IDSA Occasional Paper No. 43

Enhancing Energy Security in Rural Tanzania

Examples of Decentralized Rural Energy Approaches from India

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Introduction and Context

Access to energy is considered to play a vital role in poverty reduction by providing cross-cutting services that are required by all sectors of the economy in any country. However, the large share of biomass in the energy mix of Tanzania (about 90 per cent of the total national energy consumption) suggests that this consumption is unsustainable and is exerting pressure on the already depleted forest resources of the country. Despite being classified as a renewable energy source, biomass is by no means good for the environment or the fight against climate change. Typically, 10 to 12 tons of wood are used to produce one ton of charcoal in the traditional kiln in Tanzania, thereby requiring 342.5 hectares of forest daily.[1] As such, biofuel burning contributes significantly to climate change leading to rise in greenhouse gas emissions as well as carbon leakage that is caused by deforestation. It is estimated that over 300,000 rural families depend on charcoal production and sales for their primary source of income.[2] This makes rural earnings from charcoal greater than those from coffee, tea, cotton, sugar, cashews or horticultural crops.[3] By contributing to a significant rate of deforestation and degradation, as well as climate change and global warming, overdependence on wood fuel and charcoal poses a threat on energy security as well as socio-economic stability of communities over time. With overreliance on income generation from charcoal production amid deforestation and climate change, rural producers and urban sellers are likely to gradually run out of work. Similarly, the increasing rural and urban population who are largely reliant on wood fuel and charcoal will suffer severely as the energy source begins to deplete amid their unpreparedness to adapt to alternative energy sources such as biogas,

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1. Romanus Ishengoma. Biomass Energy in Tanzania. Faculty of Forestry and Nature Conservation, Sokoine University of Agriculture - Morogoro (2013).
2. Ibid.
3. Ibid.

micro-hydro and solar. Therefore, if left unaddressed, overdependence on wood fuel and charcoal poses great energy insecurity to most rural and urban households, and even to businesses that rely on these energy sources. Worse still, the biomass sector of Tanzania is informal, almost completely unregulated, and easily accessible by whoever wishes to partake in it. While significant changes need to be introduced to improve the regularization and legalization of this sector, those who are currently participating wish to circumvent regulation and taxation. Though challenges will always prevail because of the economic lucrativeness of the sector in the face of dire poverty levels in the country, another key area for immediate action should be to seriously consider alternative sources of energy, particularly by scaling-up renewable energy production. It is very important that rural populations are deliberately and adequately drawn on board in these developments.

Fortunately, Tanzania has an abundance of diverse energy resources of different forms such as biomass, natural gas, hydro, coal, geothermal, solar, wind, and uranium -but much of these are untapped. Renewable energy (save for large hydro) accounts for only about 5 per cent of generation capacity in the country.[4] The government targeted for this share of the energy mix to reach 14 per cent (complemented by 26 per cent large hydro) by 2015.[5] The current potential of sustainable energy production, can be categorized into large- and medium-scale as well as small-scale renewable energy systems.[6] The large- and medium-scale systems include co-generation systems (e.g., sugar and sisal industries), geothermal energy systems, large hydro power systems, and thermal power systems. However, most of these systems supply electricity to urban and semi-urban areas by feeding electricity into national grids that serve only a small fraction of the population. The small-scale systems include solar energy

4. Ministry of Energy and Minerals (MEM) (of the United Republic of Tanzania). Scaling-Up Renewable Energy Programme: Investment Plan for Tanzania, available at https://mem.go.tz/ (Accessed October 6, 2014) (2013).
5. Ibid.
6. Mary Swai. Energy Sector, Opportunities and Challenges to Attain Sustainable Energy. Tanzania Traditional Energy Development Organization (TaTEDO), Dar es Salaam (2014).

systems [*photovoltaics (*PVs), phone chargers, etc.], energy service platforms (i.e., biofuel powered systems), small hydro systems (i.e., Pico, micro and small hydro), and biomass energy systems (e.g., improved cook-stoves, biogas, ovens, etc.). These decentralized renewable energy systems can be used in rural and urban areas due to their affordability, replicability and ability to support the majority of the population.

