1 Analysis of China's UNFCCC reporting

Tab. 55: Overview of UNFCCC reporting in China

Reporting frequency	Initial National Communication	Completed in 2004, including GHG inventory for 1994
	Second National Communication	Completed in 2012, including GHG inventory for 2005

Scope	Initial National Communication	*Gases:* CO_2, CH_4, N_2O *Sectors:* Energy, industrial processes, agriculture, Land Use Change and Forestry (LUCF), waste treatment Regions Mainland China
	Second National Communication	*Gases.* CO_2, CH_4, N_2O, HFCs, PFCs, SF_6 *Sectors:* Energy, industrial processes, agriculture, Land Use Change and Forestry (LUCF), waste treatment *Regions*: China incl. Hong Kong and Macau
Methods used	Initial National Communication	Energy: For combustion related emissions combination of different approaches, for fugitive emissions Tier 2 and 3 Industrial Processes: Combination of different approaches Agriculture: Mainly Tier 1, methodology partly adapted to local circumstances LUCF: Combination of different approaches Waste: Combination of different approaches
	Second National Communication	Energy: Combination of Tier 1, 2 and 3, using 3 where data is available. Industrial processes: Tier 2 for bigger share of GHG (~95%), Tier 1 for rest Agriculture: Mainly Tier 2, some Tier 1 LUCF: Combination of different approaches Waste: Combination of different approaches
Transparency of reporting	Initial National Communication	Report submitted to UNFCCC in English and Chinese, but Chinese version includes more information. Underlying data not available
	Second National Communication	Report submitted to UNFCCC in English. Underlying data not available. Little information on methodology for emission projections. More detail in inventory than in first Communication.
Verification key features	Initial National Communication	Internal quality assessment and uncertainty analysis provided by the IPCC Good Practice Guidance
	Second National Communication	Internal quality assessment and uncertainty analysis provided by the IPCC Good Practice Guidance

11.2.2 China's MRV system for mitigation actions

Tab. 56: Overview of China's MRV system for mitigation actions

System	Statistics Indicators, Monitoring and Examination (SME) system for energy measures
Measurement	Energy production: comprehensive survey Energy circulation: for each category, relevant institutions collect data Energy consumption: data collected from industries
Reporting	Annual (progress) reports on climate policies and mitigation actions (2008-2012). Several types of reporting varying in frequency and level of detail. Annual reports include more indicators, wider statistical scope, and more statistical categories. Comprehensive reports are prepared by bureaus of statistics at provincial level.
Verification Key features	Upper-level statistics bureaus verify data from lower-level bureaus. National, provincial authorities oversee data from largest enterprises; local governments monitor other enterprises.

(Source: Climate Policy Initiative, 2012)

China began publishing regular reports on its climate policies and mitigation actions 5 years ago. The evolution of these reports show climate mitigation is becoming increasingly important to China – it is expanding the scope of its policies and measures and building capacity to track the progress and outcomes of those actions.

While the level of detail in these reports is increasing, the reports do not set out a transparent and systematic analytical framework for assessing mitigation outcomes. The data sources and methods used to assess outcomes are not presented, making it difficult to evaluate the estimated coal and emission-savings. Some of the reports provide information on government investments in many mitigation actions, however the reports do not assess the cost-effectiveness of those actions. It is unclear whether the reports and policy assessments have gone through an internal or external review process; no information on this is provided.

11.2.3 CHINA: The Statistics, Monitoring, and Examination Systems

The State Council established a target-responsibility mechanism to achieve the energy and carbon intensity reduction since the 11th FYP. This mechanism set specific goals for provincial governments and major enterprises and linked achievement of those goals to their career prospects. The Statistical Indicator, Monitoring, and Examination (SME) system was established to track enterprise, provincial, and national implementation of specific policies and programs, as well as progress towards the relevant goals. Since the low carbon policy has evolved from focusing on energy intensity to focusing on both energy and carbon intensity, the SME will follow similar suite.

