Stockholm Environment Institute

Energising Kenya's future

Reducing greenhouse gas emissions and achieving development aspirations

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Photo (above): A resident of a remote Kenyan village uses a solar-powered water pump, provided by the Catholic Agency for Overseas Development.

Key messages

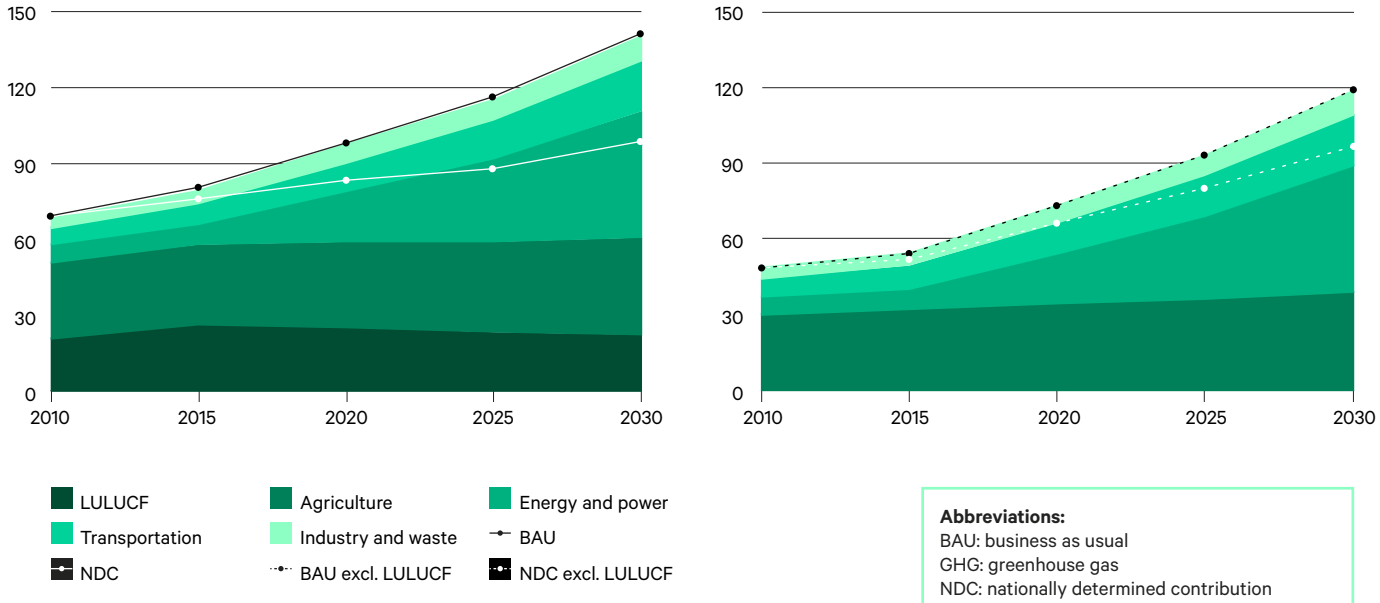
- **Achieving Kenya's nationally determined contribution (NDC) target of reducing greenhouse gas emissions by 30% by 2030 relative to business-as-usual levels will require a concerted effort to put its energy sector on a low-carbon trajectory, particularly in light of the country's economic development goal of attaining middle-income status in the same time frame.**
- **There are many different options for low-carbon development of the energy sector, but all require extensive financial investment and place significant demands on energy sector governance.**
- **Despite Kenya's impressive strides toward a low-carbon energy system, conflicts and untapped synergies remain, particularly related to perceived trade-offs between centralized and decentralized energy solutions, and between domestic fossil-fuel and renewable energy resources.**
- **Increasing public and community resistance present additional obstacles to projects, particularly where local participation in planning and local benefit-sharing is limited or is widely perceived to be limited.**
- **Key strategies for success include engaging stakeholders early in the development of projects and interventions; early public dialogue around broader energy development pathways; and transparent benefit-sharing mechanisms that are co-designed with affected stakeholders.**

Climate change impacts pose significant hazards for socio-economic development in Kenya, through prolonged droughts, unreliable weather patterns, and the emergence of new pests and diseases (Republic of Kenya 2015). Under the Paris Agreement, Kenya committed itself to tackling climate change. Its nationally determined contribution (NDC), which builds on the 2013 Kenya Climate Change Action Plan, pledges to reduce greenhouse gas (GHG) emissions by 30% by 2030, compared with a business-as-usual scenario (Ministry of Environment and Natural Resources 2015). At the same time, Kenya's NDC recognizes the country's development aspirations of becoming a newly industrialized middle-income country by 2030.

