Ethiopia's Climate-Resilient Green Economy

green economy strategy

Federal Democratic Republic of Ethiopia
Environmental Protection Authority

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List of abbreviations

B5	5% biodiesel content of transport diesel
BAU	Business-as-usual (scenario)
BRT	Bus-rail transit
CAPEX	Capital expenditure or investment rather than a cost
CDM	Clean Development Mechanism of the Kyoto Protocol
CEM IV/B	Grade IV cement
CFL	Compact florescent lights
CO_2	Carbon dioxide, the most important greenhouse gas
CO_2e	Carbon dioxide equivalent
COP	Conference of the Parties, the annual summit of UNFCCC
CRGE	Ethiopia's Climate-Resilient Green Economy initiative
CCS	Carbon capture and storage
CSA	Central Statistical Authority
E15	15% ethanol content of transport gasoline
EDRI	Ethiopian Development Research Institute
EEPCo	Ethiopian Electric Power Corporation
EIAR	Ethiopian Institute of Agricultural Research
EPA	Environmental Protection Authority
ETS	European Trading Scheme
EWCA	Ethiopian Wildlife Conservation Authority
FAO	Food and Agriculture Organisation
FDI	Foreign Direct Investment
FES	Fuel efficiency standards
FRC	Forestry Research Centre
GDP	Gross domestic product
GGGI	Global Green Growth Institute
GHG	Greenhouse gases (mainly CO_2, N_2O, and methane)
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GoE	Government of Ethiopia
Gt	Gigatonne (i.e., billon metric tonnes)
GTP	Growth and Transformation Plan
GVA	Gross value added
Ha	Hectare (ha)
IBC	Institute of Biodiversity Conservation
IPCC	Intergovernmental Panel on Climate Change
KWh	Kilowatt hour of electricity

LPG	Liquefied petroleum gas
LRT	Light-rail transit
MIC	Middle income country
MoA	Ministry of Agriculture
MoFED	Ministry of Finance and Economic Development
MoI	Ministry of Industry
MoT	Ministry of Trade
MoUDC	Ministry of Urban Development and Construction
MoWE	Ministry of Water and Energy
MRV	Measuring, reporting, and verification
MSC	Ministerial Steering Committee of CRGE initiative
Mt CO_2e	Million metric tonnes of carbon dioxide equivalent
Mt	Megatonne (i.e., million metric tonnes)
NAMA	Nationally appropriate mitigation action
N_2O	Nitrous oxide, a greenhouse gas
NGO	Nongovernmental organisation
NPV	Net Present Value
OPC	Ordinary Portland Cement
Opex	Operating expenditure or cost
PASDEP	Plan for accelerated and sustained development to end poverty
PPC	Pozzolana Portland Cement
Q1/Q2/ Q3/Q4	First/second/third/fourth quarter of the year
REDD+	Reducing Emissions from Deforestation and Forest Degradation
RELS	Reducing Emissions from the Livestock Sector
R-PP	Readiness Preparation Proposal
STC	Sub-Technical Committee of CRGE initiative
t	Tonne
TC	Technical Committee of CRGE initiative
TCO	Total cost of ownership
TWh	Terawatt hour of electricity (tera = one trillion)
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
WBISPP	Woody Biomass Inventory and Strategic Planning Project

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"Ethiopia's historical contribution to greenhouse gas emissions on a global scale has been negligible and the country will not be forced to prejudice future growth and wellbeing by restricting emissions "

Foreword

Ethiopia is experiencing the effects of climate change. Besides the direct effects such as an increase in average temperature or a change in rainfall patterns, climate change also presents the necessity and opportunity to switch to a new, sustainable development model. The Government of the Federal Democratic Republic of Ethiopia has therefore initiated the Climate-Resilient Green Economy (CRGE) initiative to protect the country from the adverse effects of climate change and to build a green economy that will help realise its ambition of reaching middle-income status before 2025.

Since February 2011, the CRGE initiative, under the leadership of the Prime Minister's Office, the Environmental Protection Authority, and the Ethiopian Development Research Institute, has been developing a strategy to build a green economy. Seven sectoral teams involving more than 50 experts from more than 20 leading government institutions have been driving the initiative. The objective is to identify green economy opportunities that could help Ethiopia reach its ambitious growth targets while keeping greenhouse gas emissions low. The government intends to attract development partners to help implement this new and sustainable growth model.

This report summarises the findings of the CRGE initiative, and particularly focuses on outlining the plan to develop a green economy. The document does not cover climate resilience, which will be added over the coming months. This strategy has been extensively discussed during the previous two months of regional and sectoral consultations to ensure national alignment on priorities, confirm initial findings, create awareness, and join forces. This document reflects the work of the CRGE initiative as well as the outcome of the consultation process.

Addis Ababa, November 2011

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"in a worst case scenario, in 25 years time, Ethiopia will have only half the potential total GDP it could have attained and this will be because of the impacts of climate change"

Technical note

This strategy is based on the data and sources of information available to the sub-technical committees as of August 2011. The BAU projections and calculation of abatement potential and abatement cost follow a consistent methodology as described in the appendix. As most of the calculations are performed on a sectoral level, they do not necessarily follow specific project-level protocols of setting baseline emission scenarios and abatement outcomes, as is for example done in the context of carbon finance schemes. Rather, the BAU calculations should be understood as a strategic emission projection against which the sectoral mitigation programmes are drafted. The sectoral mitigation initiatives and the associated costs should be understood as an initial identification and estimation of sectoral abatement potential and a base for strategic decisions regarding their implementation and required support. Although they form part of an overall strategy in building a climate-resilient green economy, and the government is committed to creating a supportive environment for them, the individual initiatives should not be understood as immediately mandatory government policies.

Executive summary

Ethiopia aims to achieve middle-income status by 2025 while developing a green economy. Following the conventional development path would, among other adverse effects, result in a sharp increase in GHG emissions and unsustainable use of natural resources. To avoid such negative effects, the government has developed a strategy to build a green economy. It is now starting to transform the strategy into action and welcomes collaboration with domestic and international partners.

The vision: Achieve middle-income status by 2025 in a climate-resilient green economy

Both the government and the International Monetary Fund expect Ethiopia's economy to continue as one of the world's fastest growing over the coming years. Building on its positive recent development record, Ethiopia intends to reach middle-income status before 2025. As set forth in the Growth and Transformation Plan (GTP), reaching this goal will require boosting agricultural productivity, strengthening the industrial base, and fostering export growth.

As a responsible member of the world, Ethiopia is also aware of the important role that developing countries play in fighting climate change, and has consequently taken on a constructive role in international climate negotiations. Ethiopia's ambition to become a "green economy front-runner" is an expression of its potential for and belief in a sustainable model of growth.

The challenge: To achieve economic development goals in a sustainable way

If Ethiopia were to pursue a conventional economic development path to achieve its ambitious targets, the resulting negative environmental impacts would follow the patterns observed all around the globe. Under current practices, greenhouse gas (GHG) emissions would more than double from 150 Mt CO_2e in 2010 to 400 Mt CO_2e in 2030. Its development path could also face resource constraints: for example, it could reach the carrying capacity for cattle. Furthermore, it could lock its economy into outdated technologies.

A conventional development path could also be financially challenging. For example, a significant share of GDP might need to be spent on fuel imports, putting pressure on foreign currency reserves.

Finally, according to the GTP, more than USD 50 billion will be needed over the coming five years for infrastructure development. More than 50% will have to be in foreign currency. Current and projected domestic savings and foreign direct investments, grants, and transfers will not be sufficient to finance these investments, leading to a significant finance gap.

The plan: To follow a green growth path that fosters development and sustainability

The Climate-Resilient Green Economy (CRGE) initiative follows a sectoral approach and has so far identified and prioritised more than 60 initiatives, which could help the country achieve its development goals while limiting 2030 GHG

emissions to around today's 150 Mt CO_2e – around 250 Mt CO_2e less than estimated under a conventional development path. The green economy plan is based on four pillars:

1. Improving crop and livestock production practices for higher food security and farmer income while reducing emissions
2. Protecting and re-establishing forests for their economic and ecosystem services, including as carbon stocks
3. Expanding electricity generation from renewable sources of energy for domestic and regional markets
4. Leapfrogging to modern and energy-efficient technologies in transport, industrial sectors, and buildings.

For more than 80% of the abatement potential, abatement costs are less than USD 15 per t CO_2e.[1] Many of the initiatives offer positive returns on investments, thus directly promoting economic growth and creating additional jobs with high value-added.

Building the green economy requires an estimated total expenditure of around USD 150 billion over the next 20 years. By developing a green economy, we could exchange GHG emissions abatement for climate finance to fund some of the required investment.

Implementing the initiatives would also offer important co-benefits. For example, it would improve public health, through better air and water quality, and would promote rural economic development by increasing soil fertility and food security.

Making it happen: The action plan to create a green economy

We have developed a strategy for transforming our ambition into reality. Under the leadership of Prime Minister Meles Zenawi, our government has dedicated significant resources to the inter-ministerial CRGE initiative. More than 50 experts from 20 leading governmental institutions were engaged in seven committees, directed by an inter-ministerial steering group.

As part of the strategy, the government has selected four initiatives for fast-track implementation: exploiting the vast hydropower potential; large-scale promotion of advanced rural cooking technologies; efficiency improvements to the livestock value chain; and Reducing Emissions from Deforestation and Forest Degradation (REDD). These initiatives have the best chances of promoting growth immediately, capturing large abatement potentials, and attracting climate finance for their implementation. To ensure a comprehensive programme, initiatives from all other sectors will also be developed into concrete proposals.

The CRGE initiative also outlines the structure of a permanent institutional setup to drive implementation, and to promote the participation of a broad set of stakeholders.

We are dedicating significant resources to building our green economy. To capture the full potential of our plan, we welcome emerging climate finance schemes, which will compensate developing countries for the provision of environmental services to the world. Bi- and multilateral development partners as well as the private sector can help us achieve our ambitious goals.

1 USD 15 per t roughly equals the price of carbon credits under the European Trading Scheme in 2011.

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The vision:

Achieve middle-income status by 2025 in a climate-resilient green economy

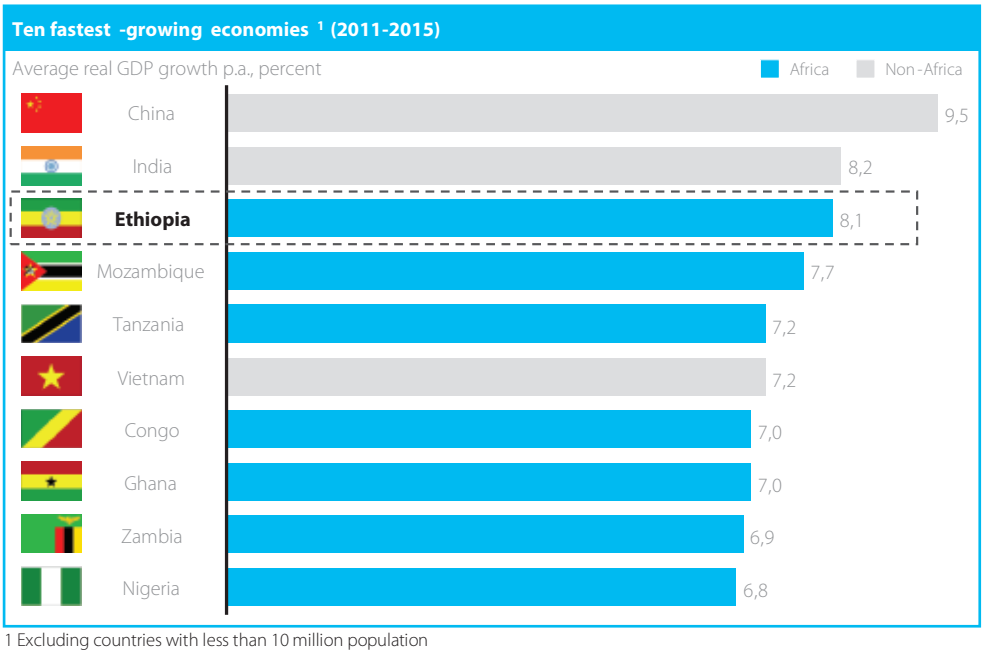
Economically, Ethiopia is one of the world's fastest-growing countries. Building on its positive recent development, it intends to reach middle-income status before 2025. It aims to do so by building a green economy.

Economically, Ethiopia is one of the world's fastest-growing countries

Despite the challenges of being one of the world's poorest countries, Ethiopia has good prospects for growth. The International Monetary Fund forecasts for Ethiopia a real gross domestic product (GDP) growth of more than 8% p.a. over the next five years. Among countries with more than 10 million inhabitants, only China and India will grow at a faster pace (Figure 1). The government is even more optimistic and it projects a growth rate of 11%.

Figure 1

Over the coming years, Ethiopia will continue to be one of the world's fastest-growing countries



1 Excluding countries with less than 10 million population

SOURCE: IMF; The Economist

Ethiopia's recent track record demonstrates that it can achieve double-digit growth rates. Between 2005 and 2010, the country's real GDP grew by 11% p.a., with the service sector accounting for the highest growth (15%), agriculture for more than 8%, and industrial development falling slightly short of expectations (the actual growth rate was 10% rather than being in the expected range of 11 to 18%). This economic success has multiple drivers. A 15% expansion of agricultural land and a 40% yield increase account for growth in the agricultural sector over the last five years. Major export products include coffee, sesame-seed, leather, flowers, and gold, and Ethiopia is the 10th largest producer of livestock in the world. Over the same five-year period, Ethiopia managed to significantly improve infrastructure, more than doubling electric power generation capacity, increasing the capacity of the telecommunication network from 0.5 million users to 25 million, opening 40 new federal roads, and adding more than 11,000 kilometres of road to the existing network.

To support its growth, Ethiopia has managed to attract more foreign investment. Foreign investment has increased from less than USD 820 million in 2007/08 to more than USD 2 billion in the first half of the 2010/11 fiscal year. Among other factors, this is a result of a comparably good investment climate as measured by various indicators: the World Bank's 2011 ***Doing Business*** report ranks Ethiopia's overall

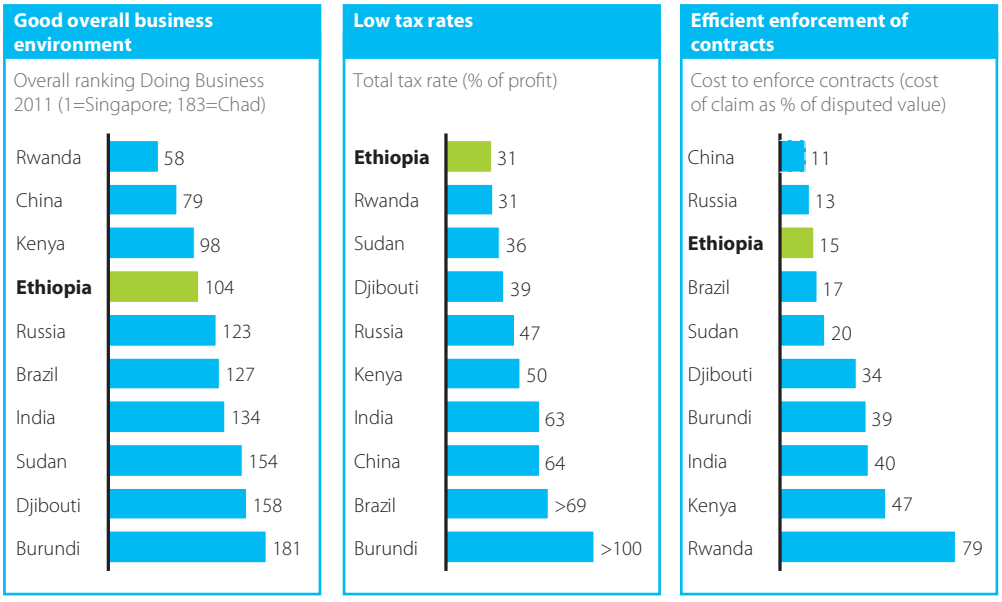
business environment as better than that of Brazil or India, for example. Ethiopia also received higher marks for criteria such as the business tax rate and enforcement of contracts (Figure 2).

Ethiopia must continue to grow: with a GDP per capita of around USD 380, Ethiopia is still one of Africa's poorest countries. Ethiopia's economy is not diversified enough: agriculture and the service sector each contribute more than 40% to GDP, and 80% of employment is still concentrated in agriculture. Because of its small manufacturing sector, the economy is not yet in a position to absorb significant increases in productivity in agriculture. Ethiopia's trade deficit amounts to almost 20% of GDP: while exports of merchandise account for around 4%, goods worth more than 23% of GDP have to be imported (2009/10). In particular, to sustain its high growth rate, Ethiopia relies heavily on imports of oil, cement, and other primary goods.