The SME system was formulated by the NDRC and other relevant ministries in 2007. Three key documents provide the basis for the system:

- The Plan to implement the statistics indicators system of energy consumption per unit of GDP,
- The Plan to implement the monitoring system of energy consumption per unit of GDP, and
- The Plan to implement the examination system of energy consumption per unit of GDP.

Data Collection

The Statistics indicators system covers three areas- energy productions, energy circulation (transmission and distribution) among provinces. Energy consumed by enterprises above the statistical scale is collected using a full survey approach, and others by a sample survey (e.g. randomly selects a sample of objects), typical survey (e.g. purposefully selects a representative sample of objects) or in-depth approach (e.g. selects the most energy- using objects for data collection). Below summarizes the key features and institutions involved in the SME system.

Tab. 57: Data collection and institutions involved in SME system of China

Area	Data	Institution	Methodology	Frequency
Energy production	Coal production, coal storage, coal sales and electricity production[23]	NBS	Full survey	Quarterly
Energy circulation	Coal	CCTDA	Full survey	Quarterly
	Oil products	NBS	Full survey	Quarterly
	Crude oil	NBS	Calculation: Production: Monthly production report; Purchase: quarterly energy consumption report; Import: Custom import & export report	Respectively: Monthly Quarterly Quarterly
	Natural gas	Top 3 petroleum companies	N/A	Quarterly
	Electricity	CEC	Full survey	Monthly
	Other energy	NBS	N/A	N/A
Energy	Primary sector:	NBS	In-depth survey	Annually

[23] Those below the statistical scale (annual revenue of 5 million RMB or less) provides only coal and electricity production data.

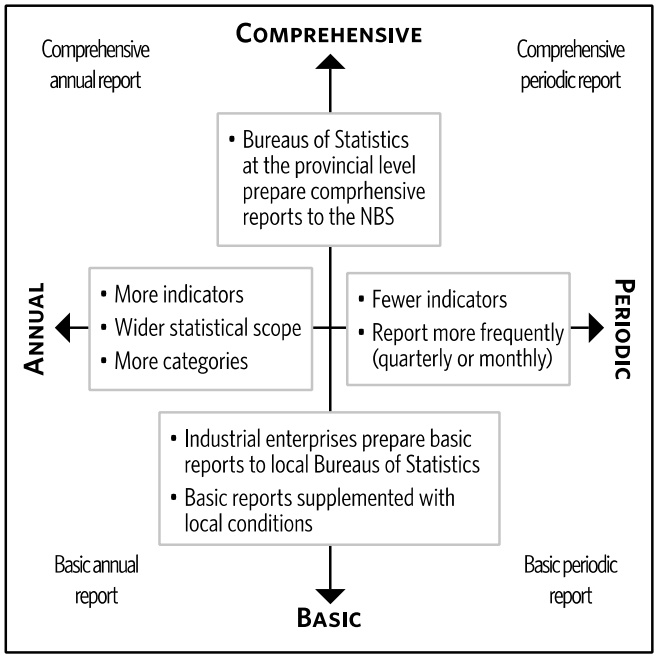
consumption	Farming, forestry, animal husbandry, fishery & water conservancy			
	Secondary sector 1: Industry (including non-energy use)	NBS	Full survey; Sample survey (below statistical scale)	Quarterly
	Secondary sector 2: Construction	MOHURD	Full survey (investigating years); Calculation (non-investigating years)	Every five years
	Tertiary sector 1: Rail, air, pipeline	MOR, local railway council, CAAC and the top 3 petroleum companies	Full survey	Quarterly
	Tertiary sector 2: Road, ship, port	NBS	Full survey (commercial enterprises); Typical survey (individuals)	Annually
	Tertiary sector 3: Catering	NBS	Full survey (big enterprises with >40 employees and annual revenue >=2 million RMB); Sample survey (Medium and small enterprises)	Quarterly
	Tertiary sector 4: Residential consumption	NBS	Sample survey	Quarterly

