Republic of Ghana

UNEP

GREEN economy
Assessment Report

Ghana

UNEP – Green Economy Assessment Report for Ghana. 92 pages

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ACRONYMS

AFOLU	Agricultural, Forestry and Other Land Use
AGOA	African Growth and Opportunity Act
AMSECs	Agricultural Mechanization and Service Centers
BAU	Business-as-usual
BDS	Business Development Services
BoG	Bank of Ghana
CDM	Clean Development Mechanism
CIA	Central Intelligence Agency
CO_2	Carbon dioxide
COAST	Collaborative Actions for Sustainable Tourism
CPESDP	Coordinated Programme of Economic and Social Development Policies
CSIR	Council for Scientific and Industrial Research
DANIDA	Danish International Development Agency
EC	Energy Commission
EFRP	Environmental Fiscal Reform Policy
EPA	Environmental Protection Agency
FAO	Food and Agriculture Organization of the United Nations
FASDEP	Food and Agriculture Sector Development Policy
FC	Forestry Commission of Ghana
FDMP	Forestry Development Master Plan
FiT	Feed-in-Tariff
FSC	Forestry Stewardship Council
FSS	National Forest Stewardship Standard
GDP	Gross Domestic Product
GE	Green Economy
GEDAP	Ghana Energy Development and Access Project
GEF	Ghana Energy Foundation
GEF	Global Environmental Facility
GE-Low Thermal	Green Economy with Low Thermal scenario
$GgCO_2e$	Total Greenhouse Gas Emissions Equivalent
GHC	Ghana Cedis
GHG	Greenhouse Gas
GHS	Ghana Health Service
GLSSIV	Ghana livings standard survey of the fourth round
GoG	Government of Ghana
GPRS I	Ghana Poverty Reduction Strategy one
GPRS II	Ghana Poverty Reduction Strategy two
GSGDA I	Ghana Shared Growth and Development Agenda one
GSGDA II	Ghana Shared Growth and Development Agenda two
GSS	Ghana Statistical Service
GWh	Gigawatt hour
HDI	Human Development Index
HIPC	Highly Indebted Poor Countries
ICT	Information and Communications Technology
IISD	International Institute for Sustainable Development
ILO	International Labour Organisation

IPPU	Industrial Process and Product Use
ISSER	Institute of Statistical, Social and Economic Research
KPMG	Klynveld Peat Marwick Goerdeler
KWh	Kilowatt hour
LCDS	Low Carbon Development Strategy
LI	Legislative Instruments
LIPW	Labour Intensive Public Works
LUCF	Land-Use Change and Forestry
MDGs	Millennium Development Goals
MESTI	Ministry of Environment, Science, Technology and Innovation
MI	Millennium Institute
MLNR	Ministry of Lands and Natural Resources
MoEP	Ministry of Energy and Petroleum
MoF	Ministry of Finance
MoH	Ministry of Health
MW	Megawatt
NAMAs	Nationally Appropriate Mitigation Actions
NCCAS	National Climate Change Adaptation Strategy
NCCMP	National Climate Change Master Plan
NCCP	National Climate Change Policy
NDPC	National Development Planning Commission
PAGE	Partnership for Action on Green Economy
PPPs	Public–Private Partnerships
PV	Photovoltaic
REDD	Reducing Emissions from Deforestation and Forest Degradation
REDD+	Reducing Emissions from Deforestation and Forest Degradation plus
RETs	Renewable Energy Technologies
SADA	Savannah Accelerated Development Agency
SAG	Switch Africa Green Project
SCORE	Sustaining Competitive and Responsible Enterprise
SEA	Strategic Environmental Assessment
SEP	Solar Export Potential
SPP	Sustainable Public Procurement
T21	Threshold 21 Model
T21 Ghana – GE	Threshold 21 Ghana Green Economy Model
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
UNFPA	United Nations Population Fund
UNIDO	United Nations Industrial Development and Organisation
UNITAR	United Nations Institute for Training and Research
VALCO	Volta Aluminum Company
VPA	Voluntary Partnership Agreement
VSI	Voluntary Sustainability Initiatives
WDI	World Development Indicators

ACKNOWLEDGMENTS

Prepared for the Government of the Republic of Ghana

Prepared by the Institute of Statistical, Social and Economic Research (ISSER)

Commissioned by the United Nations Environment Programme (UNEP) in association with the United Nations Development Programme (UNDP) and the United Nations Department of Economic and Social Affairs (UNDESA)

Institute of Statistical, Social and Economic Research Technical Team
Economic Specialist: Professor Felix Ankomah Asante
Environment Specialist: Dr. Simon Bawakyillenuo

CONTRIBUTORS
Ministry of Environment, Science, Technology and Innovation Fredua Agyeman, Peter Dery, Gyimah Mohammed
United Nations Environment Programme Steven Stone, Asad Naqvi, Patrick Mwesigye, Joy Kim, and Rhoda Wachira
Millennium Institute Zhuohua (Cathy) Tan, Adedoyin Onasanya

UNEP Project Management
The project was managed by Joy Kim and Ronal Gainza-Carmenates under the overall supervision of Steven Stone, Chief of the Economics and Trade Branch; Asad Naqvi, Acting Head, Green Economy Advisory Services Unit and Desta Mebratu, Deputy Director, Regional Office for Africa. Administrative support was provided by Désirée Leon, Fatma Pandey and Rahila Somra. The report was edited by Edward Girardet and proofreading was conducted by Richard Scotney, Adebiyi Odegbile and William Scott.

Design and layout by Thomas Gianinazzi (original) and Michel Favre, Le Cadratin.

UNEP is grateful for the generous funding support provided by the European Commission and the Government of the Netherlands for this project.

EUROPEAN UNION

Ministry of Infrastructure and the Environment

FOREWORD

Between 1991 and 2013, Ghana experienced an impressive decline in absolute poverty from 51.7 per cent to 24.2 per cent. However, the cost of environmental degradation to the country has been high. In 2012 it was estimated that the cost to Ghana of environmental degradation was equivalent to ten per cent of its GDP. In 2012 figures that amounted to US$4.1 billion. By placing sustainability at the heart of its development planning, Ghana will be better positioned to address challenges of unemployment, sustained economic growth and poverty reduction.

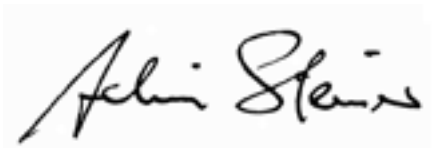
This study – the Green Economy Assessment Report for Ghana - provides comparative scenarios for future growth that estimates economic, environmental and social impacts. It provides recommendations on how greening the agriculture, energy and forestry sectors can catalyze a transition to a green economy in Ghana. Furthermore the study shows clear economic, environmental and social benefits from a transition to a green economy such as strong economic development coupled with more efficient use and preservation of natural resources. Ultimately a transition to a green economy is helpful for Ghana achieving multiple Sustainable Development Goals.

Ghana, like a number of countries in Africa, is undertaking policy reforms and green investments calibrated to mitigate against poverty and hunger, climate change and natural resources degradation, while simulaneously providing new and sustainable pathways to inclusive economic development and prosperity. Ghana's current national development plan - the Ghana Shared Growth and Development Agenda II (2014-2017) promotes the adoption of the principles of green economy in national development planning. Ghana has also embarked on other initiatives addressing environmental fiscal reform, climate change adaptation and climate change policy and is looking to build a more robust and sustainable economy.

At the 2012 Rio+20 Conference, green economy was recognized as an important tool in the context of sustainable development and poverty eradication. In past years, this tool has been increasingly adopted in national policymaking, with 65 countries now having green economy or related national strategies. A green economy bears the promise, not only of reduced environmental risks and ecological scarcities, but also economic and social development beyond business-as-usual scenarios.

Given this current national, regional and global backdrop, the steps Ghana has taken are timely and the findings of this report paint a promising picture of a more sustainable future for the Ghanaian people.

Honourable Mahama Ayariga
Minister of Environment, Science, Technology and Innovation & Permanent Vice-Chairman of the WASCAL Ministerial Council
Republic of Ghana



Achim Steiner
Under-Secretary General of the United Nations and Executive Director of UNEP

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EXECUTIVE SUMMARY

ABOUT TWO MILLION PEOPLE DEPEND ON THE FISHERIES SUB-SECTOR FOR THEIR LIVELIHOOD, WITH MOSTLY WOMEN INVOLVED IN THE PROCESSING AND MARKETING ACTIVITIES.

The Green Economy (GE) concept encompasses a change in the development agenda, in contrast to the 'brown' (unsustainable) approaches of past decades. As a nation, Ghana's vision is to become a middle-income country over the next few years. The fundamental role of GE practices in the various development plans and programmes aimed at achieving this national goal cannot be overemphasized. In recent years, the trends of Ghana's macroeconomic and environmental indicators have been declining. GDP fell from 15 per cent in 2011 to 7.9 per cent in 2012, and plummeted further to 5.4 per cent in 2013, mainly due to the poor performance of the non-oil sector. On the environmental front, Ghana has experienced one of the highest deforestation rates (2 per cent per annum) in the world, with a corresponding high cost of environmental degradation, which is estimated at 10 per cent of GDP. Waste generation and management are among the most serious environmental challenges facing the nation. About 30 per cent of total waste generated is not being disposed of properly every year. Socially, some achievements have been recorded, particularly in the health sector. Life expectancy, infant and maternal mortality, has increased in recent years; and absolute poverty has declined from 51.7 per cent in 1991/1992 to 24.2 per cent in 2013. Despite such achievements, Ghana continues to face key challenges, such as high unemployment, underemployment, and income inequities.

Over the years, Ghana has introduced several developmental plans aimed at overcoming such challenges and propelling improvements in all sectors. The current plan is the Ghana Shared Growth and Development Agenda Two (GSGDA II) which runs from 2014 to 2017. Other initiatives incorporating green economy elements include the Environmental Fiscal Reform Policy (EFRP), National Climate Change Policy (NCCP), National Climate Change Adaptation Strategy (NCCAS) and the National Climate Change Master Plan (NCCMP).

Seeking to foster the transition to GE, Ghana undertook a Green Economy Scoping study in 2012, to help identify the sectors that could help achieve this goal. Through stakeholder consultation, it was decided to prioritise the agricultural, forestry, and energy sectors for detailed GE quantitative assessments. These are based on their significant contributions to the country's GDP, economic welfare, low carbon development, global competiveness, and other imperatives. While qualitative approaches were partially based on mixed assessment methods, the overriding quantitative tool was the Threshold 21 (T21) model. The T21 is a System Dynamics-based model designed to support integrated long-term national, regional, and global development planning. As a result, the T21 Ghana-GE model was developed comprising three scenarios: Green Economy (GE), Green Economy with Low Thermal (GE-Low Thermal), and Business-as-usual (BAU). Under the GE scenario it is assumed that there will be green policies implemented and green investments from 2013-2030, and also that utilization of renewable sources for electricity generation would not cause a reduction in thermal generation. Under the GE-Low Thermal scenario, it is assumed that there will be green policies implemented and green investments from 2013-2030 and that thermal electricity generation would decrease due to increases in electricity generation from renewable sources. In all three scenarios it is assumed that the level of green investments is determined by policy targets estimated at 1.05 per cent of GDP on average from 2013 to 2030.

Generally, the findings show that an implementation of green economy policies and investments in Ghana will bring about better overall performance in social, economic, and environmental dimensions than the BAU scenario. At the macro-economic level, an average estimated annual growth rate would be 5.9 per cent between 2013 and 2030 under the BAU, while the GE scenario would produce an estimated growth rate of 6.9 per cent with the GE-Low Thermal achieving somewhat less at 6.5 per cent. Socially, green economy strategies would lead to a 5 per cent poverty reduction by 2030, representing 2 per cent lower level than the BAU scenario in 2030. Green economy scenarios would create 400,000 (GE scenario) and 200,000 (GE-Low Thermal scenario) more jobs than the BAU scenarios.

With respect to the agricultural sector, when the present low level of irrigated area is expanded in the green economy scenarios, the yield of all crop types is expected to improve. Cereal, yield, for example, can be expected to increase by 10 per cent by 2030. This would contribute to better nutrition levels and higher average farmer

income, as well as lower the poverty rate, together with other positive socio-economic impacts. Forest land is projected to decrease in all three scenarios. However, by virtue of the reforestation policy introduced in the green economy scenarios, forest area will be 11 per cent larger than the BAU scenario.

In the energy sector, the green economy policies will promote both the expansion of renewable energy on the supply side and the replacement of inefficient products and appliances on the demand side. In the two green economy scenarios, the installed power generation capacity from clean sources will be 330 million watts (MW) from wind, 145 MW from solar and 1865 MW from hydro by 2020. This would achieve the policy target of 10 per cent of total energy generation capacity from non-hydro new renewables by 2020. By 2030, the corresponding capacity will be 333 MW from wind, 146 MW from solar, and 1910 MW from hydro. This expansion requires an annual investment in renewable power of about 150 million Ghana Cedis (USD = 37,406,484[1]) through to 2030. This would be higher in the first few years of investment (315 million Ghana Cedis in 2013) but would then decline to 53.6 million Ghana Cedis by 2030.

Overall, the findings revealed that the impact of the green economy transition in Ghana will bring about an improvement in a wide range of environmental, social, and economic indicators compared to the BAU scenario. Agricultural production is expected to improve through more effective irrigation, which in turn will lead to faster GDP growth than in the BAU scenario; the industrial sector will benefit from both improved electricity supply and the growth of renewable electricity supply coupled with higher use of energy efficient equipment. By 2030, industry production will be 10 per cent greater in the GE scenario than in the BAU, and 2 per cent higher in the GE-Low Thermal scenario than the BAU. While the analysed green policies are not expected to directly influence the service sector, the ripple effects of green policies could lead to positive improvements in the production in the service sector by 8 per cent (GE) and 2 per cent (GE-Low Thermal) compared to the BAU scenario.

The realisation of these social, economic, and environmental benefits that are embedded in the green economy scenarios are contingent on several enabling conditions: regulatory and voluntary initiatives; economic and fiscal policy instruments; financing mechanisms; and strong institutional and policy processes. There is also the need for specific roadmaps to be initiated within the specific sectors to achieve these GE benefits.

Ghana boys fishing. © UNEP

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1 INTRODUCTION

SOLAR PANELS IN AFRICA.

1.1 THE CONCEPT OF A GREEN ECONOMY

The Green Economy (GE) concept entails a paradigm shift in contemporary development thinking, taking into account the dangers posed by the unsustainable approaches that have characterized development in the past decades. The United Nations Environment Programme (UNEP) defines a GE as one that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities[2]. It underscores a low carbon emission, resource-efficient, and socially-inclusive economy.

GE requires a major change in production and consumption patterns, implementation of fiscal and other policy reforms, financial investments, and a reorientation of lifestyles toward economic activities that enhance and preserve environmental quality. These need to be coupled with a far more efficient use of natural resources and the reduction of social inequality. At the operational level of a GE, growth in income and employment is driven by investments that reduce carbon emissions and pollution; enhance energy and resource efficiency; prevent loss of biodiversity and ecosystem services; and reduce unemployment and poverty, especially among the poorest segments of society. The approach is based on sound economic analysis of current trends, risks and opportunities, as well as on taking stock of national experiences in effectively applying more integrated policy tools. Given the unique economic structure of each country, it is not uncommon to have several operational definitions of the GE at the national level, since country context shapes the priorities and goals regarding the sectors to be greened.

Though implicit in UNEP's definition of GE, the implementation of such an approach in Ghana needs to focus on climate change adaptation and mitigation measures as compelling elements of a GE transition. With the phenomena of climate change and variability wreaking havoc in the country, resulting in repeated droughts, floods, poor crop yields, and an increased incidence of certain diseases, the need to strengthen the adaptive capacities of people and build robust mitigation measures are critical and GE is key to accomplishing these. Hence, GE as a vehicle for achieving sustainable development in Ghana needs to be holistic, taking into account the impacts of climate change.

While at the national level, there is no official definition of GE in Ghana[3], most of the country's development priorities are in harmony with the key objectives of the GE concept. The National Development Strategy, for instance, is based on five key themes: human development; economic growth; rural development; urban development; and an enabling environment. Similarly, the just concluded Medium-Term National Development Policy Framework: Ghana Shared Growth and Development Agenda One (GSGDA I), 2010-2013 (2010) had seven important themes: sustaining macroeconomic stability; enhanced competitiveness of the private sector; accelerated agricultural growth and natural resource management; oil and gas development; infrastructure, energy, and human settlements development; human development, employment, and productivity; and transparent and accountable governance[4]. In addition, the GSGDA II (2014-2017) is developed to build upon GSGDA I and further correct the bottlenecks that hindered the full realisation of all of the original GSGDA I objectives. Furthermore, economic development, poverty reduction, social justice and equity, and environmental sustainability have been some of the fundamental goals of past and present governments of Ghana. Continual alignment of subsequent medium-term development plans as well as various sectoral policies with GE provisions will leverage the country to develop sustainably, taking into account green growth opportunities in the current energy and environmental challenges.

1.2 OBJECTIVES OF THE STUDY, PROCESS AND PARTNERS

The overall objective of this study is to support and complement green economy initiatives in Ghana through macroeconomic assessment and policy analysis with a view to better understanding how government policies and both public and private investments can help achieve the fundamental macroeconomic objectives of income growth, economic development/diversification, and job creation. All of these also seek to contribute to social equity and environmental improvement.

Specifically, the study aims to achieve the following objectives:

1. To deepen existing research on sustainable development in Ghana and solidify related data and baseline information as well as details on related policy targets, by engaging a wide range of stakeholders;
2. To identify potential options for attaining policy targets including the shift of public and private investment towards key sectors and the public policies needed to induce the required investment flow;
3. To assess the system-wide implications of major policy options covering potential impacts on GDP growth rate, income per capita, jobs among different socio-economic groups, poverty, attainment of MDGs, natural resource use, ecosystem services, carbon emissions, and quality of life, plus compare these against the business-as-usual approach;
4. To offer policy recommendations to policy makers;
5. To strengthen the capacity of national stakeholders to participate in the development of green economy policies and to converge on the required interventions;
6. To map existing national and international programmes supporting an inclusive green economy in the country;
7. To provide recommendations on how green economy activities and other related national and international programmes and projects can be aligned to enhance the transition to an inclusive green economy.

Man holding millet cobs. © IFAD/Robert Grossman

1.3 METHODOLOGY

To achieve these objectives, the study relies on two methodological approaches: qualitative and quantitative. The qualitative analysis greatly depends on desk review of literature and stakeholder consultations, while the quantitative analysis relies heavily on the outputs of the Threshold 21 (T21) model (see Section Four). The T21 is a dynamic simulation model that integrates economic, social, and environmental factors in its analysis to support comprehensive and integrated long-term development planning[5].

The Ghana GE assessment is commissioned by UNEP and prepared by the Institute of Statistical, Social, and Economic Research (ISSER) at the University of Ghana and supervised by the Ministry of Environment, Science, Technology and Innovation (MESTI). Partnering ISSER on this assessment is the Millennium Institute (MI), which uses the T21 to build the quantitative scenarios, specifically Business-as-usual (BAU) and Green Economy (GE). Thus, this GE assessment report builds on the 2013 scoping study by offering rigorous comparative quantitative economic analyses of the different scenarios for the selected sectors. Data for building the Ghana T21 model and scenarios was gathered from the Ghana Statistical Service (GSS), Bank of Ghana (BoG), Ministry of Finance (MoF), Ministry of Energy and Petroleum (MoEP), Ghana Energy Commission (EC), Ghana Health Service (GHS), Ministry of Food and Agriculture (MoFA), Ministry of Environment, Science, Technology and Innovation (MESTI), Forestry Commission (FC), Environmental Protection Authority (EPA) and other international sources such as UNFPA, World Bank, etc. The study also benefited from the consultation of a wide range of stakeholders to ensure a high level of ownership.

1.4 REPORT STRUCTURE

Akosombo Hydroelectric Power Station on the Volta River in Ghana.
© Eunika Sopotnicka

The report is structured into six sections. Section 1 is the Introduction with Section 2 focusing on the country profile, including analysis of the macroeconomic, environmental, and social issues in the policy landscape. Section 3 identifies key sectors for greening based on a national stakeholders' consultative workshop held in November 2013, and details three key sectors (agriculture, energy and forestry) which are considered imperative to the greening of the economy. Section 4 covers the outputs of the T21 modeling of the three identified sectors for greening and examines the BAU and Green Economy scenarios and their relative implications. Section 5 discusses the policy enabling conditions for the transition into a Green Economy. Section 6 concludes the report with recommendations on the policy options and policy roadmap that will facilitate the transition to a Green Economy.

