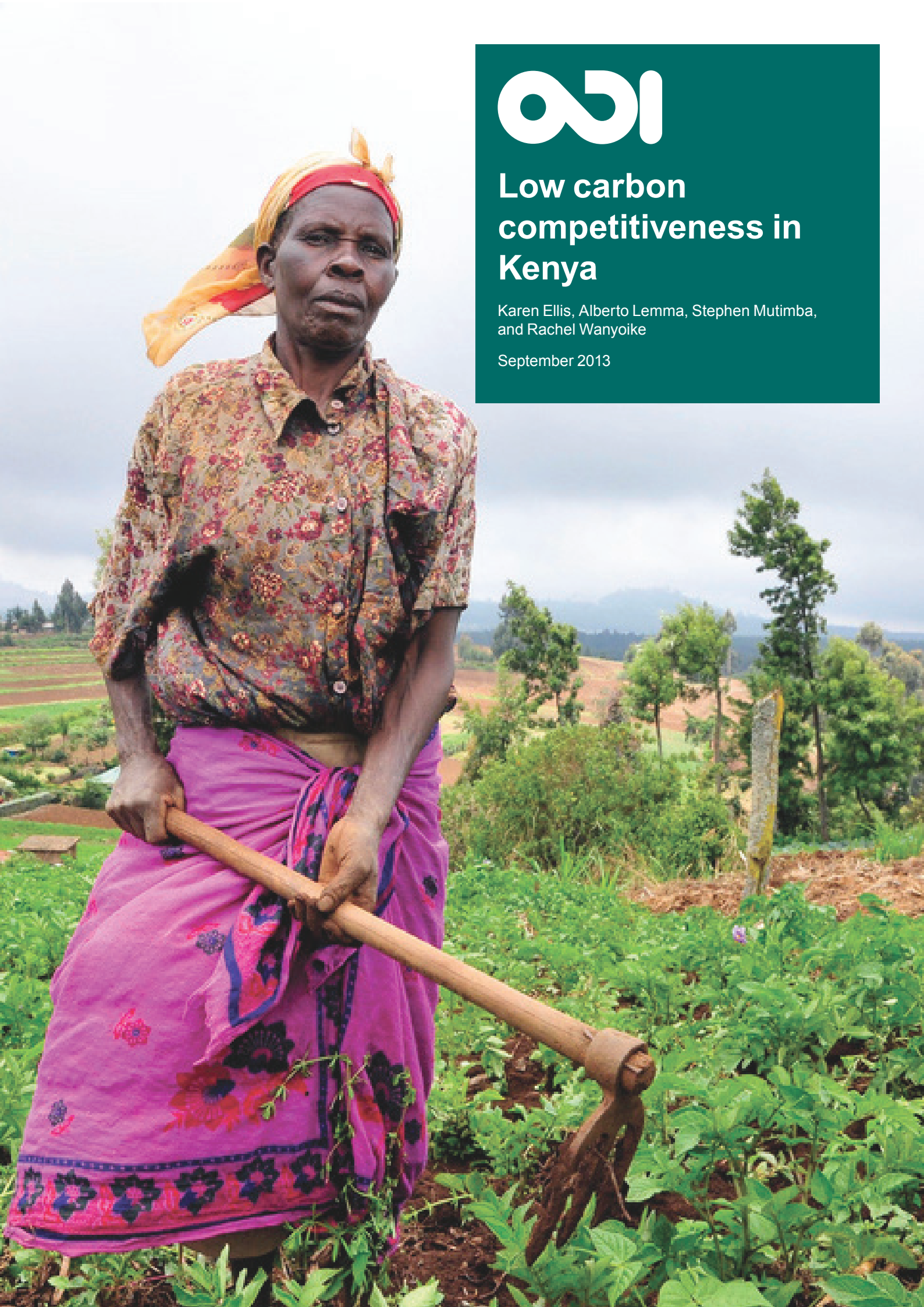

Low carbon competitiveness in Kenya

Karen Ellis, Alberto Lemma, Stephen Mutimba, and Rachel Wanyoike

September 2013

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Policy brief

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Key messages

- Climate change, international mitigation policies, and natural resource scarcity will transform global trade patterns over the next decade, creating opportunities and threats for Kenya's competitiveness and sources of growth. Policy-makers and businesses should act now to manage the risks and capitalise on the opportunities.
- With multiple renewable energy opportunities now being developed, Kenya could find itself in the enviable position of having one of the greenest energy sectors in the world, yielding significant competitive advantage in a future low carbon global economy. It will be important to utilise Kenya's recently discovered fossil fuels in a way that does not weaken incentives for renewable energy development.
- Some manufacturing firms in Kenya are innovating to generate alternative sources of energy and to improve energy efficiency, yielding impressive cost savings. Though this has been a response to the shortage of energy in Kenya, it could become a significant competitive advantage in a future low carbon global economy with rising energy prices.
- Kenya's agriculture sector should adopt productivity-enhancing sustainable agricultural practices and carbon footprinting, if it is to remain competitive in a future world of environmental certification and capitalise on rising prices and increasing global competition for agricultural land.

Acknowledgements

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Table of contents

Figures

Tables

Boxes

Abbreviations

Abbreviation	Description
AFD	Agence Française de Développement
AGOA	African Growth and Opportunity Act
ASALs	Arid or Semi-Arid Lands
BCAs	Border Carbon Adjustments
CDM	Clean Development Mechanism
CEEC	Centre for Energy Efficiency and Conservation
CIAT	International Center for Tropical Agriculture
COMESA	Common Market for Eastern and Southern Africa
DANIDA	Denmark's development cooperation
EAC	East African Community
EAPC	East African Portland Cement
EAPP	Eastern Africa Power Pool
EEPCo	Ethiopian Electric Power Corporation
EMA	Energy Management Award
EMR	Energy Management Regulations
ERC	Energy Regulatory Commission
EU	European Union
EU ETS	EU Emissions Trading System
FDI	Foreign Direct Investment
FiT	Feed-in Tariffs
FY	Fiscal Year
GCI	Global Competitiveness Index
GDC	Geothermal Development Company

GDP	Gross Domestic Product
GHG emissions	Greenhouse Gas Emissions
GIZ	Gesellschaft für Internationale Zusammenarbeit
GWh	Gigawatt hour(s)
IEA	International Energy Agency
IPP	Independent Power Producer
KAM	Kenya Association of Manufacturers
KARI	Kenya Agricultural Research Institute
KenGen	Kenya Electricity Generating Company Limited
KEPSA	Kenya Private Sector Alliance
KETRACO	Kenya Electricity Transmission Company Limited
KFC	Kenyan Flower Council
KNBS	Kenya National Bureau of Statistics
KNCPC	Kenya National Cleaner Production Centre
KTDA	Kenya Tea Development Agency
KTPC	KTDA Power Company Ltd
kWh	Kilowatt Hour(s)
KSh	Kenya Shillings
LCCD	Low carbon competitiveness diagnostic
LCPDP	Least Cost Power Development Plan
LDC	Least Developed Countries
LIC	Low-income Country
MIC	Middle-income country
MW	Megawatt(s)
NCCAP	National Climate Change Action Plan
NCCRS	National Climate Change Response Strategy
NEPIO	Nuclear Energy Programme Implementing Organization
RA	Rainforest Alliance
REA	Rural Electrification Authority

RECP	Resource Efficient and Cleaner Production
UNEP	United Nations Environment Programme
UNIDO	United Nations Industrial Development Organization
WEF	World Economic Forum
WWF	World Wildlife Fund

1 Introduction

The aim of Kenya's Vision 2030 initiative is to create a globally competitive and prosperous nation with a high quality of life by the year 2030. The success of this approach will depend to a large extent on the global trade patterns shaping the opportunities that Kenya faces.

Our analysis suggests that over the next 10 years, global trade patterns will be transformed by climate change, international mitigation, and natural resource scarcity, resulting in an inevitable shift over time to a low carbon global economy. This study has been asking what this might look like. What impact will it have on Kenya's competitiveness and growth? What threats and opportunities will it create? And how should policy-makers and businesses respond?

Achieving competitiveness is important for achieving growth and development, and most countries are keen to identify and support domestic sectors where they may have a competitive advantage. At the same time, many countries are developing green growth or climate compatible development strategies in order to promote sustainable growth trajectories. Yet these two sets of analysis are rarely brought together to ask how climate change, mitigation policies and natural resource scarcity will affect patterns of trade and comparative advantage at the global level, or to assess the implications of these global changes for national policy.

These questions are the subject of a research programme that aims to analyse how these drivers might affect economic prospects in low-income countries (LICs), and how they might achieve 'low carbon competitiveness' (i.e. remain or become competitive in a future, low carbon global economy), and to develop a 'Low Carbon Competitiveness Diagnostic' (LCCD), a framework to help policy-makers analyse these issues in their own particular country context. The study does not purport to provide detailed policy recommendations, as that can be done only on the basis of much more detailed analysis. It simply aims to highlight these drivers of change and their possible impacts, to demonstrate the importance of taking these trends into account when designing a national growth policy, and ultimately to provide a diagnostic tool to assist with this analysis at the national level.

The research explores these issues through case studies in three LICs: Cambodia, Kenya and Nepal. The aim is to raise awareness and stimulate discussion about the issues at the national level in these three countries, while at the same time facilitating the development of the diagnostic tool, which would be applicable to a wider set of LICs. Once again, the objective is not to provide detailed policy recommendations but rather to set out some possible policy and business responses to the issues identified, that would require further discussion and much more detailed analysis in each particular country context. This Policy Brief is the output of the case study in Kenya.

1.1 Changing global trade patterns

The underlying hypothesis of this study is that the three drivers – increasing natural resource scarcity (particularly with the growing global demand for energy), climate change, and international climate change mitigation policies – will inevitably create transformational shifts in prices and patterns of production and demand in future. And the changes in competitiveness patterns generated are likely to have implications for countries' growth strategies as well as their incentives to achieve low carbon growth. For example:

1. Increasing natural resource scarcity – particularly relating to energy, land and water, and partly driven by economic growth in the emerging economies – will result in
   - higher oil prices, which will reduce the competitiveness of energy-intensive industries in oil importing countries, and could enhance incentives for energy-efficiency measures in those countries

- increased competition for land and water, which could strengthen incentives for effective natural resource management and sustainable agricultural practices that improve land and labour productivity.

2. Mitigation policies introduced at the global level or by trading partners, which may affect export opportunities or import prices faced by developing countries, could result in
   - new standards requiring carbon footprinting of production in some sectors, potentially reducing access to markets for relatively energy-intensive products or products which are not certified
   - carbon taxation, which could lead to certain energy-intensive industries shifting to non-mitigating countries (often termed 'carbon leakage'), generating a possible trade-off between competitiveness and low carbon growth
   - increased climate finance to support the development of new green industries such as renewables (most likely from public funding sources in the short term, in the absence of well-functioning carbon markets).

3. The impact of climate change – in the sense of planetary warming – will be significant for some sectors. For example, climate change
   - will reduce yields and productivity of certain agricultural crops, undermining competitiveness of those products
   - is reducing the efficacy of certain renewable energy sources, such as hydropower, in certain contexts, undermining the competitiveness of countries reliant on them
   - threatens the prospects for tourism development by increasing the incidence of extreme weather events and by reducing water supplies.

1.2 The potential impact on countries' competitiveness and sources of growth

These changes could have significant implications for the sources of competitive advantage, growth, and economic opportunity that countries will face going forward. Our initial analysis suggests that a desire to remain competitive in the face of these drivers will generate a business case for low carbon investment in some sectors. This is particularly important in light of the poor state of carbon markets, which were previously seen as a key mechanism for funding the transition towards a low carbon growth trajectory in developing countries. In the absence of this funding, understanding the economic incentives that could help drive such a transition even in the absence of carbon markets will be key to developing smart and well-targeted policy and donor support mechanisms in the short and medium term.

However, in other cases there will be trade-offs between maintaining short-term competitiveness and achieving low carbon growth. Therefore, the analysis will aim to identify both synergies and trade-offs and identify implications for policy and donor support.

Policymakers are also faced with great uncertainty, relating for example to:

- Fossil fuel discoveries and technological innovation which will affect the evolution of energy prices going forward;
- Future global and national climate change policy regimes;
- The impact of climate change itself on different countries and economic activities;
- How patterns of demand will change in response to the three global drivers identified.

In this work we have posited various outcomes in different sectors based on existing knowledge and trends, but in many cases scenario analysis is warranted when weighing up different policy options, to take account of the uncertainties surrounding various factors. It is intended that the LCCD to be developed as the final output of this research programme would provide guidance on how scenario

analysis could be implemented to assist with decision-making. This uncertainty also highlights the need for countries to adopt approaches to policy-making that allow for uncertainty, by building in flexibility and keeping options open for example.

This study focuses on the opportunities and risks facing LICs in particular. Previous ODI analysis suggests that competitiveness and growth prospects in LICs will be significantly affected by the impact on trade patterns of the global trends discussed above (Ellis et al, 2010). Thus, competitiveness strategies in LICs will need to be reassessed if they are to be resilient in the face of these changes.

The analytical framework for this study was set out in an ODI Working Paper (Ellis, 2013). It identifies a number of transmission mechanisms through which the three drivers identified (natural resource scarcity, climate change and international mitigation) could potentially affect competitiveness, including

- the creation of new markets (domestic or international) or a reduction in the size of existing markets
- changes in prices of exports and imports due to changes in global supply and demand
- changes in costs due to changes in input prices
- changes in flows of foreign direct investment, and location decisions by multinationals
- impacts on the value of assets such as land, water resources, fossil fuel reserves, forests, etc.
- increased climate finance
- higher standards demanded in global value chains, and requirements for certification and labelling
- technology transfer.

1.3 The case study approach

The potential impacts identified in the analytical framework have now been assessed in three case study countries: Cambodia, Kenya and Nepal. This Policy Brief is the output of the case study in Kenya.

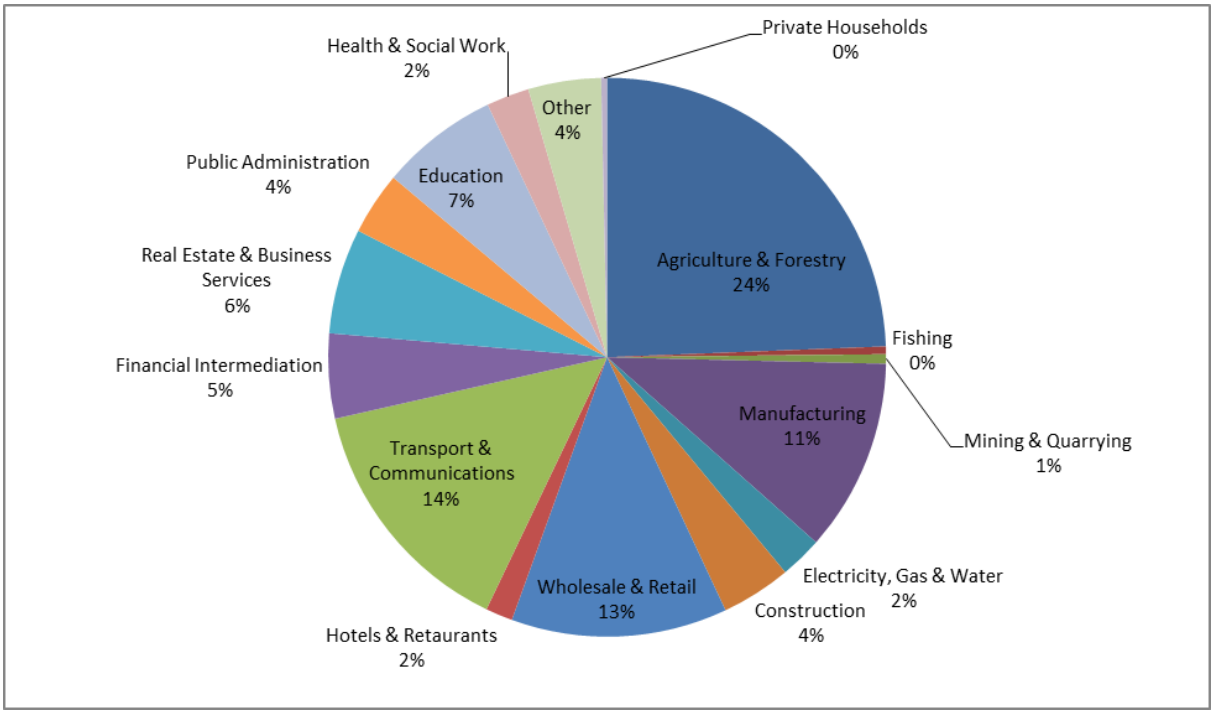
The research programme covers the five tradable sectors of most relevance in terms of the trading and production patterns of low income countries: agriculture, forestry, energy, tourism and manufacturing. In each country case study we focused on three sectors; the energy sector was an area of focus in all three countries, given its pivotal position both in determining overall country competitiveness and as a potential export industry. The other two sectors were selected for each country depending on existing patterns of production and potential, and with the objective of covering the five tradable sectors listed above across the three country case studies. In Kenya we focused on the energy sector, the agriculture sector, and the manufacturing sector. The forestry and tourism sectors were covered in the other country case studies.

