

Energy Access Review

The Price of Power: Comparing electricity prices in Sub Saharan Africa

How far one can stretch one American dollar in Uganda, US, China or UK differs significantly. A recent publication in the Economist (“The Big Mac Index”, January 2015) finds that the average price of a McDonald’s Big Mac burger in China was US\$ 2.77 compared to US\$ 4.79 in the US. The difference, to a large extent, is a function of the long run exchange rate between the Yuan and the US Dollar. Other factors including tax policies and cost of inputs are equally important. When comparing the price of electricity (or other products) across countries, straight currency conversions fail to cater for this variability. Economists have developed the Power Purchasing Parity (PPP) theory to rationalize this difference in prices of comparable products and services across countries. The World Bank, International Comparison Database (ICD) explains this simply as “The number of units of a country’s currency required to buy the same amount of goods and services in the domestic market as a U.S. dollar would buy in the United States”. (Continue to pg. 2)



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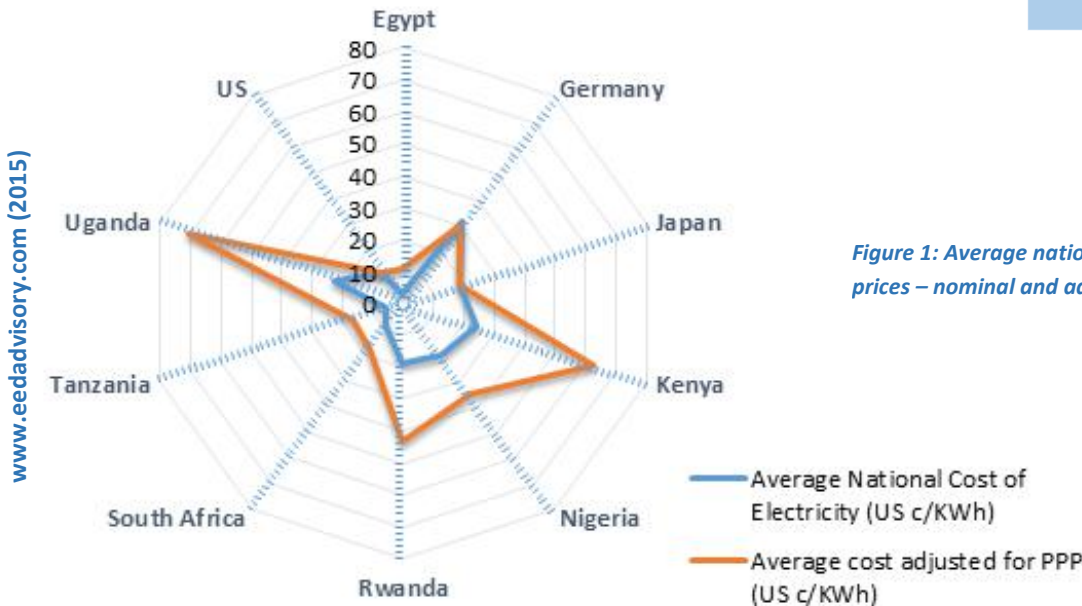
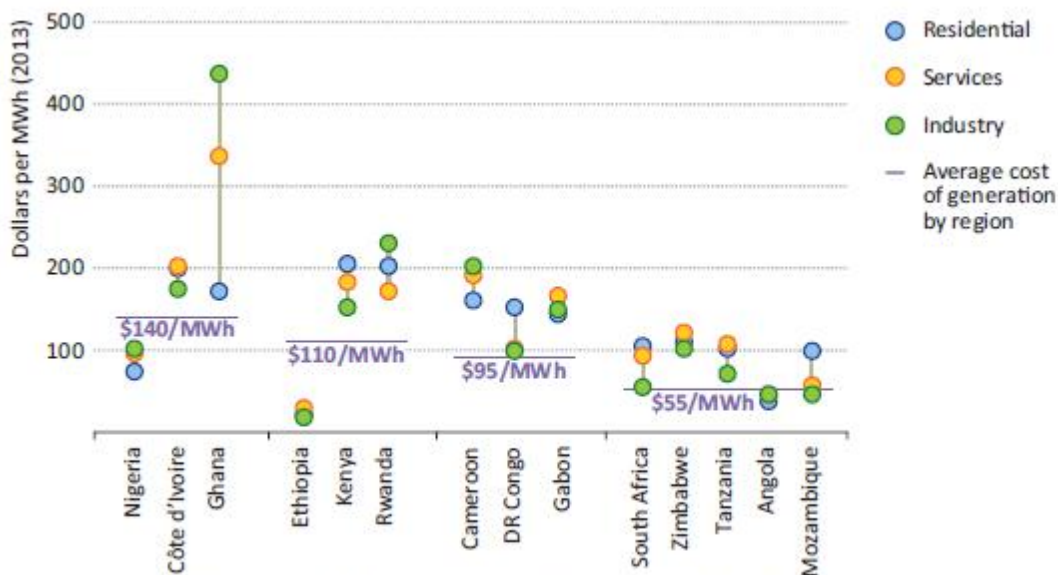