ANBS= National Bureau of Statistics, CCTDA= China Coal Trade & Development Association, MOC= Ministry of Commerce, CEC=China Electricity Council, MOHURD=Ministry of Housing and Urban-Rural Development, MOR=Ministry of Railway, CAAC: Civil Aviation Administration of China

Reporting

The SME reporting framework consists of four components- comprehensive annual report, comprehensive periodic report, basic annual report, and basic periodic report. Different energy users and producers reports to different agencies as indicated in the table of previous session.

Fig. 17: China: SME report types and key features



Source: Climate Policy Initiative, 2012

Verification

All levels of bureaus of statistics have been required to calculate total energy consumption, intensity per GDP and energy savings on a quarterly and annual basis since 2008. Upper level bureaus are responsible for verifying data submitted by lower levels. Data calculated by bureaus of statistics are cross-checked with data submitted by the top 1000 enterprises (those entities with an annual energy consumption of 180,000 tce and more). The data from top 1000 enterprises is overseen by the NBS and provincial energy management authorities, while local governments monitor data of other enterprises.

The process of verifying provincial energy saving data has two steps: (1) each province submits self-evaluation report to the NDRC, (2) the NDRC forms an expert team to perform an on-site examination and cross check the result with data provided by NBS. The first step happens before the end of March while the second step by the end of May. After the evaluation team finishes onsite verification, the NDRC and NBS aggregate data and prepare annual reports, submitted to the State Council for approval. Finally the NDRC publishes the reports on its website and the State Council decides rewards and penalties according to the provinces' completion of their targets.

To ensure the quality of GDP data, three groups of indicators are used:

- Indicators related to the level of GDP (e.g. share of citizen saving increase in GDP, share of various taxes in value-added of secondary and tertiary sector);
- Indicators related to the growth rate of GDP (e.g. the growth rate of taxes, the growth rate of loans, or of house disposal income per capita);
- Indicators related to the value-added of the tertiary sector.

To justify the amount of total energy consumption and to cross check with each province's self-submitted data, local bureaus of statistics check the following five indicators:

- The share of electricity in total energy use;
- The share of energy consumed by enterprises above the statistical scale in total energy use;
- Transformation efficiency of thermal power, heating supply, coal washing, coking, petroleum refining, and gas works;
- The growth rate of energy consumed by the primary, secondary, and tertiary sectors respectively and the corresponding growth rate of each sector's value-added; and
- Production volume of main products, as well as energy consumption per product.

11.2.4 Overview of LCDS policy framework in China

Tab. 58: Overview of UNFCCC reporting in China

Five Year Plans	Set by State Council Approved by NPC	11th Five Year Plan (2005-2010) 12th Five Year Plan (2011-2015)
Climate Change Programmes Energy/Environment Policies	Set by State Council Implemented by NDRC and other ministries	National Climate Change Assessment (2006) The National Climate Change Programme (2007) The General Work Plan for Energy Conservation and Pollutant Emission Reduction (2007) White Paper "China's Policies & Actions for Addressing Climate Change" (2008) Annual progress reports (2009-2012) 12th FYP Work programme for Energy Saving and Emission Reduction Comprehensive (2011) 12th FYP Work programme for Controlling GHG Emissions (2011) Special Plan of the National Response to Climate Change 2011-2020 (2012) National Strategy of Climate Change Adaptation (2012) Decision to Strength the Climate Change Work programme (2012)
National level programs	Administrated by ministries and delegated to provinces and industries	China's Scientific and Technological Actions On Climate Change (2004) National Science and Technology Plan for Climate Change (2007) Middle/Long Term programme of Renewable Energy Development (2007) Sectorial plans (e.g. renewables, iron and steel, building materials, electricity, coal, petroleum, chemicals, nonferrous metals, textiles, food, paper, transportation, railway, construction) (2011-2012) Five Provinces Eight Cities Low Carbon Pilot programme (2011)

