



Lake Turkana Wind Power Project has agreed to construction of wind power towers in northern Kenya

ENERGY DIVERSITY AND DEVELOPMENT IN KENYA

By ALBERT KIPROP KENDAGOR and RICHARD J. PREVOST

The overall national development objectives of the government of Kenya are economic growth; increasing productivity of all sectors; equitable distribution of national income; poverty alleviation through improved access to basic needs; enhanced agricultural production; industrialization; accelerated employment creation; and improved rural-urban balance. . . . The realization of these objectives is only feasible if quality energy services are availed in a sustainable, cost effective, and affordable manner to all sectors of the economy.¹

Since its independence in 1963, Kenya has been important to U.S. regional interests. Its significant role with the United States has increased as America has developed counterterrorism policies, sought stability in East Africa, and recognized Kenya's role in the region.² The 2007 election crises, its resolution, the drafting of a new constitution, and the ongoing role of Kenya in combating terrorism underscore its regional importance. The 2013 election, while contested in the Kenyan legal system, did not result in significant conflict. The United States congratulated the Kenyan people on conducting

a peaceful election.³ It is axiomatic that a stable, economically developing Kenya will in turn promote stability in the region.⁴ Political or economic distress in Kenya not only discourages foreign investment but may also impact the stability of neighboring countries.⁵ Energy diversity will help promote political and economic stability. This article reviews Kenya's current energy posture with a focus on rural Kenya, discusses the various sources of energy available to the nation, discusses Kenya's current national energy structure, and makes policy recommendations intended to assist its energy generation and distribution.

Like all countries, Kenya relies on energy for development and growth. In 2004, Kenya created a national energy policy and has subsequently made laudable efforts to

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address the development of energy sources and transmission. Until recently, the available forms of energy in Kenya have been limited to renewable sources. While the country has recently developed further prospects for hydrocarbon energy by way of hydraulic fracturing,⁶ at this time it produces no oil of its own and relies on imported oil from the Middle East, the Maghreb region, and central Africa. An agreement to develop a new pipeline—which could potentially aid both Kenya and South Sudan—from South Sudan to Mombasa was signed in January 2012.⁷

Kenya's Current Energy Posture

In larger towns, cities, and commercial centers, energy from imported oil is a significant source of power for domestic and industrial activities. Electricity generation from oil is supplied to the national grid. However, only about 6 percent of all Kenyans have access to the national grid.⁸ In rural areas, oil might be used for electrical generation; however, the availability of oil and refined oil products in these areas is much less than in developed ones. In these areas, the population and energy demands are less. Biomass, specifically wood, is by far the most widely used renewable fuel. Currently, the wood-fuel deficit exceeds 5,000 metric tons and is expected to grow. This excessive demand for wood fuel continues to lead to deforestation, forest fragmentation, and land degradation, and threatens water catchments.⁹ Moreover, the national demand for energy is projected to greatly increase by 2030. In response to this increase, the government must devise creative means to develop more energy sources and improve energy efficiency.

The government has recognized the differences between urban and rural energy supply and demand, the current limitations on the availability of infrastructure, and the potential for renewable energy. It has developed a national framework called Vision 2030, and it has recognized millennium development goals to bring energy to rural areas. To succeed, Kenya's government and private sector must cooperate to promote energy generation and disbursement programs.

2006 Energy Act

The 2006 Energy Act established an energy regulatory commission with a mandate to regulate the energy sector.¹⁰ Under this act, the Ministry of Energy must:

- develop and manage a comprehensive national energy efficiency program based on education, innovations, and incentives, focusing on reducing energy demand through sustainable-use education projects

and the promotion of efficient, cost-effective appliances and technologies¹¹

- promote cogeneration and sales to consumers¹²
- establish a rural electrification program, create a commission to assist with this program, and envision a funding scheme to help support electrification.¹³

The Role of Energy in the Economy.