Figure 2

Ethiopia provides a favorable environment for investments even compared with BRIC countries

Comparison with BRIC and East African countries



SOURCE: Doing Business 2011

Ethiopia has set the target of reaching middle-income status before 2025

Building on the positive development of recent years, Ethiopia intends to reach middle-income status (GDP per capita of around USD 1,000)[2] within 15 years.

Boosting agricultural productivity and strengthening the industrial base will be essential to reach this goal.

Ethiopia's Growth and Transformation Plan (GTP) is an ambitious development plan that lays out growth, development, and industrialisation targets up to 2015. It reflects the government's ambition to lift the country to middle-income status by 2025.

2 World Bank classifies economies according to 2009 gross national income per capita, calculated using the World Bank Atlas method. Lower middle income starts at USD 996. This report uses GDP per capita equaling USD 1000 to define middle income. 2009 GDP per capita and gross national income per capita in Ethiopia differ by 5%.

Capital (and largest city):
Addis Ababa | 9°1.8 'N 38°44.4 'E

Profile of Ethiopia

The population – With more than 80 million inhabitants (2010), Ethiopia is the most populous nation in Eastern Africa and the second-most populous in Africa after Nigeria. The average age of the population is 17 years. With an annual population growth of more than 2%, Ethiopia will have more than 120 million people by 2030. Orthodox Christians (>40%) and Muslims (~35%) peacefully live side-by-side in this multi-ethnic country. Altogether there are around 80 different ethnic groups today. While only 17% of the Ethiopians live in urban centers, nearly half of them live in the capital, Addis Ababa.

The geography – Ethiopia is a land of natural contrasts. It stretches over more than 1.1 million square kilometers and has a wide variety of climate zones and soil conditions. Large parts of the country are at high altitude; Addis Ababa is at an elevation of more than 2000m. With the Afar depression, Ethiopia also features one of the lowest points of the continent. Ethiopia is a landlocked country with sea-access primarily via its neighbour, Djibouti.

Politics – Ethiopia is a Federal Democratic Republic that is currently being ruled by the Ethiopian People's Revolutionary Democratic Front (EPRDF) party. Prime Minister Meles Zenawi heads the government and was re-elected for a five-year term in 2010.

To meet the middle-income target, the base case outlined in the GTP sets the following rates of growth for the period 2010-2015: GDP has to increase by more than 10% p.a., exports need to grow from 14% of GDP to 23%, and the domestic savings rate from 5.5% to 16%. These high rates are based on the following sectoral projections for the same five-year period:

- Agricultural development will continue to be the basis for economic growth. The overall targeted growth rate for the sector is 8.6%. Production of major food crops (e.g., teff, wheat, maize) is targeted to increase from 19 million tonnes to 27 million tonnes. Fruit and vegetable production is projected to increase fourfold to 5 million tonnes. This implies increasing crop productivity from 19 quintal per hectare to 22. The total value of coffee exports, by far the most important cash crop, is to increase from USD 0.5 billion today to more than USD 2 billion in 2015, while the export of live animals is projected to grow from USD 0.1 billion to USD 1 billion.
- Development of the industrial sector is crucial to reach the GTP targets. The GTP projects that the industrial sector will grow at a rate of 20% p.a. or twice the annual increase achieved over the last five years. The GTP expects the industry sector's share of the GDP to rise from 13% to 19% within five years, while the service sector remains at around 45%. To reach these targets, light manufacturing must be significantly scaled up. The GTP assumes foreign currency earnings

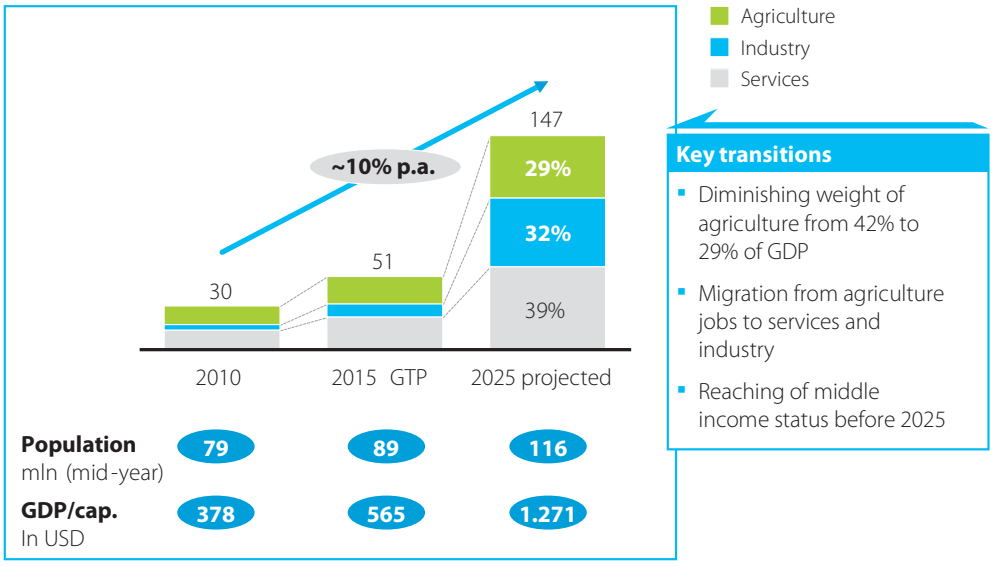
from textiles to increase from USD 22 million to USD 1 billion in 2015. Over the same period, cement production is to increase by a factor of 10, and the market share of domestically produced pharmaceutical and medical products from 15% to 50%.

To achieve middle-income status before 2025, these five-year growth rates must be sustained for 15 years. The growth will result in a significant shift in GDP shares: In 2025, agriculture would contribute only 29% to the GDP, industry 32%, and services the remaining 39% (Figure 3).

Figure 3

GTP and long term targets translate into a transition of the Ethiopian economy

GDP, billion USD



Source: GoE GTP; EDRI

The GTP explicitly addresses the sustainability of growth: "Environmental conservation plays a vital role in sustainable development. Building a 'Green Economy' and ongoing implementation of environmental laws are among the key strategic directions to be pursued during the plan period." (GTP, 2011: p. 119).

The challenge:

Realise economic development goals in a sustainable way

If Ethiopia were to pursue a conventional economic development path to achieve its ambition of reaching middle-income status by 2025, GHG emissions would more than double from 150 Mt CO2e today to 400 Mt CO2e in 2030. Ethiopia's development could result in unsustainable use of natural resources, in being locked into outdated technologies, and in losing an ever-increasing share of GDP to fuel imports. Ethiopia would lose the opportunity of making its development sustainable.

Regardless of whether the development path is a conventional or sustainable one, Ethiopia faces a critical challenge in attracting the investment needed to support the projected growth. Current and expected domestic savings and foreign direct investments, grants, and transfers will not be sufficient to fund these investments.

Conventional economic development would more than double GHG emissions

Ethiopia's contribution to GHG emissions is very low on a global scale. However, the projected environmental impact of conventional economic development in Ethiopia risks following the pattern observed around the globe. If current practices prevail, GHG emissions in Ethiopia will more than double from 150 Mt CO_2e to 400 Mt CO_2e in 2030. On a per capita basis, emissions are set to increase by more than 50% to 3.0 t CO_2e – and will thus exceed the global target to keep per capita emissions between 1 t and 2 t per capita in order to limit the negative effects on climate change.

Current level and sectoral breakdown of emissions

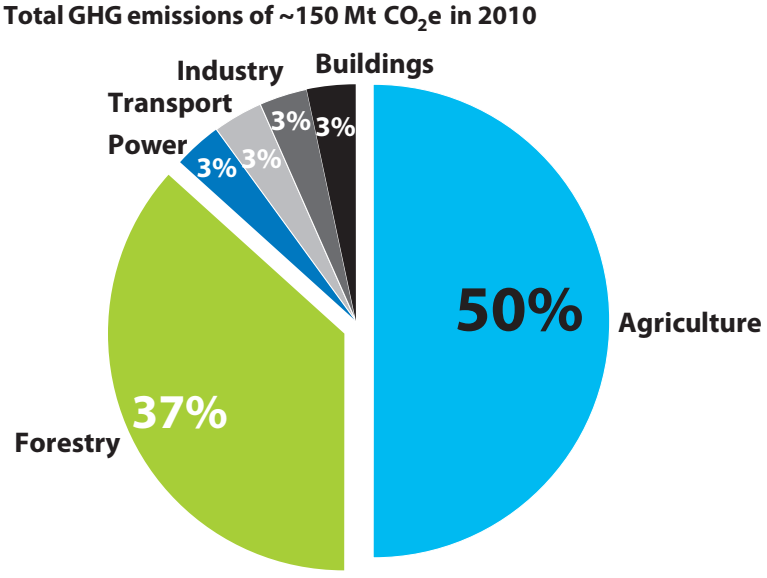
Ethiopia's current contribution to the global increase in GHG emissions since the industrial revolution has been practically negligible. Even after years of rapid economic expansion, today's per capita emissions of less than 2 t CO_2e are modest compared with the more than 10 t per capita on average in the EU and more than 20 t per capita in the US and Australia. Overall, Ethiopia's total emissions of around 150 Mt CO_2e represent less than 0.3% of global emissions.

Of the 150 Mt CO_2e in 2010, more than 85% of GHG emissions came from the agricultural and forestry sectors. They are followed by power, transport, industry and buildings, which contributed 3% each (Figure 4).

Figure 4

More than 85% of GHG emissions in Ethiopia come from forestry and agriculture

Share of GHG emissions, 2010



Major sources of emissions within agriculture and forestry:

- In **agriculture**, GHG emissions are attributable to livestock and crops in that order. The current cattle population is more than 50 million and other livestock nearly 100 million. Livestock generate greenhouse gases mainly in the form of methane emissions arising from digestion processes and nitrous oxide emissions arising from excretions. Livestock emissions are estimated to amount to 65 Mt CO_2e in 2010 – more than 40% of total emissions today. The cultivation of crops contributes to the concentration of greenhouse gases mainly by requiring the use of fertiliser (~10 Mt CO_2e) as well as by emitting N_2O from crop residues reintroduced into the ground (~3 Mt CO_2e).
- In **forestry**, the impact of human activities is a large source of CO_2 emissions amounting to almost 55 Mt CO_2e in 2010. Forestry emissions are driven by deforestation for agricultural land (50% of all forestry-related emissions) and forest degradation due to fuelwood consumption (46%) as well as formal and informal logging (4%).

Minor sources of emissions today are transport, power, industry, and buildings, as described below.

- In **transport,** ~75% of the emissions come from road transport, particularly freight and construction vehicles, and to a lesser extent private passenger vehicles. Air transport also contributes a significant share (23% of transport-related emissions). Emissions from inland water transport are minimal.
- The **electric power** sector only accounts for very low emissions as it is largely based on renewable energy, with hydro power accounting for more than 90% of total power generation capacity, supplemented by the use of on- and off-grid diesel generators administered by the Ethiopian Electric Power Corporation (EEPCo). Current emissions in the energy sector amount to below 5 Mt CO_2e or a share of 3% of the country's total emissions. (The global average for electric power generation's share of a country's GHG emissions is more than 25%.)
- Given the comparably small share of organised industrial economic activity overall, **industry** accounts for only 3% of GHG emissions. At nearly 2 Mt CO_2e or 50% of the 4 Mt CO_2e emissions from industry, cement is the single-largest industrial source of emissions, followed by mining (32%), and the textile and leather (17%) industry. Emissions from steel, other types of engineering, the chemicals industry (incl. fertiliser), pulp and paper industry and food processing together account for only around 2% of industrial GHG emissions.
- **Buildings** contribute around 5 Mt CO_2e or 3% to today's emissions. Main drivers are emissions related to solid and liquid waste (3 Mt of CO_2e) and the use of private off-grid power generators in cities (2 Mt of CO_2e).

Change of GHG emissions with time under business-as-usual scenario

In conventional paths to growth, GHG emissions are both strongly and positively correlated with economic development and population growth. Therefore the ambitious growth targets as well as the projected increase of the population will lead to higher emissions if the conventional growth path is followed. The CRGE initiative has estimated the expected development of GHG emissions from these sectors based on the current model of economic development. This development is represented in the Business-as-usual (BAU) scenario.

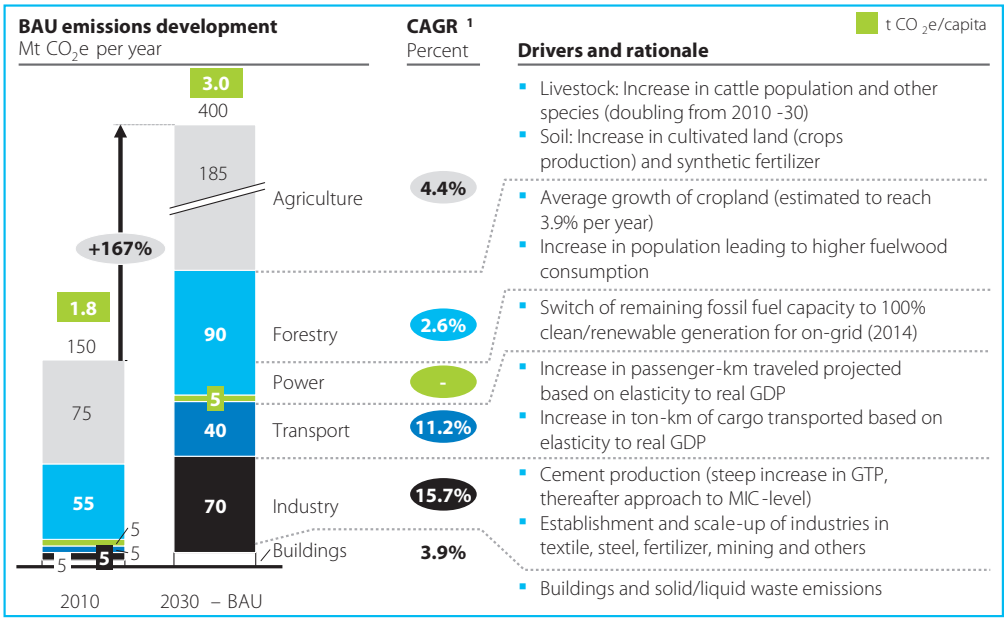
Definition of the business-as-usual scenario – The business-as-usual (BAU) estimation of GHG emissions forms the baseline for the development of a green economy strategy. The estimation answers the question: how would domestic GHG emissions develop if no actions to limit emissions were taken? The BAU is thus not the most likely and definitely not the desired scenario, but a theoretical case assuming a country would act as if there were no need for a sustainable growth agenda, because of the absence of either economic interest or funding. The main assumption in developing a BAU baseline is that a country is acting only in its economic self-interest. Actions to reduce or prevent emissions are therefore only included in the BAU baseline if they are already under development or they represent the economically most viable and feasible option. Ethiopia's BAU assumes that power generation will continue to be largely based on hydropower and other renewable energies. The two main drivers of BAU emissions are typically economic and population growth and – to a lesser extent – urbanisation.

It should be noted that the BAU in this strategy is calculated as an emissions trajectory following the overall approach described here. Hence, it does not follow specific project-level protocols of setting baseline emission scenarios, e.g., for carbon finance schemes. Rather, the BAU should be understood as a strategic emission projection against which the sectoral mitigation action programmes are drafted.

The results of the BAU estimate show that the current pathway for economic development will increase GHG emissions from 150 Mt CO_2e today to 400 Mt in 2030 – an increase of more than 150% (Figure 5). On a per capita basis, emissions are projected to increase from 1.8 t today to 3.0 t in 2030. In absolute terms, the highest increase – adding around 110 Mt CO_2e in GHG emissions – will come from agriculture, followed by industry at 65 Mt and forestry at 35 Mt. In relative terms, the emerging industrialisation will manifest itself in an annual emission increase of more than 15% from the industrial sector and around 11% from transport. Industry emissions under BAU assumptions are therefore projected to increase more than 12-fold, while transport emissions are projected to increase 7-fold.