At present, access to electricity is still restricted to the more urban areas of the country. The rural population is largely detached from the national grid and, even in the areas that are served by the grid, a large number of people cannot either afford a grid connection or are severely inconvenienced by erratic supply. Tanzania produces most of its electricity from clean hydropower, which in turn often gets affected by shortages of runoff that are linked to the consequences of climate change. Although large-scale investments may make more economic sense, they typically cater to the energy needs of urban populations who already have access to energy, even if it is sporadic and not massively distributed. Small-scale energy projects, on the other hand, reach a majority of rural populations who are currently going without access to electricity. These projects also reduce the number of large players, such as big energy companies and insurance corporations, making it easier to implement and produce quick results.

In essence, therefore, off-grid renewable forms of energy like solar, biogas and micro-hydro should not only increase rural access to energy but also reduce the share of fossil fuel and traditional fuel consumption in the country. The residential sector consumes most of the energy in Tanzania supplied by a mix of biomass, electricity and petroleum. As developing countries transition towards low carbon economies, the Government of Tanzania is also taking a difficult decision about how it should scale up its renewable energy sector. A substantial part of these efforts is clearly evidenced in preparation of the Scaling-up Renewable Energy Programme (SREP) Project initiative in 2013 that promotes clean energy for domestic end-uses like cooking and lighting, with a commendable consideration to rural residents. In addition to on-grid small hydropower projects, the government has also focused on off-grid mini- and micro-hydro and mini-grid solar PV projects that are aligned with the country's SREP Project. Renewable energy and energy efficiency projects directed at the level of household, such as biomass and improved cooking stoves, will also help

in reducing poverty and contributing to Millennium Development Goals. This is because such projects will increase income-generating activities, education, gender equality, environmental quality and health in the rural and semi-urban areas of Tanzania. Such achievements would be synonymous with the overall goal of the government of making electricity available for economic and social growth of all citizens.

One of the SREP Project's spectacular features is its particular consideration to scale up rural electrification. Interestingly, it recognizes the private sector as being the lynchpin for scaling up renewable energy investments. It also identifies numerous challenges that are constraining the key players from achieving a successful performance, such as lack of electricity culture among the rural residents and their uneven population distribution. The government is also cognizant of the fact that leveraging finance from the private sector in off-grid projects requires justifying their commercial viability, which is usually difficult given the small size of rural economies. These are some of the challenges threatening the national goal of providing stable and sustainable energy to rural areas where about three-quarters of the population resides. In the process, these challenges are also limiting the achievements of poverty alleviation and sustainable development. Even worse, the government seems to condone, and mistakenly so, the power and ability of rural communities to come together and conceptualize localized solutions to their problems. Efforts to electrify rural Tanzania, as postulated in the SREP Project, do not recognize that local communities can play an active role in developing, operating and managing low-cost renewable energy projects. Their ability to do so is overlooked at policy and institutional levels, thereby risking rural communities' access to stable and sustainable forms of energy generation by denying them the assistance they deserve. The government is probably devoid of examples of community-driven small-scale renewable energy initiatives and projects that are happening in other developing countries.

India and other South Asian countries offer a critical testimony that rural development is prominently improved by the availability of decent lighting, water pumping/irrigation, refrigeration and audio-visual/communication tools. Communities have used a variety of energy sources to cater for their development needs. Some communities use petrol or diesel generators, but these are associated with noise, large maintenance costs,

and environmental destruction. Cleaner, cheaper and technically viable renewable forms of power generation are gaining a prominent application. Solar power is highly used, though other forms, such as wind and water power, are increasingly becoming common. Rural communities of other developing countries are increasingly enjoying these forms of energy at domestic, commercial, industrial and institutional levels. Those in Tanzania remain isolated from this type of rural prosperity, thereby missing the opportunity to unlock their economic potentials.

This paper inventories several examples of community participation (decentralization) in power generation projects in rural India, and a few additional examples from Nepal and Bangladesh. Drawing from these examples, this paper argues that decentralized electrification without local participation is unlikely to yield the desired nation-wide impact in Tanzania, especially for the rural communities. The aim is provide evidence-based recommendations to augment the on-going efforts by the government towards enhancing energy security in rural Tanzania. Such projects are typically small-scale, intended to provide basic energy services to rural households as well as social and economic investments. Ranging from, but not limited to, biogas, improved cooking stoves, micro-hydropower, solar, and improved water mills projects, they play a critical role is reducing poverty as well as enhancing rural livelihoods, health, and education. They are customarily rooted deep within the grassroots level and vested on community-based solutions, thereby typically owned by communities and contributing to sustainable development.

