

Distributed Renewable Energy: The Answer to Nigeria's Energy Access Challenge

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Abstract

Nigeria has one of the greatest energy access challenges in the world, with an un-electrified population of 75 million people. Likewise, the cost of the energy access deficit is huge, and is borne by households, businesses and the government. This article emphasizes the need for cheaper, modern sources of energy to improve energy access, boost the economy and reduce government subsidy bills. With the electricity grid unlikely to reach the entire population anytime soon, decentralized renewable energy (DRE) stands out as the best solution in bridging the gap, and ensuring that the entire population gains access to energy as quickly and efficiently as possible.

Keywords: Renewable Energy, Nigeria, Electricity.

Introduction

Nigeria has one of the greatest energy access challenges in the world, with an unelectrified population of 75 million people¹. Decades of policy focus on grid expansion have not only failed to deliver improvements in energy access; they have failed to keep up with population growth. The unelectrified population has grown from 44 million in 1990 - an increase of 70%.

The cost of the energy access deficit is huge, and is borne by households, businesses and the government. For instance, in the 2017 budget, the Federal Government of Nigeria, its agencies, ministries and institutions is expected to spend N8.4bn on the maintenance, fuelling and purchase of new generators for the 2017 fiscal year alone. Out of this budgeted figure is the maintenance of generators amounting to N1.8bn; fuelling amounting to N4.1bn; while the purchase of

new generators will cost N2.5bn². Around 60 million Nigerians use diesel generators³ with households spending as much as N6,660 on kerosene monthly according to the General Household Panel Survey by the NBS and World Bank⁴. In total, an estimated N143.3 billion is spent monthly on kerosene by households in the entire country⁵. Industrial and commercial sectors suffer from a lack of reliable electricity supply combined with the huge costs associated with self-generation. 'Getting electricity' is recognized as a key indicator in the World Bank's 2017 Ease of Doing Business ranking - Nigeria comes 180th out of 190 countries. The cost to the government, in kerosene and diesel subsidies, is also significant with one 2014 estimate suggesting N250 billion is spent on kerosene subsidy alone⁶. The figure for diesel subsidies is likely to be even higher.

¹UN Sustainable Energy for All, Progress Toward Sustainable Energy (2015). ²<http://punchng.com/fg-to-spend-n8-4bn-on-generators-in-2017/> ³BBC. Nigeria: How noisy generators became a way of life (2013). ⁴NBS General Household Survey (Panel) 2012/2013 Wave 2. ⁵Leadership. Nigerians spend more on recharge cards than food (2014). ⁶Vanguard. Kerosene subsidy, tariffs, others frustrate LPG growth (2016). ⁷SolarCity. Island in the sun (2016). ⁸ARENA. Regional Australia's Renewables. ⁹Africa Portal. Workshop on 'Clean Energy Access towards a Sustainable Society in Kenya' (2013).

There is a clear and immediate need for cheaper, modern sources of energy to improve energy access, boost the economy and reduce government subsidy bills. With the electricity grid unlikely to reach the entire population anytime soon, decentralized renewable energy (DRE) stands out as the best solution in bridging the gap, and ensuring that the entire population gains access to energy as quickly and efficiently as possible.

Distributed Renewable Energy

The energy landscape globally is changing rapidly and we are witnessing a seismic shift from fossil fuel electricity generation to renewables. Even more importantly, distributed energy products are increasingly a part of the new energy landscape. A current example of this shift can be seen in the announcement by TESLA, which has recently provided power to the whole of American Samoa using a 1.4MW mini-grid⁷. Similarly, the Australian utilities is ditching the centralized grid in remote areas as renewably-powered captive systems become more cost effective⁸, whilst the Kenyan solar home system market is already saving families \$1 billion a year⁹. These successes in off-grid technologies have led to more interest from investors' year-on-year with the sector raising nearly \$500 million in investment to date¹⁰.

Distributed Renewable Energy (DRE) has already played a major role in improving energy access in Africa. The technologies include pico-solar products (solar lanterns and home systems smaller than 10W), DC solar home systems (usually between 20W – 100W), AC/DC solar home systems (100W to 2kW) and mini-grids. Various business models have been employed to make these technologies easily affordable including

piecemeal purchasing plans, microfinance loans, and most recently the Pay-as-you-go (PAYG) business model. The PAYG can either be on-network (consumers pay via mobile money through a cellular network) such as the Lumos/MTN yellowbox or off-network (consumers paying cash to appointed agents for prepaid voucher/credit/scratch cards) and can be purchased on a short-term rent-to-own plan or a long-term perpetual lease. The increasing efficiency of the system components has reduced the cost of these systems by over 50%. The same pico solar products that cost \$20 in 2010 cost just around \$4 presently¹¹. This highlights their increasing affordability and efficacy over time.