		Ten Cities and A Thousand Cars Electric Vehicles programme (2011) Pilots for Fiscal Policy for Energy Saving and Emission Reduction (2011) Carbon Emission Trading System Pilot programme (2011) Top 1,000 Enterprises programme (2011) 2nd round Low Carbon Province/City Pilot programme (2012) ...
Regional/sectorial programs and policies	Administrated at provincial, local and industrial levels	Established provincial CC coordination groups and 4 provinces complete climate change plans (2007) All provinces complete climate change plans (2009) Jiangxi and Xiamen city establish climate change monitoring and assessment centres (2009) Over half provinces complete their energy saving and emission reduction work plans (2011) ...

11.3 Additional information on India

Tab. 59: Overview of UNFCCC reporting in India

Reporting frequency	Initial National Communication	Completed in 2004, including GHG inventory for 1994
	Second National Communication	Completed in 2012, including GHG inventory for 2000 and 2007
Scope	Initial National Communication	Gases: CO_2, CH4, N20 Sectors: Energy, industrial processes, agriculture, Land Use Change and Forestry (LUCF), waste treatment divided in 29 source categories
	Second National Communication	Gases. CO_2, CH4, N20, HFCs, PFCs, SF6 Sectors: Energy, industrial processes, agriculture, Land Use Change and Forestry (LUCF), waste treatment divided into 55 source categories

Methods used	Initial National Communication	Energy: For combustion related emissions combination of different approaches, for fugitive emissions Tier 3 Industrial Processes: Combination of different approaches Agriculture: Mainly Tier 1 LUCF: Tier 2 Waste: Tier 1 General: mostly Tier I approach (7% of total CO_2e. emissions were made using Tier III); emission factors: default are used from IPCC and 26% of source categories used country specific EF
	Second National Communication	Energy: Combination of Tier 1 and 2 Industrial processes: Tier 1 and 2 Agriculture: Mainly Tier 3, some Tier 1 and 2 LUCF: Tier 2 Waste: Tier 1 and 2 General: 12% of CO_2eq emissions assessed using Tier III approach; 35% of source categories used country specific emission factor
Transparency of reporting	Initial National Communication	Report submitted to UNFCCC in English. Underlying data not available
	Second National Communication	Report submitted to UNFCCC in English. Underlying data not available. Little information on methodology for emission projections. More detail in inventory than in Initial National Communication.
Verification key features	Initial National Communication	Internal quality assessment
	Second National Communication	Internal quality assessment plus third party review, Uncertainty analysis using Tier I approach presented as per the methodology in the IPCC 2000 Good Practice Guidance

Tab. 60: Relevant Institutions and functions in India

Institution	Function relating to climate change
Prime Minister	Chair of MCCC, proposes new legislation
Parliament	Proposes and approves framework legislation
Ministry of Environment and Forest (MoEF)	Implementation of NAPCC, planning, promoting, coordinating and overseeing the implementation of environmental and forestry policies and programmes
Ministry of Finance	Member of MCCC, allocates resources
Sector specific Ministries (e.g. Agriculture, Energy etc.)	Member of MCCC, sector specific implementation of NAPCC

Planning Commission	Member of MCCC, facilitates the Five Year Plan and allocates resources
State/Region/City governments	Regional implementation of NAPCC, independent regulations
Indian Network for Climate Change assessment (INCC)	Network of scientists to assess drivers and implications of climate change in India, set up the Greenhouse Gas Inventory Programme
Ministerial council on Climate Change (MCCC)	Reviews progress of missions of the NAPCC, members are: key stakeholders (Government, Industry and Civil Society) , guidance for international negotiations
Expert group on Low Carbon Strategy for inclusive Growth	Scientific support; review existing studies on low carbon development in India; prepare report and conduct further analysis if necessary; reports to Planning Commission

