



Analysis of private investment for NDC implementation in various sub-sectors

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List of abbreviations & glossary

AECF	Africa Entrepreneurship Challenge Fund
BAU	Business as usual
CEEC	Center for Energy Efficiency and Conservation
CIDA	Canadian International Development Agency
CIDP	County Integrated Development Plan
CO ₂	Carbon dioxide
CO ₂ e	Carbon dioxide equivalent
DANIDA	Danish International Development Agency
DFID	Department for International Development
EIB	European Investment Bank
ERC	Energy Regulatory Commission
EU	European Union
FFSPAK	Farm Forestry Smallholder Producers Association of Kenya
GACC	Global Alliance for Clean Cookstoves
GDC	Geothermal Development Company
GHG	Greenhouse gas
GVEP	Global Village Energy Partnership
IFC	International Finance Corporation
IISD	International Institute for Sustainable Development
INBAR	International Network of Bamboo and Rattan
IPP	Independent Power Producers
JICA	Japanese International Co-operation Agency
KBA	Kenya Bankers Association
KCFP	Kenya Commercial Forestry Program
KenGen	Kenya Electricity Generating Company
KEREA	Kenya Renewable Energy Associations
KFS	Kenya Forest Service
KfW	German Development Bank
KTDA	Kenya Tea Development Agency

LPG	Liquified Petroleum Gas
LULUCF	Land Use, Land Use Change and Forestry
MENR	Ministry of Environment and Natural Resources
MOEP	Ministry of Energy and Petroleum
Mt	Million tons
NAP	National Adaptation Plan, 2015-2030
NCCAP	National Climate Change Action Plan, 2013-2017
NCCRS	National Climate Change Response Strategy
NDC	Nationally Determined Contribution
NEMA	National Environment Management Authority
NSE	Nairobi Stock Exchange
PPP	Public-Private Partnerships
PSAKFE	Aga Khan Fund for the Environment
REA	Rural Electrification Authority
REDD+	Reducing Emissions from Deforestation and Forest Degradation
SHS	Solar Home System
SNC	Second National Communication
SREP	Scaling-up Renewable Energy Program
TNC	The Nature Conservancy
UNFCCC	United Nations Framework Convention on Climate Change
USAID	United States Agency for International Development
VAT	Value Added Tax

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1 Executive summary

The rise in extreme weather events, surging global temperatures, and increasing sea levels present serious challenges for countries and has made climate change a global concern. The Government of Kenya (GoK) recognizes these trends and ratified international conventions, including the United Nations Framework Convention on Climate Change (UNFCCC), as well as most recently, the Paris Agreement. All party nations are required to submit their targets for this agreement through Nationally Determined Contributions (NDCs).

Kenya's NDC was submitted on 28th December 2016 with a GHG reduction target of 30%¹ to be achieved by 2030. The government took a conservative but realistic approach in setting their target, resulting in 42.9 MtCO₂e divided amongst six focus sectors – energy, agriculture, forestry, transport, industrial processes and waste. The forestry sector has the largest contribution to the target – 47% – followed by energy at 36%, then transportation at 8%.

However, to reach these goals, there is a significant amount of public and private financing required to help build projects, and even entire industries. The GoK has made strides to source financing for public-sector led projects, such as geothermal development, but their role in facilitating finance to non-public sector projects has been limited. While government documentation points to the need to engage with the private sector, and have a series of actionable plans, most notably the Nationally Appropriate Mitigation Actions (NAMAs), implementation of these plans has lagged. However, in traditionally non-government led sub-sectors, such as clean cookstoves and solar-home systems (SHSs), the private sector has seen significant growth and investment in part thanks to the conducive investment environment but also support from international organizations and donors.

However, this still means there are several sectors that have received significantly less attention and funding that warrant additional support, and could potentially help Kenya reach its targets. OCA examined several sub-sectors that were found in the NDCs and other government documents, but also considered some sub-sectors outside of these. Based on minimum existing government articulation of potential mitigation and adaptation actions, OCA's experience in the sub-sectors, and performance in key criteria selected (process explained under the scope and methodology section), OCA chose three high-potential sub-sectors for further analysis:

1. **Private sector models in forestry:** focusing on two models that help reduce deforestation through wood supply management – provision of alternative fiber and increase in overall forest stock through micro-forestry.
2. **Alternatives to wood and charcoal for residential and/or industrial processes:** similarly aims to reduce deforestation, but through provision of alternative fuels for both household and industrial use – ethanol, briquettes and liquified petroleum gas (LPG).
3. **DC appliances for industrial use:** energy efficient appliances that are compatible with many solar-home systems, mini-grids, and other renewable off-grid electrification technologies that have undergone rapid recent growth in Kenya.

The first two sub-sectors are significant in their potential to reduce deforestation, as there is increasing demand for wood in both commercial timber manufacturing industries and household use as a biofuel. It is estimated that 80% of the country's energy demand is met by wood fuel, creating a lot of pressure on the country's forest resources. This importance was also validated by government

stakeholders during consultations, as the forestry sector has been listed as one of the six NDC focus sectors, anticipated to contribute nearly 50% to the government's GHG emission reduction target of 42.9 MtCO₂e.

Additionally, there is also a need to look at both mitigation and adaptation sections. The former being sectors that directly contribute to GHG emission reduction, and the latter referring to sectors that build resilience through adaptation to climate change. The third sub-sector, DC appliances, focuses on adaptation technologies that not only promote the efficient use of energy, but that also help communities in off-grid or unreliable grid areas to improve the productivity of their income-generating activities.

The following recommendations are based on subsequent research and interviews with key stakeholders, including government, investors, private sector companies, and non-governmental organizations (NGOs).

Recommendations for private sector models in forestry

Through OCA research and analysis, that included stakeholder consultations, OCA has identified and recommended potential areas for support for the Mobilizing Private Investment (MPI) project per sector. These consider the financial and technical capacity of CDKN, the timelines of the project, and commonly focus on activities such as technical assistance, research and development, market research, awareness building, advocacy and policy lobbying, and piloting specific business or government initiatives for broader sector learning.

Micro-forestry

1. Collateralization research: Commercial and smallholder farmers both lack access to capital, and one of the contributing reasons to this is because banks traditionally see no forms of collateral, given the long timeframes. There are initial efforts looking at the collateralization of trees, and CDKN can partner with organizations such as The Nature Conservancy (TNC) to co-finance a study, with the right finance and legal expertise, on how trees can be used as collateral. This will enhance the business case for and ease of investing in sustainable tree plantations for both commercial and smallholder farmers.

2. Investment de-risking: Despite many government and non-government organization (NGO) initiatives in forestry, market-driven micro-forestry is still a very young sector with few established players and limited track record. In addition to the TA mentioned above, one additional strategy to stimulate initial investment could be to de-risk investors, either in the form of direct guarantees or by providing assistance to set up risk-mitigating investment structures such as SPVs or pooled asset funds.

3. Technical assistance: Micro-forestry relies on smallholder farmers to provide their own land and manage tree plantations to high degrees of quality according to specific agronomic techniques – this aspect can be resource and time intensive to do adequate monitoring. Working directly with strategic value chain actors, like aggregators such as Komaza, to create and test different supply chain management systems would present an opportunity to develop more scalable models. There is an opportunity to test how these systems can be improved through use of ICT.

CDKN can also play a significant role by lobbying for capitalization of similar investment vehicles such as the “Tree Fund” by TNC. Using CDKN influence with DFIs and the government, they can convince larger blended capital investors to support such funds designed to provide capital for smallholder farmers.

Alternative fibers

4. Market research & awareness building: Alternative fiber markets are constrained by a broad lack of consumer awareness regarding the availability, uses, and cost implications of fibers such as bamboo, particularly as an alternative in manufacturing industries. Many potential growers also lack information on demand and technical agronomical knowledge. There is a need for more research on the demand for alternative fiber products, building a detailed business case for potential alternative fiber value chain actors, and making the findings of this research available to the industry more broadly.

Recommendations for alternatives to wood and charcoal for residential and/or industrial processes

1. Regulatory and policy framework: Apart from direct policy formulation in the ethanol market, enforcing and introducing regulations on traditional fuels levels the playing field for all household energy fuel players in the market. VAT is charged on imported ethanol, despite no VAT on charcoal and kerosene because they are largely traded and used illegally.

Both the ethanol and kerosene markets need to be highly regulated as well, as both fuels are highly flammable – ethanol being more flammable than kerosene. There is higher potential to influence the regulation on distribution in the ethanol market as, opposed to kerosene, as the market is still developing. One of the ways in which CDKN can support the formulation of policies that would create a suitable regulatory environment is through provision of services of industry specialists to advise the Kenya Bureau of Standards (KEBS) committee on best practices and international standards to adopt.

2. Comparative analysis: CDKN can support the uptake of alternative fuels by conducting a third-party comparative analysis between different alternative fuel types to determine which are the most cost-effective and appropriate for certain customer segments, as well as the cost of mainstreaming the fuel for mass market consumption. This research could also inform the lobbying and subsequent design and pilot of a clean burning fuel subsidy by the government and/or global climate funds, as some fuels may be cheaper to subsidize than others.

3. Consumer awareness: Despite increasing efforts to raise consumer awareness of the climate, environmental, and health risks of traditional wood or charcoal-fired stoves, most of these have focused more on the stove and less on the fuel. There is therefore still little awareness among residential consumers of the uses, prices, availability, and benefits of alternative cooking and heating fuels, which has limited demand. For successful substitution of charcoal with clean energy, there is continued need for campaigns to advertise the potential health, environmental, and economic benefits of non-carbon fuels. CDKN can work with alternative fuel companies to create consumer story-focused marketing campaigns, that also address poor cooking behaviors that drive up the cost of fuel use, like prolonged boiling of beans rather than pre-soaking.

4. *Technical assistance:* Many of the alternative household cooking fuel providers still require assistance to adequately test and scale distribution models, which according to stakeholder consultations, have traditionally been harder to perfect than product-side innovation. Some of the companies that can greatly benefit from such support include KOKO Networks. CDKN can work with the company to pilot a centralized model that will achieve last mile distribution to various parts of the country, not just the major cities.

Recommendations for DC appliances for industrial use

1. *Market research:* Overall in the DC appliances markets in Kenya, there is little basic information available to help manufacturers and distributors design products tailored to local conditions and customer preferences. For example, considering water pumps, there is poor and outdated information on water tables, boreholes, and water demand based on crops grown for areas across Kenya. By working with existing organizations or businesses who are trying to collect this information, such as Sollatek, prevailing this information to the wider market would help bring better tailored products to the market faster.

2. *Product research:* Like above, basic market information hinders manufacturers and distributors from offering tailored products to the market. Further supporting these companies in their research and development (R&D) efforts, products needed to be rigorously lab and field tested, would also help more and better products reach the market faster. CDKN can work with companies like Sunculture, who have developed a breakthrough energy management platform that will allow them to design other efficient DC appliances, in attracting funding for a larger product testing initiative.

3. *Technical assistance:* DC appliance companies, especially for larger, more expensive appliances, need to come up with different, innovative lending models that will help increase access to their products. For example, Sollatek is looking at providing cooperatives with high-capacity water pumps on credit through working with MFIs, but there needs to be significant use-case and credit-worthiness research done before piloting. CDKN can support in this research as well as through the pilot phase; success of this model could be scaled to other DC appliances.

4. *Regulatory and policy framework:* While solar DC appliances and accessories are exempt from import tariffs and VAT, companies must obtain an exemption certificate for every container that is imported into Kenya, making it a needless time and resource intensive process for distributors. CDKN can make this process smoother by leading lobbying efforts with the government to issue longer-term exemption passes.

5. *Consumer awareness:* Many Kenyans might have the perception that DC appliances, especially DC fridges and water pumps, are too expensive. As cheaper but high-quality products increasingly come onto the market, as well as innovative financing mechanisms, there will be a need to boost demand through awareness-raising campaigns, with emphasis on the financial and environmental benefits of these technologies.

2 Scope of work and methodology

The following elaborates on OCA's scope of work and methodology for this project. In efforts to better understand the level of private sector investment facilitated into these sectors to reach these targets, OCA was tasked by the Climate and Development Knowledge Network (CDKN) to:

- Analyze the **extent to which the government has articulated private investment** plans and goals within existing policies and other documentation;
- **Identify 3 sub-sectors** that are relevant to Kenya's NDC where there are clear gaps in financing and the enabling environment that can be addressed by further CDKN intervention;
- **Provide an initial assessment of the investment and institutional landscapes**, as well as the scale of opportunities, risks and barriers to investment within these sub-sectors, and make recommendations for deeper analysis; and,
- **Map key actors and types of expertise** to be considered by CDKN under each sub-sector, for it to succeed in its expert facilitation and brokering role.

OCA began by reviewing all relevant government documentation such as the NDCs, the National Climate Change Adaptation Plan (NCCAP), and Kenya's Second National Communication (SNC) to determine whether the government has made a concerted effort to promote and channel private finance into climate change-related sectors. OCA also did intensive secondary research, and based on our experience in the region, on the conduciveness of the investment climate in Kenya, and historical investment and government intervention in the sub-sectors.

To choose the sub-sectors, OCA began with the NDC and related documentation by the Ministry of Energy and Natural Resources (MENR), which identified six sectors of focus to help in reaching the 30% GHG emission reduction in 2030. Though the analysis and research were conducted around these six NDC-identified focus sectors, the final three sub-sectors were as a result of considering additional sectors outside of the NDC documentation. The list of sectors also considered represented both mitigation and adaptation actions.

To narrow these down to three sub-sectors, several criteria were applied to determine the most suitable sub-sectors for further analysis – additional investment opportunities, GHG reduction potential, market growth stage and potential, development co-benefits resulting from growth of the sub-sector, and amount of additional capital to be deployed to fill significant financing gaps. These criteria are elaborated on in section 4.1.

The findings in this report were also informed by intensive secondary market research with nine stakeholder consultations. Many of the stakeholder consultations focused on better understanding market dynamics, and specific financing or capacity gaps within each sub-sector.

Consultations with stakeholders were carried out at different stages of the project and are outlined in Table 1, below.

Table 1: Stakeholders consulted in OCA research

Organization engaged	Description of stakeholder/organization engaged
Ministry of Environment and Natural Resources	<i>Directorate of Environment.</i> They co-ordinate all activities relating to policy formulation and implementation within the ministry.

Kenya Association of Manufacturers (KAM), Kenya Private Sector Alliance (KEPSA)	<i>Multiple representatives, including Center for Energy Efficiency and Conservation (CEEC).</i> KAM and KEPSA are associations representing private sector interests, both who have several climate-change related initiatives, including CEEC, who run energy conservation and efficiency programs.
National Treasury	<i>Green Climate Fund project.</i> The National Treasury prepares government and local climate change organizations to access funding from the Green Climate Fund (GCF).
KOKO Networks	<i>Founder.</i> KOKO Networks is a technology company, currently focusing on scaling the use of ethanol cooking fuel in Kenya.
Sollatek	<i>Projects and Partnerships division.</i> Sollatek is a company that provides energy efficient appliances and renewable energy solutions.
Clasp	<i>Africa Regional Lead.</i> Clasp is an NGO leading efforts aimed at providing energy efficient solutions in off-grid markets.
Sunculture	<i>Founder.</i> Sunculture is a solar water pump and DC appliance company.
Novastar Ventures	<i>Co-founder and Investment Director.</i> Novastar is focused on impact investing across multiple sectors including forestry and renewable energy.
The Nature Conservancy	<i>Strategy Analyst.</i> The Nature Conservancy is an NGO working towards reversing deforestation and encouraging sustainable forestry practices

Source: OCA research

3 Attracting private sector investment in NDCs and LEDs

The following section broadly discusses the various initiatives set by the government in response to climate change, and specifically the participation of the private sector and private sector financing.

Section 3.1 aims to understand the general targets, as prescribed by global accords, set by the government to reduce greenhouse gas (GHG) emissions and how this translates to the economic sectors targeted – specifically the Nationally Determined Contributions (NDCs) under the Paris Agreement. This section also includes analysis of the various policy documents prepared by the government with regards to these targets and comments on how well they articulate actionable plans and if they are informative to potential private sector partners. Lastly, sections 3.2 and 3.3 discusses the prevalence and nature of strategies set by the government to attract investments into projects related to climate change, the general Kenyan investment climate, and trends within private sector investment in Kenya.

3.1 Elaboration of Nationally Determined Contribution

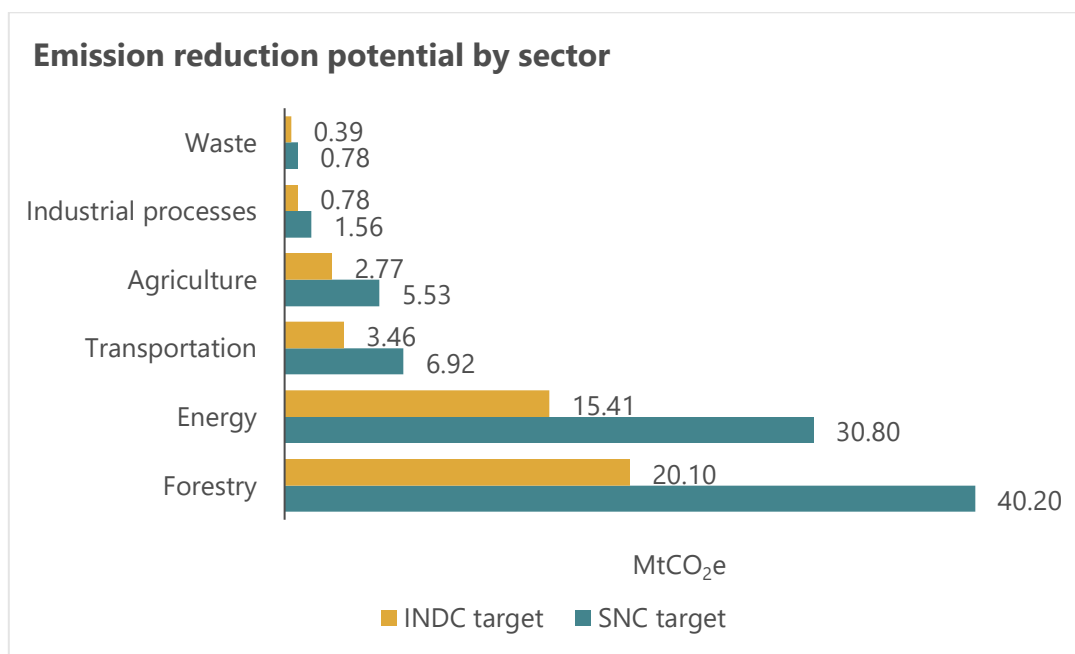
Nationally Determined Contributions (NDCs) are targets set by country governments in accordance with Article 4 of the Paris Agreement for the reduction of GHG emissions. Kenya's NDC was submitted

in July 2015 with a GHG reduction target of 30%₂ to be achieved by 2030, under the assumption that projected emissions amount to 143 million tons of carbon dioxide equivalent (MtCO_{2e}). This is the most recent and relevant target set by the Kenyan government, and thus analysis of these efforts is the focus of this research.

Kenya's Second National Communication (SNC), a document that outlines the government's action plans on GHG emission reduction, to the United Nations Framework Convention on Climate Change (UNFCCC) points to the potential to decrease projected emissions by 85.79 MtCO_{2e} in 2030. However, this is a best-case scenario that was determined using a low-carbon approach, which government officials stated was idealistic in nature and assumed widespread efficient energy use and adoption of improved technologies to enable the successful implementation of the target mitigation actions.

The government took a conservative approach in setting NDC targets based on what was deemed feasible in 2015, using already existing technologies in the country. **Therefore, the NDC target, which is more conservative and assumes that all sectors are focused on achieving their individual reduction targets within the current policy frameworks, is half of the total potential outlined by the SNC.** The resulting NDC target of 42.9 MtCO_{2e} is divided amongst six target sectors – energy, agriculture, forestry, transport, industrial processes and waste. These sectors, shown below with the highest mitigation potential labelled as forestry, are elaborated on in the coming sections.

Figure 1: NDC greenhouse gas emission reduction targets by sector



Source: Government of Kenya (2015), Second National Communication

The NDC further outlines adaptation goals and priority adaptation actions for each sector to achieve the overall 30% reduction target, stating "Kenya will ensure enhanced resilience to climate change towards the attainment of Vision 2030 by mainstreaming climate change adaptation into the Medium-Term Plans (MTPs) and implementing adaptation actions. Any reasonable achievement of the adaptation goal will require financial, technology and capacity building support.³

Kenya developed a National Climate Change Response Strategy (NCCRS) in 2010, which focuses on the adverse economic effects of climate change and addressing how those challenges can be tackled. The National Climate Change Action Plan (NCCAP) was then developed in 2012 as Kenya's first proposition that would be used to help guide the execution of strategies listed in the NCCRS. The National Adaptation Plan 2015-2030 (NAP), Kenya's first set of strategies focused on building resilience through adapting to climate change, was developed to support the implementation of NCCAP by county governments.

The NAP describes in detail the adaptation actions proposed across 20 economic sectors, ongoing climate adaptation projects in these sectors, investment budgets required, and financial and technological gaps to be filled. However, the NAP does not provide specific actions and strategies for all the six NDC target sectors. Instead, the NAP discusses broader themes such as devolution and how to mainstream NCCAP with County Integrated Development Plans (CIDPs), public sector reforms, and land reforms. **Though there may be some overlap in the sectors listed in both the NDC and the NAP, the NAP does not elaborate on the technological gaps existing within all the six NDC target sectors, ongoing initiatives, or the amount of investment that would be required for any adaptation and mitigation actions to be met.**

The NDC sector assessments by the Ministry of Environment and Natural Resources (MENR) provides a more detailed analysis for the energy, transportation and forestry sectors, compared to agriculture, waste and industrial processes sectors. For the former three sectors, the analysis describes the specific mitigation actions to be undertaken, their expected contribution to reducing GHG emissions, their development impact, ongoing projects in the sector, and the technologies required, as well as additional detail on the assumptions underlying the emission projections and determination of potential by mitigation action. For the latter sectors, government officials noted they were deprioritized due to the low potential emissions reduction.