The remainder of this Policy Brief sets out the findings from the Kenya case study. Background is provided in Section 2, which briefly describes Kenya's existing economic structure and growth dynamics, challenges, and opportunities for growth and competitiveness, as identified in recent studies and indices, as well as the country's growth and climate change response strategies. The Brief then examines the energy, agriculture and manufacturing sectors in turn, discussing the various opportunities and threats they face, and possible implications and policy responses. The concluding section summarises the issues identified as the most important for further discussion at a national level in order to maintain Kenya's competitiveness going forward, as well as possible policy responses for further consideration and analysis.

2 The economic context in Kenya

Kenya's economy has seen an annual average growth rate of 3.9% over the period 2000 to 2011, and a threefold increase in inward FDI flows (UNCTAD, 2012). Figure 1 below shows the importance of different sectors to the economy, and shows that agriculture and forestry play an important role, accounting for nearly a quarter of all GDP, while manufacturing represents just over one tenth of GDP (Kenya National Bureau of Statistics, 2012).

Figure 1: Contribution to GDP in 2011



Source: KNBS (2012)

2.1 Challenges and opportunities for growth and competitiveness

Table 1 below shows how Kenya scores on a number of key competitiveness-determining indicators from the Global Competitiveness Index (GCI) and the Sustainable Competitiveness Index (World Economic Forum, 2012), as compared with a number of other countries.

Table 1: 2012-13 WEF GCI scores for selected Indicators – Kenya competitors

	Kenya	Cambodia	Nepal	Ethiopia	Tanzania	Rwanda	South Africa
Overall Rank GCI (2012-13)	106th	85th	125th	121st	120th	64rd	52nd
Quality of Electricity Supply	3.6	3.6	1.4	3.2	1.9	4.2	3.9
Quality of Infrastructure	4	4.2	2.9	3.6	3.1	4.9	4.5
Quality of Roads	3.9	4	2.6	4.1	3.2	5	4.9
Mobile tel. /100 pop.	64.8	69.9	43.8	16.7	55.5	40.6	126.8
No. of procedures to start a business	11	9	7	5	12	2	5
No. of days to start a business	33	85	29	9	29	3	19
Availability of financial services	4.7	4.4	3.9	3	3.9	4.9	6.4
Availability of latest technologies	4.9	4.8	4.3	3.8	4.1	4.7	5.7
Firm-level technology absorption	4.9	4.9	4.1	3.7	3.9	4.6	5.4
Capacity for Innovation	3.5	3.2	2.4	2.3	3.1	3.3	3.5
Quality of Education System	4.3	3.9	3.4	3.4	3.5	4.1	2.2
Overall Rank SCI (2012-13)	69^{th}	75^{th}	-	-	79^{th}	-	65^{th}
Environmental Sustainability Score	4.63	4.47	-	-	4.62	-	3.52
No. of ratified Int. Env. Conventions	22	17	-	-	16	-	21
Agricultural Water Intensity (lower is better)	7	0.4	-	-	11.8	-	15.6
CO_2 Intensity (lower is better)	0.58	0.89	-	-	0.34	-	2.91
Forest Cover Change	0.98	0.94	-	-	0.94	-	1

Source: WEF (2012)

The World Bank's most recent investment climate assessment of Kenya noted that although the country has recorded some improvements in the past four years, including an increase in productivity, Kenyan firms still face an adverse business environment. In fact, the losses incurred by businesses because of power outages, theft and breakage during transport, payments of bribes and protection payments are significantly undermining competitiveness as compared with other countries. The top constraints identified through the survey were tax rates, access to finance, corruption, security, infrastructure services (electricity and transportation) and business licensing (World Bank, 2009).

In a more recent study, the World Bank notes that Kenya's competitiveness in some sectors has declined (as domestic prices, including food, energy and transport, remain high) and this is putting pressure on exporters' margins as well as on overall competitiveness. As a result, non-tradable sectors, especially services and construction, are driving growth while the share of tradable sectors, especially manufacturing, is declining. (World Bank, 2012)

2.2 Kenya's growth and climate change response strategies

The Government of Kenya has set out its plan for long-term economic development through its 'Vision 2030' strategy, which aims to transform Kenya into a 'newly industrialising, middle-income country providing a high quality of life to all its citizens by the year 2030'. The strategy envisages Kenya becoming a prominent provider of basic manufactured goods in Eastern and Central Africa, as well as in other international markets at a later stage. The strategy talks about the development of 'niche' products, such as organic foods and beverages, which will be achieved through improved competitiveness bolstered by government support for training and R&D. Another objective is for Kenya to substitute imported goods with locally produced goods (without the need for import restrictions) in a number of key local industries.

With regard to the manufacturing sector, the strategy envisages some restructuring to increase the competitiveness of enterprises and enable them to make greater use of local raw materials; increasing the level of value addition in a number of key niche exports through additional local product processing; and exploiting opportunities to add value to imports that can then be re-exported.

The strategy for agriculture is broadly aimed at raising incomes in agriculture, fisheries and livestock as well as promoting industrial agricultural processes. The main aim is to increase the value of products made within the country (by moving up the value chain) and thus improve international competitiveness. The strategy envisages transforming Kenya's agricultural sector into an 'innovative, commercially orientated and modern sector'. The main strategies involve the transformation of key agricultural institutions, and aim to promote growth in private sector agriculture, increase crop and livestock productivity, and introduce policies to improve land usage (GOK, 2008).

Kenya's strategy for the energy sector is set out in the 'Least Cost Power Development Plan' (LCPDP), which covers the period 2011 to 2030. The plan estimates a ten- to twenty-fold increase in energy demand in Kenya over the period, and sets out a number of planned investments in a range of different technologies including renewables (with geothermal power and hydroelectric power at the forefront), thermal sources of energy such as coal and diesel, and nuclear energy (GOK, 2011).

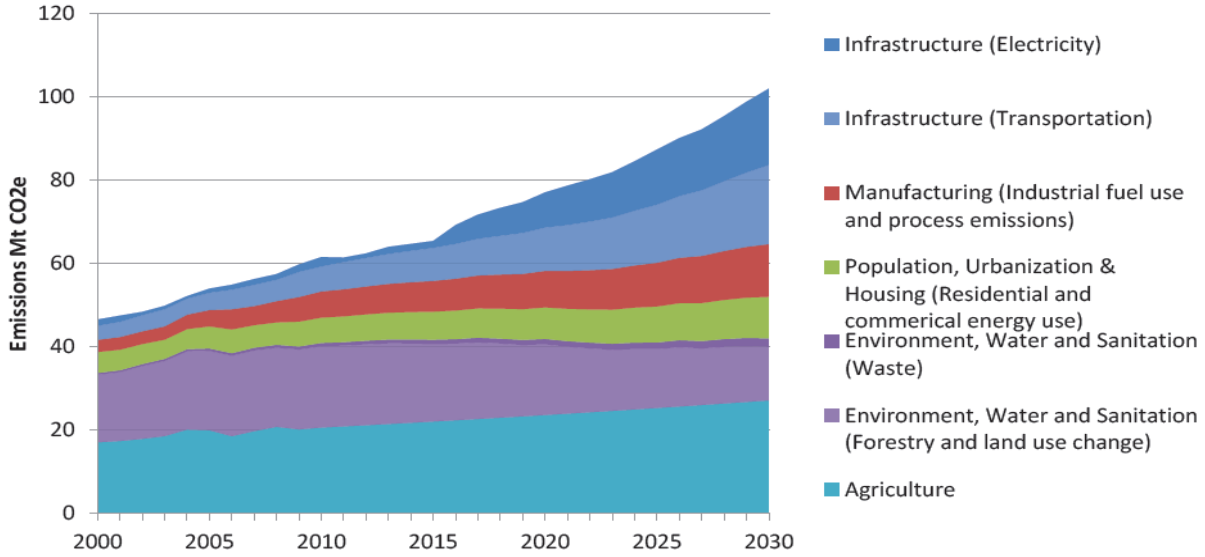
The Government developed the National Climate Change Response Strategy (NCCRS) in 2011 and the National Climate Change Action Plan in 2012, which sets out the steps needed to achieve sustainable development and address climate change issues within Kenya. (The Climate Change Authority Bill was also developed in 2012, but the Bill was rejected by the President in December 2012 due to insufficient private-public dialogue. There are hopes that a revised draft will be tabled in Parliament in 2013.)

The Action Plan recognises the importance of moving towards a low carbon and climate resilient development pathway, including through the following: creating new jobs through green growth, which will improve the lives of the poorest and most vulnerable members of society; reducing disaster risks; leveraging investment in climate adaptation and mitigation through the private sector; and attracting international climate finance, technology and capacity-building assistance (GOK, 2012).

The Action Plan brings together analysis of growth, development and climate impacts in a way that is considerably further advanced than in some other LICs. It also includes useful analysis of the impacts of, and implications for particular economic sectors: for example, it provides a breakdown of GHG emissions by sector in Kenya (including projections up to 2030) and shows that manufacturing and agriculture (two of the sectors reviewed in this report) are relatively high emitters. However, the study does not explicitly address competitiveness issues or consider future changes in trading opportunities resulting from climate change, mitigation and natural resource scarcity, so we hope this report will

usefully extend the sectoral analysis contained in the Action Plan, and facilitate further discussion of appropriate policy responses.

Figure 2: GHG emissions by sector in Kenya, 2000 to 2030



Source: CCAP (2012)

3 The energy sector

Despite good potential for renewable energy generation in Kenya, and a rapid increase in the generating capacity over the last 10 years, there is still a significant energy supply shortage in Kenya, and the limited availability of energy is thus seen as one of the constraints to industrial development. For commercial enterprises, the high costs of energy, limited availability and poor reliability undermine competitiveness significantly. One source states that Kenya has the most expensive electricity in East Africa, and that while Kenyan manufacturers are paying between KSh10 and KSh15 per kilowatt hour of electricity, their competitors in China and India pay the equivalent of between KSh2.50 and KSh3.80 per kWh for the same.[1]

This problem is exacerbated during dry periods, when Kenya's hydropower plants – which represented nearly 50% of generation[2] in Kenya in 2010/2011 – are unable to operate at full capacity. In a survey by the Kenyan Association of Manufacturers, firms stated that they lost between 12 and 36 hours of productive work every week due to the rationing of energy during dry periods, and that power interruptions cost them 7% of sales. Transmission losses as of 2012 cost the country approximately US$17 million per year in lost output.[3]

The high electricity costs have led to an increasing number of commercial enterprises seeking alternative sources of energy. For example, many enterprises rely on diesel-based back-up generators to supplement electricity access; these are very expensive and introduce considerable cost volatility due to fluctuating international crude oil prices. Utilisation of diesel also contributes to GHG emissions and contradicts the low carbon development pathway set out in Kenya's NCCRS and corresponding NCCAP. But some firms are investing in renewable energy sources in order to overcome the high cost and unreliability of traditional energy sources. This is discussed further below.

More than 20% of Kenya's energy needs are currently met by imported fossil fuels, mainly oil, and demand has been growing fast. But as international oil prices are expected to rise – by 1.5-2.5% annually in real terms until 2035, according to the EIA (2012) – the competitive advantages of moving to an energy system based on domestic renewables rather than imported fossil fuels will become ever clearer over time, especially as new and maturing technologies in renewable energy generation are resulting in rapidly falling prices. This is particularly the case given that industries in LICs tend to be more energy intensive than those in developed countries, implying that higher fossil fuel price rises will hit the competitiveness of LICs hardest.

3.1 Kenya's energy sources

According to Kenya's LCPDP, biomass (including wood fuel, charcoal, and agricultural waste) accounts for close to 76% of the total energy consumption in Kenya. Of the remainder, 21% is supplied by imported petroleum products, and 3% is supplied by electricity generated from hydro, thermal and geothermal resources.[4]

Biomass

Biomass energy sources support livelihoods for rural populations and are a source of affordable household energy for urban dwellers. They are also used by some industries for energy generation. However, recent studies show that the supply of biomass is increasingly unable to meet demand as forests are being depleted, and prices are therefore rising. Current patterns of biomass use are

[1] http://www.theeastafrican.co.ke/business/-/2560/653554/-/view/printVersion/-/xv7jo6z/-/index.html
[2] National Energy Policy, Third Draft –11 May 2012
[3] National Energy Policy, Third Draft – 12 March 2013

unsustainable, with attendant negative impacts on the environment,[5] such as deforestation, depletion of water resources, and land degradation.

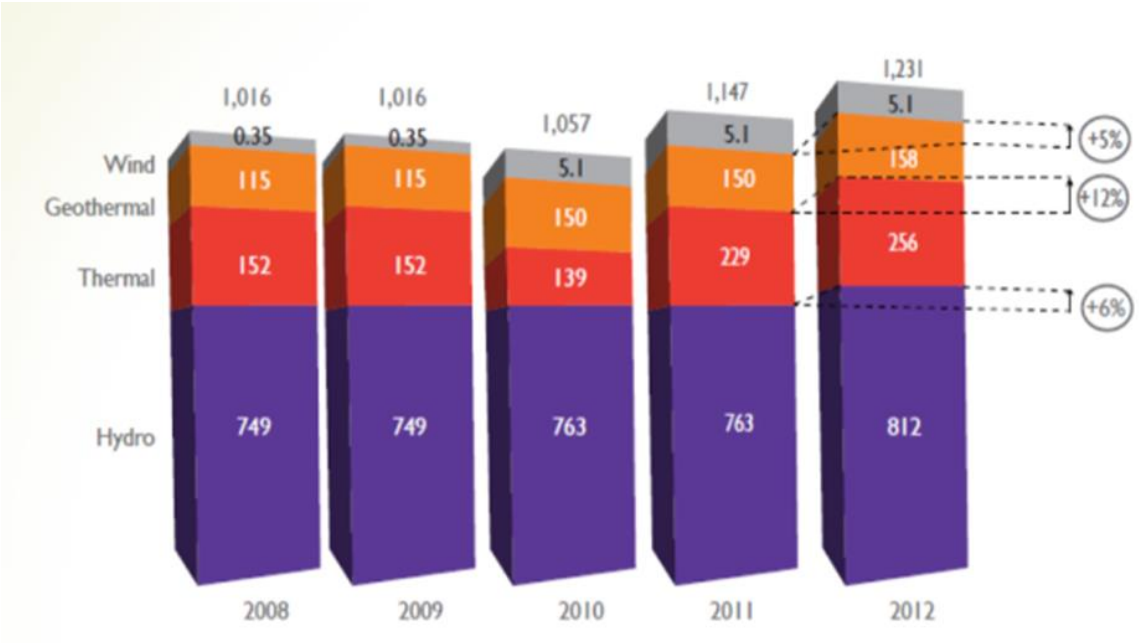
In the face of this growing shortage and rising prices, some industries are planting their own trees in order to secure a sustainable source of wood fuel and to maintain their competitiveness. For example, Williamson Tea farms plant all their own trees for timber, to avoid damage to surrounding forests.[6]

Domestic electricity generation

Various state-owned institutions are responsible for the generation, transmission and distribution of power. Kenya Electricity Generating Company Limited (KenGen) is the leading electric power generation company in Kenya, producing about 80% of electricity consumed nationally, using sources such as hydro, geothermal, thermal and wind.[7] Kenya Power (formerly known as Kenya Power and Lighting Company) transmits, distributes and retails the electricity supply throughout Kenya.[8] Kenya Electricity Transmission Company Limited (KETRACO) is mandated to develop transmission lines and associated substations infrastructure. A number of independent power producers (IPPs) also supply bulk electricity to Kenya Power.