The most recent draft of Kenya's national energy policy recognizes the key role that energy plays in the nation's economic development. For example, it notes that the energy sector contributes about 20 percent of the nation's overall tax revenue; that Kenya imports all of its crude petroleum requirements, which accounts for about 25 percent of its national import bill; that Kenya's one refinery meets about 40 percent of local demand; and that energy prices in a liberalized market are a significant determinant of the nation's competitiveness.¹⁴

The policy emphasizes renewable sources of energy to meet the national vision and millennium development targets. Policy Paper No. 4 of 2004¹⁵ and the Energy Act of 2006, respectively, are the Kenyan policy and legal frameworks for energy development. Through these documents, the government expresses its commitment to promote electricity generation from renewable energy sources. Further support for renewable energy development can be seen in Kenya's efforts to obtain outside funding. Kenya is one of six countries selected by Climate Investment Funds for their targeted program "Scaling Up Renewable Energy Program [SREP] in Low Income Countries."¹⁶

Feed-in Tariff. Kenya has formulated a feed-in tariff (FIT) policy to promote the generation of electricity using renewable energy resources and to improve the rating of its renewable energy sector. By using FIT, the government hopes to make Kenya an attractive destination for substantial private sector investment.¹⁷ The tariff makes it mandatory for companies transmitting energy to purchase electricity from renewable energy sources at a predetermined price. Renewable energy producers then have a guaranteed market, and, if the pricing mechanism is correctly gauged and equitably adjusted to reflect changes in cost, these companies will receive an attractive return on investment for the electricity they produce.

Under the FIT system, investment security and market stability are provided for investors of electricity generation from renewable energy sources. This is done while encouraging private investors to operate their powerplants prudently and efficiently

to maximize returns. According to Policy Paper No. 4 on energy, the national energy policy "is to ensure adequate, quality, cost effective and affordable supply of energy to meet development needs, while protecting and conserving the environment."¹⁸ This policy facilitates the exploitation of abundant renewable energy sources available in the country. The feed-in tariffs were introduced in 2008 and revised in 2010 to accommodate additional renewable energy.¹⁹

Kenya and Oil. The country has several sources of renewable energy that can be exploited and supplement oil. However, importation of foreign oil will be necessary for the short and medium terms. The country imports oil both for domestic use and for subsequent export as a refined product. The nation's one refinery at the port of Mombasa has two distillation units. Next to the refinery, a pipeline was built that can transport product through the middle of the country to the Kenya-Uganda border. Rural Kenyans and those on the outskirts of cities use kerosene and liquefied petroleum gas for lighting and cooking.²⁰

Plans have been announced to extend the aforementioned pipeline into Uganda and to construct another pipeline from the port of Lamu to South Sudan and Ethiopia.²¹ These pipelines, along with over-the-road transport, are the major source of transport of refined petroleum products. Inland depots have been established in every major town along the national highway. The proposed pipelines, connected to depots, would allow products to reach consumers faster and more efficiently relative to road transportation. The second port at Lamu will have several berths and supporting infrastructures and could not only improve the energy sector but also spur regional economic growth.²²

Renewable Sources of Energy

Kenyan sources of renewable energy are diverse and at varied stages of development. Hydropower generation is by far the largest source of renewable energy supporting commercial and industrial manufacturing.²³ Hydropower currently generates 57 percent of national electricity.²⁴ There are seven hydroelectric generating plants set along two major rivers, the Tana and Turkwel. The power generated is transmitted to the national grid for further distribution.

Geothermal energy is a renewable energy source with great promise. In Kenya, geothermal energy involves tapping geysers and channeling steam through pipes to turn turbines and mainly has been developed along the Rift Valley.²⁵ Currently, geothermal energy converted to electricity contributes

approximately 15 percent of Kenya's electric energy to the national grid.²⁶ According to the Ministry of Energy, geothermal generation has great potential for development: "Olkaria currently hosts three geothermal power plants. Once new geothermal power plants at Olkaria and Menengai are commissioned, notes [Permanent Secretary Patrick M.] Nyoike, geothermal power capacity will increase by 490 [megawatts]. Kenya is one of the few African countries that [has] successfully tapped geothermal energy."²⁷ Geothermal expansion builds on the concepts of Vision 2030 and is intended to promote the government and the private-sector partnership program.