Figure 5

If a typical development path were followed, emissions would increase from 150 Mt to 400 Mt (2010 to 2030)



1 Compound average growth rate

Main drivers for this projected development are:

- **Agriculture**
  - Livestock – The cattle population is expected to increase from close to 50 million today to more than 90 million in 2030. This will increase emissions from 65 Mt CO_2e today to almost 125 Mt in 2030.
  - Soil – Agricultural crop production will increase from around 19 million tonnes today to more than 71 million tonnes in 2030. This is primarily due to the increased fertiliser usage and an increase in land used for agriculture. This will increase emissions from 12 Mt CO_2e today to more than 60 Mt in 2030.
- **Forestry**
  - Deforestation leads to CO_2 emissions, and is mostly caused by the conversion of forested areas to agricultural land. Emissions are projected to grow from 25 Mt CO_2e in 2010 to almost 45 Mt in 2030.
  - Forest degradation leads to CO_2 emissions, and is primarily caused by fuelwood consumption and logging in excess of the natural yield of the forests, with the major driver being population growth. Emissions are projected to grow from around 25 Mt CO_2e in 2010 to almost 45 Mt in 2030.
- **Electric power** – The power sector in Ethiopia is an exception as it is the only sector in which emissions will stay very low. Emissions are projected to remain below 5 Mt CO_2e in the BAU scenario. The total power demand is projected to grow from 4 TWh in 2010 to more than 75 TWh in 2030. EEPCo plans to switch off current diesel power plants and off-grid generators in 2012-2014 (according to its master plan) and to generate power exclusively from clean or renewable sources from 2015 onwards. Residential off-grid fossil fuel based generation in rural areas will account for the only remaining emissions. By basing electricity generation almost exclusively on renewable energy, Ethiopia is avoiding emissions of around 50 Mt CO2e (2030) as compared to the electric power sectors in neighbouring countries.
- **Transport** – Emissions from transport are projected to grow from around 5 Mt CO_2e in 2010 to 40 Mt CO_2e in 2030. The increased emissions are driven first by higher emissions from freight transport (+13% p.a.) and also by higher emissions from passenger transport (+9% p.a.).
- **Industry** – Industries are expected to grow at annual rates of up to 20%. Output from the largest industrial GHG emitter, cement production, is projected to increase from 2.7 Mt of cement today to 27 Mt in 2015 and more than 65 Mt in 2030. The industry sector shows the highest emission growth rates of all sectors, as its output is rapidly growing and its processes are very emission intense: Overall industrial emissions are projected to grow by 16% p.a. from 4 Mt CO_2e today to 71 Mt in 2030.
- **Buildings** – An increasing urban population drives increasing waste generation and (off-grid) energy consumption. Total buildings-related emissions are expected to increase from 5 Mt CO_2e today to 10 Mt in 2030, with around 25% of the emissions in 2030 related to off-grid energy consumption, 75% to waste.

Current development path would lead to further challenges

Besides increasing GHG contributions to global emissions, rapid economic growth will lead to other challenges, if not carefully managed and planned.

- It may jeopardise the very resources it is based on and lead to unsus-tainable levels of use (i.e., preventing the current generation from pass-ing on an equivalent level of resources to the next generation): The combination of growing demand for agricultural products and inefficient agricultural practices may result in an over-exploitation of natural resources. In the period 2001-2009, cropland increased at a ratio of 0.7 ha of deforestation for 1 ha of cropland. Assuming a decrease of this ratio to 0.55 ha by 2030, and a cropland increase from 12.6 million ha today to 27 million ha in 2030, this would require the deforestation of nearly 9 million ha of forest

land. Furthermore, with a projected increase in the cattle population from more than 50 million today to more than 90 million in 2030, Ethiopia will reach its overall cattle-carrying capacity within 20 years and put additional pressure on forests for expansion of grazing land.

- It would bind significant resources and put pressure on foreign currency reserves as fossil fuel demand – already today more than 4% of GDP, which roughly equals the foreign currency and gold reserves[3] – would increase to around 7% of GDP in 2030.
- It would lead to a lock-in into outdated technologies if Ethiopia continues to import technologies that have the lowest upfront investment requirements – for example, outdated second-hand technologies in the cement sector.

Beyond the economic impact, the conventional development path would lead to a lower quality of life and health problems, for example, from air polluting exhaust from old and inefficient vehicles and the inhalation of fuelwood smoke due to inefficient cooking technologies.

Funding not readily available for investments required to reach growth targets

Funding the investments required to support the projected growth will be a challenge. Even in the conventional scenario, the country will need more than USD 50 billion over the coming five years for infrastructure development – more than 50% of which will need to be in foreign exchange. The development of power infrastructure alone will require almost USD 38 billion over the next 20 years, the development of water supply and sanitation infrastructure requires USD 1.2 billion p.a. (World Bank, 2011: p. 18).

Ethiopia's current savings-investment gap is large. While the country expects to invest 27.5% of GDP over the coming five years, average domestic savings will equal only 11.9%. The projected levels of foreign direct investment, grants, and transfers will not be sufficient to fund the required additional investments. Moreover, 55% of the investment will be denominated in foreign currency, requiring a large inflow of international capital.

Consequently, finance mobilisation is identified in the GTP as one of the major constraints on economic development: 'Low mobilisation of domestic financial resources was another implementation challenge encountered' (GTP, 2010: p. 19). Mobilising private international capital will play a fundamental role, but public finance – such as climate finance – can also contribute significantly to close the funding gap. Attracting international capital will not be easy. International competition for scarce capital increases the challenges for least-developed countries in accessing such funding.

The capital constraint is also an immediate threat to sustainable growth: Infrastructure development projects required for economic growth, especially for transport and power supply infrastructure, have high capital costs and long lives. Many existing carbon-inefficient solutions – such as road transport as opposed to rail transport – often require less upfront investment than their low-carbon alternatives. Capital-constrained developing countries such as Ethiopia are often inclined to invest in low-CAPEX alternatives and thereby lock themselves into solutions that are inefficient and ultimately less sustainable, although more climate-compatible alternatives exist and might offer higher social and economic benefits in the long run.

3 Source: Economy Watch, foreign currency and gold reserves figure for 31 December 2009

crgestrategy

While building its resilience, Ethiopia will also take steps to ensure that its economy is green and sustainable. To do this, we will seize the opportunities presented by low carbon technologies and invest in green industries.

The plan:

Follow a green growth path that fosters development and sustainability

Ethiopia has the ambition to develop along a green economic trajectory. It has consequently outlined a strategy to build this green economy. So far, it has identified and prioritised more than 60 initiatives that could help the country to achieve its economic development goals while at the same time limiting net GHG emissions in 2030 to below today's 150 Mt CO_2e – around 250 Mt CO_2e less than estimated for the current development path (BAU). Building a green economy will lead to further socio-economic benefits and allow Ethiopia to tap climate finance.

The ambition is to build a green economy

Political leaders worldwide realise the need for immediate and effective action to respond to climate change. These responses include actions to reduce GHG emissions as well as adaptation initiatives to reduce the vulnerability of the population and the economy to the effects of climate change. At the same time, leaders – especially in developing countries – have the obligation to promote economic development to improve living standards. Achieving economic development goals requires significant funds and binds a large share of government capacity. If climate change mitigation and adaptation are seen as goals in conflict with economic development, they risk being de-prioritised and under-funded.

It is to avoid such conflicts, that the Climate-Resilient Green Economy (CRGE) initiative was started in 2011, giving the initiative three complementary objectives:

- Fostering economic development and growth
- Ensuring abatement and avoidance of future emissions, i.e., transition to a green economy
- Improving resilience to climate change.

Building a green economy – which is in the focus of this strategy – offers an opportunity to achieve its economic development targets sustainably. It represents the ambition to achieve economic development targets in a resource-efficient way that overcomes the possible conflict between economic growth and fighting climate change. This would be achieved by emphasising good stewardship of resources and seizing opportunities for innovation based on the latest production platforms ("leapfrogging" to the newest and best technology rather than reproducing each evolutionary stage undergone by already-developed economies). Building a green economy should thus result in the creation of a competitive advantage out of a focus on the sustainable use of resources and a higher productivity growth.

The government is aware of the important role that developing countries play in fighting climate change. They represent a large share of the world's GHG abatement potential and they can therefore be essential contributors to limiting global warming to 1.5 degrees Celsius compared to the beginning of industrial age. Consequently, Prime Minister Meles Zenawi has taken a leading role in the international climate negotiations. He is co-chairing the High-Level Advisory Group on Climate Change Financing of the United Nations Framework Convention on Climate Change's (UNFCCC). Addis Ababa is part of the C40, a group of 40 large cities committed to tackling climate change.

The ambition to build a green economy is grounded in the country's potential for and belief in a sustainable growth model for developing countries. Ethiopia has already followed a relatively green and sustainable development path, and most of the power generated in the country already comes from renewable sources, mainly hydropower.

The development of a green economy will be based on four pillars

The CRGE initiative follows a sectoral approach and aims at overcoming the challenges of developing a green economy. This strategy focuses on four pillars that will support Ethiopia's developing green economy:

- Adoption of agricultural and land use efficiency measures
- Increased GHG sequestration in forestry, i.e., protecting and re-establishing forests for their economic and ecosystem services including as carbon stocks
- Deployment of renewable and clean power generation
- Use of appropriate advanced technologies in industry, transport, and buildings.

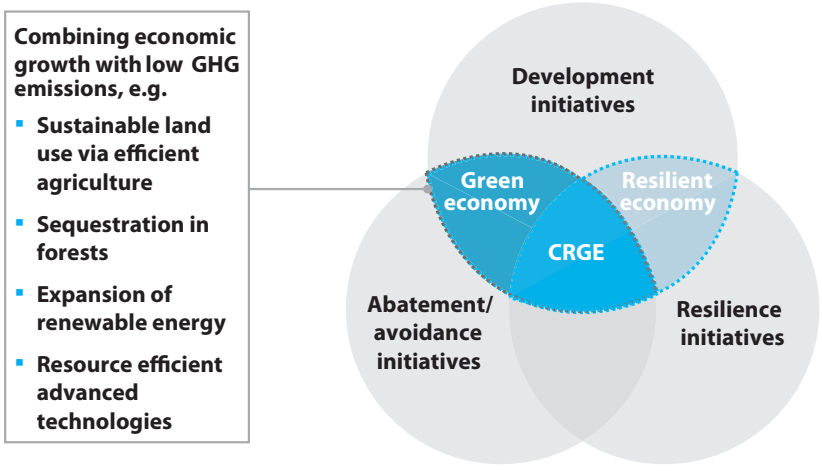
Establishing these pillars within the relevant parts of the economic development plan will prevent the

economy from being locked into an unsustainable pathway and can help to attract the investment required for their development (Figure 6).

The CRGE initiative analysed 150 potential green economy initiatives across seven sectors, taking into account their potential to simultaneously enable/support the country in reaching its GTP targets and reduce/avoid GHG emissions in a cost-efficient way. Current development practices were compared and contrasted with alternatives that have proven successful elsewhere as well as with green economy options newly developed and adapted to the Ethiopian situation. The long list of initiatives that was generated has been rigorously assessed to select and prioritise those that can form a green economy programme for Ethiopia.

Figure 6

Developing a green economy requires the integration of economic development and GHG abatement/avoidance



Green economy can help to avoid lock-in in old technologies, unsustainable growth and land use

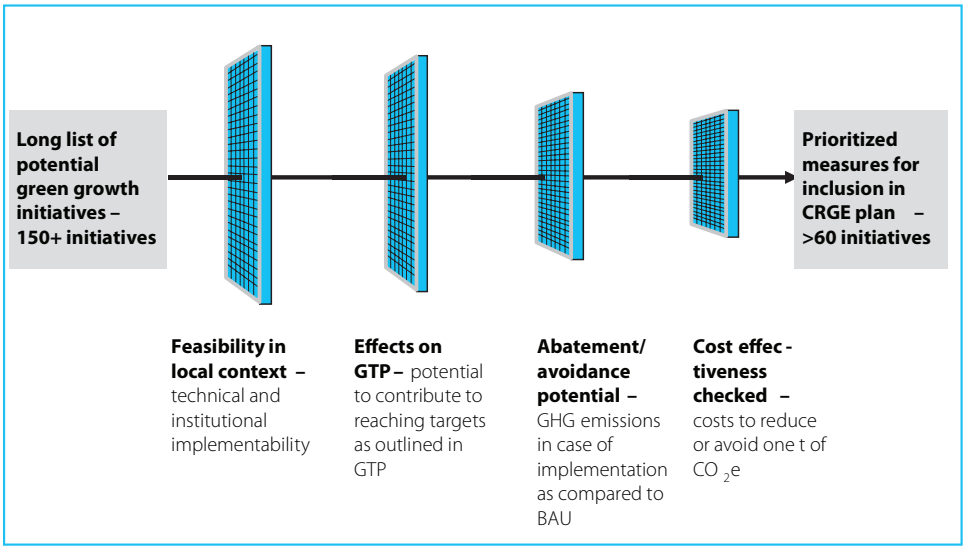
For an initiative to be retained as a 'prioritised measure' within the green economy plan, the following criteria had to be met:

- Pass an initial assessment of relevance and feasibility to be implemented in the local context,
- Enable a positive contribution to reaching the targets of the GTP,
- Provide significant abatement potential at reasonable cost for the respective sectors.

More than 60 priority initiatives, split across the seven different sectors passed this test based on the analyses made by the CRGE initiative. For each sector, at least three initiatives are available (Figure 7).

Figure 7

150 potential green growth initiatives were screened, >60 have been shortlisted for inclusion in the CRGE strategy



Each of these initiatives will support one or several of the four pillars of the green economy mentioned above, and will complement existing programmes and policy measures aiming at increasing resource efficiency.

The following sections give an overview of all four pillars. A detailed account of each of the individual initiatives is given in the appendix.

Agriculture: Improving crop and livestock production practices for higher food security and farmer income while reducing emissions

Well into the foreseeable future, agriculture will remain the core sector of the economy and provide employment for the vast majority of. Sustained high growth rates of the agricultural sector – the GTP projects more than 8% over the next five years – are needed not only to increase household income of most families, but also to provide food security for a growing population and support the growth of direct exports of agricultural products and/or the establishment of more light manufacturing, which often requires agricultural input.

The traditional economic development path could deliver the required growth, but at the cost of significant agriculture land expansion (inducing pursuing and accelerating deforestation), soil erosion, and higher emissions as well as at the risk of reaching the limits to further development, e.g., by exceeding the carrying capacity for cattle of Ethiopia.

Building a green economy will require an increase the productivity of farmland and livestock rather than increasing the land area cultivated or cattle headcount. In order to offer a viable alternative to the conventional development path without foregoing growth in the short term and significant advantages thereafter, a set of initiatives has been identified that can provide the required increase in agricultural productivity and resource efficiency.

The CRGE initiative has prioritised the following initiatives to limit the soil-based emissions from agriculture and limit the pressure on forests from the expansion of land under cultivation:

- Intensify agriculture through usage of improved inputs and better residue management resulting in a decreased requirement for additional agricultural land that would primarily be taken from forests,

- Create new agricultural land in degraded areas through small-, medium-, and large-scale irrigation to reduce the pressure on forests if expansion of the cultivated area becomes necessary,
- Introduce lower-emission agricultural techniques, ranging from the use of carbon- and nitrogen-efficient crop cultivars to the promotion of organic fertilizers. These measures would reduce emissions from already cultivated areas.

To increase the productivity and resource efficiency of the Livestock sector, the following initiatives have been prioritised:

- Increase animal value chain efficiency to improve productivity, i.e., output per head of cattle via higher production per animal and an increased off-take rate, led by better health and marketing,
- Support consumption of lower-emitting sources of protein, e.g., poultry. An increase of the share of meat consumption from poultry to up to 30% appears realistic and will help to reduce emissions from domestic animals,
- Mechanise draft power, i.e., introduce mechanical equipment for ploughing/tillage that could substitute around 50% of animal draft power, which – despite burning fuels – results in a net reduction of GHG emissions.
- Manage rangeland to increase its carbon content and improve the productivity of the land.

These initiatives offer the combined benefit of supporting economic growth, increasing farmers'/ pastoralists' income and limiting emissions and should be integrated into the plan of activities for implementing the transformation plan under development by the Ministry of Agriculture.

Forestry: Protecting and re-establishing forests for their economic and ecosystem services, including as carbon stocks

Deforestation and forest degradation must be reversed to support the continued provision of economic and ecosystem services and growth in GDP. Fuelwood accounts for more than 80% of households' energy supply today – particularly in rural areas. Furthermore, forests contribute an estimated 4% to GDP through the production of honey, forest coffee, and timber. They also provide significant and precious eco-system services: they protect soil and water resources by controlling the discharge of water to streams and rivers, preserve biodiversity, function as a carbon sink, clean the air to create important health benefits, and boost land fertility.

Despite their economic and environmental value, Ethiopian forests are under threat. The growing population requires more fuelwood and more agricultural production, in turn creating needs for new farmland – both of which accelerate defor-estation and forest degradation. Projections indicate that unless action is taken to change the traditional development path, an area of 9 million ha might be deforested between 2010 and 2030. Over the same period, annual fuelwood consumption will rise by 65% – leading to forest degradation of more than 22 million tonnes of woody biomass.

