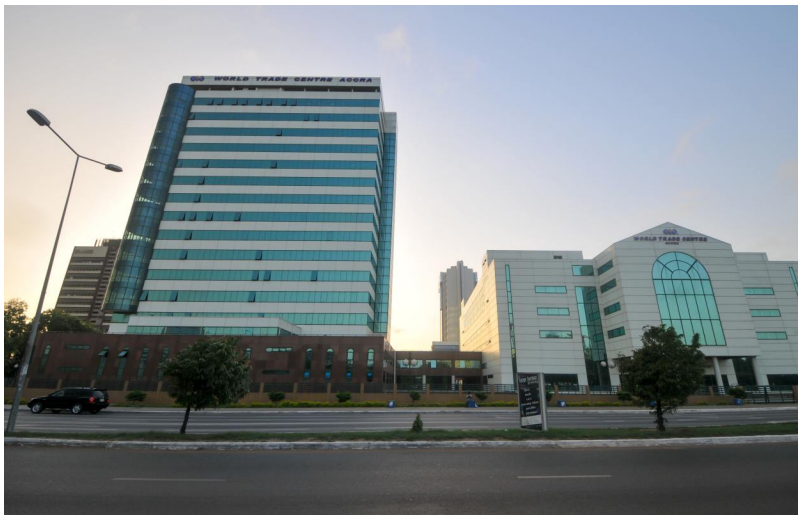
PAGE PARTNERSHIP FOR ACTION ON GREEN ECONOMY

GHANA: GREEN INDUSTRY AND TRADE ASSESSMENT



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EXECUTIVE SUMMARY

This Ghana Green Industry and Trade Assessment is one of several efforts to identify actions supportive of a green economy transition in Ghana, in this case through sustainable industry and trade. The assessment starts with a review of the multiple planning and policy regimes that have the potential for greening industry, encouraging the manufacture of environmental and renewable energy technologies and supporting green industry trade. It moves on to describe the current pattern of industrial production and green industry trade and the environmental impact and resource use of industrial production, to the extent limited data allow. It then proposes a new initiative for greening industry, describes several options that could reduce the policy implementation gap and suggests actions that could green trade in manufactured goods.

The Assessment finds that a resource efficient green industry initiative endorsed by the Ministry of Trade and Industry and the National Energy Commission would be a modest but powerful step towards greening industry, delinking industrial output from resource use and environmental impact. The initiative could support the National Cleaner Production Centre to work with one or more manufacturing sectors to reduce resource use, primarily energy, by a specific amount and date as an example of the potential for improving resource efficiency and bringing about improved competitive performance that would enhance export potential. Other measures supporting greening of industrial production and of trade in manufactured goods would be an expanded use of current regulatory authority; more effective use of industrial zoning authority; timely collection of data on industrial activity, resource use and environmental impacts; expansion of the pollutant disclosure program; more systematic review of the resource efficiency of imported technology; financial assistance for the manufacture of accessories for and assembly of renewable energy technologies; encouragement of greater public advocacy; greater uptake of environmental management standards and support for programs to green industry supply chains in sectors that are or have the potential to become significant exporters of manufactured goods.

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ACRONYMS

CSPG	Cross sectorial planning groups
DMC	Domestic material consumption
DME	Domestic material extraction
EEDP	Energy efficiency development plan
EIA	Environmental impact assessment
EMP	Environmental management plan
EPI	Environmental performance index
EPRD	Environmental performance rating and public disclosure
EPA	Environmental Protection Agency
FAGE	Federation of association of Ghanaian exporters
FYP	Five-year plan
FDI	Foreign direct investment
GNCCI	Ghana national chambers of commerce and industry
GNCPC	Ghana national cleaner production centre
GSGDA	Ghana shared growth and development agenda
GCI	Global competitiveness index
GDP	Gross domestic product
HDI	Human development index
IPPS	Industrial pollution projection system
ISIC	International standard industrial classification
Ktoe	Kilotonnes of oil equivalent
MVA	Manufactured value added
MEPS	Minimum energy performance standards
OECD	Organization for economic cooperation and development
RECP	Resource efficient cleaner production
REGI	Resource efficient green industry initiative
SME	Small and medium enterprises
SSA	Sub-Saharan African
PAGE	Partnership for Action on Green Economy
UNCTAD	United Nations Conference on Trade and Development
UNEP	United Nations Environment Programme
UNIDO	United Nations Industrial Development Organization

1 INTRODUCTION

This chapter offers definitions of green industry production and green industry trade set within the context of the green economy. It describes why greening of industry is important and offers a brief overview of green industry and green trade policies. It sets this assessment within the context of other green economy activities in particular the Partnership for Action on Green Economy. It lists the key issues and questions that will be addressed in the assessment. It concludes by listing the remaining chapters in this Ghana Green Industry and Trade Assessment (GITA).

1.1 What is green economy?

An assessment of green industry production and green industry trade needs to start with an understanding of what is meant by green economy. Several definitions, all reasonably similar, are:

The United Nations Environment Programme (UNEP) defines a green economy as one which is "low-carbon, resource-efficient and socially inclusive", or to put it in other words, a green economy is "one that results in improved human well-being and social equity while significantly reducing environmental risks and ecological scarcities" (UNEP, 2011). For the purpose of this Assessment, the UNEP definition will be adopted as working definition.

The Organisation for Economic Cooperation and Development (OECD) states that "green growth means fostering economic growth and development while ensuring that natural assets continue to provide resources and environmental services on which our well-being relies" (OECD, 2011). Whereas green growth is a subset of the concept of sustainable development entailing an operational policy agenda that can help achieve measurable progress at the interface between economy and environment, green economy stems from "a growing recognition that achieving sustainability rests almost entirely on getting the economy right" (UNCTAD,2012).

The UNCTAD in its report on how African countries can promote sustainable development, which is of most relevance for this assessment, states "that achieving sustainable development in Africa requires deliberate, concerted and proactive measures to promote structural transformation and the relative decoupling of natural resource use and environmental impact from the growth process. Sustainable structural transformation, as defined in the report, is structural transformation with such decoupling" (UNCTAD, 2012).

1.2 Definitions of green industry production and green industry trade?

First what is green industry? Both "green" and "industry" are rather generic terms that could mean many different things to many different people.

UNIDO describes Green Industry as industrial production and development that does not come at the expense of the health of natural systems or lead to adverse human health outcomes. Green Industry is aimed at mainstreaming environmental, climate and social considerations into the operations of enterprises. It provides a platform for addressing global, interrelated challenges through a set of immediately actionable cross-cutting approaches and strategies that take advantage of emerging industry and market forces (UNIDO, 2011a).

For purposes of this assessment, industry is limited to the manufacturing sector as follows:

Industry is those activities which are described in Section C (manufacturing) of the International Standard Industrial Classification of All Economic Activities (ISIC), Revision 4, of the Statistics Division of the United Nations Department of Economic and Social Affairs. Industry as used in this assessment refers exclusively to manufacturing activities; the terms industry and manufacturing are herein used interchangeably.

The Green Industry Platform, convened by UNIDO and UNEP, states that Green Industry involves a two-pronged strategy to create an industrial system that does not require the ever-growing use of natural resources and pollution for growth and economic expansion. These two components are:

(1) Greening of existing industry: Enable and support all industries regardless of their sector, size or location, to green their operations, processes and products by using resources more efficiently; transforming industrial energy systems towards greater sustainability by expanding renewable energy sources; phasing out toxic substances; and improving occupational health and safety at the industrial level.

(2) Creating green enterprises: Establish and expand (new) green enterprises that deliver environmental goods and services. Green enterprise is a rapidly expanding and diverse sector that covers all types of services and technologies that help to reduce negative environmental impacts and resource consumption. This includes material recovery, recycling, waste treatment and management, as well as the provision of environmental and energy consulting and services, such as energy service companies and companies that provide monitoring, measuring and analysis services.

For purposes of this assessment and in keeping with this strategic approach, green industry encompasses four activities:

- Greening industry. This refers to any activity by which the processes of manufacturing industry (1) improve their efficiency of energy, water and raw materials to reduce pollutant discharges to move towards compliance with environmental norms and (2) shift to the extent possible the use of renewable energy.
- Environmental goods and services industry. It is the manufacture of pollution control and monitoring equipment. In addition, environmental services, such as environmental engineering and auditing, are included even though they are not a direct part of industry according to ISIC 4. However as such services are needed for greening industry, they are included within the category of green industry.
- Renewable energy industry. It is the manufacture of renewable energy technologies (e.g. solar panels, wind turbines, mini-hydro turbines). They are clearly part of industry even though there is no one specific ISIC subcategory for these technologies.
- Materials recovery and recycling industry. To the extent that these activities include transformation during production, they are part of the manufacturing subsectors where this transformation occurs (e.g. transforming scrap metals into new metals, remanufacturing car engines). If they mainly refer to sorting activities, they are classified under waste management activities or wholesale of waste and scrap. Note: Recycling used to be classified under manufacturing in ISIC 3, but this did not well reflect its production process.

Second, what is green industry-related trade? As above, "green" and "industry-related trade" are rather generic terms that could mean different things to many different people. For purposes of this assessment, industry-related trade and green industry trade are defined as follows:

Green Trade: for the purpose of this assessment, trade is defined as the aggregate of imports and exports, as defined by the glossary of the United Nations Commodity Trade Database (COMTRADE). Green Trade is defined as the import and export of goods and services that are produced using green value chains with enhanced sustainability of transport, production, use, maintenance and end-of-life cycling. This entails the segment of environmental goods and services, including products for energy efficiency, renewable energy pollution control, water and wastewater, and organic agriculture. Green trade in goods and services is generally signalled and standardized through the use of recognized and creditable sustainability standards and certification.

Industry-related trade: Trade in manufactured goods includes commodities in the following COMTRADE HS Sections: prepared foodstuffs and beverages (IV), products of the chemical industries (VI), plastic and rubber articles (VII), skin and leather articles (VIII), articles and manufactures of wood (IX), paper and paperboard (X), textile articles (XI), footwear, headgear, umbrella (XII), articles of stone, ceramic, glass (XIII), precious metal articles, jewellery (XIV), articles of base metal (XV), electric machinery and mechanical appliances (XVI), vehicles (XVII), optical, photographic, medical instruments, clocks and watches, musical instruments (XVIII), arms and ammunition (XIX), miscellaneous manufactured article (XX) an works of art (XXI). In these sections we excluded all the products in primary forms such as polymer, natural rubber, cocoa beans, natural pearl, un-worked gold or diamonds and raw animal skins.

Green industry trade: For purposes of this assessment, "sustainable or green trade has a key role to play in the interface between international trade and the transition to a green economy. While there is no universally agreed definition of sustainable trade, it broadly refers to trade that does not deplete natural resources, harm the environment or deteriorate social conditions while promoting economic growth." (UNEP 2013).

Green trade opportunities for manufactured goods are mostly export of environmental goods and services and renewable energy technologies, in complying with quality, health and environmental standards (ISO 9000, HASP ISO 1400 and eco-labelling) to enhance export potential, in embedding sustainability as a core business strategy, in promoting the complete disassembly, recovery and re-use of individual product components (re-manufacturing) and in the greening of global supply chains.

1.3 The importance of green industry and trade policies

Governments play an essential role in promoting industry and trade. These roles are briefly described in the two sections below.

1.3.1 Green industry-related policies

History shows that successful efforts to decouple economic growth from environmental pressures have been underpinned by effective policy frameworks which address a range of market, institutional and information needs. In other words, there is no single policy instrument that promotes green industries; multiple instruments must be applied variously and simultaneously within an integrated and interconnected framework.

[1] Properly implemented standards can facilitate sustainable trade by contributing to improving the quality of traded goods, increasing productivity and efficiency of manufacturing by specifying product characteristics, and by favouring the transfer of environmentally sound technologies. Consumers, large manufacturers and retailers can put pressure on suppliers worldwide through the introduction of voluntary standards, and thus transform business practices in profound and greener ways. (UNEP, 2013 p.38)

Governments can promote the greening of industries through a broad range of public policy measures (e.g. environmental, energy, industrial, fiscal, technology and regional development policies) and supporting infrastructures. Such measures cover both supply and demand aspects. Governments also have a key role to play in influencing certain framework conditions (e.g. finance, education, innovation), which create an environment conducive to the greening of industries.

Policy development needs to be supported by effective strategies and processes which integrate the economic, social, and environmental dimensions of green industries. This integration needs to occur both horizontally (across government agencies), and vertically (within tiers of government). Partnerships and meaningful consultation with industry and the wider community are essential if green industry policies are to be effectively implemented. Moreover, the promotion of green industries requires resources and commitment across multiple sectors of government.

1.3.2 Green trade policies

If managed appropriately, international trade and the green economy can interact in a bi-directional and mutually beneficial way. Trade, when accompanied by appropriate policies for the environment and society, can be a principal driver of the shift to greener economies and to sustainable consumption and production patterns. It can open domestic production to larger and often completely new global markets for environmental goods and services, thereby encouraging or even providing the basis for investment and growth in green industries. The Rio+20 Conference outcome document, The Future We Want, affirms that trade is an engine for sustained economic growth and development. At the same time, environmental innovation is fostering dynamic new international markets.

Green trade can foremost be promoted through the reduction or elimination of tariff and non-tariff barriers on environmental goods and services, at multilateral level in the WTO but also through regional and bilateral trade agreements. At national level, countries can enhance the export of green industry products through direct or indirect support to green segments of industries (incl. through subsidies or tax breaks); requirements for industry application of environmental norms and standards; and the harmonization of national standards with internationally recognized ones. Global trade now operates in a fundamentally different way from that of previous generations, with global value chains that span all countries, moving rapidly from the extraction of natural resources, to multiple processing or manufacturing steps, to final products and services, often crossing borders and adding value at every stage. Countries can enhance their green trade by identifying and promoting strategic industry sectors, either at intermediate, processing or assembly stage, to contribute to global value chains. For this purpose, especially small- and medium-sized industry needs to be supported in the quest for greener production and export, through supportive policy frameworks and export promotion agencies.

The rigorous development and implementation of policies for the creation or expansion of green industry trade needs to be accompanied by international support offers for identifying and developing high-potential green industry segments for export, and by capacity-building activities, especially in least-developed and developing countries, for participation in greener value chains.

It must be recognized that, when not managed properly, trade can also accelerate environmental and social degradation, by exacerbating natural resource exploitation, growing industries using unsustainable production methods or elevating pollution from international transport. Sound environmental and social management policies are necessary to ensure that trade facilitates rather than undermines the shift to greener, more inclusive economies.

1.4 Differentiation/linkage to other assessments

The Partnership for Action on Green Economy (PAGE) in Ghana is undertaking a number of initiatives to support the transition to a Green Economy. It is operating within the framework of existing policies, such as Ghana's medium term development strategy (2014-2017) - the Ghana Shared Growth and Development Agenda II - and the National Climate Change Policy (2013). The medium term development strategy policy focuses on enabling conditions for sustainable economic growth, with an emphasis on industrialization and modernization of agriculture, as well as job creation. The Green Economy Assessment for Ghana (Bawakyillenou and Asante, 2015a) builds on the medium term development strategy and complements the SWITCH Africa Green programme in Ghana with a major focus on business development and networking (UNDP, 2014). PAGE aims to contribute to evidence-based selection of priority areas for the implementation of concrete Green Economy actions, and to promote green industry, trade and jobs, as well as institutional capacity building for Green Economy through training-needs assessment and delivery. A recently completed stocktaking exercise reviewed all relevant policy frameworks, institutions and initiatives and consulted with stakeholders and institutional mechanisms in the country with a view to identifying key sectors and actions and avoiding duplication of activities (Bawakyillenou and Asante, 2015b).

The Ghana Green Industry and Trade Assessment (GITA) will form a central part of the empirically-based analysis to be undertaken through PAGE in Ghana. It will complement the already written Green Economy Assessment for Ghana which focused primarily on three key sectors for greening the economy - agriculture, forestry and energy (Bawakyillenou and Asante, 2015a[2]). As the Green Economy Assessment for Ghana did not examine in any depth the role of industry and trade in greening the industrial component within the three key sectors (agro industry within agriculture; industrial energy efficiency within energy and the wood products sector within in forestry), the GITA will play a critical role in identifying a set of both modified and new policies to support the transition to green industrial production and trade, It will put forward specific green industrial and trade policy recommendations, which will be presented to key stakeholders for their consideration.

1.5 Key issues and questions to be addressed

This assessment focuses on a few key issues that are most relevant to green industry and trade. These are:

- What existing policy regimes have the potential for greening industry, encouraging the manufacture of environmental and renewable energy technologies and supporting green industry trade?
- What is the current status of industry and trade, in regards to priorities and environmental performance?
- What is known about industrial environmental pollution and resource use? Can green trade help to mitigate environmental pollution or reduce resource use? What modifications in or effective use of existing industrial policies could contribute to greening industry and industry trade?
- What new initiative(s) might be undertaken to accelerate the greening of industry and trade, or even aspects thereof?
- What new industry segments could offer potential for green industry and trade?
- How could the development of these green industry segments be supported?

[2] The three priority sectors were selected at a consultation workshop based on the following criteria—social, economic, environment, resource dependency, strategic relevance and data availability (date?);the Threshold 21 (T21) integrated model was then applied to measure the implications for the criteria of the three sectors. (Tan, Pedercini and MI Modeling Team, 2015).

1.6 Remaining chapters

The chapters listed below, which are based on a review of policies and programmes, various national and international data sources and interviews with key informants (listed in Annex 2) will answer to the extent possible the questions above:

- **Chapter 2: Ghana's policy regime for green industry production and trade.**
  This chapter reviews the major policies that have or could influence the greening of industry, the manufacture of environmental and renewable energy technologies and the export of manufactured goods.
- **Chapter 3: Ghana's manufacturing sector and trade in manufactured goods.**
  This chapter describes Ghana's industrial and export structure. The data on manufacturing will be taken primarily from UNIDO and export from UN COMTRADE.
- **Chapter 4: Industrial environmental pollution and resource use.**
  This chapter utilizes the limited international and national data to characterize the current situation and describe where possible the potential for decoupling of resource use and industrial output.
- **Chapter 5: Formulating an overarching resource efficient green industry initiative.**
  This chapter describes the rationale for a resource efficient green industry initiative (REGI), quantifiable objectives for decoupling and long-term agreements essential for improving the resource efficiency for sub-sectors.
- **Chapter 6: Decoupling programmes in Ethiopia and Asian Countries.**
  This chapter reviews best practices for greening industry in other countries with a focus on decoupling of resource use from industrial production.
- **Chapter 7: Complementary interventions for greening industry.**
  This chapter proposes government interventions to complement the resource efficient greening of industry initiative in Chapter 5. These interventions include measures to improve the implementation of current policies and programmes and new measures that have the potential to contribute to the transition to green industry. It can be seen as identifying policy implementation gaps that limit the greening of industries Ghana in spite of the notable efforts by the Government to introduce a conventional industrial environmental management programme.
- **Chapter 8: Measures and priorities for trade in green goods and for greening trade in manufactured goods.**
  This chapter identifies the key sectors for greening trade based on the findings of Chapter 3. It describes the current manufacture of environmental goods and renewable energy technologies, the current institutional capacity for supporting industrial use of quality, health and environmental standards and the potential for greening the supply chain of the dominant manufacturing export sub-sectors.
- **Chapter 9: Findings and recommendation.**
  This chapter summarizes the findings in the above chapters and recommends practical measures that have the potential to support green industry development and trade in Ghana.

2 GHANA'S POLICY REGIME FOR GREEN INDUSTRY PRODUCTION AND TRADE

This section briefly summarizes and comments on the most relevant government policies and associated institutions that have the potential to support green industry production and trade. The policies reviewed are industrial, trade (including regional level), environmental climate change, energy and technology policies as well as the national medium-term development framework, which is the blueprint for Ghana's development agenda. It lists several relevant institutions, both those associated with specific policies and plans and those supportive of industrialization and trade promotion.

2.1 National medium-term development framework

In 1995 Ghana launched its long-term development plans (Vision 2020) with the aim of transforming itself from a low-income developing country status into an upper middle-income one by 2020. The prevailing development plan within the context of the Ghana Poverty Reduction Strategy forecasts an average real GDP growth of 7-10 % for the period 2003 to 2015 and is expected to achieve a per capita income of US $1,000 by 2015 from less than US $400 in 2001. The drivers of the expected economic growth according to the strategy are agro-based (agricultural sector), manufacturing (industrial sector) and information communications technology.

The Government's vision for the medium to long-term is articulated in the Ghana Shared Growth and Poverty Reduction Strategy (2006-2009), the Ghana Shared Growth and Development Agenda I (2010-2013) and most recently in the Ghana Shared Growth and Development Agenda II (2014-2017). The current agenda (II) is a continuation of the 2010-2013 agenda. Its purpose is to attain "a stable, united, inclusive and prosperous country with opportunities for all by levering Ghana's natural resource endowments, agricultural potentials and human resource base for accelerated economic growth and job creation through value addition."

Due to the variety and multiplicity of stakeholders, coordination among players involved in the formulation of the agendas is rather complex. According to the National Development Planning Commission Act (1994, Act 479, Section 15 (1)), Ghana's National Development Planning Commission has been required to "establish cross-sectorial planning groups to integrate and co-ordinate the planning and development activities of such sectors of the economy as it may determine" in order to ensure broad participation in the preparation and implementation of development plans. (GoG, 1994b)

Cross-sectorial planning groups comprise both state and non-state actors from the ministries, departments and agencies, professional bodies, tertiary institutions, research institutions and think tanks, non-governmental organisations, community-based organisations, private sector, organized labour, identifiable groups and associations, specialized institutions, outstanding individuals with expertise in relevant fields as well as development partners. In addition to the cross-sector planning groups, public consultations (held at district, regional and national levels) are undertaken to solicit the views of stakeholders and the general public about development policy and plan proposals. A development communication Strategy is being formulated by the Commission.