The remainder of this section analyzes the depth of elaboration and information provided for each of the six NDC target sectors in the NDC sector assessment.

3.1.1 Energy sector

Energy, while the second highest mitigation potential as outlined in Figure 1, has historically received the most government attention given its implication in supporting economic growth. The main priority for the energy sector articulated in the NAP is to "enhance implementation of an energy generation mix plan that increases the resilience of the current and future energy systems to the impacts of future climate variability and change.⁴ **Greenhouse gas emissions in this sector are projected to increase by seven-fold to 42.7 MtCO₂e in 2030; it is for this reason that the mitigation actions developed for the energy sector revolve around alternative power supply sources and efficient use of grid electricity.**

The energy sector has a reduction target of 15.41 MtCO₂e which, to be achieved by 2030, would require expansion of the geothermal electricity generation capacity. Otherwise, a mix of other actions, as shown in Figure 2 below, must be implemented to collectively reach the targeted volume. These mitigation and adaptation actions represent supply-side and demand-side interventions. The supply-side is focused on electricity generation whereas the demand-side not only touches on electricity, but fossil fuels and biomass as well.

Beyond describing reduction initiatives in the sector and their expected impact, the NDC lays out the existing projects within each sector - the bulk of the ongoing projects in the country are geared towards expansion of the electricity generation capacity. The government is especially focusing on this action because of the expectation for it to take responsibility in large-scale power generation.

As at 2015, Kenya had an installed on-grid electricity capacity of 2,295 MW,⁵ 70% of which is from renewable sources.

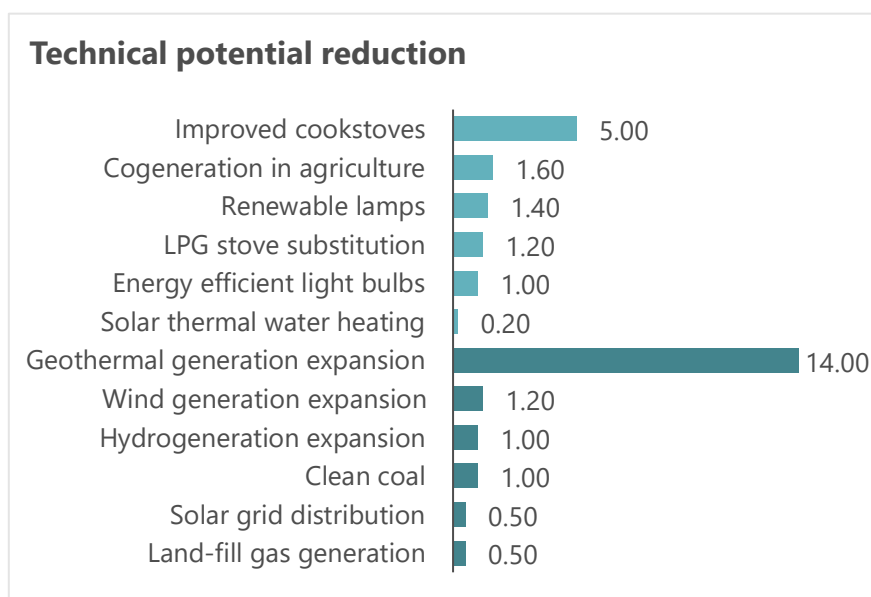
Table 2: Kenya electricity generation capacity as at 2015

Source	Geothermal	Hydro	Wind	Fuel oil	Biomass	Gas turbine	Total
Capacity	593 MW	827 MW	26 MW	751 MW	38 MW	60 MW	2,295 MW
# of plants	8	18	1	14	1	1	43

Source: USAID (2015), Kenya's Power Sector 2015-2020

The government had prioritized increasing the installed capacity of electricity generation in anticipation of growth in energy-intensive industries arising from government devolution.⁶ This anticipated demand has not been realized and the country now has an installed capacity of 2,400 MW, sufficient to meet the peak demand of 1,600 MW. Some of the projects undertaken include the expansion of geothermal capacity at Olkaria I, IV and V.

Figure 2: Emission reduction by NDC mitigation action in the energy sector



Source: Ministry of Environment and Natural Resources, Kenya's Nationally Determined Contribution (NDC): Sector Assessment (2017)

The Ministry of Energy and Petroleum (MOEP) constructed one 140 MW, one 70 MW and two 79 MW steam power plants respectively with support from the Kenya Electricity Generating Company Limited (KenGen) and the Geothermal Development Corporation (GDC).

Demand-side

Efficient use of energy supplied is now a critical factor with several initiatives developed to this effect, for example the Centre for Energy

Efficiency and Conservation (CEEC). CEEC is supported by MOEP and the Danish International Development Agency (DANIDA) to conduct energy audits in companies at a low cost. The center also offers other services focused on helping companies conserve energy such as capacity building programs on energy management, certification programs by the Association of Energy Engineers (AEE) and creating awareness on GHG emissions and climate change.

Additionally, there are also regulations imposed on facilities (public and private institutions and residential units) – those that consume more than 100 liters of water a day – are required to install solar heating systems, and every facility that consumes more than 180,000 kWh⁷ per year must conduct energy audits every three years. The government is also targeting efficient energy use through application of energy standards on some electrical appliances and improved biomass cookstoves.

The government has also made efforts to promote clean energy by lifting the value added tax (VAT) on LPG, denatured ethanol, and clean cookstoves. Renewable energy technologies, including solar panels and related accessories, are also exempted from VAT and import duties. To further incentivize the use of renewable energy, the government has developed feed-in tariffs for small-scale producers of renewable power.⁸

For both demand and supply side interventions, the NDC lists a pipeline of projects in the energy sector that are anticipated to be implemented through Private-Public Partnerships (PPPs) and the stage in which they are. Information on the project costs or implementation plans are not provided for the pipeline projects, but investment costs and source of investments are included for projects already ongoing in the sector.

Therefore, the NDC only clearly lays out the target initiatives, their expected impact and pipeline projects in the sub-sectors, but not how private sector participation can be facilitated, the specific investment cases or rationale, nor what amount of investments are needed. However, efforts are expanded on in the related NAMA, which we elaborate on below.

3.1.2 Forestry

Forestry is an important target sector because of the immense contribution it can make to both climate change mitigation and adaptation actions and targets. The sector contributed 32%⁹ of the carbon emission volumes recorded in the country in 2015, due to deforestation.

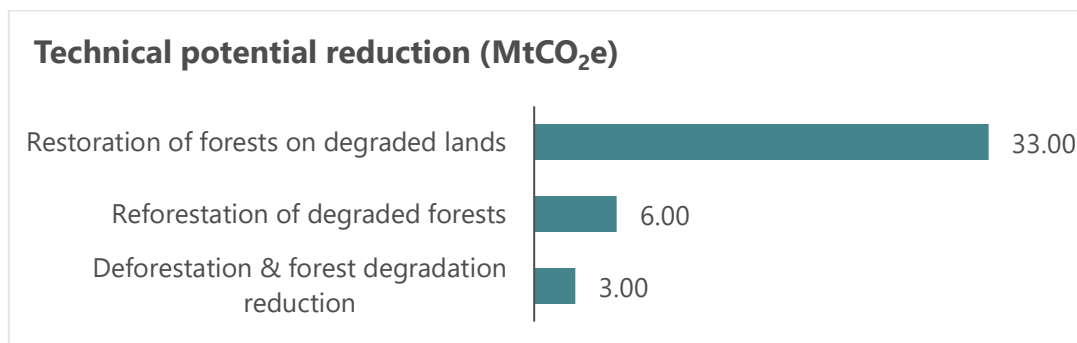
The NDC sector assessment prepared by MENR describes in detail the three main forest restoration actions: restoration of forests on degraded lands, reforestation of degraded forests, and reducing deforestation and forest degradation. As seen in Figure 3, restoration of forests has the highest potential for GHG reductions as this action involves land that previously had forest cover, and thus is reserved for this action. To do this, the target areas would have to be protected from factors that resulted in the initial degradation, including harvesting of wood for use as biofuel, fires and use of land for animal grazing.

Within the NDC project database there are several programs and initiatives the government is planning or implementing already. The Kenya Forestry Services (KFS), which is the main government body mandated to manage and ensure conservation and proper utilization of forest lands, is implementing forest rehabilitation projects. An example is the “Water Towers Protection and Climate Change Mitigation and Adaptation 2016-2022”,¹⁰ which entails the protection of the country’s two water towers – Mt. Elgon and Cherangany – through forest conservation. The Green Belt Movement, on behalf of Community Forest Action, is involved in some reforestation projects in the Aberdare Range transforming grassland to forests.

Programs such as REDD+, a program led by the UNFCCC that encourages the conservation of forests by offering payments to countries based on results, are crucial in ensuring the protection of forests.

Kenya is in the process of developing a national REDD+ strategy and a monitoring system that will help in the assessment of emission volumes and impact of initiatives, as a part of a broader strategy to monitor all ongoing and planned forestry projects.

Figure 3: Emission reduction by NDC mitigation action in the forestry sector



Source: Ministry of Environment and Natural Resources, Kenya's Nationally Determined Contribution (NDC): Sector Assessment (2017)

Aside from the mitigation actions mentioned, these priorities are anticipated to play a significant role in enhancing the country's adaptation to climate change and ensuring there is improved land management. However, the NDC documents discusses the government's participation in forestry actions but there is no specific mention of private sector models within these mitigation actions nor the amount of investment that it would take to achieve these actions. There is also no mention of any further government projects for the future. **Therefore, there is an opportunity to better understand, not only what private sector players are currently doing and which models exist as related to deforestation mitigation and reforestation, but also government's future investment plans and delivery model.**

3.1.3 Transportation

The transport sector is a significant contributor of GHG emissions accounting for 13%¹¹ of total emission volumes in 2015. As noted in NDC documentation, the sector is also prone to climate change which can damage infrastructure over time through severe storms, heavier rainfall and higher temperature levels.

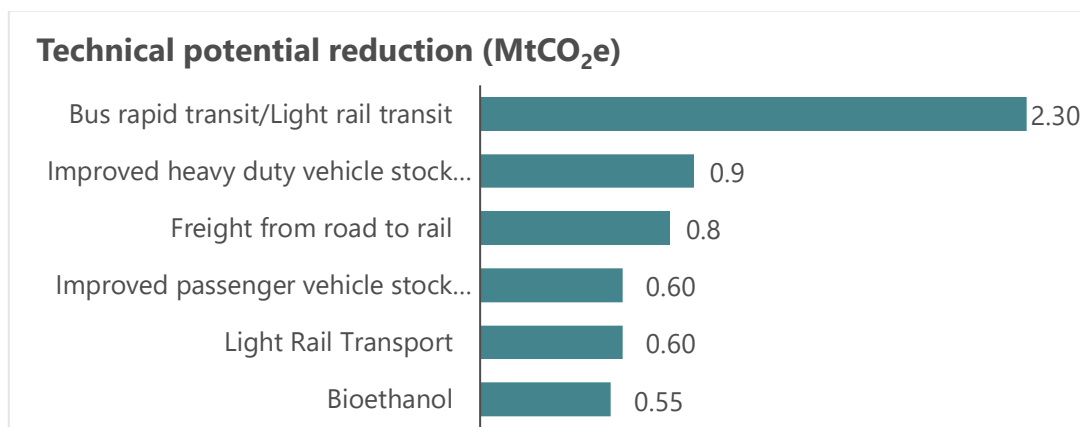
The NDC provides details for six mitigation actions under the transportation chapter, out of the seven originally presented in the SNC: (1) bus rapid transit/light rail transit, (2) improved heavy duty vehicle stock efficiency, (3) freight from road to rail, (4) improved passenger vehicle stock efficiency, (5) light rail transport, and (6) bioethanol, as noted in Figure 4 below.

The use of biodiesel is no longer being considered as a mitigation action as this has proven controversial in the past. Government officials noted that the production of biofuel crops was controversial in nature within the development of Kenya's NDC and other related climate change plans, as it competes with food crops, thus impacting food security. Production of adequate biodiesel volumes requires large-scale plantations and/or consistent supply from other sources. Previously, developers of such plantations are reported to have evicted smallholder farmers resulting in decreased acreage of land to be used for food production.

While the NDC does not include biodiesel as it was articulated in the SNC, bioethanol was left a feasible mitigation action. This is because sugar production in the country is rapidly increasing and

the trend is expected to stay relatively similar. The government is currently testing bioethanol with an E10 blend that requires 10% of regular petrol to be replaced with bioethanol. This has been mandated in Kisumu and Nakuru counties.¹²

Figure 4: Emission reduction by NDC mitigation action in the transport sector



Source: Ministry of Environment and Natural Resources, Kenya's Nationally Determined Contribution (NDC): Sector Assessment (2017)

Of these six actions, bus rapid transit and light rail transit are estimated to have the highest mitigation potential if they can achieve ridership of 148,000 passengers per hour during peak hours in 2030. For the mitigation actions to be implemented, there needs to be policy making that will encourage and help implementers facilitate improved vehicle efficiency. These include imposing a ban on inefficient vehicles, developing fuel efficiency standards to be met by imported cars, reducing the number of small public vehicles on the road and reducing the total number of cars being driven on the road.

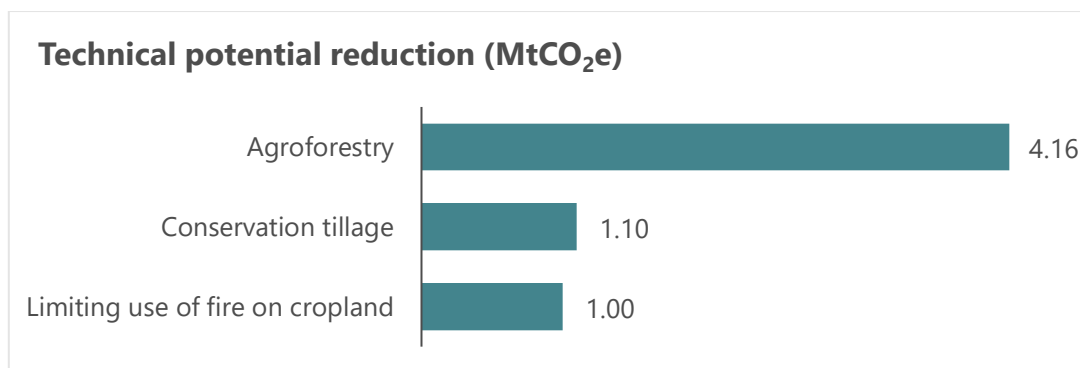
Additionally, the NDC refers to the current projects undertaken by the government in line with the above six actions but does not mention any pipeline projects. One of the ongoing projects include the "The Approved NAMA Support Project" that supports the development of "one of five bus corridors planned as part of greater Nairobi's Mass Rapid Transit (MRT) system".¹³ However, it is also not articulated how much financing would be required in each of the sub-sectors, or the entire transport sector, to help in achieving the reduction targets set.

Similar to the other sectors described above in 2.1.1 and 2.1.2, there is a heavy focus on articulating possible government intervention actions, and less focus on private sector-driven models of intervention. However, this is as expected given the politicized nature of the transport sector in general, from public transport to private vehicles.

3.1.4 Agriculture

The government's interest in the agricultural sector is high due to its high contribution to the GDP, the number of Kenyans employed in the sector and its role in ensuring food security. The sector is significantly vulnerable to climate change as crop production is dependent on weather conditions. Therefore, the government's focus with regards to this sector is on climate change adaptation actions as opposed to mitigation actions like in the other five NDC target sectors. The main adaptation actions listed include conservation tillage to aid in the retention of soil moisture, and mitigation actions are limiting the use of fire in cropland and agroforestry.

Figure 5: Emission reduction by NDC mitigation action in the agriculture sector



Source: Ministry of Environment and Natural Resources, Kenya's Nationally Determined Contribution (NDC): Sector Assessment (2017)

Though the NDC notes that this sector has the highest contribution to GHG emissions, amounting to 40% of 2015 volumes, it has one of the lowest reduction targets. This is likely due to the lower emission volumes projected for 2030, amounting to 31% of total volumes – more than half of which are from the livestock sub-sector. The agriculture sector is anticipated to grow at lower rates than the other economic sectors, hence its decreased contribution to GHG emissions.

Despite expected decreased contribution, the government is still working on reducing GHG emissions in the sector with agroforestry listed as the priority action with the greatest potential. The target is to have 10% of all arable land planted with trees; second to this action is conservation tillage, which is expected to improve soil moisture content through leaving at least 30% of the remnants after crop harvesting on the soil. While these actions focus on crop farming, as mentioned previously the livestock sub-sector is the largest contributor to GHG emission. NCCAP documentation points to a few actions, such as cross breeding and range land management, as possible mitigation and adaptation options but there is little detail on ongoing government projects.

The NDC documents for the entire sector point to ongoing projects but do not mention private sector involvement and/or any pipeline projects. The World Bank appears to have financed most of the government projects listed in the NDC documentation. Some of these are the "Kenya Climate Smart Agriculture Project" aimed at building the resilience of the agricultural sector to climate change and "Kenya Agricultural Productivity and Agribusiness Project (KAPAP)" which, as the name suggests, is focused on enhanced productivity of smallholder farmers. One of the projects targeted at encouraging agroforestry among farmers is the "NCF: Climate Smart Agriculture for Improved Rural Livelihoods" funded by the Nordic Development Fund (NDF).

3.1.5 Industrial processes

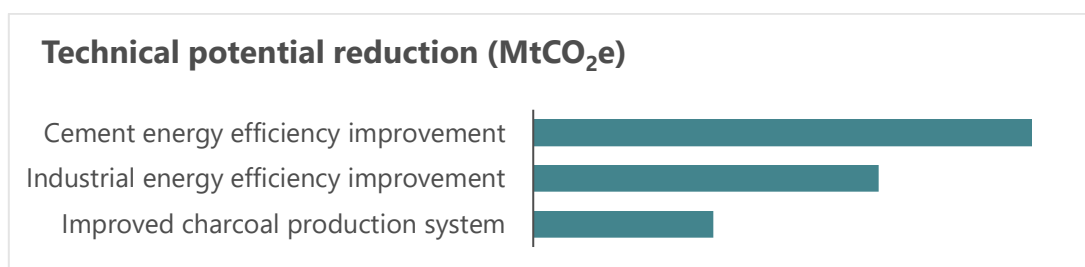
The industrial processes sector is important in mitigating GHG emissions as Kenya has the largest industrial sector in Eastern Africa. However, its contribution to GHG emissions in 2015 was low at 7% of total volumes, contributed largely by cement and charcoal manufacturers; this contribution is estimated to stay the same despite the sector projecting an increase from 5.4 MtCO₂e currently to 9.9 MtCO₂e in 2030, with a total potential reduction of 3 MtCO₂e.

From consultations with government officials, we found that the government's focus in the industrial processes sector is to improve the wood to charcoal output ratio. The charcoal production sub-sector is informal and the NCCAP cites the use of newer technology kilns, such as metal kilns, more efficient

than the traditional earth mound kilns as the main opportunity for GHG emission reductions in this sector.

The NDC does not mention ongoing projects in the sector linked to the mitigation actions shown in Figure 6 nor mentioned in the paragraph above. It is unclear whether these exist and thus the government's participation in the sector is unknown – therefore providing an opportunity for further research.

Figure 6: Emission reduction by NDC mitigation action in the industrial processes sector



Source: Ministry of Environment and Natural Resources, Kenya's Nationally Determined Contribution (NDC): Sector Assessment (2017)

3.1.6 Waste

Similar to industrial processes, GHG emissions from waste are relatively low, and these are expected to reach 2 MtCO₂e in 2030. These emissions are largely produced by landfills and sewage treatment plants. The NDC identifies only one priority mitigation action under this sector – landfill methane capture. Capturing the methane produced from landfills can contribute to emissions reduction by 0.78 MtCO₂e in 2030; methane contributes the most to CO₂ and capturing it would require the use of bio-digester technology.

According to the KCCAP, there are a few practical mitigation options to be considered in the waste sector and the most prominent is methane capture through landfills. The NDC mentions these other options, such as landfill gas flaring and wastewater treatment, that were proposed in the initial validation meetings but discarded due to lack of financial sustainability. Though methane capture is listed as the main option, there has been a failed attempt to generate electricity from the country's largest landfill site in Dandora. Overall, the waste sector, appears to be less of a priority for the government at this time.

3.2 Linking climate plans to attraction of private sector investments

From the detailed analysis of each of the six NDC target sectors, private sector participation and funds needed for implementation of sector initiatives are not clearly articulated, if at all. This section considers existing government strategies to attract private sector investments into climate mitigation and adaptation plans and projects separately from NDC documentation. There exist at least two documentation and initiatives by the government aimed at attracting private sector investment into climate change target sectors: a green bond program, and the Nationally Appropriate Mitigation Actions (NAMAs).

Earlier this year, Kenya announced it would launch its first green bond program through a conjunction with various entities – the Kenya Banker's Association (KBA), Nairobi Stocks Exchange (NSE), Climate Bonds Initiative (CBI), Financial Sector Deepening Africa (FSD Africa), International

Finance Corporation (IFC), and the Dutch Development Bank (FMO),¹⁴ likely to be implemented in 2018. The green bond, issued to the public, would be an instrument being used to raise funds for climate change related projects in the NDC target sectors.