Figure 1: Average national domestic electricity prices – nominal and adjusted for PPP

“...the average American would have to pay up to five times the current price of electricity to experience a “comparable purchasing burden” to a Ugandan who purchases their electricity in local currency.”

Figure 2: Grid electricity prices by end-use sector in selected countries (IEA, 2013)



Due to the differences in the purchasing power of hard currencies across countries, one US Dollar is perceived to be of a higher value in Kampala than in New York City, for example. In this review we use the same theory to relook the prices of electricity across a number of countries illustrating the perceived burden of purchase in those countries relative to the US. We find that when adjusted for PPP, the average American would have to pay up to five times their current cost of electricity to experience a “comparable purchasing burden” to a Kenyan or Ugandan who purchases their electricity in local currency

Karl Gustav Cassel (1866 – 1945), a Swedish economist is regarded as one of the founding protagonist of the PPP theory. He is quoted as having said that, “At every moment the real parity is represented by this quotient between the purchasing power of the money in one country and the other. I propose to call this parity purchasing power parity.” (Cassel, 1918, p. 413)¹. PPP is established by comparing different countries’ currencies through a standard basket

of goods. Two countries are at par in PPP, when a basket of goods - taking into account the exchange rates - is priced the same in both countries. Estimating purchasing power parity is complicated, and even controversial at times, due to various reasons. First, the differences in various products and services do not always have a uniform price level when compared across countries. For example, the differences in energy prices may be greater than the difference in food prices or housing. Second, people in different countries consume different baskets of good and even those goods that are comparable, may have some unique qualities from market to market. Third, different countries consume different portions of the items in the basket of goods. Ethiopians for example, consume teff as a staple food while Thai consume rice and hardly any teff. In spite of these and other challenges, calculating PPP is now a widely accepted and standardized procedure.

¹ Dornbusch, R. (1985). Purchasing Power Parity. *Working Paper No. 1591*

US\$ 0.14

..the average effective tariff in Africa in 2010 compared to South Asia and East Asia at US\$ 0.04/kWh and US\$0.07/kWh respectively (source: AfDB, 2013)

Grid based electricity prices in Africa vary greatly and it is futile to classify the same as expensive or otherwise. Zambia and Ethiopia have some of the lowest prices in the world while Djibouti and Gabon have some of the highest. Compounding the complexity of comparison is the varying degrees of reliability. Reliability of supply contributes the final cost of electric energy and may take away what would otherwise have been a benefit of low electricity prices. It is not uncommon to find many commercial and industrial users across Sub Saharan depending on a back-up solution, often powered by diesel, to supplement the intermittent grid based supply. Power back-up systems are estimated to account for up to 6% of installed generation capacity in Sub Saharan Africa and can top 12% in extremely low income countries².