These agendas are recognized as the National Sustainable Development Strategy because they address the three pillars of sustainability: economic, social and environmental. They have been prepared by the National Planning Development Commission.

2.2 Industrial policy (2010)

The thrust of Ghana's Industrial Policy lies in the expansion of productive employment and technological capacity in the manufacturing sector, and the promotion of both agro-based industrial development and spatial distribution of industries in order to reduce poverty and income inequalities. The Policy is set within the context of Ghana's long-term strategic vision of achieving middle income status by 2020 through transforming itself into an industry-driven economy capable of delivering decent jobs.

The specifics of industrial policy are set forth in the Ghana Industrial Policy (GoG, 2010) and Industrial Sector Support Programme (2011-2015) (GoG, 2011). Several provisions are supportive of greening industry i.e. making industry more resource efficient and environmentally compliant. These are:

- Plant, Machinery and Equipment: 1.1.6.4 Government will regulate the importation of aged equipment except where the associated technology is right (whatever that means).
- Venture Capital and Private Equity Market: 1.3.3.2 Government will provide incentives to attract both foreign and local investors to the venture capital market.
- Land for Industrial Development:1.4.2.3 Government will strictly enforce zoning regulations to ensure that industrial zones/estates are reserved only for industrial purposes
- Electricity and Water: 1.4.3.3 Government will draw up and implement energy and water efficiency and conservations programmes (has that been done?)
- Voluntary Standards: 1.7.2.1 Government will help strengthen the linkage between Ghana Standards Board and industry associations in the development of voluntary standards. (Does this include ISO 9001 and IS) 14001?)
- InvestmentIncentives: 3.1.2.1 Government will ensure that investment incentives are appropriated to attract (domestic and foreign) investments into the manufacturing sector.
- Export Incentives: 3.1.3.2 Government will streamline and enhance incentives to export-oriented manufacturing firms [and reduce import barriers].
- Cleaner Production: 4.2.1.1 Government will facilitate the development of programmes that promote the efficient use of raw materials, energy and water in industry
- Cleaner Production: 4.2.1.2 Government will support industry to adopt cleaner production technologies and improved manufacturing processes.
- Cleaner Production: 4.2.1.3 Government will strengthen the capacity of regulatory bodies to enforce environmental regulations as well as effectively monitor manufacturing processes.
- Cleaner Production: 4.2.1.4 Government will ensure the promotion within industry of relevant ISO standards on environmental management.
- Cleaner Production: Government will encourage industry to develop and implement self-regulatory measures on environmental management.

Component Two in the Policy (Technology and Innovation) makes no mention of promoting the development or application of environmental or renewable energy technologies.

The Industrial Policy is being implemented by the Ministry of Trade and Industry.

2.3 Trade policies

The Ghana Trade Policy (2005) fits strategically with other key national development programmes such as the Ghana Poverty Reduction Strategy and the Private Sector Development Strategy. Ghana's aspiration is to become a middle-income country. The policy realizes that attainment of such rapid growth rates with structural transformation of the productive sectors of the economy will require the country to move away from a heavy dependence on exports of a limited number of primary commodities to create competitive advantage on a more diversified range of products with higher levels of value-addition. The Trade Policy is designed to systematically deliver strategic expansion of Ghana's productive base and takes a new approach to international trade capacity building focused on strengthening local capacity in the public and private sectors in a sustainable manner.

Several other schemes are in place to promote exports of non-traditional products with a view to diversifying Ghana's export base. Key programmes include market access facilitation for export companies, technical advisory services on export product development, trade information services, and export-related human resources development. The main entity is the Ghana Export Promotion Authority (GEPA), which identifies and supports exports of new products (WTO, 2014; see also chapter 2.8).

Key design features of the Trade Policy include the aim to improve structures for international trade negotiations to improve the capacity of all stakeholders. It also includes the formulation and implementation of trade negotiation strategies strategically to ensure effective participation by Ghana in international trade negotiations in support of national development objectives. Others are an import-export regime for tariff and non-tariff measures to ensure a level playing field for all economic operators through effective and system applications.

The WTO Trade Policy review of Ghana (2014) found that considerable efforts are still required for trading across borders, so as to bring import and export procedures into conformity with the standards of a modern economy. Specific issues identified were: very slow clearance procedures; defective scanners or inefficiencies in their use; multiple destination inspection agencies that duplicate the work of customs officers; and frequent physical inspection of goods.

In addition, Ghana still applies a considerable degree of tariffs to its trade; in 2013, the most-favoured nation tariff of Ghana averaged 12.8%. Moving forward, key indicators used to measure the overall performance of trade policies will include increased volume and value of exports; improved performance of domestic firms and SMEs in targeted sectors; increased flows of domestic and foreign direct investment; and increased sector competitiveness.

2.3.1 Regional trade policy – ECOWAS (2007)

The Economic Community of West African States (ECOWAS) seeks to promote economic integration in "all fields of economic activity, particularly industry, transport, telecommunications, energy, agriculture, natural resources, commerce, monetary and financial questions, social and cultural matters" (ECOWAS, 2007). The ECOWAS has fully established free movement of persons and capital. In 2013, ECOWAS members concluded negotiations on a common external tariff for the region, and those on an Economic Partnership Agreement with the European Union, Ghana's main trading partner (WTO, 2014). Within the context of regional cooperation, Ghana and its neighbours have had cross-border trade arrangements for decades, including for trans- boundary electricity supply.

2.4 Environmental policy

Several policies, acts, regulations and programmes form the overall environmental framework of Ghana. The bedrock of this framework is the environmental protection agency act. Other policies, acts, regulations and programmes support the environmental protection measures set out in the act.

2.4.1 National Environmental Policy (2012)

Among other things, the policy describes the Government's focus in the medium term on shifting the economy from the current factor-driven one to an efficiency-driven one. "This will be achieved by anchoring industrial development on the conversion of Ghana's natural resources into value-added products with emphasis on agro-based manufacturing, down-stream oil and gas and mineral processing and manufacturing, tourism, and creative arts."

The policy reconfirms the government's commitment to the polluter pays principle. "Those responsible for environmental damage must be liable for the repair caused both to the physical and human environments. They must also be held responsible for the costs of preventive measures to reduce or prevent further pollution and environmental damage."

On Green economy, the policy calls for macro-economic assessments with a view to better understanding how government policies and public and private investment can help achieve the fundamental macroeconomic objectives of income growth, economic development/diversification, job creation and which follows a path that contributes to social equity and environmental improvement.

The policy endorses the concept of Sustainable Consumption and Production that calls for minimizing the use of natural resources, toxic materials and emissions of waste in production and consumption processes. It envisages a holistic approach to minimizing negative environmental impacts from production and consumption whilst considering the practical implementation of strategies to achieve sustainable development.

2.4.2 Environmental Protection Agency Act, 1994 (Act 490)

The Environmental Protection Act, promulgated in December 1994, provides a comprehensive legal and organisational base for duties related to environmental protection in Ghana and comprises the following parts:

Part	I	-	Establishment of the Environmental Protection Agency (EPA)
Part	II	-	Enforcement and control
Part	III	-	Establishment of National Environment Fund
Part	IV	-	Administration and General Provisions

The major institutional provisions are given by the Environmental Protection Agency Act (GoG, 1994a). In Part II of the Act, the functions of the EPA are defined. With regard to tasks of industrial wastes management, the following functions are considered to be the most relevant ones. However, there are no specific actions on environmental greening of industries but these function give incite to all opportunities that ensure implementation activities towards a green industry economy for Ghana. These include:

(a) advise the Ministry on the formulation of policies on all aspects of the environment and in particular make recommendations for the protection of the environment;

(b) co-ordinate the activities of bodies concerned with the technical or practical aspects of the environment and serve as a channel of communication between such bodies and the Ministry;

(c) co-ordinate the activities of such bodies considered appropriate for the purposes of controlling the generation, treatment, storage, transportation and disposal of industrial wastes;

(d) secure collaboration with such persons as it may determine the control and prevention of discharge of wastes into the environment and the protection and improvement of the quality of the environment;

(f) issue environmental permits and pollution abatement notices for controlling the volumes, types, constituents and effects of waste discharges, emissions, deposits or other sources of pollutants and of substances affecting the quality of the environment or any segment of the environment;

(g) issue notice in the form of directives, procedures or warnings to such bodies as it may determine for the purpose of controlling the volume, intensity and quality of noise in the environment;

(h) prescribe standards and guidelines relating to the pollution of air, water, land and other forms of environmental pollution including the discharge of wastes and the control of toxic substances;

(i) ensure compliance with environmental impact assessment procedures established for the planning and execution of development projects, including compliance with respect to existing projects;

(j) act in liaison and co-operation with government agencies and institutions to control pollution and generally protect the environment;

(k) promote effective planning in the management of the environment;

(l) develop a comprehensive database on the environment and environmental protection for the information of the public;

(m) co-ordinate with such international agencies as the agency considers necessary for the purpose of this Act;

(n) impose and collect environmental protection levies in accordance with this Act and the regulations promulgated by this Agency to implement the Act.

The Act also prescribes enforcement and control measures for activities that in the opinion of the Board has, or is likely to have, adverse effect on the environment. It has been stated that the Board shall provide Enforcement notices:

1) Where it considers that the activities of an undertaking pose a serious threat to the environment or to public health, serve on the person responsible for the undertaking, an enforcement notice requiring that person to take the steps stipulated by the Board to prevent or stop the activities.

2) An enforcement notice shall specify

   a) the offending activity,
   b) the steps required to be taken,
   c) the time within which the steps shall be taken, and
   d) the immediate cessation, where necessary, of the offending activity.

3) A person who acts contrary to an enforcement notice issued under subsection (1) commits an offence and is liable on summary conviction to a fine not exceeding two hundred and fifty penalty units and in default to a term of imprisonment not exceeding one year or to both the fine and the imprisonment.

The Environmental Protection Agency Act gives the EPA all the conventional regulatory powers needed to bring industry into compliance with environmental norms - formulate guidelines, issue permits, compliance monitoring and enforcement. To-date, the EPA has issued general environmental quality discharge guidelines for air, wastewater and noise for industry and specific effluent limitation guidelines for nine manufacturing subsector and some permits and required that industry monitor its pollutant discharges: Specifically,

- There are still no guidelines or standards for industries discharging into communal wastewater treatment systems. Nor are there comprehensive standards for solid and hazardous waste management other than guidelines for the development of landfills issued in 1998 and for the safe and sound management of health-care and veterinary wastes issued in 2000.
- As of 2014, EPA had permitted between 250-300 manufacturing plants (provision [f] above). A permit is to be renewed every three years. The provisions in the permit application are comprehensive with the following sections - commitment to pollution prevention, minimization and mitigation in the environmental management plan completed as part of environmental impact assessment; exploitation of cleaner production options; air emission management; wastewater management; water management; solid/hazardous waste management; energy management; chemical management; waste oil/spill management; environmental quality monitoring and pollution inventory; environmental reporting to EPA; and environmental management plan implementation and permit awareness.
- The EPA started to develop a complete industrial database in 2013 with the Ghana Statistical Service but this did not go far due to lack of funds for field work and currently still does not have a publically accessible database on the compliance status of the permitted firms even though it has some information on permitted facilities.
- Even though there are no trade effluent charges, the EPA does have a mandate to penalize facilities that consistently breach environmental regulations (section 13 of the EPA Act 490 and regulation 29 of the LI 1652). However, the EPA has hardly used this authority. Rather it prefers to recognize facilities for continuous environmental improvement approach.
- Manufacturing firms are required to monitor their pollutant releases and to report monitored data to the EPA. This has been mandated through the Environmental Assessment Regulations, 1999 (LI 1652) which ensures the registration and permitting of existing industries as well as certification of industries in respect of which Preliminary Environmental Reports, Environmental Impact Statements and Environmental Management Plans (EMP) are prepared and submitted to the EPA before permits are issued. As part of the requirements for issuing a permit, all industries monitor and report their pollutant releases and compare their releases with the EPA guidelines. The EPA also carries our regular compliance monitoring on all industries and undertakes regular pollutant monitoring in industries to validate what industry is submitting to the EPA. What is troublesome is that the EPA does not have a publically accessible database on the compliance status of the permitted firms.
- There are no trade effluent charges nor penalties for exceeding discharge levels so here is no incentive for industries to carry out their own on-site treatment nor to reduce wastewater concentrations (provision [n] above).
- However there is the Environmental Performance Rating and Public Disclosure (EPRD) programme and its successor, AKOBEN. The focus of the EPRD Programme is to increase compliance with environmental regulations and to create incentives for companies to take voluntary initiatives for pollution prevention. In 2005, eighteen (18) mining industries and thirty-two (32) manufacturing industries participated in the Pilot Phase I of the EPRD for the award of EPA's prestigious Annual Continual Environmental Improvement Award. EPA has since institutionalized the EPRD programme with the AKOBEN initiative, which started in 2008. Under the AKOBEN initiative, the environmental performance of mining and manufacturing operations is assessed using a five-colour rating scheme. AKOBEN ratings are evaluated by

analysing more than a hundred performance indicators that include quantitative data as well as qualitative and visual information. These ratings measure the environmental performance of companies are based on their day-to-day operations. The first AKOBEN report in 2009 and the latest in 2012 listed 100 manufacturing firms. The overall ratings for both years classified the majority of firms as having either poor (causing serious risk) or unsatisfactory (non-compliance) performance. In 2009, 63 firms had poor performance and 27 unsatisfactory performances; in 2012, 61 firms had poor performance and 29 unsatisfactory performances. These findings have brought about the realization that most firms were operating at variance with environmental regulations and standards.

The EPA is one of the key institutions under the Ministry of Environment, Science, Technology and Innovation for which it provides technical support. The Ministry has oversight responsibility over the following Departments and Agencies:

The Ghana Atomic Energy Commission

The Council for Scientific and Industrial Research

The Environmental Protection Agency and the

Town and Country Planning Department

2.4.3 Environmental Assessment Regulations, LI 1652 (1999)

Ghana is one of the many countries that have recognized EIA as a major tool for the realization of environmental sound development. The EPA Act 490 mandates the Agency "to ensure compliance with laid down environmental impact assessment procedures in the planning and execution of projects including compliance in respect of existing projects".

In 1999, EIA was given a complete legal status in Ghana, when existing procedures developed to facilitate the implementation of EIA were enacted into Regulations – The Environmental Assessment Regulations 1999 (LI 1652). The Regulations basically requires that:

(i) No person commences certain undertakings (specified in schedule 1) unless the undertaking is duly registered with the Agency and the environmental permit has been obtained.

(ii) No person commences an activity in respect of any undertaking which in the opinion of the Agency has or likely to have adverse effect on the environment or public health unless prior to the commencement it has been registered and an environmental permit duly from the Agency.

(iii) No environmental permit shall be issued by the Agency for certain undertakings (specified in Schedule 2) unless an Environmental Impact Assessment has been submitted.

(iv) An EMP must be submitted on relevant approved undertakings within eighteen (18) months of commencement of operations and thereafter updated every three (3) years.

(v) An EMP shall be submitted by undertakings mentioned in schedule 1, which was in existence before the coming into force of LI 1652 within eighteen months from the coming into force of these regulations and thereafter every 3 years.

The Environmental Assessment Regulations, 1999 (LI 1652) therefore mandates the registration and permitting of existing industries as well as certification of industries in respect of which preliminary environmental and environmental impact statements are submitted to the EPA.

The EMP constitutes a non-regulatory approach to enforcing the requirements of the LI 1652. The plan aims at initiating an evolving process of environmental awareness and management development from a period of an ill-informed industry to one in which industries are aware of their obligations in under existing regulations. The Regulation enjoins all existing companies to submit an EMP to the EPA every three years and ensure that the action plans therein are implemented. The EMP is to serve as a management tool for effective resource management and pollution control. This compliance and enforcement functions conferred on EPA include the authority to request from various categories of undertakings or any development, which in the opinion of the EPA has (or likely to have) significant impacts on the environment; impact assessment or environmental management plans that identify issues of environmental concern and to proposed preventive, minimization and mitigation measures to the identified concerns.

Obligations of industry under the Environmental Assessment Regulations are that industries granted permits and certificates by the Agency are required to comply with all the environmental permit conditions and schedules stated in the permit. In addition the operator is obliged to comply with all the reporting requirement of the Agency. Reporting requirements include:

- Submission of annual environmental reports in accordance with Regulation 25 of the LI 1652
- Submission of either monthly or quarterly environmental quality monitoring reports as directed by the Agency
- Submission of an updated EMP every three years in accordance with Regulation 24 of the LI 1652.

The Environmental Assessment Regulations, 1999 also specifies penalties for non-compliance. Under regulation 26 of the LI1652 the Agency may cancel, suspend or revoke, a permit or certificate, where the holder of the permit/certificate in the following situations:

1. fails to obtain any other authorization required by law in relation to his undertaking before commencement of operations;
2. is in breach of any provision of these regulations or any other enactment relating to environmental assessment;
3. fails to make any payments required under these regulations on the due date
4. acts in breach of any of the conditions to which his permit or certificate is subject; or
5. fails to comply with mitigation commitments in his assessment report or environmental management plan.

2.4.4 Ghana National Cleaner Production Centre Programme

The Environmental Protection Agency launched the Ghana National Cleaner Production Centre (GNCPC) in January 2012 to promote the application of Resource Efficient Cleaner Production (RECP) measures. This landmark achievement followed a series of preparatory activities, including UNIDO's sponsored cleaner production demonstration projects initiated in 2001. The Government has asked UNIDO/UNEP to obtain technical and financial assistance for the GNCPC in the practical implementation of cleaner production assessment and financing. The GNCPC will only become active once funding is secured either from the Government or international donors.

2.4.5 Ghana National Cleaner Production Centre Programme

Long before drafting the proposed environmental report policy, the Government of Ghana realized in 2005 that fossil fuel subsidies in the country were hardly benefiting the poor. After a public discussion on fuel subsidy reforms, the government decided to support the removal of these fuel subsidies. This has enabled it to 1) eliminate fees for attending primary and junior secondary schools; 2) allocate extra funds for primary health care in the poorest areas; 3) expand the provision of mass urban transport; and 4) increase funds for a rural electrification scheme. These policies redirect government subsidies to where they are most needed.

The draft Ghana Environmental Fiscal Reform Policy provides for strategic direction and coordination to achieve welfare gains for the entire society by:

- Reforming taxes, introducing new taxes and reforming public budgeting and expenditure systems such that sustainable development, environmental protection, climate change and green economy principles are supported.
- Moving tax bases and burdens away from taxes on economic goods (such as labour, investment and consumption) to environmentally damaging activities (such as use of natural resource or pollution) in order to provide incentives to consumers and producers.
- Reforming existing subsidies which counteract environmental, climate change and sustainability policies.

One strategic focus areas of the draft policy is a programme to establish the Ghana Green Fund. It is to be established as a comprehensive cross sectorial fund to facilitate, co-finance and foster investments required to implement relevant Ghanaian policy and law, including investments in climate change adaptation & mitigation, waste management, industrial pollution & resource use, biodiversity & nature protection, as well as other sectors covered by Ghanaian environmental and climate change policy.

2.5 National Climate Change Policy (2013)

The National Climate Change Policy has prioritized five (5) main Areas:

1. Agriculture and Food Security
2. Disaster Preparedness and Response
3. Natural Resource Management
4. Equitable Social Development
5. Energy, Industrial and Infrastructural Development

The objective of energy, industrial and infrastructure development areas is to minimize greenhouse gas emissions is to encourage the use efficient energy and cleaner energy technologies that contribute towards economic development, as well as result in green development and optimal national emission rates.

Key policy interventions to address the objective and which encourage green industry include support for research, development and transfer of low emission technology such as natural gas combined cycle power generation, natural gas distribution system, and mini and small hydroelectricity projects; promotion of energy efficiency and management activities that include new and innovative energy efficiency methodologies and techniques in various sectors, especially power generation, oil and gas production, transport, biomass, industry, and waste; promotion of the use of cleaner and more efficient energy sources and production methods that minimize resulting emissions and pollution;

creation of an enabling environment, including incentives and financing mechanisms that encourage and support the use of renewable sources of energy; establishment of effective mechanisms for reducing the volume of wastes, and for controlled and safe disposal of unavoidable wastes; establishment of sustainable recycling and waste management technologies that generate energy (e.g., biomass energy, biogas, methane, etc.) and reduce emissions from solid and liquid wastes, especially in urban areas; and support for public awareness of energy efficiency and of renewable energy use.

2.6 Strategic National Energy Plan (2006) and National Energy Policy (2010)

The National Energy Commission developed the Strategic National Energy Plan (SNEP) for the period 2006 – 2020 with the goal to contribute to the development of a sound energy market that would provide sufficient, viable and efficient energy services for Ghana's economic development through the formulation of a comprehensive strategy that identifies the optimal path for the development, utilisation and efficient management of energy resources available to the country. The SNEP presents an outlook of energy in Ghana for the period 2006-2020 based on the economic growth rates forecasted in the Ghana Poverty Reduction Strategy (GPRS) II. The SNEP contains the vision for Ghana to become an "energy economy" that ensures the reliable production and distribution of high-quality and sustainable energy services to all sectors of the economy while developing Ghana into a major exporter of energy, without compromising on environmental objectives (Energy Commission, 2006; UNEP, 2015).

The Plan's objective with regard to the industrial sector is to ensure sufficient, cost effective but affordable high quality energy supply to meet the increasing demand of an efficient and expanding industrial sector. Light or non-energy intensive industrialization will be encouraged. The strategy is to achieve a target of high quality and reliable (95% uninterrupted) electricity supply to the industrial sector per annum by 2015 and improving reliability to 98% by 2020 while introducing pollution charges in high-energy intensity industries to encourage efficiency by 2015.