Currently, the base load generation source for electricity is hydro and, increasingly, geothermal. However, the adverse impacts of climate change and climate variability have made hydro generation unreliable and volatile. Kenya's reliance on such a climate sensitive resources has severe effects on the base load supply of hydropower. For example, the low energy contribution from hydropower in 2009 was attributed to poor dam flows due to the severe drought at that time. This has necessitated the running of expensive thermal power plants as base load, leading to high tariffs culminating in high inflation and consumer dissatisfaction.[9] Subsequently, domestic supply of electricity has been affected. Reduced rainfall arising from climate change could exacerbate this problem over time.

Figure 3: Current generation mix (MW)



Source: KenGen's Annual Report and Financial Accounts, 2012

[6] http://www.williamsontea.com/our-tea-farms/our-environment/#2
[7] http://www.kengen.co.ke/
[8] http://www.kplc.co.ke/index.php?id=58
[9] Republic of Kenya, SREP Investment Plan for Kenya, May 2011

However, Kenya's LCPDP incorporates a range of generation sources including geothermal, hydropower, wind, coal, oil-fired and nuclear power plants. The integrated mix of energy sources is deemed necessary to sustain a consistent service in the face of fluctuations in demand and supply, and to achieve energy security. (Though the use of more flexible, smart grid technology could help to alleviate this constraint.)

In particular, Kenya's abundant geothermal energy is a viable alternative to hydropower as the main source of energy, though most of the resource base remains undeveloped as yet. The energy system expansion plan based on the LCPDP ranks geothermal as the least cost generation source for base load to sustain Kenya's increasing energy demand. In addition to its being a renewable energy source, the main advantages of geothermal energy are reliability, absence of fuel cost, and long plant life.[10] However, the upfront costs are relatively high, which has deterred private investment. Thus for the purposes of expanding its geothermal resources, the government of Kenya established the Geothermal Development Company (GDC), a state corporation mandated to fast track the development of geothermal resources in Kenya.

According to the National Energy Policy (2013), the country has 205 MW (megawatts) installed geothermal capacity and has put in place a geothermal development plan. GDC is in the process of acquiring 12 modern deep drilling rigs at a total cost of US$360 million to enable drilling of at least 60 wells per year with 140 MW geothermal generation capacity every year beginning from 2012/13.[11] The cost and risk of infrastructure provision (such as building roads to geothermal generation locations, providing security, etc.) and steam extraction is currently borne by the Kenyan government, though it is keen to collaborate with private sector investors through public private partnerships to facilitate further geothermal expansion, and quite a number of firms have expressed interest in this opportunity. With the development of geothermal capacity in Kenya, it is projected that the availability of affordable energy will improve.

Local engineering skills have been developed through intensive on-the-job training, and this has resulted in the accumulation of considerable labour skills and expertise in geothermal energy generation, which is now in demand in other countries including the Comoros, Rwanda, Uganda and Sudan, creating a new export opportunity. A training college is now being set up by GDC to facilitate capacity-building in the geothermal sector.

In addition to the above energy sources, Kenya has installed capacity of 5.1 MW in wind power. The limited exploitation of wind energy prompted the government to develop a feed-in tariff policy, which provides for a fixed tariff not exceeding US$0.11 per kWh for installed capacity of up to 10 MW supplied to the grid from wind generated electricity. The high capital costs and lack of sufficient data on wind potential in Kenya are two key barriers that are undermining the exploitation of wind energy resources. In addition, the volatility of wind energy and the potential to disrupt the base load and consistent power generation through its integration in the national grid have also contributed to its limited exploitation. Moreover, potential areas for wind energy generation are many miles from the grid and load centres, requiring high capital investment in transmission lines. Thermal generation accounts for approximately 33% of installed capacity, and its contribution to the energy mix stood at approximately 37% in 2011.[12] However, thermal generation is not preferred in Kenya due to the fluctuations in global fuel prices that make it an expensive option, which is why there is an emphasis on developing alternative sources of power generation.[13]

Table 2 below shows power generation sources in 2011/2012. Table 3 illustrates the planned diversified power generation prescribed by Kenya Power for the period 2012 to 2020.

[10] Republic of Kenya, SREP Investment Plan for Kenya, May 2011
[11] Least Cost Power Development Plan, 2011-2030
[12] Republic of Kenya, SREP Investment Plan for Kenya, May 2011
[13] Least Cost Power Development Plan, 2011-2030

Table 2: Electric power generation sources and energy generated in FY 2011/2012

Sources of Electric Power Generation		Installed Capacity		Annual Generation	
		MW	Percentage	GWh	Percentage
Renewable Energy	Hydro	807	49%	3,427	46.9%
	Geothermal	205	12.5%	1,453	19.9%
	Wind	5	0.3%	18	0.2%
	Cogeneration	38	2.4%	87	1.2%
	Imports	-	-	30	0.4%
	Total	**1,055**	**64.1%**	**5,015**	**68.7%**
Fossil Fuels	MSD	452	27.4%	1,976	27.1%
	Gas Turbines	60	3.6%	1	0.0%
	HSD	18	1.1%	44	0.6%
	Emergency Power Plans	60	3.6%	267	3.7%
	Total	**590**	**359%**	**2,288**	**31.3%**
Installed Capacity and Units Generated		**1,645 MW**		**7,303GWh**	

Source: National Energy Policy, Third Draft – 12 March 2013

Table 3: Planned diversified power generation sources from 2012 to 2020

Year	Hydro	Medium speed diesel	Import	Cogeneration	Gas Turbine/ Kerosene	Gas Turbine/ Natural Gas	Geothermal	Coal	Wind
2012	50.6%	30.1%	-	1.7%	4.0%	-	13.2%	-	0.3%
2015	26.5%	29.2%	-	0.8%	-	-	26.6%	-	16.9 %
2020	16.1%	15.0%	15.5%	-	-	5.6%	26.8%	9.6 %	11.4 %

Source: Kenya Power, Annual Report and Financial Accounts, 2012

The exploitation of Kenya's diverse renewable energy sources (such as hydro, geothermal, wind, solar, natural gas, biogas and cogeneration, etc.) have the potential to significantly enhance energy supply in the country and improve domestic energy security.

The government is committed to promoting electricity generation from renewable energy sources. Through the preparation of Sessional Paper No. 4 of 2004, enactment of the Energy Act of 2006 and finalisation of the National Energy Policy, the government has provided a regulatory and institutional framework for energy development in Kenya. In addition, a Feed-in-Tariffs (FiT) Policy has been formulated to promote the generation of electricity using renewable energy resources and to attract private sector investment. [14] The FiT Policy allows power producers to sell renewable energy generated electricity to an off-taker at a predetermined tariff for a given period of time.[15]

The policy is designed to provide an incentive for private sector investment in energy generation; however, some have suggested that the proposed rates are too low to accommodate the substantial investment required for pursuing some forms of power generation development. Nevertheless, the policy also provides for review every three years, so there is scope to increase the current rates. There is a possible trade-off here, between short-run competitiveness (best achieved through low tariffs, which reduce the cost of energy) and long-run competitiveness through the development of renewable energy generation (best achieved through higher tariffs that attract investment).

Additionally, to support private sector power generation and reduce the risk and upfront costs for renewable projects, development partners have also come forward to support electricity system expansion plans. There is the potential for Kenya to leapfrog older grid technologies through the use of more modern and flexible smart grid technology, which would enhance the potential for renewable energy development.

As part of the LCPDP, the government is also considering pursuing nuclear energy for electric power generation. In Kenya the energy system expansion plan over the 20-year plan period indicates that 26% of the total installed capacity will be obtained from geothermal, 19% from nuclear plants, 13% from coal plants, and 9% from imports. Formal steps to implement nuclear energy development have not been initiated; however, the Ministry of Energy, through the Nuclear Energy Programme Implementing Organization (NEPIO), plans to undertake preparatory work for nuclear power generation that is expected to come on stream in 2022.[16]

Although the high costs of electricity have to date undermined competitiveness of Kenya businesses, the focus on developing renewable energy sources is likely to stand the country in good stead in the face of future rising fossil fuel prices, and to improve its competitiveness considerably in the medium to long term.

Electricity imports

Kenya also imports electricity, through an interconnection with Uganda, Tanzania and Ethiopia through the Eastern Africa Power Pool (EAPP). In 2009/2010 the total imports were 38GWh, mainly from Uganda, while the country exported 27GWh to Uganda.17 In 2012, the Ethiopian Electric Power Corporation entered into a power purchase agreement with Kenya Power under which it will dedicate 400 MW of capacity to Kenya Power for a period of 20 years from 2017. Ethiopia is endowed with hydro generation potential estimated at 45,000 MW, which it plans to develop for domestic consumption and export to neighbouring countries.18 The import of energy into Kenya from its neighbours provides an opportunity to reduce the current energy deficiency as and when required. However, Kenya is unlikely to export substantial amounts of energy in the medium term at least, due to the insufficient supply within its own borders.

In light of the increasing populations and growing demand for energy within the region, the EAPP (including Kenya) through its 'Regional Power System Master Plan' has sought to identify regional power generation and interconnection projects in the power systems of EAPP and East African

[14] SREP Investment Plan for Kenya, May 2011
[15] MoE, Feed-in-Tariffs Policy, 2nd Revision December 2012
[16] Least Cost Power Development Plan, 2011-2030
[17] Least Cost Power Development Plan, 2011-2030
[18] Kenya Power's Annual Report and Financial Accounts, 2012

Community member countries in the short-to-long term[19] to satisfy the national and regional demand growth. A regional power pool can create incentives to invest in larger power plants and thus reap associated economies of scale.

Fossil fuel imports

Kenya imports petroleum and a relatively small amount of coal. Presently, petroleum accounts for 21% of the country's primary energy supply. The demand for petroleum has been growing steadily at above 10% per annum. Petroleum fuels are imported in the form of crude oil for domestic processing and also as refined products, and are mainly used in the transport, commercial and industrial sectors.

Coal is mainly used in the industrial sector, particularly for heating furnaces and steam generation processes. Coal utilisation has remained low in Kenya despite international prices having been reasonable and fairly stable over the years relative to petroleum.[20] Commercial generation of electricity using coal is anticipated in the LCPDP by 2014. The coal being used in Kenyan industries is imported mainly from South Africa and some Asian countries. There are confirmed coal reserves in eastern parts of Kenya, and commercial exploitation is planned.[21]

3.1.1 Strategic questions raised by recent fossil fuel discoveries

Recent reports of discoveries of fossil fuels in Kenya have created the hope that Kenya can become an oil and gas exporter. If and when the commercial viability of these discoveries is confirmed, Kenya will have some strategic choices to make about the use of the fuels as part of the LCPDP and Kenya Vision 2030. These fossil fuels could be exported to generate revenue that could be used to invest in domestic renewable energy generation, which could benefit competitiveness in the longer term. Alternatively, they could be utilised domestically to substitute for imports (which would require the construction of an oil refinery).

The domestic consumption of these fossil fuels could in the short and medium term enhance energy security, promote industrial development, and potentially provide local benefits (including community shared revenues accrued from coal mining, local employment, stimulation of local business, and improved infrastructure and skills development). Some have suggested these fuels should be used domestically to help reduce the price of kerosene used by local households, which would reduce deforestation as this would substitute for charcoal. Others point out that developing the necessary infrastructure to export the fossil fuels would be too costly, so they should be consumed domestically. Also, the political acceptability of exporting the fossil fuels is unclear, given the significant energy deficit facing the country.

However, domestic usage of the fossil fuels would be likely to result in a higher carbon growth trajectory, and would reduce the incentive to invest in renewable energy sources. Thus such usage may not maximise competitiveness in the longer term, as compared with investing in the development of domestic renewable energy sources, as these domestic fossil fuel reserves will eventually run out, and global fossil fuel prices could be much higher by then. This could therefore result in higher domestic energy costs in the long term and, consequently, reduced domestic competitiveness in Kenya.

On the other hand, exporting fossil fuels could generate Dutch disease, whereby the competitiveness of other tradable goods is undermined, leaving the economy relatively undiversified and more vulnerable to oil resource depletion. There is also a risk of creating stranded assets, (i.e. environmentally unsustainable assets which suffer from unanticipated or premature write-offs, downward revaluations or become liabilities[22]) perhaps as a result of increasingly stringent international mitigation policies, or competition from lower-cost Middle Eastern producers of fossil fuels. Thus the potential trade-offs between short- and long-term competitiveness will need to be assessed under different possible future scenarios with regard to fossil fuel prices, international mitigation policies, and technological developments.

[19] EAPP – http://www.eappool.org/eng/publications.html
[20] Kenya's Vision 2030
[21] Least Cost Power Development Plan, 2011-2030
[22] http://www.smithschool.ox.ac.uk/research/stranded-assets/

3.2 Clean Development Mechanism (CDM) and the energy sector

Africa has so far benefited relatively little from the Clean Development Mechanism (CDM). There are only 141 registered CDM projects in Africa, making up only 2.12% of the total registered CDM projects globally. Of those, 8 are in Kenya – see Table 4 below.

Table 4: CDM projects in Kenya

No.	Project Type (as at 16 July 2013)	Date of Registration	Developer	Estimated Annual Emission Reductions ('000 t CO2e)
1.	35 Bagasse based Cogeneration Project	03/09/2008	Mumias Sugar Company	129,591
2.	Olkaria III Phase 2 Geothermal Expansion	04/03/2010	Ormat	177,600
3.	Olkaria II Geothermal Expansion Project	04/12/2010	Kengen	149,632
4.	Lake Turkana Wind	28/02/2011	Lake Turkana Wind Consortium	736,615
5.	Aberdare Range-Mt Kenya Reforestation: Kipipiri	11/07/2011	Green Belt Movement	8,542
6.	Aberdare Range-Mt Kenya Reforestation: Kirimara	05/10/2011	Green Belt Movement	8,809
7.	Redevelopment of Tana Hydro Power Station	11/10/2011	Kengen	25,680
8.	Karan Biofuel CDM project – Bioresidues briquettes supply for industrial steam production	25/09/12	Karan Biofuel Limited	43, 699
9.	Ol Karia IV Geothermal	28/12/2013	Kengen	651,349
10.	Ol Karia I Unit 4&5	28/12/2013	Kengen	635,049

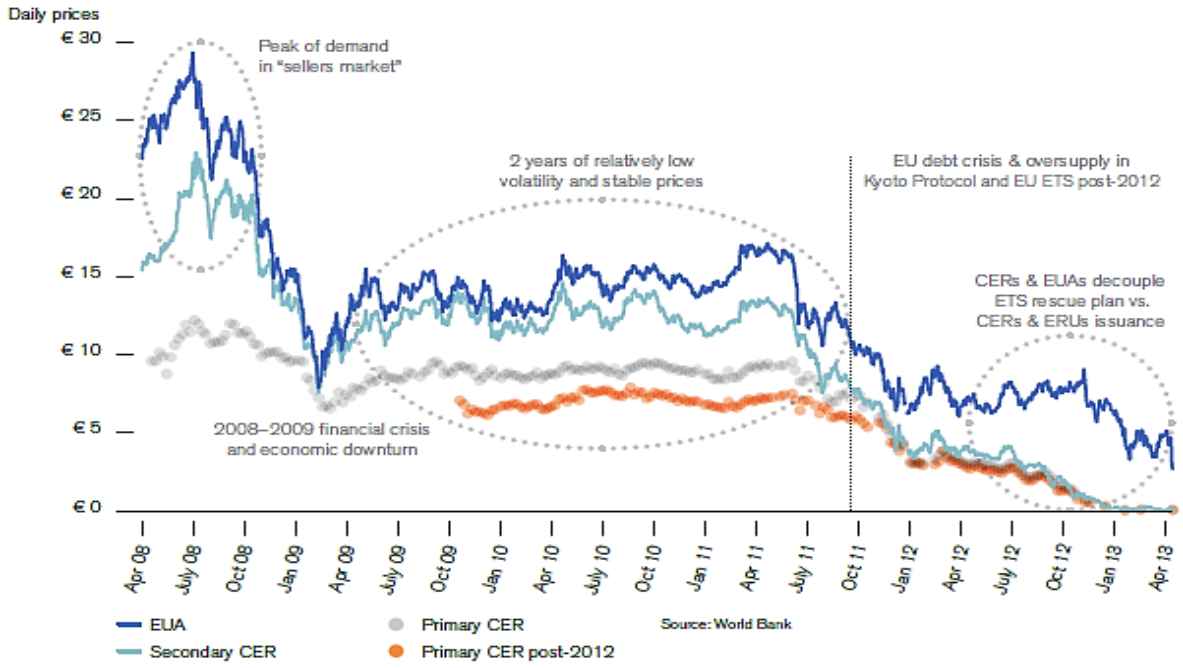
Source: UNFCCC-CDM website

Notable factors considered to contribute to Africa's poor participation in CDM include (i) high interest rates, which make it difficult, if not impossible, to obtain financing from financial institutions; (ii) government bureaucracy and corruption, which deters potential project developers from implementing carbon/CDM projects; (iii) limited access to finance, which makes initial start-up costs for CDM projects difficult to cover; (iv) limited technical and human resources; and (v) lack of institutional capacity, which act as an obstacle to CDM projects and CDM investments.

