An Assessment of Opportunities for Low Carbon Growth in Kenya

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Summary

The DFID/DANIDA funded SEI study on the 'Economics of Climate Change in Kenya' is assessing low carbon growth, the impacts and economics costs of climate change in Kenya, and adaptation financing needs (based around costs and benefits of adaptation). As part of the work, the study is estimating the potential for low carbon growth in Kenya, looking at the potential changes in emissions, and low carbon growth opportunities, consistent with planned development. This report summarises this work.

Background

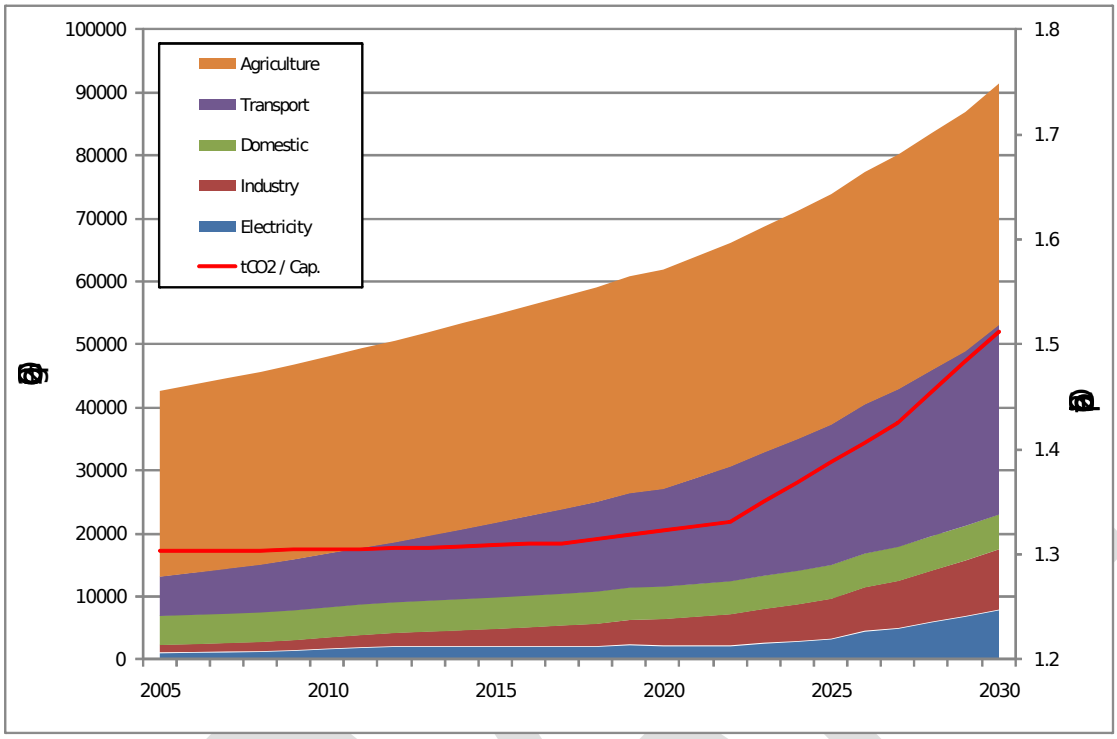
- Kenya has a relatively low carbon economy, indicated by per capita emissions of 1.3 tCO_2 (excluding LUCF). This is primarily due to a low carbon energy sector, with high renewable electricity generation and household energy dominated by biomass use.
- The only published estimates of emissions for Kenya are from the 1st National Communication (2002) for the year 1994. The largest emitting sector is agriculture, primarily comprising CH_4 emissions from livestock. The next most significant sector is energy consumption, primarily from consumption of oil products in transport and industry, and biomass burning.
- Whilst the 1994 inventory indicates that Kenya is a net sink due to the removal from the forest sector such estimates are subject to significant uncertainties due to unreliable stock information and a simplistic estimation approach. This LUCF sector of the inventory needs considerable development to improve estimates (which may have been undertaken for the forthcoming 2nd National Communication). In addition, the inventory for 1994 does not account for emissions from soils; alternative estimates for this source (CAIT) suggest that Kenya was a net emitter in 1994.
- Although it has low emissions in global terms (ranked 76th globally), Kenya has a plan for significant growth in the economy, outlined in its strategic development plan, Vision 2030. However, emissions are growing quickly - using historic estimates, energy sector emissions increased by 50% between 1994 and 2005, and these are likely to continue in the future in realising the Vision.
- A key issue is the likely emissions from this planned (business as usual) development pathway, and whether Kenya can achieve the same level of growth through an alternative low carbon pathway. A part of this latter pathway would be any additional advantages and economic benefits that would arise from following an alternative plan. This also links with the analysis of potential climate change impacts, and the need to develop climate resilient growth. This study has investigated these issues through analysis of future projected emissions and low carbon alternatives.