For Vision 2030 to materialize, Kenya needs more than 10,000 megawatts of electrical (MWe) output, and of this, a minimum of 5,000 MWe is expected to come from geothermal sources. Kenya's geothermal potential is in excess of 7,000 MWe spread over more than 14 locations. This opens new investment opportunities from supply of equipment to construction of powerplants; the planned developments are enormous and the Geothermal Development Company is committed to facilitate and stimulate investor entry²⁸ and will drill wells and absorb some of the costs that usually would be incurred by private companies.

Wind energy in Kenya relies on windmills that are erected along the wind path. This source has huge potential as the country experiences strong winds throughout the year. The average wind speed in Kenya is 3 to 10 meters per second, and the country has several sites conducive to wind energy. The most recent national energy policy envisions at least 1,000-MW wind-generation capacity by 2016.²⁹ The Ministry of Energy—jointly with private investors—has carried out extensive feasibility studies in the Northern Province and construction is due to commence around Lake Turkana.³⁰ The Lake Turkana Wind Power Project aims to provide 300 MW of reliable, low-cost wind power to the Kenya national grid, equivalent to approximately 20 percent of the electricity generating capacity currently available. The project is of significant strategic benefit to Kenya and, at a cost of KSh75 billion (\$893 million), will be the largest single private investment in the country's history. The wind farm site in northeastern Kenya covers 40,000 acres and is located in Loyangalani District, Marsabit West County, approximately 50 kilometers north of South Horr Township. Data collected and analyzed since 2007 indicate that the site has some of the best wind resources in Africa, with consistent wind speeds averaging 11

meters per second and from the same direction year round.³¹

Solar power also offers potential as a renewable energy source. Solar power is most prevalent in the outskirts of large towns and rural areas. It has huge potential considering that much of the country enjoys sunlight throughout the year. Unfortunately, this source does not currently contribute any electricity to the national grid. Instead, solar energy is consumed at the generation site or in close proximity to it. It is estimated that close to 500,000 homesteads in Kenya use solar power to heat water. The government is committed to making serious efforts to expand this resource.³² Private-sector firms and individual entrepreneurs, to some extent supported by both governmental and nongovernmental organizations, are responsible for the development of solar energy. In fact in 1995, Richard Acker and Daniel Kammen reported that 20,000 to 40,000 small photovoltaic systems had been installed in Kenya over the previous decade.³³ In more recent decades, Kenya has registered additional increases in the use of solar power. This effort is a continuation of past policies.

The widespread introduction and adoption of renewable energy technologies remain high on virtually every national development policy agenda; renewable energy systems can assist national energy autonomy, decentralize resource management, promote environmental conservation, and serve as a means to reduce global warming.³⁴

Biofuels are among the most promising alternatives to fossil fuels, and Kenya is making significant efforts to develop them. Many farmers are encouraged to invest in nonedible plants that have high yields.³⁵ This resource remains underdeveloped, and the government has identified it in the Vision 2030 development plans.³⁶

The last common source of renewable energy is biomass. This source, which involves the use of firewood and pulp, is by far the oldest in Kenya and the most widespread source of energy in the rural areas. It is the major cause of deforestation, with great adverse effects on the environment and long-term economy. In fact, the country has lost forest cover from 9 percent at independence (1963) to a mere 3 percent today.³⁷ The government faces great challenges in trying to curb the use of biomass; it meets up to 70 percent of Kenya's final energy demand and provides for more than 90 percent of rural household energy needs—with approximately one-third in the form of charcoal and the rest from firewood. It is estimated that 80 percent of urban households' wood-fuel demand is met by charcoal.³⁸

The development of nuclear energy is recognized as another source of power that will be considered in the future.³⁹ Many experts have long believed that nuclear energy is the best cure for the seasonal vagaries that tremendously affect the nation's hydropower generation.⁴⁰ Notwithstanding the high initial costs, safety concerns, and technical skills required to acquire nuclear power, there remains a strong national will to pursue this option. According to the Ministry of Energy, the government is considering building a nuclear powerplant.⁴¹ Developing local and national expertise in the nuclear field will be a challenge as will addressing the issue of spent nuclear fuel. These challenges are made more acute given Kenya's plan to be a nuclear energy generating nation by 2030.