To help achieve this, a number of options were identified including energy efficiency and conservation. Here the strategy is to ensure that energy is used efficiently in industry, commerce and in residential facilities, The Energy Efficiency and Conservation Act - that would spell out mandatory energy management practices, building codes, requirements on energy efficiency levels of energy consuming equipment, energy audit regimes for formal industries and commercial entities such as hotels should be implemented to give legal support to energy efficiency initiatives. The strategy would support the Government in the introduction of standards, legislation and labels highly to help ensure that inefficient energy consuming devices and appliances are eliminated. Energy efficiency standards and labels are expected to stimulate the development of cost-effective, energy efficient technology. The Plan would introduce a monitoring and targeting energy management scheme to monitor efficiency performance of the amount of energy used per unit output. Electrical load management for industries is to be considered to reduce peak electricity demand and shift loads to off-peak periods using time of use tariff. This is to enable industries such as metal smelting, cement milling, electrical heating operations that operate 24 hours a day to shift some of their energy intensive operations from the peak electricity demand period. Another option would be industrial co-generation and fuel substitution which is expected to offers immense opportunities for Ghanaian companies to displace their more expensive industrial heating oil's to combined heat and power production technologies, which can greatly enhance fuel use efficiency and reduce the environmental impact of energy production and consumption while oil palm and wood industries would be encouraged to generate combustible residues and wood wastes for both power production and process heat for operational purposes.

The National Energy Policy (NEP; 2010) reiterates the energy sector vision of becoming an Energy Economy. The NEP is intended to facilitate the development and effective management of the energy sector. The medium term (2010-2015) goal is to increase national power generation capacity to 5,000 MW. The NEP outlines a number of policy actions to ensure the realisation of this goal in the medium term, focusing on thermal (natural gas), hydropower and wind. According to the Ministry of Energy (2010),"the implementation of the NEP policy will require a legislative framework for renewable energy resource development as well as the development of a communications strategy to manage public anxiety and expectations, development of procedures and criteria for competitive licensing, and creation of a new institutional framework for the subsector." To support the development and diffusion of renewable energy technologies, the government of Ghana in 2011 passed the Renewable Energy Law (Act 832).

At regional level, Ghana forms part of the West African Power Pool (WAPP) initiative, which is housed under the ECOWAS secretariat, and pursues the integration of national electricity networks in a competitive unified regional market, in order to ensure, in the medium and long term, an optimal electricity supply, reliable and at an affordable cost to the population of the various Member States (WAPP, 2006).

2.7 National Science, Technology and Innovation Policy (2010)

The National Science, Technology and Innovation Policy aims to ensure that science and technology drives all sectors of the economy. In order to achieve these objectives, sectoral policies, programmes and strategies are to be implemented in agriculture, health, education, environment, energy, trade, industry, natural resources, human settlements and communications.

In the long-term, the objective of the policy is to create endogenous science and technology capacities appropriate to national needs, priorities and resources and address issues on deterioration of the environment whist in the medium term, the objective is to accelerate the promotion of innovation through the development and utilization of modern scientific and technological capabilities to provide the basic needs of the citizenry and to compete ably in the global market. This includes moving away from old technologies to newer and more knowledge-intensive technologies.

For the energy sector, the policy proposes the following programmes: (1) research and development relating to alternate energy sources such as solar energy, biomass, wind and other renewable energy sources to supplement the current traditional energy sources; (2) efforts to acquire and adapt sustainable safe and economical energy technologies for national development; (3) research aimed at upgrading hydropower energy production technology; (4) research and development efforts aimed at popularization and dissemination of energy technology for rural development; (5) public support for energy conservation and encourage private investment in energy technologies; (6) community investment and ownership of energy systems e.g. solar farms, windmills and biomass plants; and (7) utilization of nuclear energy resources for domestic and industrial use.

For the industrial sector, the policy recognizes several needs as follows: (1) strengthen systems and mechanisms for acquisition, assessment, adaptation, adoption and application of essential technologies for industrial activities; (2) Encourage R&D activities that develop tools, equipment and machinery for industries; (3) Encourage quality assurance in manufacturing; (4) Promote S&T activities that would accelerate technology transfer and innovations; (5) Create incentives to promote investment and support in research and development by the private sector; (6) Facilitate capacity building in engineering design and manufacturing technology to enhance national development; (7) Enhance industrial technology development infrastructure; (8) Promote and facilitate recyclable materials technologies, and application to minimize industrial waste in the environment; (9) Promote scientific knowledge acquisition and development of technologies in the new and emerging sciences of biotechnology, materials science, micro-electronic and laser technology; (10) Create the national capacity to exploit opportunities for innovation addressing climate change; and (11) Institutionalize regular interaction between research institutions/universities and the private sector.

On trade, the policy is to promote STI applications in commercial activities to ensure quality, reliability and efficiency in the delivery of goods and services in conformity with appropriate local and international standards. Some of these activities include: (1) encourage the adoption of scientific and technological innovations to ensure effectiveness and efficiency of product output and high quality of products; (2) utilize science and technology in improving national standardization and quality management programmes; (3) utilize science and technology to improve packaging; and (4) promote the adoption of standards for the production of goods and services for the local and international markets.

The policy places emphases on the environment as a source of natural resources, and the fact that its deterioration can be detrimental. Some of the activities and programmes to apply STI in the management of the environment to maintain and enhance quality and sustainability and to integrate environmental concerns in all development policies include the following: (1) integrate environmental concerns in all development policies and ensure public understanding of the scientific basis of their actions on the environment; (2) encourage and support science and technology interventions that promote sustainable environmental conservation and management; (3) strengthen research and development activities that would promote sustainable development especially of ecosystems and ecological processes; (4) develop the STI capacity to monitor, predict and mitigate the adverse effects of natural phenomena such as earthquakes, floods, droughts, desertification and bushfires; (5) develop an efficient integrated waste management system for using the principle of waste as a resource and (6) promote the use of clean technologies in production systems.

2.8 Organisations supportive of industrialization and trade

Several organisations are established to support industrialization and trade. The more active one are the National Board of Small Scale Industries, the Private Enterprise Foundation, the Association of Ghana Industries, the Ghana National Chamber of Commerce and Industry, the Ghana Export Promotion Authority, the Ghana Free Zone Board, the Federation of Association of Ghanaian Exporters and the Council for Scientific and Industrial Research.

2.8.1 National Board for Small Scale Industries

Act 434 established the National Board for Small Scale Industries in 1985 to oversee the growth of micro and small-scale industries in Ghana. The Board developed a policy document that sought to assist micro and small-scale industries in technology and product development, market development, inter industry linkage and networking, entrepreneurship development, financing and to promote enterprise culture through counselling and guidance for the self-employed.

2.8.2 Private Enterprise Foundation

The Private Enterprise Foundation (PEF) is the premier private sector umbrella organisation founded through the initiative of four major business associations' - Association of Ghana Industries, the Ghana National Chamber of Commerce and Industry, Ghana Employers Association and Federation of Association of Ghanaian Exporters - and with the financial assistance from USAID, the Government of Ghana and DANIDA.

PEF provides leadership in private sector coordination, advocacy, promotion and support (technical, managerial, marketing and financial). Through cooperation with the Trade Union Congress, PEF promotes industrial harmony by active involvement in wages and service conditions negotiations and education, to achieve higher productivity. Above all, PEF is to promote production of excellent, superior and global competitive goods and services, promote creativity and good business practice, to ensure long-term success and growth of the private sector.

2.8.3 Association of Ghana Industries

The Association of Ghana Industries is a non-profit voluntary business association with more than 1500 members-large, medium and small industries-operating in all parts of Ghana. Members-companies of the Association, from both the private and the public sectors, account for the majority of the nation's industrial output. The main objectives of the Association are:

- To provide a central organisation for the promotion of the interests of industry in Ghana
- To study, support or oppose legislative or other measures affecting industry in Ghana
- To consider all concerns connected with industries in Ghana and to present the views and suggestions of industry to Government.

2.8.4 Ghana National Chamber of Commerce and Industry

Members of Ghana National Chambers of Commerce and Industry is open to any registered established in all sectors of the economy including trade, baking and insurance, motor and transport, shipping and ports operations, manufacturing industries, professional services, export, agriculture and fishing, and building and engineering.

The main objective of the chamber is to provide the sector a constant flow of commercial intelligence and a range of practical services designed to help their business operations. It is charged with the following functions:

- Promotion and protection of trade, commence, industry and manufacturing
- The collection and circulation of statistic relating to trade, commence, industry and manufacturing
- Provision of facilities for the communication and interchange of views between members of the chambers on the one hand and departments of Government, public institutions and other associations.

Additionally it provides services in communications, research and seminars to members.

2.8.5 Ghana Export Promotion Authority

The main objective of the Ghana Export Promotion Authority is to ensure that export trade plays a role in aiding economic growth of the country. They concentrate on strategic marketing of non-conventional products. Some of the activities of the authority include: Creating awareness about export in the country, identifying products suitable for export and identifying appropriate markets for them, organizing exhibitions and trade fairs in and outside the country to create a goodwill for products made in Ghana, providing Ghanaian exporters with all the required help, so that they can enter competitive markets abroad, organizing market missions to facilitate meetings between exporters and prospective buyers from abroad, offering advice to exporters on export marketing.

2.8.6 The Free Zone Board

The Free Zone Board was set up in 1995 by an Act of Parliament (Act 504). The Act affords free zone enterprise the right to produce goods and services that are not hazardous to the environment for export. Enterprises established in the free zones enjoy some privileges, which include total exemption from payment of direct and indirect duties, and levies on all export commodities manufactured in the free zones.

The main objective of the free zone programme is the promotion of economic development through foreign direct investment; creation of employment opportunities; increase in foreign exchange earnings; provision of business opportunities for foreign and local investors to undertake joint ventures; enhancement of technical and managerial skills/expertise; transfer of technology and the diversification of exports.

The Free Zone Board was established on 31st August, 1995 by an Act of Parliament to enable the establishment of free zones in Ghana for the promotion of economic development, to provide for the regulation of activities in free zones and for related purposes.

Apart from the obvious measures to make the free zones programme investor friendly, Ghana has the advantage of being strategically located within West Africa which gives easy access to one of Africa's biggest markets with a population of 250 million people. The location of Ghana as well as the relative stability of the country makes Ghana a gateway for regional trade and investment.

The unique advantages Ghana possesses coupled with the generous incentives e.g. tax rebate on certain importations such as manufacturing equipment and the efficient services makes the business environment more than ready to provide maximum returns on investment.

2.8.7 Federation of Association of Ghanaian Exporters

The Federation of Association of Ghanaian Exporters is a private non-government, apolitical, non-profit making organisation, established with the assistance of US Agency for International Development and Government of Ghana under the trade and investment programme. Its mission is to:

- be the umbrella organisation, which represents the interests of the exporters of non-traditional products, particularly interests common to its members as well as those of the individual associations;
- work towards the expansion and diversification of Ghana's exports to foreign markets and to raise the productivity of exporting firms; and
- guide and influence collective efforts of private business enterprises in Ghana to serve the development needs of the non-traditional sub-sector.

The federation helps to resolve business and industrial problems by clarifying policies and providing documentation.

2.8.8 Council for Science and Industrial Research

The Council for Scientific and Industrial Research (CSIR), located with the Ministry of Environment and Science, is the foremost national science and technology institution in Ghana. It is mandated to carry out scientific and technological research for national development. The Council was established in 1968.

The Institute of Industrial Research is one of the 13 Research Institutes of CSIR. The Institute assists in poverty reduction through the creation of opportunities for generating and increasing incomes within the SMEs; contributes towards food security, generates foreign exchange earnings and applies cost-effective industrial technologies that are both environmentally friendly and commercially viable. Within the Institute there are information management, energy technology, environmental management and materials and manufacturing programs. Currently priority activities within the Institute are development and promotion of renewable energy technologies, industrial processes, new materials, improved sanitation, local equipment fabrication and information communication technology.

The Science and Technology Policy Research Institute (STEPRI), established in 1987 and under the (CSIR) acts as a focal point to articulate policy on national science and technology development. STEPRI provides research support necessary for the formulation and implementation of the relevant Science and Technology (S&T) policies and programmes aimed at creating the enabling conditions for effective use of S&T in all sectors of the economy and for the advancement of society. The Institute therefore conduct science and Technology policy studies to support the formulation and implementation of relevant policies; facilitate the transfer, diffusion and commercialization of technological innovations; promote the acculturation and popularization of Science and Technology in the society; support S&T in human resource development and management and provide advocacy for science and Technology commitment on the part of all stakeholders.

The Institute is organized into three technical divisions comprising Agriculture, Medicine and Environment Division (AMED); Industry and Services Division (ISD); Commercialization and Information Division (CID); and the supporting division of Finance and Administration Division.

2.9 Summary

This chapter summarizes several planning and policy arenas that have the potential to enhance or create green industry production and trade and describes industry and export related institutions that could participate in the process of greening. The planning and policy arenas include the national medium-term development framework, industrial policy, trade policy, several environment policies (environmental protection act, environmental assessment regulations, national environmental policy), national climate change policy, national energy policy and national science technology and innovation policy. Institutions that have or could have a role in greening industry and trade are the National Development Planning Commission, the Ministry of Trade and Industry, the Ministry of Environment, Science, Technology and Innovation (which houses the Environmental Protection Agency, the Ghana National Cleaner Production Centre and the Institute of Industrial Research), the National Energy Commission and several bodies supportive of industrialization and trade (National Board of Small Scale Industries, Private Enterprise Foundation, Association of Ghana Industries, Ghana National Chamber of Commerce and Industry, Ghana Export Promotion Authority, Ghana Free Zone Board and Federation of Association of Ghanaian Exporters).

Several policy arenas have the potential to accelerate green industry and trade in Ghana. One is industrial policy with its provisions for electricity and water efficiency programs and several dimensions of cleaner production-efficient use of materials, technology promotion, voluntary standards and self-regulatory measures. A second is trade policy, at national and regional level, which is geared towards delivering a strategic expansion of Ghana's productive base and promoting exports of non-traditional products with a view to diversifying Ghana's export base. A third is environmental policy with the comprehensive permitting requirements (energy and cleaner production audits) under the 1994 Environmental Protection Law, and the upcoming environmental fiscal reform policy that could use the Ghana Green Fund resources to promote greening of industry and environmental activity more broadly. A fourth is energy policy with a number of energy efficiency and conservation options such as energy audits and energy management practices, as well as the "energy economy" vision, put forth in the Strategic National Energy Plan.

3 GHANA'S MANUFACTURING SECTOR AND TRADE IN MANUFACTURED GOODS

The chapter begins with an overview of the economy and the contributions to Gross Domestic Product (GDP) of the three major sectors. It then describes in some detail the manufacturing sector and its subsectors as well as presenting an estimate of employment in three major sectors. Next it turns to describing Ghana's non-manufactured and manufactured exports and their destinations within the world and the West African region. It also briefly characterizes Ghana's imports before it concludes by placing Ghana's industry within the West African context.

3.1 Overview

Contributions to GDP in 2011, the latest year for which data are available, are fairly evenly split among the agriculture, industry and services sectors. The service sector, which contributed 49.1 % to Gross Domestic Product in 2011, is expected to continue to be the major driver for economic growth in Ghana. The industrial sector, as defined by the International Standard Industrial Classification (ISIC), includes mining, manufacturing, construction, electricity, water and gas (ISIC divisions 10-45) (Table 3.1). It was the second largest contributor to GDP at 28.5 % in 2013. The contribution of the agricultural sector was less than industry but it employed the majority of the labour force, approximately 42 %, in 2013 according to the World Bank.

Table 3.1: Selected Indicators for Ghana
(World Bank 2015a)

Indicator	Unit and Time Period	2013
GDP per Capita (constant 2005$)	USD	769
GDP Growth	% (2003-2013)	7.4
Agriculture (contribution to GDP)	%	21.9
Industry (contribution to GDP)	%	28.5
Services (contribution to GDP)	%	49.6

3.2 Manufacturing sector

The manufacturing sector, described as industry in common usage and in this report, is limited to ISIC divisions 15-37; its economic output is measured in terms of manufacturing value added (MVA) (Table 3.2). The manufacturing sector contributed 6.8 % to GDP in 2013, which was less than the 8.8 % in 2003. However, the absolute value of manufacturing output, measured as MVA increased from US$ 0.8 million in 2003 to US$1.3 million in 2013 and its share of world MVA increased from .01 % to .02 % between 2003 and 2013. The annual average growth rate over the period was 4.8 % with a low of -1.3 % in 2009 and a high of 13 % in 2011 (UNIDO, 2014).

[3] The Ghana Statistical Service estimates that the annual growth rate of the manufacturing sector between 2007-2014 was 3.3% and that total manufacturing output declined by 0.5% in 2013 and 0.8% in 2014 compared to 2.0% in 2010 and 2011 due to activities related to the development of the offshore oil fields (IISER, 2015)

Table 3.2: MVA and GDP change over the period 2003-2013
(World Bank, 2015a and UNIDO 2014)

Ghana	Years		Percent Change
	2003	2013	
GDP (Current US $)	$ 7,632 M	$ 48,137 M	530%
GDP (Constant 2005 US $)	$ 9,597 M	$ 19,928 M	108%
MVA (Constant 2005 US $)	$ 845 M	$ 1,347 M	59%

3.2.1 Manufacturing sectors

The UNIDO Industrial Statistics for Ghana's industrial structure are dated; the last reported results are for 2003. As an alternative, data on Ghana's industrial structure are taken from the sampling framework for UNIDO's African Investor Survey (2012); the survey itself was undertaken in 2010. The sampling framework included approximately 4,400 registered manufacturing establishments (Table 3.3). The greatest numbers of establishments are in wearing apparel (22.7 %), food products and beverages (21.5 %) furniture (14.0 %) fabricated metals (8.6 %) and wood (8.5%).

Table 3.3: UNIDO Sampling Framework—Industrial Subsector Distribution
(UNIDO 2012)

	By subsector (ISIC rev 3.1) - Manufacturing	Number	Percent
15	Food products and beverages	943	21.5
16	Tobacco products	2	0
17	Textiles	146	3.3
18	Wearing apparel; dressing and dyeing of fur	996	22.7
19	Tanning and dressing of leather	121	2.8
20	Wood and of products of wood and cork	372	8.5
21	Paper and paper products	21	0.5
22	Publishing, printing and reproduction of recorded media	129	2.9
23	Coke, refined petroleum products and nuclear fuel	5	0.1
24	Chemicals and chemical products	158	3.6
25	Rubber and plastics products	87	2
26	Other non-metallic mineral products	183	4.2
27	Basic metals	34	0.8
28	Fabricated metal products, except machinery and equipment	375	8.6
29	Machinery and equipment n.e.c.	60	1.4
30	Office, accounting and computing machinery	14	0.3
31	Electrical machinery and apparatus n.e.c.	32	0.7
32	Radio, television and communication equipment and apparatus	7	0.2
33	Medical, precision and optical instruments, watches and clocks	9	0.2
34	Motor vehicles, trailers and semi	45	0.1
35	Other transport equipment	6	0.1
36	Furniture; manufacturing n.e.c.	613	14.0
37	Recycling	17	0.4
	TOTAL	**4375**	**100**

A qualitative characterization of the manufacturing subsectors and their location within Ghana can be found in Annex 2. As could be expected most of the manufacturing activity is located in Greater Accra and the Ashanti regions.

3.2.2 Manufacture of environmental and renewable energy technologies

Discussions with experts in Ghana in May 2015 suggest that there is as yet no manufacture of environmental (pollution control and monitoring equipment) nor renewable energy (solar panels, wind turbines, mini-hydro turbines) technologies. The absence of manufacture of environmental technologies is not surprising given that only a few plants have been required to install pollution control technologies or to monitor their discharge. For renewable energy technologies, the absence of manufacture is more surprising, as national generation capacity in renewable energy segments has been growing (UNEP, 2015). The explanation for solar panels is that economy of scale production is not yet feasible. In addition, Ghana currently has a policy directive that applies a zero rating on imports of complete solar PV systems, inverters and solar panels, while some system components (batteries, regulators) attract a 15 per cent value added tax (AGSI, 2011). This provides for an incentive for plant operators in Ghana to rather import complete solar PV systems than to source domestically. However, there may be potential for Ghana to nurture a national industry for intermediate components to the solar PV value chain (see section 8.1 and UNEP, 2015a). Further, there is assembly of solar water heaters from imported components from China (UNIDO, 2013a).

3.2.3 Environmental engineering and energy firms

Although environmental and energy consulting services are classified for the most part as part of civil engineering in the International Standard Industrial Classification (ISIC F. Rev 4) rather than as part of manufacturing sector (ISIC C Rev. 4), their presence in Ghana needs to be documented as they are essential to greening of the manufacturing sector. Fortunately, Ghana has a number of environmental and energy engineering firms. Most of them specialize in environmental assessment reporting for manufacturing companies and also carry out energy and water audits. Few also go beyond to design and install wastewater treatment systems as well as undertake environmental quality monitoring on wastewater, ambient air and noise (including workplace noise) with appropriate and well-resourced environmental laboratories. In addition some firms provide consulting services not only in Ghana but also across the West African region.

3.2.4 Size distribution of establishments in the manufacturing sector

The number of plants by size distribution is reported by UNIDO and the Ghana Statistical Service (Table 3.4). The UNIDO sampling framework for the Africa Investor Report classified establishments in four size categories – micro with 1 establishment (0.0 %), small with 3,756 establishments (86.5%), medium with 304 establishments (7.0 %) and large (100+ employees) with 283 establishments (6.5 %). The Ghana Statistical Services reports a reasonably similar number of plants classified as small, medium and large.