It is estimated that in 2010, the average effective tariff in Africa was US\$ 0.14/kWh compared to South Asia and East Asia at US\$ 0.04/kWh and

² Foster, V., and Steinbuks, J. (2008) Paying the price for unreliable power supplies: In-house generation of electricity by firms in Africa. Africa Infrastructure Country Diagnostics, Working Paper 2, World Bank, Washington.

US\$0.07/kWh respectively³. Ironically, in spite of the relatively high electricity prices, they – for the most part, do not fully reflect the true cost of supply rendering many of the utilities financially untenable. The International Monetary Fund estimates that state-owned electricity companies across the region were in 2010, operating with deficits equivalent to 1.4% of the Sub Saharan Africa GDP⁴.

In spite of the challenges of cost, reliability and access, a lot of progress is being experienced across the region. A century of under-investment is now being remedied by a frenzy of activities in power generation, transmission and distribution. While most countries aim for self-sufficiency, others including Ethiopia and the DRC are positioning themselves to be net electricity exporters. In Kenya the government has outlined a 5000 MW expansion plan with 280MW of additional capacity from geothermal already injected. Ghana plans to double its generating capacity to 5,000 MW by 2016 with the iconic 155MW Nzema solar plant – the largest in Africa underway. Gabon plans to expand the current capacity of less than 200 MW to 1,200 MW by 2020 with a 160MW hydroelectric plant already under construction in Haut Ogooué. South Africa now has some of the largest solar parks on the continent including the 75MW Kalbult, 75MW Lesedi, 75MW Letsatsi, 96MW Jasper, 75MW Kathu, 94MW Sishen, among others solar parks. Zambia's Zesco plans to double its generation capacity to 2,800 MW in the next 5 years – mainly powered by coal. Nigeria has unbundled the Power Holding Company of Nigeria (PHCN) with the aim of speeding up the restructuring of