Analysis

Kenya has enormous energy opportunities and supply challenges as it faces increased energy demand. In 2009, the country separated the generation and distribution of electricity. Since then, two national companies have operated as separate entities. Kenya Generating Company is the major supplier of electricity to the Kenya Power Lighting Company. There are, however, other privately owned suppliers that produce and supply power to the national grid. Kenya now encourages the private sector to invest in this area, which has been dominated by the government for perhaps too long.

The government must account for the varying impacts of energy generation on the environment, but impacts from energy generation are difficult to measure, and it remains to be seen whether there is political will to measure the ecological damage caused by human activities associated with energy production and to measure the interference with ecosystems. Kenya desires to encourage investments in clean energy to augment the current energy sources to meet increased energy needs.⁴²

In addition to encouraging energy development investment, the government has tried to increase the efficiency of energy production. Greater efficiency can be achieved through acquisition and installation of modern equipment. Significant energy loss occurs from the transmission of energy from generating plants to the national grid—the old technology appears to be the major source of seepage, and modernization may go a long way toward alleviating this loss.

Once energy enters the national grid, Kenya Power and Lighting distributes that energy. The customers can be classified as government, multilateral institutions, nongovernmental organizations, corporate insti-

tutions, and individuals. Jointly with the private sector, the government has begun to support the generation and efficient distribution of energy to rural areas. Where this has been done, there has been a positive economic impact. Over the last 10 years, government-, private-, and nongovernment-supported Kenyan efforts have extended electricity to more than 8 million homes. The SREP initiative and private sector have been instrumental in carrying out surveys and financing installations of the renewable sources of energy.⁴³ This expansion of electricity distribution and the ongoing effort to develop pipelines may provide the most immediate positive return on investment.

Also, Kenya has been successful in monitoring and estimating energy waste. Many sectors are improving their energy efficiency to reduce consumption without affecting their production. The sectors leading this effort are motor, chemical, and food-processing plants. According to the Kenya Association of Manufactures, these savings will reduce consumption by significant margins, between 20 and 50 percent.⁴⁴ These efficiency efforts will help improve Kenya's competitiveness, especially if these efforts can be made regarding cement, steel, pulp, and paper production.⁴⁵

Other exogenous challenges and externalities arise as Kenya tries to develop and implement its energy programs. Globalization affects the energy sector in terms of the demand, supply, and prices. Additionally, rule-of-law and security issues can make it difficult to do business in neighboring economies; the effects of regional and national security challenges can cascade down to the citizens, businesses, and local communities. Overall, Kenya has been relatively stable; however, the recent violence in Mombasa—and past violence associated with the transition of government—make one realize how fragile a nation can become and how security is a necessity.⁴⁶

Members of MEND, the Movement for the Emancipation of the Niger Delta, moving fast in heavily armed speedboats, evaded security and launched an attack on Bonga, the most prominent of all oil platforms, 70 miles from the shore. Group members managed to climb onto the platform, but they were repelled before they could blow up the computerized control room. It was a close call, and a scary one. The Bonga attack sent shockwaves throughout the market. In an email to journalists, a spokesman for MEND warned, "The location for today's attack was deliberately chosen to remove any notion that offshore oil production is far from our reach."⁴⁷



Conveyor drill with linkage pump at rear of geothermal powerplant in Kenya

Likewise, global and regional impacts because of attacks on Kenyan pipelines, its power grid, or/and infrastructure would have adverse effects. Electricity-generation companies that import and use oil as a steady source of fuel would have to reduce or stop production if that source of oil is interrupted. Loss of the grid would produce electricity shortages, disrupt production of manufacturers, and cause price instability to the producers and consumers that rely on the grid. Reduced electricity, even if controlled by scheduled brownouts, would have cascading effects. Higher unit prices for electricity are not only directly passed on to consumers in towns and rural villages, but they are also indirectly passed on to higher prices for consumer goods.