2 COUNTRY PROFILE: MACRO-ECONOMIC PROFILE AND IDENTIFICATION OF PRIORITIES

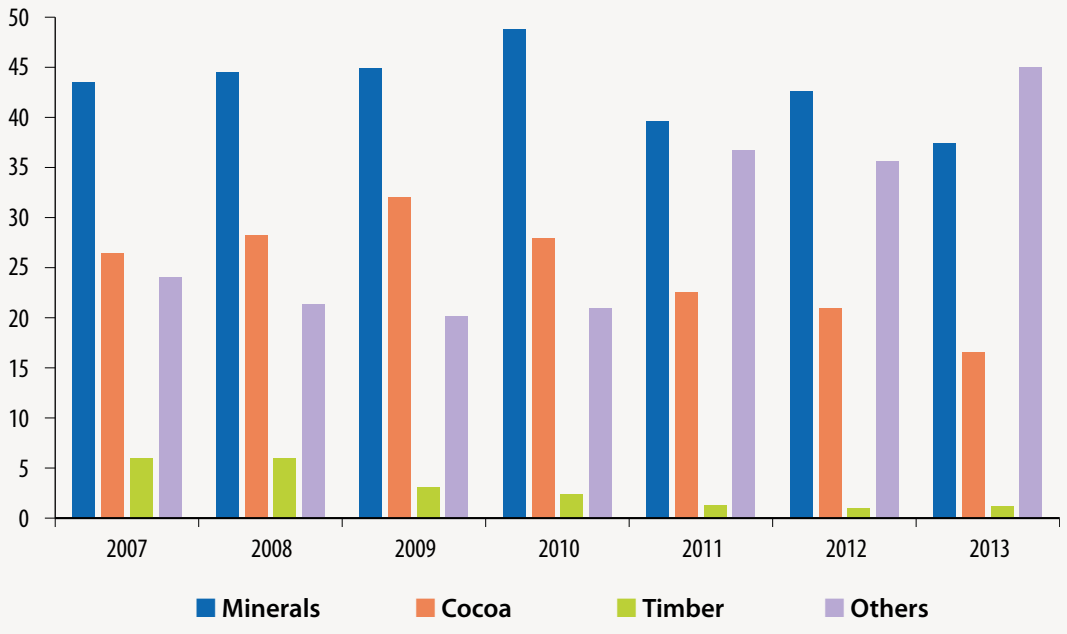
COCOA HARVEST.

2.1 MACRO-ECONOMIC PROFILE

Ghana attained lower-middle income status in 2011 when the GDP growth rate was one of the highest in the nation's history, at 14.4 per cent[6] with a value of $39.2 billion. The 2011 GDP growth rate was also about four times the world average of 3.8 per cent[7]. The growth was highly associated with the recent commercial extraction of oil and gas in the country. Political stability, good governance, and traditional exports were other factors that led to this growth miracle[8]. GDP growth rate used to vary between 3 per cent and 8 per cent until the commencement of commercial oil extraction in 2011 producing a double-digit growth rate. An average growth rate of 5 per cent was recorded between the years 1990 to 2010[9]. Beyond 2011, however, GDP growth rate has been declining. In 2012, GDP was estimated to be 7.9 per cent and further dipped to 5.4 per cent in 2013. The spiral slump in GDP is attributable to the poor performance outside of the oil sector. Non-oil real growth rate was estimated to be 9.4 per cent in 2011, slipping to 7.8 per cent and 3.9 per cent in 2012 and 2013[10] respectively.

Before 2011, major contributors to GDP were the minerals, cocoa, timber, and non-traditional export sectors. Minerals (gold, bauxite, diamonds, and manganese) are the major export earners of the country (Figure 2.1). In 2012, minerals accounted for 43 per cent of merchandise exported and contributed to 8.8 per cent of GDP growth. These contributions slightly dipped in 2013, where they accounted for 37.6 per cent of exports and 7.9 per cent of GDP growth[11]. As part of this sector, gold is the major export earner, accounting for about 97 per cent of total mineral export

FIGURE 2.1 COMMODITIES' CONTRIBUTIONS TO EXPORT EARNINGS



Source: ISSER, 2011; ISSER, 2014

earnings[12]. Gold earnings in 2012, for example, were $5,309 million whereas bauxite, diamonds and manganese represented $28.5 million, $11.16 million and $98.61 million respectively[13].

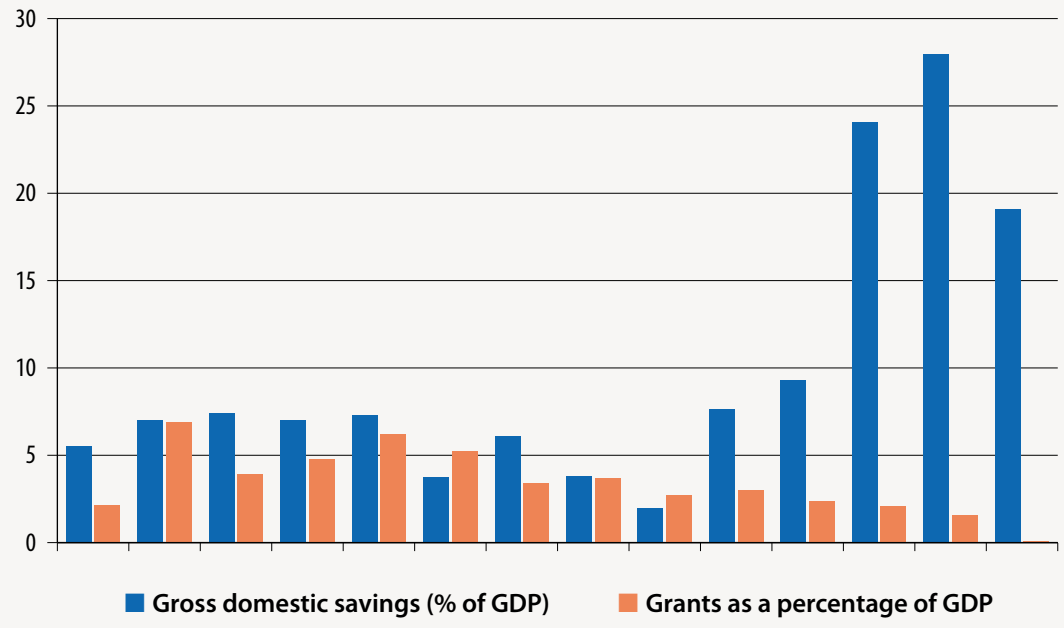
Cocoa is the second highest contributor to export earnings (Figure 2.1), accounting for about 20.9 per cent of total merchandise exported in 2012 and 16.5 per cent in 2013[14]. Cocoa accounted for 8.2 per cent of agricultural GDP[15] and 3.2 per cent to total GDP[16] in 2010. Some 599,318 metric tonnes of cocoa beans were exported in 2005 increasing to 903,646 metric tonnes in 2010[17]. Earnings from cocoa were estimated at to be $1,544.4 million in 2010, $2,870.8 million in 2011 and $2,828.6 million in 2010[18]. Timber is the least contributor to export earnings accounting for 1.3 per cent, 1.0 per cent and 1.2 per cent of merchandise export earnings in 2011, 2012, and 2013 respectively[19].

Mineral, cocoa, and timber export contributions changed in 2011 when Ghana became an oil-producing nation. Crude oil exports in 2012 accounted for 21.06 per cent of total export receipts. Comparatively, gold, cocoa, and timber exports came to 38.03 per cent, 20.9 per cent and 1.0 per cent respectively. This significantly altered the overall export picture. Given the current emphasis on oil production, traditional export contributions are expected to continue to fall over the years, particularly in the case of timber[20].

Despite impressive growth in GDP since 2011, Ghana faces major trade and fiscal deficits. Starting from 1990, the country recorded its lowest trade deficit in 1992 with a value of 1.39 million Ghana Cedis. In 2012, this rose to 11.8 million Ghana Cedis[21]. Reasons for this rising trade deficit include the high import of foreign products, particularly oil, for meeting energy demand[22].

An over-reliance on external partners coupled with low domestic savings for financing development projects is another critical challenge. Until 2009, grants were relatively equal to domestic savings (Figure 2.2). This was because of macro-economic recovery support for Highly Indebted Poor Countries (HIPC), which included Ghana, but also resulting in its reliance on donor backing for development[23]. Beyond 2009 however, domestic savings have risen in order to support government development initiatives (Figure 2.2). This growth in domestic savings versus the decline in grants was also the result of Ghana attaining medium income status in 2011[24].

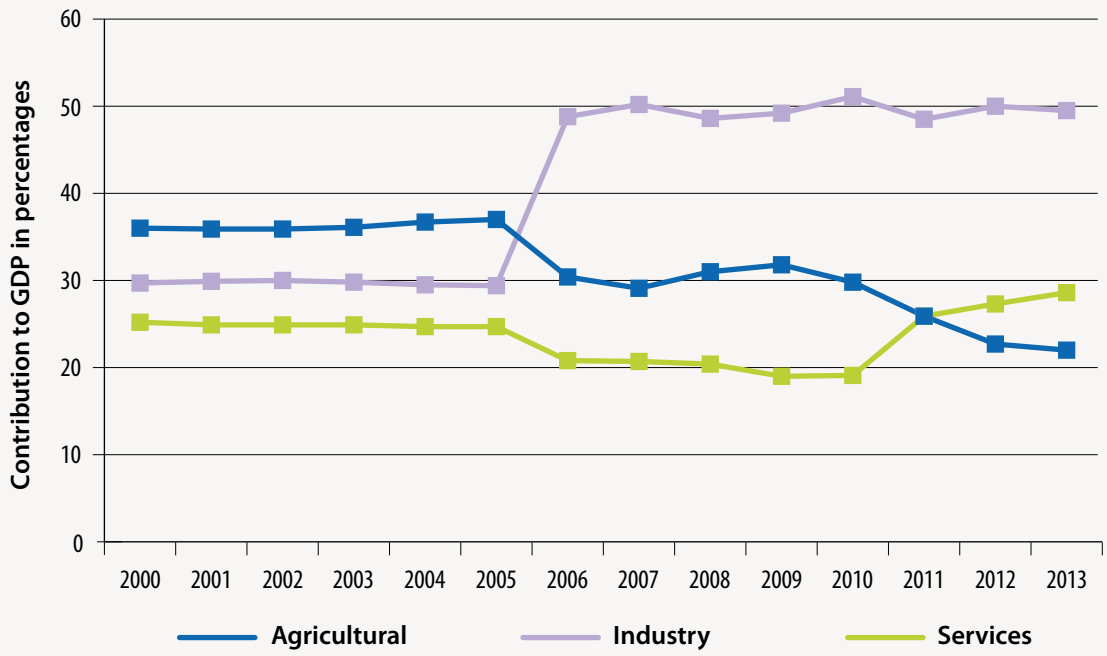
FIGURE 2.2 RELATIONSHIP BETWEEN GRANTS AND DOMESTIC SAVINGS AS PERCENTAGES OF GDP



Source: WDI; ISSER, 2014; ISSER, 2011; ISSER, 2005

Until 2006, Ghana's economy was largely driven by the agricultural sector, with its GDP contribution varying between 36.3 per cent and 48.8 per cent[25]. In recent years however, as the agricultural contribution declined, those of the service and industrial sectors have kept rising. In 2006, the service sector became the lead contributor to GDP, accounting for 48.8 per cent, while agriculture and industry contributed 30.4 per cent and 20.8 per cent respectively. The information and communication sub-sectors were the drivers behind the service sector's performance[26]. These trends in GDP contributions continued until 2011, when both services (48.5 per cent) and industry (25.9 per cent) outperformed the agricultural sector (25.6 per cent)[27] (Figure 2.3).

FIGURE 2.3 CONTRIBUTION OF SECTORS TO GDP IN PERCENTAGES

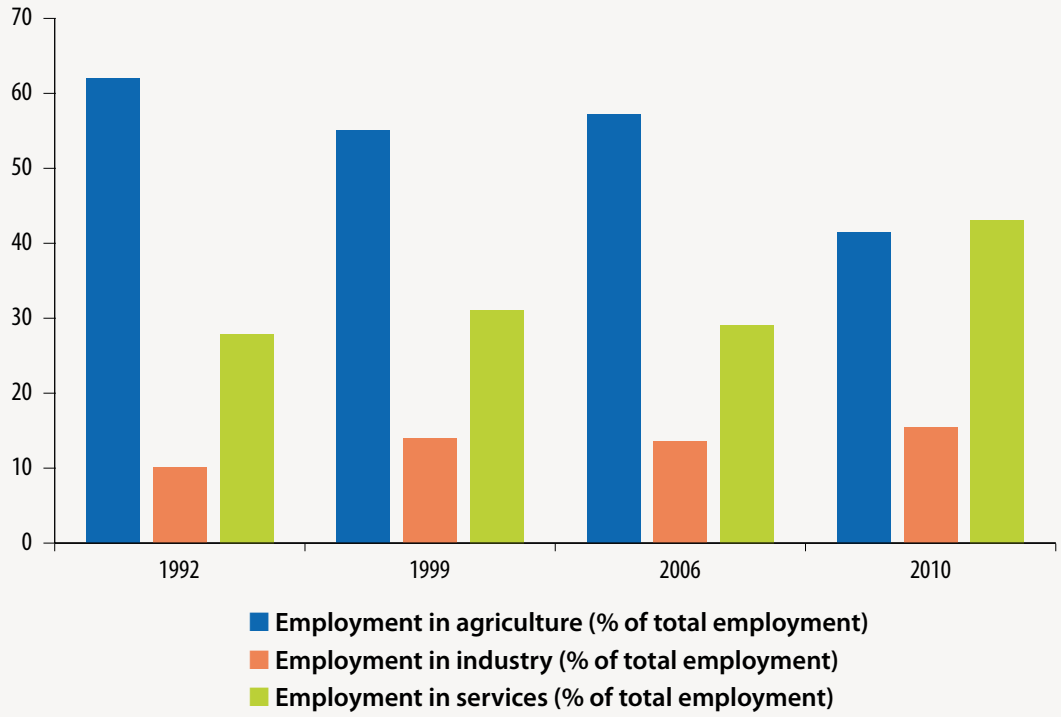


Source: ISSER, 2006; ISSER, 2014

The shift in the economy from agriculture to services altered employment numbers per sector, although not immediately. In 2006, when the service sector dominated the economy for the first time, agriculture still represented the highest number of jobs, representing 60 per cent of the total work force. In contrast, the service and industrial sectors accounted for the remaining 40 per cent (Figure 2.4). However, in 2010 the service sector became the country's lead employer, representing 43.1 per cent of the total labour force. Both agriculture and industry, on the other hand, accounted for only 41.5 per cent and 15.4 per cent respectively[28]. Over the years, industry has employed the fewest Ghanaians even though its overall share of the labour force has been increasing.

Ghana's economically active population has remained relatively steady over the years. In 2000, 77 per cent of the adult population (15 years plus) were considered to be economically active. An estimated 80.7 per cent were employed, 6.7 per cent unemployed while the remaining were either in school or sick/disabled[29]. In 2008, at least seven out of 10 adults were economically active. Of these, however, 3.6 per cent were unemployed, this was significantly more pronounced in urban (6.3 per cent) than rural (1.6 per cent) areas[30]. In 2012/2013, the economically-active population group was estimated at 75.7 per cent, representing a decline in unemployment of 2.3 per cent. Unemployment, however, was far more pronounced among females (3 per cent) than males (2.1 per cent)[31].

FIGURE 2.4 EMPLOYMENT BY SECTORS OF THE ECONOMY



Source: WDI

In the industrial sector, Ghana generally performs better than the sub-Saharan African regional average.
© IFAD/ Nana Kofi Acquah

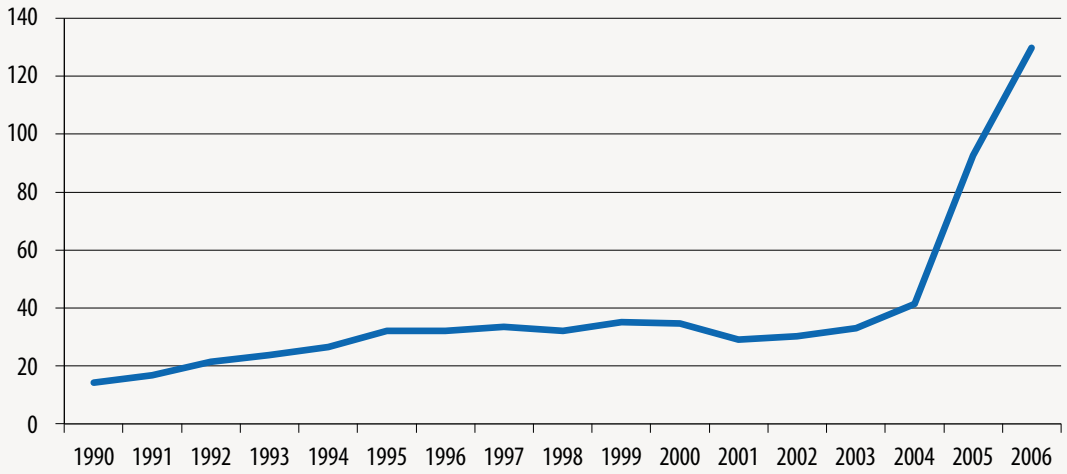
2.2 ENVIRONMENTAL FOOTPRINT

Ghana is endowed with abundant natural resources. These include minerals, forests, biodiversity, and freshwater. Despite the notable contribution of forest products especially, timber to Ghana's foreign earnings over the years, Ghana's forests have suffered from heavy degradation and deforestation mainly as a result of human activities including, illegal logging, burning and illegal mining activities. In mitigation, between 2000 and 2010 there have been mitigation interventions to improve and expand forest cover. Nevertheless, during this period Ghana experienced a net deforestation rate of 0.81 per cent of total land surface[32]. In addition, the cost of environmental degradation ranks as one of the highest in the world, roughly 10 per cent of GDP[33].

As previously noted, Ghana is also endowed with significant mineral resources, notably gold, manganese, bauxite and diamonds. While such minerals represent major contributors to the country's foreign exchange earnings, their extraction endangers both the environment and the health of human beings. Extractive operations comprising predominantly of illegal mining, account for 5 per cent of Ghana's forest degradation[34]. Mining pollutants have risen in recent years (Figure 2.5). This is attributable not only to the growing number of investors, but also the rise in illegal mining activities.[35]

Ghana has abundant water resources and with multiple uses. Nevertheless, water resources have come under heavy threat of pollution from domestic, agricultural, and industrial activities. Studies have revealed that the concentration of pollutants in some water bodies in the country, including the Oti, Densu and Angaw Rivers, are alarmingly high as they have exceeded the World Health Organisation's (WHO) recommended levels for fecal coliform counts; total coliforms; turbidity; total iron; color; and manganese in particular, making them unsafe for domestic purposes without any form of treatment[36].

FIGURE 2.5 EMISSIONS FROM EXTRACTIVE OPERATIONS IN GHANA IN $GTCO_2E$



Source: EPA, 2011

A key environmental challenge for Ghana is waste generation, comprising predominantly non-degradable elements (polythene bags, electronic products, bottles)[37]. About 3.3 million tonnes of waste is estimated to be generated annually[38]. In 2009, 2010, and 2011 70 per cent, 75 per cent and 77 per cent respectively of total waste generated were disposed of properly[39]. However, this leaves 30 per cent that have not been managed correctly.

While the allocation of government expenditure for environmental management increased in absolute terms, its share to GDP declined. More specifically, allocations to the Ministry of Lands and Natural Resources (MLNR) and the Ministry of Environment, Science, Technology and Innovation (MESTI) declined as a share of GDP in 2013 to 0.43 per cent compared to the 2011 provision of 0.49 per cent[40]. Table 2.1 presents public annual expenditure on the country's environment as compiled by the Ghana Statistical Service. While public expenditure on the environment has been declining, private sector expenditure on environmental issues has also been lacking[41].

TABLE 2.1 PUBLIC SECTOR'S ANNUAL EXPENDITURE ON THE ENVIRONMENT IN GHANA BETWEEN 2006 AND 2010 (IN US$ MILLION[42])

Year	Ministry of Food and Agriculture	Ministry of Water Resources, Works and Housing	Ministry of Energy and Petroleum	Ministry of Lands and Natural Resources	Ministry of Environment, Science, Technology and Innovation (MESTI)	Ministry of Local Government and Rural Development	Total
2006	1.11	8.87	0.02	3.57	0.83	5.71	19.95
2007	0.10	21.30	0*	3.90	6.33	1.80	33.43
2008	0.22	28.42	0*	7.86	4.24	37.03	77.77
2009	0*	40.44	0*	6.85	0*	0*	47.29
2010	0*	32.52	0*	5.46	0*	0*	37.98

*No data received from that ministry

Ghana is endowed with forests and wildlife.
© Walter Callens

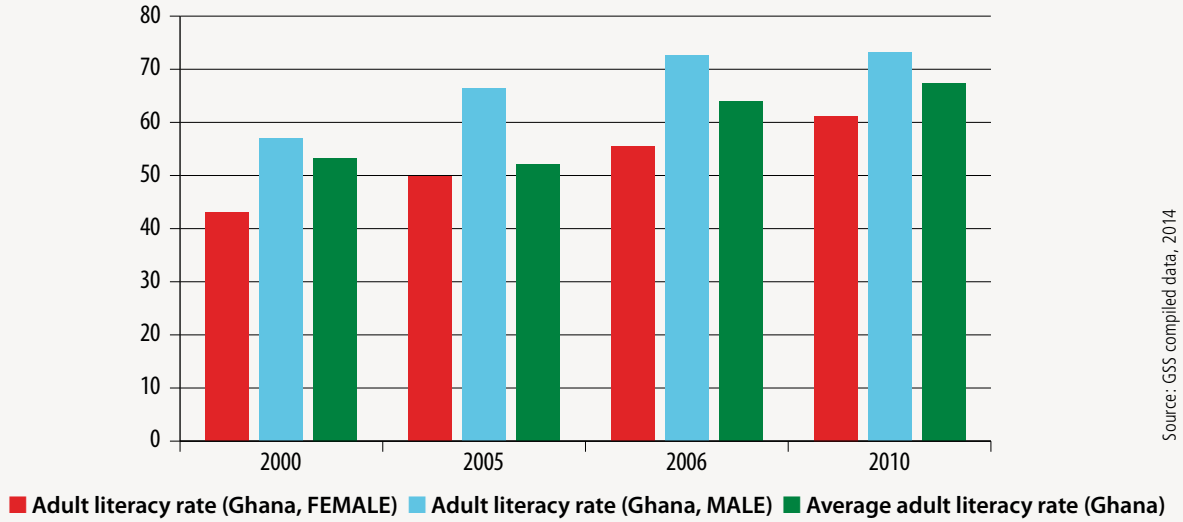
2.3 SOCIAL PROFILE

Ghana's population stood at 24,658,823 in 2010; 51.2 per cent female and 48.8 per cent male. Population growth rate was estimated at 2.5 per cent in 2010, a slight decline from the 2000 estimate of 2.7 per cent. The 2010 population and housing census further illustrated population dynamics by locality. Regions such as Greater Accra (16.3 per cent) and Ashanti (19.4 per cent) had the highest population share, while Upper East (4.2 per cent) and Upper West (2.8 per cent) recorded the lowest.