As shown in Figure 1, the country's ambitious climate mitigation goal relies on emission reductions in several sectors, by expanding renewable energy sources (e.g., geothermal, solar, and wind), increasing tree cover to at least 10% from a current level of 6.2% (World Agroforestry Centre 2012), and adopting agricultural practices that sustainably increase productivity and build resilience to climate change impacts.

Given the expected growth of the energy sector in Kenya as the country industrializes, pursuing a low-carbon energy development pathway is essential to meet the 30% emissions-reduction target.

Figure 1: Contribution of different sectors to greenhouse gas (GHG) emissions in Kenya, including (left) and excluding (right) contributions from land use, land use change and forestry (LULUCF)



Abbreviations:
BAU: business as usual
GHG: greenhouse gas
NDC: nationally determined contribution
LULUCF: land use, land use change and forestry

Low-carbon energy may be more beneficial in the long run, but fossil fuels' ability to meet short-term goals often proves more attractive to governments, politicians, and industry.

Recent scenario modelling work by the Energy research Centre of the Netherlands (ECN) shows that it is feasible to expand Kenya's power sector to meet growing demand using low-carbon energy options. However, nothing guarantees that power-sector expansion in Kenya will rely only on low-carbon energy solutions, especially given the large financial costs involved.

There are multiple potential energy pathways that could help Kenya achieve its ambitious goals, each with its own uncertainties, risks and financial costs. Indeed, the increased energy system costs associated with introducing low-carbon technologies – e.g. from investments in grid expansion, deployment of high-efficiency demand-side technologies, and fuel switching in the transport sector – could range from an estimated USD 5 billion to USD 30 billion, depending on how ambitious an energy pathway Kenya seeks to pursue. Informed dialogue and debate among decision-makers and the public are necessary to understand the implications of different options and pathways, including how these increasing costs would compare with the broader economic benefits that might accrue from a transition to low-carbon energy systems, such as employment opportunities, lower operation and maintenance costs, reduced dependence on imports, improved air quality, and increased confidence among investors, banks and project developers (see Nelson et al. 2014).

This discussion brief presents potential energy pathways for achieving Kenya's NDC, and highlights conflicts, synergies and public perception issues that generate uncertainties and risks. The analysis is part of ongoing research in the international project Transitions Pathways and Risk Analysis for Climate Change Mitigation and Adaptation Strategies (TRANSrisk)[1] In particular, the brief draws on discussions from a TRANSrisk expert meeting held in Nairobi in February 2017. The meeting was organized by SEI and ECN.

Conflicts and synergies

Even in the absence of stringent climate policies, significant changes over the coming decades will almost certainly transform Kenya's energy sector. Kenya's energy development pathway is likely to be shaped by a range of economic, social and political forces, such as continued population growth, rapid urbanization, international climate mitigation commitments, foreign and domestic investment patterns, employment trends, and local political action.

The expert meeting provided a venue for participants to discuss potential energy pathways for achieving Kenya's NDC. A summary of the expert meeting discussions regarding challenges and opportunities for transforming Kenya's energy sector to meet NDC goals is presented here.

An electrical distribution and transmission project in rural Kenya, where electrical coverage remains low

Low-carbon and high-carbon development pathways

With its growing economy, Kenya stands at a crossroad between systems that use fossil fuels and low-carbon fuels. While Kenya seeks to achieve its carbon-reduction goals with a low-carbon development pathway, the exploitation of indigenous fossil fuel resources (coal and oil) for power production and export is gradually growing. The high-carbon development pathway poses a risk of concentrating the benefits of economic growth and industrial development in urban areas, with rural areas losing out.