Rural Electrification

The rural electrification program continues to encounter many constraints. Generating companies often use old technologies for the production and generation of power. The antiquated technology results in waste and inefficiency of between 10 and 30 percent. The unit of energy produced is not economical. Infrastructure support, even when there is a strong desire to conduct maintenance, is another difficult constraint. Kenya does not have sufficiently developed road networks in rural areas, and this hampers private companies accessing their equipment. Many investors are discouraged by dilapidated or nonexistent roads.

There is a chicken-and-egg aspect to rural electrification as it relates to the area's

economic capability. The lower individual incomes in rural areas result in relatively lower purchasing power. Thus, fewer people and small enterprises in these areas can afford installation. Low purchasing power has the corresponding effect of further depressing the rural customer base for operators, and is one of the limiting factors to what can be charged for electricity. Lack of electrification impacts how much the local population can produce and reduces purchasing power. There is an economy-of-scale issue in rural areas that reduces operators' margins and makes it difficult to spread out the risk of providing electricity. The operators see greater risk as there is a lower per capita income and greater per capita operating costs because there are fewer consumers. Consequently, only a limited number of operators are willing to invest in these areas.

Legal and environmental challenges may delay the smooth implementation of the electrification program. In rural areas, transmission lines must be installed either underground or overhead. In either instance, companies are obliged to acquire rights of way in rural areas whereas in urban areas, rights of way may have been previously established. National regulations and protocols must be complied with, but they may serve to slow development or rural electrification. Conservation areas, such as important historical sites and aquatic and ecological areas, must remain protected or at least weighed against the value received from rural electrification programs.



Workers at Olkaria Geothermal Power Plant, Kenya

Wikipedia

in this effort, but public-private ventures may also be lucrative if properly incentivized.

Fifth, the nation needs to address the future role of biomass energy. This energy use has been detrimental to Kenya's limited forests. Adverse impacts of biomass energy on the environment remain a major concern, and the government should take measures to reduce, over time, the use of biomass as an energy source. The government should revise the environmental regulations through the newly commissioned National Environment Management Authority. In view of the forest degradations, the government should consider, in addition to regulations, incentives for the use of natural gas and kerosene through tax exemptions to make them affordable. The government should ensure availability of fuels that can be used in lieu of biomass. Finally, the government should encourage sensible reforestation where the climate can support it.

Conclusion

Kenya is a key nation to building stability and prosperity in East Africa. The United States has an interest in a stable Kenya that is involved in counterterrorism, continues to develop democratic institutions, and supports its neighbors. Kenya has huge potential for economic growth and development, and its rural electrification programs are important in achieving this potential. Joint public-private partnership programs can help provide rural electrification. As the government leads through deregulation and tax policy, it will help leverage the private sector. Ever-increasing energy demands require a continuation of the paradigm shift that has begun, from acceptance of intermittent energy supply to one that embraces advanced technology, a variety of energy sources, greater efficiency, and is friendlier to the environment.

Kenya's opportunities for becoming more energy self-sufficient lie in energy diversification. We see this diversification as requiring the development of renewable forms of energy and, potentially, the development of nuclear power. The rural electrification program should be people-driven, meaning that the local population must be educated and involved in the formulations and decisionmaking process. Such involvements would not only promote ownership and sustainability but also build capacity for skills and technology transfer. Negative impacts of energy development on the local environment can be significantly controlled through economic empowerment and education of the citizens. State infrastructure development in rural areas must be prioritized in

Also, the hydroelectric generation intensity of Kenyan energy creates some risk for potential rural electrification. Erratic patterns of seasons and variable climatic conditions have put huge limitations on hydroelectric capacity. One current debate is whether Kenya's economic planners should anticipate, and to what extent, permanent climate change.

Policy Recommendations

Public and private recognition of the value of energy generation and distribution in Kenya is becoming widespread. There is huge potential for planned, stable development, and, at the same time, there are numerous challenges and negative externalities that must be addressed. First, the government has recognized that rural Kenya does not have all the characteristics of a pure market, so government intervention and encouragement are planned. The rural electrification program is a laudable goal and should be pursued. The program should be people-driven, meaning that the local population must be educated and involved in the formulation and decisionmaking process. Such involvement will not only promote ownership and sustainability but also build capacity for skills and technology transfer.