Besides the agricultural initiatives to reduce the pressure on forests (see above), the CRGE initiative has prioritised two strategies that could help to develop sustainable forestry and reduce fuelwood demand:

- Reduce demand for fuelwood via the dissemination and usage of fuel-efficient stoves and/or alternative-fuel cooking and baking techniques (such as electric, LPG, or biogas stoves) leading to reduced forest degradation,
- Increase afforestation, reforestation, and forest management to increase carbon sequestration in forests and woodlands. These initiatives would result in an increased storage of carbon in Ethiopia's forests, provide a basis for sustainable forestry, and even allow the forestry sector to yield negative emissions, i.e., store more carbon in growing forests than are emitted from defor-estation and forest degradation.
- Promoting area closure via rehabilitation of degraded pastureland and farmland, leading to enhanced soil fertility and thereby ensuring additional carbon sequestration (above and below ground).

Power: Expanding electricity generation form renewable energy for domestic and regional markets

Electricity is a fundamental enabler of modern economic development, from powering cities and fuelling industrial activity to pumping water for irrigation purposes in agriculture. If not adequately scaled up to support economic development, it also risks becoming a fundamental bottleneck to growth. To support economic development at an annual growth rate of more than 10% that the government aspires to, it is necessary to expand electric power supply at a rate of more than 14% per year.

Ethiopia is endowed with ample natural resources to meet this demand, primarily by exploiting its vast potential for hydro, geothermal, solar and wind power – all of which would deliver electricity at virtually zero GHG emissions. If adequately captured, the projected power supply could even exceed the growing domestic demand: while the demand is projected to be nearly 70 TWh in 2030, energy efficiency measures exists to decrease the demand by 19 TWh. Hence, increasing the supply and at the same time maximizing energy efficiency offers the possibility to export clean energy to neighbouring countries. These exports, in turn, provide the opportunity to replace electric power generated from fossil fuels, which has significantly higher average costs and significantly higher emissions.

Developing the necessary electric power capacity from renewable energy will be an enormous challenge as the pace of growth required is high. The total investment in expanding electric power generation capacity through 2030 would be approximately USD 38 billion over 20 years or around USD 2 billion annually. This requires a doubling of the current expenditure of USD 1 billion, which could be achieved via a combination of tariff adjustments and the attraction of private capital, climate finance and sovereign wealth funds. The latter could be obtained by exporting clean energy to neighbouring countries and capturing a share of the monetisation of their reduced emissions or by mobilising international assistance in the form of grants.

Taken together, the generation of clean and renewable electric power also allows for green development of other sectors of the economy, such as the replacement of trucks by electric rail or diesel pumps by electric pumps for irrigation. Moreover, via electricity exports, Ethiopia can share its green development to other countries in the region while contributing positively to its trade balance. By basing electricity generation almost exclusively on renewable energy, Ethiopia is avoiding emissions of around 50 Mt CO2e (2030) as compared to the electric power sectors in neighbouring countries.

Transport, industrial sectors and buildings: Leapfrogging to modern and energy efficient technologies

A short planning horizon as well as the lack of required funds for expensive technologies often lead to the adoption of technologies that require the lowest upfront investment. However, these technologies are usually less resource efficient, hence offering lower economic, social, and environmental benefits than alternative technologies in the medium to long term.

The **transport** sector is a prime example of this. The total cost for export shipments, for example, could be significantly reduced by revamping the railway connecting Addis Ababa with the seaport of neighbouring Djibouti. However, maintaining the road connecting both cities in good condition requires much less capital investment than revamping the railway. Shifting transport from road to rail would not only decrease transport costs and improve the trade balance through reduced import of fossil fuels (economic benefits), but would also lower emissions, congestion, air pollution, and traffic accidents (social and environmental benefits).

The government sees the opportunity to gear the development of the transport sector to contribute to a sustainable development pathway. Therefore, it plans to:

- Introduce stricter fuel efficiency standards for passenger and cargo transportation and promote the purchase of hybrid and electric vehicles to counter the low efficiency of the existing vehicle fleet
- Construct an electric rail network – powered by renewable energy – to substitute road freight transport
- Improve urban transport in Addis Ababa by introducing urban electric rail, and enabling fast and efficient bus transit
- Substitute imported fossil fuels with domestically produced biodiesel and bioethanol.

The urban population is expanding at 4.4% annually, and will surpass 30 million people by 2030. Rapid growth of cities will require large scale investment in urban infrastructure, including the development of management systems for solid and liquid waste, two of the largest sources of emissions in this sector. Off-grid fossil fuel energy use (e.g., diesel generators, kerosene lamps) is the largest source of GHG emissions in the **buildings** sector in 2010, but the rise of inexpensive electricity generated from renewable energy will help to curtail the growth of this emissions source. The three major green economy initiatives identified in this sector are:

- Accelerated transition to high efficiency light bulbs for residential, commercial, and institutional buildings
- Use of landfill gas management technologies (e.g., flaring) to reduce emissions from solid waste
- Reduction of methane production from liquid waste.

Among the **industrial** sub-sectors, cement will be one of the fastest growing, also causing the vast majority of GHG emissions from the industry sector. Output will increase tenfold from 2.7 Mt in 2010 to 27 Mt in 2015. Some cement factories use outdated technology that is not only energy inefficient, but also causes high emissions from the production process. The CRGE initiative has identified a series of initiatives that could help to increase the competitiveness of the cement industry by reducing production cost and – at the same time – would yield significant environmental and health benefits:

- Improved energy efficiency of the process by converting the technology used from dry to precalciner kilns and from rotary to grate coolers and by introducing computerized energy management and control systems, which can decrease the energy demand and hence the cost of and emissions from cement production
- Substitution of clinker by increasing the pumice content leading to a decrease in both variable production costs and emissions
- Increased share of biomass in the mix of energy for production in cement factories, potentially decreasing costs and emissions

Although the cement sub-sector has been highlighted in this report because it represents the most GHG emitting industry and its GHG abatement initiatives have high chances of implementation, the government will take action to put the other industrial sub-sectors also on a sustainable economic development path. The textile, leather, and fertiliser industries are important parts of the envisaged economic development model. The government aims to promote – among other initiatives – energy efficiency and the usage of alternative fuels in these sub-sectors. Further initiatives have also been identified for the steel, chemicals, and mining sub-sectors.

Building a green economy offers cost-efficient abatement potential while promoting GTP targets

Ethiopia's green economy offers GHG abatement potential of nearly 250 Mt domestically. Of the total abatement opportunities, more than 80% cost less than 15 USD per ton. Adopting the green economy path promotes socio-economic targets such as rural development, health, and the creation of employment in high value-added production.

Ethiopia's green economy offers GHG abatement potential of 250 Mt to the global community

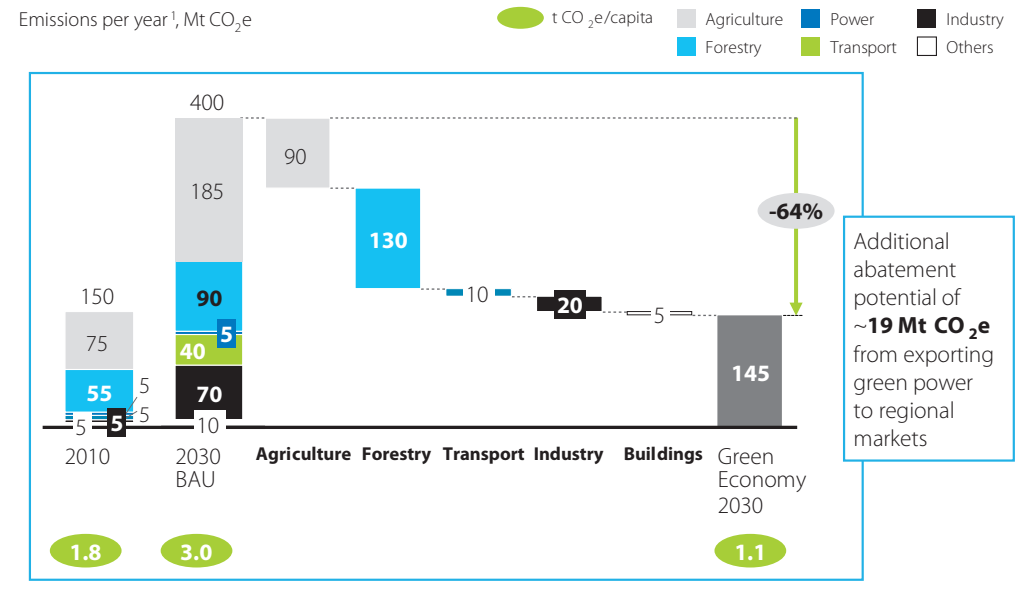
The priority initiatives that form the foundation of the green economy concept could help to curb the increase in the global emissions projected in the BAU scenario. While contributing to reaching economic and social development targets, we have the domestic potential to contribute to the global effort by abating around 250 Mt CO_2e in 2030 as compared to conventional development practices – this equals a decrease in GHG emissions of up to 64% compared to BAU in 2030. [4] Given the projected population growth, emissions on a per capita basis would decrease from 1.8 t of CO_2e to 1.1 – a decrease of around 35% – while multiplying GDP per capita from USD 380 to more than USD 1,800.

Ethiopia and the global community have finite human, technological, and financial resources. The CRGE strategy must make choices about the levers not only to capture a large share of the abatement potential but also to boost economic and social development at the same time.

Two sectors – agriculture and forestry – should receive particular attention: they contribute around 45% and 25% respectively to projected GHG emission levels under business-as-usual assumptions and together account for around 80% of the total abatement potential (Figure 8).

Figure 8

CRGE implementation could ensure a low carbon economic development pathway, decreasing per capita emissions by 60%



1 Rounded numbers
2 Currently estimated emissions form buildings and waste

The magnitude and relative importance of the initiatives identified to reduce GHG emissions vary significantly. The following section gives a brief overview of the abatement potential identified (in Mt CO_2e abatement potential in 2030 as compared to the BAU level of emission). Table 1 and Table 2 display the key assumptions that were taken to project the abatement potential in each sector. A more detailed account on assumptions and calculations can be found in the appendix.

4 More GHG abatement available beyond the one of the initiatives considered in the low carbon scenario through afforestation, reforestation and forest management on additional land. However, this comes with incremental costs and more stringent requirements on land use management across the different needs through the country.

Table 1: Core assumptions for abatement initiatives (1/2)

Sectors	Abatement levers	Core assumptions (2030)	Gross abatement potential, Mt CO2e
Forestry[1]	• Fuelwood - efficient stoves	• Household reach2 (million): 15.7/0.3	**34.3**
	• LPG stoves	• Household reach2 (million): 0/0.3	**0.6**
	• Biogas stoves	• Household reach2 (million): 1.0/0.1	**2.3**
	• Electric stoves and mitads	• Household reach2 (million): 1.0/up to 4.9	**14.0**
	• Afforestation/Reforestation	• Area in million ha: 2 (A) and 1 (R)	**32.3**
	• Forest Management (forest/ woodland)	• Area in million ha: 2 (F) and 2 (W)	**9.7**
Soil[3]	• Lower - emitting techniques	• Household reach2: 13.2/0.0	**40.1**
	• Yield increasing techniques	• Only 1.7% growth in cropland needed under intensification to achieve 9.5% crops GDP growth due to 3.5% yield growth and 4.0% crops value growth	**27.2**
	• Irrigation	• Area in million ha: 1.4 (large scale); 0.3 (small scale)	**10.6**
Livestock	• Value chain efficiency	• Household reach2: 19.5/0.0	**16.1**
	• Enhancing diversification of animal mix	• Target share of chicken: 30%	**17.7**
	• Mechanisation	• Household reach2: 13.2/0.0	**11.2**
	• Pastureland improvement	• Area in million ha: 5	**3.0**

1 Initiatives for reduced deforestation (agricultural intensification and irrigation) stated under soil based levers
2 Household reach for rural / urban households
3 Abatement potential from reduced deforestation (agricultural intensification and irrigation) counted under forestry sector

Forestry in 5 million ha of forest and 2 million ha of woodland alone represents around 50% of the total domestic abatement potential (or 130 Mt CO_2e) and, as a sector, can even yield 'negative emissions' via sequestration, i.e., storage of carbon in the form of wood, at a level that surpasses emissions from deforestation and forest degradation. The single most important lever is to reduce demand for fuelwood through fuelwood efficient stoves, offering a potential of almost 35 Mt CO_2e reduction, while other advanced cooking and baking technologies (electric, biogas, and LPG stoves) offer an additional combined potential of more than 15 Mt CO_2e. Capturing this abatement potential requires the switch of more than 20 million households to more efficient stoves. In addition, afforestation (2 million ha), reforestation (1 million ha), and forest management (2 million ha of forests and 2 million ha of woodlands) can help to increase sequestration by more than 40 Mt CO_2e and hence even surpass any remaining emissions from the forestry sector. Pressure from agriculture on forests can be reduced by agriculture intensification on existing land or unlocking degraded land thanks to irrigation, with the potential to lower deforestation and thus the associated emissions by nearly 40 Mt CO_2e in 2030.

- The **agriculture** sector has a total abatement potential for soil- and livestock-related emissions of 90 Mt CO_2e, representing around 35% of the total domestic abatement potential
  - **Soil.** The introduction of lower-emitting techniques, such as conservation agriculture

(including applying zero or minimum tillage), watershed management, and nutrient and crop management, could reduce emissions by 40 Mt CO_2e in 2030. The introduction and enhancement of these lower-emitting techniques will form a priority for the soil sector in the coming years and the initiative will target 75% of rural households by 2030. Moreover, through agricultural intensification and capture of new agricultural land in arid areas through irrigation, techniques from crop production help to increase the abatement potential from saved forests. In fact, these initiatives increase the sequestration from forests by 38 MT CO_2e in 2030.

- **Livestock.** There is ample potential to increase the efficiency of the cattle value chain via higher productivity of cattle (for both meat and milk) and an increased off-take rate (decreasing the age at which livestock are sold). Several initiatives would fall underneath this umbrella, including improving the market infrastructure, health facilities, and feeding for livestock. This could reduce emissions by more than 15 Mt CO_2e in 2030. Furthermore, a partial shift towards lower-emitting sources of protein – e.g., poultry – could yield another emission reduction of nearly 20 Mt CO_2e, assuming the share of chicken in the protein mix will change from 15 to 30%. Finally, the mechanisation of draft power, i.e., the introduction of mechanical equipment for ploughing/tillage, could help to substitute about 50% of animal draft power and lower emissions by more than 10 Mt CO_2e in 2030, while the improvement of pastureland lowers emissions by 3 Mt CO_2e in 2030.

Table 2: Core assumptions for abatement initiatives (2/2)

Sectors	Abatement levers	Core assumptions (2030)	Gross abatement potential, Mt CO2e
Power	• Clean power exports	• Domestic surplus capacity: 28 TWh • Substitution of power generation at carbon intensity of 0.7 kg CO2e/kWh	**19.3**[1]
Industry (cement only)	• Clinker substitution (e.g. by pumice)	• Share of additives: 32% to 55%	**5.2**
	• Biomass (agri-residues) usage	• Share grade IV cement: 36%	
	• Energy efficiency equipment (Precalciner kiln; grate cooler; computerized process control)	• Share of energy substituted: 20% • Energy reduction potential of 12%; 8%; 4.5%	**4.3** **5.3**
	• Waste heat recovery	• Energy reduction potential: 4.5%	**1.0**
Transport	• Electric rail	• Total km of track: 5,196	**8.9**
	• Fuel efficiency standards	• Programme reach: 30% for passenger vehicles; 10% for freight vehicles	**3.1**
	• Light rail and bus rapid transit	• Shift in passenger-km: 7% for LRT; 3% for BRT	**0.2**
	• Hybrid and electric vehicles	• Decreasing cost of ownership	**0.1**
	• Mixing ethanol and biodiesel	• Maximum blends: 15% and 5%	**1.0**
Buildings & Green cities	• High-efficiency lighting	• Efficiency improvement: 60-77%	**5.1**[1]
	• Improved landfill gas management	• Adoption in all towns above 20,000 inhabitants (271) up to 2030	**0.9**
	• Improved liquid waste management	• Adoption in all towns above 100,000 inhabitants (34) up to 2030	**0.9**

1 Not counted as domestic abatement potential 2 Accounted in power

- The **electric power** sector projects below 5 Mt CO_2e domestic emissions for 2030. However, one important initiative can be identified: If the installed electric power generation capacity exceeds domestic demand as planned, Ethiopia will have capacity to export electricity generated from renewable energy to countries in the region (up to 28 TWh). This will substitute for their conventional electric power generation and hence decrease GHG emissions by nearly 20 Mt CO_2e (which could come on top of the around 250 Mt CO_2e identified in other sectors).
- Of the identified **industry** abatement potential, around 70% is concentrated in the cement industry. The main lever, clinker substitution, would increase the share of additives in cement, particularly pumice (5 Mt CO_2e of abatement). The upgrade to more energy efficient technologies and waste heat recovery can reduce up to 6 Mt CO_2e in 2030, while the usage of biomass (mainly agri-residues) will help to reduce GHG emissions by 4 Mt CO_2e. All other industrial sectors that were analysed (e.g., chemicals, fertiliser, textile, leather, paper and pulp) account for an abatement potential of around 6 Mt CO_2e in 2030.
- **Transport** offers various opportunities to decrease emissions. All of these opportunities achieve their abatement potential through increased efficiency or a shift to lower-emitting fuel sources. The largest initiatives with the greatest abatement potential are the construction of an electric rail network (9 Mt CO_2e) followed by the introduction of fuel efficiency standards for all vehicles (3 Mt CO_2e). This assumes the construction of more than 5000 km of rail tracks and new fuel efficiency standards for 30% of passenger vehicles and 10% of freight vehicles by 2030. Although the abatement potential is not as large, the introduction of bio-fuels will also form a priority. The combined abatement potential of increasing the use of ethanol and biodiesel in the fuel mix is 1 Mt CO_2e.
- The main abatement levers identified for **buildings** will result in an accelerated transition to high efficiency light bulbs (leading to increased power export potential reducing around 5 Mt CO_2e abroad) and an improved handling of solid and liquid waste. The total abatement potential of improved waste handling (for liquid and solid waste) amounts to around 2 Mt CO_2e.