Future projections

- The study has found that in many areas, Kenya is already initiating measures and policies that are consistent with low carbon development, and these provide practical demonstrations of the benefits of such a policy. The most obvious progress is in the electricity sector, where carbon intensity is predicted to fall with planned policy proposals, as well as reducing energy costs and improving the environment. There has also been progress in a wide range of other sectors.
- Nonetheless, the future challenge is significant. As set out in the Vision document, annual economic growth rates of 10% are predicted, while population is expected to almost double by 2030, from 34 million in 2007 to 63 million in 2030. High rates of urbanisation rates are also projected, rising from 9 million in 2007 to 43 million in 2030.
- These GoK projections have been used to develop a future 'business as usual' emissions scenario consistent with the Vision document. Some sensitivity analysis has been undertaken to investigate the potential implications of key assumptions.
- Using a simple projections approach, the economic growth and development associated with Vision 2030 is projected to increase emissions of greenhouse gases by over two times between 2005 and 2030 (from 42 to 91 Mt CO_2). It is also estimated that Kenya's per capita emissions could increase to

over 1.5 tCO_2 by 2030, note this is a lower relative rise as future population increases reduce per capita emissions.

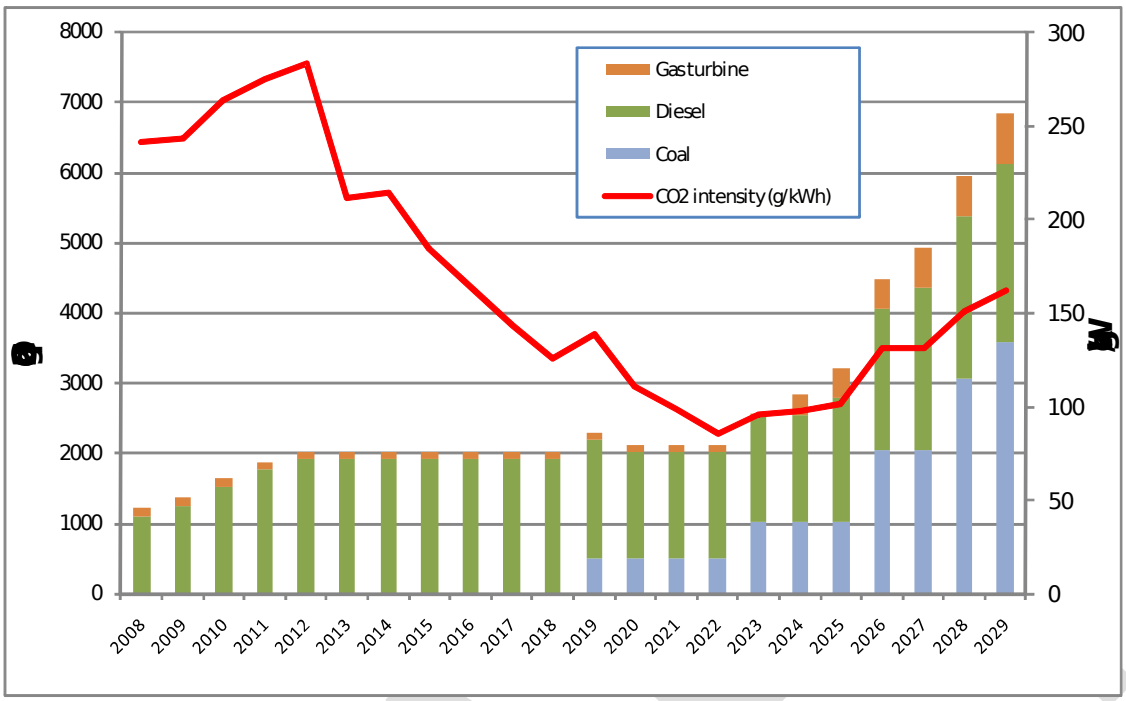
- A summary of the potential growth in emissions is shown in the figure below.