Tab. 61: The missions of the National Plan on Climate Change in India

Mission	Main Objective	Responsible institution
National Solar Mission	Create enabling policy framework for the deployment of 20,000 MW of solar power in 2022 Promote programmes for off grid applications, reaching 1000 MW by 2017 and 2000 MW by 2022 15 million m^2 solar thermal collector are in 2017 and 20 million in 2022 Deploy 20 million solar lighting systems for rural areas in 2022	Ministry of New & Renewable Energy
National Mission for Enhanced Energy Efficiency	Four programmes: Perform achieve and trade Market transformation for energy efficiency Energy efficiency financing platform Energy efficient economic development	Ministry of Power
National Mission for Sustainable Habitat	Energy efficiency in residential and commercial building (Building Code), public transport, solid waste management	Ministry of Urban Development
National Water Mission	Water conservation, river basin management, minimize waste	Ministry of Water Resources
National Mission for Sustaining the Himalayan Ecosystem	Conservation and adaptation practices, glacial monitoring	Ministry of Science and Technology
National Mission for a Green India	Double the area to be taken up for afforestation/ eco-restoration in the next 10 years Increase GHG removals by forests to 6.25% of Indias annual total GHG emissions by the year 2020	Ministry of Environment & Forests
National Mission for Sustainable	Drought proofing, risk management,	Ministry for Agriculture

Agriculture	agricultural research	
National Mission on Strategic Knowledge for Climate Change	Vulnerable assessment, Research and observation, data management	Ministry of Science and Technology

11.4 Additional information on Mexico

Tab. 62: Overview of UNFCCC reporting in Mexico

Reporting frequency		5 National Communications to the UNFCCC so far: 1997, 2001, 2006, 2009 and 2012. The 5th National Communications contains an inventory 1990 - 2010
Methods used	5th NatCom	Mainly IPCC 1996 tier 1 methodology with default emission factors with some exceptions: Solid waste - 2006 tier 2; other waste categories - 2006 tier 1; methane emissions from cattle, buffalo and pigs - 1996 tier 2 country specific emission factors; enteric fermentation for cattle, buffalo and pigs - country specific emission factors; energy emissions from transport and commercial/residential sector - 1996 tier 1&2; energy emissions from energy industry and manufacturing & construction - 1996 tier 1&2; NO_x - 1996 tier 3
	1st NatCom	No detailed overview provided. Methodologies prepared by the Intergovernmental Panel on Climate Change (IPCC), Organization for Economic Cooperation and Development (OECD) and the International Energy Agency (IEA) was used.
Coverage	5th NatCom	CO_2, CH_4, N_2O, HFCs, PFCs, SF_6
	1st NatCom	CO_2, CH_4, N_2O, CO, NO_x, NMVOC
Reporting: data availability		The submission of the National Communication is normally in Spanish with an Executive Summary in English. Only the 3rd National Communication was translated fully into English. The 1st National Communication is available in English in a draft version. Information on methodologies used and underlying data has increased over time, although for example country specific emission factors used in some categories in the latest NC are not provided. Detailed data is available for the last inventory year only (within the NC). The submitted inventory remains mainly at aggregate reporting levels (second level) and only shows individual years, not complete time series.

11.5 Additional information on South Africa

Tab. 63: Overview of UNFCCC reporting in South Africa

Reporting frequency	Initial National Communication	Completed in 1998, including GHG inventory for 1990 and 1994
	Second National Communication	Completed in 2011, , including GHG inventory for 2000; Inventory report online available (including data for 1990, 1994, 2000)