Table 3.4: Size distribution of manufacturing establishments
(GSS 2003 and UNIDO 2012)

GSS	Size	Number	%	UNIDO	Size	Number	%
Micro	<10	22,181	85	Micro	<10	1	0
Small	10-49	3,369	13	Small	10-49	3,756	86.5
Medium	20-99	287	1	Medium	50-99	304	7
Large	100+	251	1	Large	100+	399	6.5
Total		**26,088**	**100**	**Total**		**4,344**	**100**

3.2.5 Employment in the manufacturing sector

A reasonable assessment of the total employment and employment within manufacturing is available in the database for the 2013 Industrial Development Report (UNIDO, 2013) (Table 3.5). The estimated employment is comparable in coverage to ILO estimates in that it includes formal and informal employment. While the absolute employment in all sectors has grown, the %age share of total employment has declined in the agricultural and manufacturing sector and has increase significantly in the service sector.

Table 3.5: Employment in different sectors
(UNIDO 2013b)

	Employees (% of total Employment)			%Variation Employment (1990-2010)
Sectors	**1990**	**2000**	**2010**	
Agriculture	54%	54%	42%	23%
Manufacturing	13%	11%	11%	-26%
Nonmanufacturing	3%	5%	5%	168%
Services	31%	31%	43%	127%
Total	**6.46 M**	**7.43 M**	**10.24 M**	**58.6%**

3.3 Exports

3.3.1 Composition and destination of Ghana exports

Ghana's exports consist mainly of three primary commodities, namely gold, crude oil, and unprocessed cocoa. Due to strong world prices and production increases, the financial volume of exports has more than tripled since 2007, to US$14 billion in 2012 (WTO, 2014). Foreign direct investment more than quadrupled to US$16 billion in 2012, from less than US$4 billion in 2007.

The first destination for Ghana exports is South Africa which accounts for 22 per cent of the total 2013 exports, followed by United Arab Emirates (13 %), Switzerland (9 %) and the countries near Ghana (9 %) (Table 3.6 and Figure 3.1) The composition of the exports to neighbouring countries is more heterogeneous while for other destinations gold is the predominant exported good (Table 3.7).

Table 3.6: Destination of Ghana exports
(UN COMTRADE 2015)

Countries	Value	% of total	Description of exports
South Africa	$ 2,833,217,000	22	(Mostly Gold 87% and Oil 13%)
United Arab Emirates	$ 1,659,719,000	13	(Mostly Gold 89% and Wood 10%)
Countries near Ghana	$ 1,110,709,000	9	(More heterogeneous: wood, essential oils, beverages...)
Switzerland	$ 1,172,029,000	9	(Almost exclusively gold 98%)
Others	$ 5,868,225,000	46	
Total	**$ 12,643,899,000**		

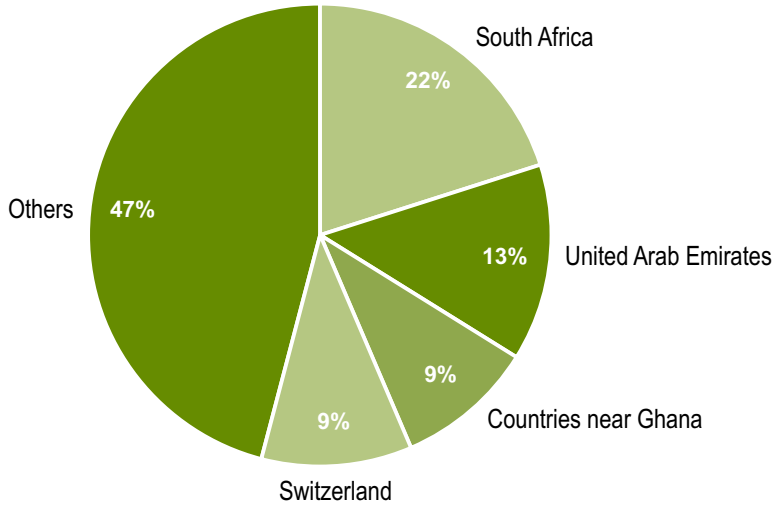

Figure 3.1: Destination of Ghana exports 2013
(UN COMTRADE 2015)

3.3.2 Manufactured exports 2003 - 2013

Performance in the manufacturing sector has been mixed, with expanding agro-processing industries contrasting with failing aluminium production at Ghana's state-owned smelter. Export bans are in place on scrap metals to ensure inputs for the local steel mills, while import bans are in place to promote local pharmaceutical capacity (WTO, 2014).

In 2003 the value of manufactured exports was US$ 600 million and accounted for 26% of the total exports which were US$2.3 billion (Figure 3.2). These exports consisted mainly of:

- Wood panels, sheets for plywood, wood sawn, chipped lengthwise, sliced or peeled (29% of the total manufactured exports);
- Products related with cocoa: cocoa paste, cocoa butter, fat, which accounted (27% of the total manufactured exports); and
- Prepared or preserved fish particularly tuna, skipjack, bonito, prepared and preserved (17% of the total manufactured exports).[4]

Figure 3.2: Manufactured exports share of total exports
(UN COMTRADE 2015)

[4] The next highest are cotton (carded, combed, woven cotton fabric) (7%) and plastics and plastic articles (5%). The other four categories are 3 % or less.

In 2013 manufactured exports were estimated at US$1.6 billion, which accounted for 13% of the total exports of US$ 12.6 billion[5] [6] These exports consisted mainly of:

- Articles of wood, wood panels, wood sawn, chipped lengthwise, sliced or peeled that accounted for 29% of the total manufactured exports;
- Essential oils, cosmetics, toiletries that accounted for 16% of the total manufactured exports; and
- Parts of machines and mechanical appliances for lifting and moving that accounted for 9 % of the total manufactured exports.[7]

In 2013 the picture was different even though the manufactured exports increased by 160% over the period 2003-2013. The relative share of manufactured products in total exports decreased by more than 10% because of extraordinary growth (+544%) of non-manufactured exports including gold (42% of total exports in 2013, compared to 36% of total exports in 2003) and petroleum oils and oils from bituminous minerals (24% of total exports in 2013, compared to 0.1% of total exports in 2003).

3.3.3 Destination of manufactured exports

Most of Ghana's manufactured exports go to neighbouring countries[8] which account for 64% of the total manufacturing exports in 2011, followed by United States of America with 8% of the total, Netherlands 4% and Germany and India with 3% of the total manufacturing exports (Figure 3.3 and Table 3.8).

Table 3.7: Destination of manufactured exports
(UN COMTRADE 2015)

Destination of exports	Trade Value	% of tot Manufactured Exports
Countries near Ghana	$1228 M	64.1%
USA	$160 M	8.4%
Netherlands	$69 M	3.6%
Germany	$61 M	3.2%
India	$60 M	3.2%
Other	$338 M	17.7%
Total Manufactured Exports	$1917 M	100.0%

Among the neighbouring countries Burkina Faso is the biggest importer of Ghana's manufacturing goods with a share of 36% of the total manufacturing exports of Ghana, followed by Togo and Cote d'Ivoire with 16% and 15% respectively of the total (Figure 3.4 and Table 3.8).

[5] The WTO (2014) even estimates that the financial volume of total exports from Ghana amounted to US$14 billion in 2012, hence having tripled since 2007. All estimates recognize the vast growth in exports over past years.
[6] In 2011 (latest data), manufactured exports were stated by World Bank (2015) to be 55% of all manufactured goods (MVA) using 4 digit UNCOMTRADE data and by UNIDO to be 75% of all manufactured goods using 2 digit UNCOMTRADE data (UNIDO,2014).
[7] The next highest (5%) are two categories—cocoa and cocoa preparation and plastics and plastic articles. The other 13 categories are less than 3% or less.
[8] Benin, Burkina Faso, Cameroon, Côte d'Ivoire, Guinea, Liberia, Mali, Niger, Nigeria, Sierra Leone, Togo.

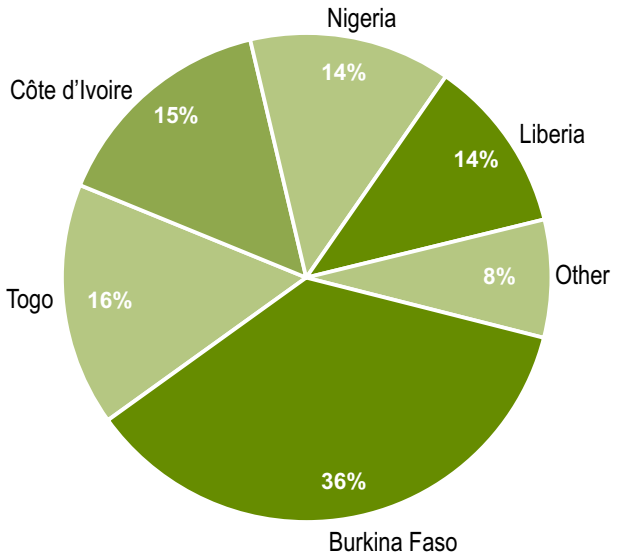

Figure 3.3: Destinations of manufactured exports (neighbouring countries)
(UN COMTRADE 2015)

Table 3.8: Destinations of manufactured exports (neighbouring countries)
(UN COMTRADE 2015)

Destinations of Exports (Countries near Ghana)	Trade Value	% Of tot Manufactured Exports towards neighbouring countries
Burkina Faso	$ 444 M	36.2%
Togo	$ 198 M	16.1%
Cote d'Ivoire	$ 185 M	15.1%
Nigeria	$ 166 M	13.5%
Liberia	$ 140 M	11.4%
Benin	$ 26 M	2.1%
Mali	$ 18 M	1.4%
Guinea	$ 16 M	1.3%
Sierra Leone	$ 22 M	1.8%
Niger	$ 9 M	0.7%
Cameroon	$ 5 M	0.4%
Tot Manufactured Exports towards neighbouring countries	**$ 1,228 M**	**100.0%**

3.3.4 Export of environmental goods

There is no universally agreed definition of what constitutes an environmental good, but different approaches to comprehensively and exhaustively list the goods that qualify as environmental goods are used by the OECD, World Bank and APEC. Applying the OECD list of environmental goods (Steenblik, 2005), and based on UN COMTRADE data, US$ 36 million of the overall US$ 1.6 billion of manufactured goods exported from Ghana in 2013 are classified as environmental goods. Applying the World Bank classification of 43 environmental goods, Ghana exported US$ 1.0 million in environmental goods in 2013. For the same year, the APEC classification of 54 environmental goods results in environmental goods

exports of US$ 21 million from Ghana. Applying the World Bank definition, the environmental goods for export from Ghana were mainly:

- Containers of any form for liquid or solid waste in iron, steel and aluminium;
- Aluminium reservoirs, tanks, vats and similar containers for any material (Figure 3.4).

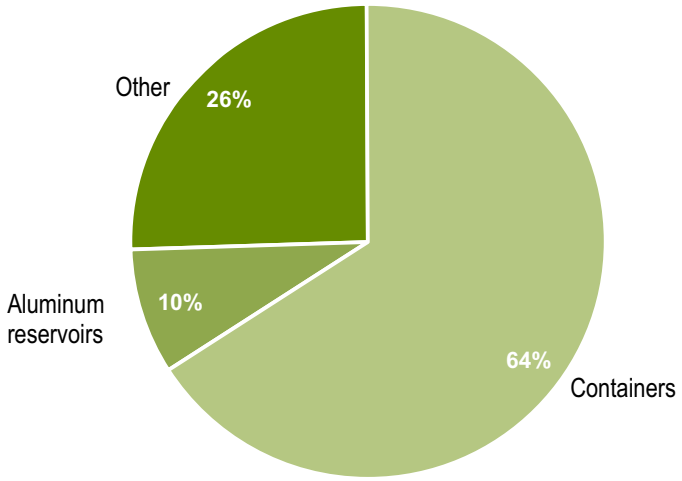

Figure 3.4: Ghana environmental goods exported 2013
(UN COMTRADE 2015)

3.4 Imports

The import of manufactured goods into Ghana in 2013 was US$ 12.8 billion, an increase of almost 300 % from US$ 3.2 billion in 2003. Environmental goods as identified by World Bank classification were approximately 2 % of the 2013 total (Table 3.9) and consisted of several categories (Table 3.10 and Figure 3.5).

Table 3.9: Percentage of environmental goods imports in total imports, 2013
(UN COMTRADE 2015)

Tot Import Ghana 2013	$ 12,787,233,000
Environmental goods (WB list)	$ 202,115,000
Environmental goods imports share of total Imports %	2%

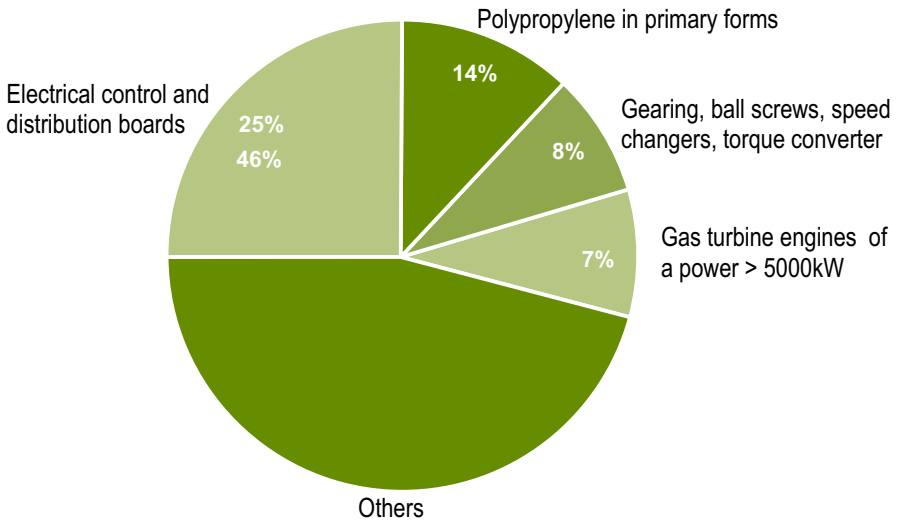

Figure 3.5: Ghana environmental goods exported 2013
(UN COMTRADE 2015)

Table 3.10: Description environmental goods imported by Ghana
(UN COMTRADE 2015)

World Bank environmental goods import 2013 Ghana	Value USD	% of Total
Electrical control and distribution boards	$49,935,000	25%
Polypropylene in primary forms	$28,420,000	14%
Gearing, ball screws, speed changers, torque converter	$15,253,000	8%
Gas turbine engines of a power > 5000 kW	$14,937,000	7%
Machinery for treatment by temperature change	$11,143,387	6%
Parts of steam or vapour generating boilers	$10,088,522	5%
Distilling or rectifying plant	$8,605,301	4%
Cooking appliances for gas fuel	$8,154,190	4%
Parts, laboratory/industrial heating/cooling machinery	$6,863,510	3%
Heat exchange units, non-domestic, non-electric	$6,134,460	3%
Refrigerating or freezing equipment	$4,874,550	2%
Clutches, shaft couplings, universal joints	$4,507,544	2%
Lead-acid electric accumulators except for vehicles	$3,040,975	2%
Producer, water and acetylene gas generators	$2,912,296	1%
AC generators, of an output 75-375 kVA	$2,748,590	1%
Photosensitive/photovoltaic/LED semiconductor devices	$2,726,116	1%
Compression refrigeration equipment	$2,359,398	1%
Other	$ 19,411,161	9%
Total EGS Import	**$ 202,115,000**	*100%*

3.5 Ghana and its industry in the West African context

There are several indices that permit comparison of Ghana's performance with other countries in the West African region. Two are general (Human Development Index and Environmental Performance Index) and the others are more specific comparisons of industrial performance.

3.5.1 Human Development Index

The Human Development Index (HDI) is a summary measure for assessing long-term progress in three basic dimensions of human development: a long and healthy life, access to knowledge and a decent standard of living.

Ghana's HDI value for 2013 is 0.573 - which is in the medium human development category - positioning the country at 138 out of 187 countries and territories (Table 3.11). Between 2000 and 2013, Ghana's HDI value increased from 0.487 to 0.573, an increase of 17.6% or an average annual increase of about 0.93 %. Comparison countries in West Africa (Cameroon, Senegal, and Côte d'Ivoire) had similar performances over the same period, with increases of the HDI value in the order of 16% on average between 2000 and 2013, however their current positions remain below Ghana in the global ranking.

Table 3.11: Human Development Index ranking 2000-2013
(UNDP 2015)

Position	Country	2000	Position	Country	2013
116	Ghana	0.487	138	Ghana	0.573
129	Cameroon	0.433	152	Cameroon	0.504
138	Senegal	0.413	163	Senegal	0.485
139	Côte d'Ivoire	0.393	171	Côte d'Ivoire	0.452

3.5.2 Global Competitiveness Index

The Global Competitiveness Index (GCI) attempts to quantify the impact of a number of key factors which contribute to creating conditions for competitiveness, with particular focus on the macroeconomic environment, the quality of the country's institutions, and the state of the country's technology and supporting infrastructure. (UNDP, governance assessment portal 2015)

Ghana ranked 111 out of 144 countries in 2014-2015 on the GCI, a decline from 101 out of 132 countries in 2008 (Table 3.12). However, comparison countries in West Africa (Cameroon, Senegal and Côte d'Ivoire) also experienced a decline in their global ranking position. However, three out of these 4 countries showed an increase in their actual GCI value from 2008-2015. Only Senegal showed a decline in this measure, and was overtaken by Ghana as leader in this West African group.

Table 3.12: Global Competitive Index ranking 2008-2015
(WEF 2014)

Position	Country	2008-2009	Position	Country	2014-2015
95	Senegal	3.73	111	Ghana	3.71
101	Ghana	3.61	112	Senegal	3.69
108	Côte d'Ivoire	3.51	115	Côte d'Ivoire	3.67
112	Cameroon	3.48	116	Cameroon	3.66

3.5.3 Competitive Industrial Performance Index

The UNIDO Competitive Performance Index ranked Ghana119 out of 139 countries in 2012 (Table 3.13). This index focuses on industrial performance, which reflects a country's actual wealth creation, and not its industrial potential, which refers to factors that may ease or impede it. Even though Ghana ranks at the bottom of the group of comparison countries, over the period 2003-2012, Ghana was the only country that climbed eight positions in the global ranking; Cameroon also gained ground, while Côte d'Ivoire and Senegal lost respectively 2 and 4 positions.

Table 3.13: Competitive Industrial Performance Index ranking 2003-2012
(UNIDO 2013c)

Position	Country	2003	Position	Country	2012
91	Côte d'Ivoire	0.02	93	Côte d'Ivoire	0.016
99	Senegal	0.013	103	Senegal	0.011
109	Cameroon	0.009	104	Cameroon	0.011
127	Ghana	0.005	119	Ghana	0.007

3.5.4 Environmental Performance Index

Probably the best and most current overview of environmental pressures in Ghana is to be found in the 2014 Environmental Performance Report. The Environmental Performance Index (EPI) ranks how well countries perform on high-priority environmental issues in two broad policy areas: protection of human health from environmental harm and protection of ecosystems (Yale, 2014).

The EPI score for Ghana in 2014 was 32.1, almost half of what it was in 2006 (Table 3.14). Ghana is ranked 151 out of 178 countries, near the bottom of the weaker performance group and it is the worst among the comparison West African countries (Cameroon, Senegal, and Côte d'Ivoire). All these countries experienced a decrease in the EPI value, however. However Ghana lost almost 70 positions in global ranking over the period 2006-2014 while Senegal, Cote d'Ivoire and Cameroon lost 35 positions on average in the same period.

Table 3.14: Environmental Performance Index ranking 2006-2014
(YALE 2014)

Position	Country	2006	Position	Country	2014
72	Ghana	63.1	124	Senegal	40.8
86	Côte d'Ivoire	57.5	129	Côte d'Ivoire	39.7
100	Cameroon	54.1	141	Cameroon	36.6
107	Senegal	52.2	151	Ghana	32.1

3.5.5 Foreign direct investment

The latest value for foreign direct investment (FDI) in Ghana was US$3,226 million in 2013 (Table 3.15). The value for this indicator increased dramatically from $110 million in 2003 to a high point of $3,293 million in 2012, largely due to investment in the Jubilee oil field discovered in 2007. FDI was 7.14% of GDP in 2013. According to data since 1979, it was highest in 2009 (11.15%) and lowest in 1976 (-0.51%) The FDI in Ghana was more than double all the investment received cumulatively by Cameroon, Senegal and Côte d'Ivoire.

Table 3.15: FDI Inflows 2003-2013
(UNCTAD, FDI/TNC database (www.unctad.org/fdistatistics)

Country	FDI inflows (Millions of USD)	
	2003	2013
Ghana	110	3,226
Cameroon	336	572
Senegal	52	298
Côte d'Ivoire	165	371

3.5.6 Ease of Doing Business and Starting a Business

The World Bank's "Doing Business" Index ranks countries on the ease of doing business. A high ease of doing business ranking means the regulatory environment is more conducive to operating a firm. The rankings are determined by sorting the aggregate distance to frontier scores on 10 categories, each consisting of several indicators, giving equal weight to each topic (World Bank, Doing Business). This Index ranks Ghana a respectable 70th out of 189 countries in 2015 - well above other comparable countries like Cameroon, Senegal, and Côte d'Ivoire and even above some EU member states (Table 3.16). However, there is still scope for improvement in some areas, given that the ranking is slightly lower than in the previous year.

In the "Starting a Business" Index, rates the ease of starting up a business in a country. Here, for Ghana, the situation is different. Ghana ranks 96th, 3 positions lower than the previous year, lower than both Senegal and Côte d'Ivoire which have considerably improved their global ranking positions, climbing 43 and 80 positions respectively, compared to the previous year.

Table 3.16: Ease of doing business index and starting a business Index 2014-2015
(World Bank 2015b)

Country	2014		2015	
	Ease of doing business	Starting a business	Ease of doing business	Starting a business
Ghana	69	93	70	96
Cameroon	148	127	158	133
Senegal	171	133	161	90
Côte d'Ivoire	158	124	147	44

3.5.7 Comparative export data

The export performance of Ghana compared to other countries is illustrated in Table3.17. In fact Ghana's manufactured exports as a percentage of merchandise exports are relative low compared to Cameroon and Senegal and slightly greater than Cote D'Ivoire.