From basic solar lighting to large mini-grids delivering equivalent or more grid power capacity as conventional generators, DRE has provided energy access to over 10 million households. For instance, in the first 3 months of the Solar Nigeria program, 49,000 families and businesses had access to reliable and affordable solar energy¹². According to GOGLA / Lighting Global, sales almost doubled from Jul-Dec 2015 (74,000) to Jan-Jun 2016 (129,000) where almost 130,000 Lighting Global quality-verified¹³ pico-solar products were sold in Nigeria. This market trend signifies huge market potential for DRE technologies in the country. Despite facing serious macro-economic challenges in the last 18 months, most Nigerian renewable energy companies are witnessing increased sales--a testament to the innovation and drive through which they have adopted new business models. This trend is recognized by the Federal Government who recently launched its own National Solar Program by the Nigerian government in early February 2017¹⁴. The program aims to provide electricity to 20,000 households and powering rural homes that cannot be serviced

¹⁰Berkeley Laboratory. Powering a home with just 25 Watts of solar PV (2015). ¹¹GOGLA and Lighting Global. Global Off-Grid Solar Market Report (2016). ¹²Energy Mix Report. Nigeria adds 49,000 solar homes in 3 months (2016). ¹³Since 2009, Lighting Africa and then Lighting Global have managed a quality-assurance programme for pico-solar products, aiming to set a baseline level of quality, durability and to ensure truth-in-advertising to protect consumers ¹⁴Business Day. VP Osibanjo flags off solar power initiative by Azuri. (2017)

by the national grid and is expected to scale through a federally supported financing scheme to several other states over the next eighteen months.

The efficiency of several DRE technologies are improving daily, and prices for the technology has come down drastically. Further improvements in tech and cost reductions are likely. It has also led to significant savings for both the consumer and the government. Majority of Nigerians living off-grid have a daily income of less than \$2 according to GOGLA / Lighting Global. Consumers save an average of \$3.15 on every dollar spent on a pico-solar product in Africa. About \$70 is saved annually for an \$8 solar lighting solution lasting for 3-5 years for a single consumer¹⁵. Businesses have the potential for increased profitability due to extended working hours and savings on diesel/petrol. In Nigeria, over 100 barbers using solar PAYG systems offered by Consistent Energy pay weekly installments of N3000 for 18 months rather than spend N5000 to N8000 weekly on powering their diesel/petrol generators. Governments have also been able to make huge savings from kerosene displacement due to the adoption of DRE technologies such as the Kenyan government household reduction in the use of kerosene for lighting has dropped from 74% to 44% in 10 years¹⁶. Nigeria stands to significantly reduce its over \$1 billion annual expenditure on kerosene subsidy¹⁷ by DRE displacement of kerosene in this potentially huge market.

Manufacturing and Assembly in Africa and Nigeria

The growth of local industrialization recorded in developing countries resulted from the growth of various markets in and outside the

country. In China, the city of Shenzhen moved from a mere fishing village to dominating the electrical components industry globally. With a current population of about 15 million people, its massive Huaqiangbei electronics market is home to every electrical/electronic component and hardware that can be produced¹⁸. The growth of renewable energy and DRE has made the city one of the fastest growing industrial centres for solar components and DRE technology generating millions of dollars in revenue to the country. This growth has had strong government support in terms favourable policies, solar panel subsidies and other incentives with the government declaring the sector one of China's "pillar" industries¹⁹.

In Africa, the growing market for DRE means more and more companies are exploring options for local assembly and manufacturing. In Senegal, Nadji.Bi locally manufactures solar products including solar lighting solutions, phone chargers and solar mini-kits²⁰ in the off-grid solar market while companies such as Ifrisol and NR-Sol in Tunisia manufacture solar PV modules for the on-grid solar market²¹. Similarly in Ethiopia, South Africa, Algeria, Kenya, Morocco, Mozambique, and Ghana, solar manufacturing for the on-grid market is present^{22,23,24}.

In Nigeria, some solar companies and entrepreneurs having recognized the potentially massive market for DRE solutions in the country have commenced local manufacture and assembly of solar products. Solar lighting products have been developed by solar entrepreneurs such as Naura Technologies and presently a solar assembly facility is being built in Kaduna state by Blue Camel Energy, an indigenous solar company,

¹⁵Sunnymoney. Kerosene vs Solar (2017). ¹⁶FSD Kenya. A decade of energy access transformation (2006-2016). ¹⁷Punch Newspapers. Nigeria spent \$1bn on kerosene subsidy in 2015 (2016). ¹⁸The Guardian. Inside Shenzhen: China's Silicon Valley (2014). ¹⁹Zhao, Z., Huang, X., Ye, D., Gentle, P. China's Industrial Policy in Relation to Electronic Manufacturing (2007). ²⁰Nadji.B. (2014). ²¹Infrisol (2017). ²²Clean Leap. Ethiopia's leap towards solar energy (2017). ²³Skyei. First solar panel made in Ethiopia. (2017). ²⁴IRENA. Solar PV in Africa: Costs and Market (2016).

with the potential to train hundreds of people upon operation. However these entrepreneurs face challenges ranging from accessing funds for operation and commercialization to the costs of importing key solar components that are not produced locally. In some cases, the cost of importing whole products can prove cheaper than importing components and assembling locally. Some companies tend to import whole products and assembling with locally made components for their deployment such as iron/steel poles, mounting kit etc.