Ghana has made a significant effort in reducing poverty and income inequality over the years. The 1991/1992 poverty estimate of 51.7 per cent was almost halved by 2005/2006 to 28.59 per cent. This further declined to 24.2 per cent in 2013[43], representing Ghana's attainment of the first Millennium Development Goal (1a) of halving extreme poverty by 2015. Despite such poverty reductions, income inequality remains high across regions and between social groups[44]. The 2005/2006 income inequality estimate of 41.9 per cent increased slightly to 42.3 per cent in 2012/2013, with rural areas facing much higher inequality than urban areas[45]. For instance, the 37.8 per cent income inequality estimate for rural areas in 2005/2006 increased to 40.0 per cent in 2012/2013, in contrast, the 38.3 per cent estimate for urban areas in 2005/2006 rose slightly to 38.8 per cent in 2012/2013. In Ghana, underemployment is a far more pressing socio-economic issue than unemployment. It affects all age groups, unlike unemployment, which is more of a youthful phenomenon[46]. Underemployment is estimated to be twice that of unemployment (7.3 per cent to 3.6 per cent respectively) in the labour market[47].

Health indicators have improved over the years. Births attended by specialists have increased from 50.2 per cent in 2000 and to 58.5 per cent in 2011[48]. Infant mortality has declined from 57 to 31 per 1000 live births from 1993 to 2008. Maternal mortality has also dropped by 27.9 per cent between 1990 and 2013[49]. Furthermore, average life expectancy has increased over the years, from the 1993 estimate of 55.7 years to 60 years in 2008, this continued to rise to 61.8 years in 2012[50]. The literacy rate has gradually improved adult literacy (Figure 2.6) with males dominating[51].

FIGURE 2.6 ADULT LITERACY RATE BY GENDER



Source: GSS compiled data, 2014

2.4 POLICY LANDSCAPE

With Ghana's long-term development plan (Vision 2020) becoming obsolete, the policy architecture reflects a medium-term rather than long-term perspective. In other words, 'long-term' policies initiated by governments tend to reflect the politically expedient short or medium-term rather than long-term. These policies are usually drawn from the ruling government's development blueprint known as the 'Coordinated Programme of Economic and Social Development Policies (CPESDP)'. In line with this approach, the Ghana Poverty Reduction Strategy One and Two (GPRS I and II) were developed in 2003 and 2006 respectively.

GPRS I, which was implemented between 2003-2005, was designed to achieve significant debt relief under the HIPC initiative. Furthermore, the policy aimed at achieving macroeconomic stability in order to address poverty and its related issues[52]. The GPRS II built on the achievements of the GPRS I. It had the central objective of accelerating economic growth through structural transformation by developing the private sector, diversifying the export base, and increasing agricultural productivity in order to attain medium income status with a per capita income of $1000 within the implementation period of 2006 to 2009[53].

Ankasa Forest canopy.
© Courtesy www.carboafrica.net

The country's recent overarching medium-term development policy plans are the Ghana Shared Growth and Development Agenda One (GSGDA I 2010-2013)[54] and Two (GSGDA II)[55]. These policies had seven important themes: sustaining macroeconomic stability; enhanced competitiveness of the private sector; accelerated agricultural growth and natural resource management; oil and gas development; infrastructure, energy, and human settlements development; human development, employment and productivity; and transparent and accountable governance. The strategic plan for its implementation had provisions for the transition to green economy and several opportunities to reform various sectors. *Inter alia,* it stressed the following: carrying out a Strategic Environmental Assessment (SEA) to inform decision-making in all sectors of the national economy; reducing the environmental impacts of mineral extraction; expanding the Protected Area System; promoting regulatory or economic incentives, and improving institutional/ policy reforms for the sustainable management of natural resources, including forest, water, land and coastal resources management.

The GSGDA II (2014-2017) is developed to build upon GSGDA I and further correct the bottlenecks that hindered the complete implementation of GSGDA I's initial objectives. This medium-term development plan was based on GSGDA I's ability to attain middle income status for the country and the commercial exploitation of oil and gas. GSGDA I did, in fact, succeed in creating the expected results of poverty reduction among different segments of the society; it also led to job creation and infrastructure investment. GSGDA II therefore envisions "a stable, united, inclusive, and prosperous country with opportunities for all" through "leveraging Ghana's natural resource endowments, agricultural potential, and the human resource base for accelerated economic growth and job creation through value addition." Implementation of the development plan is pegged to four pillars: human development, productivity and employment; ensuring and sustaining macroeconomic stability, enhancing competitiveness of Ghana's private sector, accelerated agricultural modernization, and sustainable natural resource management; infrastructure and human settlement development, as well as oil and gas development; and transparent and accountable governance.

Ghana's Environmental Fiscal Reform Policy (EFRP), National Climate Change Policy (NCCP), National Climate Change Adaptation Strategy (NCCAS) and National Climate Change Master Plan (NCCMP) are other related initiatives undertaken by the Ghanaian Government to foster green economy transition as well as create resilience for climate change adaptation and mitigation. These policies are built on the context of scarcity of natural resources and they advocate controlling negative externalities, plus encouraging more efficient utilization of resources by incorporating a 'polluter pays' principle; a 'user pays' principle; the prevention principle; and the precautionary principle[56]. The EFRP further seeks to modify taxes and public expenditures as a disincentive to polluters in order to encourage sustainable development, environmental protection, climate change mitigation, and adherence to green economy principles[57]. The Energy Policy and Renewable Energy Act further shows government commitment to transforming the economy into a green one. These will help contribute to the reduction of pollution and to promote energy security by shifting attention from conventional to renewable energy sources.

2.5 MAPPING OF PROGRAMMES IN SUPPORT OF AN INCLUSIVE GREEN ECONOMY IN GHANA

Several national and international programmes have been identified to support an inclusive Green Economy in Ghana[58].

Table 2.2 below presents the objectives and funding agencies of such programmes.

TABLE 2.2 NATIONAL AND INTERNATIONAL PROGRAMMES IN SUPPORT OF INCLUSIVE GREEN ECONOMY IN GHANA

Programme	Objectives	Duration	Implementing Agency
Switch Africa Green (SAG)	Supporting the development of green businesses and eco-entrepreneurship. Promoting the use of sustainable consumption and production practices in industries.	January 2014 to December 2017	UNEP
Green Economy and Trade Opportunities Project (GE-TOP)	a) National Study to assess Ghana's solar export potential and its contribution to national economic growth, employment creation and climate change mitigation. b) Strategy Proposal to recommend a step-by-step action plan for planning and financing a solar-ready, cross-border grid line between Ghana and Burkina Faso.	August 2013 to December 2015	UNEP
Biogas Technology and Business for Sustainable Growth	To increase clean energy access through the promotion of industrial-scale biogas technologies.	September 2013 to August 2016	UNIDO
Green Economy in Biosphere Reserve	Supporting biodiversity conservation.	September 2013 to August 2016	UNESCO
China Ghana South Cooperation on Renewable Energy Technology Transfer	To help facilitate the UN's Sustainable Energy for All initiative to boost Ghana's attainment of universal access to modern energy sources.	July 2014 to June 2018	UNDP
Low Emission Capacity Building Programme	To help design and implement low emission development strategies and national mitigation actions.	January 2011 (Commenced in 2012) to December 2016	UNDP
Capacity building for the elimination of polychlorinated Biphenls	To help build human and institutional capacities to undertake effective management of all polychlorinated biphenyls (PCBs).	Dec. 2008 to Dec. 2013	UNDP/UNITAR

Programme	Objectives	Duration	Implementing Agency
Sustainable Public Procurement (SPP)	To help embed the principles of transparency, accountability, and sustainability in public procurement by strengthening the monitoring & evaluation system in Ghana.	3 years 2014 to 2017	SECO
National Resources and Environment Governance	To support the government through reforms at improving environmental and natural resource management in the forest, wildlife, and mining sectors.	4 years Sept. 2008 to Sept. 2012	World Bank
Sustainable Energy for All	To help achieve three overarching goals: universal access to modern energy services, doubling the rate of improvements in energy efficiency, and doubling the share of renewable in the global energy mix by 2030.		Government of Ghana
Green Climate Fund Readiness Project	To help finance projects and implement strategies that are geared towards climate change mitigation and adaptation; REDD+; and low-carbon development.	2015 to 2016	UNEP and UNDP
Ghana National Low Carbon Development Strategy	To help develop an economically efficient and comprehensive LCDS for Ghana together with a monitoring, reporting and verification system and an action plan.		MESTI
Sustaining Competitive and Responsible Enterprise (SCORE)	To support SMEs to adapt to best international practices in the manufacturing and service sectors. To enhance SMEs participation in the global supply chains.	Phase one (2009 to 2013) Phase two (2014 to 2017)	ILO
Ghana Climate Innovation Centre Ghana	To support the growth of local climate (clean) technology businesses through the provision of financing and business incubation services.	2014 to 2019	DANIDA
Labour Intensive Public Works (LIPW)	To improve socio-economic status of rural dwellers through the provision of local employment and income-earning opportunities in the agricultural off-seasons.		World Bank
Partnership for Action on Green Economy	To support a green economy transition in terms of policies, processes, and institutional mechanisms for policy dialogue.	2013 to 2017	UNIDO
Global Environmental Facility (GEF)	To support developing countries with funds for projects and programmes related to biodiversity conservation, climate change, land degradation, and waste, water and chemical managements.	1991 to date	World Bank
Promotion of Energy Efficiency and Transformation of the Refrigerating Appliances Market in Ghana (EETRAM) Programme	To support Ghana's effort of reducing emissions in the energy sector through refrigeration systems recovery, recycling, and/or disposal of environmentally damaging refrigerants.	July 2011 to June 2014	UNDP
Collaborative Actions for Sustainable Tourism Project (COAST)	To support and enhance the conservation of globally significant coastal and marine ecosystems and associated biodiversity in Sub-Saharan Africa, through the reduction of the negative environmental impacts associated with them.	2009 to 2014	UNEP/UNIDO
The One UN Climate Change Learning Partnership (UNCC: Learn)	To support the government in developing a national climate change learning strategy. Through the strategy the country will identify skills development needs in priority sectors and agree on a number of specific actions to scale-up education and training activities in line with national climate change objectives.	June 2015 to December 2016	UNDP

Waterfall in Ghana. © UNEP

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3 KEY SECTORS IDENTIFIED FOR GREENING THE GHANAIAN ECONOMY

SMILING WOMAN IN FRONT OF HER MARKET STALL IN GHANA.

3.1 INTRODUCTION

The agricultural, forestry and energy sectors present key opportunities for greening the economy in Ghana, and are thus the focus of this assessment. These sectors were selected through a national stakeholders' consultative workshop in December 2013 (see Appendix 1). This was based on their significant contributions to gross domestic product (GDP), economic welfare, low carbon development, global competiveness and other imperatives. See criteria in Appendix 3. Detailed descriptions of the key elements of these sectors are noted below.

Stormy weather at Lake Bosumtwe.

3.2 AGRICULTURE SECTOR

Until 2006, the agricultural sector was the engine of growth in Ghana, accounting for approximately half of the country's GDP (48.8 per cent in 1996), underpinned by the then productive lands, good pattern of rains, budgetary allocations, and the large number of employees. The sector is the main source of livelihood for many Ghanaians and employed over 60 per cent of the working age population in 2006. However, between 1991 and 2010 its share of the labour force declined from 62 per cent to 41.5 per cent respectively[59].

Statistics from the Ministry of Food and Agricultural (MoFA) for 2011 indicate food sufficiency in the country, predominately from carbohydrate foodstuffs[60]. A net surplus of various food commodities was recorded before 2012/2013. Where the food products were

imported, such as cereals, the quantity of imports were less than domestic production[61]. The crop sub-sector accounts for 19.3 per cent of the country's GDP, and constitutes one of the vital components of the agricultural sector[62]. Crop production has consistently witnessed positive growth over the years. In 2002, crop production grew by 30.6 per cent in comparison with the 2000 production value and, between 2003 and 2011, registered a growth rate of 47.8 per cent. Crop production, however, faces a major challenge with erratic rainfall sometimes affecting yields[63].

Quality cocoa beans are a major commodity of this sector as Ghana is the world's second largest exporter[64]. Until the commercial production of oil in 2011, cocoa was also the country's second largest export earner, accounting for 28.7 per cent of foreign exchange in 2010. Total earnings were estimated at US$ 2,285.2 million in 2010, roughly twice as much as in 2007 estimated at US$1,103.3 million[65]. This rise was largely attributed to improved tree crop management, infrastructure, research programmes and the provision of investor incentives[66].

Various practices, such as the use of traditional farm machinery, land clearing and bush burning, inorganic fertilizers, and the over-reliance on rainfall are major challenges confronting the sector. These practices have contributed to deforestation, greenhouse gas emissions, and water pollution. The contribution of agricultural practices to deforestation was estimated to be 50 per cent in 2010[67], while annual CO_2e emissions rose by 44.17 per cent between 1990 and 2006[68]. This has increased further in recent years to 45 per cent of total emissions by 2012, primarily due to the merging of the Agricultural, Forestry, and Other Land Use (AFOLU) sectors[69].

3.2.1 CURRENT AGRICULTURAL POLICIES

Agricultural mechanization is the bedrock of GSGDA I (2010-2013) and GSGDA II (2014-2017). As part of its core objectives, GSGDA I sought to promote the modernization of agriculture, food security, and the creation of employment opportunities within the agricultural sector. Key strategic aspects of this policy include: improving agricultural productivity; increasing agricultural competitiveness and enhanced integration into domestic and international markets; reducing production and distribution of risks/bottlenecks in agriculture and industry; selected crops development; livestock and poultry development; promotion of fisheries development; and improving institutional coordination.

The Food and Agricultural Sector Development Policy (FASDEP) II also offers a framework for the achievement of agricultural sector policy goals. As a result of FASDEP I's failure to provide a framework for the modernization of the sector, FASDEP II was formulated to create an enabling environment for all categories of farmers, particularly the poor; enhance food security and emergency preparedness; boost income earnings of farmers; enhance market competitiveness both domestically and internationally; enhance institutional coordination, adaptation of science and technology; and sustainability of land and environment.

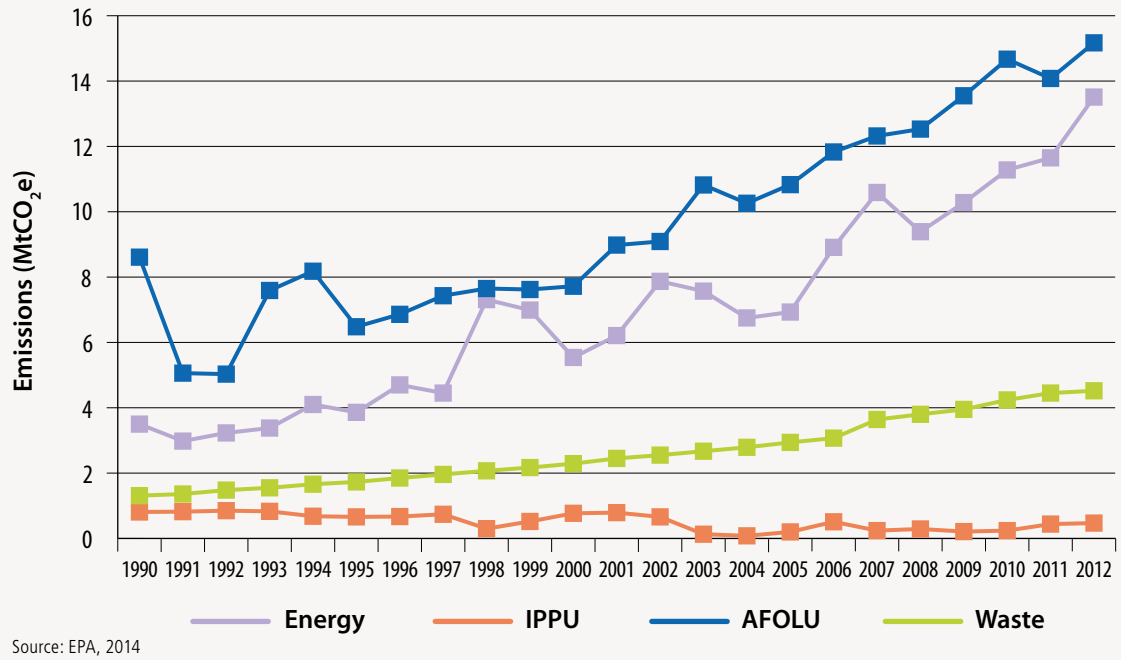
Mechanizing agriculture through the establishment of Agricultural Mechanization and Service Centres (AMSECs), which are based in all district capitals, coupled with government support to the private sector for strengthening their capacity to either manufacture or assemble appropriate and affordable agricultural machinery, all represent opportunities for the greening of the sector. GSGDA II and Ghana's Vision 2020 highlight the Government's readiness to partner with private sector enterprise to form a Private-Public-Partnership (PPP) as a means of mechanizing the sector by promoting modern scientific technologies that are not harmful to the environment and human health. This will contribute, above all, to food security, job creation, and minimizing sectoral emissions from this sector, since the policies underscore the need for more environmentally-conscious practices.

3.3 FORESTRY SECTOR

There are two main types of natural forest in Ghana: the closed forest located in the middle belt, and Savannah forest found in the northern part of the country[70]. Savannah forest constitutes 66 per cent of the country's woodland areas with 14.7 million hectares, while the remaining 34 per cent constitute closed forest. There are 266 forest reserves in the country with a forest cover of 2.5 million hectares[71]. There are also 216 off-reserve forest areas totaling 1.6 million hectares. The forest sector is indispensable both to the economy and the environment of Ghana. Until 2011, timber was the third major export earner, but is currently fourth. Primary woods, which are highly traded in the timber export market, account for 89 per cent of lumber exports while the processed wood accounts for the remaining 11 per cent[72]. Over the years, forestry contributions to GDP have declined. For instance, the 8.1 per cent contribution of timber to export earnings in 2005 fell to 0.99 per cent in 2012[73]. These drops are attributable to past overexploitation of the forest resources through illegal chain-saw operations as well as Ghana's over-dependence on wood fuel as a major source of energy[74].

Forestry has two main sub-sectors: the formal and informal. The formal sector incorporates some 200 timber-processing mills employing about 120,000 Ghanaians. while the informal constitutes some 130,000 illegal chain-saw operators, mostly rural dwellers[75]. About one-third of rural households in Ghana derive their livelihoods from forest products and two-thirds from non-cash income[76]. Despite the gains from this sector, deforestation, forest degradation, reduction in the sink capacity of forest for carbon dioxide (CO_2), and the ecological destruction of

FIGURE 3.1 EMISSIONS BY SECTORS IN GHANA



Source: EPA, 2014

biodiversity are all challenges confronting the sector. Accordingly, about 50 per cent of the high-forest zones were lost between 1900 and 1946 because of deforestation and forest degradation, while in the mid-1950s, the non-reserve forest lands were further halved due to agricultural activities, settlements, and other forms of deforestation[77]. Currently, the annual rate of deforestation is estimated to be 2 per cent (2010 est.). Thus annually, about 135,000 hectares of forest lands are degraded[78], thereby further reducing the capacity of forest to absorb CO_2 (Figure 3.1).

3.3.1 CURRENT FORESTRY POLICIES

The 2012 Ghana Forest and Wildlife Policy currently governs the forestry sector. It is a revised version of the 1996 Forestry Development Master Plan (FDMP) and the 1994 Forest and Wildlife Policy, which were the main policy tools previously used. This revision was necessitated by a number of factors, notably climate change and also the weaknesses of the then policies to halt illegal activities including logging and mining, which caused the extinction of several species and degradation of the forest[79]. The Ghana Forestry Commission is responsible for the management and implementation of policies and laws in the sector. The sector, comprises both private and government bodies, which are responsible for the administration, development, and utilization of forest and wildlife resources. Key government agencies include the MLNR which includes, the Forestry Department, Wildlife Department, Forest Products Inspection Bureau, Timber Export Board, Forestry Commission and the Forestry Research Institute of Ghana.

The MLNR is the sector ministry and responsible for the direction and monitoring of polices on environmental sustainability. The protection and management of wildlife and the preservation of their ecology are the functions of the Wildlife Department; the certification of products in the timber market is solely the function of the Forest Products Inspection Bureau. The Ghana Forestry Research Institute undertakes research that is in line with forest management.