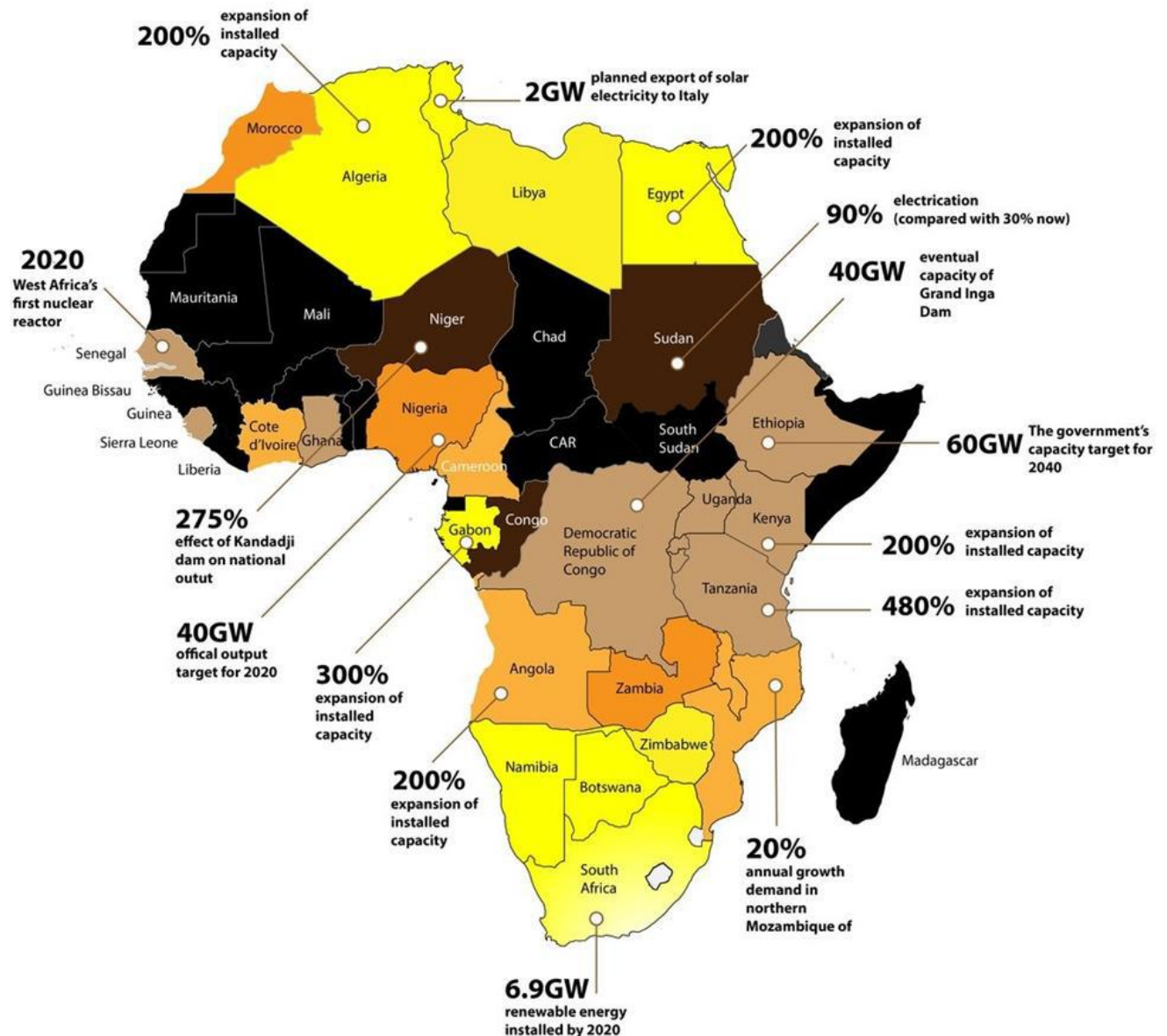
³ AfDB (2013), High Cost of Electricity Generation in Africa, African Development Bank [online article](#) accessed in March 2015.

⁴ IMF (2013), Energy Subsidy Reform in Sub Saharan Africa: Experiences and lessons, International Monetary Fund, Washington DC.

the power sector by creating spaces for generating and distribution companies. This build up is expected to create more than 2.5 million temporary and permanent jobs across the continent⁵. The general outlook remain positive (see figure 3 below).

How this will affect the relative price of electricity on the continent – in nominal and PPP terms, is an important question to consider lest a majority of the citizens are excluded by restrictively high electricity prices.

Figure 3: Blue-Sky Projection - Africa in 2020 (Source: Global Construction Review)



⁵ McKinsey and Company (2015), Brighter Africa, The growth potential of Sub Saharan Africa Electricity Sector, McKinsey and Company, Johannesburg

The ABCs of INDCs: Perspectives from the electricity sector in Kenya

It has been 20 years of talks since the first UNFCCC Conference of Parties (COP 1) in Berlin. Whether these talks have been successful or not is not the issue of discussion in this review. Some COPs have been more important than others and the upcoming COP 21 in Paris is burdened with high expectations. Perhaps a realization that this is set-up to be a quintessential turning point in this journey - whether progress is realised or not. This year's conference comes at an opportune time; the conscious realization that the Kyoto protocol may not achieve its targets, coupled with the pledge by China and USA⁶ – who contribute about half of the world's greenhouse gas emissions– to reduce their emissions, sets the stage for a watershed moment. A new international climate change agreement first muted at COP 17 in Durban is set to be adopted at this conference. Unlike the Kyoto protocol, this agreement will see both developing and developed countries commit to reducing or limiting GHG emission. The new term is Intended Nationally Determined Contributions (INDCs).