More than 80% of the abatement opportunities cost less than USD 15 per ton

Like many other developing countries who have not yet 'locked in' their fast growing economy into carbon intensive infrastructure, Ethiopia could provide to the international community a cost efficient contribution to the global effort to abate GHG emissions: More than 80% of the green economy initiatives' abatement potential is priced at less than USD 15 per t CO_2e (before potential carbon revenue), i.e., more cost competitive than most abatement initiatives in developed economies, and 16 initiatives have zero or negative costs of abatement, i.e., economically attractive initiatives albeit a significant initial investment often difficult to bear by the entity responsible for its implementation.

The CRGE initiative has conducted a quantitative assessment of the economics of the prioritised abatement opportunities, including estimating the abatement cost to be incurred for the measures within each sector (expressed in USD/t CO_2e abatement).[5] (The text box at the end of this section provides a description of the method for determining GHG emission abatement cost curve.)

The outcome of the cost analysis for the prioritised green economy initiatives testifies to a good starting position for establishing a green economy: more than 45% of the abatement potential (16 initiatives) comes at zero or negative costs – these initiatives would not only lead to lower emissions, but would also save costs as compared to their conventional alternatives (i.e., the net present value of their cash flows is positive). Of the remaining 12 initiatives that have been costed, 5 have abatement costs lower than USD 15 per ton, i.e., abatement costs would still be lower than the average market price for CO_2

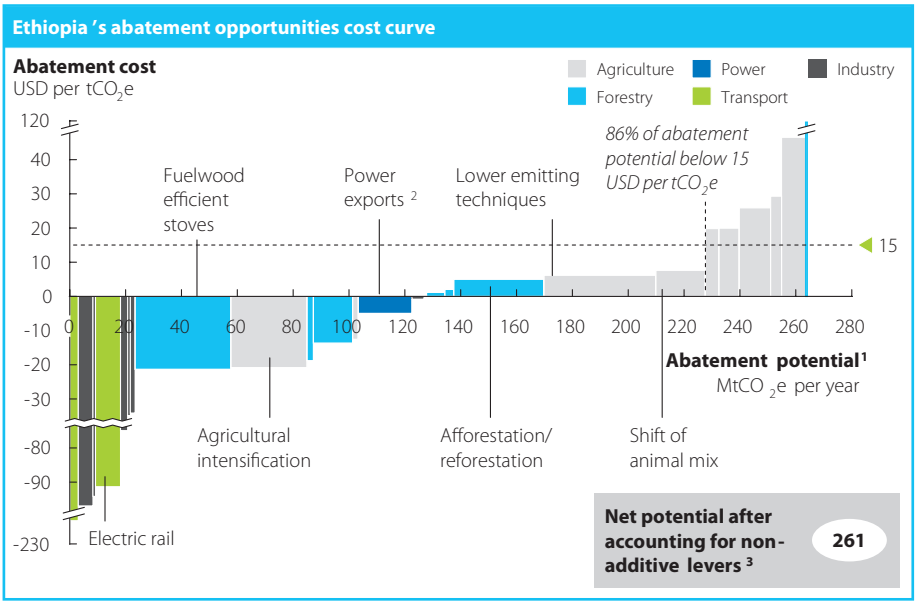
5 Understanding the costs of GHG mitigation is a critical step in the development of a green economy plan as it helps to identify and prioritise the most cost-efficient ways to reduce GHG emissions

emission certificates traded via the European Trading Scheme (ETS). Although these initiatives come at higher costs than the traditional development pathway, they might offer the possibility to fully fund the incremental costs via a monetisation of the emission reduction. In a global comparison, many of Ethiopia's initiatives are comparatively inexpensive – which can be crucial in giving the country a competitive advantage in attracting climate finance. The majority of abatement potential is concentrated on few initiatives – about 55% of the total abatement potential can be captured by 5 initiatives: lower emitting techniques in agriculture, fuelwood efficient stoves, afforestation/ reforestation, yield increasing and power exports (Figure 9).

The total abatement potential as displayed on the horizontal axis of the cost curve in Figure 9 (264 Mt CO_2e) is not equivalent to the total abatement potential displayed in Figure 8. This is due to three reasons: first, the non-domestic abatement potential from power exports is displayed in the cost curve, but not shown as a part of the total domestic abatement potential in Figure 8; second, the total abatement potential of all initiatives is not equal to the sum of the abatement potential of each individual initiative, e.g., introducing fuel-efficiency standards in the absence of hybrid cars has a higher abatement potential than if both initiatives are introduced at the same time. The total net potential of the initiatives included in the cost curve after accounting for non-additivities is around 261 Mt CO_2e. Last, some initiatives with very small abatement potential have not been evaluated with regard to their cost and are hence not included in the cost curve.

Figure 9

Most green growth initiatives are economically viable and could reduce GHG emissions at relatively low cost

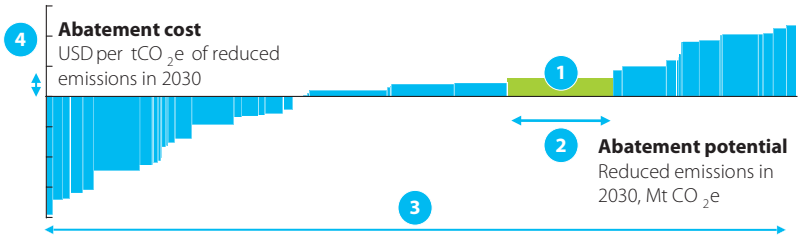


1 Represents total identified gross potential, some measures are not additive (total net potential is less than sum of all gross potentials)
2 Non-domestic potential (will arise only in importing countries)
3 Assuming full implementation of all levers where cost has been e valuated (excluding buildings/green cities and industry other than cement)

Figure 10

Abatement Cost Curve: General overview of methodology

The Abatement Cost Curve allows us to **view and compare all the available options for reducing emissions** along two key dimensions at once: How much can each option contribute to emissions abatement, and at what cost does it do so?



1. Each option for reducing emissions is represented by a bar on the cost curve.
2. The width of each bar shows the abatement potential – the tons of annual emissions that would be reduced in 2030 if we implemented this option fully.
3. The sum of the width of all bars shows the sum of the abatement potential of all initiatives – in reality the aggregated abatement potential will be lower than the sum of each initiatives as it might not be feasible to implement some initia tives at the same time
4. The height of each bar shows the abatement cost – the cost of implementing this option fully in terms of dollars per ton of reduced annual emissions.

   The bars on the right represent costly options, while the bars that face downward represent options that actually have negative cost: they save money as well as emissions.

Method for calculating the GHG emission abatement cost curve – The cost curve describes green economy initiatives based on two characteristics: the annual potential of abating GHG emissions in a given year and the costs per tonne abated (Figure 10). The underlying assumption is full implementation of the initiative; the reference year is 2030. The abatement cost curve visualises two important pieces of information concerning each initiative:

- What is the cost of abatement? The answer is reflected in column height, sorted by the most cost efficient, from the left
- What is the potential volume of GHG abatement? The answer is displayed as column width – the wider the column, the more potential the initiative offers.

The abatement cost of each initiative is defined as the incremental cost (positive if more expensive, negative if more cost economical) of a low-emission path compared to the required cost or benefits of the conventional alternative underlying the BAU scenario. Costs are measured in USD/t CO_2e of abated emissions in a given year in the future (here always referring to year 2030). It includes both the incremental capital expenditure (investment) required for the implementation of the abatement lever compared with the BAU scenario, the incremental operating cost required for the abatement lever and potential benefits (e.g., lower costs or higher revenues) compared with the BAU scenario. The capital expenditure is taken into account in the form of an annualised investment cost. The annualised cost is calculated with an economic amortisation period (usually between 20 and 50 years, depending on type of investment) and a real capital cost of 6%. Costs and benefits are estimated from a societal perspective, i.e., irrespective of who bears costs or who benefits. The costs do not include any subsidies, taxes, or external costs that are incurred indirectly and that largely depend on the exact form of implementation, such as communication cost and transaction cost.

The columns that extend upwards represent measures with a cost higher than USD 0 per tonne of reduced emissions, while the columns that extend downwards represent measures that have a negative cost per tonne of reduced emissions: they save money as well as emissions. Therefore, initiatives with a negative abatement cost are economically advantageous in any case.

Green economy will unlock economic growth, create employment, and provide additional socio-economic benefits

Moving our economy forward on the green pathway will require a transformational shift in current economic development practices, will touch most sectors of its economy, will contribute to the welfare of the population and to the increased quality of our environment, and will stimulate economic benefits in several sectors.

The CRGE effort has estimated that its selected initiatives would reach up to two-thirds of the whole economy (by 2030) and move them onto a more sustainable pathway (Figure 11). Some of the initiatives also support the creation and growth of new business opportunities, e.g., the local production of efficient stoves. The initiatives have the highest reach within agriculture by creating a green agricultural sector that generates increased output originating from higher yields rather than from an expansion of agricultural land or the cattle population. As initiatives have been identified for most of the industrial sub-sectors, a high share of these sub-sectors is also likely to be positively affected by the green economy. In addition, a smaller part of the service sector will also be reached by the green economy through initiatives identified in transportation and buildings.

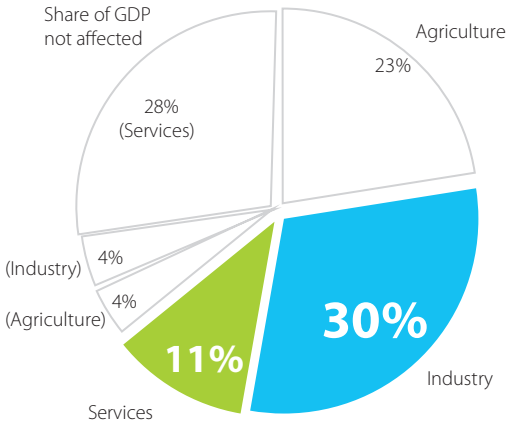
Adopting a green economy development path would have benefits for the population, the environment, and the economy: it would improve public health through better air and water quality and accelerate rural development by increasing soil fertility, food security, and rural employment. Households would benefit from higher energy efficiency – especially from more efficient cooking/baking and transport – with savings worth up to 10% of household income (particularly in rural areas). This would lead to an increase in domestic savings and hence result in an enhanced investment capacity.

From a macroeconomic perspective, green economy initiatives would also improve the balance of payments by reducing dependency on imports of, e.g., fossil fuels, and create a more secure power supply, an essential prerequisite for sustainable economic development. This effect alone could improve the balance of payments by several billion USD (in 2030). The low-carbon supply of goods and services (e.g., manufactured goods, power) can easily be marketed as a major competitive advantage for Ethiopia's exports. Moreover, the decision to commit to sustainable economic development opens the door to different sources of international environmental funding, such as "Fast Start" funding, CDMs, and voluntary markets, that could complement the funds earmarked for development.

Figure 11

Up to two moving to a green growth path

Share of GDP affected (2030) and examples of economic impact/benefits from green economy



Agriculture and forestry

- Creating USD 1 bn yearly **savings from fuelwood** expenditure for rural population
- Increasing **productivity** of up to 40 million head of livestock

Industry

- Total **fuel cost savings** of more than USD 1 bn p.a. in 2030
- Enabling renewable **power generation** of more than 67 TWh, opening high potential for power exports

Service

- Savings of around 1/3 of **fuel imports** for transportation

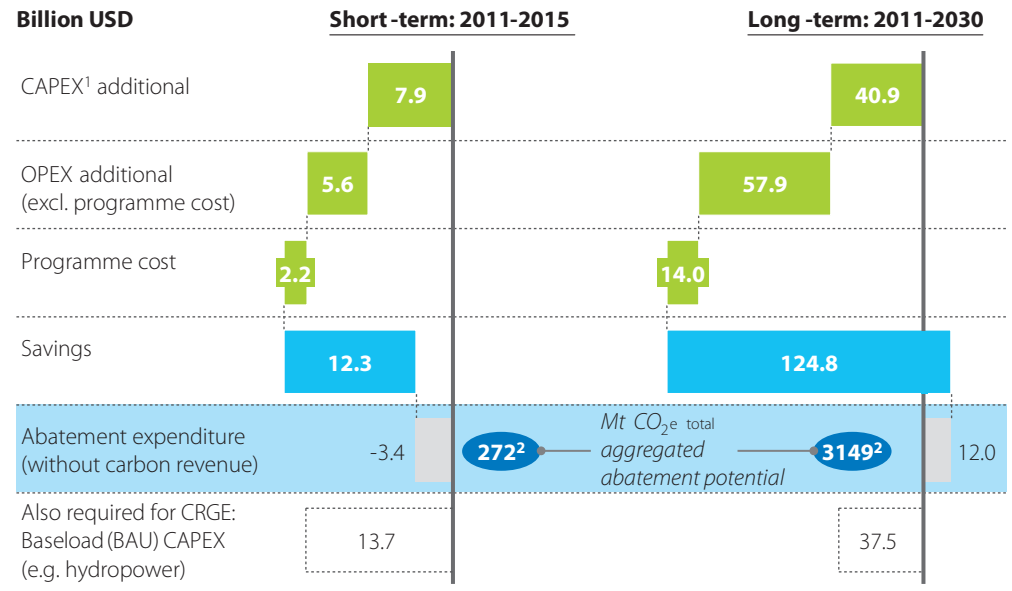
Total share of the economy affected by green economy ~64%

Building a green economy requires more than USD 150 billion over 20 years, but provides access to climate finance

Developing the green economy will require an estimated expenditure of around USD 150 billion over the coming 20 years – around USD 80 billion of which is capital investment and the remaining USD 70 billion operating and programme expenses. Of the total expenditure, almost USD 30 billion are projected to occur in the short term up to 2015, with almost USD 22 billion of this being capital expenditure (Figure 12). These figures underline the significant funding needed to build a green economy despite the overall low average cost of abatement, and the need to mobilize capital investment in the early years of the development of the green economy. However, not all of this expenditure is necessarily additional to current investment plans – rather, a large part of this expenditure, e.g., for power generation infrastructure or transport infrastructure, would also occur in a conventional growth scenario.

Figure 12

Building a green economy requires around USD 150 billion up to 2030



1 Full capital expenditure, not amortized
2 Aggregated abatement potential; expenditure per tCO_2e not equivalent to abatement cost in cost curve, as the CAPEX abatement expenditure is not annualized via amortization (rather: cashflow perspective)

The largest share of the total investment of USD 80 billion will be required for the development of power generation and transmission infrastructure (48%), followed by the transport sector (29%) and financial requirements for the transformation of the agricultural sector (2% for soil and 3% for livestock) as well as the forestry sector (12%, including agricultural intensification and irrigation initiatives that ultimately create GHG abatement in the forest sector). Upgrading technology in the cement sector will require investments equal to nearly USD 5 billion over the next 20 years – or 6% of the total estimated green economy capital investment.