In addition to this program, the government has developed the NAMAs, whose main goal is to attract and scale private sector investments in the NDC target sectors. NAMAs are “policies, programs and projects that developing countries undertake to contribute to the global effort to reduce greenhouse gas emissions.”¹⁵ The government has developed six NAMAs since 2011, in alignment with the NCCAP and Kenya Vision 2030.

Table 3: NAMAs developed by Kenya since 2011

NAMA	Sector	Year	Stage	Objective
Transport NAMA on BRT	Transport	2011	Implementation	Reduce GHG emissions by vehicles through a Mass Rapid Transit System (MRT)
Emission reduction through solid waste management in Kenya	Waste	2013	Under development	Reduce GHG emissions through landfill by capturing methane produced
Rural household energy	Energy	2013	Under development	Supply of clean energy to rural households
Accelerated geothermal electricity development	Energy	2013	Under development	Develop 5,000 MW of installed geothermal capacity
Circular economy solid waste management approach for urban areas	Waste	2016	Under development	“Promote an alternative to the existing waste value chain in Kenya”.
NAMA for the dairy sector	Agriculture	2016	Under development	3% reduction in GHG emissions

Source: NAMA database

Though the NAMAs link actual projects to the NDC and climate change targets, not enough information is provided on all of them. Some NAMAs do not have the estimated finance costs of the projects – information that would be critical to share with private sector investors. As of now, NAMAs are simply documents articulations and there is not concrete reporting on what has been accomplished so far.

Outside of the links (the NAMAs and the green bond program) created by government, private sector participation in climate-relevant projects in the country is led by climate investment funds such as the Scaling-up Renewable Energy Program (SREP) and the Africa Enterprise Challenge Fund (AECF).

Kenya is among the pilot countries for the SREP initiative which is focused on increasing access to energy through renewable energy sources and products. The Kenya Climate Innovation Center (KCIC), supported by the World Bank, offers a range of services including business acceleration to innovative business models addressing climate change. The center also provides financing support to businesses based on their growth stage, with the Kenya Climate Venture Facility (KCVF) used to fund early stage companies. AECF, who has a presence in Kenya, also provides funding to innovative businesses whose model is centered on climate change. Overall, there is need for more actionable plans in creating links between private sector and climate plans, from both the government and the private sector.

3.3 Review of country conditions with respect to private sector engagement in finance

As outlined in the prior sections, there are gaps in each of the target NDC sectors with regards to private sector participation in terms of technology and funding. The government has initiated projects and developed policies and regulations to create an enabling environment, some of which are elaborated above and in section 5. For the NDC targets to be achieved, participation of the private sector will be critical.

The following section provides an overview of the country's private sector, the sources of financing, recent investment trends, and how these are mapped across the various sectors.

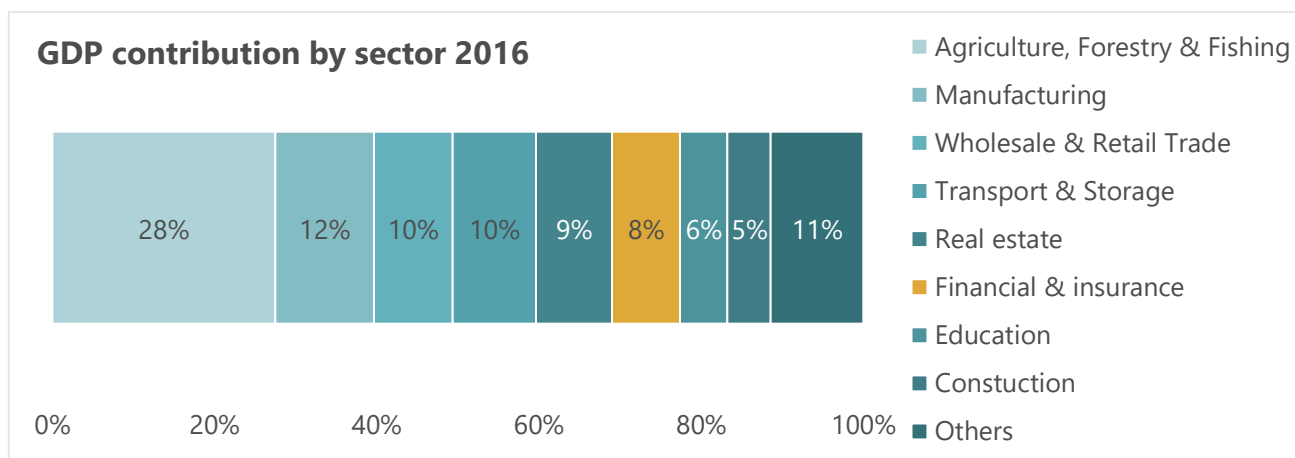
3.3.1 Investment climate and brief overview of private sector composition

Generally, Kenya has a positive investment climate which has influenced the participation of international investors in the ecosystem and the set-up of regional offices by many international firms. Some of the reasons attributed to this include favorable fiscal and monetary policies, a legal framework that clearly differentiates between local investments and foreign investments, and a stable political environment. However, there is little information on the size and type of local investment as compared to international investment.

Kenya's positive investment climate has led to a strong economic growth seen with an average real GDP growth rate of 5.2%¹⁶ over the last ten years, and a 4.7%¹⁷ year-on-year growth seen in the first quarter of 2017. Current GDP is estimated at USD 70.5B.¹⁸ This is attributed to the growing trade industries supported by the Mombasa port and the fusion of the EAC. Other factors that have contributed to GDP growth are the recovery of the tourism industry which had earlier plummeted and the recent infrastructure developments, particularly investments in road networks.¹⁹

The top five industries making up the Kenya economy are agriculture, manufacturing, trade, transport and real estate. Agriculture remains the largest contributor to GDP at 28%, employing ~75% of the workforce. The manufacturing industry (both food and non-food items) follows next, with less than half of what is contributed by the agriculture sector.

Figure 7: Kenya GDP contribution by sector 2016



Source: Quarterly Gross Domestic Product Report: Third Quarter 2016, Kenya National Bureau of Statistics

Kenya's private sector comprises of a large informal sector where, according to Kenya National Bureau of Statistics (KNBS), 90% of the working population is employed, with a smaller more productive formal sector. The informal sector is estimated to contribute 34.3% to the GDP.²⁰

The country's economy remains the largest in the East African Community trading block that comprises of Kenya, Tanzania, Uganda, Rwanda and Burundi. This, coupled with the stability in the Kenya Shilling (KES) and a conducive legal framework that distinguishes local investment from foreign investments, makes Kenya's investment climate attractive to international investors.

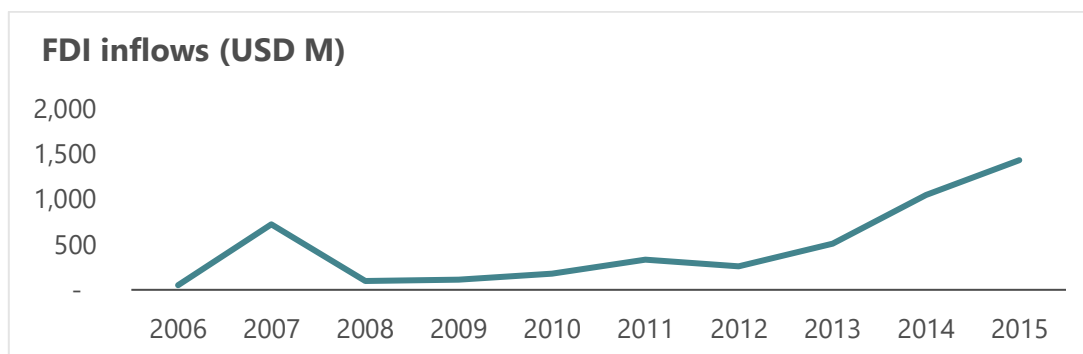
However, Kenya ranked 92 out of 189 countries on the World Bank's "Ease of doing business index".²¹ This is mainly attributed to the corruption levels in the country and the perceived high risk of terrorist attacks. Kenya has suffered a couple of attacks from Al-Shabaab, the Somali-based militant group. A recent terror attack in January 2017 was carried out on Kenyan soldiers in a military base in Somalia. These attacks have not diminished the favorability of the country's investment climate, and the next section discusses the contribution of private sector investments in the country's economic sectors.

Additionally, some of the main challenges faced by investors involve unclear taxation policies for certain sectors, and unreliable energy supply. Electricity supply and availability is unreliable which means businesses have to invest in back-up power options. On the up side, Kenya is ranked second after South Africa in the "Logistics Performance Index". This translates to a higher ease of distributing products and services across the country, as compared to other African countries.

3.3.2 Mapping of sources of private finance available in country by sector

Due to its positive investment climate, Kenya has strong diversification of private finance sources, indicating an appetite to invest in and grow varied sizes of businesses and sectors. The growing GDP as noted in section 3.3.1 has attracted an increase year-on year in foreign direct investments into the country, as shown in Figure 5 below.

Figure 8: Kenya FDI inflows 2006-2015

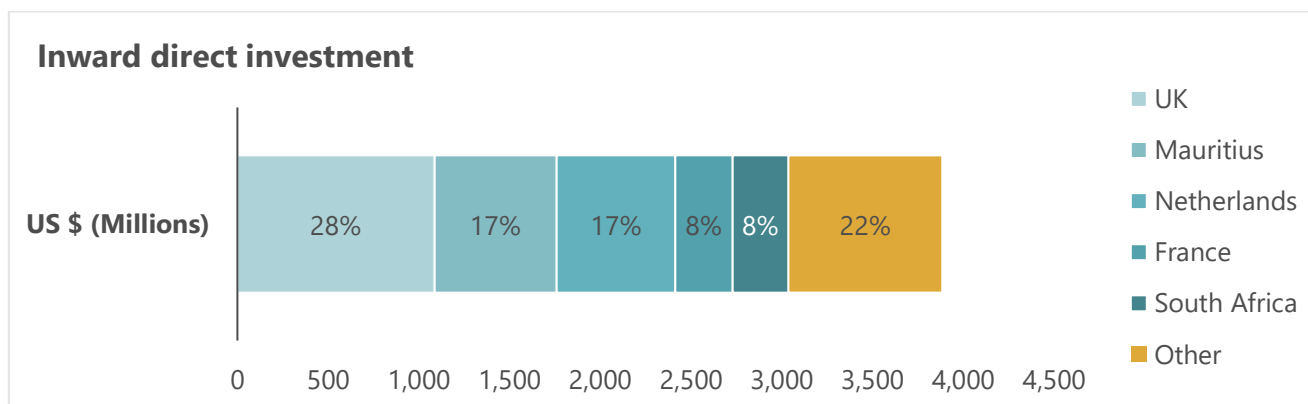


Source: UNCTAD

The rest of this section discusses the sources of these growing investments, the financial instruments used to deploy funds in the country and the economic sectors of interest for these investors.

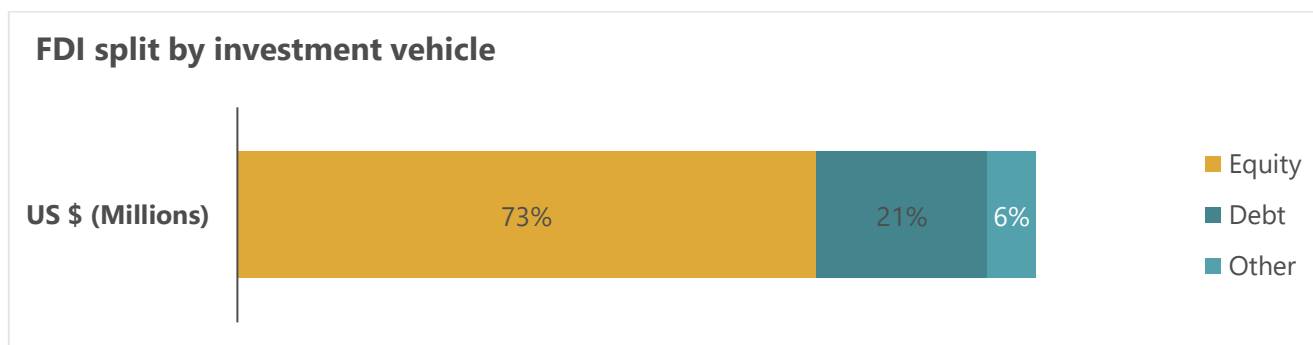
As of 2015, the United Kingdom contributed the most to FDI inflows in Kenya, followed by Mauritius and the Netherlands. Collectively, 62%²² of the total FDI inflows in the country can be attributed to these three countries. More than 70% of the total USD 3,885M of FDI channeled by the countries in Figure 10, were in the form of equity instruments. In aggregate, the UK, Netherlands, and Mauritius account for more than 50% of the debt instruments and more than 50% of the equity instruments.

Figure 9: Kenya FDI inflows by source country



Source: IMF Coordinated Direct Investment Survey

Figure 10: Kenya FDI inflows by investment vehicle

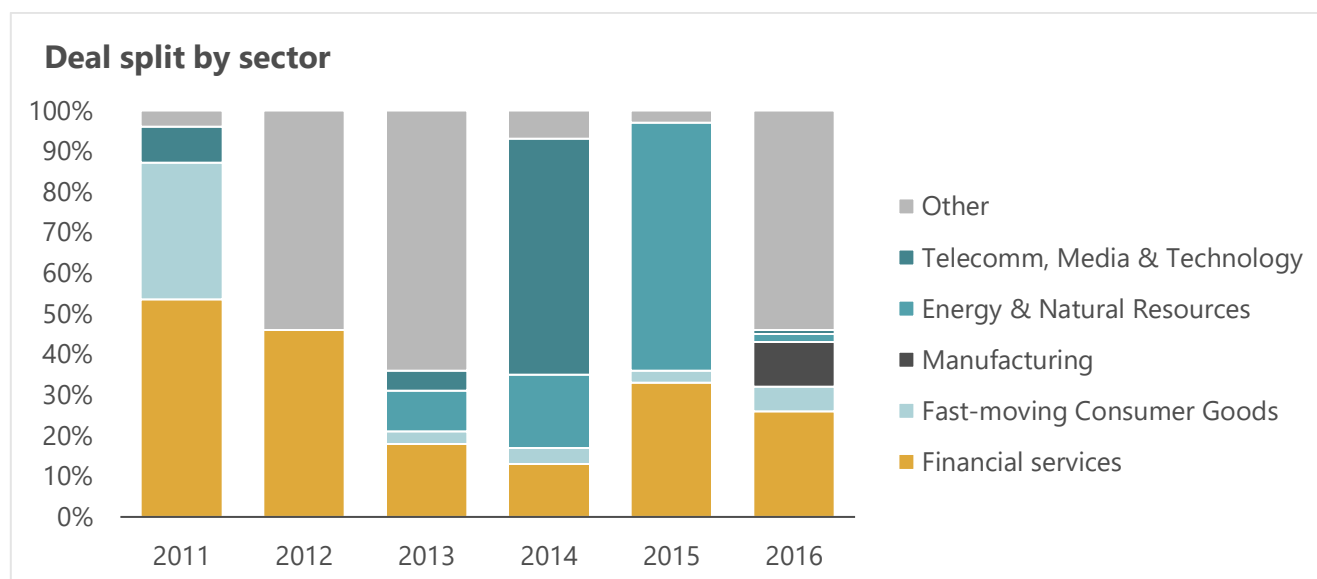


Source: IMF Coordinated Direct Investment Survey

A report by the East Africa Venture Capital Association (EAVCA) shows that there are different classes of equity investors, namely: impact investing, venture capital, angel investors and private equity, which represent upwards of 80% of total capital invested with average deal sizes of USD 5M.

The same report also discusses the preference by large-scale investors to finance businesses and initiatives in the financial services sector, deduced from the number of deals received in each of the sectors (Figure 9). However, the majority of angel investors and venture capital is channeled to information communication and technology (ICT) sector, agriculture and clean energy, indicating that there is existing appetite to invest in climate-change related sectors, and opportunities for initiatives like CDKN to facilitate investment into less-explored sectors. With the stable investment climate and the government's aim to improve the enabling environment through policy formulation and implementation of regulations, clean energy and renewables appear to be one of the most attractive sub-sectors for climate change related private sector participation and investment.

Figure 11: Split of investment deals by sectors in Kenya



Source: KPMG and EAVCA, *Private Equity in East Africa Survey Final (2017)*

4 Priority sub-sectors seeking private investment

4.1 Selection process

The process of sub-sector selection was comprised of two aspects: (1) identifying existing mitigation and adaptation actions, as proxies for sub-sectors, within NDC or NCCAP documentation or from OCA experience; and (2) identifying sub-sector selection criteria based on consultations with CDKN, our experience in climate-relevant sectors, and additional research, including the GCF investment criteria.²³ These criteria take into account both quantitative factors such as abatement potential (where available) and key qualitative considerations such as development impact.

OCA identified a list of over 40 sub-sectors (Annex D) which can support the country in achieving its NDC target. Though all sub-sectors listed had significant GHG abatement potential, it was imperative that three commercially viable sub-sectors were selected, where impact of investment would be significant. The five criteria used included:

Table 4: Criteria used for selection of sub-sectors

	Criteria	Definition
High priority	Additional investment impact	The amount of additional investment that can be deployed in the sub-sector to fill significant financing gaps.
	Market growth potential	The extent to which the market can grow, such as based on size of underserved market and/or structural market characteristics.
Second priority	Market growth stage	The status of the market in terms of size, product/service saturation, and the positioning of market players.
	Development impact	The environmental, social, and economic co co-benefits resulting from growth of the sub-sector.
	Technical potential emission reduction in 2030	The amount of GHG emission that can be reduced in the sub-sector to help reach the NDC target, as identified in NDC documentation.

Though sub-sectors were ranked based on the criteria mentioned above, the overarching determinant was to identify sub-sectors which CDKN would be able to influence with IKI funding. The sub-sectors were categorized based on these criteria and the resulting top three are discussed in the subsequent sections. Using the process elaborated above, OCA proceeded to further narrow down on the list of 40 sub-sectors to 15. Table 4 below, shows these 15 sub-sectors and a summarized assessment, in simplified form.

The final three sub-sectors were selected after consultations with stakeholders and further research to back the performance under each criterion. These sub-sectors were considered to be the easiest to be influenced by CDKN, but had clear financing and enabling environment gaps, with a strong presence of commercial and scalable business models.

Table 5: Sub-sector shortlist

	Subsector/ Assessment Criteria	High priority criteria			Second priority criteria				
		Ability to influence	Growth potential	Existing investment	Growth stage	Emission reduction (MtCO ₂ e)	Development Impact		
							Environ- mental	Social	Economic
Transport	Bioethanol	Yes	Medium	Low	Nascent	0.55	Medium	Low	Medium
Forestry	Alternative-Raw Wood Resources	Yes	High	Medium	Growth	N/A	High	Low	High
	Micro-forestry	Yes	High	Low	Nascent	N/A	High	Medium	High
Energy	Landfill Gas Generation	No	Low	Low	Nascent	0.5	Medium	Low	High
	Solar PV- distributed grid- connected	Yes	High	Medium	Nascent	0.5	Low	High	Medium
	D.C appliances	Yes	High	Low	Growth	N/A	Low	High	High
	Energy efficient light bulbs	Yes	Medium	High	Growth	1	Low	Low	Medium
	LPG Stove Substitution	Yes	High	Medium	Nascent	1.2	Low	High	Medium
	Improved Cookstoves	Yes	Medium	High	Growth	5	Medium	Low	High
	Briquettes	Yes	Medium	Low	Nascent	N/A	High	High	High
	Ethanol-Based Cooking Fuel	Yes	High	Low	Nascent	N/A	Medium	High	High
Agri- culture	Solar Irrigation	Yes	High	Low	Growth	N/A	Low	Medium	High
	Affordable Dairy Feeds	Yes	Medium	High	Growth	N/A	Medium	Low	High
	Affordable Greenhousing	Yes	Medium	Medium	Nascent	N/A	High	Low	High
Waste	Reusable Bags	No	N/A	N/A	N/A	N/A	High	Low	High

4.2 Private sector models in forestry

While there is great demand for wood in both commercial timber manufacturing industries and household use as a biofuel, this section will focus on the supply-side of the wood market.

This high demand for wood needs to be addressed as only 6%²⁴ of total land in Kenya is covered by forests and the current annual demand shortfall in wood volumes is anticipated to keep growing. As such, deforestation is a big concern for the government and this comes out clearly in the NDC documentation, with forestry collectively having the highest GHG emission reduction target; significance of the sector was also emphasized during consultations with government stakeholders, particularly MENR. Furthermore, the sector is important because of its economic contribution: 3.6% of the national GDP is attributed to the forestry sector, which provides employment for marginalized communities and serve as tourist sites.²⁵ While the government already has several programs which are elaborated in different sections of this report, attempting to formalize and introduce market-driven models is important to ensure the sustainability of these forests over time, rather on a time-bound project basis.

This section will therefore analyze in detail two private sector forestry models that can help reduce deforestation through wood supply management, as participation by both private and public sector is crucial to reach the 10% forest cover goal. The first model entails **provision of alternative fiber** for timber manufacturing industries and other industries that require wood fiber as an input to produce goods. The second model aims **to increase overall forest stock by managing wood supply** through micro-forestry programs.

4.2.1 Rationale for inclusion

The following points outline OCA's initial analysis of the sub-sector, of which these details are fully elaborated on in subsequent sections of this report.