Energy Situation in Tanzania

Energy supply, consumption and demand

Tanzania's per capita electricity consumption is very low. MEM (2013) estimates this consumption to be under 100 kWh per year; that is, 20 times less than the world average annual consumption and more than 5 times less than that for Sub-Saharan African developing countries. About 31 per cent of the Mainland Tanzanian population has access to grid electricity, of which seven per cent is in rural areas.[7] To realize the preferred socio-economic transformation, the government is working towards increasing connection levels to 30 per cent by 2015, 50 per cent by 2025 and more than 75 per cent by 2033.[8] This makes taping into renewable energy generation sources a necessary action, accompanied with deliberate efforts to ameliorate the electricity situation in rural Tanzania.

Biomass is a dominant source of energy in Tanzania. Biomass (mainly fuel wood and charcoal) accounts for about 90 per cent of the total national energy consumption, whereby commercial energy sources (i.e., petroleum and electricity) account for about eight per cent and 1.2 per cent respectively of the primary energy used, as coal, solar and wind account for less than one per cent of energy used.[9] The residential sector is the most dominant consumer of energy (73 per cent), followed by the industry sector (14 per cent).[10] Figure 1 shows the current consumption rate of energy in Tanzania.

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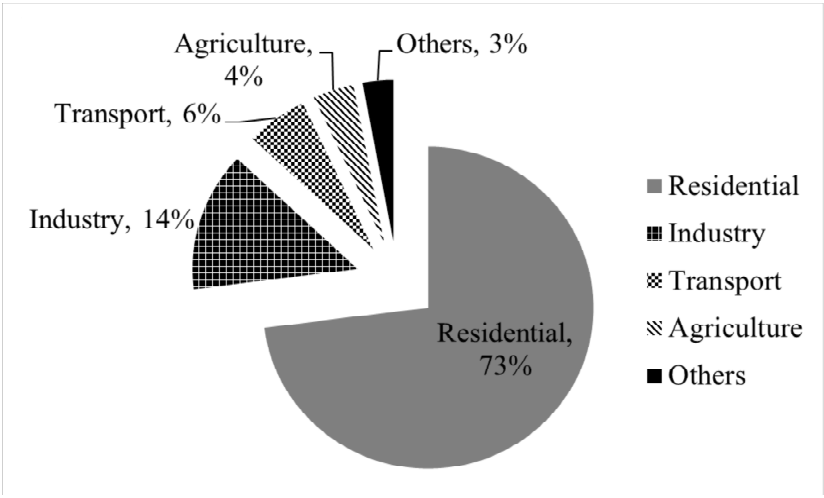
7. Ministry of Energy and Minerals (of the United Republic of Tanzania). Tanzania Electricity Supply Industry Reform Strategy and Roadmap 2014/15, available at https://mem.go.tz/wp-content/uploads/2014/02/0001_17022013_National_Energy_Policy_2003.pdf (Accessed October 4, 2014) (2014).
8. Ibid.
9. Ibid.
10. Mary Swai, no. 6.

Figure 1. Energy Consumption in Tanzania



Source: Swai, M. Energy Sector, Opportunities and Challenges to Attain Sustainable Energy. Tanzania Traditional Energy Development Organization (TaTEDO), Dar es Salaam (2014).

Fuel wood is the major source of domestic energy in rural areas where more than 70 per cent of the Tanzanian population resides. It is also a significant source of domestic energy in semi-urban areas, used in households, schools, hospitals, bakeries, etc. Notably, that some industries in Tanzania, such as the 21st Century Textiles of Morogoro, have shifted from using electricity to using fuel wood.[11]

Charcoal is a massive industry, whereby more than one million tons of charcoal is consumed annually in Tanzania (half in Dar es Salaam).[12] Some 28,000 bags (each weighing 60-80kg) are delivered into Dar es Salaam every day.[13] Many people, especially the increasing urban population, use charcoal because it is readily available and relatively cheap. Electricity, on

11. Romanus Ishengoma, no. 1.
12. Ibid.
13. Ibid.

the other hand, is considerably expensive for most of the domestic chores (especially cooking) and it is characterized by limited and unstable supply.

The government recognizes that consumption of biomass causes substantial environmental and health consequences, with a significant gender dimension. Exposure to indoor air pollution (IAP) resulting from the incomplete combustion of biomass cooking smoke has been linked to numerous respiratory diseases.[14] At least half a million people die each year in Sub-Saharan Africa alone due to IAP-related health problems.[15] These health impacts are disproportionally prevalent among women owing to their traditional roles inside the home and communities.