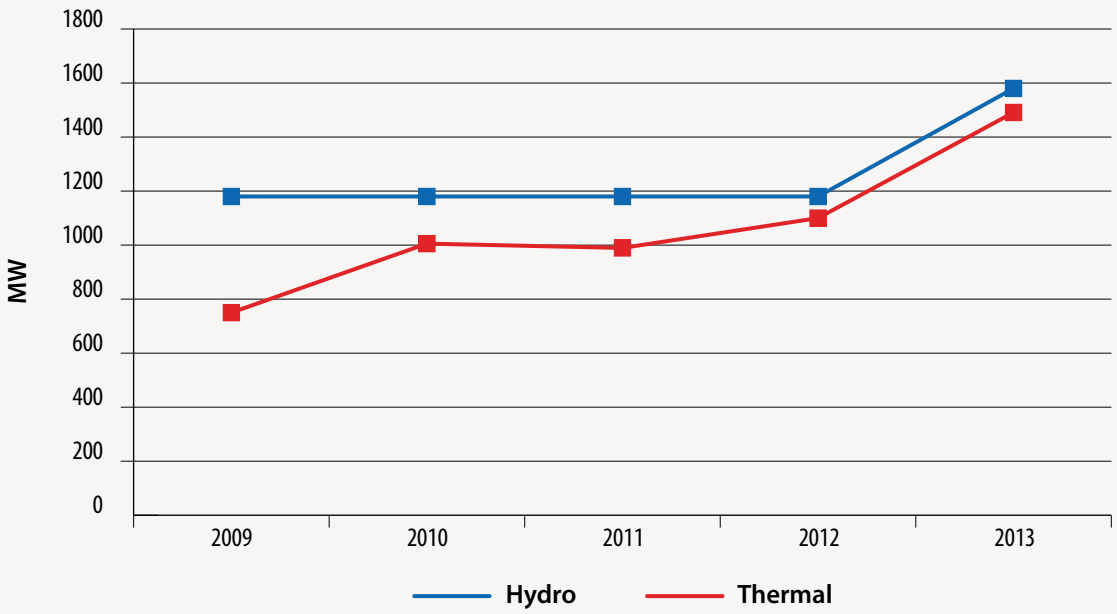
The 2012 revised Forest and Wildlife Policy of Ghana placed major emphasis on sustainability. "Conservation and sustainable development of the nation's forest and wildlife resources for the maintenance of environmental quality and perpetual flow of benefits to all segments of society" became its prime objective, very much in line with the key elements of green economy. Several strategies have been designed to underpin this new central focus of the forest and wildlife policy: revision of forest reserve management planning procedures for more sustainable approaches, including development of biodiversity conservation and environmental protection in the high-forest zone; establishment of databases, and Information and Communications Technology (ICT) to facilitate decision-making and policy analysis; local community participation in the management of forest and wildlife resources, with rights to consultation, access, and benefits; private sector investment in plantation development, focusing on the conversion of the timber industry into a low volume, high value industry; and legislative reform in support of these strategies.

Ghana is currently implementing the Reducing Emissions from Deforestation and Forest Degradation Plus (REDD+) programme. This has the potential to create employment opportunities, enhance livelihoods and biodiversity, as well as the capacity of the forest to absorb more carbon dioxide. More green economy investment opportunities are available within REDD+ for both private and public sectors can take advantage. The Savannah Accelerated Development Agency (SADA) project also possesses potential for greening the forestry sector, which will ultimately contribute to the absorption of carbon dioxide. This is an investment opportunity for any private investor and could lead significantly to the creation of jobs for the vulnerable segments of society.

3.4 ENERGY SECTOR

Ghana is well endowed with a variety of energy resources, notably biomass, hydrocarbons, hydropower, solar, and wind. Until the completion of the Bui dam with a capacity of 400 MW in 2013, the Akosombo and the Kpong plants were the two main hydro-electric plants in the country with total capacity of 1,180 MW[80]. With the inclusion of Bui Dam's generation, the country's total hydropower generation capacity is about 1,580 MW[81], constituting 57 per cent of total electricity production. Several thermal plants have a generation capacity of 1100 MW, constituting 43 per cent of electricity (Figure 3.2).

FIGURE 3.2
INSTALLED POWER GENERATION CAPACITIES FROM HYDRO AND THERMAL SOURCES IN GHANA

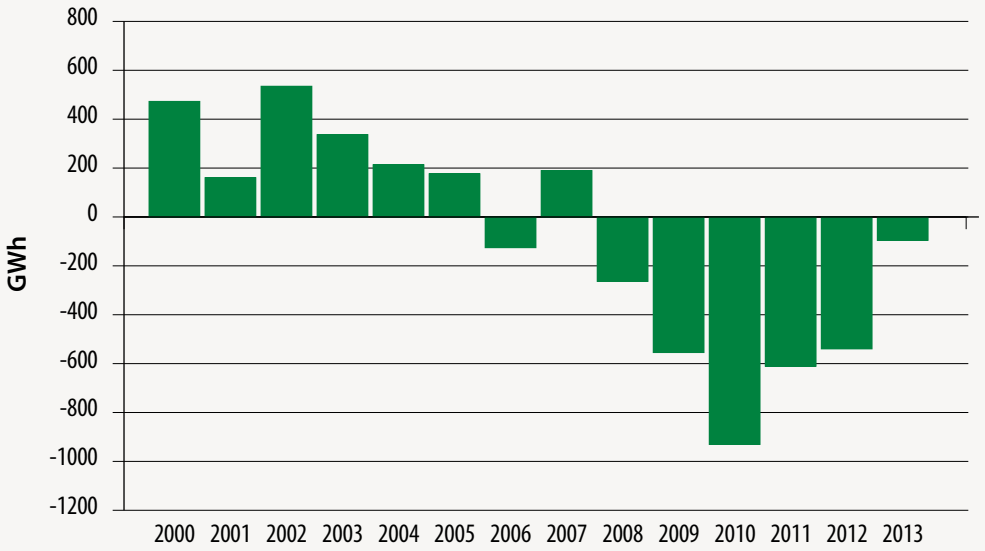


Source: EC, 2014

Despite its production of commercial oil, Ghana remains a net importer of crude oil. Imported crude recorded the highest value in 2007 with a volume of 2,053.7 kilotonnes[82]. In 2007, 40 per cent of imported crude oil went into electricity production with the remaining 60 per cent into refinery. The importation of natural gas started in 2009 for the thermal plants from 197,977.0 MMBtu in 2009 to 30,524,558 MMBtu in 2011 before falling to 15,491,670 MMBtu in 2012.

Ghana either imports or exports electricity depending on fluctuation of its own power demand and supply, which are further conditioned by weather conditions, availability of natural gas to power the thermal plants, and transmission losses. In 2000, for example, 2.8 per cent of the total energy generated was lost during transmission, rising to 4.3 per cent in 2012[83]. Industry and population growth, the use of inefficient electrical appliances, and inefficient energy use habits

FIGURE 3.3 IMPORT AND EXPORT OF ELECTRICITY IN GHANA (KILOTONNES)

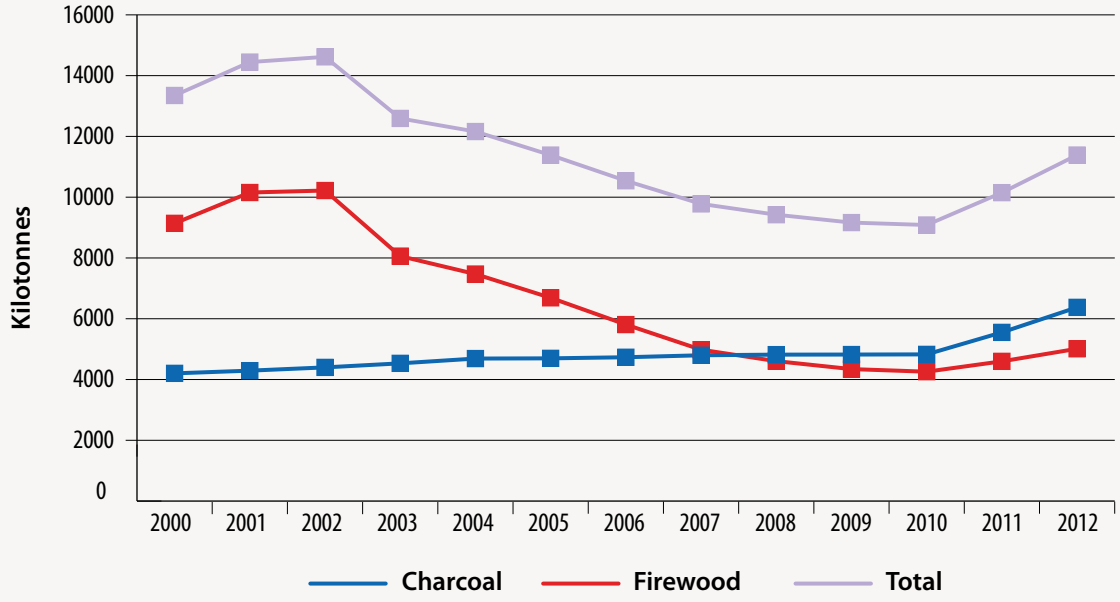


Source: EC, 2014

of the population are additional factors causing fluctuations in demand and supply. Figure 3.3 shows the relationship between imports and export of electricity in the country.

Wood fuels, mainly in the form of wood and charcoal, make up 75 per cent or more of the national energy consumption[84]. Although the demand and supply of wood fuel have been falling over the years, they are still substantial at the current rate with the depletion of forest resources (Figure 3.4). About 40 per cent of households use firewood as their major energy source for cooking, followed by charcoal (33.7 per

FIGURE 3.4 WOOD-FUEL SUPPLY IN GHANA (KILOTONNES)



Source: EC, 2013

cent), and gas (18.2 per cent)[85]. It is estimated that Ghana's growing stock of biomass stands at roughly 322 million metric tonnes with an annual incremental growth of 12.3 million tonnes[86]. The wood fuels are obtained mainly from vegetation woodland resources resulting in the loss of vegetation cover in the country.

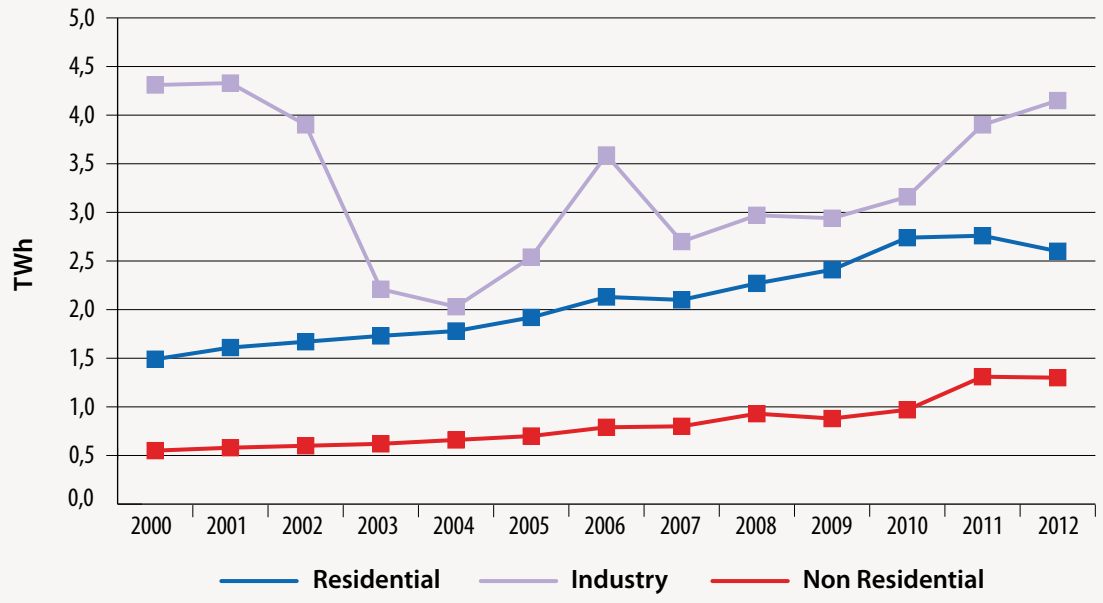
Other than existing hydroelectric generation, new renewable energy sources (bioenergy, solar, wind, biogas, etc.) remain the least tapped in Ghana despite their abundance. Only 2.5MW capacity of solar PV has been installed so far in the country, while wind turbine installations are non-existent. Bioenergy in the form of biofuel and biogas, which have been tested, are being used by few individuals, and are yet to be developed on a large scale. The composition of energy by type reveals that Ghana's wood fuel and charcoal use dominates energy consumption type (60 per cent) with electricity accounting for 11 per cent and petroleum 29 per cent[87].

Among the demand sectors, a large percentage shares in the total electricity supply is absorbed by the industrial sector, followed by the residential, and the non-residential sectors, including the transport sub-sector (Figure 3.5). The significant industrial sector increment was largely due to the Volta Aluminium Company (VALCO). The percentage growth in the residential demand has been positive and consistent over the decade indicating the extent of rising household energy use, especially in the urban centres.

Current energy consumption statistics reveal that the mines are now the highest electrical energy consumers within the industrial sector, accounting for 34.5 per cent (2013 estimate) of industrial use, but representing 15.6 per cent of total energy demand[88]. Electricity access increased from 60.5 per cent in 2010 to 75 per cent by the end of 2013[89]. Notwithstanding this level of access, disparities still exist between rural and urban settings. With as high as 80 per cent of urban dwellers having access to grid electricity, less than 30 per cent of rural dwellers, predominately in the Northern Regions, have access to grid electricity[90].This is mainly a result of the government's inability to meet the huge investment cost for grid extension to places with relatively small settlements and populations of less than 100[91].

The energy sector is the leading contributor to greenhouse gas (GHG) emissions in Ghana. In 2000, the sector accounted for about 41 per cent of total GHG emissions in the country. Between 1990 and 2006, a 183 per cent increase in emissions was recorded from this sector[92].

FIGURE 3.5 ENERGY DEMAND BY SECTOR



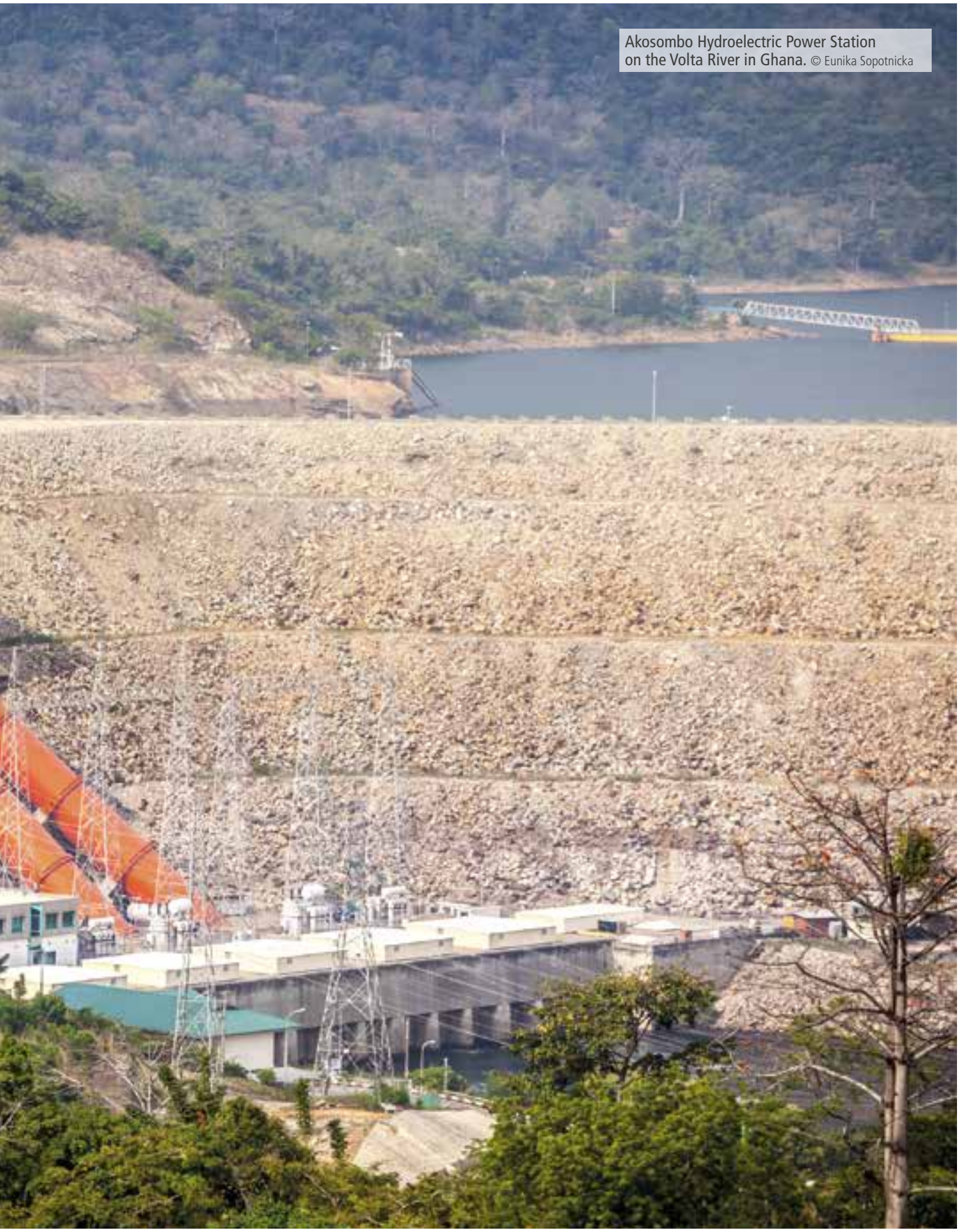
Source: EC, 2013

3.4.1 CURRENT ENERGY POLICIES

The National Energy Policy, which was formulated in 2010, is the current driver of the sector[93]. The central objective of this policy is to develop an "energy economy that would secure a reliable supply of high quality energy services for all economic sectors. It further aims to improve energy production in order to have a surplus that can be exported for foreign exchange. The goals of this central objective include: readily available energy services at any time to meet demand; universal accessibility of energy services through infrastructure investment; promotion of energy efficiency measures and achieving quality standards at acceptable prices in both local and international markets.

At the power sub-sector, the policy is aiming to achieve universal access to electricity by all Ghanaians at affordable prices by 2020 through increased power generation. As part of the petroleum sub-sector, it seeks to achieve sustainability in the exploration, development, and production of Ghana's oil and gas endowment and discerning management of its revenue for social wellbeing maximization. The policy also seeks to increase the use of renewable technologies in the national energy mix, while at the same time ensuring efficiency in production and use. Actions outlined to achieve the objectives of the renewable sub-sector include: improvement in the production and efficient use of biomass in the short term while increasing regeneration; fuel substitution in the medium to long-term by shifting from the use of biomass to alternative sources of energy; engagement of Ghanaian engineers and scientists to cooperate with other experts to bring down the cost of solar and wind energy technologies in order to make them competitive; creation of fiscal and pricing incentives to enhance the development and use of renewable energy.

The 2010 energy policy of Ghana has goals for the transformation of waste into energy through various technological approaches. The policy offers various green economy opportunities for investments in the renewable energy sub-sector. The passing of Ghana's Renewable Energy Act, 2011 (Act 832) with the enshrinement of the Feed-in-Tariff (FiT) scheme is a measure that will guarantee investors a good return for their investments.



Akosombo Hydroelectric Power Station on the Volta River in Ghana. © Eunika Sopotnicka

4.1 DESCRIPTION OF MODEL, ASSUMPTIONS AND DATA SOURCES

4.2 SCENARIOS OF INCREASED INVESTMENTS, INCLUDING TARGETED SECTORS AND CAPITAL INVESTMENTS

4.3 MODELLING RESULTS IN COMPARISON WITH BAUS

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4 GREENING SCENARIOS FOR GHANA

GHANAIAN OPEN PIT GOLD MINE.

4.1 DESCRIPTION OF MODEL, ASSUMPTIONS, AND DATA SOURCES

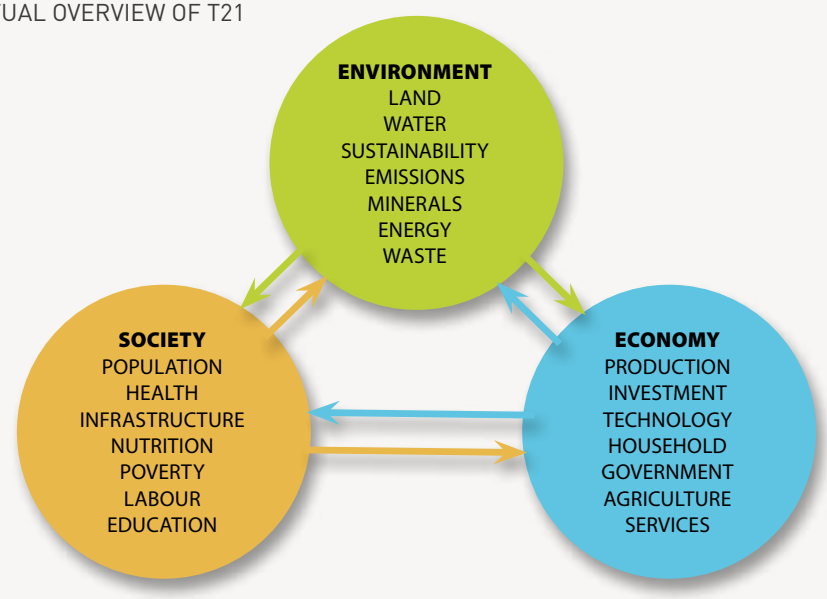
4.1.1 OVERVIEW OF MODEL STRUCTURE

The Threshold 21 (T21) is a System Dynamics-based model designed to support integrated long-term national, regional, and global development planning. The model integrates in a single framework the economic, social, and environmental aspects of development. Various sectors under the different spheres (environment, society, and economy) interact with one another (Figure 4.1), with each of these sectors being further divided into modules (MI, 2011a). Unlike other models, which are limited to one or two sectors, the T21 combines all sectors in its analysis.