1. Technical potential emission reduction in 2030: This sub-sector has a significant GHG abatement potential, as natural forests act as carbon sinks reducing the amount of carbon emissions in the air. The NDC estimates that 33 MtCO_{2e} can be reduced from restoration of forests on degraded land and an additional 3 MtCO_{2e} from reduction in deforestation and forest degradation – both actions being the focus of this sub-sector.

2. Additional investment impact: Overall, there have been few and/or earlier stage investments in the sub-sector so far; lack of access to capital by farmers and supply management forestry companies is a key challenge presenting a significant financing gap. It is possible for private investment to influence the market given its competitive nature, and existence of fully-operational business models.

3. Market growth stage: Though there has been proof of concept, with some businesses taking off and receiving further investment, the market for private sector participation in forestry is still at a nascent stage with relatively few players.

4. Market growth potential: As discussed later in this section, there is a tremendous opportunity to scale the current business models in the market to meet the anticipated growing demand in wood and timber. As it stands, the country's wood net balances are at a deficit with demand exceeding supply.

5. Development impact: Tree farming results in various other environmental co-benefits, other than reduction of carbon in the air. Rain water is retained by trees which improves the moisture content of soil, making it more fertile for agriculture. Trees therefore enhance the soil quality and improve water catchment in regions.

Additionally, this sub-sector has several economic co-benefits. Both private sector business models analyzed require a lot of human resource creating employment for many in the working population. The Kenya Forest Service (KFS) cites that the forestry sector employs more than 50,000 Kenyans directly and another 300,000 indirectly. This has a direct impact on the lives of many as household income levels are increased, especially for more rural communities. The management of wood supply and the processing thereafter involves local industries, directly contributing to the national GDP.

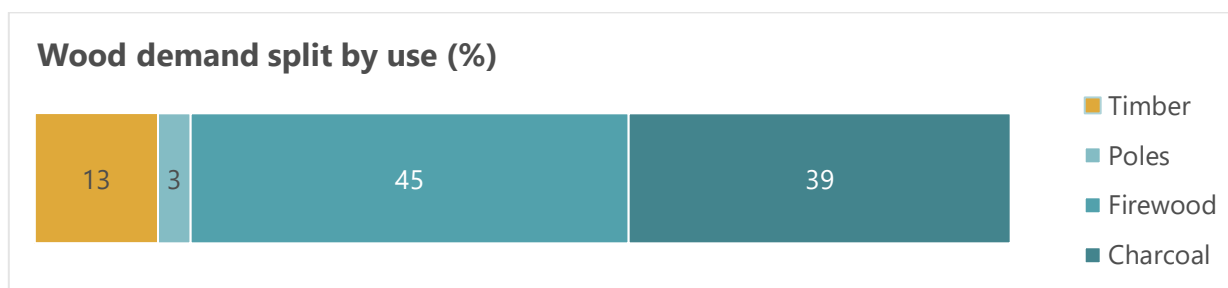
4.2.2 Sector overview

Wood supply management, though driven by demand from consumers, is focused on the initial stages of the forestry sector value chain. The distinct phases of the value chain include the production of trees, processing of trees to wood, value addition of the processed wood and finally distribution to the end-consumer market.

Demand

The per capita annual wood demand is estimated at 1m³. With a population of 47 million,²⁶ and an average price of KES 2,000 per m³,²⁷ this equates to KES 94B or nearly USD 1B. According to KFS, wood demand outstrips supply and the current national deficit is estimated to be over 10 million m³. This deficit is anticipated to grow by over 20% in 2030 creating even more pressure on current natural resources.²⁸ This growing demand is a factor of a growing economy and increased population in the cities. The annual growth rate of demand for furniture is estimated at 10%.²⁹

Figure 12: Wood demand split by use



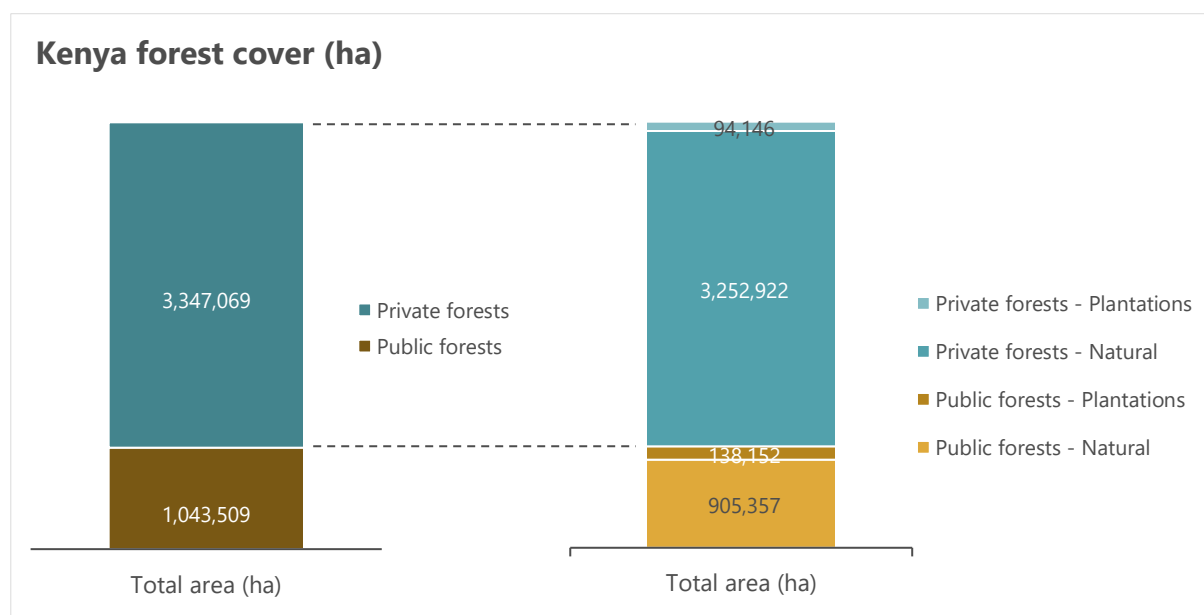
Source: Ministry of Environment, Water and Natural Resources, *Analysis of Demand and Supply of Wood Products in Kenya*

Supply

Total wood demand is unmatched by supply due to the small size of forest land and low yields from the tree species planted. The current forest cover stands at 6%³⁰, and forest resources in the country are categorized into either public or private: public forests are those run by the government, mainly for environmental protection, while communities and private land owners run private forests to supply the commercial wood market. Under both classifications, natural forests account for more than 80% of the cover; therefore, tree plantations account for very little of the total forest cover in the country, as elaborated in Figure 11.

As seen in this figure, more than 70% of the forest cover is privately owned, and only 3% is plantation forestry compared to 93% being natural forests. It is estimated that 11.4% of the wood supply comes from commercial plantations, 41% from natural forests, and 47.6% of wood from on-farm trees. This therefore presents a massive opportunity to work with existing farmers to sustainably harvest and grow more trees on their land. The most popular and profitable commercial tree species in Kenya are cypress, pines and eucalyptus. While all three are used to make timber, eucalyptus is common for making electricity transmission poles. The average maturity period of the trees varies from 10-15 years for eucalyptus, to 28 years for the other two species.³¹ Though practiced, the commercialization of small-scale tree farming is limited by lack of access to funds and the long pay-back period associated with long maturity period of trees. Smallholder farmers who have taken up tree farming are organized in tree growers' associations across the country that help them tackle operational challenges and provide market linkages, however there is little information as to what scale these farmers are growing at.

Figure 13: Kenya forest cover composition



Source: Ministry of Environment, Water and Natural Resources, *Analysis of Demand and Supply of Wood Products in Kenya*

Trees are harvested by chain-saw technology, apart from in government-owned forests where it is banned. The processing into and treatment of timber is done near the harvest sites and wholesalers (middlemen) are responsible for resale and distribution to timber dealers. Some businesses have come up with micro-forestry models to enable large scale harvests contributed by many farmers. Komaza is an example of such businesses and is elaborated in Case 1.

While Komaza is focused on planting more trees and increasing forest cover, there are several companies tackling deforestation from the other end – production of non-traditional sources of wood. Wood plastic composites or materials made from recycled plastics are available within Kenya, with some main producers being EcoPost and Sagana Manufacturers, among others. While these businesses have growing opportunities, the technology required and subsequent price of these products means they are not designed for mass market use yet. Also, increasingly common in other

countries is mixing fly ash or timber sawdust with concrete to reduce the amount of concrete needed while maintaining similar quality standards.

However, in Kenya, wood is still used heavily in construction and manufacturing industries, mainly eucalyptus trees; in other countries such as India and China, bamboo use is becoming popularized and has several advantages over traditional wood. Bamboo trees mature in only four years as compared to two or three decades for normal hardwood trees, and can be harvested monthly. However, bamboo seedlings are up to 10 times more expensive than eucalyptus seedlings³². Kitil Farm is one of the players integrated across the value chain, selling the seedlings to farmers, offering bamboo management training services, and running its own plantations, as well as GreenPot Enterprises who also grow bamboo on formerly degraded land, in addition to other small companies.

Apart from serving as an alternative source of fiber in manufacturing industries, bamboo can also be used as an alternative source of biofuel. Earlier this year, Bidco Africa, one of the big FMCG manufacturing companies announced that they would start using bamboo as fuel in its factory plants.³³

Case 1: Private sector model - Komaza

Komaza, a social enterprise based in Kilifi, runs a micro-forestry business model that has seen them plant two million trees with an out-grower network of more than six thousand farmers. While the farmers contribute their own land into the scheme, the enterprise provides all other inputs such as seedlings and extension services throughout the planting cycle. The farmers are assured of a ready market as the enterprise buys the trees, which Komaza harvests itself, from them. Though this business model has been proved to work in the market, there is still opportunity for more growth and have more smallholder farmers involved. The provision of land by the farmers themselves makes for easy scale, as land is one of the most limited and expensive resources in the country.

4.2.3 Assessment of investment area

Scale of investment opportunity

Looking at both the demand and supply sides, the forestry sub-sector has received limited investment for purely commercial and financially sustainable business models. The Gatsby Foundation's Kenya Commercial Forestry Program initiative is one of the investments made in supporting the development of market infrastructure. The program's focus is on smallholder farmers and building "the capacity and commercial sustainability of key institutions that can provide important services to the sector."³⁴ The Nature Conservancy (TNC) is also playing a role by filling the gap in financing of smallholder farmers by setting up the "Tree Fund" that will provide long-term debt financing.

There also are several non-financial initiatives by both the government and the private sector to reduce deforestation in the country. For instance, the Aga Khan Foundation in partnership with other donors, have planted about 120 million trees across Africa and Asia, Kenya being one of the beneficiary countries in Africa.³⁵ The foundation, also runs a project that promotes a mix of technologies and approaches such as clean cookstove and forest business ventures in Kilifi and Kwale

County. Another initiative, though a PPP, is the Initiative for Sustainable Landscapes (ISLA) Kenya.³⁶ ISLA Kenya is a program for restoration of forests on degraded land, and particularly the South West Mau Forest.

There is an opportunity to overcome the challenge of a lack of regulation enforcement by promoting commercial forestry models that have clear certifications and standards, and encouraging the construction and manufacturing sectors to procure from certified sources. However, the challenge of supply remains as existing commercial forestry industry cannot meet demand. As long as wood demand outstrips supply, there will be deforestation in natural forests. One way to improve the management of the wood supply is through increasing access to capital for smallholder farmers and already existing businesses who focus on sustainable forestry.

Barriers and risks to investment

Both private sector models discussed – micro-forestry and alternative fibers to wood – experience similar barriers and risks to investment. This is because both models are considering tree farming in plantations, only difference being the type of trees planted. However, if compared, micro-forestry presents a greater opportunity at the moment as there is more private sector traction for investors or organizations like CDKN to tap into.

Working capital constraints: For larger companies growing on plantations or wanting to raise capital with an out-grower scheme, the extended growing period of trees beyond common debt timelines means that there is a high perception of risk.

Collateralization: Commercial banks also cite uninsured collateral as a disincentive to provide debt capital, and currently, there are no insurance policies for trees in Kenya.³⁷

Smallholder credit risk: Not only is it already difficult to lend to smallholder farmers in agriculture, it is made more difficult by the extended growing period as noted above. The ability for smallholders to pay back loans depends on their abilities to monitor their farms to gain the best yields as well as their ability to remain resilient during unexpected weather events. Therefore, smallholder farmer lending is still perceived as risky by the majority of investors.

Regulatory environment: Currently, the lack of enforcement of regulation on illegal logging as well as land rights and titling means that it can be difficult for sustainable forestry practices to be scaled. As noted by one investor this is especially true in Western Kenya where there are many large-scale poorly regulated timber operations with political affiliations.

4.3 Alternatives to wood and charcoal for residential and/or industrial processes

Whereas this sub-sector also aims to reduce deforestation in the country, it focuses on the provision of cleaner and more efficient alternative fuels to charcoal and firewood for both household and industrial use, and the analysis of the markets for briquettes, ethanol and LPG fuels.

A Kenya National Forest Program (NFP) document estimates that more than 80% of the country's energy supply is provided by wood fuel. Whereas firewood is simply cut from trees, charcoal is produced through a carbonization process which is unregulated and inefficient, with most producers using traditional technologies. Both fuel markets are sustained by illegal deforestation and though

charcoal is mainly produced in the rural areas, the target market is urban households – 82%³⁸ of which consume the product. Across nearly all urban residential areas, charcoal vendors are easily accessible selling the product in volumes as small as 2kg tins. It is also a significant fuel for the hospitality and manufacturing industries, and one government official specifically noted public institutions as intensive users, such as schools and prisons.

Given charcoal is produced from wood, and firewood cut directly from trees, this sub-sector is significant in helping reduce the need for deforestation by households, institutions and industrial sectors, and thus a climate change mitigation initiative.

4.3.1 Rationale for inclusion

1. Technical potential emission reduction in 2030: As discussed in the previous section on private sector models in forestry, reducing deforestation is a priority action for the government and the GHG abatement potential from this is high. Therefore, this sub-sector is important as it reduces the need to cut down forests for provision of household and industrial energy fuels. Also, both briquettes and ethanol are manufactured from bio mass waste resulting in no pressure on the country's natural resources.

2. Additional investment impact: The markets for ethanol and briquettes have received limited investment thus far. There are a number of gaps present, some of which include financing businesses to scale, and supporting the development of distribution networks.

3. Market growth stage: Both ethanol and briquettes markets are nascent, with LPG being significantly more developed with the exception on the low-income household level. There are many emerging manufacturers of briquettes, and the product has been more popular with small scale commercial use than household use. The ethanol market is also in the development phase with even fewer players.

4. Market growth potential: Demand for charcoal is high in both household and industrial level, and is anticipated to continue growing. Given ethanol, briquettes and LPG aim to replace charcoal as a fuel in the market, their potential market size can be considered as a full substitute market (as well as for kerosene).

5. Development impact: Apart from direct contribution to the GDP from involvement of local industries for production, there is significant employment creation. With both sectors still in the development stage, a lot of human capital will need to be integrated at the various levels of the value chain – from input sourcing, all the way to distribution of final products. While the charcoal industry employs a significant number of Kenyans, this employment is usually not full-time and done as a last measure of income generation. There is also potential for involvement of already existing businesses to diversify and generate more revenue.

There are some health and social benefits that arise from these markets as well – a 2016 report states that “reducing smoke emissions from cooking decreases the burden of disease associated with household air pollution and improves wellbeing, especially for women and children”³⁹.

4.3.2 Sector overview

In line with mitigating GHG emissions through reduced deforestation, this section will study alternative bio fuels to the currently common firewood and charcoal. The focus will be on clean energy solutions that can be applied to household, institution and industry consumers of all sizes.

Despite the significance of wood fuels in the country – meets 80% of energy demand as earlier mentioned – there lacks a proper monitoring and tracking system for the products. This is mainly because of the high degree of informality of the sector and as such, there is scanty data on the demand and supply volumes. However, FAO estimates that local production of wood charcoal has been growing by approximately 4%⁴⁰ annually, with 2015 production volumes reaching 1,119,116 m³.⁴¹

In a bid to move from charcoal, the energy fuels industry has evolved over time to offer new innovations, as noted in Table 2.

Table 6: Cookstove classifications

	Traditional solutions	Improved cooking solutions			Clean cooking solutions	
Technology	Three-stone cookstoves	Basic improved cookstoves	Intermediate improved cookstoves	Advanced improved cookstoves	Modern fuel stoves	Renewable stoves
Fuel energy	/ Firewood	Charcoal	Charcoal	Charcoal	LPG/electricity	Ethanol/bio-gas/solar
Example		Kenya ceramic jiko	Burn stove	Gasifier	LPG burner	Fuel-specific stove

Source: Kenya Climate Innovation Center, *Sector Mapping and Assessment on the Improved Cookstoves Sector in Kenya*

Even with the availability of clean energy solutions, charcoal remains popular with the mass market because of the little investment required for production, and is especially cheap, along with firewood, in rural areas. The fuel can be used on cheap stoves and is readily available in small quantities. When the price of charcoal increases making it less affordable, the use of kerosene increases as it is seen as the cheap alternative and can be ignited, controlled and extinguished easily.

The market for alternatives to firewood and charcoal such as ethanol, briquettes and LPG is underdeveloped for mass market consumers, with low market penetration. However, with the increased need to reduce deforestation and the increasing price of charcoal due to scarcity in forest resources, there is potential for the market to grow. In stakeholder consultations, there was consensus that these alternative solutions would have a strong business case in urban areas, but to fully phase out firewood and charcoal, the cost of distribution in rural areas means there will need to be more government intervention in terms of either enforcing regulations or increasing taxes, or providing clean fuel subsidies. likely The remainder of this section will discuss the markets for these alternative fuels, assess their suitability as an alternative to firewood and charcoal, and briefly elaborates on LPG (liquified petroleum gas) as the other main alternative.

Supply - Briquettes

Briquettes are an alternative to charcoal and reduce GHG emissions from two ends: the first being that it burns much more efficiently, and second because it is made from recycled waste. This waste includes bagasse, human waste and other bio-waste, but currently local production is mainly done from charcoal dust. The market is competitive with many manufacturers present; the majority of these manufacturers are small enterprises with centralized operations which makes distribution to rural areas costly, and collectively the manufacturers still don't produce enough volumes to sustain industries and export markets. Some of the players in the market include Greenchar, Chardust, Hermisons Green Energy Solutions Limited, Global Supply Solutions Limited, and Acacia Innovations. According to an assessment by GVEP on the market, the main challenges faced by businesses operating in the space are inadequate human resource with the expertise needed for large volume production and the capacity for input collection.

Supply - Ethanol

Ethanol, the second alternative fuel discussed in this section, is a globally traded commodity with about ten manufacturing plants in Africa. The three main producers in Kenya are Spectre International (based in Muhoroni), Agro Chemicals and Food Corporation (ACFC, based in Kisumu), and Mumias Sugar Company.⁴² The fuel can then be used in specially designed cookstoves in either liquid or gel form, the latter reported to be more energy efficient according to sector experts. According to test results by one of the stakeholder companies consulted, ethanol-based cooking stoves are twice more efficient than kerosene stoves, two to three times more than charcoal stoves, and five times more than the traditional three stone firewood stove. Examples of companies operating in the market include Consumer's Choice Limited whose cookstove retails as "Moto Safi" and Koko Networks' product retailing as "Smart Cook".

More broadly, ethanol has the potential to scale rapidly through existing infrastructure, such as urban and rural petrol stations, like kerosene. Scaling on the distribution side to reach communities in rural, last mile and urban areas will take further investments to make it as easily accessible as charcoal, but ensuring it is done in a secure manner to avoid human consumption as an alcoholic beverage. While the transportation and storage of a liquid presents higher transportation costs than hard materials like charcoal, the low market price of wholesale ethanol means it is only slightly more expensive than charcoal.

Supply - Liquefied Petroleum Gas

LPG is a mixture of flammable gases used as a clean burning fuel for heating and cooking purposes. The LPG market in Kenya is regulated by the ERC and has a capital-intensive value chain, due to the production and transportation of a compressed gas. There is only one refinery in the country manufacturing the product, and therefore meeting demand requires importation. The product is then stored in bulk with the primary storage facility in Mombasa; transportation from storage facilities is also done in bulk via several channels – pipeline, railway or use of road tankers. Once transported to wholesale facilities, the fuel is filled into cylinders of either of the four standard sizes – 1kg, 3kg, 6kg, and 13kg. The primary merchants of these cylinders are fueling stations and supermarkets across the country.

Even with the development and existence of a strong supply chain, the market is faced with several challenges, mainly being cost of expansion in production and distribution infrastructure. With only

one refinery in the country, shortages of the product are common and due to importation, the end-consumer retail price is high, locking many households out.⁴³ If local production was to be increased, the market would still be challenged by limited storage capacity; and there is no space available to expand the facility at the port.⁴⁴ Further down the value chain, challenges faced include limited and uneven distribution of both wholesale and retail merchants into rural areas, illegal refilling of cylinders and the high yet infrequent costs of using the product.