INDCs, a term introduced at the COP 19 in Warsaw, are voluntary commitments publically outlined by countries to address domestic GHG emissions. In Warsaw countries were invited to either commence or intensify domestic preparations for the INDCs and submit these by the end of the first quarter of 2015. The idea is to develop a bottoms-up system in which countries bring forward their contributions determined within the context of their national priorities,

⁶ PBL NEAS (2013) Trends in global CO2 emissions 2013 Report, PBL Netherlands Environmental Assessment Agency Institute for Environment and Sustainability (IES) of the European Commission's Joint Research Centre (JRC), Hague.

Figure 4: Cartoon credits – Horsey 2009 ©



circumstances and capabilities. INDCs are central to the 2015 agreement as they prominently in the main agenda. While there is no clear structure yet, there is a general consensus that elements of mitigation and adaptation should be part of the contents of the INDCs. Discussions are still ongoing to include financial support, capacity building, and technology transfer especially for developing countries⁷. INDCs are set to operate as: (i) Economy wide targets-reductions in absolute terms relative to a historic base year or baseline, (ii) Carbon intensity-reductions expressed in emissions per GDP output, per capita emissions (iii) Compilation of sectoral policies- regulations, standards, and financial instruments such as taxes, carbon markets, incentives, and subsidies. These commitments, unlike Kyoto, do not necessary mean that developing countries' aggregate GHG emissions are capped relative to a base year but that these countries will identify ambitious low carbon development pathways.

⁷ Carrington D., 2014, Technical paper on the United Nations Climate Change Sessions-AD Hoc Working Group on the Durban Platform for Enhanced Action (ADP 2.4), held on 10th -14th March, in Bonn, Germany

Overview on INDCs:

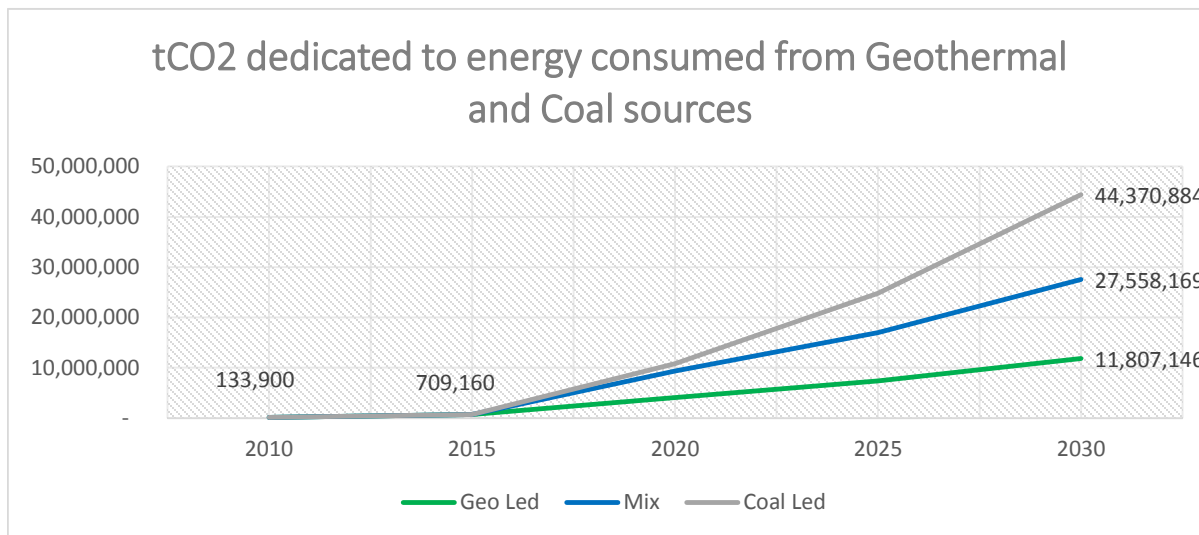
- By definition, voluntary GHG reduction actions publically outlined by countries
- First mentioned at Warsaw Conference of Parties, 2013
- To be submitted by the end of first quarter of 2015
- To be submitted by both developing and developed countries that are parties to the convention
- Have components of mitigation as well as adaptation
- Can be set as: economy wide contributions, energy targets, projects and policies.
- NAMAs could become INDCs