The power generation investment, however, has to be considered as part, not as an addition, of the 'conventional development path' because the renewables-based development of the electric power sector is part of the existing development path. Indeed, the scale-up of renewable energy infrastructure builds on existing competitive advantages and represents the most viable pathway economically, socially, and environmentally, and the Ministry of Water and Energy through the Ethiopian Electric Power Corporation has consequently built its development master plan very strongly on hydro, solar, geothermal, and wind power. Hence, this expenditure is displayed as a BAU expenditure in Figure 12.

In order to analyse the required type of financing for the respective initiatives, their expenditure is grouped into 3 distinct categories (Figure 13):

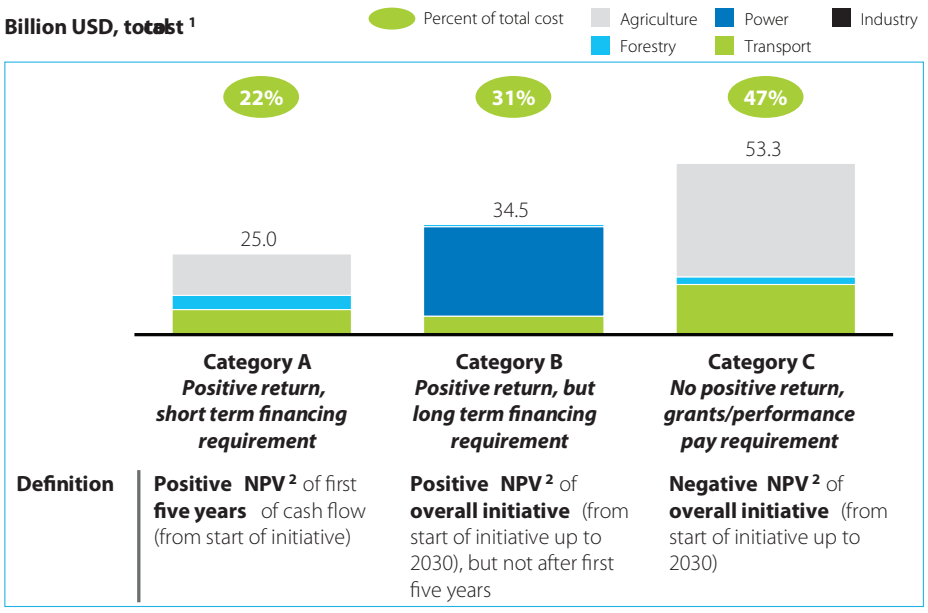
- **Category A:** Expenditure for initiatives that have positive return and only require short-term financing. These are defined as yielding a positive Net Present Value (NPV[6]) from the first five years of cash-flow (from start of implementation of the initiative).
- **Category B:** Expenditure for initiatives that have a positive return, but require long-term financing. These are defined as yielding a positive NPV from the overall initiative (from start of implementation of the initiative) up to 2030, but not during the first five years.

6 The NPV is calculated with 6% discount rate (real, derived according to usual market-based risk-free interest rate and risk premium) and takes into account all expenditure and benefits (taking the societal perspective). It should be noted that the implementing agency might face higher net expenditure when benefits (i.e., savings or income) are captured by different parties.

- **Category C:** Expenditure for initiatives that do not yield a positive (financial) return, hence they require grants or performance payments for GHG abatement. These are defined as yielding a negative NPV from the overall initiative from start of implementation of the initiative up to 2030. This does, however, not necessarily mean that the initiative does not yield a positive NPV at all. The construction of electric rail, for example, has been calculated with a much longer depreciation period and generates positive returns from the initial investment even beyond 2030, which can eventually make the overall return positive.

Figure 13

More than 50% of expenditure will have positive returns out of that, more than 20% in the short to medium term



1 Including additional CAPEX, additional OPEX, and programme cost (not containing baseload/BAU expenditure)
2 NPV calculated with 6% discount rate; societal perspective, the implementing agency might face higher net expenditure when benefits (i.e. savings or revenues) are captured by different parties

This categorization shows that more than half of the expenditure of the proposed initiatives will have positive returns, i.e., the green economy initiatives are less expensive – over the 20-year horizon – than the conventional alternatives (Figure 13). This also translates into negative GHG abatement cost as displayed in the cost curve in Figure 9.

More than 20% of the expenditure for green economy initiatives will already have positive returns and pay back in the short run (i.e., five years or less after start of the implementation). However, the profile of expenditure of the green initiatives typically has a bulge at the beginning due mainly to upfront capital investment. Upfront investments for green economy initiatives are usually higher due to the higher investment required in modern and efficient technology, compared to the one of the traditional path, as well as the investment required to set up the different scale-up programmes. On the other hand, the medium- to long-term running costs are typically lower due to the combined effects of fuel savings and efficient use of other resources. This effect is reflected in a large part of the expenditure only paying off in the long run.

On the one hand, the green path for 2010 to 2030 is more capital intensive. For some initiatives, accounting for 47% of the expenditure, the green path could be even more expensive than the conventional development path.[7] The implementation of these green economy initiatives will require

7 This is not necessarily the case; please refer to description of category C expenditure.

the support of international funding. On the other hand, potential support from climate-related sources of funding comes as a complement and hence helps to fund initiatives that would otherwise not be financed. They provide the additional support required to steer the economy towards sustainable growth instead of developing along a traditional path, and will reinforce the robustness of many sectors, especially in agriculture.

A funding pool of at least USD 20 billion annually should be obtained from various climate finance schemes set up to foster the green economy initiatives of developing countries like Ethiopia (Figure 14). These funds are typically available only for initiatives that reduce GHG emissions, i.e., only if the receiving party proves reduced GHG emissions as compared with BAU development. In the short term, support from climate finance can take the following forms:

- Bi-/multilateral grants primarily for project setup, capacity building, technology development, and dissemination
- Bi-/multilateral pay-for-performance deals, i.e., payments linked to verified GHG abatement
- Trading schemes or offset markets, i.e., emission reduction, for example resulting from Clean Development Mechanisms (CDMs), sold to companies (in ETS) or committed countries (cap and trade) or via voluntary carbon markets.

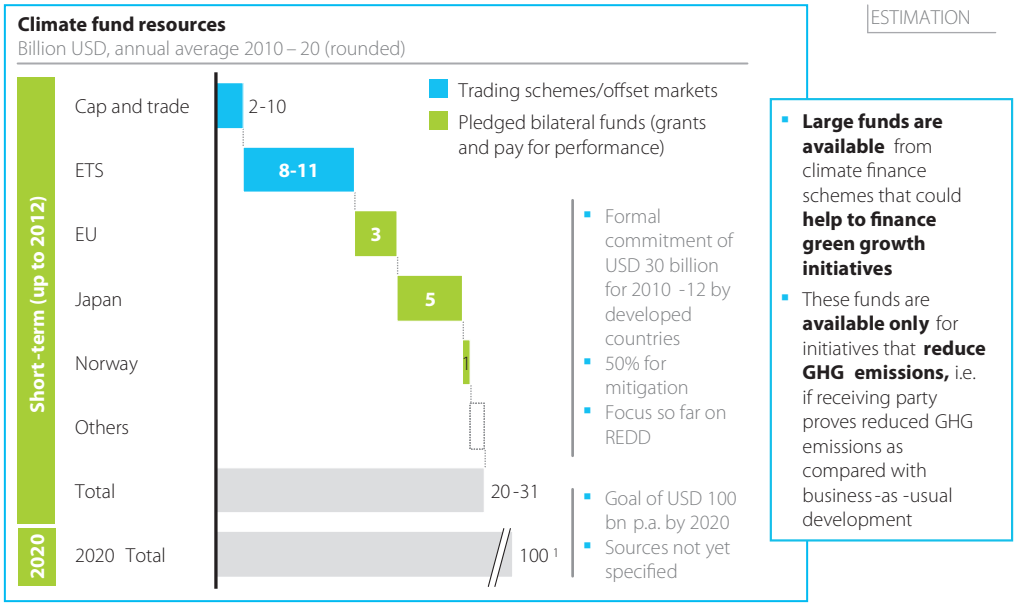
At the 2009 Conference of Parties in Copenhagen, developed countries formally committed "Fast Start Funding" of USD 30 billion for 2010-2012, half of which is to be spent on GHG abatement. Beyond 2020, the same countries have pledged USD 100 billion p.a. for abatement and adaptation, but the sources of these funds have not yet been specified. Trading of emission certificates offers an additional USD 10 billion to USD 20 billion p.a. under the Kyoto Protocol or the European Trading Scheme (ETS).

Ethiopia will divide all prioritised green economy initiatives into three categories:

- **Own** initiatives that are planned and fully funded by the government
- **Supported** initiatives that are planned by the government but require support in implementation
- **Market-based** initiatives for which Ethiopia might be able to monetise carbon credits in exchange for GHG abatement.

Figure 14

Ethiopia can have access to a vast pool of climate funds resources totalling at least USD 20 billion p.a.



1 Bilateral and multilateral funding pledge, does not include carbon markets

All of the prioritised green economy initiatives could potentially be candidates to access the emerging climate finance pool in exchange for GHG abatement. The value given to each tonne of GHG abated differs with the 'monetisation' scheme. For example, existing bilateral deals targeted at reducing and avoiding emissions as well as increasing sequestration in the forestry sector were valued at around USD 5 per t of CO_2e abated while the average market price of a t of CO_2e in the European Trading Scheme (ETS) is three times higher, at USD 15 per t. If fully monetised, the total technical abatement potential of Ethiopia's green economy of around 250 Mt CO_2e by 2030, using these reference prices, could be worth between USD 1.2 billion and USD 3.6 billion p.a. by 2030. However, due to the uncertainty concerning the future of the global climate finance regime (particularly the extension of the Kyoto Protocol), there is uncertainty about how much of this potential can indeed be monetised.

While it is not realistic for Ethiopia to capture the full technical abatement potential, nor to monetise every single initiative, the indicative market value of its abatement potential reflects the importance for the nation to deploy all its effort to embrace the green economy plan.

crgestrategy

Making it happen:

Ethiopia's action plan to create a green economy

We are starting to put in place the building blocks necessary to implement its green economy initiative. The government has developed an action plan to set up a permanent financial mechanism, initiate the stakeholder engagement process, and set priorities for implementation of initiatives. Four initiatives have been selected for fast-track implementation: attracting the investment required to exploit hydropower potential; promoting advanced rural cooking technologies on a large scale; improving the efficiency of the livestock value chain; and Reducing Emissions from Deforestation and Forest Degradation (REDD).

The government is using significant resources to build and implement its green economy, but to capture the full potential of the plan, it welcomes the partnership with bilateral and multilateral development partners as well as contributions by the private sector.

Gearing up: permanent commitment, an emerging institutional setup, and stakeholder mobilisation

To achieve the Climate-Resilient Green Economy (CRGE) vision, the government can draw on its demonstrated track record of commitment to developing a green economy.

Strong commitment

Ethiopia has repeatedly demonstrated its commitment to developing a green economy. Besides Prime Minister Meles Zenawi's leadership role in international climate negotiations, we have launched the CRGE initiative, which is led by the Prime Minister's Office, the Environmental Protection Authority (EPA), the Ethiopian Development Research Institute (EDRI), and six ministries.

These institutions and the relevant ministries have dedicated significant resources and have organised a robust and participatory process to develop the green economy initiative.

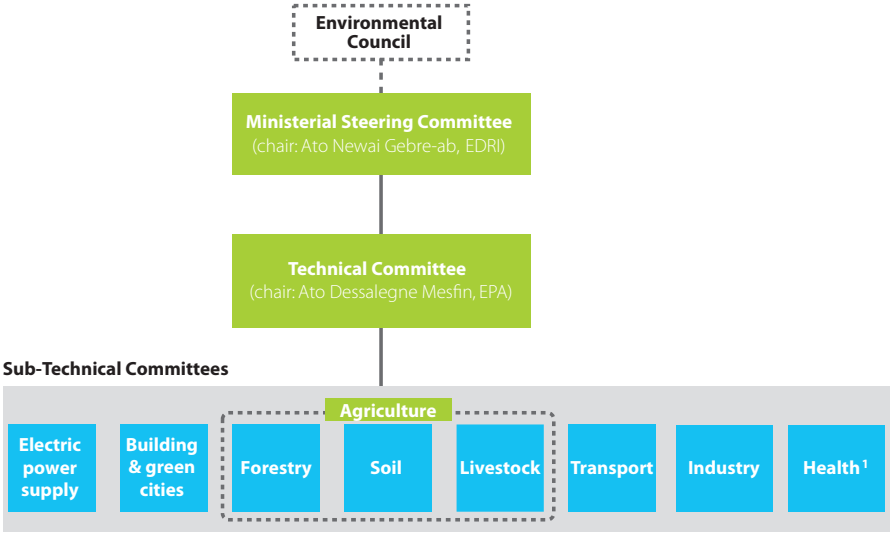
As shown in Figure 15, seven sectoral sub-technical committees (STCs) have been established to work on these plans and see them through to successful implementation. Since February 2011, more than 50 experts from about 20 leading governmental institutions have dedicated time, effort, and resources to developing sectoral plans and an integrated federal plan. The results of this work have been discussed in the biweekly Technical Committee meetings that have been chaired and administered by the Environmental Protection Authority. The Ministerial Steering Committee – chaired by H.E. Ato Newai Gebre-Ab and composed of the State Ministers and senior officials from the participating institutions – represents the most senior body in the CRGE effort and has decided on the overall direction of the work as well as discussed and approved the sectoral and overall results.

As its first major deliverable, the CRGE initiative has conducted a comprehensive investigation of the current development path and options for building a green economy as outlined in this report. The government has thereby started a process that will be pursued and improved in the coming years.

In addition to the green economy initiative, which is oriented to GHG mitigation, the economy will be made climate resilient. As part of the CRGE initiative, the threats related to climate change have been identified and a cost effective adaptation programme has been developed.

Figure 15

PM's office's leadership and inter-ministerial approach ensure national commitment and alignment across government



1 Not operative, yet

Emerging institutional setup

The current setup outlined above has proved instrumental to kick-start the CRGE initiative – however, responsibility for further development and implementation of this crucial undertaking ought to be transformed into a permanent setting. To establish this lasting platform, the government has started to develop a permanent setup and to identify the required personnel capacity.

Overall responsibility and oversight lies with Ethiopia's Environmental Council. The council is chaired by the Prime Minister and comprises members drawn from Federal Ministries, Presidents of National Regional States, and representatives of non-governmental bodies, the private sector, and trade unions. The Environmental Council is responsible for recommending laws and regulations for approval by the Council of Ministers. The Environmental Council can approve environmental standards and directives independently. It is envisaged that the Environmental Council installs a subsidiary body to directly oversee the CRGE initiative. This subsidiary body will be the already established Ministerial Steering Committee, granted the required legal status of a permanent public institution. The appointment of its chair would then be under the responsibility of the Environmental Council.

The government plans to govern the CRGE initiative under the co-responsibility of the EPA and the Ministry of Finance and Economic Development (MoFED), with the following roles and responsibilities:

The EPA supervises and regulates implementation of the technical components of the CRGE initiative. To this end, it will have a team of experts working on each economic sector to monitor projects so as to ensure their effectiveness, measure, report, and verify (MRV) project outcomes, and provide appropriate access to information on projects and outcomes to the public. It will maintain close links with all relevant ministries including by fostering the establishment of environmental units within those ministries and other relevant sectoral agencies that do not already have them. The EPA is accountable to the Environmental Council and will collaborate under the Council's direction with all institutions relevant for the CRGE process – such as the MSC and the TC that are responsible for the alignment and approval of technical content.

Specifically, the EPA will be responsible for (a) deciding on proposals to be submitted for financial support or carbon credit; (b) organising and conducting independent measurement, review and verification; and (c) adopting guidelines, procedures; and templates. The latter includes, inter alia, templates and guidelines for preparing proposals for financial support or access to carbon credit as well as monitoring reports of their implementation. The EPA will develop procedures for the review of green economy initiatives as well as provide relevant methodological guidance on determining geographical and sectoral boundaries, on setting baselines for the quantification of credits, and on measuring GHG emissions. Addressing – among others – the confidentiality of information, the EPA will develop a code of conduct and procedures. For transparency, the EPA will maintain and upload on a web-site a register with up-to-date information on decisions on and implementation of all green economy initiatives.

The MoFED, in collaboration with the EPA, will solicit financial support from international sources and channel the available funds in the form of advance support or ex-post payment. The MoFED will ensure transparency, objectivity, consistency, and professionalism in its operations in compliance with international agreements. The UNDP has offered its support in establishing a Multi-Donor Trust Fund within this ministry through which funds could be channelled. The government will eventually fully and independently run the facility – regardless of the concrete organisational design.