Overall demand

Demand for charcoal is expected to continue growing as the population increases and more people become urbanized. Thus, the market for alternative cooking fuels is not only large, but has high growth potential. The main gaps in the briquettes market as reported by GVEP International revolve around the technology used and the go-to-market approach. The demand for charcoal, especially on the household level, has also not been successfully replaced with demand for briquettes due to lack of consumer awareness, and unsustainable business models resulting from high cost of distribution compared to willingness to pay. Though the product can be used on a smaller scale in households (on the same stoves as those of charcoal) or on a larger scale in manufacturing industries, the main consumers are small businesses such as poultry farms and restaurants; penetration on the household level is negligible.⁴⁵ An example of a large manufacturing company using briquettes as the primary source of fuel is the British American Tobacco (BAT), whose energy need is met by Mumias Sugar Company, one of the country's largest sugar producers. Mumias makes the product from the bagasse collected during sugar production. The KTDA factories are also gradually switching from firewood to briquettes for the energy needs. **From consultations with industry stakeholders, it was also noted that industrial use of briquettes increases when the price of oil also increases, using it as a substitute. Therefore, production of briquette is currently mainly for commercial institutions, with distribution done directly to the consumer.**

Ethanol is currently the least well-known fuel as compared to briquettes and LPG, as it is still currently new in the market. Over time, as companies invest more in demand-creation marketing and advertising activities, ethanol is expected to be a main replacement for kerosene and charcoal in

urban areas; as noted above, demand for charcoal and firewood in rural areas will need to be tackled with stronger government intervention as distribution models will prove to be costly.

LPG, though well-known in the market for household fuels, has a low penetration with only 5% of households across the country using the product. The penetration in urban households is higher at 21% but still a quarter of the market penetration rate of charcoal. Constraints to market penetration revolve around the cost of the product. Consumers are faced with a high upfront cost of purchasing compatible cookstoves for the technology, the gas cylinder and infrequent but high costs of refilling the cylinder when it empties after several months. This can be tackled through a periodic payment plan of smaller amounts spread over a consumer's income cycle, as shown by PayGo Energy, one of the players in the market.

Case 2: Private sector model - PayGo Energy

PayGo Energy offers pay-as-you-go technology for LPG cylinders, enabling consumers of all income levels to access the clean energy fuel.

The business' model is based on a smart prepaid metering system that only dispenses the fuel after payments have been made. Consumers are required to first register with the company's agents, a process through which a small fee is charged then they can start using the technology from their homes. Just like the Kenyan electricity technology, consumers load their meters with whatever amount they can afford, and they can then use the energy until they have consumed to an amount equal to the purchase made. The smart meters monitor fuel levels to enable cylinder replacements to be done in good time so consumers always have the product when needed.

4.3.3 Assessment of investment area

Scale of investment opportunities

While investments in this sub-sector have been mostly directed towards the briquettes market with mixed results on household-level products, there has also been emerging investment in LPG for small-scale use, followed by ethanol. As seen with various other economic sectors in the country, access to capital by SMEs, especially those aiming to prevail access to urban and rural communities, remains a big challenge.

However, the market still shows promise as demonstrated from the interest expressed by investors in just the past five years, although there is no data available on the total amount invested in the sector. For example, in 2017 the Industrial and Commercial Development Corporation (ICDC) provided KES 110M debt financing for a local manufacturer producing briquettes from pineapple waste, Global Supply Solutions, to scale operations and boost production by 100%.⁴⁶

On the other hand, the ethanol cooking fuel market faces a separate set of challenges as the industry is still in the formative stage. For the business enterprises to be able to reach the target market, they need to leverage already-existing infrastructure and distribution networks - fuel traders can play a role in facilitating last mile distribution, in addition to investing further into ethanol cooking fuel and stove companies who have received early stage investment.

Despite the under-development of the ethanol market, it has received some attention from investors with one of the most recent financing vehicle being an innovative revolving fund by ClimateCare. The solution entails supporting microfinance institutions to extend loans to low-income households to enable them to purchase ethanol cookstoves which are estimated to reduce GHG emissions by 5 tCO₂e⁴⁷ annually. Total emission reductions are measured, and the carbon credits sold to provide more financing for the fund.

Investments into the LPG infrastructure have mainly been from the government, given its capital-intensive nature, which is higher than both briquettes and ethanol when considering costs of scale beyond semi-urban areas. The government, in a bid to increase the penetration in rural areas from the current 1%, set aside KES 3B in its latest budget to increase imports through expanded storage capacity in the country; the additional 15,000 tons at the Mombasa refinery site would be linked to the Standard Gauge Railway (SGR) for more efficient transportation, and reduced costs, for distribution to rural areas. Large scale investments in LPG infrastructure will help improve price and availability of this product to smaller consumers. Investments into mass-market companies are emerging: PayGo Energy raised nearly USD 1.5M earlier this year.

Barriers and risks to investment

Uneven regulatory playing field: The playing field between traditional and alternative cooking fuels is uneven, constraining the development of and investment in the sub-sector as a whole. As noted by private sector players, scale in the ethanol cooking fuel market hinges on imported ethanol becoming tax and duty exempt for it to be competitive with charcoal and kerosene, especially if there is no capacity to implement the ban on charcoal use or introduce an additional tax on kerosene. LPG also became VAT exempt in 2016, applying to both locally produced and imported LPG.⁴⁸

Capital-intensive infrastructure: As noted, one of the major barriers to LPG expansion is the capital-intensive nature of processing and transportation, meaning that this type of technology may not be suitable for more rural to rural areas.

Last-mile distribution: As noted by an investor, last-mile distribution and awareness is key for consumer uptake but is one of the main issues in the sub-sector. Investors historically have funded more on the product side in aims to decrease cost, but from experience, business to consumer (B2C) distribution has been the main cost contributor and overall there is investor sentiment that few distribution models have been effective.

Working capital constraints: Common not just in this sub-sector but also in DC appliances, the working capital and credit intensive nature of these technologies means that the cost of capital is generally quite high, and like last-mile distribution, companies must demonstrate proven lending models with high repayment rates.

4.4 DC appliances for commercial use

DC appliances are particularly relevant to Kenya's Vision 2030: the aim of reaching middle-income status will create an enormous demand for energy, as household income increases and industries grow rapidly. The efficient use of energy and the promotion of off-grid energy systems, are considered necessary if NDC commitments are to be reached.

While the clean and renewable energy sector continues to receive attention from investors, private sector companies, and the government on the energy supply side, initiatives to promote more efficient energy use on the demand side provide an equally impactful but more nascent opportunity – therefore this section focuses on the supply side market for DC appliances. DC appliances have the dual advantage of being more energy efficient than AC appliances, while also being directly compatible with many solar home systems (SHS), mini-grids, and other renewable off-grid electrification technologies, such as wind, small-scale hydro and biogas, that have undergone rapid recent growth in Kenya.

As these communities' demand for both residential and commercial power continues to increase, DC appliances could play a critical role in minimizing associated carbon intensity. At the same time, the prospect of a wider range of available DC appliances is likely to further stimulate demand for off-grid renewable generation technologies as a replacement for traditional energy sources such as wood, charcoal, kerosene, candles, or batteries.

In this section of the report, we analyze the market demand and supply of DC appliances, both for residential and commercial use.

4.4.1 Rationale for inclusion

1. Technical potential emission reduction in 2030: As official NDC documents do not include DC appliances as a mitigation action, there is no government data on DC-powered water pumps and DC refrigerators' MtCO_{2e} reduction potential. However, a draft document by the Food and Agricultural Organization states that replacing a diesel-powered refrigerator with a solar milk cooler would result in annual GHG savings of 10 tCO_{2eq}.⁴⁹ Therefore, a shift from diesel-powered refrigerators to DC-powered refrigerators for the off-grid market could result in significant GHG emission reductions. Further, "Kenya's Second National Communication reported that agriculture emissions accounted for approximately 40% of total national emissions in 2010"⁵⁰ whereby rice cultivation which involves irrigation is a leading contributor to the emissions. Considering that irrigation in Kenya is mainly done using diesel powered water pumps, we believe that using DC-powered water pumps to replace the diesel-powered water pumps would significantly reduce the GHG emissions within the agricultural sector.

2. Additional investment impact: Generally, there is mixed investment within the DC appliances space. There have been major investments in the small residential DC appliances space in the recent past, with over 40 solar companies operating in Kenya. However, investment in the commercial DC appliances sector has remained low. There are relatively few companies in the country selling DC refrigerators and DC-powered water pumps, This, therefore, presents an opportunity to support a lucrative sector.

3. Market growth stage: The DC appliances sub-sector for some products is saturated, and for others is nascent. Major appliance manufacturers understandably still focus on the much larger AC market, and as a result the DC market has mostly been driven by off-grid energy companies looking to bundle devices with their generating equipment. The market for larger, independent DC appliances (some of which also have in-built generating technology such as solar panels) is in its early stages, but could benefit greatly from the burgeoning growth of the off-grid solar market, provided appropriate incentives and initiatives are in place.

4. Market growth potential: Our consultations with DC refrigerator distributors revealed that the demand for DC refrigerators in off-grid locations across Kenya is rising for reasons related to climate change adaptation. There is also a possibility that demand for DC-powered water pumps will grow further as products become cheaper with better lending models as replacement of diesel pumps with DC water pumps in irrigation, as it looks to cut down on GHG emissions within the agricultural sector.

5. Development impact: DC powered water pumps derive power from renewable sources such as solar and wind. Therefore, they do not emit harmful GHGs into the atmosphere. On the other hand, DC refrigerators offer social and economic co-benefits by providing an opportunity to off-grid communities to live a higher quality of life through access to more appliances that they would have otherwise not been able to use.

4.4.2 Sector overview

This section segments the market for DC appliances into three sub-sectors according to their use: residential, water pumping and DC refrigeration. Descriptions of these as well as a discussion of supply and demand are found below.

Overall supply and demand of DC appliances in Kenya is low due to a lack of consumer awareness. Demand will grow as solar home systems (SHSs) become more pervasive and small industry more commonly adopt off-grid energy generation technologies. Currently, only 55% of Kenyan households are linked to the grid, up from 27% in 2013.⁵¹ While connectivity to the grid is increasing, it is still inconsistent and often households and industries will be looking for alternative and more reliable sources of power, as well as efficient ways of utilizing this power. According to stakeholder consultations, DC appliances that have been designed for commercial use have been mainly for small businesses, as it is assumed that large scale industry would have the capacity to source and utilize AC appliances. Additionally, some large commercial DC appliances such as those used in industrial processes come with high maintenance costs for their DC motors. However, DC motors are seen as easier to maintain despite this, thus necessary care should be taken to avoid the need for frequent replacements.⁵²

DC-powered water pumps

There has been a rise in the uptake of solar irrigation pumps from specialized providers offering integrated irrigation and generation systems such as Davis and Shirtliff, FuturePump and Sunculture. These companies have received significant private sector investment and are gaining increasing traction in Kenya. However, the target market for solar irrigation pumps have been small to medium scale farmers due mainly to affordability and preference. Firstly, the units are too expensive for smallholder farmers, especially those who require larger units if they are further from a water source, and require financing mechanisms (which companies are now introducing).⁵³ On the other hand, the units are not powerful enough for large-scale farms on hundreds of acres. With the units having become significantly cheaper over the years and with the emergence of pay-as-you-go technology, reaching more smallholder farmers is possible. Stakeholder consultations reported an increasing interest from some of their larger clients, such as agricultural Savings and Credit Cooperative Organizations (SACCOs) who have the ability to purchase larger pumping systems for their members' use. There are also other uses for DC-powered water pumps beyond irrigation. For example, water can be pumped from a borehole to be used in washing farm equipment or feeding cattle. To this end, companies are now starting to explore other use cases, in efforts to offer more and better

products to the market faster. For example, Sollatek is working with a few NGOs to identify other uses of solar water pumps apart from irrigation.

DC refrigeration

According to stakeholder consultations, solar refrigeration is slowly emerging in Kenya to become a main DC appliance in the sector, after DC TVs available in the Kenyan market. Fridges and freezers are still extremely expensive and will still require further design-innovation to reduce the cost of the units, as well as financing options. Currently, demand for DC fridges is mainly driven by the vaccine market, and secondarily in other cold-chain industries like dairy and fisheries. Our stakeholder consultations revealed that there are other sectors other than dairy, fisheries and health care which have cold chains, and as such, would further drive uptake of DC refrigerators. However, according to stakeholder consultations, much of the investment of DC fridges for smaller businesses in these sectors has been subsidized by either county governments or donors/development programs. DC fridge providers also noted that they provide these units on-demand and usually do not import any stock. Some of the companies providing solar refrigerators in Kenya are Sollatek, Sundanzer, SureChill and Go Solar Systems.

Other residential and commercial DC appliances

Devices in this category include, but are not limited to, LED bulbs, television sets, radios, cooking ovens, electric fans, and cereal mills, egg incubators and oil presses. Most of the large DC appliances like oil presses and cereal mills are widely used in countries like India, but are rare in Kenya. Solar Home System (SHS) companies that bundle solar panels with batteries and DC appliances have been major drivers of growth in this category. Today, close to a million households in Kenya have purchased SHSs, which represents a small portion of the approximately 8 million households living in off-grid electricity zones⁵⁴. Our consultations with various DC appliance market stakeholders suggests that the demand for more sophisticated appliances like DC TVs, even without bundling the sale with solar panels, is on the rise. This is because DC TVs are a relatively new product in the market, and few people who have SHS own DC TVs. Some of the companies in the small residential DC appliances space include Sollatek, d.light, M-Kopa Solar and Solarcentury.

4.4.3 Assessment of investment areas

Scale of investment opportunities

There has been a lot of investment activity around the DC residential appliances sector in the recent past, specifically SHS and related accessories. M-Kopa Solar alone has already raised over USD 40M in equity funding and a further sum of over USD 20M in debt fundings⁵⁵. Another off-grid solar company and small-scale residential appliance distributor, d. light, recently received USD 10.5M on top of last year's USD 22M which they raised for expanding their pay-as-you-go reach in off-grid markets. Additionally, the Department for International Development (DfID) has launched the global Low Energy, Inclusive Appliances (LEIA) innovation program to support the development of DC appliances targeting the off-grid households in Africa. While the scope of the program's activities is unknown, this program could possibly contribute to the expansion of Kenya's off-grid DC appliances market.⁵⁶

Solar refrigeration has received minimal investment in Kenya. However, water pumping particularly solar irrigation has gained significantly more traction with the likes of Davis and Shirliff, FuturePump,

and Sunculture – for instance, as demonstrated by Energy Access Ventures investing into Sunculture with Partners Group and unnamed angel investors of an undisclosed amount.

Even taking into account the SHS sector, however, investment in the DC appliances space has been dominated by equity capital. It is difficult for companies operating within the DC appliances space to raise debt capital for their business needs because of the high upfront capital cost of equipment and the long receivables cycle in cases where businesses offer their own in-house consumer financing. However, there has been a strong emergence of financial institutions extending consumer financing, most notably Equity Bank in Kenya, who have partnerships with both Sunculture⁵⁷, Fenix International⁵⁸ and other DC appliance providers.

Overall, we see a significant opportunity for targeted policies and incentives to replicate the ongoing success of the small residential DC appliances market in the refrigeration and water pumping sub-sectors.

Barriers and risks to investment

Unclear and inconsistent tariff policy: Regulations that have been implemented considering the growth of SHSs have been applied inconsistently. For example, in 2011, the government removed tax on imported raw materials for manufacturing solar panels.⁵⁹ In 2013, they then introduced a 16% VAT on all solar products and materials, with stakeholder consultations citing abuse of the regulation.⁶⁰ In 2014, the government again removed VAT on all solar products, hurting local manufacturing but making imported products more affordable.⁶¹ Additionally, the import policy requires importers to obtain an exemption certificate for every container they import, causing inefficiency to importers such as DC appliance distributors. This has created an environment where there are unclear clearance procedures, leading to unpredictable additional expenses and time delays for imported equipment. The combination of these factors creates uncertain conditions for companies to invest in a greater variety of DC-powered water pumps and DC refrigerators, as well as local manufacturing capacity.

Insufficient information: According to one of the DC-powered water pump distributors in Kenya that we engaged, there is no information regarding the existing boreholes and water tables for different places across the country, which would be considered basic information required by the sector. Consequently, manufacturers have ended up producing DC-powered water pumps generally suitable for shallow water tables, learning over time that much of the country seems to have deeper water needs.

Capital constraints: As the size (and subsequently cost) of DC appliances continues to grow, this creates working capital constraints on the side of the distributor/importer. As noted above, DC appliance companies do not store stocks of appliances but rather order them on-demand because of the perception of low, one-off demand. Without large buyer contracts, most companies find it difficult to obtain working capital funding for these more expensive products. On the distribution side, the emergence of DC-powered water pumps and DC refrigerators demonstrates a need for more financing mechanisms to allow lower-income farmers and smaller businesses access.

5 Institutional landscape

While Kenya has strong climate change policies in place, the extent to which the institutional landscape is coordinated to promote private sector investment is weak. This section discusses existing and planned initiatives by the GoK and other public & private sector actors to facilitate private sector financing, beyond NDC documentation.

5.1 Institutions and actors promoting private sector finance for climate relevant activities

GoK ministries have clearly articulated climate change related mandates, and the mandate of climate change coordination across government is delegated to the National Climate Change Council, and specifically the Climate Change Directorate (CCD) within the MENR. However, it overall appears that the extent to which there are different initiatives led by the government to attract private finance to non-public climate change related sectors are few, and these are elaborated later on in this section.

Yet it must be noted that the GoK has made significant efforts to access finance and technical assistance from non-private sources, such as bilateral and multilateral institutions. This includes the GCF, the African Development Bank's (AfDB) Climate Change Fund (who have also funded large-scale solar and geothermal in Kenya), USAID's Power Africa, and most notably the Scaling-Up Renewable Energy Program (SREP) – funded by multilateral banks for facilitating investment in geothermal energy development, mini-grids, and solar water heating systems. This type of financing is necessary for large-scale project development, but not as appropriate for funding many other mitigation actions noted within the NDCs. This is expanded on further within this section.

Private sector consultation in the development of climate change policy

Based on OCA research, the level of private sector consultation in formulating climate change policies is mixed. A government official from CCD stated that overall, the private sector to date has only been minimally consulted during the development of the NDCs and the sub-sector articulations, but that they are planning dissemination workshops which will include the private sector. However, according to consultations with private sector associations, the private sector feels they have been adequately consulted in the development of the NDCs and NAMAs, except for Kenya's bid to access the GCF, which they feel they could play an active role to support. For example, within the development of the NCCAP, there was a study conducted on private sector engagement in climate change adaptation that included interviewing dozens of firms and private sector associations on how climate change has impact their businesses and industries.⁶²

Most recently in March 2017, the Kenya Private Sector Alliance (KEPSA) participated in a workshop led by the Kenya Climate Innovation Centre (KCIC) on mainstreaming climate change into Kenya's third Medium Term Plan;⁶³ KEPSA's main purpose is to play a strong consultative role representing the private sector in these discussions, and several other sector-specific associations have also met with their relevant government departments.^{64,65} Additionally, KEPSA's climate change work doesn't stop here: it also set up the Climate Business Information Network, supported by the Danish Government, which is a network and set of regular meetings of private sector firms to discuss climate change advocacy issues.⁶⁶

Institutional oversight and coordination

As stated earlier, the responsibility for the implementation of climate change initiatives spans the whole of GoK, but coordination lies with the National Climate Change Council, chaired by Kenyan president. The CCD is the Secretariat of the Council, who are to “spearhead the development and implementation of climate change policies, strategies and action plans”⁶⁷ but report to the Cabinet Secretary of Environment and Climate Change. The Council also has the responsibility to ensure that national and county governments mainstream climate change, oversee the implementation of the NCCAP, administer the Climate Change Fund, and set targets for the regulation of GHG emissions.⁶⁸ There are also several “climate desks” established within the Ministry of Agriculture, Livestock and Fisheries, National Treasury, and MOEP.⁶⁹ The National Treasury has been tasked with leading Kenya’s efforts to access finance from the multilaterally-funded GCF.

While it is not unusual for a government to spread climate change initiatives to encourage participation and engagement across ministries and regional governments, this approach does complicate exact attribution of responsibility and accountability for facilitating private sector finance.

However, this does not mean that government-led efforts on facilitating private sector investment in climate change-related sectors do not exist. Most notably, the GoK implements the National Environment Trust Fund (NETFUND), a state corporation under MENR which facilitates environmental awards competitions, research programs, and an incubation and investment program for “green” SMEs.⁷⁰ As noted earlier, the KFS is implementing REDD+, which also articulates activities to help relevant businesses access private sector financing, including conducting value chain analyses and developing investment cases.⁷¹ The Kenya Investment Authority (KIA) also promotes the private sector to work in climate change prone areas, with a role in facilitating appropriate PPPs, helps stakeholders access funding under the Clean Development Mechanisms (CDMs), among other roles.⁷² A last example is the Kenya National Cleaner Production Centre (KNPCPC), housed within the Ministry of Industrialization and Enterprise Development, promoting resource efficiency within Kenyan industry with several projects on building business cases in eco-innovation, and supporting process efficiency in the tea, sugar and textiles sectors.⁷³

Generally, initiatives to attract private sector investment seem to be ad-hoc and sector dependent; however, an overarching Climate Change Fund was established under the Climate Change Act of 2016 but it is unclear whether this Fund has been developed as an entity and subsequently implemented. Named the Kenya Climate Fund, it will resource and channel funding from domestic and international donors for climate change initiatives.⁷⁴

5.2 Existing initiatives facilitating private sector investment in climate relevant activities

Most of the non-government led initiatives to drive private sector investment in climate change related sectors and/or address investment barriers are donor-driven or -funded, and there is little evidence to suggest there are any projects that are purely private sector driven. However, this is not surprising: donors traditionally have played a role in buying down the risk of private sector businesses and investors entering sectors perceived to be unproven or nascent, of which many climate change related sectors fall.