Projections of Kenya's GHG emissions (Gg CO2 eq.), 2005-2030

Analysis of the Electricity sector

- Kenya already has a low carbon electricity sector. The overall plans for the electricity sector indicate an even lower carbon generation mix in future years, dominated by geothermal capacity and high levels of imports (dominated by hydro generation) from Ethiopia. This low carbon electricity will result in low carbon energy for the consumers in end use sectors.
- However, these reductions are potentially offset by planned use of coal fired generation, and post 2020, the reductions in emissions in the power sector may be reversed if the planned development in the least cost plan are implemented.
- The emissions profile for the sector under the least cost plan is shown below. The graph shows the total absolute increase in emissions from the sector. Note that the red line reflects the average carbon intensity of the Kenyan electricity mix. It can be seen that the carbon intensity is currently falling, but would increase post 2020 with the introduction of more coal.
- These increases in emissions in the sector would occur at exactly the time when international negotiations are likely to get much stricter, and where the opportunities for future credits is likely to be more financially advantageous to Kenya, i.e. they represent a lost opportunity for Kenya for future credits, because of the 'lock-in' of high emission plant.



Projected CO_2 emissions by generation type (2008-2029)[1], and CO_2 intensity of generation (g/kWh)[2]

- The study has investigated other low carbon options as an alternative, developing a lower carbon alternative pathway to the least cost plan. It finds that there are other lower cost opportunities for renewable power generation, which would allow further access to international carbon credits.
- It is clear that renewable electricity generation makes economic sense, not only for centralised generation but for off-grid application, particularly for rural areas where access is limited and alternative diesel generation is very expensive. For example, solar systems are widely used in rural homes and communities.
- In addition to the direct economic benefits of low carbon alternatives, the study finds that this alternative low carbon pathway would have wider economic benefits from reducing air pollution, reduced environmental impacts associated with coal extraction and greater energy security and diversity.
- Any future plan has challenges for implementation, and may be vulnerable to climate impacts in future years. On implementation, large-scale investment is required in plant and transmission systems; however, there are opportunities for carbon financing as shown in recent plant expansions. Vulnerability may come from over-reliance on hydro (imports and domestic), particularly during drought years when the demands on water are significant. This latter point is extremely important. There is a need to consider the potential effects of climate change on the electricity sector itself. Other parts of the study have shown that there are projected scenarios which might increase the vulnerability of the Kenyan power sector to future climate, notably in relation to future hydro power. There is a need to undertake a climate risk screening analysis for the electricity generation plans, and to adjust the plans accordingly. This includes both domestic generation, but also for planned imports, especially as these are from climate sensitive technologies (hydro).