A 2009 directive by the European Union (EU) Parliament restricts the trade in certified emission reduction credits (CERs) from industrial gas projects and projects registered post-2012 from non-Least Developed Countries (LDC). This effectively excludes CERs generated from all CDM projects implemented in Kenya and registered after this date. Exclusion from the EU emissions trading system (EU ETS), which is the largest CER market in the world, will inevitably slow down investments in such projects within Kenya. However, a number of other countries are now establishing or discussing the introduction of domestic emissions trading schemes (e.g. the US, Japan, Australia, South Korea, New Zealand, Switzerland and China, among others), which suggests that over time new sources of demand may emerge for CERs in Kenya.

The dramatic fall of the global price of CERs further decreases the viability of renewable energy projects, as the return may be insufficient to warrant the initial investment in such projects. Thus in the short and medium term, the scope for Kenya to obtain carbon finance through such mechanisms looks very limited. However, public climate finance from climate funds and donor agencies is more likely to be forthcoming, particularly for LICs, and Kenya is well placed to benefit from that funding given the relatively developed nature (compared with many other LICs) of its climate change policy framework and renewable energy opportunities.

Figure 4: Carbon markets and policy trends



Source: World Bank, 2013

3.3 Energy availability – innovations and opportunities for private firms

As noted above, high and rising energy costs and unreliable supply pose a potentially significant threat to the competitiveness of Kenyan industry. This situation has led an increasing number of commercial enterprises to seek alternative sources of fuel and energy. For example, some tea farms are investing in mini-hydros, flower farms are investing in solar systems, sugar companies are investing in cogeneration measures and agricultural producers are investing in biogas generation, as well as some companies directly tapping into geothermal energy sources. For example:

- Oserian Flower Farm in Naivasha has invested $12 million in a 3 MW geothermal power plant that helps it meet 98% of its electricity requirement. The investment has so far proved to be financially sound for the company as it is currently saving between US$3 and US$4 million in energy costs annually. The company also uses the geothermal heat directly to keep greenhouses warm at night as well as directing the geothermal carbon emissions to its plants. This has also generated productivity increases of up to 10%. The company is also planning to increase its geothermal power generation capacity and sell the excess electricity into the national grid. [23]

- The Kenya Tea Development Agency (KTDA) is planning to construct mini-hydro power plants in tea growing areas. The 1 MW Imenti mini-hydro project was the first of its kind among the KTDA-managed factories, and a power purchase agreement has been signed. The agreement

[23] Oserian Flower Farm – http://www.oserian.com/tomorrow_ecopower.html

authorises Imenti to supply surplus power to the national grid.[24] In addition, four tea factories in Nyeri are also set to benefit from a multimillion dollar small-hydro power project to produce green energy that will see them also diversify their revenue sources. For example, the Gura Small Hydro Power Project is expected to cost KSh1.3 billion and will generate up to 5 MW of electricity. The revenue generated will be shared between Gathuthi, Gitugi, Iriaini and Chinga tea factories in Nyeri, and the KTDA Power Company Ltd who are the shareholders.[25]

- Mumias Sugar Company Limited has invested in the 35 MW Bagasse Based Cogeneration Project, which supports its power requirements, with exports of up to 26 MW to the national grid. The technology employed for the project is based on conventional steam power cycle involving direct combustion of biomass (bagasse) in a boiler to raise steam, which is then expanded through a condensing extraction turbine to generate electricity. Some of the steam generated is used in the sugar plant processes and equipment, while the power generated is used internally by the company with the excess exported to the national grid, remunerated through feed-in tariffs. The cogeneration plant has allowed the factory to become fully self-sufficient with regard to energy, and has also allowed them to freely dispose of bagasse, which previously was costly to remove from the premises. In addition, it has contributed 33% of total revenues through sales of energy to the grid. The plant is operating at only half capacity, so there is scope for Mumias to increase generation depending on the tariff set. Mumias is hoping to sell carbon credits; however, as this carbon financing is not yet forthcoming, Mumias is also considering the construction of a coal fuelled power plant to generate more energy and further revenues from surplus electricity sales.

- Bilashaka Flowers Ltd has invested in clean energy through the use of solar heating panels at its farm. Since 2006, Bilashaka Flowers has been using 5,500m^2 of solar panels to generate heat during the day for use in the greenhouses at night. This heating prevents fungal diseases from affecting the roses and other produce. Notably, the usage of chemicals for flower protection is, due to this environmentally friendly system, considerably lower than in unheated greenhouses. The development and construction of the solar panels was executed using local supplies and labour. The solar panels are used to heat water, and the steam is recycled in the greenhouses. In the near future, the farm hopes to implement solar energy structures to generate its own electricity.[26]

- P.J. Dave Limited in conjunction with the Ministry of Energy is developing a pilot scheme to convert farm waste into biogas, which can potentially serve as a model to be replicated in others flower farms. The project is still in its preliminary stages; however, the hope is that the energy produced from the biogas process will be used to supplement the farm's energy needs, and will potentially generate additional revenue for the farm.

In rural and remote locations, decentralised renewable energy generation is often the most cost-effective option, and its expansion – potentially supported by new forms of climate finance – can support increased economic development and improved competitiveness in those areas.

Currently, the Rural Electrification Authority (REA) assists rural community groups that invest in mini-hydro power plants, by setting up mini-grid frameworks, providing transformers, preparing feasibility studies and providing maintenance. This kind of assistance is currently not available to firms, but if it was, this would represent a possible new opportunity, and would have the benefit of encouraging firms in areas without access to the national grid to invest in their own renewable energy generation, which would provide energy to the surrounding area while generating an additional revenue stream for the firm. This arrangement would need to be accompanied by the establishment of

[24] Kerea- http://kerea.org/renewable-sources/small-hydro/
[25] KTDA – http://www.ktdateas.com/index.php?option=com_content&view=article&id=362:multi-million-gura-small-hydro-power-station-to-generate-green-energy-for-ktda-factories&catid=47:press-releases&Itemid=190
[26] Bilashaka Flowers – http://www.zuurbier.com/newsitem.php?id=20

feed-in tariffs and possibly a net metering framework – currently being developed in Kenya –, which will enable small scale power producers to sell power into the grid on a flexible basis.

As noted above, direct access to geothermal energy could also provide a source of competitive advantage for firms located in Kenya. One source estimated that energy costs could be half the price of electricity. GDC is helping to develop direct access of geothermal energy by companies. This could result in the decentralisation of the industrial base away from Nairobi, and could potentially attract foreign direct investment (FDI) into Kenya to take advantage of low energy costs. However, there is a need to invest in associated infrastructure such as roads and security systems in these areas in order to capitalise on that opportunity.

The potential growth in the market for biofuels represents another interesting opportunity within the Kenyan context, and one that is not yet being explored much at all. This is discussed further in the section on agriculture below.

3.4 Energy efficiency

The Energy Act of 2006 through the Energy Management Regulations[27] provides a regulatory framework that establishes compulsory energy audits for certain firms within Kenya. The Energy Regulatory Commission (ERC) in the implementation of this regulation sought to limit the high losses of energy in industries, commercial buildings and large institutions. The regulation creates the institutional framework for the licensing of energy auditors by the ERC, and requires that energy audits be carried out every three years. The organisation must show that it has complied with at least 50% of the recommendations provided in the energy audit during the subsequent inspection by ERC.

As a result of this regulation, organisations such as the Kenya Association of Manufacturers (KAM), through the Centre for Energy Efficiency and Conservation (CEEC), and the Kenya National Cleaner Production Centre (KNCPC) are undertaking audits and promoting the adoption of innovative tools of environmental management in Kenyan firms.

Uptake by businesses has been fairly high. We were told that more than 200 companies have been audited, and potential savings of KSh10 billion identified. The manufacturing and hotel industries have been particularly responsive to pursuing energy-efficiency measures, and some have already demonstrated considerable energy savings. It was calculated that one of the audited flower farms, upon implementation of the energy conservation measures identified in the energy audit, would save more than KSh4 million, equivalent to 20% of its annual energy bill.[28] The biggest potential savings are perceived to be in the sugar, tea and textiles sectors.

Other examples include the following companies:

- British American Tobacco, Kenya: Through the energy-efficiency audit performed by CEEC in 2009 (and repeated every consecutive year thereafter), it has achieved a total energy reduction of 25% in the first two years. Consequently it is benefiting from improved production efficiencies, financial savings and competitiveness, in addition to reducing carbon emissions.[29]

- Spin Knit Limited, Kenya: Through the energy-efficiency audits performed by CEEC, the organisation has identified new opportunities and practical solutions to reducing energy consumption. To date they have achieved (i) 26.33% savings on kWh usage, which translates to KSh31,764,487; (ii) 41.29% less fuel consumption, saving KSh3,312,292 as a result; and (iii) a cumulative return on investment of over KSh4 million.[30]

[27] http://www.renewableenergy.go.ke/downloads/policy-docs/the_energy_management_regulations_2012.pdf
[28] Kenya Flower Council – http://www.kenyaflowercouncil.org/blog/?p=3647
[29] CEEC – Press Ad for British American Tobacco, Kenya
[30] CEEC – Press Ad for Spin Knit Limited, Kenya

In addition to the cost savings achieved, participating businesses can capitalise on the improved company brand equity associated with participating in the Energy Management Awards (EMA). The EMAs are annual awards facilitated by KAM to recognise enterprises that have achieved significant reduction in their energy consumption through implementation of energy-efficient measures and technologies. This is discussed further in the manufacturing section below.

3.5 Conclusion

Table 5 below summarises the main opportunities and risks that are currently faced in Kenya's energy sector, associated with the three key drivers identified at the beginning of this report: natural resource scarcity, international mitigation policies, and the impact of climate change. Possible policy and business responses are suggested, for further discussion and exploration at the national level.

Table 5: Summary table of opportunities and risks associated with three drivers

Opportunities / risks	Implications / possible responses
Natural resource scarcity	
High prices and unreliable electricity supply, along with rising and fluctuating fossil fuel import prices, reduce competitiveness of domestic industry.	Investment in renewables and innovative ways to obtain electricity will improve competitiveness in the long term.
Use of biomass is unsustainable and driving deforestation. Growing shortage is pushing up prices.	Investment in alternative energy sources. Private sector tree planting to provide more sustainable source of fuel wood.
Geothermal power – potential to attract FDI and provide cheaper source of energy that will support industrial development. Geothermal skills and expertise – can be developed further and exported.	Invest in upfront costs and establish public-private partnerships to develop geothermal generation. Build infrastructure and services to support industrial development in areas with geothermal energy. Skills development strategy, training facilities, formal qualifications, etc.
Energy generation by private enterprises for their own use or for sale to the grid. Saves energy costs, creates additional revenue source for the company and enhances supply of energy, including in rural areas where grid access is limited. Opportunities include mini-hydro, geothermal, solar, biogas and cogeneration.	Appropriate regulatory framework needed, e.g. a policy framework for mini-grids, feed-in tariffs, net metering. Mechanisms to support access to finance to overcome upfront costs.
Energy-efficiency measures can yield substantial savings and improve competitiveness.	Need for energy-efficiency regulation, incentives, awards, demonstration projects, and access to finance to cover upfront costs.
Fossil fuel discoveries – for import substitution or export – will improve energy security but could undermine development of renewables.	Strategic decisions to be faced, requiring analysis of long-term and short-term implications for energy costs and competitiveness.
International mitigation	
Access to finance through carbon market could support investment in renewables and energy-efficiency measures. However, such finance may be limited in the short term, though public climate finance may be increasing.	Develop a strategy that optimises contribution from public sources of climate finance in the short term, and positions Kenya to access carbon markets in the longer term.
Biofuel production could serve domestic or growing international market but also increases competition for land.	Investigation of potential market for dual crops, which provide both food and biofuels. Need to balance competing demands for land.
Impact of climate change	
Hydropower losses due to dry weather push up energy costs as a proportion of total costs, and reduce availability.	Diversify energy generation base, invest in alternative sources of energy including geothermal.

Kenya is at a crossroads in terms of its energy system. Until now, the high and variable costs and unreliability of energy have significantly undermined the competitiveness of Kenyan business. However, with multiple renewable energy opportunities now being developed, Kenya could in future find itself in the enviable position of having one of the greenest energy sectors in the world. That would be likely to yield a significant competitive advantage in a low carbon global economy, as well as attracting potentially large amounts of climate finance.

However, with the recent discovery of fossil fuels, Kenya now has some strategic decisions to make about the uses of those fossil fuels, which will have important implications for the future energy mix and the competitiveness of industry. If their commercial viability is confirmed, exploitation of these fossil fuel reserves seems inevitable, and it will be important to utilise them and the resources they generate in a way that does not undermine the country's wider long-term competitiveness, or undermine incentives for the development of renewable energy sources.

Some firms in Kenya are at the forefront of innovation to secure alternative sources of energy for their own use and to sell to the grid, and it would seem sensible to encourage this, as a way to enhance competitiveness and improve the energy supply in Kenya, particularly in underserved areas. This kind of innovation could be the beginning of the kind of transformation that is needed to achieve a low carbon growth trajectory in Kenya, that will look very different from the high carbon growth paths that today's industrialised countries pursued.

While the business case for low carbon investment to achieve a more competitive industrial base seems clear, there is still an important role for climate finance and carbon markets to support such investment in LICs. While some effort has been expended, by government, donors and businesses alike, to develop projects that incorporate finance from carbon markets (through CDM for example) into the business case, in practice this unfortunately now seems unlikely to yield much finance in the short term. Thus a shift in focus, for the short term at least, seems warranted, to support and incentivise the kinds of investments discussed here, which are linked to a wider business case based on rising energy prices and natural resource scarcity. Given Kenya's current profile on renewables development, it should be well positioned to secure public climate finance to support these kinds of investments.

4 The agriculture sector

4.1 Introduction

Agriculture is a very important contributor to the Kenyan economy, providing 24% of GDP, creating employment for around 80% of the population, and providing 60% of foreign exchange earnings. Much of Kenya's manufacturing industry is based on agricultural production as well (NIDOS, 2009).