At the federal level, ministries and other sectoral agencies will participate and encourage the participation of other entities in their respective sectors in the formulation and implementation of the components of the green economy. These ministries and other sectoral agencies are responsible for:

- Formulating proposals of green economy initiatives for financial support or carbon credit
- Coordinating the implementation of sectoral or sub-sectoral green economy initiatives
- Preparing and submitting monitoring reports
- Designing, establishing and staffing their respective environmental units.

National regional states – in collaboration with the relevant federal level institutions – are responsible for implementing the majority of the initiatives outlined in the CRGE strategy. The coordination between regional and federal levels will be under the responsibility of the respective environmental agencies of the national regional states. This collaboration has proved efficient in numerous other undertakings.

A key design principle for the permanent institutional setup is to use existing institutions and responsibilities in order to minimize requirements for funding and organisational reform. The EPA plans to largely deploy people who are already involved in the CRGE initiative today. This shortens the time needed for recruiting and ensures the high quality and fit of the staff.

Stakeholder mobilisation

To kick-start implementation and build widespread awareness and support, the initiative has conducted and will continue to conduct extensive stakeholder consultation. Around 300 stakeholders have already been identified and consulted by the STCs. Consultation was conducted under the co-responsibility of the STCs/ ministries and the EPA between July and September 2011 and primarily focused on governmental and public stakeholders.

- Sectoral consultation was organised and conducted by the STCs/ministries. These events focused on the presentation, discussion, and improvement of the sectoral work on green economy initiatives. Consultation events focused on workshops involving experts from ministries and other public sector organisations as well as selected experts from academia.
- In addition to this sectoral consultation, a national consultation was led and organised by the EPA and the EDRI. National consultation involved regional governments, standing committees of the parliament, and workshops with selected researchers.

Providing a focus for action: CRGE has already fast-tracked Four initiatives for immediate implementation

Four initiatives have been fast-tracked for implementation: attracting financing to exploit Ethiopia's vast hydropower potential, promoting advanced cooking technologies on a large scale, monetising reduced emissions from livestock, and Reducing Emissions from Deforestation and Forest Degradation (Table 3). Each of these initiatives offers the chance to immediately promote growth, capture large abatement potential, and attract available climate finance for implementation. Moreover, they are important enablers for the country's economic development, and their implementation is feasible and considered as a priority by the government.

The following subchapters outline each of these four initiatives – highlighting key findings from the detailed analyses and describing the tactical plan developed to translate them into investment-ready projects that attract finance and get implemented.

To ensure a comprehensive programme, initiatives from all other sectors will be developed into concrete proposals. These initiatives will be detailed over the coming months. The main criteria for selection as a priority initiative are the initiatives' effect on reaching GTP targets, their abatement potential, and their ease of implementation.

Table 3: STCs have started to translate green economy opportunities into investment - ready projects in 4 sectors

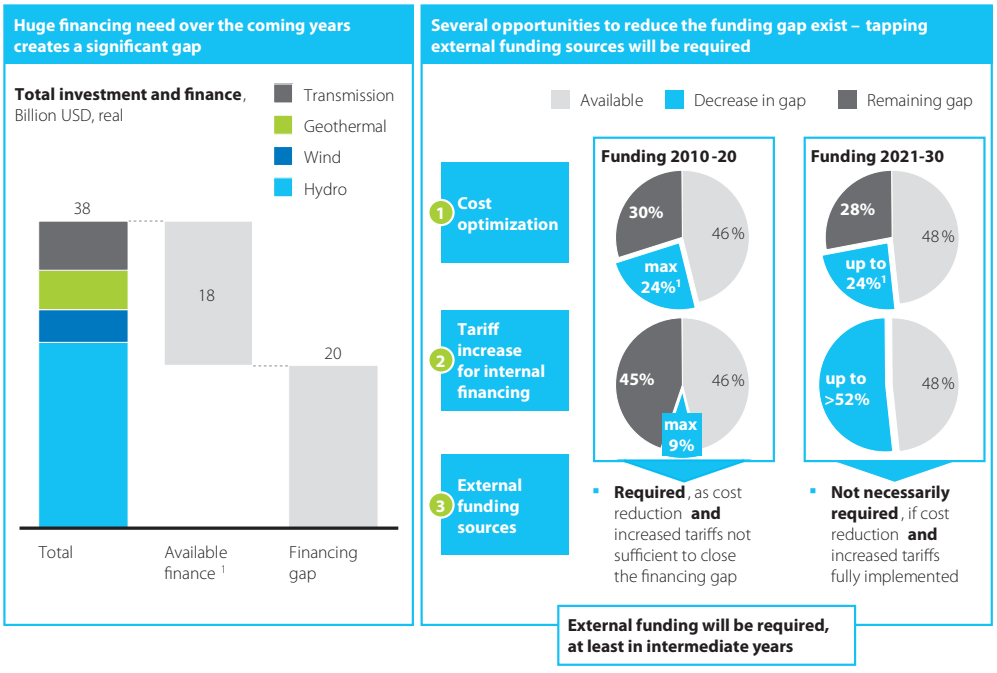
	Rationale for importance of green economy initiative
Power infrastructure financing	• Electric power generation is a critical component to realize growth and economic development and a condition for green growth in other sectors – Fundamental to meet growing domestic demand – Offers significant export potential • Securing the financing enables scale-up of clean/renewable power generation capacity
Rural energy-efficient stoves	• Fuelwood usage is the largest source of rural energy supply and one of the largest contributors to GHG emissions • Efficient stoves can have massive benefits by increasing rural household income, health, women's empowerment, and education while decreasing emissions by around 50 Mt CO2e
Efficient livestock sector	• Livestock accounts for around 11% of the formal GDP and is also the largest source of GHG emissions in the country • Sectoral growth can be achieved while reducing the projected emissions of the sector by up to 45 Mt CO2e per year in 2030 • Ethiopia could possibly monetise these reduced emissions to support GDP growth in Livestock
Buildings & Green cities	• Forests account for 1/3 of total emissions today and offer huge abatement potential through less deforestation and less forest degradation • In addition, already today Ethiopia has the second-largest afforestation and reforestation programme in the world

Initiative 1 – Electric power financing

Electric power generation has been identified as one of the most critical components to capture growth and economic development and a condition for building a green economy in other sectors. Making use of the vast renewable energy potential (particularly in hydropower), is not only fundamental to meeting growing domestic demand but also offers significant export potential. Securing appropriate financing has been identified as one of the major challenges to the scale-up in power generation capacity (Figure 16):

Figure 16

Electric power financing – preparing a roadmap for tapping external financing for power infrastructure development



1 Assuming constant domestic tariffs; projections assume that fina ncing from existing debt and equity sources remains roughly constant

In order to build the power generation and transmission infrastructure necessary to fulfil the supply projections for the electric power sector, a financing need of USD 38 billion in capital expenditures over the coming 20 years has been forecasted. If the current sources of financing remain constant, however, there will be a financing gap of more than 50% (around USD 20 billion). To close the financing gap, the deep-dive analysis on power sector financing identified and analysed three options:

- Cost optimization
- Increasing internal funding capability through tariff adjustments
- Tapping external funding sources.

While cost optimization and an increase in internal funding capability can partly close the financing gap, they will not be sufficient, making it vital to obtain funding from external sources (e.g., from the private sector, sovereign wealth funds), particularly in the early years. To tap external funding sources, it will be necessary to offer a convincing proposal for project financing. A first version of this proposal has already been drafted in the deep-dive work, leading into both the return and the risk elements of electric power generation investments.

Initiative 2 – Rural energy and efficient stoves

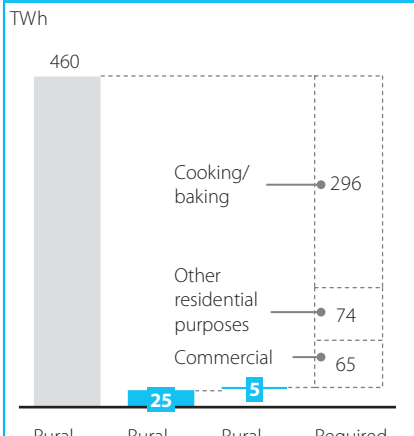
Fuelwood usage – by far the largest source of rural energy and the second-largest contributor to GHG emissions – can be reduced with efficient stoves. With a sufficiently large scale-up, the use of efficient stoves will have a massive impact on the green economic development by increasing rural household income by 10%, creating an industry worth USD 15 million in gross value added (GVA), decreasing GHG emissions by 50 Mt CO_2e [8] in 2030, and increasing health and gender equality (Figure 17).

8 Referring to abatement potential in both rural and urban areas, Figure 17 focuses on rural areas only.

Figure 17

Rural energy – reducing emissions from fuelwood consumption through efficient stoves

As fuelwood is largest source of rural energy, efficient stoves can have massive benefits…



… that can be captured through a massive scale-up programme

Technology	Rural penetration Percent	Households (people) Millions	Abatement potential[1] Mt CO_2e
Fuelwood efficient stoves	Up to 80	15.5 (80)	**30**
Alternative fuel stoves	Up to 10	2 (10)	**6**
Total	Up to 90	17.5 (90)	**36**

In order to capture the benefits of efficient stoves, several dissemination models are analyzed to define a scale -up programme containing

- **Technology choice**
- **Dissemination approach**
- **Financing (incl. role of climate finance)**

1 Only rural areas

The analysis conducted in the deep-dive work on rural energy has focused on both the impact of improved cooking/baking technologies on rural energy and on the choice of technology, current and improved dissemination approaches, and financing options.

For the required scale-up to 9 million stoves in 2015, the current dissemination value chain is inefficient and will lead to a very high programme cost of USD 300 million – equalling 10-15 times current budgets for this purpose, for which there is currently no appropriate financing mechanism available.

Nevertheless, we can achieve the required scale-up by using best-practice approaches to reduce the scale-up cost to USD 170 million and by mobilizing international climate funds to obtain the necessary financing. The tactical plan, which foresees the start of the implementation of the programme for the beginning of 2012, has already been drafted. Its full execution is necessary to get the required support and ensure timely implementation.

Initiative 3 – RELS: Reduced emissions from livestock

Livestock accounts for about 11% of the formal GDP, and is also the largest source of GHG emissions in the country. We have identified initiatives that help to achieve sectoral growth while reducing the projected emissions of the sector by up to 45 Mt CO_2e per year in 2030. While doing so, we also aim at establishing a mechanism to monetise these reduced emissions from the Livestock sector (RELS) – which could be based on existing mechanisms like REDD and unlock funds for implementing the initiatives (Figure 18).

Therefore, the deep-dive analysis has focused on the prerequisites for establishing such a mechanism and the steps to follow in order to eventually monetise the reduced GHG emissions. Briefly, it will be necessary to:

- **Prove the feasibility** of reducing GHG emissions from the Livestock sector through research and pilot projects
- **Set up the necessary institutional framework,** including a system for measuring, reporting, and verifying (MRV) livestock-related GHG emissions
- **Identify and engage development partners and investors** to finance the implementation.

A more detailed description of each of the tasks has been developed in the deep-dive work that will enable us to push forward on this topic and establish us as a thought leader on abating GHG emissions from livestock.

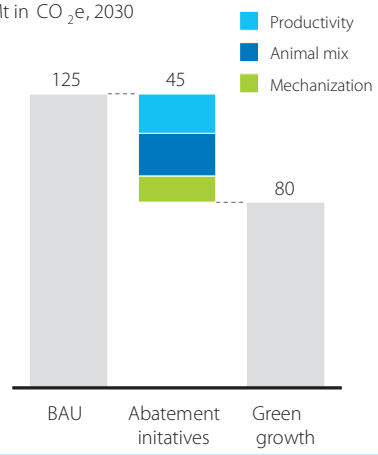
Figure 18

Livestock – preparing a REDD-like mechanism for reduced emissions from the livestock sector

STCs identified initiatives to increase the GDP of the livestock sector and reduce emissions at the same time

GHG emissions from livestock

Mt in CO_2e, 2030



Ethiopia aims at establishing a REDD-like mechanism to monetise reduced emissions from livestock, which could unlock climate funds for implementation of initiatives

Monetisation of reduced emissions requires

- **To prove feasibility** of efficiency initiatives and effect on GHG emissions via research and pilot projects

- **To set up the necessary institutional framework** including a system for measurement, reporting and verification of livestock related GHG emissions

- **To identify and engage development partners and investors** to finance the implementation of the efficiency initiatives

Initiative 4 – Reducing Emissions from Deforestation and Forest Degradation

Deforestation and forest degradation account for one third of total emissions today. However, the forestry sector also offers huge abatement potential through reduced deforestation and forest degradation. In addition, it holds large potential for sequestration – which is underlined by the fact that already today Ethiopia has one of the largest afforestation and reforestation programmes in the world.

REDD+ offers the opportunity to implement forestry abatement levers and monetise the respective abatement potential in a structured way. Hence, we have already prepared a Readiness Preparation Proposal (R-PP) that lays out its plan to prepare for REDD+ implementation. This R-PP has been accepted and we are now ready for its REDD+ preparation. The preparation phase will include the setup of an organisational structure, the definition of a REDD+ strategy, as well as the preparation for implementation of concrete mitigation actions within REDD+.

The development of the REDD+ strategy builds on the existing experience and structures developed locally, and will enable a broader learning experience for all affected stakeholders. It will target to leverage the assessments of the main initiatives to mitigate deforestation and forest degradation, to identify implementing options, and to define the key enablers required at regulatory and institutional level.

The mitigation levers identified based on the work carried out by the CRGE initiative focus on addressing the main two drivers of deforestation and degradation (conversion to agricultural land and unsustainable fuelwood consumption), through a combination of proposed measures to increase agricultural yields, manage soils and forests better, and adopt alternative energy sources and energy-efficient cooking technologies (Table 4). Particularly for the latter initiative, REDD+ will strongly interact with initiative 2 (rural energy).

Table 4: REDD+ - Identified levers for GHG mitigation

Macro levers	Levers	Description
Reduce pressure from agriculture on forests	• Agriculture intensification on existing land	• Decrease requirements for new agricultural land by increasing yield and value of crops
	• Prepare new land for agriculture through medium and large-scale irrigation	• Shift of new agricultural land from forest to degraded land brought into production due to irrigation and use of natural fertiliser
	• Prepare new land for agriculture through medium and small-scale irrigation	• Shift of new agricultural land from forest to degraded land brought into production due to irrigation and use of natural fertiliser
Reduce demand for fuelwood	• Fuelwood efficient stoves	• Reduce wood requirements thanks to efficient stoves (mostly in rural areas)
	• Electric stoves	• Switch to electric stoves (in urban areas mostly)
	• LPG stoves	• Switch to LPG stoves
	• Biogas stoves	• Switch to biogas stoves (in rural areas)
Increase sequestration	• Afforestation and reforestation	• Large-scale afforestation and reforestation of degraded areas
	• Forest management	• Large-scale forest management programmes

Based on the previous work conducted in the field and the assessment of the mitigation levers, a series of REDD+ pilots will be identified. This could range from Participatory Forest Management and Conservation approaches, which support strengthened local user rights and sustainable forest management, to various initiatives designed to take pressure off the forest resources; including better management of previous plantations, and support for bamboo growth and use as well as intensified agro-forestry. All pilots will be assessed at the end of the R-PP implementation according to various criteria, including effectiveness, efficiency, and social justice. The better-performing strategies will be selected for scale up. Other key activities of this work are the development of a REDD+ learning network and a REDD+ good-governance project that supports the development of good governance around REDD+ pilots.

Main changes in the regulatory environment to enable the proposed mitigation mechanisms to be implemented should, according to the consultations made in the preparation phase, focus on local people's rights, develop a dedicated forestry institution, and better coordinate land-use planning.

Taken together, REDD+ and the associated activities are intended to help capture the mitigation potential from forestry that has been estimated to be up to 130 Mt CO_2e in 2030. The REDD+ initiative will help not only to put an institutional structure in place that supports the implementation of abatement levers in forestry, but also to finance these levers, e.g., by monetising abatement potential and putting in place the necessary prerequisites such as a reference scenario and an MRV (monitoring, review, and verification) system.

We welcome Global collaboration to tackle climate change

Our resources commitment to building its green economy has been described. To capture the full potential of our green economy plan, we welcome emerging climate finance programmes designed to compensate developing countries for the provision of environmental services to the world. Gaining support from international partners is essential to prepare and implement our green economy. Addressing the technology, expertise, and financial needs is a fundamental element of

such support. Bi- and multilateral development partners as well as the private sector can help us achieve our ambitious goals and inspire other green economy efforts around the world at the same time.