Analysis for other sectors

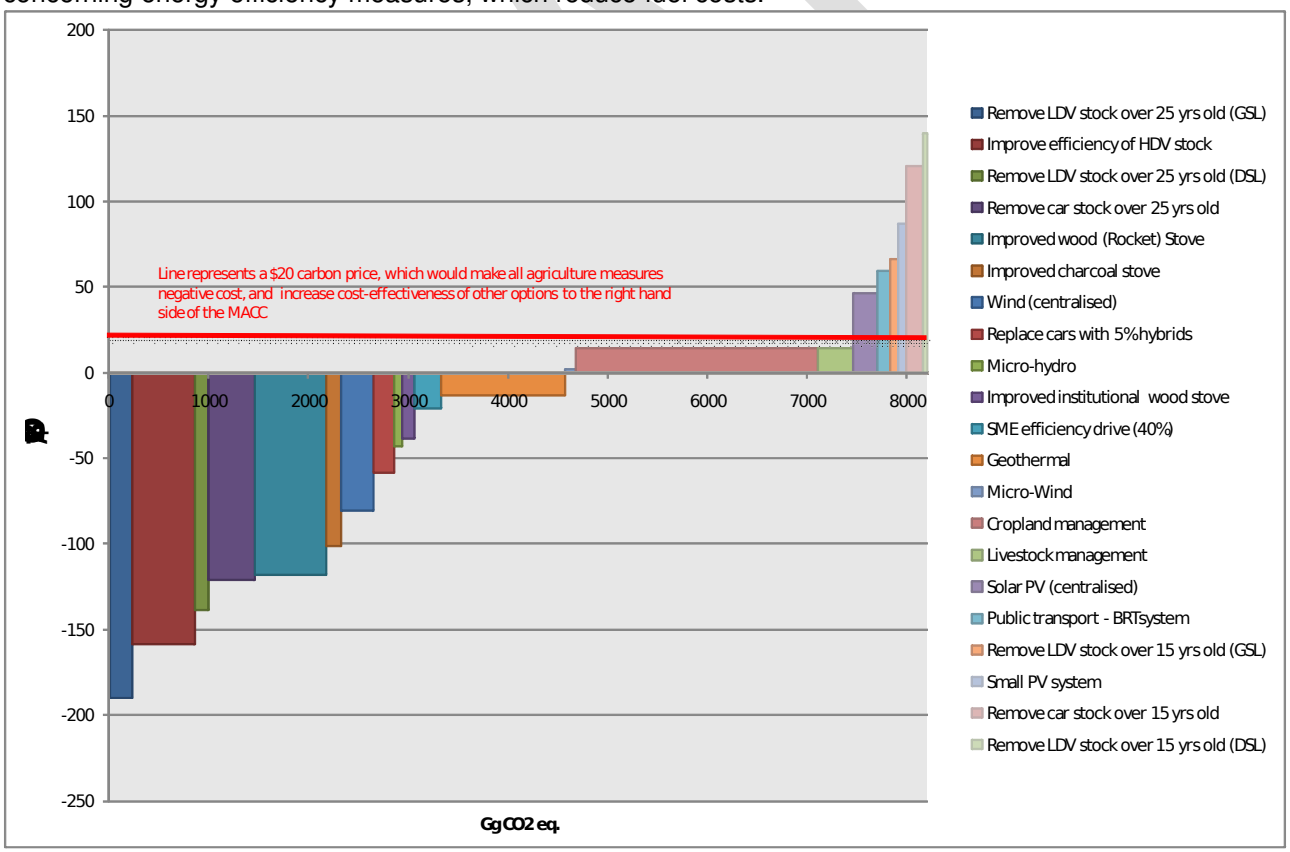
[1] Assumed efficiencies: gas (45%), coal (35%), diesel (35%). All oil based generation assumed to be diesel not HFO, so emissions might therefore be underestimated.

[2] Generation levels adjusted for losses before intensity calculation

- As shown in the projections above, electricity generation emissions are a small proportion of future Kenya GHG emissions. Therefore a much wider economy-wide view is needed to advance low carbon growth.
- The key driver of future emissions in these projections is the transport sector, particularly due to increasing private car use and freight on roads. Whilst it is very difficult to project agriculture emissions in the absence of detailed information, it is likely that livestock and arable output will grow with population demand, a strong export sector and changing agricultural practices e.g. increased use of fertilisers.
- In addition to being the largest emitting sectors, these are often the most challenging sector for ensuring low carbon reductions. However, a range of low carbon options are available at low cost but which will require extremely effective policies for implementation.
- Biomass remains an important energy source in future years; more efficient use could see reduction in resource pressures on the fuelwood supply, as well as other benefits. The projections also incorporate significant switching to electricity (due to large scale electrification envisaged). This ensures Kenya maintains a low carbon residential sector in future years.

Opportunities for carbon reduction

An indicative cost curve for Kenya (below) demonstrates that Kenya can move to a lower carbon pathway without significantly impacting on growth; in fact, many of the measures would make the economy more productive and competitive (all these below the $0 line, i.e. with a negative cost $/t$CO_2$). Many lower carbon options therefore promote rather than undermine the ambitions of growth. This is particularly the case concerning energy efficiency measures, which reduce fuel costs.