The sector is highly diverse, ranging from nomadic pastoralism in dryland areas to intensive export crop cultivation in the higher rainfall uplands, and with a large number of smallholder food and livestock producers. Several pressures are affecting the sector, however. Increasing human and animal populations have put growing pressure on the agriculture sector for a least half a century, by reducing land productivity, causing erosion, and extending cultivation into marginal areas. These pressures are now being exacerbated by an increasing incidence of rainfall variation and rising temperatures. Soil depletion and land pressures have also led to a growing reliance on external energy-intensive inputs, including chemical fertiliser. In addition, limited export diversification has been found to be hindering the country's export potential; 50% of exports are tea products, 60% of which go to Pakistan, Egypt and the UK (MAFAP, 2013).

There are also sector-wide concerns, at least on the part of government if not yet all producers, over carbon emission levels, whether from extensive grazing, mechanical land tillage by smallholders, or energy use for agro-processing. But there are also several sub-sector-specific issues, some of which are already eliciting responses to environmental and resource cost challenges. For example, the availability of energy particularly affects the development of agro-industrial products; environmental export standards are putting pressure on the higher-value beverage and horticulture industries; and finding alternative, low input use systems is becoming urgent for arable farmers. This section examines both sector-wide issues and industry-specific challenges and opportunities.

4.2 Potential impacts of climate change on agriculture

A study by the Stockholm Environmental Institute (SEI, 2009) found that flooding and drought events are already causing major socioeconomic impacts and reducing economic growth in Kenya. Major droughts occurred between 1998 and 2000, from 2004 to 2005, and in 2009. The 1998 drought is estimated to have cost around US$2.8 billion due to losses in livestock and crops, while the 1997 and 1998 floods cost between US$0.8 billion and US$1.2 billion due to infrastructure damage, negative health impacts and loss of crops. The annual burden of droughts and floods is estimated to be as high as US$0.5 billion per year on average, negatively affecting long-term growth (SEI, 2009).

Mutimba et al (2010) state that the agriculture sector is one of the first economic sectors to be impacted by climate change, as droughts dries the soil, reducing crop productivity. The unpredictability of Kenyan agriculture yields are negatively affecting subsistence farmers, and may affect productivity of the sector as a whole.

A World Bank study showed that an average increase in temperature of between 3.5° C and 4° C by 2030 would increase yields by 1% in 'high potential zones', but decrease yields by 21.5% in 'low potential zones'. As most of Kenya consists of Arid or Semi-Arid Lands (ASALs), which are low potential zones, the impact of temperature increases on agriculture could be highly significant (Kabubo-Mariara & Kranja, 2007).

Herrero et al. (2010) confirm these findings, indicating that increases in temperature would have a positive effect on productivity in particular areas within the country (the highland areas), but that while precipitation may increase, water evaporation rates would also increase, effectively offsetting any

productivity gain. They estimate that production of key staple crops (such as maize and cereals) could decrease by 10% to 55%, and imports of these crops could potentially increase between 21% and 44%. Increased imports of staple crops may result in increased prices and a reduction in food security.

While there could be some potential winners from climate change (for example, the Kenya National Environment Management Authority (NEMA, 2005) reports that increased temperatures and rainfall in some pastoral areas could benefit the livestock industry), all the reviewed studies show that the net impact of climate change will be an overall decrease in agricultural productivity.

Water scarcity is a growing problem, as Harding & Devisscher (2009) and Mutimba et al. (2010) point out, since the country's ability to capture watersheds is deteriorating, through deforestation and the resulting soil erosion, and through increased droughts, all of which reduce water availability for irrigation. This poses a challenge to agriculture, which accounts for 64% of the country's total water usage.

The challenge is further compounded by poor water distribution infrastructure, which does not efficiently allocate water resources. The World Bank,[31] together with the Ministry of the Environment, is currently implementing a project that aims to promote sustainable land use practices and improve water quality and availability. The project also includes a plan to increase water collection and storage when there is plenty, and to make it available during scarcity. The government is also implementing a project to promote 'climate smart agriculture', discussed further below in the section on sustainable agricultural practices.

4.3 Competition for land

Reduced agricultural productivity could potentially increase competition for land as farmers require more land to produce the same amount of crops. Competition for land is also increasing between food crops, export crops, and non-food crops such as biofuels. A number of foreign companies have started to produce biofuels; for example, Bedford Biofuels has set up a 60,000 hectare Jatropha project,[32] G4 Industries Limited has been awarded a 28,000 hectare plot of land to grow Jatropha,[33] and the Italian based Nuove Iniziative Industriali Srl has obtained 50,000 hectares for Jatropha.[34] Most of these deals have, however, come under local community and national NGO opposition due to the displacement (of both people and food crops) that they may cause, and they have yet to reach their full potential in terms of biofuels production. (The potential for biofuels production in Kenya is discussed further below.) Thus there are serious economic, social and environmental trade-offs to weigh up in relation to land management.

In principle, if properly controlled and well managed, increased foreign direct investment into land and agriculture could potentially result in spillover benefits in the form of technologies (e.g. climate resilient seeds or irrigation techniques) that could promote increased yields and build competitiveness. However, the distribution of the economic benefits associated with such investment will depend very much on how the land is managed and what it is used for. The new Constitution and Land Act is proposing caps on acreage for land ownership, which could reduce large-scale production, and limits may also be placed on land ownership by non-citizens, which may discourage future foreign investment.

There is also increased competition for land arising from the growing fuel wood shortage, which is incentivising tree planting by the private sector to provide a more secure source of fuel. However, the development of alternative energy sources could potentially help to reduce pressure on land for fuel wood, as discussed above.

[31] http://siteresources.worldbank.org/INTDEVIMPEVAINI/Resources/3998199-1285617002143/7430173-1335196588945/8602907-1336591491009/IDA_Kenya_Water_Security_and_Climate_Resilience_IE.pdf
[32] http://www.edmontonjournal.com/news/insight/Kenyan+biofuel+dream+proves+elusive+Alberta+firm/7636520/story.html
[33] http://www.guardian.co.uk/world/2011/jul/02/biofuels-land-grab-kenya-delta
[34] http://www.bloomberg.com/news/2010-08-04/italian-biofuels-project-arouses-opposition-from-kenyan-environmentalists.html

Increased competition for land is pushing up the value of land assets, and could have a knock-on impact on food prices, which could undermine competitiveness and increase food imports. There is also a greater incentive to reclaim land or irrigate land in arid and semi-arid areas in order to increase the amount of productive land available.

4.4 Energy prices

High energy prices and lack of access to national grid electricity are undermining competitiveness and growth in relation to agricultural production, particularly agro-processing, e.g. for tea leaf production, floriculture development and sugar processing. This is, however, incentivising many agro-processing firms to themselves adopt new, often renewable, energy generation techniques that provide greater reliability of supply and reduce operational costs, as discussed in the energy section above. These strategies include sugar producers such as Mumias Sugar Ltd. setting up their own cogeneration plant, and tea processors investing in micro-hydro systems. Some companies are also tapping directly into geothermal energy sources.

Agro-processing firms could also, in principle, access carbon financing to support this kind of innovation. However, discussions with agro-processing companies and related business associations have shown that gaining access to such funding is often a laborious process and has not always resulted in positive outcomes. At the international level, the slow development of carbon markets, as well as current low prices for carbon credits, are significantly undermining the potential for carbon financing.

4.5 Sustainable agricultural practices

Currently, apart from some organic certification schemes for particular sub-sectors (see labelling section below), sustainable agricultural practices and 'conservation agriculture' are not widely used in Kenya. This is partly due to a lack of awareness of, or a belief in, the benefits of such practices, among farmers. There is a perception of reduced productivity when chemical fertilisers are replaced with organic ones. Farmers need to be shown that such methods can prove more efficient and sustainable over the long term than current techniques. The low use of sustainable agricultural practices is also partly due to the upfront costs associated with an immediate loss of production due to lower fertiliser application, and to the higher labour costs in land preparation and weeding, etc., and to the fact that organic fertilisers are not always readily available in the market.

The Ministry of Agriculture is promoting 'Climate Smart' agricultural practices with the aid of the World Bank. The World Bank (2013) describes Climate Smart Agriculture as proven techniques that aim to create triple wins: increased mitigation through agriculture (i.e. through increased soil carbon retention), increased yields, and greater resilience to climate change. Techniques being tested include the adoption of 'no tillage' systems, although Kenyan farmers seem resistant to the technique since they prefer to have a newly ploughed field when planting.

Resistance to sustainable agriculture techniques may be to the detriment of agricultural competitiveness in the medium term, if neighbouring and/or competing countries adopt these techniques more rapidly. In Argentina, yields are claimed to have increased by 150% since the implementation of no-tillage techniques (Derpsh & Friedrich, 2009), while a study on yields in Zambia in 2005 shows that farmers practicing these techniques had a 2.8 tonne/ha yield (for maize), compared to similar farmers using traditional techniques who had yields of 0.8 tonnes/ha (FAO, 2006). A study by the United Nations Environment Programme (UNEP, 2012) shows that switching to green production techniques can increase yields by between 54% and 179%.

Kenya has seen more limited uptake of conservation agriculture vis-à-vis its neighbours (see Table 6 below), which could be hampering Kenya's long-term food security and export prospects (FAO, 2009). Additionally, increased demand for the uptake of sustainable agricultural practices (as captured in certification schemes such as Rainforest Alliance, and standards such as GLOBALG.A.P. – see below) from high income country (HIC) retailers and consumers may make such practices more of a

requirement in the future, and Kenyan farmers could potentially be unable to sell to these markets if they have not adopted these techniques.

Table 6: Conservation agriculture uptake in Sub Saharan Africa (2009)

Country	No. of Farmers Involved	Hectares of Land
South Africa	n/a	377,000
Ghana	400,000	300,000
Zambia	100,000	110,000
Malawi	5,407	47,000
Kenya	5,000	18,000

Source: FAO (2009)

Climate smart programmes being supported by the World Bank in Kenya aim to increase drought resistance for livestock dependent communities, and improve water management techniques in ASALs (World Bank, 2011). The Kenyan government also plans to develop its Agriculture and Climate Change Policy; it carried out a baseline survey in 2012 to assess what training and other interventions are required by farmers, and what capacity-building is required within the Ministry itself.

The Ministry of Agriculture has also introduced the 'Farm Forestry Rule', which mandates that 10% of all farmland needs to be dedicated to forest. This is aimed at reducing CO_2 emissions by increasing forest cover and providing an alternative livelihood source (i.e. fruit or nut trees) for farmers. However, it is not clear how widely the rule is being implemented in practice, and the rationale and technical requirements do not seem to be well understood.

In principle, carbon markets could help to finance reforms that enhance soil carbon sequestration, as this is one of the most relevant and substantive mitigation opportunities available in LICs. However, mechanisms such as CDM currently do not provide carbon credits for emissions reductions through agriculture, and there are many technical issues (e.g. relating to the monitoring of emissions reductions achieved) that would need to be resolved before this could become a feasible option. Public sources of climate finance (e.g. climate funds set up by donors) could potentially provide significant support for these types of efforts, however.

4.6 Labelling schemes & organic production

Labelling schemes for agricultural products – such as Fair Trade, Rainforest Alliance, or Organic labels – can be seen as potentially either an opportunity or a threat for Kenyan farmers. Successful, early adherence to labelling schemes can help farmers to access markets, sometimes obtain a price premium, and gain a competitive advantage compared to farmers in countries that have not adopted them. However, such schemes can also pose a threat if a failure to meet the required standards – or a failure to develop the necessary certification mechanisms and institutions – results in the exclusion of Kenyan farmers from export markets as a growing number of consumers and retailers demand such certification.

Industry-wide initiatives such as GLOBALG.A.P. are making compliance with sustainable agricultural practices effectively mandatory for a high proportion of western markets. And company specific standards are also growing fast: in 2010 there was an 8% increase in global demand for organic products and the market stood at US$59 billion, projected to rise to US$105 billion by 2015 (Soil Association, 2012 & UNEP, 2012). Thus if Kenya is able to establish a reputation as a green agricultural producer, with a high proportion of its production certified, it could gain a significant

competitive advantage. Efforts are already underway to do this, through, for example, the 'KenyaGap' label and the 'Grown under the Sun' initiative (see Box 1 below).

Box 1: 'Grown Under the Sun'[35] & 'Kenya-GAP'[3637]

The **'Grown Under the Sun'** label aims to inform European consumers that Kenyan produce is less energy intensive and results in less CO_2 emissions than the equivalent European products, since products are grown naturally in Kenya without the use of artificial heat and light.

The **'Kenya-GAP'** label is the only African certification scheme that has acquired EUREPGAP/GLOBALG.A.P. equivalence (in 2007) and covers vegetable, flower and fruit producers. The Kenyan government promoted the development of Kenya-GAP in order to ease access to high-value markets such as those in the EU. Such recognition can help adhering Kenyan farmers gain a competitive edge.

Organic production is also growing fast in Kenya – indeed, much production is already organic even if it is not labelled as such, so this represents an important opportunity. In 2006 there were about 3,300 hectares of agricultural land under organic certification (and over 180,000 hectares of wild harvest land) (IFOAM, 2008). The number had grown to about 78,000 hectares in 2008 (Kledal et al. 2010), and by 2011, according to Ministry of Agriculture estimates, around 133,000 hectares of land were under organic certification, with a further 100,000 remaining uncertified.[38]

There is likely to be an increasing demand from retailers and buyers for 'carbon footprinting' going forward, i.e. measurement and certification of the carbon emissions associated with production. The growing demand will provide a competitive advantage to producers with superior carbon credentials, but it represents a threat to producers with relatively high carbon emissions. This suggests that policies should be introduced as soon as possible, to incentivise and support efforts to measure carbon emissions in order to build the capacity of producers to collect this information; they should also incentivise producers to take the steps necessary to improve their own 'low carbon competitiveness' in advance of the roll-out of such measures. Producers such as Unilever have already developed tools to assist with the measurement of carbon emissions, such as the 'Cool Farm Tool'– see Box 2 below.

4.7 Biofuels

Increased biofuel production could potentially alleviate energy security concerns by allowing locally produced biofuels (i.e. bioethanol) to replace imported fossil fuels, as well as by providing a potential source of revenues if any surplus production is exported. With projected global demand for biofuels doubling from 21 million tonnes in 2011 to 41 million tonnes in 2020,[39] there is a potentially significant market opportunity. As previously discussed, a number of foreign companies are already investing in biofuel production within Kenya; however, this also raises concerns about competition for land, as biofuels compete with food crops, forests and urbanisation.

The focus has mostly been on Jatropha, which is not necessarily the best biofuel source for Kenya, firstly because it requires larger amounts of water to produce a litre of fuel than other biofuels, and secondly because there are also significant economies of scale associated with Jatropha production,

[35] http://grownunderthesun.com/
[36] http://www.fpeak.org/27-36.pdf
[37] http://www.isealalliance.org/sites/default/files/E051_Kenya_KenyaGAP.pdf
[38] http://oneco.biofach.de/en/news/kenya-supports-organic-self-sufficiency-and-organic-export--focus--5b899c71-a1a4-46b6-a4f6-0f781d1d1e45/
[39] http://www.nesteoil.com/default.asp?path=1,41,538,2455,8529,12421

and compared to major biofuel producers the average farm size in Kenya is very small (see Table 7 below).

Table 7: Average farm size for largest biofuel exporters

Country	Average Farm Size (Hectares)
Brazil	63
Argentina	587
USA	100
Kenya	2.5

Source: Acumen Fund (2013),[40] MacDonald (2011), Berdegue & Fuentealba (2011)

According to the Kenya Agricultural Research Institute (KARI), there is also potential to plant dual crops such as sugar, cassava, sweet sorghum, or castor, which can be used either as food or fuel, which are more climate resilient, and which could help address energy and food security concerns, as well as diversifying livelihoods. It is also important to note the effect of import taxes on such dual use products – e.g. importing sorghum into Kenya from the EAC and the Common Market for Eastern and Southern Africa (COMESA) – which keeps the producer prices low; hence such crops may not be profitable if they can be imported at more competitive prices (MAFAP, 2013).