Subsidies for DRE Manufacturing and Assembly in Nigeria

Considering the tremendous economies of scale achieved by the DRE industry in China, and the infancy of Nigeria's DRE market, subsidizing local production to the point where prices for quality DRE products and services are globally competitive would require huge subsidy. This would place a significant burden on the government looking to exit recession and improve government finances by reducing subsidies in general.

Subsidies also have tremendous potential to distort markets, and run the risk of benefiting businesses involved in subsidized value chains more than end-users, as witnessed with the subsidy on petroleum products in the country²⁴. Financial support or tax incentives for local manufacture of DRE products could give local companies an unfair competitive advantage compared to international companies, making Nigeria a less attractive market for international DRE companies, reducing investment in the sector, and slowing overall market growth.

To maximize the sector's contribution to job creation and overall economic growth, the focus must be on ensuring that as many

people gain access to DRE products – and the cost-savings that DRE brings for households and businesses - as quickly as possible. As the market grows, we can expect in-country assembly and manufacture to emerge organically. The business case for in-country production will be greatly improved when there are tens of millions of customers in the country, as opposed to the hundreds of thousands that exist today.

DRE markets have emerged rapidly in countries where governments have helped to create an enabling environment for market growth to occur. The Government of Nigeria could replicate proven policies, programmes and processes that have helped the market to grow in East Africa, such as:

1. Extending preferential access to foreign exchange for project developers and entrepreneurs in the renewable energy sector.
2. Central Bank of Nigeria support to the Bank of Industry in funding MSMEs through DRE technologies and provision of credit guarantees/de-risking mechanisms for the sector.
3. Raising awareness of the benefits of DRE technologies through 'above the line' media campaigns such as radio, TV, print media etc.
4. Tax incentives such as VAT/tariff exemptions and reduced import duties for importation of quality-assured products and components.
5. Promoting Public/Private Partnership to drive investment and market growth.
6. Limiting the inflow and use of substandard solar products through Customs and the Standards Organization of Nigeria (SON) as well as in the marketplace with public solar projects.

²⁵PV Tech. Inside Ghana's first module manufacturing facility (2016). ²⁶Sun Newspaper. Senate begins N10 trillion fuel subsidy probe (2017). ²⁷UNEP. Lifting the darkness on the price of light (2014). ²⁸Vanguard Newspapers. Remove oil subsidy now, World Bank tells Buhari (2015).

With these measures driving the growth of the DRE market, the viability of an active local DRE manufacturing industry in the country and Africa would be achieved similar to the growth of the telecommunications industry in the country where a huge increase in the market boosted local production of telecommunication equipment and mobile phone accessories in the country.

Potential for Reduction in Government's Fuel Subsidy Bill

According to a UNEP report, half of African countries spend an average of 1.4% of their GDP in yearly fuel subsidies²⁵. Even with this huge expense, just 19% of the subsidized products out of which 33% is subsidized kerosene get to only 40% of the poorest household²⁶. ECOWAS countries are estimated to spend US\$4 billion per year in kerosene subsidies for lighting alone²⁷.

While there have been various calls for the removal of kerosene subsidies in Nigeria, including by the World Bank²⁸; subsidy reduction or removal is challenging. Higher kerosene prices would force poor people to use less kerosene, increasing the use of firewood. According to the UNEP report, there is also the associated political risk where the consumers have become accustomed to kerosene subsidies with the fundamental view of it being a permanent entitlement and could create resistance leading to social unrest and violence. In 2012, the Federal Government removed the subsidy on petrol which immediately led to the massive "Occupy Nigeria" protest, civil disobedience and nationwide strike shutting down all economic activities in the country for a week²⁹. Subsidy removal on kerosene could lead to an even bigger protest especially as it affects the poorer percentage of the population.