Table 3.17: Manufactures exports (% of merchandise exports) in comparable countries
(UN COMTRADE 2015)

Country	Manufactures exports (% of merchandise exports)	Tot manufacturing exports / MVA	Tot manufacturing exports / GDP
Ghana	12%	55%	4%
Cameroon	21%	25%	4%
Senegal	10%	37%	5%
Côte d'Ivoire	44%	53%	8%

3.6 Summary

The contribution of the manufacturing sector to GDP and employment is modest compared to more advanced developing countries. The sector contributed 6.8% to GDP in 2013, which was less than the 8.8% in 2003. The sector generated only an estimated 11% of total employment in 2010, much less than agriculture (42%) and services (The greatest numbers of establishments are in wearing apparel (22.7 %), food products and beverages (21.5 %) furniture (14.0 %) fabricated metals (8.6 %) and wood (8.5%). There is no manufacture of environmental and renewable energy technologies, but there are number of environmental engineering firms.

The export of manufactured goods in 2013 was US$1.6 billion, which accounted for 13 % of the total exports of US$ 12.6 billion. These exports consisted mainly of: (a) articles of wood, wood panels, wood sawn, chipped lengthwise, sliced or peeled (29% of the total manufactured exports); (b) Essential oils, cosmetics, toiletries (16% of the total manufactured exports; and (c) Parts of machines and mechanical appliances for lifting and moving (9 % of the total manufactured exports). The manufactured goods share of total exports decreased by more than 10% between 2003 and 2013 because of the extraordinary growth of non-manufactured exports primarily and petroleum oils.

The import of manufactured goods in 2013 was US$12.8 billion, an increase of almost 300 % from US$ 3.2 billion in 2003. Environmental goods and services were approximately 2% of the 2013 total import.

Ghana's general and industry specific performance compared to other West African countries was mixed. It ranked higher than three other West African countries (Cameroon, Cote d'Ivoire and Senegal) on the Human Development and Global Competitive Index and lower than the others on the Competitive Industrial Performance Index and the Environmental Performance Index. It ranked higher on FDI inflows (primarily due to oil field investments) and ease of doing business, but ranked the same as are lower than the others on manufactured exports as a percentage of merchandise exports.

According to The African Development Bank, the manufacturing sector has the potential to grow and expand rapidly in the medium to long term. The potential for expansion will be driven primarily by agro-business industries, but it is contingent upon government funding of infrastructure improvements and reducing transaction costs through ongoing sector reforms. The Bank calls for the Government to enhance the level and quality of skills needed for manufacturing with a view towards developing entrepreneurship and employment opportunities (African Development Bank, 2011).

4 INDUSTRIAL ENVIRONMENTAL POLLUTION AND RESOURCE USE

This chapter describes to the extent that data permit the environmental implications of industrial development and resource use by industry. It used relatively date data, the only data available, to characterize the water, air and solid waste pollutant discharges by industrial subsectors. Similarly it presents data on energy use by the manufacturing sector and its subsectors along with estimates of energy decoupling from industrial output and of sub-sector energy intensity. It concludes with the only known estimate of domestic material extraction and consumption.

4.1 Environment

This section starts with the only known comparative overview of environmental pressures in Ghana and then presents an estimate of potential pollutant discharge. From there it describes effluent discharge and water pollution, emission discharge and air pollution and solid and hazardous waste generation. It concludes with a characterization of pollutant abatement activities by larger industrial enterprises in Ghana.

4.1.1 Overview

Probably the best and most current overview of environmental pressures in Ghana is to be found in the 2014 Environmental Performance Report, which was already introduced in Chapter 3 (Yale, 2014). It includes 178 countries and describes environmental performance in 2010 and trends in performance for the period 2000-2010.

The Environmental Performance Index score for Ghana in 2014 was 32.1, ranking it 151 out of 178 countries. Its score increased by 7.6% over a ten year period. This score placed it near the bottom of the weaker performance group, but kept it out of the group of weakest performers. Countries with similar scores were Rwanda, Benin and Pakistan.

Of relevance for this report is Ghana's performance on water resources, which is based on the degree of treatment of domestic and industrial wastewater. Here Ghana's score is 10.25, lower than its overall average, but its overall country ranking is higher - 88 out of 178 countries. The other potentially relevant indicator is air pollution, which is measured in three different dimensions: household air quality, air pollution average exposure to particulate matter. The most relevant of these is exceedance of the particulate matter 2.5 micron standard, where Ghana's score is 90.7 and its overall ranking is 100 among 178 countries.

4.1.2 Potential pollutant discharge

Data on industrial compliance are limited as indicated by the fact that only 150 out of 300-500 registered medium and large firms are covered by the AKOBEN initiative. Consequently, the World Bank's Industrial Pollution Projection System (IPPS) was used to estimate a comprehensive profile of the pollutant intensities for the manufacturing sector and its sub-sectors. In addition to pollutant coefficients, the IPPS includes sub-sector average abatement cost (US$ 1994/tonne for water and air pollutants). Hartman et al. (1994) explain the approach to estimating the cost of air pollution abatement;[9] there is no explanation for the cost of water pollution abatement. A brief description of

[9] There are cost estimates for Sulphur Dioxide (SOs), Nitrogen Oxide (NO2), Particulates, Lead, Volatile Organic Compounds, Toxic Air, Air Other, and Water Conventional, Water Non-Conventional, Toxic Metal Water and Toxic Organic Water.

the IPPS can be found in Annex 3 and a detailed description of the modelling system can be found in The Industrial Pollution Project System (World Bank, 1995).

Annex 4 shows the pollutant estimates and costs of reduction for five pollutants for Ghana based on Value Added data from 2003, the latest year for which data are available. The highest potentially polluting categories are - basic precious and non-ferrous metals account for 39% of total toxic pollutant loadings and plastics 22%; basic precious and non-ferrous metals account for 83% of metal pollutant loading and basic iron and steel for 9%; cement, lime and plaster account for 54% of total sulphur dioxide loadings and basic precious metals 21%; cement, lime and plaster account 62% of total particulate matter loadings and refined petroleum 11%; and dairy products account for 70 % of organic pollutant loadings and basic precious and non-ferrous metals account for 17%.

4.1.3 Effluent discharge and ambient water pollution

The only estimate of industrial wastewater discharge that could be found was a consultant report from 1996 (GOPA-Consultants, 1996). In 1996 there were an estimated 1,400 companies, of which 40 (representing almost 26% of the larger companies with more than 200 employees) were included in the survey. The subsector totals are representative based on the plants visited. For example, the food and beverages estimate included only 9 out of 188 companies and even then only 7 plants provided data. Typical wastewater discharge from various industry sectors is shown in Table 4.1.

Table 4.1: Estimate on population equivalent of total industrial effluents in Ghana
(GOPA 1996)

Manufacturing sector	Waste water effluent	Biological Oxygen Demand (estimated)	Population Equivalent
	m^3/a	kg/d	amount
Food & Beverages Industry	5.000,000	17,500	> 300,000
Textile Industry	9.000,000	7,500	> 150,000
Metal Industry	2.500,000	2800	> 55,000
Chemical Industry	500,000	3,000	> 50,000
Petroleum Industry	770,000	850	> 30,000
Wood Processing Industry	1.000,000	1000	> 20,000
Paper Industry	700,000	1000	> 17,000
Miscellaneous Industries	1.200,000	2000	> 5,000
Palm Oil Processing Industry	750,000	120	> 3,000
TOTAL INDUSTRY	21.420,000	40,000	> 700,000

The major water pollution concern, especially in the metropolitan areas of the country, is the pollution of surface water, ground water and the coastal waters ecologically disturbed by effluent discharges. The population equivalent of industrial effluent, calculated on a biological oxygen demand basis, is to be 700,000 to 1,000,000 as shown in Table 4.1.

Due to the concentration of industrial enterprises, the following geographic areas are prone to industrial pollution in Ghana (GOPA, 1996):

- In Accra, most of the industries are located within the catchment area of River Odaw and the Korle Lagoon into which waste water effluents are discharged. In Accra, various important manufacturing industries (including the branches of food processing, textiles, metals, and chemical industry) are sited in the catchment area of the Korle Lagoon and its tributary, the Odaw River.
- In Tema, the Chemu Lagoon receives most of the industrial waste water effluents which currently is biologically dead. Several factories including the branches of fish canning, food processing, oil refining, and aluminium processing are located in the environs of the Lagoon.
- In the Ashanti Region, most of the industries are located in Kumasi. Effluents from these industries are discharged into the River Sisai and the tributary rivers Subin and Aboabo.
- In the Western Region, where most of the enterprises are situated in the industrial zone of Sekondi-Takoradi; their waste water effluents are discharged into a swampy area nearby.

According the World Water Development Report, industrial water demand accounts for around 10% of annual water use, industrial activities are the main source of pollution. This adds to water stress and impairs the health of society. Mining is the industrial activity that contributes most to pollution. The 2008 report of Ghana's Commission for Human Rights and Administrative Justice stressed that 82 rivers and streams in five mining communities in Ghana had either been polluted, destroyed, diverted or dried-up as a result of mining companies. In its 2010 evaluation report, Ghana's Environmental Protection Agency concluded that mining companies' observation of environmental standards is poor. This is caused by environmental laws that are not sufficiently strict on pollution prevention. The major concern lies not with the big mining firms, whose activities are easy to monitor, but with illegal small-scale miners whose activities are neither registered nor monitored (UNESCO, 2014).

4.1.4 Water withdrawal

The only data about water withdrawal (not use) in Ghana come from the Food and Agriculture Organisation. It estimated that agriculture accounted for 60% of water withdrawal, municipalities accounted for 30% and industry 10% in the year 2000 (FAO Statistics, 2015).

4.1.5 Estimates of industrial air pollutant emissions

The only estimate of air pollutant emissions to be found was the 1996 survey, which also reported industrial air pollutant emissions (Table 4.2). Most of the emission of sulphur oxides (SOx) and nitrogen oxides (NOx) from manufacturing industries were caused by burning fossil fuels. The emissions were lower than expected due to the relatively low energy consumption in 1996.

Table 4.2 Estimates of industrial air emissions in Ghana per industrial branch
(GOPA 1996)

	Estimation of emissions (t/a)			
Type of industry	**NOx**	**SOx**	**Dust (PM)**	**CO2**
Food & Beverages	2,500	1,000	150	400,000
Textile Ind.	250	120	20	50,000
Chemical Ind.	900	450	100	210,000
Petroleum Ind.	300	100	27	120,000
Metal Ind.	400	200	900	7,200
Paper Ind.	./.	./.	./.	./.
Palm Oil Processing	20	./.	350	100,000
Wood Processing	60	./.	800	240,000
Charcoal Production	1,000	./.	22,000	7,000.000
Miscellaneous Industries	500	200	30	80,000
Burning of old lube oil	360	132	60	78,000
Total Industrial Emissions	**6,290**	**2,202**	**24,437**	**8,285,200**

Most industrial air pollution comes from the metal industry, oil refineries and the operation of old steam boilers. Apart from the metal industry, the major industrial emissions of dust are from fuel consumption. Another source of air pollution is the uncontrolled burning of industrial and residential solid waste at dump sites and sometimes on site at industrial facilities (GOPA, 1996).

4.1.6 Greenhouse gases emissions

As can be seen in Table 4.3, manufacturing is a relatively small source of greenhouse gas emissions. Emissions from the manufacturing sector are defined as process non-energy related emissions and accounted for 2.4 % of CO2 emissions in 2012. For estimating emissions from export (e.g. emissions from trans-boundary transportation - shipments etc.) there is no suitable inventory because of the frequent cross border transit.

Table 4.3: Greenhouse gas emissions
(EPA 2015a)

Sector and sub-sectors	With AFOLU		
	CO2 [%]	CO4 [%]	N2O [%]
1. All Energy (combustion & fugitive)	**85**	**7.7**	**2.6**
%Stationery combustion within all energy	50.0		
%Transport within all energy	50.0		
Fugitive emission within all energy	0		
2. Industrial Process & Product Use	**2.4**	**0.0**	**0.0**
3. AFOLU*	**12.6**	**44.2**	**92.7**
Livestock within AFOLU	0	57.5	9.6
Land within AFLOU	98.7	0	0
Non-CO2 emissions within AFOLU	1.3	42.5	90.4
4.Waste	**0**	**48.1**	**4.7**
Total net emissions (w/ AFOLU)	**100**	**100**	**100**

*AFLOU is Agriculture, Forestry and Other Land Uses

Fossil–fuel carbon emissions in Ghana are growing. They have almost doubled, from 1.1 million metric tons in 1992 to 2.03 million tons in 2009. They stem from the burning of fossil fuels (liquid fuels almost exclusively) and the manufacture of cement. Carbon emissions from the burning of liquid fuels have increased over the same time period from 0.97 to 1.78 million metric tons, and they account for the most part (88%) of total carbon emissions (Marland et al, 2015).

The CO2 emissions (metric tons per capita) in Ghana were reported at 0.4 in 2010, an increase of 0.1 metric tons per capita from 1992 levels (World Bank, 2015).

4.1.7 Solid and hazardous wastes

Another environmental problem caused by Ghanaian industries is illegal disposal of hazardous solid industrial wastes. The awareness of industries in this regard is very low. Therefore, it was difficult to gain sufficient information about types and quantities of wastes generated. The estimated quantity of non-hazardous industrial wastes generation is about 50,000 tons per year; there is no estimate of hazardous industrial waste (GOPA, 1996).

Total waste generated from all sources is about 3.3 million tons of waste annually (EPA, 2011). In 2009, 2010 and 2011 about 70 %, 75 % and 77 % respectively of the total waste generated in the country were properly disposed of. Thus, about 30 percent of total waste generated in the country was not managed properly (NPDC, 2013).

4.1.8 Installed water and air pollutant abatement technology

The situation in Ghana is that most wastewater is discharged untreated to drainage ditches, surface water and water-bodies, which is contrary to promulgated environmental regulations that have had limited enforcement. Similarly most air pollutants are released unabated to the ambient air.

However it would be an inaccurate characterization of industrial pollutant abatement in Ghana not to describe the efforts of several large and mainly international firms. These activities are listed in Table 4.4. All pollutant abatement hardware was imported and installed by expatriates. Some installation was supervised by local engineering firms. They also built stabilization ponds.

Table 4.4: Installed water and air pollutant abatement technologies
(EPA 2015b)

	Company	Industry type	Pollutant abatement technologies	
			Emissions	Effluent
1.	Accra Abattoir Ltd	Meat		physical and biological treatment
2.	BBC Industrial Ltd	Paint		Sedimentation Tanks
3.	Coca Cola Bottling Co of Ghana Ltd	Non Alcoholic Beverage		1500m3/day capacity fully automated biological wastewater treatment plant
4.	Cocoa Processing Company Ltd	Food (Cocoa)	40m high boiler stack	
5.	Fan Milk Ltd	Food (Dairy)		effluent equalisation system 120m3/d capacity biological wastewater treatment
6.	Ferro Fabrik Ltd	Steel	Integrated air scrubber system	
7.	Ghacem Ltd	Cement		45 m3 capacity Chemical reactor
8.	Guinness Ghana Brewery Ltd	Alcoholic and Non Alcoholic Beverage		9295 kg COD/Day anaerobic/ aerobic treatment pond
9.	Nestle Gh Ltd	Food		3210 m3 aerated lagoons
10.	Pioneer Food Cannery Ltd	Food (Fish)		1400 m3 /day Dissolved Flotation Treatment
11.	Printex Ltd	Textile		800kg/l / day sedimentation tanks
12.	SBC Beverages Ltd (Pepsi Cola)	Non Alcoholic Beverage		500m3/ day aerobic treatment
13.	Unilever Ghana Ltd	Food and others		physical and biological treatment
14.	Tema Lube Oil Co. Ltd	Lubricant		4,100 litters/day waterloo bio-filter and oil –water separator
15.	GOPDC Ltd	Food (Palm Fruit) Agro process)		Aerobic/anaerobic waste stabilization ponds
16.	Ghana Rubber Estate Limited	Rubber		13.57 m3 aerobic/anaerobic treatment pond

4.2 Energy assessment

This section describes industrial (manufacturing) energy use and the share of electricity consumed by the industrial sector broadly defined. It presents estimates of energy decoupling in the SSA region and of sub- sector energy intensity.

4.2.1 Energy availability

The Total Primary Energy Supply (TPES) in Ghana was 9,586 Kilo tons of oil equivalents (Ktoe) in 2011 and 10,131 ktoe in 2012. In both years the TPES was mainly constituted by bio-fuels and waste which accounted for half of the total, followed by oil products and crude oil which accounted for 20 % and 14% respectively of TPES. Natural gas and hydro on the other hand represented a small percentage of the total primary energy supply 5% and 7 % respectively. The country imported 5,021 ktoe in 2011 and 5,123 ktoe in 2012 and the imports were mainly constituted by crude oil and oil products with a small contribution of natural gas (IEA, 2015).

4.2.2 Industrial energy use

The total fuel consumption by industry in 2011 was 1,379 ktoe and 1,443 ktoe in 2012 (IEA, 2015).

The National Energy Commission has estimated energy consumption by the manufacturing subsectors for 2010 and has projected energy consumption for 2030 as shown in Table 4.5. Not surprisingly, the iron and steel and cement subsectors are the major energy users.

Table 4.5: Energy consumption and shares in the manufacturing sector in Ktoe
(NEC 2006)

Sub-Sectors	2010	Share (%)	2030	Shares (%)
Iron and Steel	236.3	21.3	757.0	19.4
Cement	159.7	14.4	599.7	15.3
Textiles	44.0	4.0	139.5	3.6
Plastics	28.9	2.6	92.3	2.4
Wood processing	66.3	6.0	126.9	3.2
Beverages	25.8	2.3	79.5	2.0
Food processing	22.0	2.0	81.9	2.1
Paper and Paper Products	3.8	0.3	12.2	0.3
Chemicals and chemical products	56.9	5.1	193.1	4.9
Lubricating oils	1.0	0.1	6.5	0.2
Fabrication of metals	8.1	0.7	26.4	0.7
Other	456.5	41.2	1793.0	45.9
Total	**1109.2**	**100.0**	**3908.1**	**100.0**

4.2.3 Manufacturing and other sector electricity consumption

The share of electricity consumed by the industrial sector (broadly defined to include aluminium smelting, mines and manufacturing) decreased from 68% of total demand in 2000 to 48.9% in 2011 whereas non-residential use increased from 8.7 % to 16.4% and residential use from 23.5% to 34.6%. Industry broadly defined was the sector most severely affected by the load shedding in 2003-4 and 2007 and is still being severely affected in 2014/2015 for the same reasons. The nationwide load shedding is due to low inflows into the Volta reservoir, and reduced hydropower generation (about one-third to half capacity less). The largest user share of industrial power historically was the Volta Aluminium Company (VALCO). Faced with operational difficulties as well as shortages of power, its share in electricity use declined sharply between 2000 and 2011, whereas the share of the mining subsector, dominated by gold mining, increased over that same period from 9.9% of total electricity consumption to 16.3%. Manufacturing increased its share of national electricity consumption from 18.5% in 2000 to 25.1% in 2011, becoming the largest sector within industry broadly defined (Table 4.6).

Table 4.6: Industry broadly defined electricity consumption
(NEC 2012)

Year	Industry Sector								
	Valco			Mines			Manufacturing		
	1000 GWh	% share of industry	% share of total electricity	1000 GWh	% share of industry	% share of total electricity	1000 GWh	% share of industry	% share of total electricity
2000	2.50	58.0	39.4	0.63	14.6	9.9	1.17	27.1	18.5
2001	2.56	59.1	39.2	0.57	13.2	8.7	1.20	27.7	18.4
2002	2.06	52.8	33.4	0.56	14.4	9.1	1.28	32.8	20.7
2003	0.25	11.3	5.5	0.57	25.8	12.5	1.38	62.4	30.3
2004	0.01	0.5	0.2	0.60	29.6	13.2	1.42	70.0	31.3
2005	0.26	10.2	5.0	0.75	29.5	14.5	1.53	60.2	29.7
2006	1.20	33.4	18.4	0.87	24.2	13.4	1.52	42.3	23.3
2007	0.21	7.8	3.8	1.00	37.0	17.9	1.48	54.8	26.5
2008	0.17	5.7	2.8	1.14	38.4	18.5	1.65	55.6	26.8
2009	0.01	0.8	0.2	1.25	42.5	20.1	1.66	56.5	26.6
2010	0.01	0.3	0.1	1.24	39.2	18.1	1.91	60.4	27.8
2011	0.60	15.4	7.5	1.30	33.3	16.3	2.00	51.3	25.1

4.2.4 Industrial energy intensity

Industrial energy intensity (energy use per unit of manufacturing value added) in Ghana increased from 0.7 to 1.1 tons of oil equivalent (toe) per US$1,000 of MVA between 1990 and 2012, an increase of 60%. The percentage increase was similar to the average increase in Sub-Saharan African (SSA) countries (+68%). In Kenya energy intensity stayed the same over the period 1990-2012 (0.39 toe per US$1,000 MVA). It increased in Senegal by 82% to 0.3 toe per US$1,000 MVA and decreased in South Africa by 25% to 0.5 toe per US$ 1,000 MVA (UNIDO, 2014; IEA, 2015).

The energy intensity of Ghana manufacturing in 1990 was relatively low compared to the average for all SSA countries, being 0.7 compared to the average 0.8 toe per US$1,000 MVA. However by 2012 energy intensity in Ghana was above the average for all SSA countries, being 1.1 compared to the average 0.8 toe per US$1,000 MVA.