The returns from dual crops would need to be assessed, and would depend on the market price available and the extent of competition from imports. A study of estimated returns per hectare for dual crops (based on 2011 prices) showed that sugar cane can make about a US$2,000 gross margin per hectare, sweet sorghum can make around US$900 and cassava about US$200. More traditional crops, on the other hand, have much lower returns; e.g., beans make about US$100 and maize about US$50, while Jatropha is the least profitable and barely breaks even (Wiggins et al. 2011). KARI has stated that the initial push to invest in Jatropha was taken up by many farmers, but its low return meant farmers were switching back to more traditional crops.

Croton trees are another potential opportunity; they are drought resistant and the oil could be sold locally to the benefit of rural economies. A processing plant has been established in Meru. Croton trees have often been planted as a windbreak, but now are often cut down to expand farmland. Using Croton trees for biofuel may reverse this practice and help to prevent desertification. Castor plants are another opportunity; they can withstand arid climates, they can be grown and harvested by semi-subsistence farmers in poorer regions, and castor oil can also be used to create biodiesel.

The potential market for biofuels could be fairly large domestically and within the Eastern African region, and this seems to be the major focus for biofuel producers in Kenya at the moment. However, there is also the potential to export to other markets. For example, the EAC has a preferential agreement with the EU that includes tariff-free exports of sugar for human consumption, and which would also apply to bioethanol – preferential access that other major biofuel producers such as Brazil and Indonesia do not currently have (Wiggins et al. 2011). However, there are also risks associated with exporting biofuels, since biofuel export markets are politically created and thus vulnerable to policy reforms. In addition, any biofuels exports would have to meet sustainability criteria, which may be difficult to achieve within Kenya.

The domestic market for biofuels could be stimulated through government policy. In 2010 the Kenyan government proposed a policy that would require petroleum to be blended with bioethanol; by 2012 this had yet to occur as there was insufficient domestic production of biofuel. Both Mumias Sugar and

[40] http://www.acumenfund.org/investment/juhudi-kilimo.html

Kibos Sugar[41] are, however, looking to produce ethanol, so progress in this direction may once again resume.

4.8 Tea sector

Kenya's tea sector is important to the overall national economy. By 2010 the sector accounted for 26% of total export earnings and 4% of GDP. The sector provides livelihoods to about 3 million Kenyans and contributes to environmental conservation through improved water infiltration, reduced surface erosion rates, and enhanced carbon sequestration (TRFK, 2010).

A study by the International Center for Tropical Agriculture (CIAT) of climate change impacts on tea production in Kenya (up to 2050) estimated that with increasing temperatures and rainfall, optimal areas for tea production will decrease, and that production will have to shift to higher altitude areas, moving from around 1,500 m to 2,000 m above sea level (CIAT, 2011).

Tea leaves need to be processed soon after harvesting to avoid fermentation and decomposition, hence tea processing facilities need to be located close to the tea growing areas. The heating process means that electricity and fuel represent a large proportion of tea manufacturing costs, and high energy prices in Kenya are therefore a significant problem for tea producers' overall competitiveness. Tea manufacturers in Kenya are thus finding renewable energy alternatives, including electricity generation through micro-hydro plants (as discussed in the energy section, above), in order to reduce energy costs and potentially generate further revenues by selling surplus electricity back to the national grid[42].

Tea processors are also looking at other modes of energy production and efficiency in order to reduce operational costs, including the use of mini-hydro plants, the use of biomass (i.e. bagasse or maize waste from surrounding farmers) to power their water boiler systems, and the use of coal to generate power. Another innovative idea involves the use of gravity-powered ropeways (e.g. by Finlays in its Kitumbe tea plantations) or the installation of wind energy plants (which KTDA is considering piloting in the Meru region).[43]

The KTDA is now requiring its factories to acquire open land (of which a high proportion is deemed to be ASAL) in order to plant seedlings and grow trees as a sustainable source of firewood. Such a strategy will help them save money on the purchase of firewood or alternative fuels and could potentially generate revenues from carbon trading if the planted forests are managed sustainably.

The KTDA states that there is a growing impetus to adopt Rainforest Alliance (RA) certification, which is effectively becoming a requirement. The price premium provides an incentive to adopt the label, spurred on by increased global demand for RA certified tea, and while it was initially regarded as extra work for tea producers, most have now adopted it, as those who are not certified are increasingly seen as outdated.

Box 2: Unilever & tea production

Unilever established a Sustainable Agriculture Programme in 1999, which includes adaption to the impacts of climate change through the development (i.e. breeding) of drought resistant tea varieties. The introduction of sustainable agricultural practices has increased tea yields by four to five times.

Unilever is setting up mini-hydro plants and growing eucalyptus trees to use as fuel wood for its tea boilers in order to overcome high energy prices and limited access. The company is

[41] http://www.biofuelsdigest.com/bdigest/2012/12/18/kenyas-kibos-sugar-to-invest-in-ethanol-production-and-co-gen
[42] http://kerea.org/renewable-sources/small-hydro/
[43] http://www.renewableenergyworld.com/rea/news/article/2012/05/renewable-energy-generation-is-big-business-in-kenya

carrying out energy-efficiency audits in its manufacturing plants.

The company states that, together with local communities, it is active in protecting its local water catchment areas in order to ensure the sustainability of the water supply. Unilever also developed the Cool Farm Tool (a calculator of Greenhouse Gas emissions freely available for use by farmers and suppliers), in a joint effort with others, and in collaboration with the Kenyan government has been using it to quantify carbon within its plantations.

4.9 Flower industry

Kenya is the fourth largest flower exporter in the world, providing 40% of Europe's imported cut flowers. The sector constituted 7% of GDP in Kenya in 2010, employing close to 90,000 people directly and between 600,000 and 700,000 people indirectly (World Bank, 2011). The sector comes under constant scrutiny from international and local NGOs, and as it is a luxury good, its international customers demand evidence of responsible sourcing.

The flower industry is likely to be affected by climate change in a number of ways. Changing rainfall patterns and the associated reduction in water availability will have a potentially significant impact, especially in arid and semi-arid areas, where the majority of Kenyan floriculture occurs. Increased frequency of extreme climatic events, increased soil degradation, and greater incidence of pests and diseases are also likely to increase the variability of production. The quality of the flowers themselves may also be affected, and the types of flowers chosen for production may need to be adapted to changing conditions (World Bank, 2011).

There will be some indirect impacts on the floriculture industry, too, such as damage to the transport infrastructure system (which is critical to a time sensitive product such as flowers) caused by floods, droughts or other extreme climatic events. There will also be increased costs associated with the greater power consumption required to maintain refrigeration levels at an optimal temperature as external temperatures increase.

Given that flowers are a luxury good that usually requires air-freighting (and because there is limited local demand, with most produce being exported), there has been considerable pressure from buyers and retailers to measure and reduce the industry's carbon footprint. The introduction of the 'air-freighted' label by some European retailers in recent years generated some pushback by the industry within Kenya, and a demand that carbon footprints be assessed more holistically to include other aspects of carbon emissions, such as artificial heating and lighting, which are less necessary in the Kenyan industry as compared with European producers operating in colder climates. The Kenyan Flower Council (KFC) estimates that production of flowers within the country is five to six times less energy intensive than it is in competitor countries like the Netherlands; thus it was argued that the air-freight labelling scheme would unfairly discriminate against Kenyan producers by focusing on only one aspect of the carbon footprint (World Bank, 2011). The air-freight label has subsequently been withdrawn, ostensibly because consumers did not understand it, and KFC is now working with the Kenya Bureau of Standards and the Swedish Institute of Standards (SIS) in the development of ISO standards linked to ISO 14067 – the carbon footprinting of products.

KFC is also planning to set up a pooled carbon scheme to enable all of its members to collectively earn carbon credits (including members too small to earn credits on their own) by planting trees to create a 'flower industry forest'. In addition, KFC has set up its own code of practice, which establishes environmental and social criteria including energy, water and waste audits, and awards Silver or Gold certification depending on performance. KFC has engaged with international retailers and certification bodies in order to have this accreditation scheme internationally recognised, and so far it has been recognised under the GLOBALG.A.P. scheme, the South African National Accreditation System and

the Tesco Auditor Recognition Programme. Additionally, KFC has established a database including water and chemical use – and now also energy use and tree cover – to assess the extent to which the flower industry operates as a carbon sink.

Like other Kenyan industries, floriculture is suffering from high energy costs, which reduce its competitiveness, and some flower firms have been proactively seeking alternative energy sources, as discussed in the energy section above. For example, Bilashaka Flowers has invested in a major solar energy plant to provide heat and steam for its flower growing processes, reducing its expenditure on fuel wood and grid electricity (Hortfresh, 2012). Other flower farms are investing in biogas production; Kisima Flowers has set up a biogas plant, which reduces its carbon emissions, helps remove waste by-products cheaply and reduces its dependence on fuel wood, thus helping to cut costs. It also plans to sell surplus biogas to local schools.

A number of flower farms have also been carrying out energy audits, spurred by KFC leadership. According to the Kenyan Geothermal Development Company, there is a good potential for flower farms to set up production in geothermal areas of the country; this would allow them to access cheap, renewable energy as well as move flower farms away from their current production locations, where there is greater competition for water resources, such as in Lake Naivasha. There are also other forms of green innovation, such as the use of more effective biocontrol agents, improved use of hydroponics, and new irrigation techniques.

The Kenyan flower sector is also facing a number of other threats, including increased competition from countries such as India and China, which have started to grow and export their own flowers. These countries tend to face lower transportation costs than Kenyan producers: according to the 2013 Doing Business Indicators, it takes 21 days to clear goods for export[44] from China and 16 from India, while it takes 26 days from Kenya; but perhaps more importantly, the Kenyan price per container unit is $2,255, which is double the price in India and more than four times the price in China. Rising transport costs associated with rising oil prices could exacerbate these trends (World Bank, 2013).

Increased investment in flower producers in other African countries, such as Ethiopia, is another threat, as there has not been much recent investment in the sector within Kenya. According to the KFC, other African countries, where the cost of doing business (and, crucially, the cost of land) is lower, have an opportunity to expand production and gain market share. The KFC has also seen an increase in the number of delegations from other African nations interested in the flower sector, such as Sudan. The KFC states that in order to differentiate themselves from competition in other countries and add value to their products, Kenyan flower producers are now also providing finished products, e.g. bouquets and dried flower products, which require greater skills in the production process. Improved packaging to maximise the freshness of the product is also being developed, though this may generate increased transportation costs. Packaging and processing may also be able to reduce the perishability of certain products, and thus avoid the need to air-freight them, reducing both transport costs and the carbon footprint. This suggests that specific value chain development projects could be identified and supported that would yield synergies between environmental goals and competitiveness objectives.

4.10 Conclusion

Table 8 below summarises the main opportunities and risks that are currently faced in Kenya's agriculture sector, associated with the three key drivers identified at the beginning of this report: natural resource scarcity, international mitigation policies, and the impact of climate change. Possible policy and business responses are suggested, for further discussion and exploration at the national level.

[44] Within the 'trading across borders' section of the Doing Business Index, *Time to Export (days)* indicator

Table 8: Summary table of opportunities and risks associated with three drivers

Opportunities / threats	Implications / possible responses
Natural resource scarcity	
Increased demand for food and biofuels may drive up returns to farmers.	Increased returns from higher yields could incentivise greater investment in productivity improvements.
Dual crops – biofuels and food – create new, more diversified livelihoods for subsistence farmers.	Analyse potential of different biofuel crops, including impacts on economic returns, energy and food security.
Sustainable agricultural practices increase yields and competitiveness, but farmers currently fail to adopt sustainable agricultural practices as fast as competitors.	Support farmers in transition to sustainable agricultural practices. Invest in demonstration projects. Enable farmers to learn from practice in other countries.
Higher transportation costs may reduce scope to move up value chain in terms of enhanced packaging and processing of products if it increases bulk or if they still need to be air-freighted.	Undertake sector-specific risk analysis. Improve transport infrastructure to offset high transport costs. Invest in biofuels.
High transportation costs may be a threat to some export markets, especially as China and India expand production at lower costs.	As above.
International mitigation policies	
Certification and labelling can exclude producers from markets but can also be proactively used to establish Kenya's green credentials.	Proactive strategy to promote Kenyan products through standards and labels. Investment in necessary market institutions such as certification bodies.
Use of carbon footprint calculator to demonstrate superior carbon credentials compared with competitors. However, carbon credentials may not always be superior – will need to be determined on sector-by-sector basis.	Support efforts to measure carbon emissions, to incentivise improved soil carbon sequestration, which will yield improved competitiveness and access to carbon markets over time.
Packaging/processing may be able to reduce perishability and avoid air-freighting as well as adding value.	Invest in selected value chain development projects that yield synergies between economic and environmental goals.
Mitigation could also increase transportation costs – as above.	
Climate change impacts	
Climate change will reduce agricultural productivity overall, though may benefit some specific types of producers.	Invest in climate smart agriculture, adapt to changes in climate. Encourage diversification into new industries as necessary. More detailed analysis of climate change impacts on different crops.
Shortage of water – competition for water between agriculture, hydropower, and water use in cities.	Invest in improved water management system, more efficient irrigation for agricultural production.

Kenya's economy is highly dependent on the agriculture sector. Yet the sector currently faces significant threats arising from climate change, increased competition for land, certification and

labelling, high and rising energy and transport costs, and new sources of competition from other countries.

There are various solutions to these challenges and new opportunities that could be grasped. These include new markets such as biofuels and dual crops, which provide both food and fuel; alternative energy sources and energy-efficiency measures that can reduce costs and enhance competitiveness; certification schemes, which can be used proactively to help market Kenya's green credentials; sustainable agricultural practices that increase yields; and opportunities to move up the value chain that would also generate emissions savings. These kinds of reforms would position Kenya to compete effectively in a future low carbon global economy.

Although carbon markets are as yet unable to properly reward mitigation efforts within the agriculture sector, they could develop over time, and in the shorter term, public sources of climate finance could help to support the necessary transformation, yielding economic, social and environmental gains.

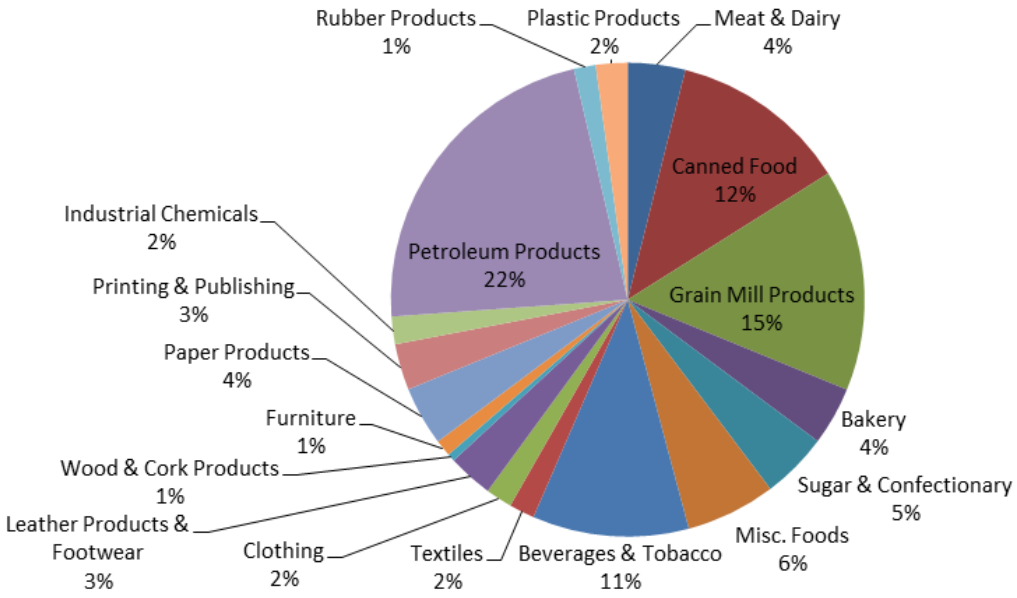
5 The manufacturing sector

5.1 Introduction

Kenya's manufacturing sector accounts for around 11% of its GDP and employed around 275,000 people in 2011, according to the Kenya National Bureau of Statistics (KNBS, 2012). The sector's output has increased from US$8.6 million in 2008 to US$12 million in 2011 (a 39.5% increase); thus, despite constituting a relatively small proportion of the economy, as a source of growth it is important. The majority of manufacturing sector output is based on agricultural products (57% in 2010).