Meanwhile, demand for electricity is increasing rapidly as a result of accelerating productive investments, a growing population, and improving access.[16] A significant part of this demand is met, in part, by private diesel generators. The Power System Master Plan 2012 Update (PSMP) (2010-35) projects that Tanzania's electricity supply will rise from 18 per cent in 2013 to at least 75 per cent by 2035, whilst demand from connected customers will increase significantly as Tanzania reaches middle-income status as stipulated in the Tanzania National Development Vision 2025.[17] However, the increase in demand for electricity has, thus far, been confronted by several prevailing challenges. Some of the power sector challenges include unreliable energy supplies, poor quality of supply, reliance on imported petroleum products (costing the country about 30 per cent of its foreign currency earnings), escalating local and world prices, low energy security characterized by high electricity loses (21-23 per cent), and reliance on traditional biomass.[18] These challenges threaten achievement of the middle income status and transitioning Tanzania to an industry-

14. Ministry of Energy and Minerals (MEM), no. 4.

15. Ibid.

16. Ibid.

17. Ibid.

18. Christian Matyelele Msyani. C. M. Current Status of Energy Sector in Tanzania: Executive Exchange on Developing an Ancillary Service Market, available at http://www.usea.org (Accessed October 12, 2014) (2013).

based economy by 2025 as premeditated in its Development Vision 2025. Also, Tanzania's overdependence on hydropower energy whose energy cannot be ascertained in times of drought has severe implications on its energy sector. According to Msyani, the effects of droughts faced during 1992/1993, 2005/2006, 2009/2010, 2010/2011 and 2011/2012 led to reduced reserve capacity of reservoirs, curtailed loads (e.g., in 2012 unsaved energy was 66.3 GWh), and caused high frequency of power outages.

The government recognizes that diversification of generation sources is necessary to sidestep the risk of supply disruptions and price increases, particularly amid the increasingly unpredictable hydroelectric power caused by changing weather patterns. This problem is aggravated by having most hydropower sources located along two river systems that are now at the risk of drying. This situation has caused extensive load shedding and running expensive thermal power plants as base load.[19] As an immediate solution, the government intends to add a significant thermal capacity, mainly from natural gas, so as to address current and impending power shortages up to 2016.[20]

Highlight of the key characteristics of the energy sector in Tanzania:

- Growth in power demand is 10-15 per cent per annum.
- The highest energy demand stands at 16.9 GWh/day.
- Total existing generation capacity is 1,431MW [the overall development from 2013 has increased only 65MW (37 per cent) out of the expected 175MW].
- The annual energy consumption for the country is 5,740.84GWh (2012).
- Large consumption of biomass in residential sector is caused by affordability and location of a large part of population (more than 70 per cent) in the rural areas.

19. Ministry of Energy and Minerals (MEM), no. 4.

20. Ibid.

- Maximum number of connections per annum achieved is 90,000.
- Total number of customers by 2013 was 1,032,000.
- The Tanzania Electric Supply Company Ltd. (TANESCO) currently operates with a target of 250,000 grid connections per annum.
- The current unconstrained peak demand Stands at 950 - 1,000MW.
- Due to recent recurring droughts (2010, 2011 and 2012) - recorded suppressed peak demand is 851.35MW (October 2012).
- Efforts of the government are currently directed towards expanding electricity generation and revising policies. On-going efforts undertaken by MEM include:
    - Revising Policies and Strategies (the energy policy, liquid biofuel policy, gas policy, biomass energy strategy, Petroleum Policy and will be followed by geo-thermal strategy, renewable energy policy and rural energy strategy).
    - Big Results Now (BRN) programme will develop 29 large infrastructure projects mainly for electricity and gas.
- Some of the on-going projects in the energy sector are :
    - Power generation projects ($\sum$11010 MW).
    - Power transmission projects.
- Renewable energy to be scaled up (i.e., geothermal, mini-grids and off-grid electrification).
- The target is to attain access by 50 per cent of the population by year 2020.

Sources: Swai, M. Energy Sector, Opportunities and Challenges to Attain Sustainable Energy. Tanzania Traditional Energy Development Organization (TaTEDO), Dar es Salaam, (2014) & and Msyani. C. M. Current Status of Energy Sector in Tanzania: Executive Exchange on Developing an Ancillary Service Market, available at http: / /www.usea.org (Accessed October 12, 2014) (2013).