Scope	Initial National Communication	*Gases:* CO_2, CH_4, N_2O *Sectors:* Energy, industrial processes, agriculture, Land Use Change and Forestry (LUCF), waste treatment (according to IPCC 1996)
	Second National Communication	*Gases.* CO_2, CH_4, N_2O, PFCs only for aluminium production, (SF_6 and HFCs not estimated) *Sectors:* (1) Energy, (2) Industrial processes & productive use (IPPU), (3) Agriculture, Forestry, and Land Use (AFOLU), (4) Waste (according to IPCC GL 2000) Data access was key challenge, some sectors have been omitted due to missing or inappropriate data (like electronics industry, health sector and some IP activities)
Methods used	Initial National Communication	IPCC Guidelines 1996 Energy: For electricity generation, specific emission factors used, supplied by Eskom (Tier 2). Specific SA emission conditions for fugitive emissions of coal mining For the rest default values of IPCC GL 1996 (Tier 1) Industrial Processes: Emission factors determined by SA industry used for emissions from the production of aluminium and ammonia. For all other process emissions, IPCC default values were used. Agriculture: Specific emission factors for CH_4 of livestock (Tier 2),
	Second National Communication	IPCC Guidelines 2006 (mainly) Tier 1 approach predominantly used with IPCC default factors due to aggregated data sources; Only for some specific sub-categories more specific emission factors were available and Tier 2 used (details in inventory report) Energy: Tier 1; except Road Transport (Tier 2 for y2000); improved methods for fugitive emissions (higher than NC1) and inclusion of CtL Industry: Mainly Tier 1, hardly any country-specific factors AFOLU: Livestock (IPCC GL 1996 applied until NDA will complete sector inventory (NC2); Forestry Tier 1 except plantation categories (Tier 2); Biomass burning (Tier 2)
Transparency of reporting	Initial National Communication	Report submitted to UNFCCC in English. Summarized details on emission factors were given as well as information on estimate, quality, disaggregation and documentation
	Second National Communication	Report submitted to UNFCCC in English. The detailed inventory report is also online available.
Verification key features	Initial National Communication	No details found
	Second National Communication	GHG inventory: SA validation & verification process for "GHG assertions" according to ISO standards for data documentation (p. 10/11, DEA 2011a). QA/QC according to IPCC GL 2006 intended for next inventory. For 2000 inventory data evaluation rather on basis of expert cross-checking. Verification of industry emissions is done by external consultant (in CDP), but no official coordination or standardized guidelines.

11.6 Additional information on South Korea

Tab. 64: Overview of UNFCCC reporting in Korea

National Communication	1st NC KOR/COM/1 B	2nd NC KOR/COM/2 B	3rd NC 3 KOR/COM/3 E
Reporting frequency	Publication date 12/02/1998 GHG inventory data for 1990 (90-95 for 1A, Energy-related emissions)	Publication date 01/12/2003	Publication date 01/01/2012 GHG inventory data for up to 2009
Responsible institution	MOTIE (Energy and Resources Policy Division)	MKE (coordination) KEEI (Korea Energy Economics Institute)	MOE (overall coordination) GIR
Methods used		IPCC GL 1996, Tier 1, Tier 2 for emissions from Power generation, aviation, PFC, SF_6 and enteric fermentation	IPCC GL 1996, Tier 2 for majority and own EF/Parameters; GPG 2000 and GPG-LULUCF 2003; IPCC GL 2006 and Tier 1 for single subsectors (e.g. Biological treatment); → details not included in NC
Coverage: Gases, sectors	CO_2, CH_4, N_2O and indirect greenhouse gases (NOx, CO, and NMVOC)	6 Kyoto gases CO_2, CH_4, N_2O, HFCs, PFCs, SF_6	6 Kyoto gases CO_2, CH_4, N_2O, HFCs, PFCs, SF_6
Transparency of reporting			Inventory data (of annual NIR) summarized, but details not given in NC; NIR not available in English
Verification Key features			National GHG Committees and technical groups (see list above) ensure verification of factors & data used QA (internal and by foreign experts); QC internal and by GIR; BUT no details or underlying data given in NC3; NIR published only in Korean
Key category Analysis			Performing in accordance with GPG2000 with Tier 1 method, Level assessment and trend assessment