4.2.5 Energy decoupling

Between 1990 and 2012, relative decoupling occurred at the global level but not at the SSA regional level, while in the recent period of 2007 to 2012, relative decoupling occurred neither at the world nor at the SSA level. Not surprisingly, absolute decoupling did not occur at either level the global or SSA in any period. (Table 4.7)

National energy use data from the IEA are only available for SSA eight countries (excluding South Africa). Out of those eight countries, relative decoupling occurred in only three countries (Mozambique, Tanzania and Zambia) over the longer time frame (1990 to 2012), and all three achieved better relative decoupling than the world as whole. Over the shorter time frame (2007 to 2012), however, relative decoupling occurred in four countries (Kenya, Ghana, Mozambique and Zambia) and all of them even at a better rate than the global or average SSA level. Absolute decoupling did not occur in any of eight SSA countries over the longer time frame.

Table 4.7: Energy decoupling in SSA countries
(IEA 2015 and UNIDO 2014)

	Relative Decoupling Indicator		Absolute Decoupling Indicator	
	1990/2012	2007/2012	1990/2012	2007/2012
World	-0.22	0.04	0.41	0.11
SSA	0.14	0.03	1.28	0.28
Cameroon	0.08	0.02	0.63	0.13
Ethiopia	1.07	0.31	3.70	1.00
Ghana	0.65	-0.12	1.10	0.17
Kenya	0.00	-0.10	0.75	0.06
Mozambique	-0.47	-0.07	2.03	0.16
Nigeria	0.91	0.06	3.77	0.53
Tanzania	-0.48	0.28	1.88	0.42
Zambia	-0.28	-0.01	0.35	0.20

4.2.6 Manufacturing sub-sector energy intensity

Unfortunately data are not available for estimating manufacturing sectors energy intensity, or for current value added for sectors. However, it is possible to approximate conventional energy intensities for sectors by using energy consumption and sales data from the African Investor Survey 2012 (Table 4.8). For three subsectors in Ghana (15 - food products and beverages; 24 - chemicals and chemical products and 26 - non-metallic products) their energy intensity is lower than the SSA average whereas for two subsectors (17 - textiles and 28 - fabricated metal products) their energy intensity is higher than the SSA average.

Table 4.8: Energy intensity in major energy using manufacturing sectors (Kilojoules per $1 of sales)
(UNIDO 2012)

Sub-sector (ISIC Rev 3.1 2-digit)		Ghana		SSA	
		Mean	Median	Mean	Median
15	Manufacture of food products and beverages	2,640	670	3,270	830
17	Manufacture of textiles	3,280	1,630	3,190	1,140
24	Manufacture of chemicals and chemical products	1,270	390	2,490	350
25	Manufacture of rubber and plastics products	3,190	1,150	3,590	1,420
26	Manufacture of other non-metallic mineral products	3,090	980	4,120	1,320
28	Manufacture of fabricated metal products, except machinery and equipment	3,950	700	3,060	770

4.3 Domestic material extraction and consumption

There are country-level data on domestic material extraction and consumption defined as follows:

- **Domestic Material Extraction (DME)** is the amount of raw material (excluding water and air), in physical weight, extracted from the natural environment for export and domestic material consumption measure.
- **Domestic Material Consumption (DMC)** is the total amount of materials used within an economic system and is defined as the quantity of raw materials extracted from the domestic territory, plus all physical imports minus all physical exports. Hence, if DMC > DME, this implies a relative material intensity of imports of a country; if DMC < DME, the country extracts more material than it domestically consumes, in order to enable exports. In Ghana, the latter is the case.

  Domestic material consumption = Domestic extraction + Physical imports - Physical exports

Domestic material extraction grew significantly over the period 1980 to 2010 with the greatest growth in industrial and construction minerals (Table 4.9). In 2010 the manufacturing sector accounted for 21 % of material consumption in Ghana, compared to 41% by agriculture and 23% by the mining sector. These data show that industry was not the largest consumer of DMC and was slightly less than the mining sector. The large (positive) difference between Domestic Material Extraction and Domestic Material Consumption shows that a considerable share of material extraction in Ghana is done to enable the exports to external markets.

Table 4.9: Domestic material extraction and consumption

Domestic Material Extraction (in kt)	1980	2010	%Variation
Biomass	22260	79630	256%
Fossil Fuels	0	180	--
Industrial And Construction Minerals	2880	35200	1125%
Ores	3720	27350	635%
Total	**28860**	**142090**	392%

Domestic Material Consumption (in kt)		2010	%Of Total
Agriculture		71184	48%
Manufacturing		25211	17%
Mining		51905	35%
	1980	**2010**	**%Variation**
Total	**30300**	**148300**	**389%**

4.4 Summary

Describing the environmental performance of industry is difficult because of the lack of data on pollutant discharge and its impact on ambient environmental quality. Based on the only available and dated data, the food and beverage and textiles subsectors are the largest dischargers of organic water pollutants, which is partially in line with estimate based on the Industrial Pollution Projection System. Based on the same dated data, charcoal production is the largest source of particulate matter emissions followed by metal fabrication and wood processing subsectors. Overall the manufacturing sector accounts for only a small percentage of CO2 emissions.

The three subsectors that are the greater energy consuming subsectors are iron and steel, cement and wood processing. The manufacturing sector became the largest consumer of electricity within the industry category by 2011. The energy intensity of Ghana manufacturing in 1990 was relatively low compared to the average for all SSA countries, but was above the average for all SSA countries by 2012. The very approximate data on sub-sector energy intensity data suggest that most subsectors were below the SSA subsector averages except for the fabricated metal products.

The Ghana Private Sector Development Strategy succinctly characterizes the manufacturing sector's resource use and environmental management. It states that there are substantial losses of raw materials and water, waste generation, and inefficient energy consumption among enterprises. This leads to, beside non-compliance with environmental regulations and thus possibly fines and penalties, a significant loss of competitiveness. Those issues are commonly attributed to the lack of understanding with regard to the economic and environmental benefits associated with more attentive enterprise management (Government of Ghana, 2010b). The Domestic Material Extraction in Ghana considerably exceeds the Domestic Material Consumption, which implies a net material intensity for exports over imports.

5 FORMULATING AN OVERARCHING RESOURCE EFFICIENT GREENING OF INDUSTRY

What is clearly lacking and needed in the current Ghana policy framework for greening industry is a time-bound commitment to decoupling resource use from industrial output. Most pressing is the need to decouple energy use and in particular electricity use from industrial output as the unreliability of electricity adversely affects a firm's productivity.[10]

A national Resource Efficient Greening of Industry (REGI) initiative would complement current scattered efforts by:

- Setting specific decoupling trgets for each resource (energy, water, raw materials and chemicals) first for the manufacturing sector and then for several resource intensive manufacturing sub-sectors. Its implementation would initially focus on decoupling energy use (perhaps only electricity) and industrial output while recognizing the importance of decoupling material and water use
- Focusing on the more resource intensive plants in each sub-sector
- Envolving subsector business associations in setting sub-sector decoupling targets for resource use intensity and requiring them to enter into voluntary agreements to meet agreed upon targets
- Requiring, where feasible, the use of new and renewable energy sources
- Attempting to integrate all resource use and environmental compliance targets into long-term comprehensive operating permits for industrial enterprises.

As such a national REGI initiative would be a major undertaking that is not possible given government resources and as of now there is no apparent donor support it is roposed to focus initially on one manufacturing subsector (most likely steel rolling) as was done in Vietnam for the teel-rolling subsector (UNIDO. 2010)

5.1 Rationale for a REGI initiative

Three compelling reasons underpin the need for Ghana to decouple energy (fossil fuel) use as well as other production inputs from industrial output - to enhance the productivity of the industrial sector by reducing the cost of energy used in production processes; to improve energy security by reducing the need to import energy resources; and to reduce the generation of pollutants, both conventional pollutants such as particulate matter and sulphur dioxide, and of global pollutants (specifically GHGs). There is sufficient evidence from global studies and from the perspective of Ghana that underlie these reasons:

Productivity: Recent research has focused on the benefits to be derived from energy efficiency especially from a macroeconomic perspective. Many empirical studies agree that energy efficiency generates positive outcomes such as higher output, competitiveness (Taylor et. al. 2008) and employment (IEA, 2009) as well as environmental improvement induced by lower energy bills (WEC, 2008) and sustainable production methods (World Bank, 2006). On-going research based on an econometric analysis using firm level data in 24 developing countries suggests a robust relationship between firm level productivity (or technological change) and energy efficiency (Cantore et. al., 2011) and a recent survey of 119 projects in developing countries across nine manufacturing sectors found a generally high level of internal rates of return at the project level (Alcorta et, al., 2014)

[10] See UNCTAD (2012) for a discussion of the importance of relative decoupling for achieving sustainable structural transformation.

The importance of energy efficiency for productivity enhancement is more compelling in Ghana than many other SSA countries because of the high cost of grid electricity. The cost for grid electricity (dollars per MWh for industry in Ghana is greater than US$400 which is significantly higher than the reported cost for 13 other SSA countries. The next highest grid electricity price is US$250 for industry in Rwanda. The lowest cost for grid electricity (less than US$ 55) is for Angola and Mozambique (IEA, 2014b).

Energy Security: The first concern about energy security for the manufacturing sector at the country level is that Ghana is a net exporter of crude even though it is a net importer of refined products due to the lack of refineries in the country. Being an importer of refined products means that energy supplies for manufacturers could be curtail by global crises. The import of total refined products increased from 2361 ktoe in 2000 to 5123 ktoe in 2012, which was only marginally higher than in 2011. The composition of total imports was 1560 ktoe of crude oil, 2736 ktoe of oil products, 632 ktoe of natural gas whereas in 2012 it was 1232 ktoe of crude oil, 3528 ktoe oil products and 361 natural gas. (EIA, 2015).

Eventually energy security may improve because oil production in Ghana started in 2000. However, only in 2011, after the discovery of the Jubilee oil field in 2007 off the cost of Ghana, did production become relevant for the country. Crude oil now represents an important part of Ghana exports (in 2013 the crude oil share of total exports was 24 per cent compared to 0.1 per cent in 2003). Daily production was 99,000 barrels of oil in 2013. Oil consumption has grown over time and averaged 66,000 barrels per day in 2013. (EIA, 2015).

The other concern about energy security from the micro perspective is the past and current load shedding due to due to low inflows into the Volta reservoir which has reduced generation (about one-third to one- half less capacity) from the nation's hydropower. This situation has implications for firm level operations and the continuing need for expensive on-site generation of electricity. The decline in electricity supply for instance is partly attributable to the overreliance on conventional energy sources with very little government commitment in developing alternative energies sources such as renewable energy technologies which are sustainable and environmental friendly in nature (Bawakyillenou and Asante, 2015b). For example, UNEP (2015) found that Ghana has potential for competitive production of power from solar PV, with large positive social (in terms of direct and indirect jobs, livelihood creation) and environmental (in terms of emission savings, climate change mitigation) externalities, provided the right framework conditions are in place (UNEP, 2015).

Environment: As the example of solar power shows, many of the policies available to alleviate energy insecurity can also help to mitigate local pollution and climate change, and vice-versa. In many cases, those policies bring economic benefits too, by lowering energy costs that would increase productivity and generate jobs - a "triple-win" outcome. An integrated approach to policy formulation is, therefore, essential. The right mix of policies to address productivity enhancement, energy-security and climate concerns depends on the balance of costs and benefits, which vary among countries. The most cost-effective approach would involve market-based instruments, including those that place an explicit financial value on CO2 emissions. Regulatory measures, such as standards and mandates, will also be needed, together with government support for long-term research, development and demonstration of new technologies.

The urgent need to tackle local air pollution in Ghana would undoubtedly continue to provide the primary rationale for further efforts to stem the growth in greenhouse-gas emissions. In terms of air pollution load, sulphur dioxide (SO2) and particulate matter 10 microns (PM10) are clear priorities owing to their significant share of total air pollutants. But from a hazard standpoint, PM10 is a slightly higher priority than SO2 as the impacts of particulate pollution on respiratory illness, chronic bronchitis and asthmatics is particularly severe in urban and heavily industrialized areas.

In Ghana, the leading sources of outdoor air pollution are vehicular emissions from motor vehicles, (believed to be the primary source affecting ambient air quality), industrial pollution, residential burning of fossil fuels and wood (including singeing of animals after slaughter), agricultural burning

and open field burning of solid waste as well as dust emissions during mining operations. However, there is very little evidence-based information available on direct linkages between air pollution and specific ailments.

5.2 Quantifiable objectives for decoupling

The concept of decoupling, as defined by the OECD (2002) and introduced in Chapter 4, refers to the relative growth rates of both resource use and pollutant discharge into the environment and economic activity with which they are causally linked (Figure 5.1). Decoupling occurs when the growth rates of resource use and/or pollutant relevant variables, energy use in this proposal, are less than the growth rate of the economically relevant variable, industrial output in this case, over the same period of time. For the most part, however, the fundamental concern is not the relative but the absolute change in resource use and pollutant discharge variables, because decoupling could occur but yet not be sufficient to keep economic activity within the limits of resource use constraints and/or environmental standards. If industrial output displays a positive growth, then 'absolute decoupling' is said to occur when the growth rates of resource use and/or pollutant variables are zero or negative; that is, demand on resources or release of pollutants into the environment are either stable or falling. 'Relative decoupling' is said to occur when the growth rates of resource use and pollutant releases into the environment are positive but less than the growth rate of industrial output.

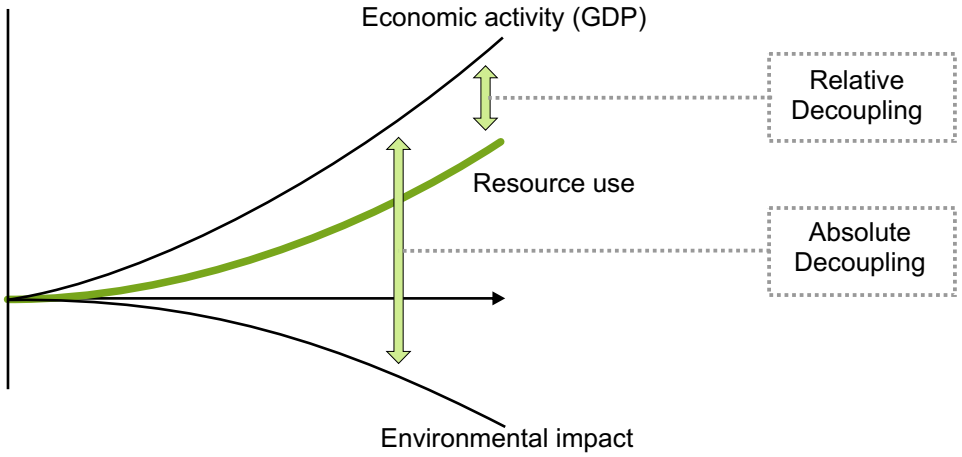

Figure 5.1: Two aspects of decoupling
(based on UNEP (2011a), figure 1.1.)

Relative rather than absolute decoupling of energy use in the manufacturing sector is the only realistic goal for developing countries given that even developed countries have not been able to achieve absolute decoupling of energy use and industrial output (Castellanos and Luken, 2008). Comparable data on the relative decoupling of water and material use and industrial output are not available for either developed or developing countries.

The experience of Ghana to date in the relative decoupling of energy and growth, as described in Chapter 3, indicates it occurred over the shorter period between 2007 and 2012 (Table 5.1). Although there has been no absolute decoupling in the period 1990 to 2012, there has been relative decoupling between energy use and MVA and between energy use and gross domestic product (GDP). Energy use did not increase as much as MVA or GDP as well over two shorter time intervals. (It was not possible to construct a table for water and raw material given the absence of data).

Table 5.1: Energy decoupling estimates for Ghana
(IEA 2015 and UNIDO 2014)

Economic Unit	Relative Decoupling			Absolute Decoupling		
	1990-2007	1990-2012	2007-2012	1990-2007	1990-2012	2007-2012
GDP	-0.4	-0.52	-0.2	-0.32	0.6	0.21
MVA	0.87	0.65	-0.12	0.8	1.1	0.17

The REGI initiative should include energy, water and material efficiency (intensity) and conservation (total use reduced) targets for the manufacturing sector that would contribute to meeting the sector's share of the national objective for decoupling, which should be set in the larger Green Economy Strategy for Ghana. As it may not be possible to set targets for water and material efficiency given the paucity of data, these could be put forward at a later time. However, the target setting process should not lose sight of the potential for energy conservation that could result from reducing wasteful water and materials use.

5.3 Long-term agreements on resource efficiency for sub-sectors

The proposed REGI initiative would consist of implementation plans for sub-sectors rather than for the manufacturing sector as a whole. It is too difficult to formulate a cost-effective and responsive action plan for the entire manufacturing sector as is the case for development plans, which also have been formulated for sub-sectors rather than for the entire manufacturing sector. Sub-sector action plans with an initial focus on energy efficiency and conservation and to the extent possible for water and materials would consist of the following components:

- Resource efficiency targets set for sub-sectors;
- Targets incorporated into established or revised sub-sector development strategies that reflect a consensus of state owned, foreign direct investment and domestically owned enterprises; and
- A written long-term agreement between industry associations and the government on how and when targets would be achieved.

5.3.1 Initial target specification

Targets are normally a given percentage reduction from the baseline scenario for each sub-sector. The targets are not necessarily uniform for each sub-sector and would be based on sub-sector specific energy efficiency potential studies. These targets could be set for a REGI based on an established inventory of economically viable measures that could be implemented in each sub-sector as done in the Netherlands (Gerritis and Oudshott, 2003) or on the general technology configuration in the sub-sector and level of best performance by existing and new plants as done in China (Price, 2010). Interestingly, both the well-considered Dutch target and the hastily formulated Chinese target were a 20% reduction from the business as usual scenario

5.3.2 Manufacturing sub-sector target modified as needed

For a sub-sector where a large number of industrial plants and data are available, which is not the current situation in Ghana, the baseline scenario specified in sub-sector development strategies (business as usual) would be modified to show the least cost (alternatively most profitable) composition of existing and new plants that will be needed to meet the decoupling target for a sub-sector. The modified composition should be reviewed in the light of productivity, employment, trade outlook and environmental implications. If these implications are unacceptable, then the percentage reduction and how it is allocated among existing and new plants could be revised by the sub-sector working group that would consist of industry and government representatives. The consensus scenario would specify the long term production estimates and the social, energy use and environmental outcomes.

5.3.3 Long-term agreement on manufacturing sub-sector target

Long-term agreements, often called voluntary or negotiated agreements, are essentially a contract between the government and industry with commitments and time schedules on the part of all significant enterprises in a sub-sector (OECD, 2003). These agreements typically have a long-term outlook, covering a period of five to ten years, so that strategic resource-efficiency investments can be planned and implemented. A key element of these agreements is that they focus the attention of all actors on resource efficiency, conservation and pollutant reduction goals and often result in the exchange of information among participating companies (Price, 2010; Hu, 2007; Eichhorst and Bongardt, 2009).[11]

5.4 Government support programmes

Establishing supportive and harmonized programmes for participating enterprises is necessary before launching a sub-sector plan to improve energy efficiency. Such programmes, which have yet to be developed by the National Energy Commission of Ghana, should include to the extent possible financial incentives, technical assistance, rewards and publicity for enterprises that reach targets, and perhaps penalties for failure to achieve targets. Financial incentives for investing in energy efficiency technologies and measures could include targeted grants or subsidies, tax relief, loans for investments in energy efficiency and partial risk guarantees for loans made by banks. Financial disincentives could include differentiated electricity and other energy sources based on levels of energy efficiency with the more inefficient plants bearing a higher price, elimination of tax rebates for exports of energy-intensive products and penalties.

5.5 Information dissemination

Internationally, information dissemination is an important component of target setting and other industrial energy efficiency programs. Technical information sources such as energy efficiency guidebooks, databases, software tools, and industry or technology-specific energy efficiency reports are available. The most relevant sources of information for Ghana would be the reports being produced by the Asia Pacific Partnership on Clean Development and Climate Change, the SE4All Energy Efficiency Hub at the UNEP DTU Partnership and the UN Climate Change Technology Centre. In the near future the Climate Innovation Centre located at Ashesi University, which is being funded by the Government of Denmark, should become a useful source of information.

[11] The drafting of voluntary agreements needs to be done carefully. For example, an initial review of the Danish voluntary agreement on industrial energy efficiency revealed that it was an administrative nightmare, resulting in huge compliance costs for the government. Then there is the problem of free-riders in sub-sector agreements. OECD studies show that voluntary agreements should be used within a suitable mix of policy instruments rather than on their own to meet particular outcomes.

5.6 Monitoring programme

International experience indicates that it is extremely important to establish effective monitoring guidelines at the beginning of an energy-efficiency programme. Clear and transparent monitoring guidelines would specify what needs to be reported, when it would be reported, how it would be reported and to whom. Enough detail should be provided at the beginning of the programme as to how enterprises' savings would be documented and the desired level of accuracy.

For example, the Top-1000 programme in China requires all participating enterprises to report directly to the National Bureau of Statistics. There is a generic spreadsheet used by all enterprises to report via an on-line website their energy consumption by fuel type on a quarterly basis (should also include reporting on output). The monitoring programme for the REGI initiative would be a similar comprehensive operating and reporting requirement.

As of May 2015, there was no programme for monitoring and reporting industrial energy use in Ghana. A starting point for a monitoring programme would be to build a monitoring requirement into the AKOBEN programme for reporting on environmental performance.

5.7 Summary

A national REGI initiative by the Government would consist of the following components - (a) a goal and associated rationale for moving towards decoupling resource use from industrial output in order to move towards a resource efficient and low carbon manufacturing sector; (b)quantified sector and sub-sector targets for decoupling specific resource uses (energy, water, raw materials and chemicals) and industrial output, (c) a generic approach for integrating sub-sector decoupling resource use targets into sector development plans, (d) government programmes to assist industry in meeting targets (e), information dissemination and (f) a comprehensive monitoring and evaluation scheme. Ideally a REGI initiative would be supported by the Ministry of Trade and Industry and the National Energy Commission and draw on the services of the Ghana National Cleaner Production Centre and the Ghana Climate Innovation Centre (World Bank and DANIDA, 2013).