The Kenyan Government is keen to develop the country's manufacturing base, as set out in Vision 2030. Government strategies for growth in the manufacturing sector mainly involve restructuring in order to increase the competitiveness of industries that use local raw materials, although there is also an aim to strategically increase the level of value addition in a number of key niche exports through local product processing, and value addition to imported products for re-export.

Figure 5: Manufacturing by value of output in Kenya (2010)



Source: KNBS (2012)

Kenya has a number of good trade links that benefit the manufacturing sector. For example, Kenya's membership in the EAC and COMESA means that its manufacturing firms are able to take advantage of regional markets. Kenya is also an AGOA (African Growth and Opportunity Act) signatory with the USA, which gives it a number of trade preferences when exporting to the USA.[45] This has meant that Kenyan manufacturers are being encouraged to invest in the production of textile, leather, horticulture, fish, rubber, iron and steel products since they can potentially benefit from the AGOA scheme (GoK, 2011a). Kenya is also currently involved in negotiations with the EU on a new Economic Partnership Agreement (EPA) that would allow it to export duty free goods to Europe.

[45] http://www.ustr.gov/countries-regions/africa/east-africa/kenya

5.2 Energy & manufacturing

The competitiveness of the manufacturing sector suffers from poor infrastructure and particularly from limited access to energy. In a recent report, KAM listed improved energy security as the highest priority for government action to improve industrial competitiveness. Poor access, and unreliability of electricity services resulting in load shedding and blackouts, mean that over 65% of companies in Kenya own an electricity generator (World Bank, 2007), the use of which substantially increases their overall production costs.

KAM has estimated that energy costs are much higher in Kenya (at US$0.18 per kWh) than in many competing countries, including Ethiopia (with electricity costs at US$0.03 per kWh), Egypt (US$0.05 per kWh) and Tanzania (US$0.09 per kWh), and attributes declining growth rates in the manufacturing sector in recent years largely to energy price increases (KAM, 2012). According to the Government of Kenya, industrial energy prices in Kenya in 2011 were US$0.16 per kWh, while they were US$0.06 in Korea, US$0.11 in France, and US$0.07 in the USA. Regionally, energy prices in South Africa and Tanzania were at about US$0.07 per kWh with only Uganda having comparable prices to Kenya (GoK, 2011).

KAM also estimates that over 60% of energy from the national grid is used by the manufacturing sector. Currently around 1,400 MW are being produced with an estimated 500 MW to be added to the grid by 2015; however, such an increase may still not be enough to cope with the demand from manufacturers (KAM, 2012).

Because of the high cost of energy, limited access, and unreliability of supply, many enterprises – including in the manufacturing sector – have been innovating in order to access alternative sources of fuel and energy. This is discussed in more detail in the energy section above. In addition, many manufacturing firms use fuel wood as a source of energy, and this is a significant driver of deforestation, which is becoming increasingly unsustainable as biomass resources are depleted and prices rise.

A better solution could be to establish sustainably managed ‘tree farms’ that implement continuous coppicing to generate a sustainable supply of wood biomass, an approach being developed in Cambodia, as discussed in Bona & Dana (2005). Some firms in Kenya (e.g. Williamson Tea) have themselves been planting trees with a view to providing an ongoing source of timber. This could help to reduce firms’ vulnerability to rising and fluctuating energy prices. Such private management of forest resources, perhaps supported by an appropriate incentive mechanism and regulatory framework, could provide a possible model for more sustainable forest management in some areas, as well as improving competitiveness and tackling energy shortages.

A growing number of firms have been conducting energy audits and undertaking energy-efficiency measures, with the assistance of the Kenya Association of Manufacturers, and the Kenya National Cleaner Production Centre, and achieving substantial savings in terms of both energy usage and carbon emissions, as illustrated in the energy section above. KAM states that this initiative has led to total cost savings of around US$116 million since it began in 2007, as well as a potential 68 MW reduction in energy consumption.

Discussions with the ERC have indicated that the nationwide scaling up of energy audits for manufacturing companies has commenced, but currently only 70 auditors are carrying out audits, while an estimated 300 are needed in order to complete the first batch by 2014. As a consequence, in order to increase the number of auditors, the ERC is providing technical training on energy-efficiency auditing.

KAM has also set up an Energy Management Award to incentivise enterprises to compete to make improvements, as discussed previously. The winners are then used as case studies by KAM to spur other companies to improve their efficiency. KAM is also looking to help secure financing for Kenyan manufacturing firms engaging in energy-efficiency procedures. One programme is linked to a number of donors, such as AFD, DANIDA, and GIZ, and aims to provide capital for companies to invest in renewable energy technologies. KAM also seeks to work with financial institutions in order to help

reduce the interest rates of loans for green investments. However, it notes that the local banks are not fully cooperating or greatly aware of issues relating to energy efficiency and climate change.

The United Nations Industrial Development Organization (UNIDO) has been carrying out the Resource Efficient and Cleaner Production (RECP) project together with selected manufacturing companies in Kenya since 2005. Table 9 below shows that the cost savings (for the selected case studies highlighted by UNIDO) were all worth over half a million US$ per year – for Chandaria Industries Ltd. (a paper manufacturer), the savings were 132 times greater than the initial investment costs. In addition, all three case studies showed a substantial reduction in annual energy use, and two of the case studies also showed some reductions in emissions. Clearly, this is just a small sample; however, it does show that there is potential for cost and energy savings in Kenyan manufacturing companies, savings that could potentially be scaled up significantly.

Table 9: Cost savings for UNIDO RECP case studies in Kenya, 2011

Company	Initial Investment (US$)	Cost Saving[46] (US$/Year)	Reduction in annual Energy Use (kWh)	Reduction in annual Air Emissions (t CO_2 Equivalent)
Chandaria Industries	4,802	633,000	5.3 million	1,456
Haco Industries	Unknown	548,000	286,847	Unknown
Pwani Oil Products	Unknown	623,768	2.7 million	22,550

Source: UNIDO, 2011

These initiatives have the potential to improve competitiveness, reduce Kenya's reliance on fossil fuels, and underpin a low carbon growth trajectory. However, innovation by firms to generate their own energy does not always result in low carbon outcomes. Often they invest in diesel generators, which can be considerably less carbon efficient than grid energy.

5.3 Environmental standards and regulation

It is very likely that over time there will be increased emphasis on environmental standards or certification down the manufacturing supply chain, as there already is in other sectors, such as agriculture as discussed above. If so, this could have an impact on access to markets for Kenyan manufacturing companies. It is also possible that as mitigation policies are strengthened, countries could require trading partners to account for the carbon used in domestic production or face the imposition of border carbon adjustments (BCAs) (Keane, 2013).

HIC retailers are already starting to impose higher environmental standards on their foreign suppliers, including LICs. Companies such as the UK's Marks & Spencer expect their suppliers to comply with all of the company's relevant environmental standards in addition to any relevant national and international regulations. Other retailers, such as Tesco (again in the UK), have set up a carbon footprinting programme.[47] Similarly, Walmart (one of the major US supermarket retailers) expects its retailers to be leaders in terms of applying high environmental standards.[48] Thus there is a concern that Kenyan manufacturers may lose (or be unable to gain) access to lucrative markets if Kenya does not adhere to more rigid 'green' standards.

[46] Factors in savings from energy, water and materials.
[47] http://www.tescoplc.com/assets/files/cms/Tesco_Product_Carbon_Footprints_Summary(1).pdf
[48] http://corporate.walmart.com/global-responsibility/ethical-sourcing/standards-for-suppliers

5.4 Opportunities for new manufacturing industries – with a focus on the solar panels industry

The Kenyan Government is keen to develop the country's manufacturing base, and the demand for renewable energy can potentially generate opportunities for new manufacturing industries to be established. One example of this is the market for solar powered appliances. Even though the Rural Electrification Authority in Kenya is scaling up its rural electrification process, there is still a substantial gap in the market – only 5% of rural residents currently have access to electricity – which is creating a market for renewable energy solutions, such as small-scale solar installations for households and certain commercial users such as telecommunications towers. It was estimated by one source that the solar energy market is growing in Kenya at a rate of 20% a year, even though it currently accounts for only around 1% of energy consumption.

Much of this demand is being met by imports, with between 20 and 30 companies importing solar panels into the country (WTO, 2009). One firm, Ubbink, has established a factory in Kenya that produces solar panels. Ubbink is cited as being the only manufacturer of solar panels in East and Central Africa. However, even in this factory almost all the components are imported, and are only assembled in Kenya, since the country is not yet able to produce the components itself, due to the high technological requirements and raw materials required (WTO, 2009).

Box 3: Ubbink – solar panel manufacturer

Ubbink is a European energy-efficiency firm that started production of solar panels in Kenya in 2011. Initially it began operations under its Corporate Social Responsibility programme, with the objective of providing solar solutions in East Africa and facilitating knowledge transfer. As a commercial venture it was seen as risky, but the value of creating a brand name and building up market share in the potentially fast-growing solar panel market in East Africa was also recognised.

Kenya was chosen to host this FDI as the country was deemed to have the best infrastructure in the region, and had good accessibility, good quality resources, a relatively skilled labour force, and adequate supporting industries. Being part of the East African Community made it easier to export regionally, and East Africa was a relatively underserved market.

However, as compared to its neighbours, Kenya is seen as lagging behind in terms of its renewable energy policies, with relatively low feed-in tariffs – which undermines commercial incentives for investment in renewables – and without any incentives for households to invest in renewable energy technology. Thus it is argued that the investment climate to attract renewable energy manufacturers could be improved.

Box 4: Winafrique – renewable energy provider

Winafrique is another provider of wind and solar power products across the country. The company offers hybrid technologies, i.e. a combination of both types of renewables, in order to provide energy greater autonomy in rural areas. The company was set up in 2001 because of the frequent power outages that the country was suffering at the time, and aimed to develop more reliable alternative energy sources. The company is well known for providing renewable energy generators to support mobile telephony infrastructure in the country's rural areas, including providing the country's largest cellular network (Safaricom) with energy for its

cellular phone towers.

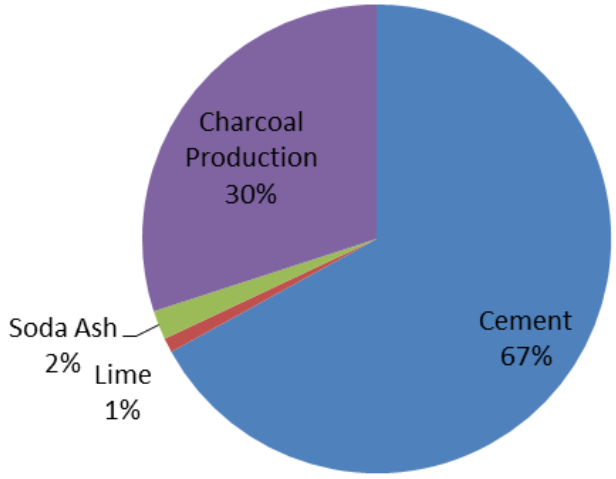
5.5 Threats to existing manufacturing industries – with a focus on the cement industry

Cement is one of the most energy-intensive industries. According to the International Energy Agency (IEA, 2007), non-metallic mineral production (of which cement accounts for around 80%) was, globally, third in terms of energy use for industry and accounted for close to a third of industrial carbon emissions. This means that increases in energy prices are likely to have a significant impact on the competitiveness of the cement sector. Although cement is not easily transported, there is still considerable trade in cement at the regional level, with around 15% of domestically produced cement being exported to Tanzania and Uganda in 2011 (KNBS, 2012), which makes international competitiveness important for the success of the domestic industry. Cement companies state that if the country had fewer power outages and the price of energy was lower, production for export purposes could have increased substantially, particularly given the fast-growing markets in countries like Uganda and Sudan.

Reducing CO_2 emissions in the Cement Sector

The cement sector is one of the biggest emitters in Kenya's manufacturing sector and accounts for about two thirds of all industrial emissions in the country (see Figure 6 below); hence the mitigation potential for the sector is potentially very high.

Figure 6: Main sources of industrial emissions (2010)



Source: GoK (2012)

There are a number of ways to reduce CO2/GHG emissions from the cement manufacturing process. The cement making process is based on clinker, which is a mix of limestone, clay, sand, bauxite and iron ore heated in a kiln. The process is typically fuelled by coal and 'petcoke' (petroleum coke). One of the methods that can be used to reduce emissions is the use of a high efficiency kiln, which uses less fuel and can thus save up to 380 kg of CO2 emissions per metric tonne of cement produced. Bamburi cement, the largest Kenyan cement producer (see Box 5 below), is already using more-efficient kilns in its cement production process.

A second method is that of replacing clinker with an alternative compound with reduced material processing requirements if compared to a traditional clinker cement process, hence reducing emissions. The materials required, such as fly ash, slag and silica fume, should potentially be available in Kenya, allowing such a substitution to become feasible, according to the Kenyan Government.

A third option is to simply replace the fuels used to heat the clinkers kilns (i.e. coal or petcoke) with renewable energy sources as well as other less conventional sources such as waste (CWR, 2011). East African Portland Cement (EAPC), the second largest cement company in Kenya, has been developing such a project, which would potentially reduce both costs and carbon emissions. Bamburi has set up a tree growing programme in order to substitute coal in its heating process with fuel wood to some degree, thus reducing carbon emissions as well as securing a more reliable fuel source with less price volatility (see below).

Box 5: Bamburi Cement

Bamburi Cement initiated a biomass and land utilisation initiative in 2006, revolving around tree planting on reserve land areas that are not being mined, with the aim of substituting coal with fuel wood in its production processes. This would help them gain a 10% saving on fuel costs, provide a reliable source of energy, and improve relationships with local communities who were given the role of planting and maintaining the trees. The programme has also provided training and capacity-building to local communities to help them to produce seedlings for the project, and has enabled them to use the space between the trees for farming. They initially envisaged a five-year rotation period, though it has taken longer to grow trees than expected, with the first batch of trees ready for harvesting by 2014 instead of 2011.

The company is also carrying out a land rehabilitation programme with the World Wildlife Fund (WWF) where it carries out afforestation activities on its old quarries, aiming to build up biodiversity and turn them into potential tourist attractions.

Bamburi is interested in the prospect of tapping into carbon markets to support these activities, and is aiming to develop a better understanding of their impact on carbon emissions, as well as to set up a baseline in order to monitor the impacts on emissions over time

Cement companies are also carrying out energy audits. EAPC has conducted one that has shown that it can substitute current fixed-speed electric motors with variable-speed motors that can help to reduce electricity usage. It has also introduced an energy management programme and, as previously noted, has been developing a waste-to-energy process using its industrial waste by-products, such as used tires. It was planning to access carbon financing, but this has taken longer and been more difficult to obtain than hoped.

In response to rising energy prices and energy fluctuations from hydroelectric power plants, several cement companies are setting up their own power plants, often using imported coal, to allow their operations to expand – and sometimes with a view to selling excess energy to the grid.[49] With the possibility that coal will be mined in Kenya, the business case (i.e. lack of affordable fossil fuels) to use renewable energy sources such as fuel wood or waste to power these plants may decline in the medium term, especially for cement companies, which unlike agro-processing firms may not have sustainable raw materials (such as agricultural waste or bagasse) to use to power their energy plants. In addition, access to potentially cheaper domestic sources of fossil fuels may prove to be a disincentive, in the medium term, for cement companies to focus on energy-efficiency procedures.