A study by Adam Smith International found that “there are currently 127 active climate-relevant projects in Kenya, with a value of \$2.29 billion, mainly across energy, agriculture, forestry, coasts and

water” funded by development partners, with roughly two-thirds of that in the form loans, and the remaining as grants.⁷⁵ A portion of these projects also include some of those mentioned above, such as SREP, Power Africa, and notably KCIC, mentioned briefly above, that supports early-stage SMEs to scale green technology innovations. However, it is unclear what portion of these projects go towards facilitating private financing or is investment directly into businesses, versus technical capacity building; it is also unclear to what extent these projects are primarily focused on climate change or whether it’s a less meaningful “add-on”.

In terms of the amount of private finance facilitated, a total figure is unknown. Nearly all reports found by the OCA research team indicated only amounts of finance allocated towards renewable energy projects; according to these, Kenya attracted over USD 150 million in private finance for renewable energy projects by 2012.⁷⁶

Many of these projects focus also on supporting the government in creating an enabling environment for climate change related investment, including the Energy Regulatory Commission (ERC). The ERC has a significant role to play on the regulation and enforcement of energy efficiency and promoting clean sources of energy, such as fining those who are not compliant with the solar water heating rules. Other enabling environment changes include:⁷⁷

- 2010: Development of simplified templates for power purchase agreements (FIT Policy)
- 2012: Introduced solar water heating legislation (SREP support)
- 2016: Development of the Climate Change Finance Policy and the Kenya Climate Fund

Table 5 below is a non-exhaustive list of initiatives for climate funding in Kenya to date. Though the government is a key stakeholder in many of these, most are managed by external organizations. The majority of this financing is channeled towards public sector-led projects, including for direct investment and technical capacity building of government bodies. Several initiatives, while not industry specific, are also promoting and providing investment to SMEs that operate in climate change related sectors. These investments, as well as regulatory changes, have largely been driven by private sector actors and DFIs. The exact breakdown percentage of how much funding is allocated towards specific uses, like those noted above, is unknown.

Overall, while there does not seem to be a leading coordinating body or institution driving private sector investment into climate change-related but non-government led sectors, this should not discount the effort by the government and its ministries to access climate change financing from donor sources.

Table 7: Indicative list of current climate change financing initiatives in Kenya

Name	Description	Type	Key Stakeholders
Finance Innovation for Climate Change Fund (FICCF)	· Component under StARCK+ · Provides £5.3M for climate relevant initiatives in the private sector, including partnerships with KAM, Climate Care, and the UNDP	· Donor-funded program with private sector component	· Development Alternatives International (DAI) · Matrix Development Consultants · IISD · UKAID
Global Environment Facility (GEF)	· Provides investments to developing country governments to tackle environmental issues · Provided USD 980K in funding to KENGEN to cover feasibility studies, training, and procurement for geothermal development	· Multilateral fund	· Kenya Electricity Generating Company Limited (KENGEN) · GEF Secretariat · Contributing agencies (15+) including the AfDB, IFC, UNDP, and the WB
Green Bonds	· First initiative in Kenya to “tap into international and domestic capital markets to finance green projects and assets”⁷⁸ · Still under development	· Donor-driven private sector initiative	· Kenya Bankers Association (KBA) · Nairobi Securities Exchange (NSE) · Financial Sector Deepening Africa (FSDA) · Dutch Development Bank (FMO) · International Finance Corporation (IFC)
Green Climate Fund (GCF)	· UNFCCC-driven multilateral fund providing USD 6B+ for climate change initiatives⁷⁹ · GoK approved for readiness program to help put in place the necessary structures required to access GCF financing	· Multilateral fund · PPP · Enabling environment	· GoK (National Treasury) · UNDP, UNEP · World Resource Institute (WRI), Government of Germany (GIZ) · GCF Secretariat
Kenya Climate Innovation Centre (KCIC)	· Provides proof of concept and seed funding for SME entrepreneurs to pilot and scale clean technology solutions	· Donor-funded private sector initiative	· The World Bank, UKAID, DANIDA, infoDev · Pwc, Energy4Impact, KIRDI, Strathmore University
Renewable Energy and Adaptation to Climate Technologies (REACT)	· Awards up to USD 1.5M in repayable grants for renewable energy and adaptation technologies	· Donor-funded private sector initiative	· Africa Enterprise Challenge Fund (AECF) · DANIDA
Sustainable Use of Natural Resources & Energy Finance Program (SUNREF)	· Implemented by KAM, the initiative finances “renewable energy and energy efficiency solutions in the private sector”⁸⁰ with concessional loans accessed through Kenyan banks	· Multilateral fund	· Agence Francaise de Développement (AFD), European Union · KAM · Cooperative Bank of Kenya, Diamond Trust Bank (DTB), Commercial Bank of Kenya

been driven by private sector actors and DFIs. The exact breakdown percentage of how much funding is allocated towards specific uses, like those noted above, is unknown.

Overall, while there does not seem to be a leading coordinating body or institution driving private sector investment into non-government led sectors, this should not discount the effort by the government and its ministries to access climate change financing from donor sources.

6 Recommendations and other areas for consideration

In response to barriers & risks identified in section 4 above, this section will discuss specific strategies to help address gaps in these sub-sectors and make them attractive to private investors. In general, we identify solutions across five broad themes – consumer awareness, market research, regulatory and policy framework, technical assistance, and investment de-risking – though each of these must be tailored to the specific sub-sector in question. These solutions, described below, have been listed in order of priority for each sub-sector, as informed by stakeholders.

6.1 Private sector models in forestry

6.1.1 Micro-forestry

1. Collateralization research: One of the main challenges cited is that commercial and smallholder farmers in the sub-sector lack of access to capital. Among many other reasons, farmers find it difficult to access capital as banks do not take trees as collateral. This presents a need to determine how farmers can use trees as collateral, or how to get banks to accept trees as collateral, within the framework of Kenyan law including the Kenya Companies Act. CDKN can partner with TNC and co-finance such a legal study that would help unlock investments for commercial and smallholder farmers; and can approach pro-bono groups such as Trust Law to support the initiative.

2. Investment de-risking: Though pooling smallholders into associations reduces investor exposure to individual farmer risk, micro-forestry is still a very young sector with few established players and limited track record. In addition to the uncertainty around farmer associations' ability to effectively organize and ensure consistent supplies, risks inherent to any agribusiness sector such as crop failure, drought, pests, and variable harvest size will also impact the investment case. In addition to the TA mentioned above, one strategy to stimulate initial investment might be to de-risk investors, either in the form of direct guarantees or by providing assistance to set up risk-mitigating investment structures such as SPVs or pooled asset funds.

Aside from direct guarantees, CDKN can play a huge role in de-risking investments by lobbying for capitalization of similar investment vehicles such as the "Tree Fund" by TNC. CDKN can have a more convincing voice in getting blended capital investors to support such funds that are designed to provide capital for small holder farmers, who would otherwise not be able to scale.

3. Technical assistance: Micro-forestry relies on smallholder farmers to provide their own land and manage plantations of trees for commercial purposes. However, being able to monitor the health of a company's out-grower tree stock, and ensuring that smallholder farmers have the technical and financial resources they need is a common problem. Often monitoring a large number of small farms is time and resource intensive as it is a manual process. Working directly with strategic value chain actors, like aggregators such as Komaza, to create and test different supply chain management systems would present an opportunity to develop more scalable models. For example, Komaza is

currently developing an ICT-based platform for easier monitoring but would require additional support in iteration and testing.

6.1.2 Alternative fibers

4. Market research & awareness building: Alternative fiber markets are still significantly constrained by a broad lack of consumer awareness regarding the availability, uses, and cost implications, such as for bamboo as an alternative for in manufacturing industries. The supply chain has also not been significantly developed, and potential growers lack market information and technical agronomical knowledge. These inefficiencies have left much of the potential alternative fiber market untapped and undeveloped, and have therefore limited investor interest to date. There is therefore a need for more research on the demand for alternative fiber products, building a detailed business case for potential alternative fiber growers, and making the findings of this research available to a broad set of industry actors.

6.2 Alternatives to wood and charcoal for residential and/or industrial processes

1. Regulatory and policy framework: As ethanol is the most nascent market, its regulatory framework is the weakest. For example, there is VAT on ethanol cookstoves and imported ethanol but not locally produced ethanol, no VAT on LPG or its cylinders, and no VAT on kerosene and charcoal (as they are largely informally traded). Both imported ethanol and the clean cookstoves are subjected to import duties as well. Additionally, due to the informal nature of the charcoal and kerosene sectors, this allows for lower cost production, however inefficient. Removing this VAT from imported ethanol would help level the playing field for all household energy fuel players in the market, and improve the growth prospects of the ethanol market as a whole.

Both the ethanol and kerosene markets need to be highly regulated as well, as both fuels are highly flammable – ethanol being more flammable than kerosene. It is important to ensure safe last mile distribution of the fuels to avoid household fires, that have been common in slum residential areas due to the presence of many informal retailers. There is higher potential to influence the regulation on distribution in the ethanol market as, opposed to kerosene, the market is still developing. One of the ways in which CDKN can support the formulation of policies that would create a suitable regulatory environment is through stakeholders involved in the development of these policies. KOKO Networks has been given a seat by the Kenya Bureau of Standards (KEBS) in the committee responsible for developing standards for the ethanol cooking fuel industry. CDKN can support the provision of services of industry specialists to advise the committee on best practices and international standards to adopt.

2. Comparative analysis: To date, the LPG industry has capitalized on market perceptions, making LPG the desired and well-known fuel for most households, regardless of income. In efforts to create a competitive industry, there is work to be done to build awareness of other competing fuels that may be cheaper and more suitable for certain customer segments. For example, while all three fuels have varying levels of social, economic and environmental impacts, the capital expenditure required to mainstream one fuel may be significantly cheaper than others. CDKN can support the mainstream of other clean energy fuels through a third-party study that performs a detailed comparative analysis of the investment required and impact of switching the country from the current energy use (traditional and dirty) to briquettes, ethanol, and LPG. Additionally, this research can be used to work

with the government to introduce a clean-fuel subsidy, likely funded by the GCF or a similar fund, in rural areas to incentivize households to switch from charcoal and firewood, which is significantly cheaper outside of urban areas.

3. Consumer awareness: Despite increasing efforts to raise consumer awareness of the health risks of traditional wood or charcoal-fired stoves, most of these have focused more on the stove and less on the fuel. There is therefore still little awareness among residential consumers of the uses, prices, availability, and benefits of alternative cooking and heating fuels. This has limited demand and traction of these models, and thus the sector's attractiveness to investors. To achieve successful substitution of charcoal with cleaner alternatives, there is therefore a continued need for broad consumer awareness campaigns to advertise the potential health and economic benefits of non-carbon fuels.

Given the market dynamics are poorly understood, there is need for further research to find comparable countries where the ethanol and small-scale LPG market has taken off, define strategies that may work in Kenya, and determine the specific gaps that can be filled by the various stakeholders. For instance, to drive such awareness amongst consumers in the ethanol market, CDKN can support the development of testimonials from PayGo or KOKO Network's consumers on their experience with the cookstoves and the fuel. These consumer insights will be a powerful marketing tool for both the stoves and the clean fuel as experiences shared can be relatable among many households.

These marketing campaigns can also address another issue present in the clean energy fuels market, which is poor consumer behaviors that drive up the cost of fuel use. For example, there is need to educate consumers on more efficient cooking practices to dampen the perception associated with cooking some traditional meals with charcoal stoves only, such as the long cooking time of beans which can be decreased by pre-soaking the beans overnight.

4. Technical assistance: While the models are different, and as noted by consultations with investors, most briquette, ethanol and LPG companies have difficulty developing profitable and efficient distribution networks. While it is important to develop mass-market friendly products, the ability to reach this mass market will determine a company's success. Working directly with these companies to develop well-tested distribution models by providing either pilot financing or technical expertise can help spur growth in the sector. Some of the companies that can greatly benefit from such support include KOKO Networks. CDKN can work with the company to pilot a centralized model that will achieve last mile distribution to various parts of the country, not just the major cities.

6.3 DC appliances

1. Market research: While there has been much success and investment in low-cost solar household DC appliances, the commercial DC appliances market does not have the same level of accurate and complete information. Basic information that should be made available to market players, such as information on the water table, location and condition of boreholes, commonly grown crops in different areas and the water requirement, and more, are not available. This has meant that companies in the space have developed products that are likely not tailored to their target customers, and there has been a lag in iteration. CDKN has the opportunity to support the entire industry by collaborating with research institutions to gather and disseminate this information. This research

could then be accompanied by analyses comparing diesel or on-grid power costs to renewable energy power costs for certain appliances that are extremely resource intensive. Conducting this market research would identify product and subsequent investment gaps within the DC appliances sector.

2. Product research: DC appliances are generally more expensive as they traditionally have not been developed for the mass market, like refrigerators, and this means that some are currently unaffordable without subsidy. Stakeholder consultations also raised the issue that manufacturers may not be focused on mass-market design because of the perception that there is little demand, as explained above. Subsequently, companies like Sunculture are setting up testing labs to further research on designing cheaper and more efficient technologies to power big DC appliances. Sunculture recently soft-launched a \$450, 80M water pump based on significant investment in R&D for developing a much more efficient energy management platform to handle the large DC power surge when turning a DC product on.

Therefore, CDKN has the opportunity to support Sunculture's efforts to take this new energy management platform and test it with different products beyond water pumps at a Kenya-based lab. CDKN can provide support in developing and marketing the idea to external investors. Clasp also tests many products through their Global LEAP Awards in Kenya and could be a collaborator in this initiative as well.

3. Technical assistance: One gap identified was a lack of lending models for larger DC appliances. Support by CDKN can cover two main aspects: first, building the business case, including additional use cases for DC fridges and especially water pumps, so that financial institutions have a better understanding of the products and repayment potential. Second is supporting companies and partnerships, such as Sollatek, in increasing the scale of pilot lending schemes to increase access to these appliances, but also build up the data and learning for future schemes.

4. Regulatory and policy framework: According to stakeholder consultations, the process of importing DC appliances is tedious because the distributor must apply for a VAT and tariff exemption certificate every time they ship in a container of solar related products. CDKN could work with market players and lead lobbying the government to build-in more clear and efficient import procedures, such as the issuance of a clearance permit covering a period of 6 months, rather than the distributor having to apply for an exemption certificate for each container.

5. Consumer awareness: Many mass-market consumers are unaware of what DC appliances are and how they are more energy efficient, even if they are already in the market. There is an opportunity to boost demand through consumer awareness. That could be done through running radio and television commercials, with the endorsement of relevant ministries such as MENR, to focus on reaching more rural populations doing irrigation and business sectors having a cold chain. Conducting "chief's barazas" and door-to-door campaigns should also be done to ensure optimal outreach. Raising awareness would lead to a rise in demand, and in turn encourage existing and new DC appliance companies to either procure and sell more product, or enter the market.

7 Recommended capacity and expertise for MPI delivery

This table below maps potential stakeholders against recommended actions from the previous section:

Table 8: Recommendations and proposed stakeholders for engagement

Recommendations	Stakeholders to engage	Nature of engagement
<i>Private sector models in forestry</i>		
1. Collateralization research	The Nature Conservancy, legal firms, finance experts	Support existing initiatives that aim to design collateralization mechanisms for those operating in micro- or large-scale forestry by engaging legal and finance experts
2. Investment de-risking	Financial sector experts	Work with sector experts to help build the business case for exactly what aspects of the sector need de-risking support
	Financial institutions, private investors	Disseminate the business case to relevant financial institutions and private investors to gain their feedback, develop the specific financing mechanisms
3. Technical assistance	Value chain actors	Work with micro-forestry value chain actors, like Komaza, to test different supply chain management systems, including those that leverage ICT
4. Alternative fiber market research	International Network for Bamboo and Rattan (INBAR)	Engage INBAR or other sector experts to conduct market research and analysis on the viability of alternative fibers for the Kenyan market
<i>Alternatives to wood and charcoal for residential and/or industrial processes</i>		
1. Regulatory and policy framework	National Treasury, ethanol cooking fuel companies	Work with private sector to lobby government for appropriate VAT and import tariff exemptions to level the playing field between ethanol and other fuels
	KEBS, ethanol cooking fuel companies	Work with KEBS and companies like KOKO Networks to introduce standards around ethanol cooking fuel and related accessories to discourage “grey market” distribution
2. Comparative analysis	Consulting company, alternative cooking fuel companies	Work with an independent consulting company to conduct a comparative cost analysis between different cooking fuels, use research to inform lobbying efforts with government for business case of clean fuel subsidy scheme, design of subsidy scheme
3. Consumer awareness	Alternative fuel cooking companies, MENR or other related gov’t ministries	Work with alternative fuel cooking companies to come up with consumer story based marketing campaigns, that will show the additional benefits of cooking with clean-burning fuels, as well as point towards more efficient cooking behaviors
4. Technical assistance	Last-mile distribution experts, alternative cooking fuel companies	Provide technical assistance to companies in testing and scaling their distribution models, such as centralized vs. decentralized scaling models in urban and rural areas

<i>DC appliances for commercial use</i>		
1. Market research	Consulting companies, sector experts	Engage a consulting company and/or sector expert to conduct market research, providing baseline market information so that DC appliance manufacturers design tailored products for the market
2. Product research	DC appliance companies, associated NGOs	Work with companies like Sunculture or NGOs like Clasp to help secure broader funding for their lab and field testing initiatives, to test more appropriate technologies with varying use cases
3. Technical assistance	DC appliance companies, associated NGOs	Work with DC appliance companies to expand the scope of lending pilots for DC fridges and water pumps, including support to build the business case for MFIs to offer this credit
4. Regulation and policy framework	MOEP, National Treasury, KAM, KEPSA	Work with relevant private sector bodies to lobby the government to introduce a relatively long-term certificate for importing DC appliances instead of the "one certificate per container" policy currently in operation
5. Consumer awareness	Kenya Consumers Organization (KCO), MENR or other related gov't ministries, DC appliance companies	Work with government and private sector companies to better market the variety and benefits of DC appliances through mass market advertising, including DC fridges and water pumps

8 Annexes

Annex A: Sub-sector selection criteria

Below is an outline of selected criteria used to guide OCA analysis and selection of subsectors.

Criteria	Measurement scale	Key Information for Analysis	Reasoning
1. Technical potential emission reductions in 2030	Million tons of carbon dioxide equivalent (MtCO _{2e})	The amount of greenhouse gas emission that can be reduced in the subsector in 2030 to help the sector reach its NDC target, as identified in NDC documentation	Subsectors chosen should demonstrate a strong ability to contribute to Kenya's reduction targets
2. Additional investment impact	Low Medium High	How much more investment can be channeled into the subsector to deliver meaningful impact? - Extent to which investments and/or initiatives are already happening in the subsector - Extent to which there are significant gaps in either the size, type or method of financing the subsector	Need to gauge whether additional investment will replicate efforts and/or potentially distort the subsector, rather than develop
3. Growth stage (current status)	Nascent Growth Mature	What is the current phase of growth in the sector? - Current size of market - Level of product/service saturation in the market - Nature of players within the subsector and their market positioning	If a subsector is nascent, there is an investment risk with low proof of concept; in mature phase, subsector may be exhausted and additional impact would be minimal

4. Growth potential	Low Medium High	How much more the market can grow, and is this a reasonable size for IKI to influence? · Extent to which sales can grow based on size of underserved market · Extent to which subsector can gain traction and sustainability with better access to finance · Level of financing required to build traction · Extent to which current market structure, (including policies and regulations, presence of market distorting actors), inhibits or supports growth in the subsector	Subsector should demonstrate an ability to generate high returns, including a large market size and market actors that can be reasonably influenced by IKI initiatives
5. Development impact	Direct Indirect <i>(These categories do not indicate directionality as development impact is difficult to evaluate across subsectors)</i>	What is the potential development benefits resulting from the growth of the subsector? (The following are indicative as different subsectors have several different aspects of impact) · Extent to which subsector can benefit and reach interrelated subsectors · Extent to which subsector can contribute to economic growth in Kenya · Number of skilled and unskilled jobs potentially created · Degrees of separation between subsector growth and development impact at the household level	It is important to understand and measure development impact to see whether any subsectors have significant differences; however, we anticipate that this will be difficult to rank as indirect and indirect impact is different for every sector

Annex B: Sub-sector shortlist

Below is a list showing the reasons for (non-) inclusion of the subsectors identified, highlighting the seven that were initially shortlisted to later be reduced to three. The highlighted subsectors are those that appeared most attractive for IKI to engage in channeling private investments – with relatively high growth potential and low existing investment and/or government influence

Sector	Sub-sector/ Assessment criteria	High priority criteria			Comments
		IKI ability to influence	Growth potential	Level of existing investment	
Transport	Bioethanol	Yes	High	Low	Though market for product has not been proven, the demand potential is attractive and private actors can influence sub-sector.
	Light Rail Transit (LRT)	No	N/A	N/A	Little traction in this sub-sector yet, making it non-existent. Additionally, as it is large-scale and a gov't driven sector, IKI influence may be difficult and outside of the timeline scope of this program.
	Bus Rapid Transit/Light Rail Transit	No	N/A	N/A	Similar to above.
	Improved Passenger Vehicle Stock Efficiency	No	N/A	N/A	Hard to influence regulation and market as stakeholders have minimal incentive to give up current vehicles in use.
	Improved Heavy Duty Vehicle Stock Efficiency	No	N/A	N/A	Would require significant policy change and government coordination; implementation of standards and regulations by government would be challenging. Timeline scope would fall outside of this program.
	Freight from Road to Rail	No	N/A	N/A	Already activity in this sector with the development of the SGR. IKI value-addition may be minimal.
Forestry	Reducing Deforestation and Forest Degradation	No	N/A	High	Hard to influence this sub-sector as framed, as it heavily relies on policy enforcement and government action.
	Alternative-Raw Wood Resources	Yes	High	Medium	Possible to influence sub-sector to meet high demand through already emerging private stakeholders.