6 DECOUPLING PROGRAMMES IN OTHER COUNTRIES

There are no decoupling programmes, as described in Chapter 5, on-going in SSA countries. However, the energy efficiency strategy for South Africa does have some of the features of the programme described in Chapter 5 as does the Tunisian programme and the Green Economy Programme in Ethiopia has a related objective with its focus on reducing CO2 emissions.[12] Given the dearth of experience in SSA countries with decoupling programmes, this chapter in addition summarizes lessons learned from decoupling programmes in seven Asian countries - Peoples Republic of China, India, Indonesia, Japan, Malaysia, Thailand, and Vietnam.

6.1 Energy efficiency strategy of South Africa

The Department of Energy released its first national energy efficiency strategy in 2005, and a review at the end of the first phase in October 2008. It sets a national target for energy efficiency improvement of 15% by 2015 relative to projected consumption. The program is implemented on a sector-by-sector basis with progress monitored and the targets reviewed after each of three stages. The strategy aims to achieve the required energy efficiency improvements through the following enabling instruments and interventions: energy efficiency standards; appliance labeling; education, information, and awareness; research and technology development; energy audits; monitoring and targeting and energy management systems.

The target for the industrial sector is a reduction in final energy demand of 15% by 2015. Within the industrial sector the target is focused on the following sectors - iron and steel (1% improvement per year), chemical/petrochemicals 1% improvement per year), mining (reduce total energy demand by 10% by 2015), paper and pulp and printing (2% improvement per year) and cement (2% per year). The strategy is thus focused on energy intensive industry with no mention of light industry. While the DME (2005/8) notes that the sector offers energy savings of around 50% of current consumption in comparison with international best practices, a "savings potential of at least 11% is readily achievable using low-cost to medium-cost technical interventions. Furthermore an additional 5% - 15% energy saving would be achievable via proven no-cost and low-cost techniques of energy management and good housekeeping" (Republic of South Africa, 2008:15).

It was not possible to find out the extent to which manufacturing as whole and specific sectors have met their targets.

6.2 Green economy programme in Tunisia

TANME (Agence nationale pour la maitrise de l'énergie) is the national agency responsible for energy conservation in Tunisia. It was created in line with the national policy of ensuring energy security and independence as well as reducing the national energy bill. The ANME has been very active in sensitising companies on the importance of EE projects. It also:

- mandates EE audits from companies with annual energy consumptions of over 800 toe,
- manages the allocation of subsidies for well implemented EE projects,
- works with another agency to manage credit funds for EE projects,
- identifies EE incentive tools
- runs training courses for energy managers.

[12] Other SSA countries that have formulated green economy frameworks are Kenya, Mozambique and Rwanda.

ANME keeps a register of all companies with energy consumption which is over 800 toe and writes to them every 5 years to remind them that their energy audits is due. The company chooses an energy auditing firm which is accredited by the ANME to carry out the audit. The auditors present the company with a report on ten different projects which would results in energy savings. The report is submitted to the ANME and they decide which of the ten projects will qualify for subsidies once completed.

The company chooses which of the projects it will implement. The company also needs to decide whether it has sufficient technical knowledge and expertise in house to implement the project. If not, the company typically has recourse to consultancy firms, equipment providers or ESCOs to implement the projects for them.

Many of the projects are financed either 100% internally or with a 40-60% split between internal financing and bank loans. Once implemented, the company needs to show proof that the projects have been accomplished for them to release the subsidy. This refund process can take up to two years to be completed.

The governmental subsidies that are available for companies through the ANME for the mandatory energy audits and energy efficiency project implementations are divided into three types:

- for energy audits: 70% of the cost of the audit with a limit of 30,000 DNT
- for intangible investment (e.g. training): 70% of the cost with a limit of 70,000 DNT
- for tangible investment (e.g. machines): 20% of the cost with a limit of 500,000 DNT

The ANME claims that a cumulative energy saving of 676 ktoe was effected solely from EE projects within the industrial sector for the period of 2004 to 2008. It assessed the potential for energy savings for 2008 to 2011 period to amount to 400 ktoe (ANME, 2015).

6.3 Green economy programme in Ethiopia

Ethiopia's Climate Resilient Green Economy (CRGE) programme lays out a strategy for reducing GHG emissions across all sectors of the economy (Federal Democratic Republic of Ethiopia, 2011). The strategy for the industrial sector focuses on five sub-sectors comprising 12 individual plants that make up the major part of Ethiopia's industrial activities (and hence account for most of the industrial GHG emissions). The five subsectors are cement, textiles and leather, steel and engineering, chemicals (including fertilizer), paper and pulp, and food processing and mining (including gold, coal, potash and others).

Given the comparably small share of organized industrial economic activity in the economy, industry accounts for only 3% of GHG emissions. At nearly 2 Mt CO2 emissions or 50% of the 4 Mt CO2 emissions from industry, cement is the single largest industrial source of emissions, followed by mining (32%), and the textile and leather (17%) industry. Emissions from steel, other types of engineering, the chemicals industry (incl. fertilizer), pulp and paper industry and food processing together account for only around 2% of industrial GHG emissions.

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

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

Of the identified industry abatement potential, around 70% is concentrated in the cement industry. The main lever, clinker substitution, would increase the share of additives in cement, particularly pumice (5 Mt CO2e of abatement). The upgrade to more energy efficient technologies and waste heat recovery could reduce up to 6 Mt CO2 emissions in 2030, while the usage of biomass (mainly agro-residuals) will help to reduce GHG emissions by 4 Mt CO2e. All other industrial sectors that were analysed (e.g., chemicals, fertilizer, textile, leather, paper and pulp) account for an abatement potential of around 6 Mt CO2 emissions in 2030. The cement industry initiatives (i.e., initiatives for which cost has been evaluated) will require a total expenditure of around USD 6.2 billion in the long run (i.e., up to 2030). Of this total, about USD 4.9 billion is capital expenditure and USD 1.3 billion is operating expenditure. Around USD 2.1 billion of the total expenditure will already be required in the short term, i.e., up to 2015.

As many governmental institutions have yet to build up their capacity, collection of high-quality data was sometimes a challenge. For many of the sectors included in the CRGE strategy, data were not readily available or were of poor quality. As a result, the writers of the CRGE had to take a pragmatic approach to compiling the baseline data required to support the analytical process, combining domestically available data with international benchmarks, experiences from other countries, expert interviews, and making several assumptions.

In summary, the Government of Ethiopia has formulated a reasonably well documented, feasible and time-bound strategy for reducing GHG emission from the industrial sector. However, the strategy is not a strategy for greening the industrial sector. It does not address the need for improving the efficiency of all resource inputs (energy, materials and water) and reducing the discharge of pollutants into the ambient environment. Also the CRGE appears not to take advantage of all the institutions working to reduce GHG emissions, such as drawing on the services of the Ethiopian National Cleaner Production Centre and the Ethiopia Climate Innovation Centre, nor to include a specific programme for monitoring progress in reducing GHG emissions.

6.4 Decoupling programmes in developing Asian countries

Asian countries with established decoupling programmes (China and Thailand) have been more successful in achieving relative decoupling in the long term, 1990–2008, and in the short term, 2006–2008 than three of the four countries in the process of initiating them (Table 6.1). The anomaly is India, which has been relatively successful in decoupling energy use and industrial output in the period 1990–2008 and in the short term, 2006–2008, but is just now initiating an explicit decoupling programme. It was not possible to identify which factors, such as a shift away from energy intensive sub-sectors in the composition of MVA, which would explain the relative success in energy decoupling. In fact, the share of energy intensive sub-sectors in total MVA increased from 40% to 50% between 1990 and 2008.

Table 6.1: Decoupling estimates for seven Asian countries
(IEA 2015 and UNIDO 2014)

Group	Relative Decoupling Indicator [13]		Absolute Decoupling Indicator [14]	
	1990-2008	2006-2008	1990-2008	2006-2008
World	-19	6	31	7
Asia (Excl China)	-20	1	21	4
Japan (OECD)	-29	-9	-16	-12
China	-66	-4	170	24
India	-47	-6	63	6
Indonesia	2	13	178	23
Malaysia	-5	3	250	12
Thailand	-14	-7	179	2
Vietnam	5	8	609	35

[13] RDI = [(Energy Use 2008/MVA2008) - (Energy Use 1990/MVA1990)]/(Energy Use 1990/MVA 1990)
[14] ADI = (Energy Use 2008-Energy Use 1990)/Energy Use 1990

Those countries with established programmes (China and Thailand) have common programmatic features which have contributed to, but certainly do not account for all, of the success in decoupling. These programmatic features are: (a) a quantitative target for decoupling of energy use and industrial output (a percentage reduction in energy use compared to the energy use associated with the business as usual scenario), (b) a government programme that offers financial incentives (loans and tax reductions) and imposes specific auditing and reporting requirements, and probably most important (c) involvement of the manufacturing sub-sectors in designing and implementing targets as they apply to individual enterprises. (See Altenburg, 2010; UNIDO, 2011a and UNCTAD, 2011 for the importance of dialogue between the government and private sector.)

Four countries are in the process of starting industrial energy decoupling programmes, all of which lack some or all of these essential programmatic features. In the case of India, there are no financial incentives directly provided by the government; the only incentive is a "perform and trade" exchange between individual plants. Nor is there evidence of industry involvement in programme design or setting decoupling targets In the case of Indonesia, the proposed programme does not set a quantitative decoupling target (s) for the manufacturing sector and sub-sectors nor does it include specific tax incentives or rebates for achieving energy efficiency measures. In the case of Vietnam, the proposed programme fails to set a quantitative decoupling target for industry, offer financial incentives and involve the manufacturing sector. Only recently has Malaysia begun to incorporate the three essential features — quantitative targets, government regulatory and support features and manufacturing sector involvement.[15] (Luken and Piras, 2011).

6.5 Summary

This chapter describes decoupling programmes in two African countries and efforts to decouple energy use in six decoupling countries in Asia. South Africa's energy efficiency strategy aims to improve energy efficiency in several sectors of the economy including industry. It is not strictly an energy decoupling programme because it does not explicitly delink energy use from industrial output and no documentation could be found as to whether it is achieving its objective. Tunisia's programme on energy efficiency is an involuntary programme that requires companies to conduct energy audits every five years and provides subsidies to do so. There appears to be no manufacturing or manufacturing sectors'target. Ethiopia's CRGE programme is a reasonably well documented, feasible and time-bound strategy for reducing GHG emission from the industrial sector. However, the strategy is not a strategy for greening the industrial sector. It does not address the need for improving the efficiency of all resource inputs (energy, materials and water) and reducing the discharge of pollutants into the ambient environment. Two Asian countries with established decoupling programmes (China and Thailand) have common programmatic features that have contributed to, but certainly do not account for all, of their success in decoupling. Three Asian countries (India, Indonesia and Vietnam) are in the process of starting industrial energy decoupling programmes, all of which lack some or all of these essential programmatic features. Only recently has Malaysia's programme begun to incorporate the three essential features of a decoupling programme - quantitative targets, government regulatory and support features and manufacturing sector involvement.

[15] Successful energy decoupling programmes in OECD countries have similar features (targets and government support (Price, 2005 and Price et.al., 2008)).

7 COMPLEMENTARY MEASURES FOR GREENING INDUSTRY

Several policy and programmes for green industry are recommended to complement a REGI initiative or as stand-alone efforts if the Government does not undertake a REGI. This assessment recommends just six potentially effective actions in order of importance that could be undertaken within the existing policy framework.

7.1 Effective use of regulatory authority

Even though the Government is making use of all its environmental regulatory authority, discharge permits for over 300 factories are not readily available. There should be available a list of firm-specific permits with discharge specifications. If there is self-monitoring and reporting by firms, then these reports should be publically available along with EPA comprehensive documented estimates of total pollutant loadings for sub-sectors and regions.

Perhaps the Ministry of Environment, Science, Technology and Innovation (MESTI) should initiate a review of EPA's use of its environmental regulatory authority to document the extent to which it is being used. One outcome of the review might be modification of discharge permits to include a requirement to document all materials release into the environment, which would become the basis for a Pollutant Release Inventory.

Modification of discharge permits should be a relatively easy task as it would be building on an existing programme. The challenge will be expand the number of plants with discharge permits, now only about 250-300.

7.2 Ghana National Cleaner Production Centre

If the Government is committed to greening the manufacturing sector, a compelling case can be made for the Government itself to provide funding for the GNCPC, which was jointly initiated by UNIDO and UNEP. The broader literature suggests that enterprises in developing countries are often using three or more times more materials and energy than the best-practice benchmark. Therefore, RECP not only is an advisable strategy to adopt from an environmental point of view but also from an economic point of view. There is also a pressing economic case under the current economic conditions in Ghana because greater material and energy efficiency would reduce operating costs. While no manufacturing specific data on material and energy for Ghana, these costs typically account for 40-60% of the operating costs of enterprises in developing countries.

The advantage of providing additional funding for the GNCPC is that it is an established programme with a proven track report. The challenge is to persuade the Government to take action rather than wait for the low probability that a donor will support an expansion of the GNCPC programme.

7.3 Industrial zoning

Until the recent Industrial Policy provided for centralized industrial zoning authority (section 1.4.2.3), industrial zones were designated by local planning departments. When there was very little development, this resulted in clearly marked heavy industrial and light industrial areas, especially in Tema. There are similar zones in certain areas of Accra, Kumasi and Takoradi. However, the designations have not been well sustained except in Tema. With the establishment of the Free Zone enclave in Tema, some light industrial areas have been re-zoned to accommodate commercial and residential activities.

The aim of the Industrial Policy is to revert to a stricter practice of reserved industrial zones and in the long run become in some cases eco-industrial parks. The problem is a chronic lack of strict enforcement, so that in most places there are now mixed zones except for Tema. Here the heavy industrial areas are mostly intact. However, even in these exclusive industrial zones, residential facilities are encroaching to no more than a kilometre or two away.

7.4 Expand AKOBEN initiative

AKOBEN ratings are evaluated by analysing more than a hundred performance indicators that include quantitative data as well as qualitative and visual information. These ratings measure the environmental performance of companies based on their day-to-day operations once they have successfully cleared their EIAs and obtained their environmental permit to operate. These ratings indicate how well companies have met the commitments they made in their EIAs at the planning stage. AKOBEN, therefore, complements the EIA process and is now serving as a monitoring and verification programme to ensure that companies follow environmental regulations on a continual basis.

As noted above, only about 200 of the 500-600 medium and large firms in Ghana are participating in the AKOBEN programme. The Government needs to expand the programme as it is proving to be effective in improving resource efficiency and environmental compliance. Again the challenge is to secure government funding for an expansion of the programme.

7.5 Second hand technology

Companies in setting up their factories and during operations import machinery as well as use locally manufactured tools. While a few companies import new machinery, most import machinery that is second hand and old. There is no law that prohibiting companies from importing second hand machinery.

Addressing the resource efficiency of foreign imports (both machinery and raw materials) is becoming increasingly important as the proportion of total inputs of foreign origin used by the average firm increased from 27% in 2007 to 48% in 2012 (World Bank, 2015c).

Rarely do companies report i.e., a technology audit, to EPA on the machinery type, source and year of fabrication. Thus only in a limited number of cases does EPA determine whether a particular machine would pollute more than other technology options. In those situations where it determines that equipment is overly resource inefficient does EPA encourage, but does not require, companies to upgrade their technology choices.

One option would be for the EPA to set new source performance standards for new technology to be used in the country. Then all imported technology as well as that manufactured locally for use in manufacturing process would have to meet these standards. This arrangement would not violate WTO requirements and would automatically ensure that resource inefficient technology is not imported into the country.

7.6 Environmental and renewable energy technologies

As yet, renewable energy technologies (RET) except for biogas are not cost competitive with other energy sources in most applications. Moreover, their manufacture in Ghana remains significantly more expensive than those that could be imported from abroad, mainly from China. In addition, numerous other factors currently mitigate against their manufacture including inadequate financing, lack of skills, lack of favourable pricing policies for renewable energy technology purchase and tariff arrangements that tax renewable energy technology components but not assembled products.

However, in the medium- and long-term, Ghana faces promising opportunities for participating in the manufacture of RET. As shown in the GE-TOP Ghana study (UNEP, 2015a), Ghana could competitively contribute to the solar PV value chain in the balance of system segment, such as charge controllers, cables and mounting frames. Some existing local manufacturing industries already possess relevant capabilities. For example, local companies that provide cables and conductors for national electrification projects could be integrated into the chain with minimal adaptation.

An on-going UNIDO biogas technology project in Ghana is currently promoting industrial-scale biogas technologies for electricity and thermal applications by using an integrated technology transfer approach (piloting of an industrial-scale biogas plant; business and enterprise development support for biogas companies; targeted research on industrial-scale biogas technologies; and awareness raising and policy recommendations).

The Ghana Climate Innovation Centre, launched in 2015, has the mission to support the manufacture of RET (World Bank and DANIDA, 2013).

7.7 Increased public advocacy

A range of stakeholders should be involved in the formulation and implementation of a green economy/industry initiative. The government is struggling to convince potential stakeholders, particularly private sector associations and individual entrepreneurs, of the critical importance of decoupling. Hence, there is a lack of political commitment and of ownership of a green industry initiative particularly one that advocates decoupling of fossil fuel use from industrial production. At this point in time (November 2015) there is urgent need to promote dialogue amongst stakeholders and to strengthen the national capacity for communication on Green Economy and sustainable development (Recourt,2015).

7.8 Summary

This chapter recommends that the government consider six actions for accelerating the greening of industry. These are more effective use of environmental regulatory authorities, financial support to the GNCPC, enforcement of the industrial zoning policy, expansion of the AKOBEN programme to include all 500-600 medium and large plants, selective review and/or technology audit of imported second hand technology, manufacture of RET and increased public advocacy in the development and implementation of green economy strategies.

8 MEASURES AND PRIORITIES FOR GREENING TRADE IN MANUFACTURED GOODS

Green trade opportunities for manufactured goods are said to be found in the export of environmental and renewable energy technologies, in the institutional capacity for accreditation (national standards body) and conformity assessment, in firms complying with quality, health and environmental standards (ISO 9000, HASP ISO 1400 and eco-labelling), in embedding sustainability as a core business strategy, in promoting the complete disassembly, recovery and re-use of individual product components (re-manufacturing), and in exporting firms that are greening their supply chains, including transport (UNEP, 2013).

8.1 Export of renewable energy technologies

In the case of Ghana, there is yet no manufacture of environmental and renewable energy technologies. Consequently there is no export of these technologies. As described in section 4.7, all pollution abatement technology currently installed in large industrial facilities was imported and installed by expatriates. As described in section 7.6, in the medium- to long-term there are promising opportunities for the manufacture of renewable energy technologies, especially solar PV components.

8.2 Metrology capacity in Ghana

There is no national accreditation body for conformity assessment bodies (consultants) in Ghana, but the European Commission is considering supporting the formation of one.

There are several conformity assessment bodies in Ghana, the leading one being the Ghana Standards Authority (GSA), formerly Ghana Standards Board. It is a government agency responsible for the maintenance of acceptable standards for products and services and sound management practices in industries and public institutions. The board's functions are to establish and promote standards. The GSA has been recognized by DAKK, a German accreditation body, for testing, certification and inspections. It has issued internationally recognized ISO 9001 and ISO22001 certificates to national firms. UNIDO with funding from Switzerland continues to build capacity in GSA for testing and certification in other areas and is supporting the national Cocoa Board to build capacities in testing and inspection. Successful certification of firms' products can enhance their market access and thereby offer new export opportunities.

8.3 ISO 14001

Over the period 2000-2013, the absolute number of ISO 14001certificates in Ghana has consistently been below the average number of certificates for a sample of comparable countries (Cameroon, Côte d'Ivoire and Nigeria) (Table 8.1) The situation is different if we take in consideration the ratio expressed as number of certificates on MVA. In this case Ghana is always above the average, and the only country in the sample that performs better than Ghana is Nigeria. Furthermore in Ghana during the last two years the number of certificates per unit of MVA increased considerably and is well above the relative indicator for Nigeria.

Table 8.1 ISO 14001 certificates
(ISO 2015)

	ISO 14001 Certificates / MVA (Scale up Number (10^9)													
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Ghana	0.0	0.0	0.0	0.0	4.5	2.2	3.1	3.1	5.0	5.1	0.0	1.7	13.4	13.4
African Countries (Mean)	0.5	1.6	1.1	1.8	2.3	1.9	3.3	2.2	3.4	4.8	3.2	3.8	5.7	5.5
Cameroon	0.0	0.8	0.4	0.4	0.4	0.0	0.0	0.3	2.7	2.4	2.0	2.6	3.5	3.4
Côte d'Ivoire	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.7	2.2	2.7	2.7	4.5	3.9
Nigeria	0.5	2.4	1.6	3.1	3.8	2.5	5.2	4.8	5.4	9.0	4.7	5.7	8.1	8.3
	Notice that the figures are scaled up (10^9); otherwise the real number would be too little to be legible													
	Number of ISO 14001 Certificates (absolute number)													
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Ghana					4	2	3	3	5	5		2	17	18
African Countries (Mean)	1	4	3	5	6	6	11	7	12	18	12	15	23	24

8.4 Greening of manufacturing supply chains

The analysis of current opportunities for greening manufacturing supply chains should reasonably focus on the largest exporting subsector in 2013, which is articles of wood, wood panels, wood sawn, chipped lengthwise, sliced or peeled. It accounted for 29% of the total manufactured exports.

8.4.1 Wood products

Eight large companies account for 80% of Ghana's export volume and 66% of the export value. According to the Ghana Forestry Commission report (2012), about 15 different tertiary products are manufactured for export. From 2000-2004, about 48% of sawn wood, 40% of the veneer sheets and 60% of the plywood produced in the country were exported. In 2004, lumber and boles accounted for 50% in volume of all exports, panel products for 39% and machined products (e.g. furniture parts, mouldings and parquet flooring) accounted for 11% (UNIDO, 2013d).