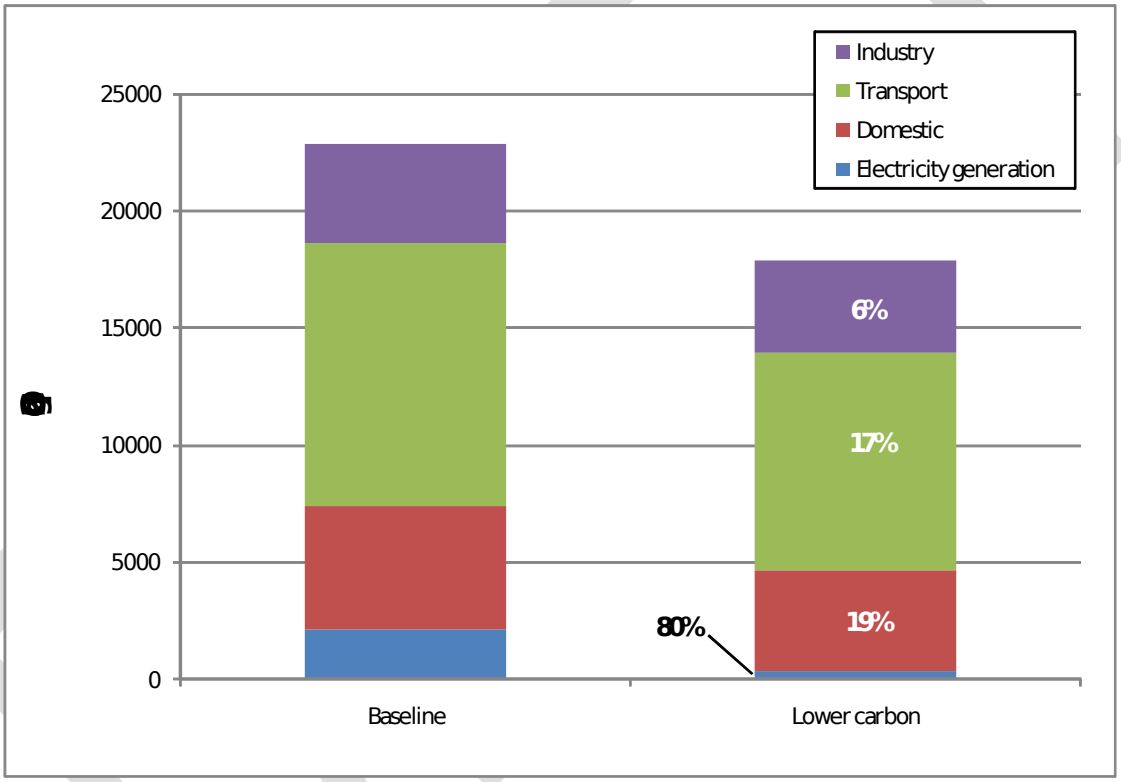


Indicative MAC curve of selected abatement measures for Kenya in 2020

All future cost and benefits are discounted at 10%, using the net present value.[3] The first measure listed in the legend is the most cost-effective, shown as the bar furtherest left on the MACC figure. Subsequent measures are listed in order of cost-effectiveness. The cost curve identifies that significant 'no regrets' potential is available (almost 50% of stated potential), particularly from improvements in transport vehicle efficiency, and performance of domestic stoves. The agriculture sector options are low cost (<$15 /$tCO_2$), resulting in no regrets / low cost options accounting for over 80% of stated potential.

The carbon credits that could be available for emission reductions are not included in the estimates in the above cost curve analysis. If they were, the negative cost potential would increase, and the less cost-effective options would appear more attractive, as shown by additional measures below the red line, which represents a $20 carbon price. This is an important point in the context of future potential and financing.

The emission reduction potential shown in the above MAC curve for 2020 is compared against the 2020 baseline for energy using sectors (Figure 27). These sectors have the potential to produce savings of 22% relative to the baseline. Of the potential savings, over 80% can be realised at negative or low cost.