To put this into context we review Kenya’s electricity sector growth trajectory to 2030 under three scenarios: (i) low carbon geothermal based generation, (ii) mixed sources and (iii) high carbon coal based generation. The present layout of the Least Cost Power Development Plan

(LCPDP)⁸ favours a predominantly geothermal future where installed geothermal capacity is expected to reach 5,530 MW by 2031 representing 26% of the overall capacity at the time. Previous experiences of power rationing during dry seasons when dam water levels decrease have seen the reliance on hydro power subside. This is rightly reflected in the Plan as hydro has been allocated a 5% portion of the power generation mix in 2031, a big decline from the current 46% capacity⁹. On the other hand, the target set for generation from coal is 2,720 MW, an equivalent of 13% of the generation mix in 2031, with a capacity of 920 MW being achieved by 2021.

This simplified comparison foresees the first scenario with geothermal contributing 70% against coal 14%. The second scenario culminates in a mix of 42% geothermal and 42% coal while the third scenario ends up with a 71% coal contribution versus 17% from geothermal. The total energy consumed is kept constant in all three scenarios.

Figure 5 Total CO2 emissions exclusively from coal and geothermal energy sources

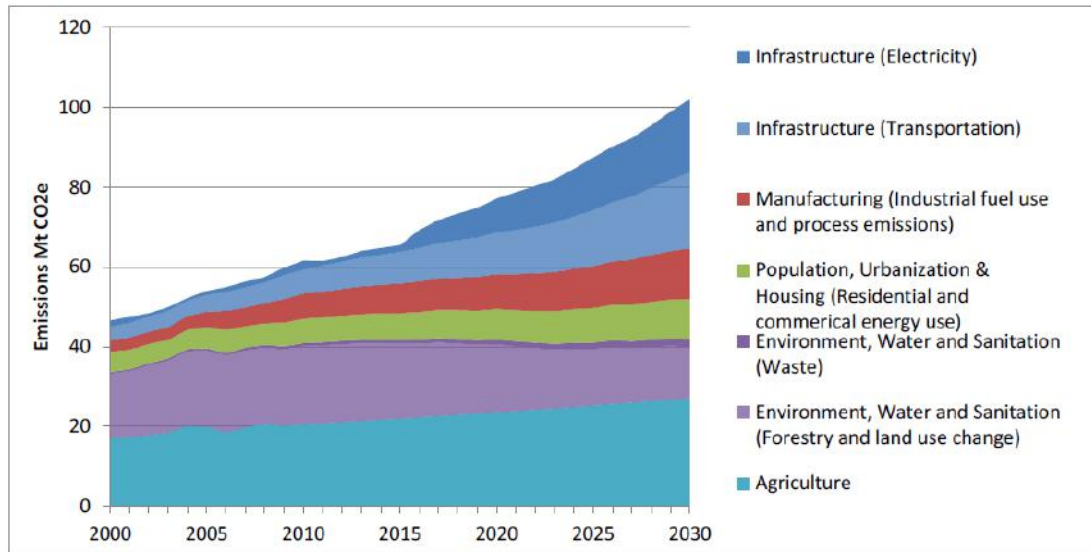


⁸ ERC (2011) Least Cost Power Development Plan 2011 - 2030, Energy Regulatory Commission, Nairobi

⁹ MoE (2013), 5000+ MW Investment Prospectus, Ministry of Energy and Petroleum, Government of Kenya, Nairobi.