Obstacles for access to electricity and electricity penetration

As stated in the preceding sections, access to electricity and electricity penetration in Tanzania are significantly low. It is expensive to extend the national grid and expand the distribution system due to scarcity of financial resources from the government.[21] A strenuous lack of foreign currency is particularly accountable for the low rate of electricity penetration in Tanzania. Obstacles limiting access to energy services in Tanzania are categorized into policy and institutional, technical, and energy resources.[22] Some of these obstacles include:

Policy and Institutional

- Lack of sufficient resources to implement national energy policy and facilitate greater access to modern energy services.
- Inadequate local institutional framework for facilitating energy access for the majority.
- Low participation of the private sector and communities in planning and implementation of energy access initiatives.
- Supporting systems for developing modern energy services are centralised in Dar es Salaam.
- The focus of the country has for long been on mega electricity and gas infrastructure projects and not energy for poor.

Technical

- Energy illiteracy is a drawback for energy technology adoption as there is no adequate knowledge to appreciate the benefits, costs, sustainability and risks of energy.
- Inadequate capacity in the country and at the local level to exploit existing energy resources.

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21. Christian Matyelele Msyani, no. 18.
22. Mary Swai, no. 6.

- Limited technical, financial and delivery mechanisms.
- Multiple risks in developing sustainable energy projects in Tanzania, including off-taker risk, currency risks, and resource uncertainty.
- Limited expertise in undertaking feasibility studies, detailed design, and construction of energy projects.
- Lack of capacity to produce energy equipment and spare parts, hence high costs of foreign expertise and equipment.

Energy Resources

- Biomass resource extraction from the forest is virtually unregulated, which leads to unsustainable harvesting of fuel wood and charcoal.
- Extraction enforcement is lacking in forests, thereby making forests easily accessible and providing low or no-cost fuel wood supplies.
- The informal nature and low incomes of the biomass energy makes it difficult to access capital for improving its production and reduce consumption by using more efficient devices.

Scaling-up Renewable Energy Programme (SREP)

Electricity needs to be made available for economic activities in rural areas, rural townships and commercial centres. Rural electrification is, therefore, a case of long-term national interest and a prerequisite for a balanced socio-economic growth for all in Tanzania.[23]

Tanzania is among the pilot countries benefitting from the Scaling-Up Renewable Energy Programme (SREP) in developing countries.[24] The SREP Project, which operates under the Strategic Climate Fund, as a part of the Climate Investment Funds (CIF), aims to demonstrate the economic, social, and environmental viability of a low-carbon development pathway by creating new economic opportunities and increasing energy access through the production and use of renewable energy. The selection of Tanzania as one of the pilot countries was based on the critical, far-reaching energy-related challenges facing the country combined with efforts already undertaken by the government to address them. Critical challenges include a climate change-induced energy crisis, high rate of energy poverty, high population and economic growth, rapidly increasing energy demand, and diverse and abundant renewable energy resources that remain largely untapped. The government has aligned the SREP Project with its strategy for renewable energy development, as specified in the Tanzania National Development Vision 2025, the National Energy Policy of 2003, and the National Strategy for Economic Growth and Reduction of Poverty, along with the key principles of the National Climate Change Strategy. The SREP Project employs an outcome-based, programmatic approach to scale up renewable energy.

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23. Ministry of Energy and Minerals (MEM) (of the United Republic of Tanzania). The National Energy Policy, available at https://mem.go.tz/ (Accessed October 1, 2014) (2003).

24. Ministry of Energy and Minerals (MEM), no. 4.

SREP Objectives

The government envisages SREP scaling up the deployment of renewable energy to transform the country's energy sector, primarily the electricity subsector, from one that is increasingly fossil-fuel dependent to one that uses a more balanced supply of diverse energy sources.[25] Achieving this goal will help Tanzania move along a low-carbon development pathway, increase energy security, generate new economic opportunities, and widen access to energy services.