Kenyan emission in 2020 under the baseline and *lower carbon* case

* The % labels in the *Lower carbon* case denote % reduction by sector relative to baseline

The inclusion of agriculture sector emissions results in an overall reduction of 13%. This is lower than the 22% reported above due to the high level of the emissions from this sector.

The measures shown in the above cost curve are listed below, showing what the policy driver might be for introducing a given option, and the co-benefits of the measure if indeed the measure was being appraised for carbon mitigation.

[3] Agricultural and public transport measures use costs derived directly from literature and therefore the discount rate is not known.

Option	***Policy driver***	***Co-benefits (as a GHG mitigation measure)***
Expanding use of renewables (centralised)	Expanding capacity to meet future needs based on strong resource base	Reduce reliance on / payments for foreign fossil imports More cost-effective across many types Leverage carbon finance to fund investment Potential to build regional expertise, and export No air quality pollution
Decentralised generation from renewables	Rural electrification	Lower cost than alternative fossil generation Limit requirements for expensive grid expansion Sustainable energy for local economic growth No air quality pollution
Introducing improved stoves	Reduce biomass demand	Reduce indoor air pollution, and therefore health impacts Reduce fuel costs Protecting fuel Saving economic / leisure time (wood collection)
Improving efficiency of road transport fleet	Reducing reliance on fossil fuel imports	Reduce reliance on / payments for foreign fossil imports Reduce costs of vehicle use Reduce air pollution Reduce road traffic accidents (due to newer cars)
Planned public transport scheme for Nairobi	Meeting urban transport demand	Reduce congestion Reduce air and noise pollution levels Save travel time / enhance productivity Reduce road traffic accidents
Tackling energy inefficiency in SMEs	Reducing industry fuel costs, increasing competitiveness	Reduce fuel costs, enhance competitiveness Enhance energy security Reduce air pollution
Improve livestock and cropland management	Improve agriculture productivity and reduce land degradation	Protect / enhance arable land quality Safeguard rural livelihoods Increase economic productivity of sector
REDD / Afforestation	Protect forestry-dependent economy and energy supply security	Protect biodiversity, and dependent sectors Ensure security of wood fuel supply

The analysis demonstrates that many of the options are important and consistent with objectives of sustainable economic growth. The costs analysis suggests that many of the above measures are also cost-effective, and can save money for the economy rather than add significant financial burden. Further work is required to develop other options and provide a more comprehensive picture of the different opportunities, building on this emerging picture of a lower carbon future.

A Low Carbon Pathway

In many sectors, Kenya is already on a low carbon pathway because of the significant renewable resources it has. This is particularly demonstrated in the low carbon intensity of the electricity generation system, the dissemination of renewable decentralised technologies (solar PV systems for homes), and the widespread use of biomass. This suggests that it is very much in the interest of Kenya to be low carbon e.g. due to the prevalence of renewable resources, this type of energy is more cost-effective than fossil-based alternatives.

The Kenyan government increasingly recognises the importance of embracing lower carbon technologies. In a recent budget speech, the Minister of Finance stated the following - *In order to move forward in transforming Kenya into a green economy, we will establish a Green Energy Facility to offer interest free long-term loans to firms that opt to replace conventional high cost energy generation with low cost green energy alternatives.*[4]

Such initiatives are key, as whilst Kenya has a relatively low carbon intensive economy, very high projected rates of economic and population growth are likely to see carbon intensity increase under a business as usual scenario. The question is whether it is in the interest of Kenya to push for lower carbon growth. Fundamentally, this is likely to be based on whether the additional costs of an alternative low carbon growth path outweigh the benefits. In addition, there is also the question of whether the low carbon growth path is also as resilient to future climate impacts predicted, including extreme weather events (droughts and flooding) which appear to be more frequent even in recent years.