Indeed, low-carbon energy may be more beneficial in the long run, but the ability of fossil fuels to meet short-term goals of rapid economic growth is often more attractive to governments, politicians and the industry itself. First, the high upfront capital costs of renewables are often perceived as a barrier to wider uptake. While this may be the case for some renewables (solar, wind), participants noted that these perceptions might not match reality, especially with local and global trends, such as decreasing costs of solar, fluctuating costs of fossil fuel imports, and the increasing competitiveness of wind. Second, renewables such as solar and wind are perceived to be less reliable than fossil fuels due to their intermittent nature, thus potentially contributing to grid instability. However, technical and operational innovations – such as increased storage, improved efficiency, more effective load management and "smart grids" – offer potential solutions, though the costs and suitability of certain innovations need to be considered.

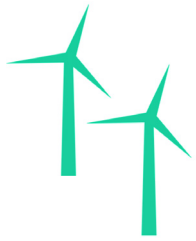
In the end, participants suggested that a balanced portfolio of low carbon and fossil fuel energy sources may be the most appropriate pathway to pursue: both are available domestically and can help the country maintain relatively low emissions without compromising economic growth. However, participants agreed that long-term solutions must be environmentally friendly, and avoid lock-in to unsustainable infrastructure. For further SEI work on Africa's energy infrastructure development and lock-in to fossil fuels, see Johnson et al. (2017) and Erickson et al. (2015).

Decentralized and centralized power generation

Both decentralized (off-grid/mini-grid) and centralized (on-grid) power-generation sources are considered necessary to achieve universal energy access. However, it is not clear that both sources receive equal consideration from policy-makers, utilities and the private sector. Participants noted an ideological disconnect between the notion of social provision of electricity services – whereby it is considered a government responsibility to ensure universal energy access and affordable tariffs – and private provision of electricity – whereby the geographical location and cost of electricity service provision are determined by supply and demand factors, such as expected profits and willingness to pay.

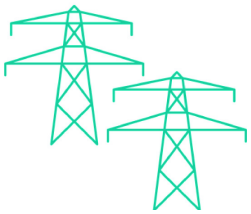
Under its ongoing Last-Mile Connectivity Project, the national distribution utility, Kenya Power, has contributed to increasing electricity access in Kenya from 27% to 60% (Wafula 2016). However, participants highlighted that full roll-out of the national grid to the entire country is not economically feasible, especially given the low consumption of those households that currently lack electricity access. However, decentralized solutions – typically pursued in poorer, remote rural areas, and often by private actors – frequently appear to be even more expensive.

Figure 2: Potential issue areas relating to energy development pathways



Low-carbon

- Intermittency
- Short-term costs
- Industry lobby
- Limited financing mechanisms
- Global climate commitments



Centralized

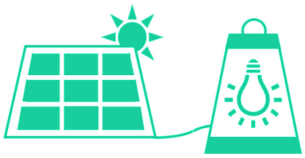
- Economies of scale
- Physical distribution network
- Adequate supply in most cases
- Standard business model

Biomass

- Expensive to make 'clean'
- Locally available
- Established markets & practices

High-carbon

- Lock-in
- Long-term costs
- Industry lobby
- Established financing mechanisms



Decentralized

- Diffusion can be scaled up
- Alternative distribution network
- Limited supply in some cases
- Tailored business models

Alternative cooking fuels

- Less smoke, fewer emissions
- Hard to change behaviour
- Not easy to regulate (charcoal)
- May rely on imports (LPG)

Source: Authors' own

Participants recognized that decentralized and centralized power options tend to require very different business models, with centralized power generation typically benefitting from an existing, cross-subsidized system. Indeed, experiences shared by the participants suggested that finding the right business models – with affordable yet cost-reflective tariffs, appropriate service provision, etc. – is a considerable challenge for many decentralized power projects.

Small-scale or household-level solutions such as solar lanterns and solar home systems are succeeding through the use of innovative financing mechanisms. However, larger systems such as mini-grids that serve larger communities are not proving so successful. Finally, participants observed that the policy and regulatory environment for decentralized systems lags behind the better-established oversight of centralized systems. Thus, there are many concerns over lack of regulatory clarity in some areas, such as tariff-setting, competition between public and private actors, and rules and procedures that apply if connections to the main electricity grid are established in the location of a mini-grid.