Second, we strongly recommend the modernization of electric generation equipment and transmission lines. For example, in many hydroelectric plants, older generators are still being used. Only one-third of

the energy generated reaches the consumer. Additional loss is due to pilferage, broken and poorly maintained lines, and aging transformers.

Third, the government should provide greater focus on generating energy from the nation's many renewable sources of clean energy. For example, in addition to feed-in tariffs, the government could provide tax incentives for private developers willing to be part of the rural electrification programs. The private sector may be leveraged through other incentives. Tax policy could encourage the importation of solar panels, wind turbines, and other key energy accessories. Wind remains readily available, and the government ought to encourage entrepreneurs to deploy windmills at appropriate locations, such as around Mombasa, Chulu Hills, and the Kapiti Plains. Encouragement could come in the form of not only tax incentives but also government-sponsored development of infrastructure that allows greater distribution of electricity generated from wind.

Fourth, individuals and local entities should be encouraged to invest in smaller domestic windmills for off-grid consumption at the villages. Notwithstanding these efforts at the rural level, the government should consider investment in wind sources through installation of massive windmills capable of integration to the grid. The Lake Turkana wind farm in northern Kenya is a good example. We see the government, perhaps with international backing, as taking the lead

order to incentivize the private sector. But first, the private sector and the government must educate and respond to the needs of the local citizenry. It can then put in place vibrant, actionable plans to provide energy, develop the local economy, and reverse deforestation and desertification. **JFQ**

NOTES

¹ Ministry of Energy, *Third Draft National Energy Policy* (Nairobi: Republic of Kenya, 2012).

² Michelle D. Gavin, "Policy Options Paper—Kenya," Council on Foreign Relations, March 13, 2008. Gavin notes that the U.S. Embassy in Nairobi is the largest, and that Kenya is a significant counterterrorism partner, providing a point of military and humanitarian access, while having played a vital role in bringing stability to Sudan and Somalia.

³ "On behalf of the President and the people of the United States, we congratulate Uhuru Kenyatta on his election as president of Kenya. We also congratulate the people of Kenya on the peaceful conduct of the election and commend Raila Odinga for accepting the Supreme Court's decision. We urge all Kenyans to peacefully accept the results of the election." Statement by the Press Secretary on the Presidential Election in Kenya, The White House, March 30, 2013, available at <www.whitehouse.gov/the-press-office/2013/03/30/state-ment-press-secretary-presidential-election-kenya>.

⁴ Vice President Joseph Biden, speaking to university students in Nairobi, drew a more direct parallel to foreign investment when he stated: "Foreign investment depends upon stability, transparency, the rule of law, and the crackdown on corruption." See "Remarks by Vice President Joe Biden to University Students in Nairobi, Kenya," June 9, 2010, available at <www.whitehouse.gov/the-press-office/remarks-vice-president-joe-biden-university-students-nairobi-kenya>.

⁵ The continued success of the East African Community, and the viability of further political and economic integration, will depend on the development of a stronger regional infrastructure. The postelection crisis demonstrated the vulnerability of inland countries to instability in Kenya, which even in stable times is a bottleneck for regional shipping. See *Kenya* (Oxford: Oxford Analytica, Ltd., 2011).

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⁸ Souleymane Diaby, *Kenya's Draft National Biofuel Policy* (Nairobi: U.S. Department of Agriculture, March 30, 2011).

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¹⁰ Republic of Kenya, *The Energy Act, 2006* (Nairobi: Republic of Kenya, 2006); Energy Regulatory Commission, available at <www.erc.go.ke/erc/>.

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¹² Republic of Kenya, *The Energy Act, 2006*.

¹³ *Ibid.*

¹⁴ Ministry of Energy, *Third Draft National Energy Policy*.

¹⁵ Ministry of Energy, *Sessional Paper No. 4 on Energy* (Nairobi: Ministry of Energy, 2004).