In accordance with SREP modalities, the government plans to achieve this goal through an integrated approach that includes investments in renewable energies, particularly the infrastructure needed for their production and distribution; stakeholder capacity building; integration with dynamic public-private partnerships (PPPs); and provision of adequate technical-assistance services.[26] MEM narrates further that SREP will support appropriate actions for consolidating or upgrading sector policy and strategic and regulatory frameworks, and will encourage the dissemination and use of renewable energies in the country. This integrated programme approach assumes that transformational change is only made possible by improving energy market conditions and financing, as well as creating specific conditions for gaining the confidence of investors, whether small-, medium-, or large-scale enterprises, public or private entities, or national or international businesses.[27] The government is confident that these conditions are necessary for replication and scaling up of public and private investments in renewable energy. It envisions SREP to play a key role in cutting across the social, economic and environmental aspects in the context of Tanzania through:

- Reducing the exploitation of non-renewable energy sources by increasing the share of renewable energy in the national energy mix.
- Reducing greenhouse gas emissions due to the use of fossil fuels.

25. Ibid.
26. Ibid.
27. Ibid.

- Maximising economic development opportunities, including to create new economic activities and jobs related to new technologies with private sector participation.
- Improving rural people's quality of life through household and institutional access to electricity.
- Improving gender equality.

Also the government envisages the following outcomes from implementing SREP:

- Improved access and reliability of the electricity services used by Tanzania's rural and urban populations.
- Increased supply of electricity from renewable energies and scaling up innovative energy delivery solutions.
- Substantive and substantial private sector participation in all aspects of renewable-energy project development and in investing and operating renewable energy projects.
- Increased gender-equitable access to renewable energy by rural and urban populations.
- Creation of jobs related to the adoption of renewable energy for women and men in the targeted areas.
- Improved enabling environment through optimization of the legal and regulatory framework and increased capacity of relevant government authorities to carry out negotiations with the private sector.
- Additional financial resources leveraged and appropriate financial instruments utilised for renewable energy projects.
- Reduced greenhouse gas emissions compared to the business-as-usual option.

SREP Investment Projects

The SREP-Tanzania Investment Programme constitutes two different but related investment projects with a combined generation potential of about 147 MW. They include:

A. Geothermal Power Development Project

The aims of this project are to: (i) catalyse the development, mainly by the private sector, of low-cost and reliable geothermal power by removing uncertainties of the resource so as to contribute significantly to Tanzania's electric power, and (ii) establish an enabling environment for large-scale geothermal development through establishing the legal and regulatory framework, capacity building, and risk mitigation.[28] The expected project outcome is a PPP project that has successfully developed, constructed, and commissioned the operation and maintenance of about 100 MW of geothermal power, supplying about 700 GWh per year to the national grid. Total avoided greenhouse gas emissions from this project are estimated at 555,590 tons CO2eq. The scope of this paper limits a further analysis of this project.

B. Renewable Energy for Rural Electrification (RERE) Project

The government is cognizant of the fact that a vast majority of Tanzania's rural population (three-quarters of all residents in the country) are off-grid. It has, therefore, committed to an aggressive rural electrification programme so as to ensure inclusiveness of the rural population by supporting equitable rural development and improving the rural economy and quality of life. The RERE Project aims to (i) build an efficient and responsive development infrastructure for renewable energy-based rural electrification, and (ii) demonstrate its effectiveness by supporting a time-slice of private-sector investments in off-grid electricity enterprises.[29] The government's target is to extend electricity service generated from renewable energy to some 400,000 households or approximately 2 million off-grid rural customers (assuming 4.9 persons per household) through mini and micro-grids and sustainable solar market packages (SSMPs).[30]

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28. Ibid.
29. Ibid.
30. Ibid.

The project will offer transaction advisory services, financing, and risk mitigation for 25 renewable-energy mini-grids and 50 micro-grids to directly benefit an estimated 47,500 households and 10 SSMP projects to directly benefit an estimated 70,000 households.[31] Also, the project will provide transaction advisory services to prepare a pipeline of 250 mini-grids and micro-grids and another 30 SSMPs to benefit 325,000 households, for which the government will seek additional financing outside of the SREP.[32] Total avoided greenhouse gas emissions from this project are estimated at 141,755 tons CO2eq.[33]

Through SREP, the government anticipates that a number of renewable energy technologies will be used to meet electricity needs, depending on the renewable sources available in the particular locality and community characteristics. The government will use a combination of grid extension, mini- and micro-grids, and stand-alone PV systems. Its preliminary investigation, which has mapped the population distribution in relation to the medium-voltage grid network and characterised it by density, has identified those groups best served by extension of the TANESCO grid, mini-grids, and solar PV micro-grids and stand-alone systems. The mini-grids could be run by a range of renewable energy sources, such as small hydro, biomass, biogas, solar, and wind. In certain locations, hybrid solutions [including the use of batteries and small amounts of diesel (e.g., to generate 10-15 per cent of electricity)] may be used to provide the required levels of availability at least cost. Micro-grids and SSMP stand-alone systems will primarily use solar PV.