	Microforestry	Yes	High	Low	Sub-sector has huge potential to grow, and appetite for private investment, making it attractive.
	Reforestation of Degraded Forests	No	N/A	High	Many existing programs with the GoK and international NGOs; also, generally not private-sector driven.
	Restoration of Forests on Degraded Lands	No	N/A	High	Many existing programs with the GoK and international NGOs; also, generally not private-sector driven.
Energy	Clean Coal (USC)	No	Medium	Low	Highly controversial sector; regardless, any clean coal projects would be large scale, gov't driven, and likely outside of IKI influence.
	Landfill Gas Generation	No	Low	Low	Hard to influence sub-sector as landfills are managed by county governments; additionally, poor track-record in the sub-sector.
	Solar Photovoltaic - distributed grid-connected	Yes	High	Low	Given the large-scale nature of this investment, likely to be government (or project-by-project) rather than private sector (or business model) driven.
	Hydro Generation Expansion	No	High	Medium	Heavy government presence in sub-sector already; IKI value-addition may be minimal.
	Wind Generation Expansion	No	High	Medium	Heavy government presence in sub-sector already; IKI value-addition may be minimal.
	D.C appliances	Yes	High	Medium	Growing sector, with some appliances still in nascent stage; opportunity to work with existing and emerging private sector players providing D.C. appliances.
	Geothermal Generation Expansion	No	High	High	Heavy government presence in sub-sector already; IKI value-addition may be minimal.
	Solar Thermal Water Heating	Yes	High	High	Though possible to influence sub-sector, it has received a lot of private investment and has many active players; IKI impact would be minimal.
	Energy efficient light bulbs (and appliances)	Yes	High	Medium	Prior to having D.C. appliances as a separate sector, promotion of energy efficient appliances outside of light bulbs still nascent;

					existing players are influencing regulation, but room for IKI influence on off-grid D.C. appliances.
	LPG Stove Substitution	Yes	High	Medium	Sub-sector still nascent but has received significant private sector investment already.
	(Solar) Renewable Lamps	Yes	High	Medium	Sub-sector considered saturated.
	Co-generation in Agriculture	Yes	High	Low	Little traction in small-scale co-generation in sub-sector so far, large-scale co-generation for electricity generation is also very nascent.
	Improved Cookstoves	Yes	Medium	Low	Sub-sector has received significant private sector investment and international NGO support; many existing private sector players.
	Briquettes	Yes	Medium	Low	Sub-sector for residential use has received significant private sector investment and international NGO support; many existing private sector players; however, for commercial use, briquettes as a sub-sector still nascent and emerging.
	Ethanol-Based Cooking Fuel	Yes	High	Low	Nascent market but with strong private sector players ripe for growth; IKI has room to influence direction of sector and government where necessary
Agriculture	Improved Management of Grazing Systems	No	Low	Low	Extremely challenging to influence sub-sector as there are too many small holder farmers involved.
	Cross Breeding	No	High	Medium	Many existing international NGOs and government currently intervening in sector.
	Drought-Tolerant Crops	Yes	Low	High	Many existing international NGOs and government currently intervening in sector.
	Rain Water Harvesting	Yes	Medium	Medium	Potential for growth and scale low; minimal existence of private sector players and sustainable businesses models.
	Insurance Schemes	No	Low	High	Difficult to influence policies of the number of insurance providers present in the country, already existing activity with international NGOs and government.

	Solar Irrigation	Yes	High	Low	Growing and nascent sector; room to support existing private sector in making products and services more efficient.
	Affordable Dairy Feeds	Yes	Medium	Medium	Many existing international NGOs and government currently intervening in sector.
	Affordable Greenhousing	Yes	Medium	Medium	Very nascent sector with minimal private sector activity; some influence by international NGOs.
	Strategic Food Reserves	No	N/A	N/A	Given this would be public mandate, Sub-sector is government's responsibility and thus not suitable.
Waste	Methane Avoidance from Landfill Gas	No	Low	Low	Hard to influence sub-sector as landfills are managed by county governments; additionally, poor track-record in the sub-sector (sub-sector similar above).
	Reusable Bags	No	N/A	N/A	Policy banning plastic bags already implemented in Kenya.
	Glass Recycling	Yes	N/A	N/A	Industry underdeveloped, and companies selling products using glass packaging already have return policy.
	Paper Recycling	Yes	N/A	N/A	Nascent sector with few private sector players; willingness to pay by consumers and thus growth likely to be low.
	Steel Recycling	Yes	Medium	Medium	Scrap metal sub-sector considered informal but thriving; pushing the sector to formalization likely outside of IKI influence.
	Oil Recycling	Yes	N/A	N/A	Little market information available; defining potential IKI influence outside of scope for this report; many existing oil recycling companies governed by NEMA regulation.
	Plastic Upcycling or Recycling	Yes	Medium	Medium	Existing players with plastic upcycling businesses, similar to scrap metal recycling, large but informal system of plastic recycling; pushing the sector to formalization likely outside of IKI influence.
	Solid Waste Management	Yes	Low	Low	Significant international NGO intervention in the sector, increasing number of private sector players and significant investment in these companies already; large-scale solid waste

					management must be government-driven, outside of the scope of IKI to influence.
Industrial processes	Industrial Waste Water Management	No	N/A	N/A	Requires updating and enforcement of regulation by NEMA and large-scale investment into infrastructure; IKI influence not within the timeline scope of this program.
	Cement Industry Energy Efficiency Improvement	Yes	N/A	N/A	Growth potential is minimal as framed, few cement industry players have invested in energy efficiency improvements.
	Voltage Control	Yes	Low	Medium	Currently significant activity by government and industry associations in promoting better energy efficiency practices; IKI value-addition would not be strong.
	Energy Efficiency	Yes	Low	Low	Currently significant activity by government and industry associations in promoting better energy efficiency practices; IKI value-addition would not be strong. Other energy efficiency appliances noted above.
	Improved Charcoal Manufacturing	No	Low	Low	Many existing international NGOs and government currently intervening in sector.

Annex C: Sub-sector analysis - high-level overview

The list below shows the performance of the sub-sectors listed in Annex 2 in each of the criteria used for decision-making.

Sector	Subsector/ Assessment criteria	High priority criteria			Second priority criteria				
		IKI ability to influence	Growth potential	Level of existing investment	Growth stage	MtCO2e reduction potential	Development criteria		
							Environmental co-benefits	Social co-benefits	Economic co-benefits
Transport	Bioethanol	Yes	High	Low	Nascent	0.55	High	Low	Medium
	Light Rail Transit (LRT)	No	N/A	N/A	N/A	0.6	Medium	Low	Medium
	Bus Rapid Transit/Light Rail Transit	No	N/A	N/A	N/A	2.3	Medium	Low	Medium
	Improved Passenger Vehicle Stock Efficiency	No	N/A	N/A	N/A	0.6	Medium	Low	Medium
	Improved Heavy Duty Vehicle Stock Efficiency	No	N/A	N/A	N/A	0.9	Medium	Low	Medium
	Freight from Road to Rail	No	N/A	N/A	N/A	0.8	Medium	Low	High
Forestry	Reducing Deforestation and Forest Degradation	No	N/A	High	N/A	3	High	Low	Low
	Alternative-Raw Wood Resources	Yes	High	Medium	Growth	Unknown	High	Low	High
	Microforestry	Yes	High	Low	Nascent	Unknown	High	Low	High
	Reforestation of Degraded Forests	No	N/A	High	N/A	6	High	Low	Low

	Restoration of Forests on Degraded Lands	No	N/A	High	N/A	33	High	Low	Low
Energy	Clean Coal (USC)	No	Medium	Low	N/A	1	High	Low	Medium
	Landfill Gas Generation	No	Low	Low	Nascent	0.5	High	Low	High
	Solar Photovoltaic - distributed grid-connected	Yes	High	Low	Nascent	0.5	Low	High	Medium
	Hydro Generation Expansion	No	High	Medium	Growth	1	Low	Low	High
	Wind Generation Expansion	No	High	Medium	Nascent	1.2	Low	Low	High
	D.C appliances	Yes	High	Medium	Growth	Unknown	Low	Low	High
	Geothermal Generation Expansion	No	High	High	Growth	14	Low	Low	High
	Solar Thermal Water Heating	Yes	High	High	Mature	0.2	Low	Low	Medium
	Energy efficient light bulbs (and appliances)	Yes	High	Medium	Growth	1	Low	Low	Medium
	LPG Stove Substitution	Yes	High	Medium	Nascent	1.2	Low	High	Medium
	(Solar) Renewable Lamps	Yes	High	Medium	Growth	1.4	Low	High	High
	Cogeneration in Agriculture	Yes	High	Low	Nascent	1.6	Medium	Low	High
	Improved Cookstoves	Yes	Medium	Low	Growth	5	Medium	Low	High
	Briquettes	Yes	Medium	Low	Nascent	Unknown	High	High	High

	Ethanol-Based Cooking Fuel	Yes	High	Low	Nascent	Unknown	Low	High	High
Agriculture	Improved Management of Grazing Systems	No	Low	Low	Nascent	Unknown	High	Low	Low
	Cross Breeding	No	High	Medium	Nascent	Unknown	High	Low	Low
	Drought-Tolerant Crops	Yes	Low	High	Nascent	Unknown	High	Low	Low
	Rain Water Harvesting	Yes	Medium	Medium	Mature	Unknown	High	Low	Low
	Insurance Schemes	No	Low	High	Nascent	Unknown	Medium	Low	Low
	Solar Irrigation	Yes	High	Low	Growth	Unknown	Low	Low	High
	Affordable Dairy Feeds	Yes	Medium	Medium	Growth	Unknown	Medium	Low	High
	Affordable Greenhousing	Yes	Medium	Medium	Nascent	Unknown	High	Low	High
	Strategic Food Reserves	No	N/A	N/A	N/A	Unknown	Low	Low	Low
Waste	Methane Avoidance from Landfill Gas	No	Low	Low	Nascent	Unknown	High	Low	High
	Reusable Bags	No	N/A	N/A	N/A	Unknown	High	Low	High
	Glass Recycling	Yes	N/A	N/A	N/A	Unknown	High	Low	High
	Paper Recycling	Yes	N/A	N/A	N/A	Unknown	High	Low	High
	Steel Recycling	Yes	Medium	Medium	Growth	Unknown	High	Low	High
	Oil Recycling	Yes	N/A	N/A	N/A	Unknown	High	Low	High
	Plastic Upcycling or Recycling	Yes	Medium	Medium	Growth	Unknown	High	Low	High
	Solid Waste Management	Yes	Low	Low	Nascent	Unknown	High	Low	High

Industrial processes	Industrial Waste Water Management	No	N/A	N/A	N/A	Unknown	High	Low	High
	Cement Energy Efficiency Improvement	Yes	N/A	N/A	N/A	1.3	High	Low	Medium
	Voltage Control	Yes	Low	Medium	Nascent	Unknown	Low	Low	High
	Energy Efficiency	Yes	Low	Low	Nascent	Unknown	Low	Low	High
	Improved Charcoal Manufacturing	No	Low	Low	Nascent	Unknown	High	Low	High

Annex D: Sub-sector analysis with detailed notes under each criterion

Sector	Subsector/ Assessment criteria	High priority		Second priority criteria			
		Growth potential	Level of existing investment	Growth stage	Development criteria		
					Environmental co-benefits	Social co- benefits	Economic co- benefits
Transport	Bioethanol	High Demand expected to rise by 60% ⁸¹ . Recent studies state that demand for bioethanol outstrips supply by 60% as mentioned above. Kenya has to import bioethanol to cover the deficit; which is expensive.	Low Low investment because there are only 4 companies assessing the feasibility of use of bioethanol in the transport sector.	Nascent Supply for use in the transport sector at the moment is nil. However, Mumias Sugar Co. could scale up their production to meet the expected demand. Ecofuels Kenya Ltd is already pioneering the use of croton as a diesel replacement. Agro-chemical Food Company Ltd. and Spectre International are researching on gasohol production to power motor vehicles.	High Releases less pollutants compared to conventional fuel used by motor vehicle engines.	Low Does not offer any direct social benefits.	Medium Investments in subsector would lead to creation of companies producing bioethanol hence creating employment opportunities.
	Light Rail Transit (LRT)	N/A The plan to set up an LRT system is still a project on paper.	N/A No investment action has been seen so far.	N/A Non-existent as there is no actionable investment plan in place.	Medium Would result in a decrease in number of road users – fewer vehicles – and thus less emission of GHG.	Low Does not offer any direct social benefits.	Medium An LRT system would create employment opportunities during and after its construction.

Bus Rapid Transit/Light Rail Transit	N/A No construction works have commenced- the project has not been implemented.	N/A The government is still contemplating the actualization of this project. Nevertheless, 135,000,000M Euros ⁸² funding has been secured from the GoK, International NAMA Facility and African Development Bank.	N/A Apart from the government, no other private sector investors have considered constructing a BRT/LRT system.	Medium The BRT/LRT would result in less road users, hence less vehicles and thus less GHG pollution.	Low Does not offer any direct benefits in the form of access to education, health and safety.	Medium Construction of the BRT/LRT would create more employment opportunities and save time that would have otherwise been wasted in traffic jams.
Improved Passenger Vehicle Stock Efficiency	N/A Chances of rising demand for efficient vehicles are unknown given importation of 14 seater "matatus" is unregulated. The absence of a retirement program for the already existing old, inefficient vehicles makes it hard for the government to push people into	N/A There is no actionable investment plan in this sector. However, the govt banned the importation of 14-seater matatus in 2011, then later lifted it in 2014 ⁸³ . During the 2013/2014 period, there was a failed attempt of digitizing the payment system in matatus.	N/A It is not possible to determine the growth stage of the subsector as it does not provide any actionable investment plan.	Medium Improved efficiency results in less pollution of the environment.	Low Does not offer any direct social benefits.	Medium Importation of more efficient PSVs would result in monetary gains for the government in terms of import duty.

		buying more efficient ones.					
	Improved Heavy Duty Vehicle Stock Efficiency	N/A No actionable investment plan exists for this.	N/A Technically, investment is too low-Apart from the recently opened plant in Thika by Volkswagen to assemble both polo cars and light trucks, there are no manufacturers of motor vehicles in Kenya.	N/A Non-existent as there is no actionable investment plan in place.	Medium Improved efficiency results in less pollution of the environment.	Low Does not offer any direct social benefits.	Medium Importation of more efficient HDVs would result in monetary gains for the government in terms of import duty.
	Freight from Road to Rail	N/A Not possible to estimate considering there is no actionable investment plan for this subsector.	N/A No actionable investment plan.	N/A There are no private investors pursuing this opportunity.	Medium Using rail to ferry goods rather than road, reduces the need for more vehicles on the roads thus less GHG pollution.	Low Does not offer any direct social benefits.	High System would create job opportunities for the service crew and save time for business men ferrying goods from one center to another.
Forestry	Reducing Deforestation and Forest Degradation	N/A If not addressed swiftly, the rate of deforestation is expected to increase by about	High There are several on-going projects. Some of them have been funded by international org's like the EU and	N/A There are no major private investors pursuing this option.	High Reducing deforestation and forest degradation directly reduces the rate of	Low Does not offer any direct social benefits.	Low Reduction of deforestation activities does not provide any direct

		50% ⁸⁴ come 2030. There is no actionable plan of investment for this subsector.	others through local partners like Safaricom.		exposure to GHG pollution because trees are literally "carbon sinks".		financial benefit.
	Micro-forestry	High The demand for commercial timber is high and is expected to remain so, going forward.	Low Few companies participating in micro-forestry in Kenya, but one example is Komaza.	Nascent While Komaza runs a proven business model, the move has not garnered any reasonable traction.	High Setting up micro-forests directly reduces the rate of exposure to GHG pollution because trees are literally "carbon sinks".	Low Does not offer any direct social benefits.	High Products of micro-forests such as timber can be used as inputs in many industries.
	Alternative raw wood resources	High The 2017 global demand for bamboo is estimated at \$60 billion ⁸⁵ and fast rising, according to INBAR.	Medium There are few companies selling bamboo trees and products in Kenya. However, GreenPot Enterprises has committed KES 5B ⁸⁶ for establishment of a factory.	Growth Increased awareness as to the numerous uses and market potential for bamboo products. There are 4 companies - Komaza, CarlMash Enterprise, Stroika and Erin Interiors Ltd- already selling bamboo in Kenya.	High Alternative raw wood resources reduce need for destroying natural forests.	Low Does not offer any direct social benefits.	High Would create inputs for use in furniture and other markets; which are sources of income for several people.
	Reforestation of Degraded Forests	N/A No actionable investment plan.	High There are a host of projects ongoing. Some of them include Saving East Africa Rare Trees	N/A Non-existent because of a lack of actionable investment plan.	High Reforestation would provide more trees that are additional "carbon sinks"	Low Does not offer any direct social benefits.	Low Provides no direct monetary gain.

			and the Mount Kenya Trust.		to absorb toxic GHG emissions from the atmosphere.		
	Restoration of Forests on Degraded Lands	N/A No actionable investment plan.	High A number of projects are already underway. Some of them include Restoration of the Mau Eburu Forest and its wider ecosystem and A Rocha Kenya.	N/A Non-existent due to lack of an actionable investment plan.	High Restoration of forests on degraded lands would provide more trees hence additional "carbon sinks" to absorb toxic GHG emissions from the atmosphere	Low Does not offer any direct social benefits.	Low Provides no direct monetary gain.
Energy	Clean Coal (USC)	Medium The potential demand for clean coal is high but the massive level of capital outlay required for the demand to be met puts off private investors.	Low GoK awarded Amu Power Ltd a tender to construct the Lamu Power Project in 2014, at a cost of USD 2 Billion ⁸⁷ . Court cases have delayed commencement of the project to-date. Latest expectations point to a commission date of early 2020.	N/A The level of investment that has taken place with regard to this subsector is too low for consideration.	High Clean coal emits less GHG pollution hence improves air quality.	Low Does not offer any direct social benefits.	Medium Clean coal firms would provide employment opportunities to locals in neighboring residences.

Landfill Gas Generation	Low There has been no traction and, as such, not much is known about this field. Demand for energy continues to rise but within the context of landfill gas generation, it is not quantifiable.	Low There is a stalled landfill gas generation project sponsored by the county government of Nairobi at the infamous Dandora dumpsite.	Nascent The Nairobi county govt. planned for a landfill gas generation project that was commissioned in 2013. However, due to title deed issues, it has not been implemented ⁸⁸ . This is a new field and no investors have channeled resources into it.	High Eliminates stinking waste from the landfills thus improving air quality.	Low Does not offer any direct social benefits.	High Generation firms would employ locals. The process also increases power for distribution on the national grid, enabling more industries to function.
Solar Photovoltaic - distributed grid-connected	High There are about 4M un-electrified rural households while grid-based rural electrification is completed at a rate of 100,000 connections per year ⁸⁹ . Connecting the 4 million households to the solar grid would require heavy capital outlay.	Low Only one government project has been commissioned to generate solar PV, thus far. There has been no traction. Ubbink East Africa is the only solar PV manufacturer in Kenya.	Nascent A projected funded by the government to provide Solar PV installation and maintenance in schools, communities, health facilities and administrative offices within the arid and semi-arid areas is already ongoing. Timeline- 2014-2020. Ubbink East Africa is the only company in Kenya that has ventured into the solar PV market.	Low Compared to a situation where no electricity is used, usage of solar PV energy adds no environmental benefit.	High Solar PV would enable school kids to read at night and also improve safety where used to power street lights.	Medium Solar PV would provide an operational boost for industries dealing with inadequate supply of power.
Hydro Generation Expansion	High Potential demand for	Medium There are a host of projects geared	Growth The GoK has invested heavily in hydro	Low Compared to a situation where	Low Hydrogeneration	High Projects create employment

		hydrogeneration is high. However, the high levels of capital outlay needed to set up a hydro-generation plant scares away potential private sector investors.	towards hydro power generation in the country. Some of them are- Hydro Dams, Hydro Power Plant and Kenya Tea Development Agency sponsored project. However, there isn't much private sector activity going on.	generation projects. Private participation is essentially non-existent.	no electricity is used, usage of hydro energy adds no environmental benefit.	expansion yields no benefits in the form of access to education or improvement of safety and health.	opportunities hydro-plants and also provides power for use by various industries in production activities.
	Wind Generation Expansion	High Wind energy already contributes to 38% ⁹⁰ of the electricity used in Kenya. With continued investment this can only increase.	Medium Several projects for generation of wind power are underway. Examples include Lake Turkana Wind Power Project, Lamu Wind Farm and Meru Wind Farm. There are also completed projects such as the Ngong Hills Wind Power Project – Phase II.	Nascent Wind generation is quickly gaining popularity with investors and entrepreneurs working towards expanding wind energy generation.	Low Compared to a situation where no electricity is used, usage of wind energy adds no environmental benefit.	Low Wind generation expansion yields no benefits in the form of access to education or improvement of safety and health.	High Wind generation firms provide employment opportunities for people and power for use in production activities by various industries.
	D.C appliances	High The rate of solar PV installations happening per year stands at 20,000 ⁹¹ . Heavy consumers of electricity are	Medium Most of the existing D.C appliances investments are targeting households. For instance, M-Kopa and Sunlar are	Growth The market for DC appliances is still growing (power is generally transmitted in the form of AC) and as such several manufacturers are	Low Using solar DC appliances has no direct environmental benefits when compared to the use of	Low Solar DC appliances confer no benefits in the form of access to education or	High Using solar DC appliances massively saves on money which would have otherwise

		now required by the Energy Regulatory Commission to cut down on their power use. Therefore, the demand for dc appliances will keep rising, owing to their energy efficiency.	companies targeting households. D.C appliances used for various industrial purposes are majorly imported on a need-by-need basis per company, especially after conducting an energy audit.	reluctant to start producing them. Though there several residential DC appliance producers. The leading producers of commercial D.C appliances are located abroad (Lifeway Solar devices in India; Phaesun GmbH in Germany; and Project Support Services, PNG in Papua New Guinea) .	conventional grid-provided electricity.	improvement of safety and health standards.	been used to pay for conventional electricity.
	Solar Thermal Water Heating	High Solar thermal heating projects have become common in Kenya. The market will continue growing but relatively slowly.	High There are numerous solar power projects in Kenya at the moment- both complete and ongoing. Examples include Off-grid Solar Access Project, National Pubic Primary Schools Electrification Project and the Solar Power Plant in Kitui.	Mature Entrepreneurs continue to generate solar energy every other day while investors and the GoK are also committed towards increasing funding for such projects.	Low Using solar thermal heating techniques add no value to the environment.	Low Solar thermal water heating yields no benefits in the form of access to education or improvement of safety and health standards.	Medium Solar thermal water heating saves the consumer money which would have otherwise been incurred in heating water using conventional electricity provided by KPLC.
	Geothermal Generation Expansion	High Demand is expected to rise by 26% ⁹² . Some of the risks involved include	High There is an investment of about USD 550,000,000 ⁹³ in geothermal power generation projects.	Growth The number of private investors working towards generation of geothermal power is low due to the massive	Low Compared to a situation where no electricity is used, using geothermal	Low Geothermal generation expansion yields no benefits in	High Geothermal generation firms provide employment opportunities

		high costs for field development and the resource exploration risks such as onsite injuries.		start-up capital required.	energy adds no environmental benefit.	the form of access to education or improvement of safety and health standards.	for people and power for use in production activities by various industries.
Energy efficient light bulbs (and appliances)	High As the government scales the number of households connected to the national electricity grid, the demand for energy efficient lighting bulbs soars too. The energy efficient lighting bulbs distributed locally are imported.	Medium There several distributors of energy efficient lighting bulbs, although they're mostly imported. Examples-East African Wind Energy, Dreampower Ricciardi SRL, Genemates Investments and Led World Ltd. Leading appliance sellers such as LG and Samsung are progressively producing energy efficient appliances. There are a number of entrepreneurs also trying to come up with the product locally.	Growth The government recently supplied over 3 million bulbs to Kenyans for free in a project that cost over Ksh.1Billion ⁹⁴ . All the bulbs were imported. Kenya has mandatory Minimum Energy Performance Standards targeting 4 types of electrical appliances- ACs, commercial display generators, industrial motors and incandescent bulbs- which has seen major companies operating in Kenya such as LG, General Electric and Samsung move towards manufacturing energy efficient appliances.	Low Using energy efficient lighting bulbs add little if no value to the environment.	Low Using energy efficient lighting bulbs and appliances yields no benefits in the form of access to education or improvement of safety and health standards.	Medium Firms producing energy efficient lighting bulbs and appliances would create employment for many people.	