The principal challenge in greening the supply chain is certifying that wood products are manufactured from legally harvested timber. Forest certification initiatives 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. Ghana has also signed the Voluntary Partnership Agreement with the EU to ensure that only legal timber and products are exported to the EU. Products derived from legal and environmentally-friendly managed forests can be certified under the Ghanaian National Forest Stewardship Standard approved by the Forestry Stewardship Council Policy and Standard Committee (UNEP, no date).

A second challenge is the need for quality control to meet international standards for wood products. The Forestry Research Institute of Ghana has responded to this challenge with the proposal to develop an accredited testing laboratory for wood products at their facilities and to establish the capacity to develop, maintain and propagate standards for the wood processing sector.

8.4.2 Other products

Further important exporting subsectors are essential oils, cosmetics, toiletries (that accounted for 16% of the total manufactured exports) and parts of machines and mechanical appliances for lifting and moving (that accounted for 9 % of the total manufactured exports) for which greening of supply chains is an opportunity for green trade.

The potential for greening other supply chains is being enhanced by an on-going UNIDO project, "Improving sustainable value chains for exports from Ghana (2013–2017)" (UNIDO, 2013d). The objective of the project is to support Ghana's integration into world markets by developing a competitive and sustainable export economy compliant with trade-related standards. The project is expected to enhance the export of targeted sustainable value chains (fruits, cocoa, fish and wood products) through a vertically integrated quality value-chain approach. The expected results are: (i) to ensure that the selected value-chains improve their sustainability, quality and export competitiveness by complying with international standards and have access to conformity assessment services and (ii) the national quality system is improved to provide world class conformity assessment services: testing, certification and inspection to the selected value chains. Apart from more "traditional" quality and safety standards, the project will also support the uptake and implementation of private voluntary standards by producers.

In addition, the "Green Economy Assessment" (UNEP, tbd) and the "Green Economy and Trade Opportunities Project" (UNEP, 2015b) in Ghana have identified sector-specific potential for greening sourcing and production processes, foremost for enhanced exports to global markets.

8.5 Summary

This chapter describes three potential options for greening trade in manufactured goods; two of which are on-going. One is the use of ISO 14000 certificate. As of 2013, 18 establishments had ISO 14001 certificates. Establishments in Ghana are more active in the use of ISO 14000 based on the ratio of certificates and MVA; the ratio for Ghana was 13.4 compared to 3.4 for Cameroon and 3.9 for Côte d'Ivoire. Second is greening manufacturing supply chains. The major exporters in wood products subsector, the largest exporter of manufactured goods, actively participates in certifying that their products are manufactured from legally harvested timber and the second largest exporter, essential oils, has many ways to green its supply chain. The third option, export of environmental and renewable energy technologies, is not possible in the short term because there is as yet no manufacture of environmental and renewable energy technologies (PV components) in Ghana. Only in the medium to long-tern are there opportunities for participation in the manufacture of renewable energy technologies.

9 FINDINGS AND RECOMMENDATIONS

This chapter briefly summarizes the findings in the previous chapters and puts forward the most promising recommendations for greening industry and trade in Ghana.

9.1 Findings

Several policy arenas have the potential to accelerate green industry and trade in Ghana. One is industrial policy with its provisions for electricity and water efficiency programs and several dimensions of cleaner production - efficient use of materials, technology promotion, voluntary standards and self-regulatory measures. A second is trade policy, at national and regional level, which is geared towards delivering a strategic expansion of Ghana's productive base and promoting exports of non-traditional products with a view to diversifying Ghana's export base. A third is environmental policy with the comprehensive permitting requirements (energy and cleaner production audits) under the 1994 Environmental Protection Law, and the upcoming environmental fiscal reform policy that could use the Ghana Green Fund resources to promote greening of industry and environmental activity more broadly. A fourth is energy policy with a number of energy efficiency and conservation options such as energy audits and energy management practices, as well as the "energy economy" vision, put forth in the Strategic National Energy Plan. A fifth is the National Science, Technology and Innovation Policy with its support for development of alternative energy sources and of more energy efficient industrial process technologies.

A major constraint in implementing these potentially useful policy options is identifying manufacturing sub-sectors that have the most potential for improved resource efficiency and pollutant reduction because of the vacuum of economic, environmental and resource use data. Missing economic data are plant size distribution and number and current sub-sector value added. The last industrial census was 2003 and a new one will not be available until 2017. Missing environmental data are: comprehensive industrial pollutant discharge and indicators of where industrial pollutant discharge is severely impairing environmental quality. Missing resource data are manufacturing sector estimates of energy, water and material consumption. The only energy consumption data are for the manufacturing sector as a whole and not for sectors. There are no data on material or water consumption even at the level of the manufacturing sector. Consequently identification of the subsectors that are more inefficient in resource use and thus targets for greening industry was not possible for this assessment.

The lack of essential economic, environmental and resource data for an assessment was anticipated because of the data problems lamented in the Green Economy Assessment (UNEP, 2014), Stocktaking for Ghana (ISSER, 2015) and Integrated Assessment of the Impacts of Green Investment and Policy Reforms in Ghana (2015). As written in the Stocktaking Report: "paucity of reliable data is a key challenge which cuts across the agricultural, energy, industry and environmental sectors. This is, however, more severe within the environmental realm, where data are either non-existent or missing for several years. An appreciable amount of statistics exists for the agricultural and energy sectors, but data for these sectors also lack information on vital indicators such as policy cost and yearly targeting." (ISSER, 2015)

In contrast, there are sufficient data on exports and imports and the institutional capacity of assisting certifying bodies to identify measures to green trade in manufactured goods. Concrete trade opportunities for manufactured goods are thereby identified in the manufacture of environmental and renewable energy technologies, in the institutional capacity for accreditation (national standards body) and conformity assessment, in firms complying with quality, health and environmental standards (ISO 9000, HASP ISO 1400 and eco-labelling), in embedding sustainability as a core business strategy, in promoting the complete disassembly, recovery and re-use of individual product components (re-manufacturing), and in exporting firms that are greening their supply chains, including transport (UNEP, 2013).

In spite of these industry data deficiencies, more efficient use of electricity in the manufacturing sector ought to be a priority given the scarcity and unreliability of the supply of electricity. An electricity decoupling programme, essentially energy audits, should target the two high energy consuming sectors, iron and steel and cement. An expanded decoupling programme to reduce environmental impact should initially target those subsectors discharging the most water pollutants, food and beverage and textiles, and emitting the most air pollutants, charcoal production, wood processing and metal fabrication.

9.2 Recommendations

Among the various measures identified for greening economy and trade, a resource decoupling initiative focused on one subsector is one of the most promising measures supportive of a transition to a green economy. The current industrial, environment and energy policies appear to have failed to decouple resource use and industrial output because they lack specificity; they do not target specific resources (such as electricity consumption) or pollutants (such as particulate matter), do not focus on particular sub-sector(s) and do not fix a date for achieving an agreed upon reduction target. A REGI initiative endorsed by the Ministry of Trade and Industry and the National Energy Commission (the carrot) and involving the Ghana National Cleaner Production Centre and the Ghana Climate Innovation Centre would be a modest step in addressing this failure. The National Cleaner Production Centre would work together with one entire sub-sector to reduce resource use (energy) by a specific date as an example of the potential for improving resource efficiency and bringing about improved competitive performance (UNIDO, 2011b).

The initiative would be backed up by the regulatory authority (the stick) of the EPA that would allow the EPA to impose resource use standards if the sub-sector fails to meet its' agreed upon target(s). Industrial associations would much prefer to collectively meet an association-set goal rather than to have each plant meet an imposed standard as doing so has the potential to reduce the collective cost of compliance.

If a REGI initiative is impossible and the Government still wants to encourage the greening of industry, a reasonable recommendation is for the Government to implement the legislative mandates of the various ministries/commissions. Clearly there is scope for the relevant ministries to be more aggressive in implementing environmental standards. For example EPA could expand its permitting activity to all medium and large plants. Currently the EPA has permitted only 250 to 300 plants out of an estimated population of 500 to 600 medium and large plants.

Along the same lines as expanded permitting is a recommendation to expand the AKOBEN programme. Currently there around 200 participating plants out of a population of 300 to 500 plants. Many more plants should be enrolled in the programme.

Essential to all of the above is a recommendation that the Ghana Statistical Service, the Environmental Protection Agency and the National Energy Commission collect timely and comprehensive economic, environmental and energy use data. Such data, which are currently not available, are essential for identifying the most promising subsector for improved resource efficiency and determining whether decoupling is actually happening. Without such data, it is not possible to measure success or failure of greening initiatives.

Another recommendation is that the Government enforces industrial zoning regulations. Effective enforcement would reduce populations exposed to industrial pollution. Successful confinement of industrial activity to specific geographic areas would also allow for use of a common wastewater treatment plant and common collection and disposal of solid and hazardous wastes.

Another recommendation is selective banning of imported resource inefficient (dirty) technologies. If not a ban then there should be a requirement for firms importing technologies to undertake a

technology audit. The current importation and use of resource inefficient technologies clearly increases the challenge of greening industry.

Another recommendation, important in light of the call for expansion of the use of RET in the draft Green Economy Report for Ghana, is government support for manufacturing accessories for RET and for setting up RET assembly plants for solar panels. This support could come in the form of finance from the proposed Ghana Green Fund and tax exemptions.

Supportive of all of the above would be an expanded public advocacy for a green economy. At this point in time (November 2015) there is an important need to promote dialogue amongst stakeholders and to strengthen the national capacity for communication on Green Economy and sustainable development.

Out of the assessed measures for green manufactured trade, two recommendations are feasible and within the current capacity of governmental organizations. One is enhancement of the capacity of the Ghana Standards Authority to issue ISO 14001 certificates that would be internationally recognized. The Authority would be able to issue these certificates as a much lower cost than conformity assessment bodies in Europe or North America. Another recommendation is to support the greening of selected supply chains. An easy first target for a government initiative would be to work with the eight major exporters of wood products. Such an effort would ensure that they are using certified logs, recycling wood wastes, complying with air pollution standards and not using child labour. A second target would be greening of the supply chain of the second largest export of manufactured goods, essential oils. Greening of this supply chain would ensure processing efficiency of raw material and use of the residual biomass for energy generation. At this time, a third green industry trade category, export of pollution control and renewable energy technologies, is not feasible because these technologies are not yet being manufactured in Ghana, while potential for future development of the manufacturing segment exists.

Annex 1 lists the ratings of the above recommendations by the participants in the validation workshop held in Accra on 22 October based on their feasibility of implementation and potential environmental impact.

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ANNEXES

ANNEX1: Rating of Recommendations

The rating of policy recommendations were discussed, developed and validated in conjunction with national government representatives and national institutions in a workshop. The results are displayed in the below table.

Recommendations	High/High*	High/Low*	Low/High*	Low/Low*
Resource Efficiency Greening of Industry Initiative	10	2	-	-
Effective Use of Regulatory Authority	7	3	1	2
Ghana National Cleaner Production Center	10	2	2	-
Industrial Zoning	1	10	2	1
Expand AKOBEN	7	2	2	1
Second Hand Technology	-	7	3	3
Manufacture of Environmental and Renewable Energy Technologies	4	3	2	4
Increased Public Advocacy	11	1	1	1
Metrology Capacity in Ghana	3	4	1	3
ISO 14000	2	3	6	2
Greening of Manufacturing Supply Chain	7	4	1	2

Out of 13 interviewees

① High/High: **high** impact on resource/environment and **high** political/administrative feasibility of implementation

② High/Low: **high** impact on resource/environment and **low** political/administrative feasibility of implementation

③ Low/High: **low** impact on resource/environment and **high** political/administrative feasibility of implementation

④ Low/Low: **low** impact on resource/environment and **low** political/administrative feasibility of implementation

ANNEX2: Primary location of manufacturing subsectors

A wide range of industrial facilities are categorised by manufacturing subsectors sectors below:

- Food and Beverages: (Breweries (Greater Accra, Ashanti Region); Palm oil processing (Western Region, Eastern Region and Central Region); Cocoa processing, chocolate and confectionery production(Greater Accra, Western Region); Soft drink production (Greater Accra, Ashanti Regions); Fruit processing (Eastern Region); Dairy products (Greater Accra, Team) and the Canning of fish and other sea food and fruits.
- Textiles: This industrial branch includes spinning, weaving, finishing, bleaching, dyeing and printing of textiles, concentrated in Greater Accra and the Eastern Region.
- Chemical: (Paint industry, production of paints and varnishes, (Greater Accra); Soap and perfume production (Greater Accra, Ashanti Region); Formulation and application of fertilisers and pesticides (Agro-chemicals).
- Petroleum: This industrial branch includes petroleum and natural gas processing (refining in Tema).
- Paper: This industrial branch includes the production of paper and cardboard as well as other products related to printing and publishing and is mainly in Ghana's Accra and Western Region.
- Metal: This industrial branch includes all processes of ferrous and non-ferrous metallurgy, foundry and metal working and is concentrating in the Greater Accra and Western Region. Includes manufacturers of primary iron and steel (e.g. bars, tin-plates, strips, tubes, wire); Manufacturer of cutlery and general hardware; Manufacturer of machinery (e.g. vehicles and parts) and aluminium production.
- Wood Processing: This industrial branch includes saw mills, furniture and cork production and concentrates in the Western and the Ashanti Region.
- Plastic and Rubber: This industrial branch includes plastic and rubber fabrication embracing the processes of moulding, extrusion and polymerisation. Typical products, kitchenware, foam, mattresses etc. These types of industries are concentrating in the Greater Accra and Western Region.
- Pharmaceutical: This industrial branch includes the production of drugs and medicines for human and veterinary use and is concentrated in the Greater Accra Region

ANNEX3: World Bank List of 43 Environmental goods

840410	Auxiliary plant for steam, water, and central boiler
840490	Parts for auxiliary plant for boiler, condensers for steam, vapor power unit
840510	Producer gas or water gas generators, with or without purifiers
840681	Turbines, steam or other vapor, over 40MW, not elsewhere specified or included
841011	Hydraulic turbines and water wheels of a power not exceeding 1,000 kW
841090	Hydraulic turbines and water wheels; parts, including regulators
841181	Gas turbines of a power not exceeding 5,000 kW
841182	Gas turbines of a power exceeding 5,000 kW
841581	Compression type refrigerating, freezing equipment incorporating a valve for reversal of cooling/heating cycles (reverse heat pumps)
841861	Compression type refrigerating, freezing equipment incorporating a valve for reversal of cooling/heating cycles (reverse heat pumps)
841869	Compression type refrigerating, freezing equipment incorporating a valve for reversal of cooling/heating cycles (reverse heat pumps)
841919	Solar boiler (water heater)
841940	Distilling or rectifying plant
841950	Solar collector and solar system controller, heat exchanger
841989	Machinery, plant or laboratory equipment whether or not electrically heated (excluding furnaces, ovens etc.) for treatment of materials by a process involving a change of temperature such as heating, cooking, roasting, distilling, rectifying, sterilizing, steaming, drying, evaporating, vaporizing, condensing or cooling.
841990	Medical, surgical or laboratory stabilizers
848340	Gears and gearing and other speed changers (specifically for wind turbines)
848360	Clutches and universal joints (specifically for wind turbines)

ANNEX4: Industrial Pollution Projection System

Most developing countries still have little or no data on industrial pollution. In response to this situation the World Bank assembled the Industrial Pollution Projection System to estimate a comprehensive profile of the pollutant intensities for the manufacturing sector and sub-sectors within the manufacturing sector. The modelling system was developed in the 1990s based on environmental and economic data for approximately 200,000 facilities in all regions of the United States in the late 1980s and subsequently applied in several developing countries (Indonesia, Mexico and Thailand). It can be applied to estimate air emissions, water effluents and solid waste loadings. An extended description of the Industrial Pollution Projection System can be found in the Manual and full description of the modelling system (World Bank, 1995).

The pollutant intensity coefficients for 14 pollutants can then be multiplied by one of four measures of economic activity - total value of shipment in millions of 1987 USD, total value of output in millions of 1987 USD, value added in millions of 1987 USD and total employment in thousands of persons based on specific country data - to give pollutant loadings.

$$\text{Pollutant loadings} = \text{pollutant intensity X economic activity}$$

In addition to pollutant coefficients, the Industrial Pollution Projection System includes sub-sector average abatement cost (US$ 1994/ton for water and air pollutants. Hartman et al. (1994) explain the basis the approach to estimating the cost of air pollution abatement; there is no explanation for the cost of water pollution abatement.[16]

[16] There are cost estimates for SO2, NO2, Particulates, Lead, Volatile Organic Compounds, Toxic Air, Air Other, and Water Conventional, Water Non-Conventional, Toxic Metal Water and Toxic Organic Water

ANNEX5: Ghana Pollutant Loadings and Costs of Removal (USD 1994)

Ghana 2003

ISIC rev3/rev 2		V.A.%	Establish-ments	Pollutant tons	% Poll.	Cost USD 1994/ton	70% of Pollutant	Total cost to reduce 70% Pollutant
TOX								
2720/3720	Basic precious and non-ferrous metals	5%	7	75	39%	2021	53	106 346
2520/3513	Plastic products	4%	32	43	22%	70	30	2125
2519/3513	Other rubber products	1%	13	9	5%	70	7	458
TOTAL		**9%**	**52**	**128**	**66%**		**89**	**108 929**
SO2								
2694/3692	Cement, lime and plaster	6%	4	672	54%	14	470	6 621
2720/3720	Basic precious and non-ferrous metals	5%	7	263	21%	151	184	27 875
2320/3540	Refined petroleum products & Fertilizers and nitrogen compounds& Plastics in primary forms; synthetic rubber	5%	2	147	12%	626	103	64 483
TOTAL		**16%**	**13**	**1083**	**87%**		**758**	**98 979**
BOD								
1520/3112	Dairy products	6%	3	84	70%	89	59	5 242
2720/3720	Basic precious and non-ferrous metals	5%	7	20	17%	85	14	1 203
2101/3411	Pulp, paper and paperboard & Corrugated paper and paperboard	0.4%	2	5	4%	84	4	305
TOTAL		**11%**	**13**	**1083**	**91%**		**77**	**6 751**
METAL								
2720/3720	Basic precious and non-ferrous metals	5%	7	48	83%	672	34	22 641
2710/3710	Basic iron and steel	1%	12	5	9%	487	4	1 741
2731/3710	Casting of iron and steel	0%	3	1	2%	487	1	453
TOTAL		**6%**	**22**	**55**	**94%**		**38**	**24 835**
PT								
2694/3692	Cement, lime and plasters	6%	4	325	62%	13	227	2 957
2320/3540	Refined petroleum products & Fertilizers and nitrogen compounds& Plastics in primary forms; synthetic rubber	5%	2	56	11%	65	40	2 557
2010/3311	Sawmilling and planning of wood	9%	230	34	6%	42	24	989
TOTAL		**21%**	**236**	**415**	**79%**		**291**	**6 503**

ANNEX6: List of parties interviewed

No.	Name	Institution	Position
1	Mr. Lambert Faabeluon	Environmental Protection Agency	Director, Environmental compliance monitoring and Head Ghana Cleaner Production Centre
2	Mr. Kofi Nuhu	Ministry of Trade and Industry	Director of Manufacturing
3	Mr. Papa Bartels	Ministry of Trade and Industry	Director of Logistics and Value Chains
4	Mr. Fredua Agyemeng	Ministry of Environment Science, Technology and Innovation	Director of Environment
5	Mr. Seth Twum Akwaboah	Association of Ghana Industries	Chief Executive Officer
6	Mr. Isaac Dadson	Ghana Statistical service	Programme Officer, Industrial Statistics
7	Mr. Kofi Agyarko	Energy Commission	Head, Energy efficiency and Climate Change
8	Dr. Simon Bawakyillenuo	Institute of Statistical, Social and Economic Research (ISSER), University of Ghana, Legon	Research Fellow
9	Mr. Nana Osei Bonsu	Private Enterprise Foundation	Chief Executive Officer
10	Mr. Seth Adjei Boye	SWISS Embassy	Programme Officer
11	Mr. Lars Joker	Danish Embassy	Programme Manager
12	Mr. Herbert Obiri	Institute of Industrial Research	Director
13	Dr. Felix Addo-Yobo	Nat. Development Planning Commission	Deputy Director

PAGE PARTNERSHIP FOR ACTION ON GREEN ECONOMY

Ghana has achieved strong economic growth over the past two decades, prompted by strong cocoa production, construction and transport, a more robust service sector, continued increased gold output and the commercialization of oil, and has out-performed regional peers at reducing poverty and improving social indicators. However, a triple crisis from 2006 to 2009, centering on food, fuel and finance, stimulated the Government of Ghana to begin a transition to a more sustainable approach. Starting with the 2010 publication of Ghana Goes for Green Growth, the government recognized the importance of a shift to a green economy and drafted a National Energy Policy, including a strategy for renewable energies. Prior to joining PAGE, the Government of Ghana demonstrated further commitment to promoting environmental issues in policy design and passed a medium term development strategy, the Ghana Shared Growth and Development Agenda (GSGDA) II, and the National Climate Change Policy Framework to ensure a climate-resilient and climate-compatible economy while achieving sustainable development and equitable low-carbon economic growth.

This assessment provides an in-depth examination of the role of industry and trade in facilitating the transition to a green economy in Ghana. The assessment reviews the multiple planning and policy regimes in place and plays a critical role in identifying a set of both modified and new policies to support the transition to green industrial production and trade. The report identifies further opportunities for the international community to assist Ghana to transform its economy.

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Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety
Ministry for Foreign Affairs of Finland
Norwegian Ministry of Climate and Environment
환경부
Government Offices of Sweden
Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra
Swiss Confederation
Federal Department of Economic Affairs, Education and Research EAER
State Secretariat for Economic Affairs SECO