Household biomass energy or sustainable charcoal vs LPG and other options

Kenya's energy sector is often equated with electricity supply, yet household cooking accounts for the majority of total final energy consumption – 72% in 2014.[2] This means that household energy needs to be a much larger part of the debates over Kenya's energy development and NDC goals.

Even households with electricity access may prefer to cook with fuels rather than electricity due to costs or for social and cultural reasons.

In this context, Kenya has to grapple with the choice between biomass-based options, including more "sustainable" charcoal, and liquefied petroleum gas (LPG). On the one hand, LPG is the most efficient cooking fuel, and the one that produces the least indoor air pollution. On the other hand, LPG has to be imported, and it is a fossil fuel, whereas well-managed biomass options are locally available and renewable.

Participants recognized that the transition to any new fuel/technology combination is fraught with challenges. Household income is an important factor determining how people cook. However, participants pointed out that fuel cost is not the only consideration. Changing fuels and technologies also require related changes in perception and behaviour. In many cases, myths associated with the cost of certain fuels and flavour of food cooked on certain stoves need to be dispelled. Furthermore, cultural aspects regarding cooking traditions often present a barrier to change, and should not be overlooked.[3]

Finally, participants appreciated the considerable scope for policy support to promote cleaner, more efficient cooking fuels and technologies. Biomass is such a major resource used by the Kenyan population that it deserves more outright attention and a clear policy and/or national legislation. There are increasing synergies between the forestry, environment and energy sectors, all of which have a stake in seeking to improve the sustainability of charcoal production and consumption. Managing illegal logging and forest degradation from charcoal production requires effective intervention on both the supply and demand sides, and thus requires coordination between a range of actors with similar goals (Wanjiru et al. 2016). Participants advocated for a "coalition of the willing" that could provide the critical mass needed to achieve real progress in improving sustainability of the charcoal sector in the short to medium terms, while pursuing the switch to cleaner, more efficient and environmentally sustainable fuels over the longer term.

Public perception of renewables in Kenya

Various aspects of public perception are well known to be significant barriers to deployment of renewable energy technologies (see Devine-Wright 2005; Stigka et al. 2014). Among others, access to land – either private or community owned – is becoming a clear obstacle, particularly where projects are perceived to provide few local benefits, such as electricity generation projects that siphon power to the national grid without connecting local communities. Another issue is distrust over projects and the changes they will cause. This issue is closely linked to weak stakeholder involvement and limited knowledge on benefits and impacts of new technologies. As a result, visual and verbal framing by opposing constituencies, such as project developers and organized opposition groups, often leads to very polarized debates.

In order to appreciate the diverse perceptions/framings of renewable energy project development, it can be instructive to put oneself into the shoes of a project developer, a local community member, a politician, etc. With this goal in mind, participants in the expert meeting were asked to play the roles of various stakeholders in simulated scenarios in which participants were asked to negotiate a joint solution to a given situation. Each scenario centred on a fictional renewable energy project – geothermal, wind, solar or biomass – and involved a consultation meeting between the project developer/investor, the local community and local politicians. Each scenario was inspired by real examples from Kenya. A summary of consultation meeting discussions for each role-play scenario is presented in Table 1.

In short, these role plays encouraged participants – many with real experience of such public consultations – to shed their preconceptions and current perspectives. Although many of the concerns raised may appear flippant or facetious, they represent examples of real and serious concerns present in renewable energy projects in Kenya and beyond. Many participants noted how much they had learned from the role-play scenarios, especially regarding concerns they had not previously appreciated, such as non-financial barriers faced by project developers/investors.