Rather than follow this route, government can implement strategies aimed at displacement - promoting DRE products that replace kerosene and diesel. According to Solar Aid, a British NGO, a basic \$8 solar light can replace a kerosene lamp, pay for itself in 12 weeks and last for 5 years. 2.7, 2.5 and 2.0 million households in Kenya, Tanzania, Ethiopia use pico-solar products with the trend gradually growing in Nigeria with 300,000 households as at June 2015x. With increased public awareness of these technologies, government would not only reduce kerosene demand but improve energy access especially as non-subsidized DRE technologies are cheaper than subsidized kerosene. Key alternatives with the greatest potential for kerosene displacement include:

1. Clean Cookstoves

Nigeria consumes million liters of kerosene daily. Also, according to the Global Alliance for Clean Cookstove, 75% of Nigerians use solid fuel for cooking and 126 million of the population are affected by Household Air Pollution (HAP) which has led to 70,000 premature deaths annually^{xxx1}. The deployment of clean cook-stove technologies has the potential to create significant savings both for the consumer and government in expenses on cooking fuel and can save up to 80% of fuel wood usages^{xxx}. Clean Cookstoves are designed to reduce or eliminate the use of solid fuels such as firewood and other forms of biomass thereby improving efficiency, preventing household air pollution (HAP) and facilitating cleaner household cooking^{xxx}. However the challenge of changing the deeply embedded and distinct cooking³⁰ practice of various communities and regions of the country would require significant and consistent effort over the long term basis. In the short term,

²⁵Vanguard Newspapers. 12 killed a subsidy protests turn bloody (2012). ³⁰Solar Aid. Solar Aid Store. ³¹GACC. Nigeria (2016).

³²Vanguard. Nigeria consumed 250,000 tonnes of LPG in 2013-PPMC (2014). ³³Business News. NLNG's subsidy on cooking gas hits \$50m (2014).

LPG subsidy and DRE technology promotion both offer cleaner and quicker ways to reduce the kerosene and diesel subsidy bill and reduce the impact of fossil fuel and ensures better climate governance.

2. LPG Subsidy

Liquefied petroleum gas (LPG) is a cleaner and better alternative to kerosene. In 2013, just 250,000 tons of LPG was consumed out of 850,000 tons reserved for domestic consumption according to the Pipelines and Products Marketing Company (PPMC)^{xxxiii}. Consumption figure stood at 1.8kg, far below the West African regional consumption average of 3.5kg³¹. Key challenges with the growth in LPG consumption in the country include issues surrounding the insufficient number of coastal LPG terminals, few LPG inland storage facilities, challenges in the distribution system, and initial costs associated with the acquisition of cylinders and LPG stove³².

Currently the Nigeria Liquefied Natural Gas Limited (NLNG) has spent \$50 million between 2007 and 2014 in LPG subsidy³³. Government could further re-direct kerosene subsidies towards improving affordability and demand for LPG. Indonesia successfully eliminated kerosene subsidies within a few years by channeling subsidy towards LPG, which led to a huge shift to LPG as the main cooking fuel. The Indonesian Government was able to save billions of dollars while significantly reducing cooking costs for low income households³⁴.

However with its existing challenges, this would require a longer term approach while also considering the fact that this would tend to benefit urban areas more than the rural areas unless the subsidy is designed such as to make LPG comparative in cost to kerosene.

3. DRE Technologies

DRE is the best alternative both in terms of cost, potential to scale rapidly, socio-economic impact, improved energy access and the ability to displace kerosene in the short term while achieving government and consumer savings. A recent Solar Aid research shows that one basic solar light replaces a kerosene lampⁱ. On average 2-3 solar lights is enough to prevent a household using kerosene for lighting entirely^j. As the Solar Aid research further shows, 100,000 solar lights sold displaces 100,000 kerosene lamps and equals £14,513,029 (\$17,756,062) in savings for consumers throughout the life span of the solar lights³⁵. With the growing deployment of DRE technologies, an equivalent reduction in the use of kerosene in the country occurs especially as non-subsidised DRE technologies are cheaper and more efficient than kerosene. With a grid tied power plant project taking an average of nine years to complete and just weeks or months for DRE technologies³⁶, DRE's potential to scale increasing energy access and reducing expenses on dirtier fuels is immense. With increasing grid tariffs, the use of DRE also leads to cost-savings for consumer while reducing the need for tariff subsidies.

Conclusion

The growth of DRE in Nigeria will potentially lead to huge savings, significant job creation, economic growth and development outcomes. Households have the potential to reduce their fuel expenses from the use of cheaper and more efficient DRE technologies, businesses will save from reduced expenses on electricity generation and increased profitability, while the government will save from reduced expense on kerosene subsidies through displacement rather than unilateral subsidy reduction. With

³⁴Budya & Arofat. Providing cleaner energy access in Indonesia through megaproject of kerosene conversion to LPG (2011). ³⁵Solar Aid. Impact Calculator. ³⁶Power For All. Factsheet: A faster road to energy access (2016).

the growth of the market, local assembly and manufacturing will emerge, boost local growth and lead to increased job creation.

As the country looks to tackle its energy deficit and meet future energy demand, DRE is the most promising solution to achieving this within the short term while the long-term adoption of LPG and clean cook-stoves also has tremendous potential to further reduce the demand for subsidized fuel products.

References

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