¹⁶ "Scaling-up Renewable Energy Program [SREP]," *The Climate Investment Fund*, available at <www.climateinvestmentfunds.org/cif/srep>; *SREP Investment Plan for Kenya* (Nairobi: Republic of Kenya, 2011).

¹⁷ Ministry of Energy, *Feed-in Tariffs Policy on Wind, Biomass, Small-Hydro, Geothermal, Biogas and Solar Resource Generated Electricity* (Nairobi: Ministry of Energy, 2010).

¹⁸ Ministry of Energy, *Sessional Paper No. 4 on Energy; SREP Investment Plan for Kenya*.

¹⁹ Ministry of Energy, *Feed-in Tariffs*.

²⁰ *SREP Investment Plan for Kenya*.

²¹ See, for example, Eric Watkins, "South Sudan to Construct Refinery, Oil Pipeline to Kenya," *Oil & Gas Journal* (January 26, 2012).

²² "Lamu Port Agency," available at <<http://lamuportagency.com/about%20lamu.html>>.

²³ "Renewable Energy and Energy Efficiency Partnership (REEEP)," available at <www.reeep.org/index.php?id=9353&special=viewitem&cid=54>.

²⁴ *Ibid.*; UNEP places the value at 64 percent. See UNEP.

²⁵ Isaiiah Esipisu, "Kenya: Nation Becoming Economic Heartbeat of Continent," *All Africa*, April 25, 2012.

²⁶ "Geothermal Energy to Meet 30% of Kenya's Electricity Needs by 2030," *CleanTechnica*, September 3, 2011.

²⁷ *SREP Investment Plan for Kenya*; David Gathanju, "Kenya Bets Big on Renewable Energy," *Renewable Energy World.com*, June 16, 2010.

²⁸ "GDC Business Plan and Strategy," Geothermal Development Company, Ltd., available at <www.gdc.co.ke/index.php?option=com_content&view=article&id=161&Itemid=155>.

²⁹ Ministry of Energy, *Third Draft National Energy Policy*.

³⁰ *Ibid.*; "Lake Turkana Wind Power," Aldwych International, Ltd., available at <<http://ltwp.co.ke/home>>.

³¹ *Ibid.*

³² Ministry of Energy, *Third Draft National Energy Policy*.

³³ Richard H. Acker and Daniel M. Kammen, "The Quiet (Energy) Revolution: Analysing the Dissemination of Photovoltaic Power Systems in Kenya," *Energy Policy* 24, no. 12 (1996).

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³⁵ John David Bwakali, "Biofuels Boom and Bust," *Inter Press Service News Agency*, October 24, 2008.

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³⁷ UNEP.

³⁸ "Energy Profile Kenya."

³⁹ Ministry of Energy, *Sessional Paper No. 4 on Energy*.

⁴⁰ Cathy Majtenyi, *Kenya Eyes Nuclear Power Development* (Lanham, MD: Federal Information & News Dispatch, Inc., 2011).

⁴¹ "Kenya: KENYA Will Need Sh250bn to Set Up a 1000MW Nuclear Reactor: Mr. Patrick Nyoike," *MENA Report*, November 7, 2012.

⁴² The *Third Draft of the National Energy Policy* gave limited attention to climate change. The document noted that Kenya signed the Kyoto Protocol but was not required to develop emission reduction targets. The impact of a changing climate may have to be addressed in the future as Kenya depends on hydropower for electricity, yet hydropower is highly vulnerable to climate fluctuations.

⁴³ *SREP Investment Plan for Kenya*.

⁴⁴ "Energy Profile Kenya."

⁴⁵ Ministry of Energy, *Third Draft National Energy Policy*.

⁴⁶ See, for example, Drew Hinshaw, "Shooting of Cleric Stokes Tensions in Kenya," *The Wall Street Journal*, September 7, 2012; and Karuti Kanyinga and James D. Long, "The Political Economy of Reforms in Kenya: The Post-2007 Election Violence and a New Constitution," *African Studies Review* 55, no. 1 (April 2012), 31–51.

⁴⁷ Daniel Yergin, *The Quest* (New York: Penguin Press, 2011).