According to the *National Climate Change Action Plan (2013 – 2017)*, GHG emissions are expected to hit 102 million tonnes of carbon dioxide equivalent (MtCO_{2e}) in 2030 with approximately 20 MtCO_{2e} of this total coming from the electricity sector – see figure 6. From the analysis above, it’s clear that if Kenya opts for

Figure 6 GHG Emissions by MTP 2 Planning Sectors between 2000 and 2030. Source: GOK NCCAP Mitigation Analysis 2012



the third scenario (coal-led), the expected GHG emissions will be overshoot by at least 45% and this attributed to the use of coal for generation alone. Going the ‘low-carbon’ way reduces GHG emissions from the two featured energy sources to about 11MtCO_{2e} by 2030. Since an equal mix of the low- and high-carbon scenarios would raise the yields to 27MtCO_{2e}, the initial would then be an ideal route for the country to follow lending credibility to the Deutsche Bank Konzept quote which states, “if the currently agreed climate change targets are to be met with any reasonable clarity, over half of the proven fossil fuel reserves would have to stay where they are – underground.”

First Quarter 2015 Energy Access News Highlights



- Tanzania in talks with China on funding for wind farm** - Tanzania engaged in talks with the Export-Import Bank of China (EximBank) for a \$132 million loan to fund the country's first wind power project. The wind farm project is expected to have a capacity of 50 MW, with plans to raise that to 300 MW in future. The government initially aimed to commission the wind farm in 2013 but construction has been delayed by a lack of finance. The project is a joint venture between state-run National Development Corporation (NDC), state power utility TANESCO and a privately owned company, Power Pool East Africa Limited.
- IFC to aid expansion of Off Grid Electric (OGE) in Tanzania** - The IFC is providing a new \$4.5 million loan provided through the IFC Cleantech Innovation Facility and an additional \$2.5 million loan from Cordiant Capital of Montreal in Canada to support the innovation of Off Grid Electric, which provides low-cost, clean energy solutions to the millions of people in Africa not connected to the grid. Off Grid Electric has distributed nearly 35,000 solar home systems in the Arusha, Kilimanjaro and Mwanza regions and aims to reach 200,000 households in the country by the end of 2015.
- Tanzania gas pipeline built, plants almost complete** - A 532 km pipeline connecting offshore natural gas fields to Tanzania's commercial capital Dar es Salaam has been completed. A \$1.225 billion Chinese loan is financing this project alongside the ongoing construction of two gas processing plants that are part of the pipeline's infrastructure. Tanzania estimates it has at least 53.28 trillion cubic feet (tcf) of recoverable natural gas reserves off its southern coastline. Discoveries offshore of Tanzania and Mozambique waters have led to predictions of the region becoming the world's third-largest exporter of natural gas. Construction of the land and marine pipeline was expected to cost \$875.7 million while the processing plants were being built at a cost of \$349.6 million.



- AfD–DFID Green Mini-Grids £30-Million Support Facility: Call for Projects** - AfD, cooperating with DFID, are designing a £30 million Capital Support and Transaction Advisory Facility for the Development of Green Mini-grids (GMGs). A Call for projects has been issued to solicit information from mini-grid project developers currently operating or with intentions of operating in Kenya. The information is on the existing and planned projects in Kenya as well as the perceived investments risks or barriers. This could include private sector companies, NGOs, community groups or other stakeholders supporting this sector. To download the Information Form, and for more details, visit <http://eedadvisory.com/resources/news-updates/>.

- **140 MW geothermal plant commissioned** - President Uhuru Kenyatta (Kenya) and President Paul Kagame (Rwanda) inaugurated a 140 MW Olkaria Geothermal Power Plant in Naivasha, Kenya in February 2015. This came about as Kenya's main electricity producer, Kenya Electricity Generating Company Ltd (KenGen's) efforts to upgrade the country's power distribution systems to cut down costs. The commissioning was the last phase of the larger 280MW Olkaria geothermal power project.
- **Kenya and JICA sign Sh8.14 billion (\$89 million) power line deal to link western Kenya and neighbours** - Kenya signs Sh8.14 billion deal to construct a 313-km high-voltage transmission line to connect geothermal power plants to its western region and help link the grid to neighbouring countries. The Kenya Electricity Transmission Company (KETRACO) will kick off the implementation of the Olkaria-Lessos-Kisumu electricity transmission project in April this year. The transmission project shall connect to the Ethiopia-Kenya interconnector which terminates at Suswa substation, via the Olkaria-Suswa project.