But the government is concerned that rural electrification is more challenging than providing electricity to urban areas. That, even though it affects many more people, it comes at a high cost (whether grid or off-grid) because of low population densities and widely dispersed settlements, and rural people are least able to afford it.[34] However, the government has identified a key solution to this, which is to develop an investment plan for the least-

31. Ibid.

32. Ibid.

33. Ibid.

34. Ibid.

cost grid electrification roll-out, and identify those load centres and geographic areas for which off-grid electrification is the least cost option.[35] Apparently, as the Rural Electrification Investment Prospectus reveals, about 46 per cent of rural residents live close to the grid, 20 per cent far from it but in high-density population areas, and 33 per cent far away in low-density settlements.[36]

SREP's Approach to RERE and related challenges

The Rural Electrification Investment Prospectus estimates that nearly half the rural population can possibly be more cost-effectively served by mini-grids and off-grid options.[37] Twenty percent could benefit from renewable energy mini-grids and 32 per cent from stand-alone and micro-grid solar PV.[38]

The government identifies a range of key players in its approach to implement the RERE Project. However, local communities are not part of these key players. Those identified include, for example, the government itself as the overall lead agency, donor community (especially the World Bank Group and the International Finance Corporation), and the private sector (mainly direct investors, but also banks). Of these, however, leveraging of private-sector investments is at the core of the RERE Project. In fact, the SREP's objectives are directed to overcoming economic and non-economic barriers that hinder scaling up of private-sector investment in renewable energy markets. Also, the current regulatory regime enables the government to encourage private and non-governmental developers to invest in off-grid energy solutions to supply electricity directly to retail customers, TANESCO, or both. This way, the government plays a complementing role, rather than crowding out the private-sector potential. To enable the private sector to perform successfully, the government has identified the key barriers to investments and is aggressively committed to

35. Ibid.

36. Ibid.

37. Ibid.

38. Ibid.

addressing them. The government will specifically set up a world-class Transaction Advisory Services Facility, spearhead investments, develop instruments for risk mitigation, build capacity of the key players, and undertake programme management role.

The RERE Project will build on the TEDAP project, as well as other relevant REA and donor initiatives developed in Tanzania (e.g., the AFREA-financed Lighting Rural Tanzania, SIDA-financed solar PV market development activities, and the European Union's support to mini-grids). Based on the lessons learned from these activities (see Annex IV for the TEDAP project lessons), the REA is proposing a set of components that will (i) scale-up successful instruments, including a credit line and performance grants and (ii) develop new instruments to target the remaining barriers.

It is expected that scaling up existing instruments will be financed primarily by the proposed World Bank Group (WBG) and other donor co-financing, as both the credit line and performance grants are relatively well developed and tested and fit well into the WBG and donor energy-sector assistance plans. SREP funding will focus on addressing the remaining market barriers in order to act as a vehicle for market transformation.

Source: Ministry of Energy and Minerals (MEM) (of the United Republic of Tanzania), Scaling-Up Renewable Energy Programme: Investment Plan for Tanzania, available at https://mem.go.tz/ (Accessed October 6, 2014) (2013, p. 70).

Meanwhile, the government acknowledges that the rapid deployment of mini-grids is constrained by several factors[39], including:

- Inefficient and costly project preparation (related to the excessive costs and time associated with developing viable, scale-able mini-grid projects and business models, hence risking achievement of Tanzania's 2025 development goals).

39. Ibid.

- Off-take risk (whilst regulations in Tanzania permit mini-grid service providers to supply electricity to retail customers with a cost-reflective tariff, retail tariff collection is perceived as risky, as the mini-grid model is relatively new and the rural-customer payment culture is still untested).
- Administrative problems (neither the regulatory nor bureaucratic environment is optimised to make it easier for developers to secure all the rights and permits needed to develop a site).
- Limited investment capital at a high cost (typically, mini-grids are developed and run by small companies whose cost of capital is higher than that of larger companies, including TANESCO. The mini-grids space, while growing quickly, remains nascent; and, as with most SMEs, lending institutions are cautious about providing capital to businesses without a strong operational track record).