We are planning ahead to implement the green economy strategy

The CRGE initiative has developed an action plan for the coming years that details the next steps to be taken in order to put the green economy strategy into motion:

- **Institution and capacity building.** As outlined under the heading 'Emerging institutional setup', the government has started to develop a permanent institutional setup in order to establish a lasting platform for CRGE. The focus over the coming months will be on finalising an organisational structure, identifying the additional required personnel, and building up institutional capacity.
- **Getting started on early action.** Fast-tracked implementation of the prioritised initiatives will help us to rapidly capture some of the biggest green economy opportunities and demonstrate its example of the alternative green economy growth path. These initiatives will also provide lessons that we can quickly apply to design and roll out further green economy initiatives in all other sectors.
- **Completing sectoral green economy programmes.** When the formulation of the CRGE strategy has been completed and estimates verified as far as possible, green economy programmes for all relevant sectors will be developed to ensure that the programme is comprehensive. This work will include piloting and policy design in accordance with the initiatives and goals of the strategy, at both federal and regional levels.
- **MRV and benefit sharing**: We will develop the enablers required to monetise carbon credits. This includes primarily the setup of appropriate measuring, reporting, and verification (MRV) systems, which are needed to provide proof of GHG abatement. It also includes a definition of benefit sharing, i.e., specification of the stakeholders who will benefit from the proceedings of the sale of carbon credits.
- **Funding**: To implement green economy initiatives, the government will commit the country's own funds, but it will be also necessary to gain support of international private and public partners. The CRGE initiative will therefore systematically engage in discussions with targeted development partners. This also requires establishing the appropriate funding mechanisms for receiving and distributing funds.

Our vision of a Climate-Resilient Green Economy does represent a major shift away from conventional development approaches and will require significant international support. We are eager to take up this challenge and have created the CRGE initiative in order to identify sustainable and climate-resilient paths to economic growth. It builds on our strengths and has the potential to deliver high returns to its people, its economy, and its environment. In the short term, immediate action on financing hydropower production, implementing efficient stoves, reducing emissions from livestock, and REDD+ can noticeably improve the quality of life and create the momentum and funding streams necessary to see the other CRGE initiatives through to successful completion. By aspiring to – and achieving – a constructive contribution to the green economy, we are also laying the longer-term foundation for reaching middle-income status by or before 2025.

List of References

Literature, Research papers, and Presentations

Addis Ababa City (2009): Overview of SWM of Addis Ababa, presentation to the delegation of Ethiopian cities, Addis Ababa, October 2009.

BDA Group (2009): The full cost of landfill disposal in Australia, report prepared for the Department of the Environment, Water, Heritage and the Arts, Melbourne.

Bekele, Seleshi; Hagos, Fitsum; Makombe, Godswill; Namara, Regassa (2009): Importance of Irrigated Agriculture to the Ethiopian Economy: Capturing the Direct Net Benefits of Irrigation, IWMI Research Report 128, Colombo: IWMI.

Blackburn, R.S. (2009): Sustainable Textiles, Life Cycle and Environmental Impact, Cambridge.

Bracmort, K.; Ramseur, J.; McCarthy, J.; Folger, P. and Maples, D. (2011): Methane Capture: Options for Greenhouse Gas Emission Reduction, Congressional Research Service, CRS Report for Congress, Washington, DC.

Buttazzoni, M. (2009): GHG Emissions Reductions With Industrial Biotechnology: Assessing the Opportunities, Palmetto.

Canning, D. and Pedroni, P. (2004): The Effect of Infrastructure on Long Run Economic Growth, Boston.

CDM Executive Board (2011): Tool to calculate project or leakage CO2 emissions from fossil fuel combustion, Version 02, EB 28, Meeting Report, Annex 13.

CDM Executive Board (2008): Tool to calculate project or leakage CO2 emissions from fossil fuel combustion, Version 02, EB 41, Annex 11.

CDM Executive Board (2010): Indicative simplified baseline and monitoring methodologies for selected small-scale CDM project activity categories, Type II: Energy Efficiency improvement projects, Version 04, EB 54, Sectoral Scope 03.

CDM Executive Board (2010): Indicative simplified baseline and monitoring methodologies for selected small-scale CDM project activity categories, III.H./Version 15, EB 55, Sectoral Scope 13.

CDM Executive Board (2011): Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site, Version 05.1.0, EB 61, Annex 10.

CDM Executive Board (2010): Consolidated Baseline Methodology for Increasing the Blend in Cement Production, ACM0005, EB 50.

City Government of Addis Ababa (October 2010): Addis Ababa Bus Rapid Transit Line Feasibility Study, Addis Ababa.

Danish Co-operation for Environment in Eastern Europe (2004): Methane Gas Capture and Electricity Production at Chisinau Wastewater Treatment Plant, Moldova, Draft CDM Project Design Document, Danish Ministry of Environment.

Demissie, Y. (2009): CDM Project opportunities on Landfills Methane Recovery and Power Generation for Energy Utilization in Seven Cities of Ethiopia Urban Solid Waste Management, Ethiopia Ministry of Works and Urban Development, Addis Ababa, 27-28 October 2009.

Dikshita, A.K. and Birthal, Pratap S. (2010), Environmental Value of Draught Animals: Saving of Fossil-fuel, and Prevention of Greenhouse Gas Emission, Agricultural Economics Research Review, Vol. 23, pp 227-232.

Dorosh (2007): Agricultural Production, Not published.

East African Power Pool (2011): Master Plan Studies, Dar es Salaam.

Ethiopian Electric Power Corporation (2007, updated 2011): Power System Master Plan, Addis Ababa.

Ethiopian Railways Corporation (March 2011): Transport Planning for BFS of Addis Ababa-Djibouti Railway Project Final Report, Civil Engineering Dept., Addis Ababa University.

Ethiopian Railways Corporation (July 2009): Addis Ababa E-W & N-S (PHASE I) Light Rail Transit Project Feasibility Study, Addis Ababa.

Ethiopian Rural Development and Promotion Center (2007): Solar and Wind Energy Utilization and Project Development Scenarios, Addis Ababa.

Ethio Resource Group (2009): Diversity and Security for the Ethiopian Power System, Addis Ababa.

European Cement Research Academy (2009): Development of State of the Art Techniques in Cement Manufacturing: Trying a Look Ahead, Düsseldorf.

Fedderke, J.W. and Bogetic, Z. (2010): Infrastructure and Growth in South Africa: Direct and Indirect Productivity Impacts of 19 Infrastructure Measures, Cape Town.

Federal Democratic Republic of Ethiopia (2011): Forest Carbon Partnership Facility, Readiness Preparation Proposal, Addis Ababa.

Figueres, C. and Bosi, M. (2006): Achieving greenhouse gas emission reductions in developing countries through energy efficient lighting projects in the clean development mechanism (CDM), The Carbon Finance Unit, World Bank, Washington, D.C.

Forum for Environment (2009): Ethiopian Forestry at the Crossroads: The Need for Strengthened Institutional Setup, Addis Ababa: Forum for Environment.

Foster, V. and Morella, E. (2011): Ethiopia's Infrastructure – A Continental Perspective, Policy Research Working Paper 5595, World Bank, Washington, D.C.

Gaul, M. (2009): Subsidy Schemes for the Dissemination of Improved Stoves – Experiences of GTZ HERA and Energising Development, Eschborn.

GIZ Energy Coordination Office Ethiopia (2011): The Energy Development Intervention in Ethiopia, March 2011.

Gruenspecht, H. (2010): International Energy Outlook 2010 with Projections to 2035, Center for Strategic and International Studies, Washington, D.C.

GTZ (2010): Energising Development – Report on Impacts, Eschborn.

GTZ Information and Advisory Service on Appropriate Technology (ISAT) (2009): Biogas – Costs and Benefits and Biogas – Programme Implementation, Biogas Digest, Volume III.

Hongyang He, O.; Gallagher, K. S.; Donglian, T. and Jinhua, Z. (2009): China's Fuel Economy Standards for Passenger Vehicles: Rationale, Policy Process, and Impacts, Discussion Paper 2009-03, Belfer Center for Science and International Affairs, Harvard University.

Hussain, I. (2005): Pro-poor Intervention Strategies in Irrigated Agriculture in Asia, International Water Management Institute, Colombo, Sri Lanka.

Hydrovision (2008): Hydro Finance Handbook, Kansas City.

International Finance Corporation (2011): Doing Business 2011: Making a Difference for Entrepreneurs, Washington: The World Bank Group.

Intergovernmental Panel on Climate Change (2006): 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4: Agriculture, Forestry and Other Land Use, Geneva.

Intergovernmental Panel on Climate Change (2007): Mitigation of Climate Change, Fourth Assessment Report, Working Group III.

Intergovernmental Panel on Climate Change (2006): 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4: Agriculture, Forestry and Other Land Use, Geneva.

Intergovernmental Panel on Climate Change (2001): IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories, Geneva.

International Energy Agency (2009): Cement Technology Roadmap 2009, Carbon Emissions Reductions up to 2050, Paris.

International Hydropower Association (2010): Hydropower Sustainability Assessment Protocol.

International Water Management Institute (2009): Small-scale irrigation in the Ethiopian highlands. What potential for poverty reduction and climate adaptation?, Addis Ababa.

Kennedy/Jenks Consultants (2008): City of San Rafael and Central Marin Sanitation Agency Methane Capture Feasibility Study, KJ 0868015.

Kinfu, M. (2009): Landfill Methane Recovery and Power Generation-CDM Projects in Ethiopia, HoAREC-AAU, Addis Ababa, 27-28 October 2009.

Masera, O.R.; Saatkamp, B.D. and Kammen, D.M. (2000): From Linear Fuel Switching to Multiple Cooking Strategies: A Critique and Alternative to the Energy Ladder Model, World Development, Vol. 28 (12), pp. 2083-2103.

Megen Power (2008): Impact Assessment of Mirt Improved Biomass Injera Stoves Commercialization, Final Report submitted to MoARD/GTZ SUN Energy Programme, Addis Ababa.

Mekuriaw, A. and Jembere, K. (2008): Assessment of capacity building needs of small to medium sized utilities in the water and sanitation sector in Ethiopia, Final Report submitted to Cap-Net, Addis Ababa.

Ministry of Agriculture, Federal Democratic Republic of Ethiopia (2004): Woody Biomass Inventory and Strategic Planning Project Phase 2, Final Report, Addis Ababa.

Ministry of Agriculture, Federal Democratic Republic of Ethiopia (2004): Woody Biomass Inventory and Strategic Planning Project – Forest Resources of Ethiopia, Addis Ababa.

Ministry of Finance and Economic Development, Federal Democratic Republic of Ethiopia (2010): Growth and Transformation Plan, Addis Ababa.

Ministry of Mines, Federal Democratic Republic of Ethiopia (2007): The Biofuel Development and Utilization Strategy of Ethiopia, Addis Ababa.

Ministry of Transport and Communication, Federal Democratic Republic of Ethiopia (2008): Annual Statistical Bulletin 2007/2008, Transport Services Summary, Addis Ababa.

Ministry of Transport and Communication, Federal Democratic Republic of Ethiopia (2007): National Transport Master Plan Study, Vol. 2. Action Plan, Addis Ababa.

Nwoboshi, L. C. (1981): Soil productivity aspects of agri-silviculture in the West African rain forest zone, University of Ibadan, Nigeria.

OECD and IEA (2010): Projected Costs of Generating Electricity, Paris.

Quality and Standards Authority of Ethiopia (2005): Ethiopian Standard ES1177-1:2005, Cement – Composition, specifications and conformity criteria for common cements, Addis Ababa.

Rayner, S. (2010): Fuel economy/CO2 labeling and taxation: South African Motor Industry experience, National Association of Automobile Manufacturers of South Africa/Ford Motor Company.

Regassa, N.; Sundaraa, R. D. and Seboka, B. B. (2011): Challenges and Opportunities in Municipal Solid Waste Management: The Case of Addis Ababa City, Central Ethiopia, J Hum Ecol, Vol. 33 (3), pp.: 179-190.

Rural Electrification Executive Secretariat (2006): Off-grid Rural Electrification Master Plan Study, Addis Ababa.

Sarkar, A. (2008): The Role of Carbon Finance, World Bank, Lighting Africa 2008, Accra, 7 May 2008.

Sarkar, A. (2008): Large scale CFL deployment programs: mainstreaming carbon finance and clean development mechanism (CDM), World Bank, Shanghai, 13 May 2008.

Scottish Environment Protection Agency and UK Environment Agency (2002): Guidance on Landfill Gas Flaring.

Seyoum, T. (2007): GHG Emission in the Leather Industry, Addis Ababa University Department of Chemical Engineering, M.Sc. Thesis, Addis Ababa.

Smith, K.R. et al. (1993): One Hundred Million Improved Cookstoves in China: How Was it Done?, World Development, Vol. 21 (6), pp. 941-961.

Takeshi, T. et al. (2011): Will African Consumers Buy Cleaner Fuels and Stoves? Research Report, Stockholm Environment Institute, Stockholm.

Tennigkeit, T.; Kahrl, F.; Woelcke, J. and Newcombe, K. (2009): Agricultural carbon sequestration in Sub-Saharan Africa: Economics and institutions, World Bank, Washington, DC.

The Economist (2011): Africa's Impressive Growth, January 6, London: The Economist Group.

The Federal Democratic Republic of Ethiopia (2010): Growth and Transformation Plan, Addis Ababa.

UNDP (2009): Bio-carbon opportunities in Eastern and Southern Africa, Harnessing Carbon Finance to Promote Sustainable Forestry, Agro-Forestry and Bio-Energy, New York.

UNDP (2009): Biomass Energy for Cement Production: Opportunities in Ethiopia, New York.

UNEP and EcoSecurities (2007): Guidebook to Financing CDM Projects, The Hague.

UNFCCC (2010): CDM Methodology Booklet, Information including EB 56.

UNIQUE (2010): Carbon Finance Opportunities in Ethiopia's Agricultural Sector, Freiburg: UNIQUE.

U.S. Energy Information Administration (2010): International Energy Outlook, Washington, D.C.

Van Benthem, A. and Romani, M. (2009): Fuelling Growth: What Drives Energy Demand in Developing Countries?, The Energy Journal, Vol. 30 (3), pp. 91-114.

Vanderschuren, M. and Jobanputra, R. (July 2005): Fuel Efficiency Measures for South Africa, Proceedings of the 24th Southern African Transport Conference, Pretoria, South Africa.

Wölcke, J. and Tennigkeit, T. (2009): Harvesting agricultural carbon in Kenya, The International Journal for Rural Development, Vol. 43 Nr. 1.

Wood, S. and Cowie, A. (2004): A Review of Greenhouse Gas Emission Factors for Fertiliser Production, New South Wales.

World Bank and ECON (2008): Costing Power Infrastructure Investment Needs in Southern and Eastern Africa, Oslo.

World Bank (2007): Second Electricity Access Rural Expansion Project, Washington, D.C.

World Health Organization (2007): Indoor Air Pollution: National Burden of Disease Estimates, Geneva.

Worrell, E., Galitsky, C., and Price, L. (2008): Energy Efficiency Improvement Opportunities for the Cement Industries, Berkeley.

Internet sources

All Africa (2009): Establish a Fertilizer Manufacturing Plant, http://allafrica.com/stories/200910190826.html (August 2011).

Central Statistical Agency, Federal Democratic Republic of Ethiopia, www.csa.gov.et (August 2011).

Economy Watch (2011): Foreign Exchange Reserves, http://www.economywatch.com/economic-statistics/economic-indicators/Foreign_Exchange_Reserves/

FAO (2009), the State of Food and Agriculture, http://www.fao.org/docrep/012/i0680e/i0680e00.htm, (August 2011).

Nonor, D. (21 July 2010): Ghana: Fund to Invest in Improved Seed Production for Smallholder Farmers, http://allafrica.com/stories/201007210757.html (August 2011).

Mutumweno, N. (12 August 2010): NCZ, The sleeping giant, http://www.shout-africa.com/?p=2066 (August 2011).

U.S. Economics and Statistics Administration (2011): U.S. Carbon Dioxide Emissions and Intensities Over Time: A Detailed Accounting of Industries, Government and Households, http://www.esa.doc.gov/Reports/u.s.-carbon-dioxide (August 2011).

World Bank: GDP Per Capita, http://data.worldbank.org/indicator/NY.GDP.PCAP.CD (August 2011).

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For further information on Ethiopia's work to achieve a **Climate Resilient Green Economy** please contact

The Federal Democratic Republic of Ethiopia
Environmental Protection Authority

Telephone

+251 (0)11 646 5007

+251 (0)11 646 4604

+251 (0)11 646 4898

Email

epa_ddg@ethionet.et

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