Table 1: Summary of role-play group discussions

Scenario	Perspectives			
	Project developer	**Local community**	**County government**	**Village chief**
Geothermal project	Government Geothermal Authority • 100MW power plant: 10 hectares of land, resettlement of 800 people required • There will be compensation, jobs, road rehabilitation, boreholes, schools and houses	Key concerns • Access to land for grazing • Change to established way of life • Relocation of relatives buried on ancestral land • Require one new house for each wife	Benefits include • Will increase energy access to households • Will help reduce 60% youth employment • Will provide alternative livelihoods when cattle die in drought	• Women will not have to go far for water • Government has right to develop resource, but wants to make community comfortable
Wind power project	Upepo Wind Power Company • 500MW wind farm • 50 turbines • 10,000 hectares of land • There will be compensation, service provision, jobs, road improvement, land access	Key concerns • Bribery of local officials • Access to grazing land • Risk of electrocution • Noise pollution • Job opportunities • Relocation of relatives buried on ancestral land • Impacts on environment and tourism • Reimbursement for transport and meeting allowances • Questions regarding the meaning of "megawatts"	Key concerns • Presentation of proper documentation and consultation with central and county governments • Approval from National Environmental Management Authority (NEMA) • Impact on animals of electromagnetic waves from turbines • Job opportunities for constituents • Possibility of benchmarking trips for officials	• Gave project overview and facilitated discussion
Solar mini-grid project	Jua Kali Solar Company • 60kW solar rural mini-grid: 2000 sq. m of land, 12-hrs/day of lighting and charging to 400 households • There will be only a few jobs from project	Key concerns • Job opportunities • Have been promised 24-hour grid power from government; this project is only 12 hours • Backup plan in case of breakdown or equipment replacement	• Supportive of energy to boost development • Promised to integrate mini-grid into national grid after project closure	Requested • Clarity on land to be used • Examples of similar project from developer • Guarantees for system operation
Biomass gasification project	Hot Rocks Company • Gasification plant using invasive prosopis shrubs • There will be jobs and biochar available	Key concerns • Little benefit-sharing from use of previously unvalued shrub (based on past experiences) • Leaders undertaking project negotiations without their involvement • Decrease in firewood supply • Potential loss of biodiversity and medicinal supplies	Benefits include • Jobs, revenue, use of local energy resources • Concerns raised over: • Environmental and social impacts • Possible displacement • Pollution from raw material processing • What happens when prosopis runs out?	• Gave project overview and facilitated discussion

Conclusions

Debate about how the development of Kenya's energy sector can contribute to achievement of its NDC raises timely and fundamental questions about development priorities and trade-offs facing the country. From a technical perspective, Kenya can achieve its goal if it develops the relevant low-carbon energy systems, such as those based on wind power, solar, geothermal and modern biomass. However, the cost of doing so can be significant until demand increases to achieve better economies of scale. As a result, the Government of Kenya must provide a stable policy environment with clear objectives that balance the financial and regulatory needs of those actors involved in energy supply with provision of affordable and accessible services for energy users.

There are also a number of social and political risks associated with pursuit of a low-carbon pathway. Pursuing NDC targets without adequate benefit-sharing and without building local capabilities needed to realize local employment and economic development objectives may lead to public opposition and may derail the pathway. Mitigating these risks requires careful navigation of several complex issues.

Government policy that can catalyse investment in a structured way will depend upon coordinated planning of energy supply and demand. For example, incentive mechanisms to encourage new energy generation projects should be phased in such a way as to attract the investment needed to meet projected demand. This requires reliable forecasting of future demand, and long-term planning. Ambitious targets are necessary, but should be balanced with a range of scenarios, from optimistic to pessimistic, to help plan and implement policy accordingly.

Even if the policy environment is conducive and the timing is right, renewable energy projects can often be derailed by public opposition. Related to specific investments, early engagement with local stakeholders is imperative to overcome fear and myth associated with renewable energy projects. These projects, frequently proposed in politically sensitive and historically deprived geographical locations, rely on novel technologies, and often face the additional burden of raising high expectations. At the same time, land access in Kenya is a politically charged issue, requiring careful and transparent negotiation in order to build trust and legitimacy among stakeholders.

Women walk home after gathering firewood in Kisumu County, western Kenya. © SEI

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2 International Energy Agency, www.iea.org/statistics/statisticssearch/report/?country=Kenya&product=balances

3 For more on this, see Lambe and Senyagwa (2015) and Vulturius and Wanjiru (2017).