The T21 therefore provides policy makers with an analytical tool to understand the multifaceted interdependence among the numerous sectors of the development process, which enable them to make decisions about where to invest scarce resources (MI, 2005). Built under the assumptions of the Cobb Douglas production function and equilibrium in each sector, the T21 further supports comparative analysis of different policy options. It also reveals how different strategies interact with one another to achieve a set of goals and objectives. Its transparency and level of aggregation make it ideally suited to support comprehensive analysis of different governmental strategies. The T21 model can also serve as a complement to budgetary models and other short-medium term planning tools by facilitating their alignment with the long-term development goals of the country.

The economic sphere is made up of the major production sectors, which are characterized by Cobb-Douglas production functions. The social sphere, on the other hand, comprises detailed population dynamics. The environmental sphere tracks production sustainability and the pollution created in the process (MI, 2011b).

FIGURE 4.1
CONCEPTUAL OVERVIEW OF T21



Source: MI Team, 2014

4.1.2 T21 MODEL CUSTOMISATION FOR GHANA

In relation to Ghana, the T21 model is further expanded to disaggregate the specific priority sectors, such as separating the mining sector from other industries. This facilitates the representation of the green policies analyzed in Section 4.2.2, and will help take into account the impact of climate change in the model.

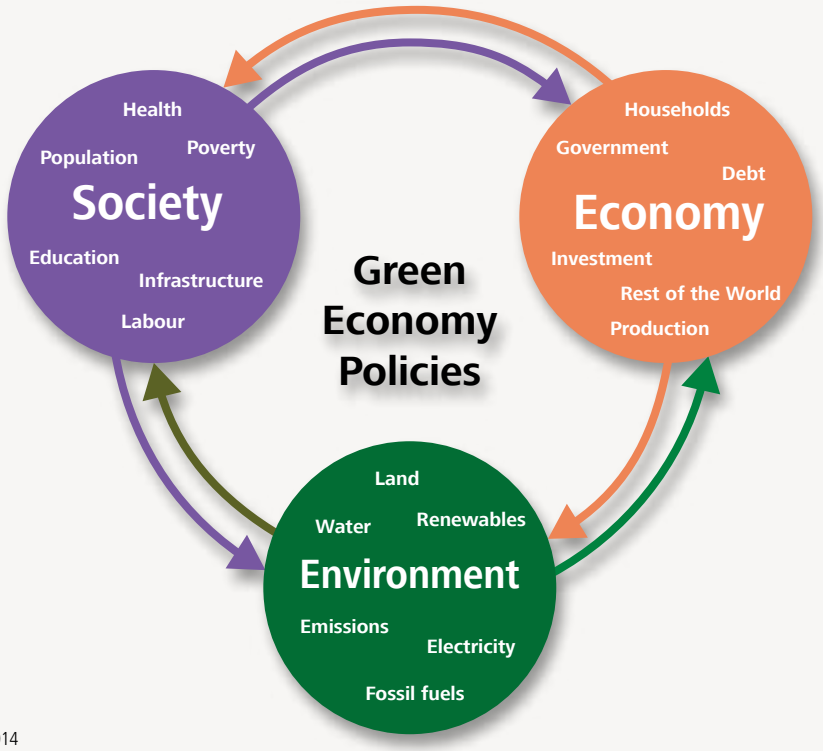
The green economy components were selected and incorporated in this study through the national stakeholders' (see Appendix 1) participatory process in December 2013. This led to the prioritization (Appendix 3) of the sectors based on various criteria resulting in their corresponding green policies being incorporated into the model. The effects of climate change were added to the model through consultation with national experts.

The T21 Ghana – GE not only integrates green policies, but also takes into account indirect effects in all sectors. This is because a change caused by a direct effect, such as the manner with which the area of land in the environmental sphere affects other variables. This also affects other sectors, such as agriculture, and by extension, overall government revenue in the economic sphere. In turn, this further affects healthcare in the social sphere. Figure 4.2 provides an overview of this integrated approach.

4.1.2.1 SECTORS OF THE T21 GHANA – GE

The T21 Ghana – GE model composes more than thirty dynamically interacting sectors. These are further grouped into three main spheres – society, economy and environment – and subdivided into sectors to estimate main indicators. These, in turn, represent the climate change issues and green economy policies. Table 4.1 provides an overview of these spheres and their respective sectors in the T21 – Ghana.

FIGURE 4.2.
OVERVIEW OF THE INTEGRATED STRUCTURE OF T21 MODEL FOR GHANA'S GREEN ECONOMY



Source: MI Team, 2014

TABLE 4.1. SECTORS AND SPHERES OF THE T21 GHANA – GE MODEL

SOCIAL SPHERE	ECONOMIC SPHERE	ENVIRONMENTAL SPHERE
Population Sector:	**Production Sector:**	**Land Sector:**
1. Population	9. Aggregate production & income	17. Land**
2. Fertility	10. Agriculture	**Water Sector:**
3. Mortality	11. Industry (other than mining)	18. Water demand
Education Sector:	11b. Gold*	19. Water supply
4. Education	12. Services (other than tourism)	**Electricity Sector:**
Health Sector:	12b. Tourism*	20. Electricity demand**
5. Access to basic health care		21. Electricity supply**
Infrastructure Sector:	**National Accounts Sector:**	**Fossil Fuel Sector:**
6. Infrastructure	13. Households accounts	22. Oil & gas demand
Labour Sector:	14. Government**	23. Oil & gas supply
7. Employment**	15. Financing and debt	**Emissions Sector:**
Poverty Sector:	16. Balance of payments	24. Fossil fuel emissions
8. Income distribution		
		GREEN POLICIES
INDICATORS		29. Renewable capacity*
25. MDGs		30. Renewable employment*
26. HDI & GDI		31. Renewable power generation*
27. Main Indicators*		32. Efficiency improvements*
28. GDP deflator & exch. rate		33. Irrigation

Note: The sectors with a * are additional sectors for T21 Ghana – GE; the sectors with ** are existing sectors with additional components for T21 Ghana – GE

An overview on the key elements of each of the three spheres (social, economic, environmental) can be found under Appendix 4. The simulation of different scenarios using the T21 Ghana – GE model enables the integrated assessment of social, economic and environmental impacts of green investments and policies.

4.1.2.2 DATA CHALLENGES

Where data specifically for Ghana was not available on select policy costs and impact coefficients, values for an average from other international sources are used (such as job creation multiplier for renewable electricity generation from US studies, efficiency factors of power generation). Sufficient data (such as policy implementation costs) are not available on some policies (such as fuel efficiency in non-electricity uses, efficient use of wood fuel, etc.) that were indicated by stakeholders to be important for Ghana, and therefore could not be quantitatively analysed in this study. Given more research and data collection in these aspects, additional studies can be conducted to include the analysis of these policy areas.

4.2 SCENARIOS OF INCREASED INVESTMENTS, INCLUDING SECTOR TARGETS AND CAPITAL INVESTMENTS

4.2.1 SCENARIOS DEFINITION AND UNDERLYING ASSUMPTIONS

Through the consultative process and inputs by experts, three scenarios have been simulated and analyzed: a business-as-usual (BAU) scenario and two of increased green investment (i.e., GE and GE-Low Thermal). The main characteristics of the three scenarios are as follows:

1) **Green Economy (GE) scenario: additional green investment from 2013 to 2030:**
   - Implementation of green policies and additional green investments from 2013 to 2030.
   - The amount of green investments are determined by policy targets, estimated as 1.05 per cent of GDP on average from 2013 to 2030 (See Table 4.2).
   - Assuming development of electricity generation from renewable sources would not cause reduction in thermal electricity generation.

2) **Green Economy with Low Thermal scenario (GE-Low Thermal):**
   - Implementation of green policies and additional green investments from 2013 to 2030.
   - The amount of green investments are estimated based on policy targets, estimated as 1.05 per cent of GDP on average from 2013 to 2030.
   - Assuming reduction in thermal electricity generation as electricity generation from renewable sources increases.

3) **Business-as-usual scenario:**
   - Additional investment, of the same amount as the green investment scenarios (1.05 per cent of GDP on average) in line with current trends and planned policies from 2013 to 2030.

On the basis of discussions at the consultation workshop, the amount of green investments required to reach the target of each policy area is calculated. In all three scenarios, the entire additional investments are assumed to be funded by public investment, which are financed through additional grants by foreign donors.

4.2.2 PRIORITY SECTORS AND GREEN POLICIES

Based on the prioritization by stakeholders following the criteria in Appendix 3, the agriculture and energy sectors were ranked the highest and were thus selected. The forestry sector, which rated third, was added as it is highly relevant to – and part of – the agriculture sector. As a result, three priority sectors were identified: agriculture (crop cultivation), energy, and forestry.

For each of these sectors, key policy priorities were highlighted. These are listed in Table 4.2.

The amounts of green investment required for each policy target in Table 4.2 were estimated through model simulation (optimization). The main factors involved are: (1) the average policy unit costs (for example, the average cost of

TABLE 4.2 POLICY AREAS IMPLEMENTED IN THE GREEN SCENARIOS

Sector	Green Economy Priority	Green Investment Required (average billion cedis per annum)
Crops cultivation	Increase in irrigated harvested areas	0.24
Forestry	Increase in reforestation	0.3
Energy	Promotion of electricity generation from renewable sources: • solar • wind • hydropower	0.16
	Installation of energy efficient light bulbs and refrigerators	0.08
Total		**0.51 (1.05% of GDP on average)**

increasing one hectare of irrigated area, and average construction cost per MW of wind power generation) and (2) the policy targets (following the previous examples, the target percentage of irrigated area in the future, and target wind power generating capacity in the future). The estimates for such costs and targets are based on country-specific data. Other factors that were also involved in this estimation included the current status and baseline for future development under current policies (for instance, the time series of irrigated harvested area percentage, and time series of wind power generation capacity).

The implications of other policies, such as agricultural extension services and removal of fuel

Woman at her fish stall. © Renate Wefers

subsidies, were also implemented in the T21-Ghana model. However, these were not selected among the green economy policies because of a lack of data on policy costs. Due to the integrated characteristics and cross-sectoral relationships of the model, these priority investments will also affect the other sectors of the model, such as health and poverty.

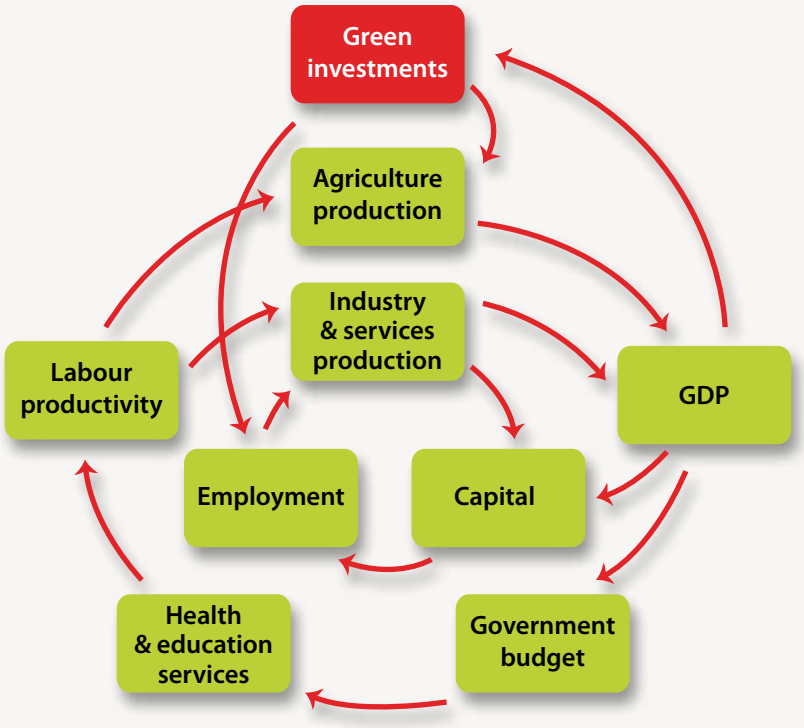
4.2.3 POLICY IMPACTS IN THE MODEL

The cross-sector relations in the model also allow for inclusion of indirect impacts in the system. Such policy synergies include the enhancing of power availability of the country through the promotion of renewable energy. This leads to higher electricity supply and energy efficiency measures, resulting in lower electricity demand. Synergies or offsets can also be found between the agriculture and water sectors. The expansion of irrigated harvested area, for example, would improve agricultural yield, but also lead to higher agricultural water use and total water stress, which can diminish agricultural yields.

Policy impacts are further passed along through interactions across sectors in the model creating feedback loops in the system. Figure 4.3 shows some of the key feedback loops in the system.

One example from Figure 4.3, green investments would potentially increase agriculture production and thus GDP, which not only increases household income, but also government revenue. The higher government revenue, in turn, positively affects investment. Higher capital levels would enhance agricultural and other production sectors. In the meantime, the total government expenditure would potentially contribute toward improved life expectancy (through health expenditures) and literacy rates (through education expenditures), both of which would lead to positive influences on labour productivity and thereby sector production.

FIGURE 4.3 DIAGRAM OF SOME KEY FEEDBACK LOOPS IN THE MODEL

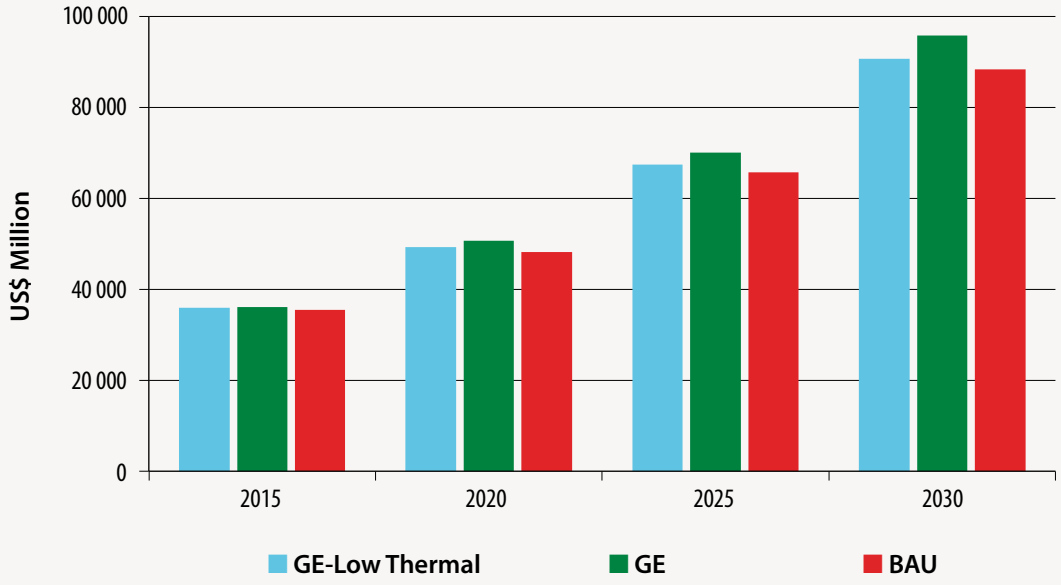


4.3 MODELLING RESULTS IN COMPARISON WITH BAUs[96]

4.3.1 OVERALL ECONOMIC DEVELOPMENT

Comparing economic development based on these three scenarios, GDP is expected to continue to increase at an average annual growth rate of 5.9 per cent between 2013 and 2030 in the BAU scenarios, reaching 84 billion Ghana Cedis in 2030. The two green scenarios are expected to see higher GDP growth at an annual rate of 6.9 per cent (under GE) and 6.5 per cent (under GE-Low Thermal). Total GDP in 2030 is expected to be 98 billion Ghana Cedis (under GE) and 91 billion Ghana Cedis (under GE-Low Thermal); giving a difference of 17 per cent and 11 per cent above the BAU cases respectively (Figures 4.4a and 4.4b).

FIGURE 4.4a REAL GDP AT MARKET PRICE



The total green investment required to achieve all the policy targets identified in the study amounts to an average of 150 million Ghana Cedis per year through to 2030; which is roughly 1.05 per cent of GDP per annum. As shown in Figure 4.5, total required investment is expected to peak at above 3.5 per cent of GDP in the first few years, primarily for initial installation and construction of renewable energy plants. It then declines to below 1 per cent of GDP. In order to ensure that the government deficit as a share of GDP remains at the same level in the BAU case, the country requires on average, annual grants of around 13 billion Cedis per year in the green economy scenarios. This includes funding for green economy investments, compared to 12 billion Cedis in the BAU scenario. Such value corresponds to 20 per cent of GDP. In the GE scenario, the amount of domestic revenue would also be 9 per cent higher than the BAU; and in the GE-Low Thermal scenario, revenue would be 3 per

FIGURE 4.4b REAL GDP GROWTH RATE

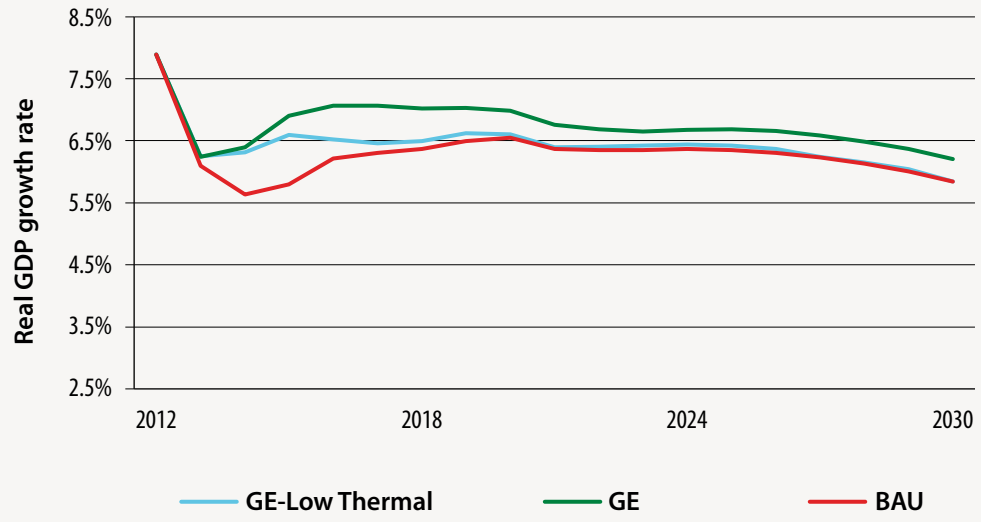
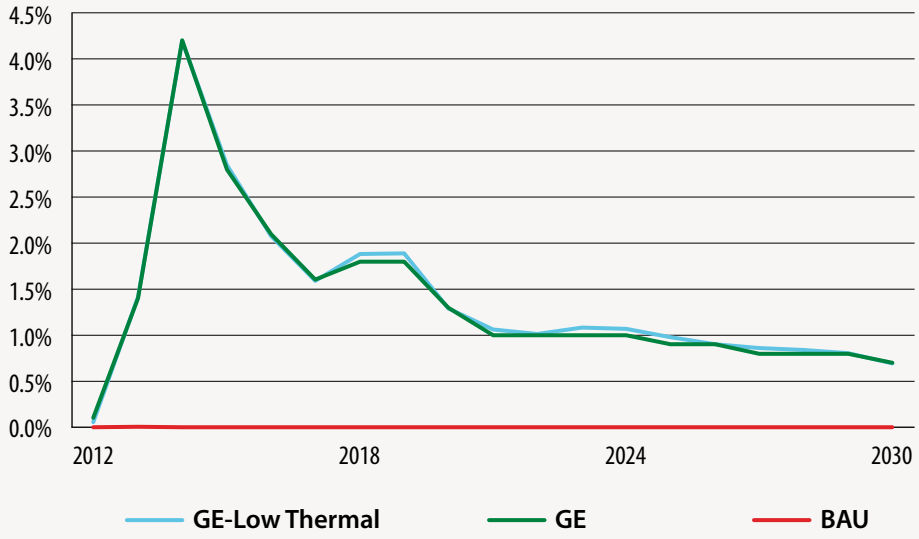


FIGURE 4.5 THE TREND IN GREEN INVESTMENT AS SHARE OF GDP



cent higher than in the BAU. This higher amount of revenue requirement is attributable to the higher GDP growth and economic development in the green economy scenarios.