The apparent benefits of a low carbon growth path are firstly economic. This is demonstrated in the electricity sector, which is projected to remain relatively low carbon under the baseline because of the abundance of cost-effective renewable generation potential, both in-country (geothermal) and in neighbouring countries (hydro, particularly in Ethiopia). There are however concerns that a significant future reliance on hydro may leave the system vulnerable to shortages (due to reduced rainfall or water scarcity due to demand elsewhere), and a move to more reliable fossil generation. Therefore, the issue of climate resilience is key. The low carbon generation system will also provide low carbon electricity to a rapidly expanding consumer base, displacing biomass and kerosene in the household sector. This change in consumption and a continuing significant contribution from biomass means that this sector will remain relatively low carbon in future years.
Secondly, a move to a lower carbon pathway can also mean technology improvements; economic modernisation may well push technology advancement forward, realising this important synergy. Thirdly, lower carbon growth opens the door to carbon financing; while access to such financing needs to improve for lower income countries like Kenya, it is clear that a range of financing options are being discussed that could make lower carbon options more economically attractive. Fourthly, many lower carbon options offer a range of co-benefits to social welfare, health, energy security and wider environmental quality.

Finally, as Kenya develops and meets its objectives of becoming a modern economy with increased quality of life (as set out in the Vision 2030), it may be treated differently as a developed nation under any future climate agreement. This could include setting carbon reduction targets; therefore, the carbon footprint of large-scale investments (e.g. power plant, transport systems) in the next 10-20 years should include assessment of the risks of *lock*-in to higher carbon technologies, particularly for investments that last 40-50+ years. Such investments once made are sunk and very expensive to stop operating in a lower carbon world.

Recognising the benefits as outlined above, in particular that a lower carbon pathway does not necessarily lower growth and require significant additional financing, this and subsequent analyses should focus the mind of policy makers on the opportunities for low carbon growth, particularly as the 2nd implementation plan for the Vision 2030 is developed. Importantly, it also supports many of the policy objectives that need to be met for sustainable development as discussed.

There are however significant challenges. One of the most significant is population growth and rapid urbanisation, which will put additional pressure on planning (including spatial planning) for a lower carbon future. These drivers will increase demand on energy, food and water, leading to increases in emissions. This means that opportunities for implementing lower carbon alternatives needs to be an integral element of the planning and policy making system. This would in effect remove the need to balance climate objectives (adaptation / mitigation) against economic growth consideration because they would be inextricably linked.

[4] Budget speech for the Fiscal Year 2009/2010 by Hon. Kenyatta, Minister for Finance, June 11 2009

In conclusion, because of its location, availability of resources, and socio-economic conditions, the study concludes that there are significant economic benefits for Kenya in following a low carbon development path, as well as large environmental and social benefits. A low carbon pathway is strongly in Kenya's self interest, and would also provide potential extra investment from carbon financing. This is also important given the goal to become a middle income country by 2030, as countries of this development level will need to be reducing GHG emissions from the planned baseline level, if the global target to limit global temperature change to 2 degrees is to be achieved.

Specific recommendations from the study are as follows:

- In this initial study, emissions projections, consistent with Vision 2030 as far as possible, suggest significant increases in emissions in future years, particularly in the agriculture sector but also in a rapidly growing transport sector. There are, however, large uncertainties around Kenya's national emissions and growth path. Whilst the broad conclusions of large increases in emissions are relatively robust, further work is needed to improve these initial estimates and to give a degree of confidence in the analysis and this is a priority research areas.

- In many areas, Kenya is already initiating measures and policies that are consistent with low carbon development. This includes the electricity sector power emissions. However, the current plans do not maximise the economic potential that could be gained. In many sectors, the current plans are likely to 'lock-in' Kenya to a higher emission pathway, which will reduce future economic opportunities and are also likely to reduce future economic growth. An example already existing in the electricity sector with the planned implementation of coal fired generation. These need to be identified and ideally, alternatives considered.

- The study has outlined an alternative low carbon path for Kenya. This initial analysis estimates very real economic, environmental and social benefits from adopting a low carbon development path. These include both direct economic benefits (no regret opportunities), additional economic benefits from carbon financing, and wider economic benefits from ancillary benefits of these policies, including reduced imports, improved air quality, improved energy security, reduced pressure on natural resources. The key aim for Kenya is to continue this switch to a lower carbon pathway, to further realise these benefits, and to maximise the potential for the flow of carbon credits under existing and future mechanisms. Further assessment of how far Kenya goes down the low carbon pathway is needed, to robustly assess the full costs and benefits.