LPG Stove Substitution	High The demand for LPG will continue to grow since the number of people living in slums and rural areas still use other means of fuel such as charcoal. A big number of households living in the urban areas use LPG instead of stoves.	Medium Organizations such as WLPGA, PIEA and the Global Alliance for Clean Cook Stoves have been leading the charge in getting LPG into houses where it can save and improve the lives of millions of Kenyans.	Nascent There are a few international companies based locally generating LPG- e.g Total, Kenol-Kobil and Hashi. There are over 30 licensed distributors of LPG in Kenya.	Low Use of LPG stoves in place of the conventional stoves result in no significant net improvement in the aggregate levels of atmospheric pollution.	High Using LPG stoves instead of the conventional kerosene-powered stoves reduces the level of toxic gases in the household environment hence reducing chances of people suffering from breathing medical conditions.	Medium Firms producing LPG provide employment for many people. Already there are LPG providers in the market and as such, only a modest number of opportunities will arise.
(Solar) Renewable Lamps	High Demand for solar lamps, just like other solar products is on the rise; and expected to continue rising since a majority of the Kenyan population is off-grid.	Medium There is a modest number of producers and distributors of solar lamps across the country.	Growth There are few companies that produce solar lamps in Kenya. Some of them are Solarworks EA, Savvy Company Ltd and Mkopa Solar.	Low Using solar lamps does not add any value to the environment.	High Use of solar lamps allow for more to be done past dusk, e.g. reading, and provides security against theft.	High Companies producing solar lamps can make profits through product sales in addition to creation of employment opportunities.

Cogeneration in Agriculture	High Cogeneration is a relatively unexplored space in the Kenyan market. Demand will continue to grow as the govt. pursues ways of reducing the amount of oil imported every year.	Low There is an ongoing project by Cummins Cogeneration Limited in Baringo for generation of biomass energy.	Nascent There are not many players. Mumias sugar company contributes 26MW of cogenerated power to the grid. The GoK has also commissioned an 18MW project for cogeneration at the coastal region of Kenya ⁹⁵ .	Medium Cogeneration puts the bagass that would have otherwise polluted the environment as waste into meaningful use. This reduces pollution hence improving quality of air.	Low Cogenerated electricity does not add any value to the society when compared to conventional grid electricity.	High Companies producing energy through cogeneration can provide employment opportunities for several Kenyans.
Improved Cookstoves	Medium The demand for improved cookstoves will continue to grow. 35 million people in Kenya continue to rely on biomass energy which creates a massive market potential for improved cookstoves ⁹⁶ .	Low The Netherlands govt sponsored project-Improved Cookstoves Programme is to be completed this year.	Growth Most improved cookstoves are produced by individual entrepreneurs in an informal way. Ecozoom is the only formal formidable producer and supplier of cookstoves in Kenya.	Medium Improved cookstoves emit lower levels of pollution compared to conventional cookstoves.	Low Does not offer any direct social benefits.	High Companies producing improved cookstoves can make profits through product sales in addition to creation of employment opportunities.
Briquettes	Medium The demand for briquettes is rising as can be confirmed from Hermisons' story- They started up	Low Global Village Energy Partnership (GVEP) has invested heavily in this subsector, supporting a	Nascent The industry is still at its initial stage, with entrepreneurs working on their own with support from international	Medium Burning briquettes produces lower levels of pollution compared to	Low Does not offer any direct social benefits.	High Companies producing briquettes can make profits through product sales

		in August 2015 ⁹⁷ , they got big clients such as Bata, Elliots and Kenya Tea Development Authority within a month.	number of SMEs and entrepreneurs to scale their briquettes production. One such entrepreneur, Paul Mworio who owns Hermisons Kenya Ltd.	organizations such as GVEP.	conventional charcoal.		in addition to creation of employment opportunities.
	Ethanol-Based Cooking Fuel	High The demand for the ethanol-based cooking stoves would most likely rise as more and more people are embracing efficient environmentally-friendly cooking approaches. However, demand for ethanol-based cooking stoves will depend on the performance of Koko's product.	Low Ethanol-based cooking stoves is still a fairly untried product within the Kenyan market. Koko Network has pioneered in this subsector -launched in April 2017.	Nascent The market is still at the earliest stage in the development cycle. The only formally recognized company producing the product in Kenya launched its operations in April 2017.	Low Compared to using conventional stoves, the net GHG emissions level is not significant.	High Using ethanol cook stoves instead of the conventional kerosene stove results in lower levels of household pollution, decreasing chances of people suffering from medical breathing conditions.	High Companies producing ethanol and those producing the relevant stoves can make profits through product sales in addition to creation of employment opportunities.
Agriculture	Improved Management of Grazing Systems	Low Grazing management systems work best for	Low There are a few management of grazing system projects that have	Nascent There were a couple of investments during the late 90s but since then,	High Improved systems would result in less	Low Does not offer any direct social benefits.	Low Does not generate any income or substantial

		pastoralists; and pastoralism is an activity that is already outdated.	been reported. One of them is Olkarkar grazing.	there hasn't been much traction.	environmental degradation.		financial gain to the implementers.
	Cross Breeding	High Statistics from the Kenya National Bureau of Statistics show that livestock demand keeps rising with the rising Kenyan population- in 2016, farmers earned about USD 840 million from the sale of cattle, sheep and goats ⁹⁸ . Demand is increasing.	Medium There are modest levels of investment in crossbreeding in Kenya. Some of the dairy farmers in the country, especially from Kiambu, use cross breeding methods to increase their yields.	Nascent Most of the crossbreeding solutions provided to farmers in Kenya are obtained from international companies. Dorper Society of Kenya is one of the few local organizations that provide the same.	High Improves the productivity of livestock while reducing the overreliance on natural pastures caused by pure breeds.	Low Doesn't provide any substantial benefits to the society; benefits in the form of access to education, health or safety.	Low Does not generate any income or substantial financial gain to the implementers.
	Affordable Greenhousing	Medium The demand for greenhouses is high due to the rising demand for horticultural products in the export market- Europe.	Medium Majority of the investors are individuals. Greenhouse investment companies are few- e.g. Diamond Merchants.	Nascent There a few companies manufacturing greenhouses in Kenya. The notable ones include Amiran, Irrico International, Agro Irrigation & Pump Services Ltd, and FirstCarbon Solutions.	High Reduces the stress on natural resources(land) hence improving the quality of soil.	Low Doesn't provide any substantial benefits to the society; benefits in the form of access to education, health or safety.	High Generates substantial income for the implementer considering global demand for horticultural produce is soaring.

	Affordable Dairy Feeds	Medium Demand for dairy feeds keeps rising as farmers look to improve their supply to meet the growing demand for milk. Within the 3 year period leading up to 2016, the market for commercial hay alone, shot up from almost 0 to 14,000 acres under production ⁹⁹ .	Medium There are 16 companies that formally manufacture dairy feeds in Kenya ¹⁰⁰ . Some of them include Milele Feeds, Nutrimix, Unga Farmcare, Palmcare Enterprises and Sigma Supplies.	Growth There are many companies supplying dairy feeds-mostly private owned. Production of milk per day in Kenya is about 4M liters obtained from 1.8 million smallholder farmers ¹⁰¹ .	Medium Dairy feeds ease the pressure which would have otherwise been borne by natural vegetation when cattle are left to graze conventionally.	Low Does not offer any direct social benefits.	High Generates high income for the farmer since demand for dairy products is generally high.
	Solar Irrigation	High The demand for solar irrigation pumps is set to grow being driven by the implementation of the government's pledge to put in place 100,000 hectares of land under irrigation in addition to the current 168,000 ¹⁰² .	Low There are a few companies providing solar irrigation equipment in Kenya.	Growth There are a few suppliers of solar irrigation equipment in Kenya. Some of the notable suppliers are Futurepump, Sunculture and EcoSolar Ltd.	Low Does not offer any direct environmental benefits.	Low Does not offer any direct social benefits.	High Generates high income for the farmer since demand for food continues to rise with the growing population.

	Insurance Schemes	Low Kenya does not have a national policy for agricultural insurance. Given that there is minimal participation in the sector by the private insurers, chances of sector growth remain very low.	High There are very few providers of insurance in the agricultural sector.	Nascent Few companies like Jubilee provide agriculture-based insurance.	Medium Due diligence requirement reduces the chances of people growing drought-sensitive crops that would in turn leave the environment bear when drought strikes.	Low Does not offer any direct social benefits.	Low Does not generate any significant income or substantial financial gain to the implementers.
	Rainwater Harvesting	Medium The demand for water is high and will continue rising. However, rain water harvesting is hampered by numerous challenges: most urban dwellers live in rented homes so cannot install harvesting systems, there is no policy regulating the health standards in roofs and limited	Medium Apart from the African Water Bank, no major institution/company has invested in providing rainwater harvesting systems to Kenyans.	Mature Few players are involved- the AWB, communities, donors and some individuals. Small market size- Installation of rainwater harvesting systems is dependent on household decisions which hampers the level of influence that rainwater harvesting systems have on the market demand.	High Reduces the reliance of people and animals on natural water bodies for drinking, washing and farming purposes. This in turn creates a balanced ecosystem where animals and humans don't compete for water.	Low Doesn't provide any substantial benefits to the society; benefits in the form of access to education, health or safety.	Low Does not generate any income or substantial financial gain to the implementers.

		information flow on rainwater systems.					
	Drought-Tolerant Crops	Low Demand for drought resistant crops is low. People tend to turn to them only when there is a severe drought.	High Different organizations such as the Kenya Agricultural and Livestock Research Organization are working with county govts to push for drought-resistance crop farming. Successful initiatives have been conducted in the Eastern and Western parts of Kenya.	Nascent There are few initiatives/investments in drought-resistant crop farming, on private sector's side.	High Reduce the chance of land remaining bare in times of drought. Drought-resistant crops ensure that absorption of toxic GHG gases continues even in times of drought.	Low Doesn't provide any substantial benefits to the society; benefits in the form of access to education, health or safety.	Low Does not generate any significant income or substantial financial gain to the implementers.
	Strategic Food Reserves	N/A Since there is no private participation, growth is limited.	N/A The private sector has no room for participation in this.	N/A There is no private participation in this sector owing to the fact that strategic food reserves establishment is govt. responsibility.	Low Storage of food in reserves adds no value to the environment.	Low Does not offer any direct social benefits.	Low Does not generate any income since it is a govt. responsibility.
Waste	Methane Avoidance from Landfill Gas	Low Potential demand remains high. However, the lack of tried ways of generating energy from the landfill gas	Low There is an ongoing feasibility study for the use of landfill gas generated from solid municipal waste ¹⁰³ . However, no concrete plans	Nascent There is not much private sector activity going on with regard to generating power using landfill gas.	High Capturing methane gas from landfills helps to reduce waste left unattended,	Low Does not offer any direct social benefits.	High Methane captured from landfills can be used in industries to make

		discourages investment.	for implementation of the same exist.		improving quality of air.		production possible.
	Glass recycling	N/A Considering that the industry is still not well developed, formally, it is difficult to estimate the future demand for recycled glass. Most companies also distribute drinks using returnable glass bottles, therefore, there isn't much left for recycling.	N/A The level of investment is very low owing to the fact that there are few known companies that do glass recycling in Kenya.	N/A Apart from the known companies that recycle glass like Central Glass and TakaTaka Solutions, the industry is hugely informal and as such statistics about its progress cannot be readily obtained.	High Glass recycling rids land of the nonbiodegradable effect of glass hence improving the quality of soil.	Low Does not offer any direct social benefits.	High Glass recycling firms create employment opportunities.
	Paper Recycling	N/A Demand for recycled paper is not readily quantifiable. Therefore, it would be hard to estimate the product's future potential.	N/A There is no actionable plan of investment. Nevertheless, there are a few companies recycling paper in Kenya.	N/A Apart from Kamongo Waste Paper, Madhu Paper and Green Pencils Ltd, there are no nationally recognized paper recycling companies	High Paper recycling rids land of the unwanted sight of paper strewn everywhere, improving the aesthetic value of the environment.	Low Does not offer any direct social benefits.	High Paper recycling firms create employment opportunities.
	Plastic Upcycling or Recycling	Medium The govt has already banned the use of plastic paper bags in	Medium There are several companies recycling	Growth There are a few big companies that recycle plastic e.g. Agriplast, Nairobi Plastics and	High Plastic recycling rids land of the nonbiodegradable effect of	Low Does not offer any	High Plastic recycling firms create

		Kenya. There are entrepreneurs devising ways of efficiently recycling plastics. All these point to a potentially high demand in the future.	plastic but with modest investments.	Premier Plastics Ltd. There are other small scale individually owned entrepreneurial ventures that recycle plastic.	plastic hence improving the quality of soil.	direct social benefits.	employment opportunities.
	Oil Recycling	N/A It is unquantifiable what potential local demand would be there in the future.	N/A The level of investment is negligible.	N/A There is only one company recycling oil in Kenya-Subira Ship Contractors. China, Japan and the U.S are some of the countries that recycle oil.	High Oil recycling rids natural water sources of the non-biodegradable effect of oil, improving the quality of natural water resources and preserving aquatic life.	Low Does not offer any direct social benefits.	High Oil recycling firms create employment opportunities.
	Steel Recycling	Medium The scrap-metal business is booming. The fact that there is huge demand for investment in real estate, some of the recycled steel is assured of a market in the form of roofing	Medium There are few major players such as Devki Steel and Premier Rolling Mills Ltd.	Growth Apart from the major players, there are several informally-owned scrap metal recycling plants in the country. Some of the scrap metal collections are exported to countries such as China.	High Steel recycling rids land of the nonbiodegradable effect of metals hence improving the quality of soil.	Low Does not offer any direct social benefits.	High Steel recycling firms create employment opportunities

		sheets and other building metal plates.					
	Reusable Bags	N/A The demand for reusable bags is low. However, it could rise in the near future depending on how effective the government's ban will be.	N/A There are no local formal producers of reusable bags ¹⁰⁴ (alternative for plastic paper bags) despite the government banning the use, manufacture and importation of plastic bags in Kenya starting September 2017.	N/A Most of the reusable bags available in Kenya are imported. The existing local producers are individuals operating on an informal small-scale productivity level.	High Using reusable bags instead of plastic bags reduce the rate of land pollution caused by plastic bags.	Low Does not offer any direct social benefits.	High Demand for reusable bags is set to sky-rocket once the impending government ban on plastic bags is implemented. Jobs would be created in the manufacturing firms.
	Solid Waste Management	Low Growth in the solid waste management space is not easy to achieve because of the heavy capital outlay required and the lack of sufficient research regarding the return potential for private investors.	Low There is a proposal to implement the Circular Economy Solid Waste Management at a cost of USD 39 million ¹⁰⁵ . Beyond that, nothing much is going on.	Nascent The county government of Nairobi has failed to implement the Circular Economy Solid Waste Management and no concrete plans on pursuing such initiatives exist.	High Reduces the pollution levels in the atmosphere thus improving quality of air.	Low Does not offer any direct social benefits.	High The practice would create jobs for several people. Demand for a solid waste management is very high in all the major towns in Kenya.

Industrial processes	Energy Efficiency	Low Any demand for energy efficient equipment would be driven by the level of compliance with the ERC's energy policy. Considering the policy was implemented in 2002 and by 2016 only 1050 out of a potential 3050 ¹⁰⁶ "big energy consumers" had conducted energy audits, we're looking at low future demand. Furthermore, the technology and resources used to manufacture energy efficient machinery is huge.	Low The Energy Regulatory Commission is pushing big energy consumers to conduct energy audits and reduce on wastage. There has been little participation from the private sector-only ICOPOWER supplies energy efficient systems in Kenya.	Nascent Despite the Energy Regulatory Commission putting in place a policy requirement for energy-intensive companies to conduct energy audits, less than half of the 3600 ¹⁰⁷ such companies have complied. Energy efficiency is majorly a matter of national policy and thus space for private sector participation is limited.	Low Using energy in an efficient way has no direct benefits to the environment.	Low Does not offer any direct social benefits.	High Efficiency in the use of energy would save the user tons of money that would have otherwise been used in offsetting power bills.
	Cement Energy Efficiency Improvement	N/A Achieving any sort of efficiency improvement requires heavy	N/A At the moment none of the industrial players have conducted any	N/A No cement manufacturer has invested in cement energy efficient	High Cement energy efficient plants require little fossil fuel to	Low Using cement energy efficient machinery	Medium If at all the cement companies would

		technological equipment investment. No immediate incentive or policy exists that would encourage cement companies to invest in the required technologically advanced equipment.	major investment in efficient machinery. It is only lately that various plants have started to sluggishly conduct energy audits which would inform the decision to put in place cement energy efficient machinery.	equipment. Considering the massive amount of capital required to install energy efficient plants, achieving any significant cement energy efficiency improvement seems too ambitious.	heat the cement kiln thus resulting in less GHG emissions.	has no social benefits such as access to education and health.	purchase energy efficient machinery then money could be saved on the purchase of fuel/coal, in the long-run.
	Industrial Waste Management	N/A Unquantifiable as there is little information on industrial waste management systems set up in Kenya so far.	N/A The proposal to build an integrated solid waste management for Nairobi county is yet to be implemented.	N/A This would be an internal process for existing companies; little information on the extent to which companies do their own waste management.	High Reduces the pollution levels in the atmosphere thus improving air quality.	Low Does not offer any direct social benefits.	Medium The practice would create jobs for people.
	Voltage Control	Low While the need for voltage control is there, demand is still low. A big push by the Energy Regulatory Council could see the consumers forced to buy	Medium There are a number of companies providing voltage control solutions in Kenya. Some of them include ICOPOWER, International Energy Technik, and	Nascent There are several companies providing voltage control systems. However, the target market (high energy consumers) are reluctant to buy these systems- due to cost implications.	Low Regulation of voltage used in industries has no direct environmental benefit.	Low Does not offer any direct social benefits.	High Voltage control reduces power wastage hence saving the user money.

		voltage control systems/devices.	AMACEC Kenya and Kinetic Controls Ltd.				
	Improved Charcoal Manufacturing	Low The industrial processes sector is hugely informal and as such it is difficult to attract investors to scale up the production of improved charcoal.	Low There are people producing the product but at an informal and individual level.	Nascent Production of improved charcoal is practiced informally and as such the demand is still low.	High Reduces the rate of deforestation characteristic of conventional charcoal manufacturing.	Low Doesn't provide any substantial benefits to the society; benefits in the form of access to education, health or safety.	Medium The demand for charcoal is high. However, there are other alternative sources of cooking fuel which reduce the demand for charcoal.

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