4.3.2 AGRICULTURE AND LAND

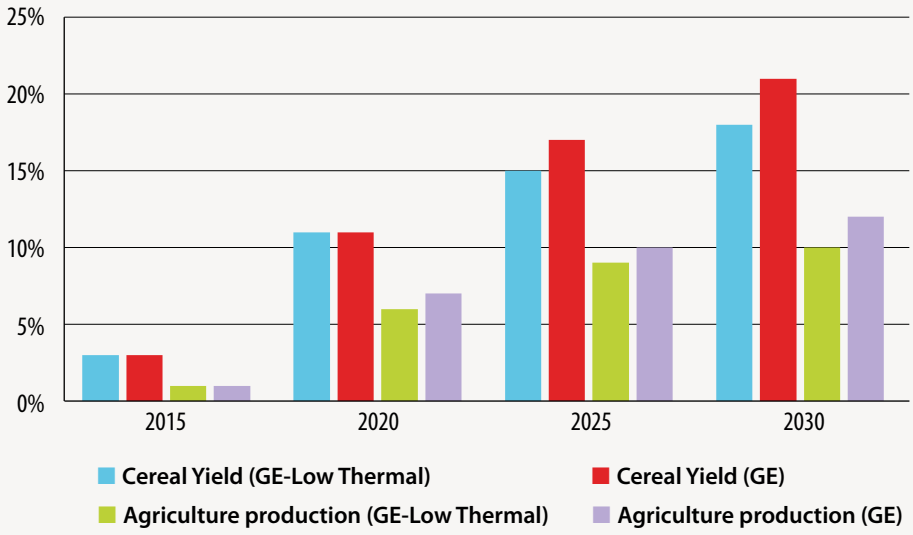
The agriculture sector employs around half of the total population and contributes to more than one-fifth of Ghana's GDP. The GE scenario is expected to see the highest agriculture production of 17.8 billion Ghana Cedis in 2030, followed closely by the GE-Low Thermal scenario (17.5 billion Ghana Cedis), with both above the BAU scenario (16.6 billion Ghana Cedis) (see Figure 4.6).

In the crop production sector, average cereal yield is expected to be 6.1 tonnes per ha (GE) and 5.9) tonnes per hectare (GE-Low Thermal) in 2030, translating into 10 per cent and 7 per cent above the BAU case for the GE and GE-Low Thermal scenarios respectively. This improved crop yield is driven by both the expansion of

harvested area with irrigation from below 0.5 per cent to close to 2 per cent by 2030, and higher agricultural capital level allowed by stronger economic development in the green scenarios.

The green investment required to achieve this irrigation expansion target increases from 135 million Ghana Cedis in 2013 to 261 million Ghana Cedis in 2030, with an average of 238 million Ghana Cedis over the next 18 years. We consider such gradual increases in investment as necessary in order to address potential issues of absorption capacity. As a result, average cereal production in Ghana will be 0.31-0.32 tonnes per hectare by 2030 in the green scenarios, compared to 0.29 in the BAU scenario.

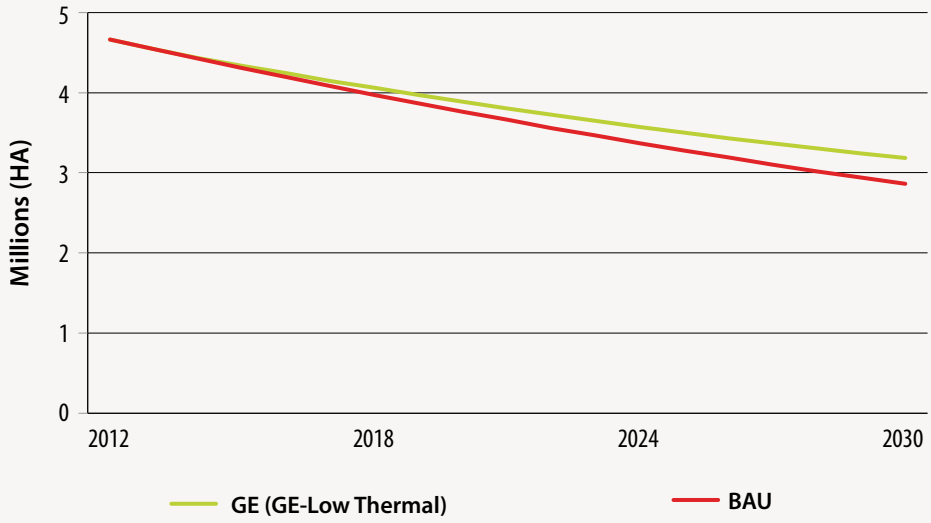
FIGURE 4.6 PERCENTAGE OF CEREAL YIELD AND AGRICULTURE PRODUCTION IN GREEN ECONOMY SCENARIOS RELATIVE TO THE BAU SCENARIO (IN PERCENTAGE)



School life expectancy (primary to tertiary education) in Ghana is 10 years.
© CGIAR Climate

The forestry sector will continue to see a significant loss of woodlands in the BAU scenario down to 2.9 million ha by 2030 from 4.7 million ha in 2012. This reduction will be mitigated by additional reforestation of 20,000 ha per year from 2014 to 2030 in the green economy scenarios, which require annual green investments of 275 million Ghana Cedis. The total forest area will be 3.2 million ha by 2030 (Figure 4.7).

FIGURE 4.7 TREND IN FORESTLAND AREA (HA) IN THE BAU AND THE GREEN ECONOMY SCENARIOS



4.3.3 ENERGY AND EMISSIONS

Green economy policies will promote both the expansion of renewable energy on the supply side and the replacement of inefficient products and appliances on the demand side. In the two green economy scenarios, the installed power generation capacity from clean sources will be 330 million watt (MW) from wind, 145 MW from solar and 1865 MW from hydro by 2020, achieving the policy target of 10 per cent of total energy generation capacity from non-hydro new renewables by 2030. The capacity will be 333 MW from wind, 146 MW from solar and 1910 MW from hydro. This expansion requires an average annual investment in renewable power of 150 million Ghana Cedis through to 2030. Costs are expected to be high during the first few years of investment (315 million Ghana Cedis in 2013) in order to install the necessary infrastructure but will then decline to 53.6 million Ghana Cedis by 2030.

The generation of electricity from new renewables and large hydropower will be 10.2 billion kWh (i.e., 0.7 billion kWh from wind power, 0.3 billion kWh from solar power and 9.2 billion kWh from hydropower) in 2030 in the green economy scenarios, compared to a mere 0.005 billion kWh of new renewables and 8.2 billion kWh of hydro power in the BAU due to the lifetime of power plants. Electricity generation from fossil fuels is expected to continue to increase from the current level of 4 billion kWh to 6 billion kWh in 2030 in the BAU scenario. The same trend is assumed in the GE scenario, so that the increased use of renewables in the electricity mix will allow for higher total electricity generation and thus larger net electricity export. The GE-Low Thermal scenario, however, assumes that the use of fossil fuels will fall to below 4 billion kWh by 2030, maintaining almost the same level of total electricity generation as in the BAU case.

On the demand side, the replacement of an average six million efficient light bulbs per year and around 300,000 efficient refrigerators per year will result in a net total electricity saving of 0.34 billion kWh. Comparing total electricity

demand in the GE and BAU scenarios, the effect of economic growth on electricity demand more than offsets the reduction in demand resulting from efficiency improvements. Total electricity demand will reach 14.5 billion kWh by 2030, still slightly higher than the BAU scenario of 14.4 billion kWh. In the GE-Low Thermal scenario, however, as GDP growth is less strong than the GE scenarios, total demand develops slower than in the BAU scenario until 2022, but then in the long run grows faster than in the BAU driven by higher economic growth resulting in an expected demand of 14.2 billion kWh (Figure 4.8).

FIGURE 4.8 TRENDS IN ELECTRICITY DEMAND (BILLION KWH) IN THE BAU, GE AND GE-LOW THERMAL SCENARIOS

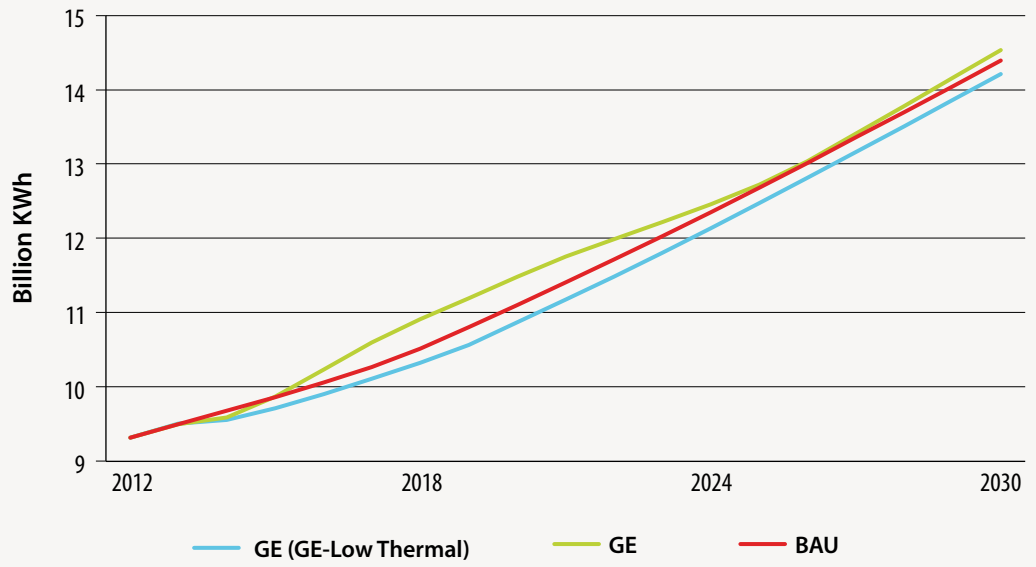
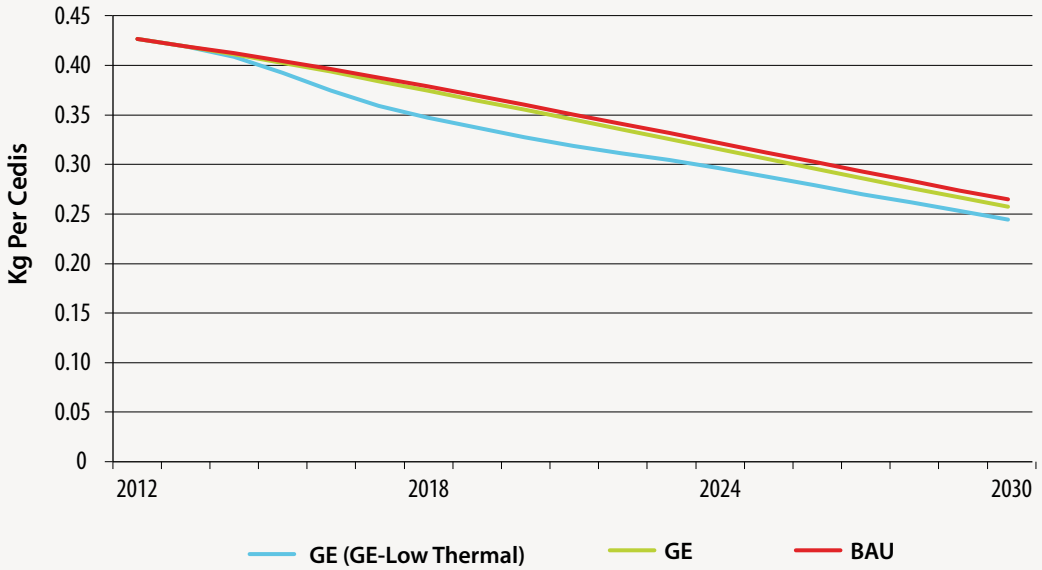


FIGURE 4.9 TRENDS IN CO_2 EMISSIONS PER UNIT OF GDP IN THE BAU, GE AND GE-LOW THERMAL SCENARIOS (KG CO_2 EQUIVALENT / GHANA CEDIS 2006)



Despite the higher electricity demand in the GE scenario, the green economy policies of expanding supply from new renewables will reduce the country's dependence on electricity imports by more than 55 per cent by 2030 and improve energy security; although the amount of net import is still expected to increase over time in all scenarios. Primarily driven by stronger economic development, total CO_2 emissions from fossil fuel consumption will be higher in the GE scenarios (approximately 25 million tonnes per year) than the BAU scenarios (approximately 23 million tonnes per year) by 6 per cent. On the other hand, in the GE-Low Thermal scenario, fossil fuel emissions from electricity generation will be 5 per cent lower than the BAU case due to reduced thermal generation, which is offset by higher emissions for non-electricity use driven by economic growth. Total emissions will remain in line with the BAU case in the long run, however, net energy imports will be slightly higher in the GE-Low Thermal scenario than the BAU, due to greater demand and a similar level of supply.

Energy intensity (i.e., less emissions per cedi of production) also improves more rapidly in the more resource-efficient green scenarios (GE and GE-Low Thermal) than in the BAU (Figure 4.9).

4.3.4 SOCIAL INDICATORS

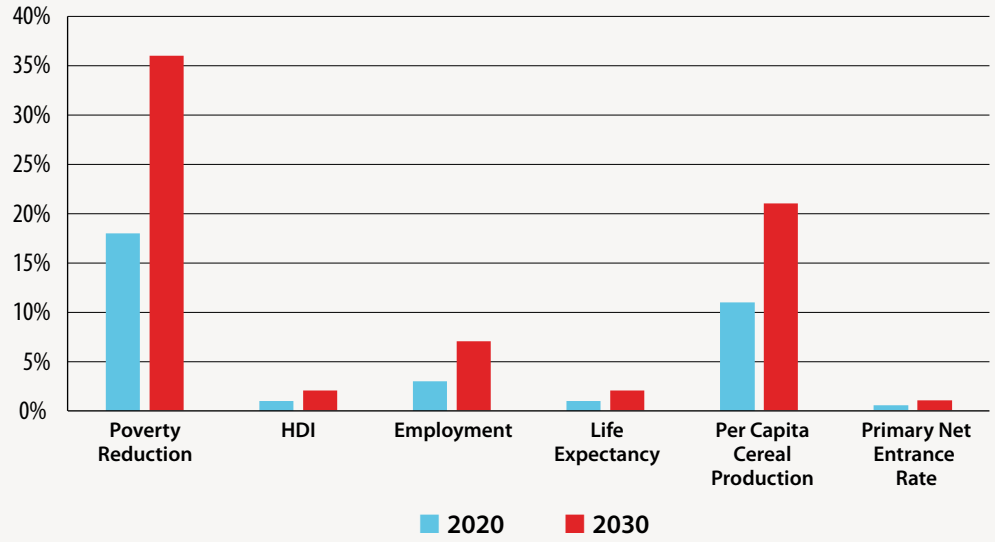
With the implementation of green economy strategies, the proportion of population below the poverty line is expected to decline to around 5 per cent by 2030, representing 2 per cent lower than the 2030 baseline. This is attributed to the positive influence of green investments, exemplified by higher real national income per capita.

The green economy scenarios will create 0.4 million (GE scenario) and 0.2 million (GE-Low Thermal scenario) respectively more jobs than the BAU scenario.

In relation to the health conditions of the population, by virtue of increased crop productivity and harvested area, the average cereal production per capita (as a proxy for nutrition level) will increase significantly by 10 per cent (GE scenario) and 7 per cent (GE-Low Thermal scenario) by 2030 compared to the corresponding BAU scenarios. Ghana's life expectancy is also expected to rise, reaching more than 72 years on average in the green economy scenarios, roughly one year longer than the BAU. In addition, the number of school enrolments will increase marginally by 0.5 per cent in 2030 as a result of higher education expenditure

While women represent more than 50 per cent of the population of Ghana, gender disparities remain in the sectors of health, education and labour market. © IFAD/ Nana Kofi Acquah

FIGURE 4.10 RESULTS OF THE GE SCENARIO RELATIVE TO THE BAU CASE (IN PERCENTAGE). SELECTED INDICATORS: POVERTY (PROPORTION OF POPULATION BELOW POVERTY LINE), EMPLOYMENT, HUMAN DEVELOPMENT INDEX, LIFE EXPECTANCY, NUTRITION (CEREAL PRODUCTION PER CAPITA), AND EDUCATION (SCHOOL ENROLMENT)

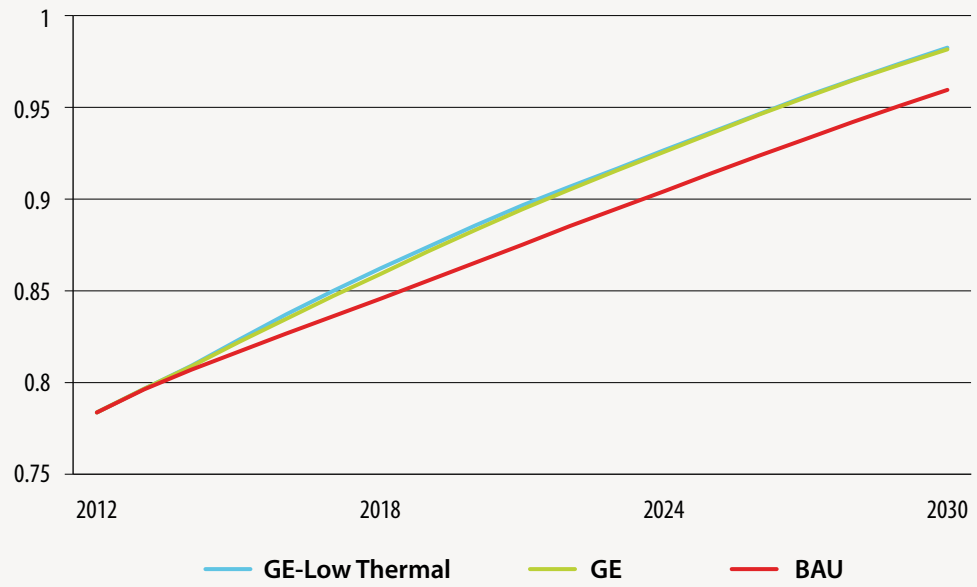


per capita (allowed by a higher GDP and thus total government expenditure) and average household income level. As a result of these improvements, especially in health, the Human Development Index (HDI) of Ghana will improve by 1.5 per cent to 2.3 per cent. Figure 4.10 summarizes the results of these main social indicators vis-à-vis the GE and the BAU scenarios.

Finally, overall MDG performance rates will improve over time in all the three scenarios, as a result of declining poverty and mortality rates[97].

However, potentially higher MDG performance is constrained by increasing emissions and deforestation as shown in this study. Moreover, the results of GE and GE-Low Thermal scenarios are very close, as the differences in MDG scores in income and emissions largely offset each other. The overall MDGs performance, the full score being 1, reaches around 0.98 in both scenarios, exceeding 0.967 in the BAU case (Figure 4.11).

FIGURE 4.11 TREND IN OVERALL MDGS PERFORMANCE IN THE BAU, GE AND GE-LOW THERMAL SCENARIOS



Ghanaian Electricians. © UNEP

© go-pong

5 DISCUSSION OF POLICY ENABLING CONDITIONS

PALM KERNEL.

5.1 REGULATIONS AND VOLUNTARY INITIATIVES

5.1.1 ADAPT AND ENFORCE STANDARDS IN THE THREE SECTORS

Adapting existing regulations and standards, or the development of new ones, for greening the three prioritized sectors (forestry, energy and agriculture) is critical for transitioning these sectors to a Green Economy. Based on prevailing policies, there exist standards and regulatory frameworks that can be tailored to enhance the transformation of these sectors.

5.1.2 VOLUNTARY SUSTAINABILITY INITIATIVES

Voluntary Sustainability Initiatives (VSI) are equally useful for the successful greening of these sectors. VSI has been defined as "any non-obligatory initiative explicitly designed to promote the objectives of sustainable development, including eco-labels, certification initiatives, standards, corporate social responsibility programs, business-to-business initiatives, roundtables, and other collaborative or multi-stakeholder initiatives"[98]. Eco-labelling Standards has the propensity to provide transparent information about the sustainability of a product to consumers but also can ensure that a certain degree of sustainability is achieved in production and distribution. Standards create awareness among stakeholders of the product's value chain and the need to transition to a Green Economy.

The eco-labelling of various products from the three sectors, such as fish, cereals, organic fertilizers, timber, and electricity produced from renewable energy sources, will be crucial. For example, in 2010, Ghanaian farmers tripled the amount of Fairtrade-certified cocoa sold to Cadbury to 15 000 tonnes[99] all because of green labelling. For VSI to succeed, it needs to be supported by cogent regulatory instruments as well as strict implementation and monitoring.

5.1.3 INTENSIFY AND SCALE-UP EXISTING EFFORTS

There are current initiatives within all three sectors that possess greening attributes, notably the responsible management of forests and timber resources (e.g. ensuring reforestation and proper harvesting of forest products); energy efficiency and conservation; and, to some extent, sustainable crop management. In the forestry sector, forest certification initiatives in Ghana started in 1997 and the National Forest Management Certification Standard has been reviewed and updated.
The process of developing forest certification standards is supported by a national Working Group on Forest Certification comprising various stakeholders. Ghana has also signed the Voluntary Partnership Agreements (VPAs) with the EU to ensure that only legal timber and products are exported to the EU[100]. Products derived from legal and environmentally-friendly managed forests can be certified under the Ghanaian National Forest Stewardship Standard (FSS), approved by the Forestry Stewardship Council (FSC) Policy and Standard Committee[101].

In the area of energy efficiency and conservation, the following Legislative Instruments (LI) have been passed: Energy Efficiency Standards and Labelling (non-ducted air-conditioners and self-ballasted fluorescent lamps) Regulations, 2005 (LI 1815); Energy Efficiency Standards and Labelling (Household Refrigerating Appliances) Regulations, 2009 (LI 1958 and LI 1970); Energy Efficiency (prohibition of the manufacture, sale,

or importation of incandescent filament lamps, used refrigerators, used refrigerator-freezers, used freezers and used air-conditioners) Regulations, 2008 (LI 1932); the Renewable Energy Act, 2011 (Act 832) with the enshrinement of the FiT Law, renewable energy purchase obligation, renewable energy fund establishment, and incentive creation; while a draft Bioenergy policy is also under consideration.