- Unlike other countries, power generation is a very low proportion of total emissions, and will continue to be so in the future under the baseline Vision 2030 projections. It is therefore a priority to tackle these other sectors, because in contrast to the power sector, emissions from these sectors are already increasing, and are projected to rise dramatically in the future along the development pathway towards a middle income country. These must also be addressed to achieve low carbon growth – and we emphasize that addressing the electricity sector is only a small part of the overall story. A key conclusion and recommendation is for the need for Kenya to move beyond the narrow interpretation of low carbon in just the electricity sector, and progress at an economy wide level.

- While the electricity generation sector plans project a low carbon future, there are some risks, and therefore more work should be undertaken to consider the following:
  - Exposure to climate impacts. Kenya will be very exposed to regional variability in rainfall due to domestic and imported reliance on hydropower. There is a need to build climate risk screening into future low carbon plans across all sectors
  - Exposure to system reliability problems. A high renewable system can carry risks if specific resources do not achieve projected generation, hydro being the obvious example. Kenya maybe reducing exposure in future years by maintaining fossil based generation

  - Energy security concerns. Future reliance on imports are premised on large infrastructure projects being completed, and political stability in the region

- Agriculture and transport remain the large emission growth sectors. For transport, while efficiency gains offer significant opportunities, the demand for private transport is going to increase significantly. This is a much harder to problem to solve but will require a robust strategy that considers improved public transport, demand management, and urban planning. Key barriers include large upfront costs associated with transport schemes, and costs to private individuals to purchase newer efficient vehicles, or more advanced technologies. The transport strategy that accompanies the Vision 2030 needs to be more robust in firstly assessing how the growth in transport demand will be met, taking account of sustainability issues. For agriculture, although low carbon options appear low cost, they are difficult to implement due to many small holdings and fragmentation of the land; therefore high transaction costs could be envisaged.

- The domestic sector remains a large consumer of biomass due to population growth, but has a much lower per capita usage. This is largely due to large-scale access to electricity, enabled by increasing urbanisation but also efforts to expand rural electrification. More research is needed to establish alternative pathways that do not see large scale electrification.

- The strategy for the forestry sector is also very important; large scale afforestation is planned as is the need to protect existing cover. New financing schemes such as REDD / REDD+ will be critical in ensuring that this happens due to the significant investment required. Kenya needs to be well positioned to take advantage of the schemes that may emerge post-Copenhagen.

- To realise the many low carbon opportunities requires the mainstreaming of mitigation policy across all part of the economy and across all of Government. Following from the points above, it would be extremely beneficial for Kenya to undertake a detailed assessment of a low carbon strategy including a detailed investment and financial flow analysis. This would identify no regret and low cost options that are justified on the basis of ancillary benefits. It would also be advisable for Kenya to strengthen its capacity to develop and implement proposals for any future schemes (programme CDM, NAMAs, REDD, etc). This would also require significant development of projections, which form the basis of understanding cost-effective potential. In combination, there is also a need to investigate the potential for further funding by exploiting synergies with adaptation.

- Related to this there is a need to re-assess the Vision 2030 document in light of the potential for low carbon growth and opportunities for growth, but also potential barriers to growth that might arise from the future global carbon market, particularly in relation to key growth sectors that have high carbon intensity or international links.

  This action is vital to address the issues outlined. More importantly it would give Kenya a first mover advantage to act quickly, and to seek funding for this plan, through whatever negotiating positions and mechanisms emerge.

Table of Contents

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23/11/2009

Technical report on Low Carbon Growth Issues produced as part of the DFID/DANIDA funded study on the Economics of Climate change in East Africa.

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The Stockholm Environment Institute (SEI) is the main contractor for this resource centre assignment. SEI is an independent, international research institute. Their researchers have been engaged in environment and development issues at local, national, regional and global policy levels for over a quarter of a century. The Institute was established in 1989 following an initiative by the Swedish Government to create an international environment and development research organisation. Since then, they have established a reputation for rigorous and objective scientific analyses of complex environmental, developmental and social issues. They are well known for work on scenarios, sustainability modelling and vulnerability assessments, which improve public policies and catalyse global transitions to a more sustainable world. They seek to be a leader in the field of sustainability science, understanding the interaction between nature and society, and improving the capacities of different societies to move to more sustainable futures.

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