[49] http://www.businessdailyafrica.com/ARM-now-enters-financing-deal-to-produce-own-power-/-/539552/1443832/-/6mg4yxz/-/index.html

However, as new technologies, inputs and processes are being developed by the cement industry internationally to respond to energy and resource scarcity, and many of these are already delivering cost savings (Saidi et al., 2012), cement firms in Kenya will need to keep up if they – and the downstream industries they serve, such as the construction sector – are to remain efficient and competitive.

5.6 The potential impact of climate change on the manufacturing sector

As a fairly high proportion of Kenyan manufacturing output is based on agricultural products, the impacts of climate change on the country's agricultural production patterns will also have a potentially significant effect on local manufacturing opportunities. In addition, as a result of climate change impacts on water availability, there may be a decline in the availability of water for industrial processes as well as more variation in hydropower generation, which will negatively impact the supply of energy (SEI, 2009). This could cause manufacturing firms to shift towards thermal energy production (e.g. by diesel generators), potentially increasing both emissions and production costs (GoK, 2012).

5.7 Challenges for a greener and more efficient manufacturing sector

One of the challenges faced in developing a 'greener' and more energy-efficient manufacturing sector in Kenya has been the issue of access to finance for firms seeking to invest in energy-efficiency measures and green technologies. Enterprises already quote access to finance as a major impediment to investment in Sub-Saharan Africa, and face high interest rates, but enterprises that want to make green investments may face additional challenges, which KAM states are threefold:

1. Banks are not interested in financing green investment projects since they are not fully aware of the financial returns that green investments can provide.
2. The financial institutions base their loan granting decisions on the credit rating of the enterprises rather than on the potential returns from that particular investment, hence most enterprises are excluded from acquiring loans.
3. Financial institutions in Kenya have not had much experience in supporting green investments, hence are wary of providing loans on this basis.

The Kenyan Ministry of Finance has initiated a number of projects to respond to these challenges. For example, it is hoping to leverage private investment through public-private partnerships that facilitate risk-sharing in order to encourage investment in geothermal power generation. In addition, it is seeking donor funding to support bank loans that will help private enterprises to install solar heating units in urban buildings.

Carbon finance could potentially support funding for these kinds of projects – although Kenya can no longer participate in the CDM as it is not a least developed country. In any case, until now the high level of bureaucracy and low value of carbon credits has hampered the development of this market. Nonetheless, public climate finance could still yield additional finance for such projects. This was discussed in more detail in the energy section above.

Another major constraint, identified by the Kenya Private Sector Alliance (KEPSA), is that many enterprises are not aware of the energy-efficiency and alternative energy opportunities that could save them money. The Kenyan Ministry of Finance is now working with organisations like KAM and KEPSA to educate their members on these investment opportunities. KEPSA is currently coordinating the 'Climate Business Information Network' (supported by the Business Advocacy Fund) to enhance private sector awareness on the challenges and opportunities related to climate change.

5.8 Conclusion

Table 9 below summarises the main opportunities and risks that are currently faced in Kenya's manufacturing sector, associated with the three key drivers identified at the beginning of this report:

natural resource scarcity, international mitigation policies, and the impact of climate change. Possible policy and business responses are suggested, for further discussion and exploration at the national level.

Table 10: Summary table of opportunities and risks associated with three drivers

Opportunities / risks	Implications / possible responses
Natural resource scarcity	
High prices and unreliability of energy supply undermine competitiveness of manufacturing sector.	Invest in energy infrastructure, including renewables.
Investment by manufacturing firms in alternative renewable energy sources could create long-term competitiveness and generate additional revenue source.	Create incentives for more manufacturing firms to do this, e.g. through feed-in tariffs.
Industry is driving unsustainable deforestation due to its consumption of fuel wood.	Establish sustainable 'tree farms' and technologies that convert biomass to electricity.
Investment by manufacturing firms in alternative renewable energy sources, e.g. agricultural waste or tree farms, could create long-term competitiveness and generate additional revenue source.	Create incentives for more manufacturing firms to do this, e.g. through an appropriate regulatory framework and feed-in tariffs.
Opportunities for new manufacturing industries, e.g. in renewable energy appliances.	Create an appropriate investment climate including clear policy framework and appropriate regulation. Dialogue with possible future investors in high-potential sectors to help identify reforms required to improve attractiveness as a host country.
Energy-efficiency measures save money, improve competitiveness and reduce carbon emissions.	Enforce regulations regarding energy-efficiency audits. Advertise benefits of energy-efficiency measures as demonstration effect.
Lack of awareness of potential cost savings associated with energy efficiency.	Advertise benefits of energy-efficiency measures, training and awareness raising through SME organisations and financial services sector.
Threats of higher energy prices to competitiveness of existing energy-intensive industries, e.g. cement – but innovation could translate into competitive advantage in future.	Weigh up economic/competitiveness costs and benefits of prioritising these energy consumers when increasing energy supplies (e.g. if and when domestic fossil fuel sources become available) vs. encouraging their investment in alternative energy supplies.
Increased domestic availability of fossil fuels may reduce energy prices but also undermines incentives for investment in renewables and energy-efficiency measures.	Strategic decisions to be faced, requiring analysis of long-term and short-term implications for energy costs and competitiveness.
International mitigation policy	
Possible future green standards, labels or demands for carbon footprinting arising from international mitigation measures could undermine competitiveness and reduce access to markets for non-certified producers.	Introduce environmental regulation of the manufacturing sector; develop appropriate standards and labels and other incentive mechanisms to encourage environmental best practice.

Public climate finance or carbon markets as a source of funding for green investment.	Develop a strategy that optimises contribution from public sources of climate finance. Reduce expectations of carbon markets as a source of finance in the short term.
Climate change impacts	
Impact of climate change on hydropower generation reduces energy availability, further undermining manufacturing sector growth.	Diversify energy generation nationally and locally.
Impact of climate change on agricultural production could threaten some agro-processing businesses.	Assess climate change impact risks and disseminate conclusions to affected firms. Put in place response strategy or diversification plan as needed.

The high price, poor access and unreliability of energy have significantly undermined the competitiveness of Kenya's manufacturing sector to date. However, as firms respond by increasingly innovating to find or generate alternative sources of energy and introduce energy-efficiency measures, this could turn into a competitive advantage in an international low carbon economy with rising energy prices. Energy-efficiency measures are another important way to promote competitiveness, and Kenyan companies adopting such measures have achieved impressive cost savings, as well as emissions reductions.

Many manufacturing firms use fuel wood as a source of energy, and this is a significant driver of deforestation, which is becoming increasingly unsustainable as biomass resources are depleted and prices rise. A more sustainable solution could be to establish sustainably managed 'tree farms' that implement continuous coppicing to generate a sustainable supply of wood biomass. Some firms in Kenya have themselves been planting trees with a view to providing an ongoing source of timber. This could help to reduce firms' vulnerability to rising and fluctuating energy prices. Such private management of forest resources, perhaps supported by an appropriate incentive mechanism and regulatory framework, could provide a possible model for more sustainable forest management in some areas, as well as improving competitiveness and tackling energy shortages.

Environmental standards, carbon footprinting and associated certification may become requirements to access certain international markets for manufacturing products in future. Thus, appropriate environmental regulation and standards within Kenya will help to ensure the sector remains competitive. Multinational companies can often be first adopters of these kinds of innovations, and often follow best practice standards set in their home country. This can yield spillovers for local firms if managed well.

There are also some specific threats to existing industries that are very energy-intensive, such as the cement industry, arising from growing global energy prices, and this is driving innovation internationally. It will be important for Kenyan companies to keep up with this technological progress, if they are to remain efficient and competitive. Multinational companies can often be first adopters of these kinds of innovations, which can yield spillovers for local firms.

There are also opportunities for new manufacturing industries to develop, for example in renewable energy appliances. Given Kenya's political and economic position within East Africa, it is well placed to attract foreign direct investment into these new industries, if the investment climate is right. Dialogue with possible future investors in high potential sectors can help to identify areas where reform may help to attract FDI.

As noted in the energy section above, while some effort has been expended developing projects that incorporate finance from carbon markets, in practice this unfortunately now seems unlikely to yield much finance in the short term, and Kenya is no longer eligible to access CDM in any case. However, support and incentives for the kinds of investments discussed here, which are linked to a wider

business case based on energy prices, could yield better results. Given the level of innovation that is already being exhibited in Kenya, it is well positioned to secure public climate finance to support these kinds of investments.

6 Conclusions

The aim of Kenya's Vision 2030 initiative is to create a globally competitive and prosperous nation with a high quality of life by the year 2030. The success of this approach will depend to a large extent on the global trade patterns shaping the opportunities that Kenya faces. Our analysis suggests that over the next 10 years, global trade patterns will be transformed by climate change, international mitigation, and natural resource scarcity, resulting in an inevitable shift over time to a low carbon global economy. This study has been asking what this might look like. What impact will it have on Kenya's competitiveness and growth? What threats and opportunities will it create? And how should policy-makers and businesses respond?

This report has examined how these issues could play out in Kenya over the next decade, particularly focusing on the energy, agriculture and manufacturing sectors. It has identified potential opportunities and threats to Kenya's competitiveness and growth, and possible policy responses.

Energy

Kenya is at a crossroads in terms of its energy system. Until now, the high and variable costs, the limited availability and the unreliability of energy have significantly undermined the competitiveness of Kenyan business and hampered industrial development. However, with multiple renewable energy opportunities now being developed, Kenya could in future find itself in the enviable position of having one of the greenest energy sectors in the world. That would be likely to yield a significant competitive advantage in a future low carbon global economy, as well as attracting potentially large amounts of climate finance.

Some firms in Kenya are at the forefront of innovation to secure alternative, renewable sources of energy for their own use and to sell to the grid, generating additional income sources. Opportunities include mini-hydro, geothermal, solar, biogas, and cogeneration. Policy could encourage companies to take advantage of these opportunities, to enhance competitiveness and improve the energy supply, thus promoting the transformation to a low carbon growth trajectory in Kenya. Such investment would also allow the development of a more decentralised system of provision that could underpin private sector development and growth in previously underserved areas of the country.

With the recent discovery of fossil fuel reserves, however, Kenya has some strategic decisions to make about the use of those reserves once their viability is confirmed, decisions that will have major implications for the future energy mix and competitiveness of industry. It will be important to utilise the reserves and the revenues they generate in a way that supports rather than weakens incentives for renewable energy development, and thus promotes Kenya's long-term competitiveness in a low carbon global economy.

Possible policy responses:

1. Continue to support renewables development and capitalise on innovation by individual firms to enhance the supply of renewable energy, by creating an enabling regulatory framework. Reward firms for investing in alternative energy solutions, through appropriate feed-in tariffs, the establishment of mini-grid frameworks, and net metering mechanisms for example.

2. Build industrial development strategies around renewable energy sources. For example, investment in infrastructure and other market support structures in areas near geothermal fields, and the establishment of partnerships with private investors to further expand geothermal generation, could be complemented by additional incentives and promotion efforts to encourage industrial relocation and attract FDI to those areas, which will in turn enhance the returns to investment in geothermal generation.

3. In order to ensure Kenya's competitiveness in a future low carbon global economy, utilise Kenya's domestic fossil fuel reserves (if their commercial potential is confirmed), in ways that support the development of renewable energy e.g. by exporting the fossil fuels and investing the revenues in renewables. Specify a clear direction for energy policy in order to avoid undermining incentives for private investment in energy generation – particularly of renewables – due to ongoing policy uncertainty.

Agriculture

Kenya's economy is highly dependent on the agriculture sector, yet it faces significant threats from climate change, environmental and carbon-related certification and labelling, increased competition for land, high and rising energy and transport costs, and new sources of competition from other countries. There are various solutions to these challenges, however, and new opportunities that could be grasped, which would position Kenya to compete effectively in a low carbon global economy.

Possible policy responses:

1. Support and promote efforts to measure the carbon footprint of agricultural production, capitalising on private sector innovation in this area, in order to incentivise improved soil carbon sequestration, which will enhance competitiveness and ensure ongoing access to export markets in a future low carbon global economy.

2. Proactively establish Kenya's green credentials on international markets, by introducing and enforcing domestic standards and working with private players in the value chain to develop and obtain internationally recognised product labels. Invest in the necessary market institutions such as certification bodies and testing laboratories.

3. Support farmers in the transition to sustainable agricultural practices and climate resilient production methods, in order to enhance yields, capitalise on rising food prices, and ensure long-term sustainability. Invest in research, demonstration projects, and awareness raising activities, and enable farmers to learn from practice in neighbouring countries.

4. Capitalise on rising food prices and competition for land and the bargaining power that gives Kenya vis-à-vis international investors, by regulating private investment in land (and agriculture) to ensure its productive utilisation and associated employment creation, and to maximise potential spillovers to the rest of the agricultural sector to enhance yields and competitiveness.

5. Analyse the market potential of different biofuel crops – particularly dual crops such as sugar,

cassava, sweet sorghum, or castor, rather than Jatropha – to generate higher incomes and more diversified livelihoods for farmers, and to promote food and energy security.

Manufacturing

The high price, limited availability and unreliability of energy have significantly undermined the competitiveness of Kenya's manufacturing sector to date. However, as firms are responding by increasingly innovating to find or generate alternative sources of energy, as noted in the energy section, this could well become a significant competitive advantage in a global low carbon economy facing rising energy prices. Energy-efficiency measures are another important way to promote competitiveness, and impressive cost savings – as well as emissions reductions – have been achieved by Kenyan companies adopting such measures.

Many manufacturing firms use fuel wood as a source of energy, and this is a significant driver of deforestation, which is becoming increasingly unsustainable as biomass resources are depleted and prices rise. Some manufacturing firms are investing in land and planting trees with a view to managing the forest sustainably and securing an ongoing source of timber for fuel, thus reducing their own vulnerability to rising and fluctuating energy prices. Such private management of forest resources, perhaps supported by an appropriate incentive mechanism and regulatory framework, could provide a possible model for sustainable forest management in some areas.

Environmental standards, carbon footprinting and associated certification may become requirements to access certain international markets for manufacturing products in future. Thus, appropriate environmental regulation and standards within Kenya will help to ensure the sector remains competitive.

There are also some specific threats to energy-intensive manufacturing industries such as cement, from growing global energy prices and potential future international mitigation policies, and this is driving innovation internationally. It will be important for Kenyan companies to keep up with this technological progress if they are to remain efficient and competitive. Multinational companies can often be first adopters of these kinds of innovations, which can yield spillovers for local firms.

There are also opportunities for new manufacturing industries to develop, for example in renewable energy appliances. Given Kenya's political and economic position as a gateway to East Africa, it is well placed to attract foreign direct investment into these new industries, if the investment climate is right. Dialogue with possible future investors in high potential sectors can help to identify areas where reform may help to attract FDI.

As noted in the energy section above, while some effort has been expended developing projects that incorporate finance from carbon markets, in practice this unfortunately now seems unlikely to yield much finance in the short term, and Kenya is no longer eligible to access CDM in any case. However, support and incentives for the kinds of investments discussed here, which are linked to a wider business case based on energy prices, could yield better results. Given the level of innovation that is already being exhibited in Kenya, it is well positioned to secure public climate finance to support these kinds of investments.

Possible policy responses:

1. Enforce regulations regarding energy-efficiency audits. Advertise the financial benefits of energy-efficiency measures more widely to raise awareness amongst the business community and trade associations. Engage with financial providers to raise awareness about lending opportunities for energy-efficiency measures that yield positive returns, and share risks through loan guarantees.

2. Identify the most energy-intensive sectors and incentivise innovation to reduce emissions, in order to remain competitive in a low carbon global economy. Possible measures include standards, reporting, sustainability awards, fiscal incentives, or self-regulatory mechanisms.

3. Identify opportunities for new manufacturing industries that Kenya has a realistic potential to develop – for example, the production of renewable energy appliances such as solar water heaters. Consult with business to create an appropriate climate for such investment, for example through the introduction of building codes and regulations that will help to develop the domestic market for such products, and through investing in the necessary skills development.

4. Explore the economic and political feasibility of private management of fuel wood plantations by industry as a possibly sustainable solution to dwindling fuel wood reserves, and assess the regulatory frameworks and governance structures required.

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