One other way that could enhance the uptake of renewable RETs is the setting up of Green certification standards for industries and multinational companies for the use of renewable energy as part of their energy consumption mix. Within the cocoa sub-sector, under agriculture, a few certification schemes/voluntary standards already operate in Ghana (Fairtrade, Rainforest Alliance, Organic and UTZ Certified) to boost the ethical and sustainable standards of the cocoa production system, albeit, they are still at the early stages. Initiatives regarding sustainable crops and irrigation practices, however, need to be identified and scaled up.

African fabrics from Ghana, West Africa.

5.2 ECONOMIC AND FISCAL POLICY INSTRUMENTS

Green economic and fiscal policy instruments, such as taxation and subsidies, are *sine qua non* to underpinning the transition of agriculture, forestry, and energy to a Green Economy. For example, growth in the country's petroleum revenues offers opportunities for the government to finance the transition of these sectors. It is, however, imperative for market interventions to be transparent and frequently evaluated to ensure continued market confidence and to prevent negative side effects, such as production shutdowns when companies cannot meet high carbon taxes. Under both the GSGDA I and II, the identification of fiscal policies include: taxation of natural resources and reduction in tax exemptions; institutionalization of tax reforms with emphasis on indirect taxes and enhancing tax incentives; and improvement of the import/export regime which could shore up the greening of the sub-sectors under consideration. The following fiscal policy instruments are indispensable to the greening processes of the three sectors.

5.2.1 ADDRESSING INTERNATIONAL TRADE BARRIERS

The removal or reduction of international trade barriers is critical for enhancing the transfer of novel and appropriate green technologies and knowledge systems in the three sectors, such as solar PV, wind turbines, waste-to-energy, waste-to-fertilizer, novel scientific farming systems on irrigation, improved seeds, and forestry management practices. Addressing trade barriers indirectly increases the confidence of investors and small-scale entrepreneurs to channel or invest in green economy ventures. While further in-depth analysis is required to understand the impact of removing trade barriers on environmental and economic fronts, it is important for Ghana to liaise with the international community to explore market access opportunities for green goods and services. Particularly through the 2000 African Growth and Opportunity Act (AGOA) that offers a platform for trade and investment between the US and sub-Saharan Africa and the Economic Partnership Agreement (EPA).

It is evident from the preceding section that huge upfront investment costs (1.5 per cent of GDP) is required for Ghana's transition to a Green Economy by 2030. For this to happen, however, there has to be an enabling economic and fiscal framework, which has the potential of bringing private investors on board. This is essential as the Government itself is incapable of providing such upfront investment on its own. Government is therefore encouraged to design incentive taxation structures that will motivate the private sector to either partner with the state or to go solo by investing in the prioritized areas.

5.2.2 REFORMATION OF SUBSIDIES

Antiquated subsidies in sectors such as energy and agriculture should be progressively removed to encourage environmentally-friendly and pro-poor investment. Several attempts by government to embark on fossil-fuel subsidy reforms have been unsuccessful, but need to be looked at critically if a green economy paradigm is to succeed. For instance, fossil fuel subsidies continue to form an important part of the country's budget expenditure, yet evidence shows that such subsidies have not benefited the poorest segment of the Ghanaian population. There is also a strong argument that funds spent on fossil fuel subsidies are worth more if spent on social development[102].

The agriculture sector has been benefiting from government subsidies on the cost of fertilizers since the 1980s, leading to an increase in fertilizer use. This subsidy programme represented 21.3 per cent (approx. $10.7 million or 20.6 million GHC) of the public agriculture budget in 2008, down to 11.7 per cent (approx. US$ 15.6 million or 30 million GHC) in 2010[103]. Meanwhile, the extent to which the different fertilizer subsidy programmes have benefited smallholder farmers have yet to be fully assessed. Hence the need for perverse subsidies to be redirected to green investment opportunities is imperative. The removal of perverse subsidies on inorganic fertilizers should be pursued since it inhibits green transition and contributes significantly to CO_2 emissions[104]. Instead, more subsidies should be directed to organic farming practices. Also, subsidies on conventional energy sources should be removed to create a level play field for the development and acceptance of Renewable Energy Technologies (RETs). In order to increase the rate of adoption of certain RETs, smart subsidies could be given to certain types such as solar PV and biogas.

Fishermen with their catch. © John and Clare

5.3 FINANCING – POTENTIAL SOURCES AND PARTNERS

For the transition to green economy in the three sectors in Ghana to be effective, innovative financing is imperative. Unfortunately, while the existing financing climate in which most banks are averse to lending to the agricultural sector because of perceived risks, does not augur well for a green economy transition in Ghana, other support instruments abound in the three sectors.

5.3.1 DOMESTIC FINANCE INITIATIVES AND GREEN BUDGETING

Generating funds domestically to finance green initiatives is crucial. This could also serve as a fundamental justification for soliciting funds

Wood transporter in the rain forest in Ghana. © bytestrolch

from the donor community. Taxation of industrial, mining, and other environmentally-harmful economic activities could serve as a potential source of generating funds for financing green economy transition. The government needs to include allocations in its annual budgets for green investments in the three sectors. The country should also embrace and implement the "green finance" paradigm, which can be defined as market-based investment and lending schemes that incorporate environmental factors. Such financing can cover numerous green economy activities in Ghana, including green agricultural loans with modest interest rates from banks; environmental bonds in the forestry sector; and venture capital for renewable energy projects.

Green finance initiatives can be funded by the government, the private sector, and the donor community. Examples of existing national initiatives to finance renewable energy in Ghana include: the Business Development Services (BDS) Fund, which contributes to renewable energy development under: the Ghana Energy Development and Access Project (GEDAP); the Renewable Energy Fund, which has supported research and development of environmentally-friendly technologies; and participation in the Clean Development Mechanism (CDM) to reduce GHG emissions in the country. In 2012, the government registered its first CDM project, which focuses on the composting of municipal solid waste in the Accra area[105]. Other financing opportunities are the Switch Africa Green (SAG)[106] project, and Green Climate Funds for the energy and forestry sectors. Ghana has also produced a list of Nationally Appropriate Mitigation Actions (NAMAs) that mainly target the energy sector to attract international funding for low carbon development.

5.3.2 FAVOURABLE INVESTMENT CLIMATE AND RISK REDUCTION INSTRUMENT

Having a favourable investment climate and reduction in risk instruments are critical conditions for financing green economy transition in Ghana. These can be achieved in several ways including: the reduction of financing barriers imposed by the local economy; intensification of capacity-building and knowledge transfer to increase awareness of green economy opportunities across the three sectors; and development of Public–Private Partnerships (PPPs) to enhance the private sector involvement through investment. Moreover, financial institutions are usually well-experienced in addressing business risks. They could inform and advise the private sector to mitigate risks in green economy related investments. Currently, for many investors, barriers to low carbon investment do exist, such as the lack of policy predictability and absence of transparent rules and procedures needed to provide stable conditions for investment in low-carbon technologies. To overcome these uncertainties, mechanisms including credit-risk guarantees and other risk-sharing instruments should be strengthened[107].

5.3.3 INTERNATIONAL SUPPORT INITIATIVES AND GREEN BUDGETING

The Global Green Fund, Ghana Climate Innovation Centre Ghana, and Switch Africa Green are some international support initiatives Ghana can utilize to generate resources for its green transition. Also programmes such as the UNEP-Ghana Green Economy Sequence and Partnership for Action on Green Economy (PAGE) are endeavouring to build the necessary institutional and human capacities necessary for a green economy transition.

Women working in the cocoa sector. © UNEP

5.4 INSTITUTIONAL AND POLICY PROCESSES

Strong institutional arrangements and policy processes are indispensable for the effective implementation of the above enabling factors in each of the three sectors. Therefore the following elements are highly important to enable institutions to support the green economy agenda.

5.4.1 SUSTAINABLE PUBLIC PROCUREMENT

Governments are major consumers of goods and services and can greatly influence purchases. In Ghana, more than half (52 per cent) of the government budget is spent on procurement.[108] Ensuring that public funds are dispensed responsibly can offer a substantial push toward a green economy. At the international level, the Marrakech Process, launched in 2003, provides a platform to support sustainable consumption and production. Existing initiatives such as the public procurement of wood and paper-based products is expected to contribute to reducing the over-exploitation of timber resources and support climate-change mitigation. Even though Ghana has prepared the Sustainable Public Procurement Policy based on the 2003 the Marrakech Process, the policy has yet to be implemented. If properly carried out, it will underpin the implementation of important programmes and strategies under the agriculture, energy, and forestry sectors in line with their green development agenda.

5.4.2 CAPACITY DEVELOPMENT AND AWARENESS CAMPAIGNS

Capacity development within academic, private sector, and government institutions in the three sectors is a prerequisite for a transition to a green economy. Academic institutions should be supported to undertake trainings (for example, quantitative modelling) that will equip them with the requisite technical expertise to design relevant courses and to initiate cutting-edge research. This will help support the three sectors as well as produce a skilled workforce equipped with the necessary qualifications for green jobs. The three government sector ministries (Energy, Agriculture and Forestry) should be supported to organize workshops to enable all levels to grasp the green economy concept. In the same vein, the private sector should be trained on corporate social responsibility and the role of private financing for a green economy transition. In parallel, green economy public awareness initiatives are needed to help inform people of the benefits and challenges in the short- and long-term. The understanding of the green economy concept at all levels is a pre-condition for its success.

5.4.3 MONITORING AND EVALUATION

The monitoring and evaluation of green economy policies in the three sectors through the application of economic, environmental, and social indicators will be essential for tracking progress. The paucity of up-to-date scientific data on all the key elements in the three sectors was a major issue in the process of undertaking this study. To enhance scientific analysis of greening activities, the country should take steps to improve the collection of data on these and other green economy sectors.

Another aspect to monitoring and evaluation relates to policy effectiveness. The government should be monitoring the implementation of enabling actions (i.e. regulations, standards, economic instruments) to ensure that they are

having the desired effects rather than being counter-productive.

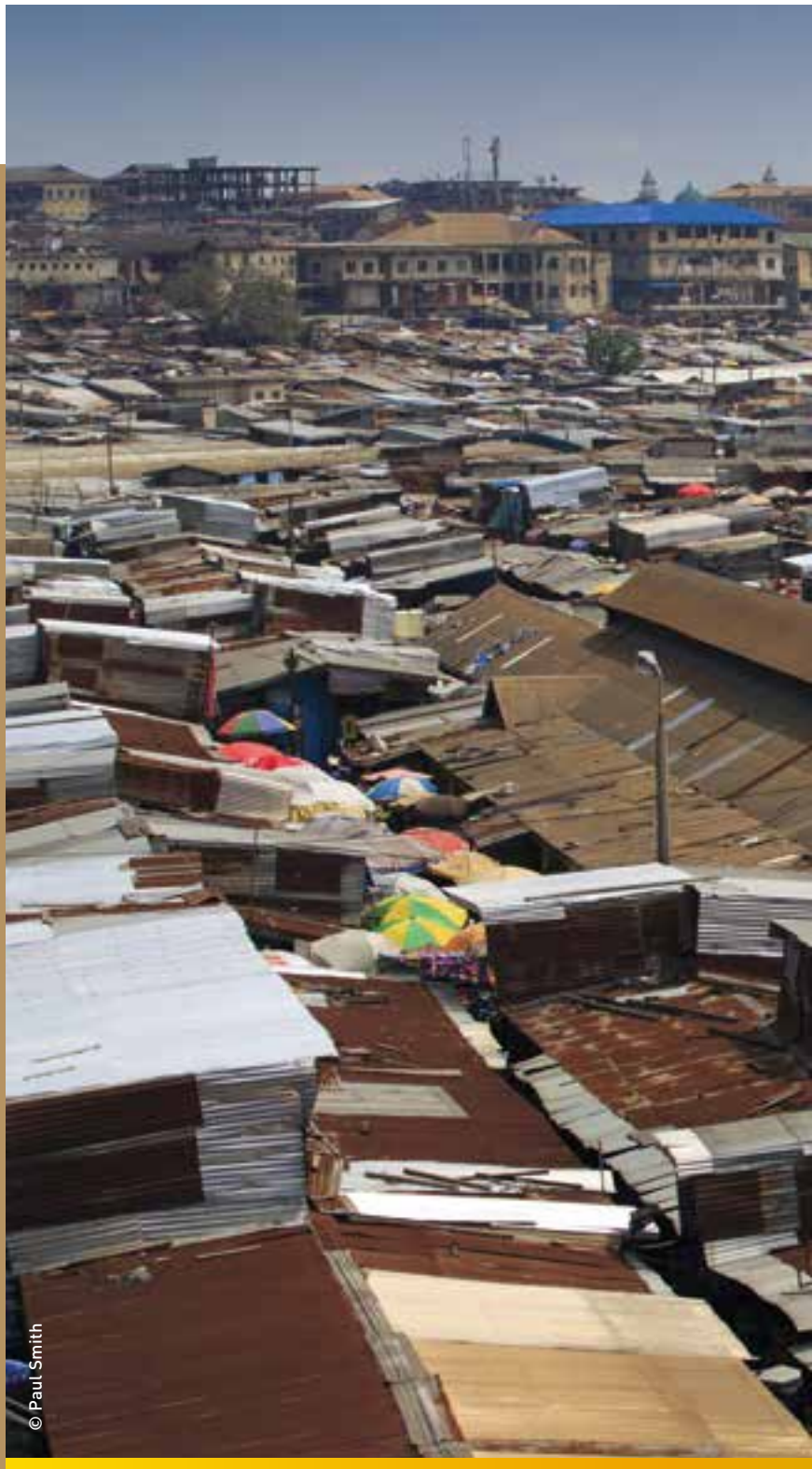
5.4.4 INSTITUTIONAL COLLABORATION AND STAKEHOLDER ENGAGEMENT

Strong and sustainable institutional collaboration among all academic, government, and private sector institutions in the three sectors involved in the transition to a green economy is pivotal for Ghana. This institutional linkage is important because the greening of any economic sector has positive multiplier effects on all other sectors. As a result, collaboration will help unveil the co-benefits of greening to various sectors as well as the synergies that can be built between different programmes and projects with greening initiatives. Furthermore, it will help avoid green initiative duplication among sectors. Strong collaboration with international organizations, such as UN agencies and the World Bank, on improving boosting the implementation of the green economy agenda is also key.

5.4.5 GOOD GOVERNANCE AND STRONG POLITICAL WILL

Good governance and sustained political stability are the bedrock for Ghana's green economy initiative. A strong political will with respect to implementing green policies and the fight against corruption within institutions championing the green economy activities will pave the way to success.

Tropical Forest of Kakum National Park. A 375 square km national park located in the Central Region of Ghana. © demerzel21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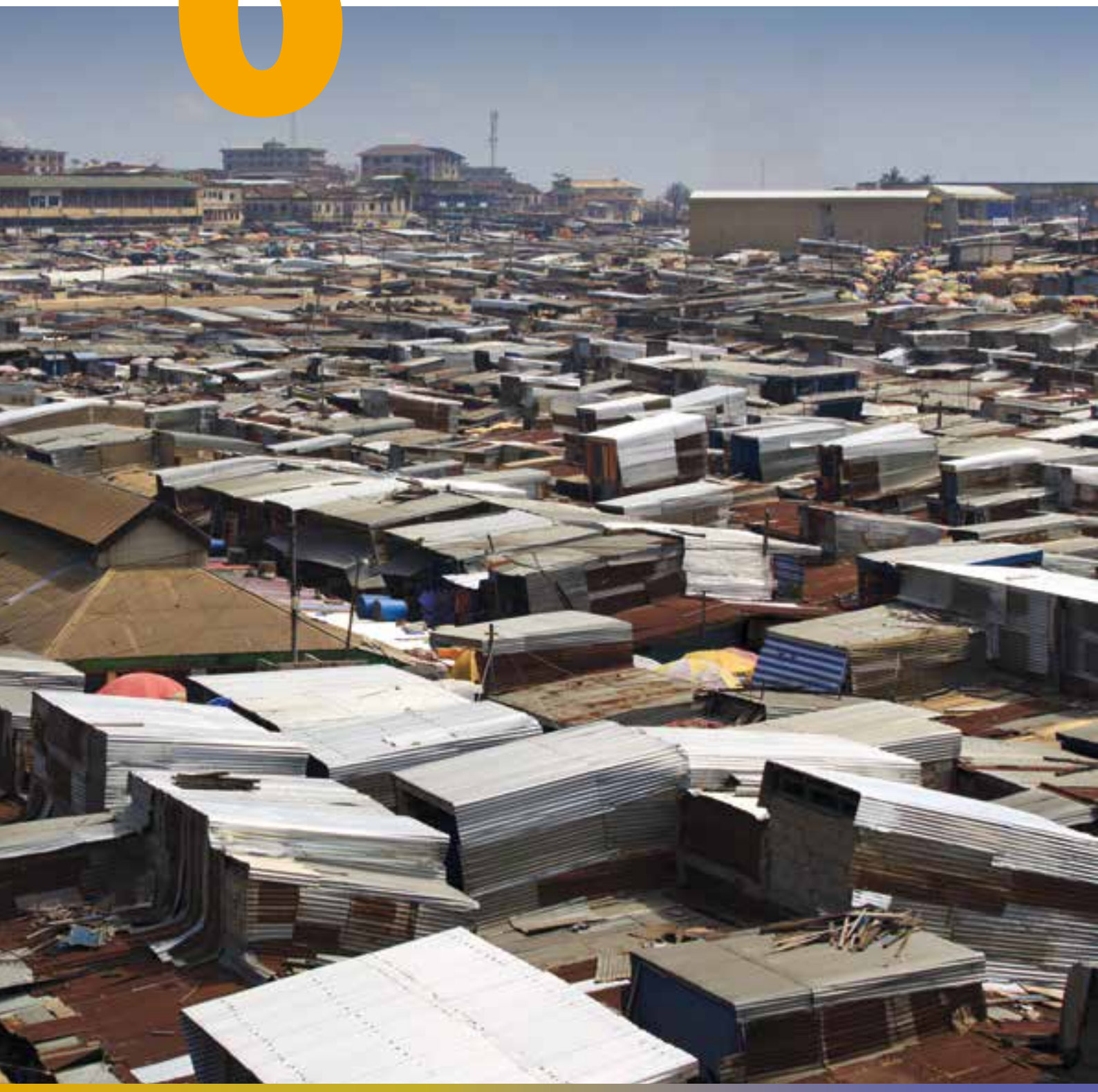
6 CONCLUSIONS, POLICY OPTIONS AND POLICY ROADMAP



THE KEJETIA MARKET IN KUMASI IS THE LARGEST MARKET IN WESTERN AFRICA WITH A MYRIAD OF ITEMS FOR SALE. FROM PLASTIC POTS TO FRUIT, VEGETABLES, MEAT AND FISH, FABRICS AND EVEN OBJECTS FOR VOODOO MEDICINE. IT HAS OVER 10 THOUSAND STALLS.

6.1 KEY FINDINGS

The transition to a green economy in the agriculture, forestry, and energy sectors is the pathway to sustainability. The implementation of green economy policies and investments is expected to produce better overall performance in social, economic, and environmental aspects than the BAU scenario. For consistency of analysis, it is assumed that in the BAU scenario, the same amount of additional investments as the green investments are implemented based on current trends and policies. Green investments of 1.05 per cent of GDP per annum are required to reach the sectoral policy targets. The costs will also be higher in the first several years for initial setup and construction than in the medium to long-term.

With respect to the agriculture sector, when the present low level of irrigated area is expanded in the green economy scenarios, the yield of all crop types is expected to improve. Cereal yield, for example, is expected to increase by 10 per cent by 2030. This would contribute to positive socio-economic impacts, such as higher nutrition and average farmer income level, as well as lower poverty rates. Forest land is projected to decrease in all three scenarios. However, thanks to the reforestation policy introduced in the green economy scenarios, forest area will be 11 per cent larger than the BAU scenario.

Under the business-as-usual, electricity generation will remain dependent on thermal and hydro power, as well as on imports. The GE and GE-Low Thermal scenarios lead to a greener energy sector on both the supply and demand side by promoting electricity generation from renewable sources and using efficient light bulbs and refrigerators. Both green scenarios lead to a more diversified energy mix. The GE scenario shows an increase in total electricity generation and a reduction in electricity imports compared to the BAU scenario, and yet continued use of thermal power. On the other hand, in the GE-Low Thermal scenario, where thermal power generation is reduced, electricity imports are only marginally larger than the BAU. As a result, total CO_2 emissions from fossil fuels in the GE-Low Thermal scenario, are below the baseline in the first few years of efficiency improvements, but then increase to eventually reach the same level of the BAU driven by stronger economic growth. In terms of emission intensity, the more resource-efficient green scenarios (GE and GE-Low Thermal) perform better (i.e., less emissions per cedi of production) than the BAU. Regarding the social aspects, the green transition in the country leads to higher levels of household income and lower poverty rates. These, in turn, positively affect life expectancy, school enrolment, and HDI, leading to better overall performance on the MDGs.