- **Total, Tullow, Cnooc Sign Uganda Deal for Oil-Output Use** - The Government of Uganda, home to sub-Saharan Africa's fourth-largest oil reserves, signed a deal with Tullow Oil Plc, Total SA of France and China's Cnooc Ltd. in February 2015 on a refinery and pipeline that may clear the way for start of crude output. Tullow Oil Plc plans to invest \$14 Billion in developing the Uganda Oil fields that the government estimates contain 6.5 billion barrels of oil resources. Crude production may begin as early as 2017 and is expected to reach 200,000 barrels per day by about 2020, according to the World Bank.
- **Russia's RT Global Resources wins contract to build oil refinery in Uganda** - A consortium led by Russian Company RT Global Resources won a contract to build an oil refinery in Uganda. RT Global beat a group led by South Korea's SK Engineering and Construction Co. The project could cost \$4 billion. The Ugandan government is to start negotiations with RT Global on a project that includes a 205-kilometer (127-mile) oil-product pipeline. The winning bidder will hold a 60 percent stake in the 60,000 barrels-a-day refinery, while Uganda has the option of selling part of its 40 percent interest to the neighbouring states of Kenya, Tanzania, Rwanda and Burundi.
- **Alstom receives turbine order for 600 MW Uganda Hydro** - The French manufacturer, Alstom, won a €58 million contract with Chinese company Sinohydro to supply equipment at the 600MW Karuma hydro plant in Uganda. Alstom will provide six 100MW Francis turbine-generator sets and related equipment for the scheme on the Nile, which will provide 40% of Uganda's power once operational. Subsidiary Alstom Hydro China will handle equipment design, manufacturing, supervision on installation, commissioning and testing as well as site services. This is Alstom's third deal with Sinohydro following the Bui hydropower project in Ghana and the Soubre project in Côte d'Ivoire.



- **BBOXX lands \$3m investment to “transform” energy in developing countries** - Clean energy specialist BBOXX has announced a Series B round of \$3m involving private equity firm Bamboo Finance and Dutch eco-fund DOEN Foundation. The company plans to use this latest funding to achieve its vision of providing 20 million people with electricity by 2020. BBOXX have already helped to supply over 50,000 customers in the developing world with rooftop ‘Solar Home Systems’.
- **M-KOPA Solar raises \$12.45m in latest funding round** - Kenyan startup M-KOPA Solar closed its fourth round of investment through a US\$12.45 million equity and debt deal led by LGT Venture Philanthropy in February 2015. The company plans to invest this funding in expanding its product range, growing its operating base in East Africa and licensing its technology to other markets. It has connected more than 150,000 homes in Kenya, Tanzania and Uganda to solar power since launching in 2012.
- **U.K. Green Bank agrees \$298 million of lending to Africa** – The U.K.’s Green Investment Bank and Department of Energy and Climate Change agreed on a 200 million pound (\$298 million) pilot program to invest in low-carbon projects in Africa and India. The money will be channelled into clean-power plants and projects that cut energy waste in East Africa, South Africa and India, the Edinburgh-based bank said in a statement on its website. It aims to lure private capital into the projects.

In the Next Issues of Energy Access Review



- Tracking the grid: A discussion on whether grid-based electrification is still the most cost-effective method of advancing electrification in SSA
- What a potential reduction in the cost of battery storage means for energy access in SSA: A review of leading global initiatives
- Energy sector and the “below 2° C” target
- Plus the regular roundup of news on energy and environment from the region

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