Overall, the impact of the green economy transition in Ghana will see agricultural production improving through the green irrigation policy, which will lead to faster GDP growth than in the BAU. The industrial sector will benefit from improved electricity supply, and the growth of renewable electricity coupled with high utilisation of energy-efficient equipment. By 2030, industry production will be 10 per cent higher in the GE scenario than in the BAU, and 2 per cent higher in the GE-Low Thermal scenario than in the BAU. Although the analysed green policies do not directly influence the service sector, production from services is expected to be 8 per cent (GE) and 2 per cent (GE-Low Thermal) higher than the BAU scenario. Such high growth is driven by fast expansion in the industry and agriculture sectors, which leads to larger investment and government expenditure in the green economy scenarios.

In summary, an additional total green investment of around 1.05 per cent of an average GDP per year during the period 2013-2030 is required to reach the green policy targets in agriculture

production (irrigation), forestry (reforestation) and energy sectors (diversified electricity mix and efficiency improvements). Such green policies result in a more efficient use and preservation of natural resources. They also lead to stronger economic development and lower dependence on natural resources and foreign imports. Based on the results of the study, the GE scenario shows stronger socio-economic development and lower emission intensity, despite higher total emissions. On the other hand, the GE-Low Thermal scenario depicts a future with lower thermal use and thus lower carbon, and still faster GDP growth than the BAU (albeit slightly slower than in the GE scenario). However, further efforts would be needed to control the increasing demand for natural resources driven by stronger economic development in the longer term. As indicated by comparing the two green scenarios, a mitigation of the increasing demand for natural resources and consequent emissions is achieved in the GE-Low Thermal scenario. On the one hand, this brings about a relatively slower – and yet still faster than the BAU- economic development. Additional social benefits from the green economy scenario include reduced poverty rates and higher average income levels, increased employment as well as improved nutrition, health, and education.

Glass bead, Ghana, West Africa.
© crimson

6.2 POLICY OPTIONS

The achievement of these social, economic, and environmental benefits embedded in the green economy transition are contingent on several enabling conditions: regulations and voluntary initiatives; economic and fiscal policy instruments; financing; and institutional and policy process (Table 6.1). Besides these enabling conditions, the transition to green economy in the three sectors will require various strong policy options (Table 6.2). Below are recommended policy options for Ghana in the three sectors.

TABLE 6.1 ENABLING CONDITIONS FOR THE TRANSITION TO A GREEN ECONOMY IN THE AGRICULTURE, ENERGY, AND FORESTRY SECTORS IN GHANA

1. Regulations and standards	• Adapt and enforce standards in three sectors considered for greening • Intensify and scale up existing efforts • Voluntary sustainability initiatives
2. Economic and fiscal policy instruments	• Addressing international trade barriers • Reformation of subsidies (emphasis on green subsidies) • Revised tariffs and taxes structures
3. Financing instruments, potential sources of funds and partners	• Domestic green finance initiatives • Include green investments in annual budgetary allocation (green budgeting) • Support and participate in green finance initiatives • Create a favourable investment climate and risk-reduction instruments
4. Institutional and policy processes to support reforms	• Support Sustainable Public Procurement (SPP) • Develop capacities and awareness campaigns for green economy • Monitor and evaluate progress towards a green economy • Foster institutional collaboration and stakeholder engagement • Ensure good governance and strong political will

TABLE 6.2 SYNOPSIS OF RECOMMENDED POLICIES FOR SECTORS AND THEIR POTENTIAL SOCIO-ECONOMIC AND ENVIRONMENTAL BENEFITS UNDER THE GE AND GE-LOW THERMAL SCENARIOS

Sub-Sector	Key Challenges	Recommended Policies	Socio-Economic Benefits	Environmental Benefits
Agriculture	• Over-reliance on traditional farming practices; • Over-reliance on rain-feed agricultural practices; • Indiscriminate land clearing and bush burning practices; • Over application of inorganic fertilizers in farming activities; and • Second contributor to GHG emissions in Ghana.	• Intensification of the use of organic fertiliser • Expansion in irrigable area, improvement in irrigation infrastructure and intensification of scientific practises within irrigation • Production of improved and high-yield crop varieties' seeds and development of scientific practices through agricultural research and development • Enhancement of post-harvesting technologies	• Increased employment in the long term • Improvement in nutrition and food security • Improvement in health • Increase enrolment in schools • Reduction in poverty level • Increase in income • Strong economic development	• Improved soil quality • Enhanced biological diversity within the soil • Decline in GHG emissions
Forestry	• Reduction in the sink capacity of forest for carbon dioxide (CO_2) • Ecological destruction of biodiversity • High rates of deforestation and forest degradation due to human activities	• Sustainable forest management (SFM) and expansion of forest	• Increase in forestry employment in the short and long term • Increase revenue from forest resources • Improvement in health of forest areas' communities	• Decline in the rates of natural forests' deforestation • Expansion in total forest cover • Increased carbon sinks in the long term • Improvement in soil quality in the long term • Increase in water availability in the long term
Energy	• Over-reliance on conventional energy sources for electricity generations • Lead contributor to GHG emissions • Low development of Renewable Energy Technologies • Over-reliance on wood fuel as a source of energy in the national energy mix	• Emphasis on renewable energy technologies in the energy generation mix and energy efficiency measures	• Increased employment opportunities in the long-term with RETs • Creation of indirect jobs • Speeds up universal access to modern energy services • Secured electricity supply/electricity self-sufficiency • Health improvement emanating from increased access to modern energy	• Reduced CO_2 emissions

6.3 PRIORITY ACTIONS AND PRACTICAL ROADMAP

The following priority actions for each sector have been recommended as part of this study in order to pursue the transition to a green economy in the selected sectors (agriculture, forestry, energy). In addition, corresponding underpinning strategies, projects, and sources of funding are included that should serve as the practical roadmap for the transition to GE in these sectors.

TABLE 6.3 PRACTICAL ROADMAP FOR GREENING AGRICULTURE, FORESTRY AND ENERGY SECTORS IN GHANA

Sectors	Strategies/Actions	Projects/Programme	Sources of Funding
Energy	• Intensify renewable energy investments and dissemination; • Intensify energy efficiency and conservation measures; • Invest in research and capacity development on energy diversification and conservation; • Develop green energy finance; • Develop and enforce policy instruments to support the dissemination of renewable energy.	• RETs villages, solar farms; wind farms, energy efficiency programmes, educational/ awareness workshops, establishment of biogas plants in various institutions	• Donor support; Private investors; Government; Banks; Developed countries
Agriculture	• Promote large-scale adoption of organic farming with support of organic fertilizer; • Promote large scale scientific irrigation farming; • Increase value-addition of agricultural products through investments in infrastructure and technology and strong farmer organizations; • Invest in sustainable agriculture research and capacity development; • Develop green agriculture finance and fiscal instruments.	• Green agricultural revolution	• Private investors; Government; Donors; Banks
Forestry	• Implement and intensify/scale up existing programmes on Sustainable Forest Management (SFM); • Invest in research and capacity development in SFM; • Develop fiscal policy/regulatory instruments for SFM.	• Reforestation; afforestation; woodlot plantations; agroforestry plantations	• Donors; Developed countries; Government; Private investors

Having identified all these sectoral strategies/ actions; programmes/projects and sources of funding for them, the next steps to translate these into reality include the following: development of action plans; detailed sectoral studies; setting up of an all-inclusive and vibrant institutional framework to oversee the drive of GE in the national economy; establishment of a coherent system of Monitoring and Evaluation of the state of GE transition (GE indicators) in the country at regular interval and deepening private sector involvement.

7 NOTES

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APPENDIX 1 PARTICIPANTS OF THE CONSULTATIVE WORKSHOP IN ACCRA – NOVEMBER 2013

NAME	INSTITUTION	CONTACT	E-MAIL
Ebenezer Nyarko Kumi	TEC-KNUST	0265060963	nyarkokumi@hotmail.com
Rhoda Wachira	UNEP	+254-737083308	rhoda.wachira@unep.org
Joseph Chonia	ISODEC	0277455154	joedecho47@yahoo.com
Calvin Atewamba	UNU-INRA	0245535708	atewamba@inra.unu.edu
Zhuohua (Cathy) tan	Millennium Institute	+16072207314	zt@millenium-institute.org
Felix A. Asante	ISSER		fasante@ug.edu.gh
Simon Bawakyillenuo	ISSER	0548731102	bawasius@hotmail.com
Danquah Yeboah Samuel	TEC-KNUST	0547277889	krypton@gmail.com
Samuel Dotse	HATOF Foundation	0207360517	samuel.dotse@hotmail.com
Lausa Sedem Dogbey	HATOF Foundation	0208326025	kunshix@yahoo.com
Luke Ahglasene	CSIR-FORIG	0208346537	langlaaene@yahoo.com
E. Kojo Ocran	GSS	0243053105	ebenezerocran@yahoo.co.uk
F. O. Y Mills	NADMO	0244701666	francisanabmills91@yahoo.com
Roselyn F. Adjei	FC	0244535772	yafossy@yahoo.com
Leha D. Mensah	KNUST	0207065185	idmensh@yahoo.com
Kwesi Asante	MoF	0244654193	kwasantus@yahoo.com
Robert Mensah	MoF	0244212959	robmenspat@gmail.com
Joshua Awku-Apaw	Earth Service	0244797638	Joshua.awukuapaw@yahoo.com
Yaw Kwakye	FC	0244769874	beemayaw@gmail.com
George Ortin	GEF/SGP	0208164683	georgeo@unops.org
I.F Mensah-Bonsu	NDPC	0208171556	ifmensabonsu@yahoo.co.uk
Winfred Nelson	NDPC	0244482407	winfrednelson@yahoo.com wnelson640@gmail.com
Richard Adjetey	MoGCSP	0246802133	richmedadjetey@yahoo.com
Eugene Nuamah	MoGCSP	0243143096	derock07@yahoo.com
George Awudi	FoE-GHANA	0545231324	geobrigkwa@yahoo.com
Baba Tuahiru	CARE	0244832133	baba.tuahiru@co.care.org
Frederick Ken. Appiah	Energy Commission	0208326959	fred.ken.appiah@gmail.com
Namho Oh	UNDP	0264253835	namho.oh@undp.org
F.D Ohemeng	GIDA	0274866970	ohemengfd@yahoo.com
Barbara Barnes	MWRWH	0244252049	bp.barnes12@yahoo.com
Mohammed Alhasan	TCPD	0245496917	alha8@yahoo.com
Christe O. Asare	EPA	0244612911	christina.asare@yahoo.com
Adelina Mensah	IESS	0244481018	ammensah@ug.edu.gh
Elaine T. Lawson	IESS	0244694070	elaine_t@staff.ug.edu.gh
Kwasi Nkansah Baawuah	WTC ACCRA	0244785429	kbaawuah@wtcaccra.com
Emml Doni. Kwame	WTC/ICC	0244251758	afridoni85@yahoo.com
Giorglo Droplo	UNEP	00393663656956	

APPENDIX 2 **POWER GENERATION BY PLANTS SINCE 2001**

Plant	Hydro			Thermal										Total
	AKOS	KPO	Sub Total	TAPCO	TICO	TT1PP	TRPP	ERPP	KRPP	MRP	TT2PP	SAPP	CEL	Sub Total	
2001	5,524 (70)	1,085 (14)	6,609 (84)	740 (9.4)	510 (6.5)	-	–	–	–	–	–	–	–	1,251 (16)	7,859 (100)
2002	4,178 (57)	858 (12)	5,036 (69)	874 (12)	1,363 (19)	-	–	–	–	–	–	–	–	2,237 (31)	7,273 (100)
2003	3,210 (55)	675 (11)	3,885 (66)	1,328 (23)	668 (11)	-	–	–	–	–	–	–	–	1,997 (34)	5,882 (100)
2004	4,404 (73)	876 (15)	5,281 (87)	536 (9)	222 (4)	-	–	–	–	–	–	–	–	758 (13)	6,039 (100)
2005	4,718 (70)	911 (13)	5,629 (83)	831 (12)	328 (5)	-	–	–	–	–	–	–	–	1,159 (17)	6,788 (100)
2006	4,690 (56)	929 (11)	5,619 (67)	1,416 (17)	1,395 (17)	-	–	–	–	–	–	–	–	2,810 (33)	8,429 (100)
2007	3,104 (44)	623 (9)	3,727 (53)	1,521 (22)	1,417 (20)	-	162 (2)	80 (1)	33 (0)	38 (1)	–	–	–	3,251 (47)	6,978 (100)
2008	5,254 (63)	941 (11)	6,196 (74)	874 (11)	1,063 (13)	-	85 (1)	45 (1)	16 (0)	46 (1)	–	–	–	2,128 (26)	8,323 (100)
2009	5,842 (65)	1,035 (12)	6,877 (77)	453 (5)	1,040 (12)	570 (6)	–	–	–	18 (0)	–	–	–	2,081 (23)	8,958 (100)
2010	5,961 (58.6)	1,035 (10.2)	6,996 (68.8)	1,234 (12.1)	1,160 (11.4)	591 (5.8)	–	–	–	20 (0.2)	28 (0.3)	138 (1.4)	–	3,171 (31.2)	10,167 (100)
2011	6,495 (58)	1,066 (9.5)	7,561 (67.5)	1,137 (10.2)	657 (5.9)	559 (5)	–	–	–	12 (0.1)	50 (0.4)	1,224 (10.9)	–	3,134 (28)	11,200 (100)
2012	6,950 (57.8)	1,121 (9.3)	8,071 (67.1)	1,061 (8.8)	1,168 (9.7)	622 (5.2)	–	–	–	20 (0.2)	141 (1.2)	848 (7.1)	94 (0.8)	3,953 (32.9)	12,024 (100)

Source: Source: ISSER, 2012

APPENDIX 3 PRIORITIZED KEY SECTORS IN GHANA TO INTERVENE GREEN ECONOMY POLICIES AND POLICIES IDENTIFIED BY STAKEHOLDERS IN DECEMBER 2013

Criteria	Social equality and wellbeing	Economic development	Environmental hazards	Dependence on natural resources	Strategic Relevance	Data availability	Possibility of implementation
Description of criteria	Effect of the sector in the welfare of people (eg health, education, quality of life)	Sectoral effect on social equality, for example through the income distribution	Environmental risks to which the sector is exposed or generated	The level of dependence on the natural resources sector	Inclusion of the sector in national development plans; importance in political decisions	The quantity and quality of data available to model the sector	The possibility that policies are implemented
Agriculture /crop cultivation (selected)	High	High	Medium	High	High	Medium	High
Energy (selected)	High	High	High	High	High	High	High
Forestry (selected)	High	High	Low	High	High	High	High
Water	High	High	Low	High	High	High	High
Waste	High	Medium	High	Low	High	Low	Medium

Source: MI Team, 2014

APPENDIX 4 ESSENTIAL ELEMENTS OF THE DIFFERENT SPHERES OF THE T21 MODEL

- **The social sphere** contains detailed population dynamics organized by gender and age. Fertility is a function of the level of income as well as education and mortality rates. These are determined by levels of income and access to basic health care. Access to education and health care services, employment and basic infrastructure are also represented in this sphere. Access to basic social services is used – in addition to income – to determine poverty levels in a broad sense. Social development is highly connected to economic sectors. With economic conditions improving, higher expenditure is allocated to health care and education, leading to increased labour productivity and supporting economic growth. The impacts of climate change on health (especially malaria and meningitis) are added to the model, which further affects life expectancy and mortality rate.

- **The economic sphere** contains the main production sectors (agriculture, industry, and services), where production is characterized by functions of Cobb-Douglas. The factors of production are resources, labour, capital, technology, and inclusive factor productivity. Specific issues, such as mining, tourism, extension agricultural or livestock are normally included in sub – modules of production by the needs. A Social Accounting Matrix (SAM) is used to represent the economic flow as well as balance, supply, and demand in each sector. The government sector generates taxes based on economic activity and allocates main category spending. Public spending affects overall economic performance and delivery of public services. Budget standard categories are used and the IMF key macroeconomic balances are included in the model as well as the current account, and capital flows (including debt management). Additional green investment in various areas are linked to baseline investment in these areas, which are also connected to the government account sector which tracks the flows of government revenue, expenditure and financing. In addition, the green agricultural policies are added to the model and linked to agricultural productivity. The mining and tourism sectors are disaggregated from the other industry and services sectors.

- **The environmental sphere** estimates the stocks of natural resources – both renewable and non-renewable – and track their consumptions, and can estimate the impact of the depletion of these resources on the production and other factors. It also examines the effect of soil erosion and other forms of environmental degradation and its impact on other sectors, such as agricultural productivity and nutrition. For example, the green policies in land recovery are linked to agricultural land, which further affects crops and livestock production. The amount of deforestation or reforestation as well as carbon storage in forests is also captured in the land sector. Other issues discussed are the supply and demand of fossil fuels, electricity (from renewables and water), and water (including natural resources and dam construction policies, which further affects agricultural productivity) and greenhouse gas emissions. It also includes cross-sector components of traditional combustible energy consumption that connects to both energy and forest land sectors.

APPENDIX 5 MODEL RESULTS ON KEY INDICATORS IN 2015 AND 2030 IN RELATION TO THE GE-LOW THERMAL, GE AND BAU SCENARIOS, ALONG WITH THE PERCENTAGE OF INCREASE RELATIVE TO THE BAU SCENARIO

Indicator (Scenario)	Unit	2015	2030	% increase relative to BAU	
				2015	2030
Economic Indicators					
Real GDP at market price	**billion cedis/year**				
GE-Low Thermal		35.9	90.6	2%	3%
GE		36.1	95.8	2%	9%
BAU		35.4	88.3		
Real GDP per capita	**cedis/person/year**				
GE-Low Thermal		1327	2548	2%	3%
GE		1332	2690	2%	8%
BAU		1307	2484		
Agriculture production	**billion cedis/year**				
GE-Low Thermal		7.5	17.5	1%	5%
GE		7.5	17.8	1%	7%
BAU		7.4	16.6		
Industry production	**billion cedis/year**				
GE-Low Thermal		9.5	26.5	2%	2%
GE		9.6	28.5	3%	10%
BAU		9.4	26.1		
Services production	**billion cedis/year**				
GE-Low Thermal		16.9	41.5	1%	2%
GE		16.9	44.0	2%	8%
BAU		16.7	40.6		
Cereal yield	**tonne/ha**				
GE-Low Thermal		2.2	5.9	2%	7%
GE		2.2	6.1	2%	10%
BAU		2.1	5.6		
Social and Overall Indicators					
% of population below poverty line	**%**				
GE-Low Thermal		12%	9%	-5%	-6%
GE		11%	8%	-12%	-14%
BAU		12%	10%		

Total employment	**person**				
GE-Low Thermal		10.04	13.47	1%	1%
GE		10.04	13.74	1%	3%
BAU		9.96	13.32		
Overall MDGs performance	**score**				
GE-Low Thermal		0.90	0.93	1%	1%
GE		0.90	0.93	1%	1%
BAU		0.89	0.92		
Environmental and Energy Indicators					
Forest Land	**million ha**				
GE-Low Thermal		4.33	3.19	1%	11%
GE		4.33	3.18	1%	11%
BAU		4.31	2.86		
Wind power generation (in addition to BAU)	**billion kWh/year**				
GE-Low Thermal		0.19	0.73	-	-
GE		0.19	0.73	-	-
BAU		0	0		
Solar power generation (in addition to BAU)	**billion kWh/year**				
GE-Low Thermal		0.11	0.32	-	-
GE		0.11	0.32	-	-
BAU		0	0		
Total hydropower generation	**billion kWh/year**				
GE-Low Thermal		8.32	9.20	3%	12%
GE		8.32	9.20	3%	12%
BAU		8.09	8.19		
Electricity saving from efficiency improvements (in addition to BAU)	**billion kWh/year**				
GE-Low Thermal		0.31	0.34	-	-
GE		0.31	0.34	-	-
BAU		0	0		
Electricity demand	**billion kWh/year**				
GE-Low Thermal		9.71	14.21	-2%	-1%
GE		9.87	14.54	0%	1%
BAU		9.87	14.39		
Net electricity export	**billion kWh/year**				
GE-Low Thermal		0.39	-2.76	67%	-1%
GE		0.66	-1.25	180%	-55%
BAU		0.24	-2.78		
Fossil fuel CO_2 emissions	**million tonnes/year**				
GE-Low Thermal		14.11	22.15	-1%	-5%
GE		14.52	24.64	1%	6%
BAU		14.32	23.35		

Aerial View of Accra, Ghana
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Worldwide, there is growing evidence that the greening of economies is a new engine for economic growth, a net generator of decent jobs, and a vital strategy for diversification of economy and the alleviation of poverty.

This publication presents the results of a quantitative analysis of three investment scenarios (Business-as-usual, Green Economy Thermal and Green Economy) and their economic, environmental and social impacts. The priority sectors are agriculture, forestry and energy. The findings show that green economy policies would produce 200,000 to 400,000 more jobs than Business-as-usual. Furthermore, greening the economy is projected to decrease poverty at a higher rate than Business-as-usual and the economy would grow at a rate between 6.5 and 6.9 per cent , compared with a growth rate of 5.9 per cent with Business-as-usual.

To help decision-makers identify priority actions that will support Ghana's transition to an inclusive green economy, the report discusses enabling policy conditions, such as regulations and voluntary initiatives, economic and fiscal policy instruments, investments and institutions needed for a green economy transformation.

To assist in implementing the recommendations of this report, the Partnership for Action on Green Economy (PAGE) is supporting Ghana through a four-year project.

Green Economy Assessment Ghana is part of a series of national assessments being prepared by countries to identify options and opportunities to advance green economy transition.

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