Also, like mini-grid service providers, operators of stand-alone solar PV systems are constrained by difficulties of payment collection from customers and access to financing.[40] They also face some distinctive challenges related to the high cost of doing business due to the remote and dispersed nature of customers, difficulty of assuring and supplying quality products (e.g., there may be competition from unscrupulous vendors who pass off poor-quality products at low prices), and the challenge of retaining trained staff in remote areas.[41]

However, numerous development partners are working with the Rural Energy Agency (REA) and other government agencies to overcome these constraints through capacity building, awareness-raising activities, innovative financing, and more suitable business models.

For example, the Sustainable Solar Market Package (SSMP) model, supported by TEDAP, aims at overcoming some of these challenges through (i) bundling provision of larger institutional systems with marketing of smaller ones for households in the same geographic

40. Ibid.

41. Ibid.

area, thereby exploiting economies of scale and reducing costs of service provision; (ii) linking the subsidy payment to products that comply with technical specifications and quality criteria, and (iii) providing incentives for the private sector to develop innovative credit / payment schemes that would make solar home systems (SHSs) more affordable for households. However, the model is relatively new, requiring continued monitoring, fine-tuning, and capacity building to achieve its full potential.

Source: Ministry of Energy and Minerals (MEM) (of the United Republic of Tanzania), Scaling-Up Renewable Energy Programme: Investment Plan for Tanzania, available at https: / / mem.go.tz / (Accessed October 6, 2014) (2013, p. 68).

The challenges noted in the section above are, however, not new to rural electrification efforts in developing countries. And, much as the government is working to address them, numerous other countries have already found practical solutions. One key strategy is to recognize the substantial role that rural communities themselves can play in localizing solutions to their own problems. Neglecting the role of rural people (who constitute at least 70 per cent of the country's population) in resolving their electricity problems is, on its own right, a challenge that the government fails to detect. Tanzania can, indeed, emulate great lessons from other developing countries - e.g., India, Nepal and Bangladesh - in achieving rural electrification by enabling and supporting rural communities to develop, operate and maintain their own small-scale renewable energy projects. The following section elaborates the crucial role that rural communities can play in this regard.

Bridging the Gap - Examples of Decentralized Rural Energy Approaches from India

The Kyoto Protocol has set quantifiable emission reduction targets for developed countries (included in Annex I of the Framework Convention). It largely promotes the use of clean technologies that not only reduce greenhouse gas emissions but also contribute towards sustainable development. Greenhouse gas emissions from Tanzania are insignificant. However, in the face of its rapid economic growth amid a fast increasing population size, Tanzania's growing use of fossil fuels for power generation and the currently dwindling hydropower capacity pose a great risk to its pathways for sustainable development. The approximately three-quarters of the rural residents comprise only about seven per cent out of the 31 per cent of the country's total population that accesses on-grid electricity. These statistics show that while most of Tanzania continues to remain in darkness, its rural area is the darkest part of the country. With their economies overwhelmingly agrarian, a sector that is seriously challenged by numerous cyclical and structural constraints, lack of access to electricity and sustainable energy supplies severely deprives rural areas of the opportunity to diversify their economies.[42]

One potential advantage that the rural residents of Tanzania could enjoy for their economic betterment if they had electricity would definitely be that of processing their agricultural produces. Being able to operate processing industries would not only add value to their harvests, thereby fetching better prices in the market, but also diversify their employment opportunities and retain the youth (labour force) in rural areas. Moreover, access to electricity and sustainable energy sources would save them from

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42. Ian Shanghvi. Operative Environment of Micro-finance: A Call for a Holistic Research Approach - The Case of Rural and Urban Tanzania. Thesis submitted in partial fulfilment of the requirements for the degree of Master of Rural Development in the Department of Rural Development, Brandon University, Fall 2012 (2012).

health problems caused by excessive use of biomass, reduce workload for women, improve studying environment for the children, and enhance household and community security. By and large, access to electricity and sustainable energy sources would improve their quality of life in many dimensions, including playing a significant role in addressing poverty. This is especially so because infrastructure and economic growth are positively related, whereby electricity, telecommunications, and road networks account for the strongest economic growth impacts.[43] The ability of rural Tanzanians to fight poverty is, therefore, further compromised given the fact that the development of the telecommunication infrastructure tends to take place simultaneously with that of electricity.[44] The country's road infrastructure, especially in rural areas, is also horrible.[45] However, major improvements are being waged to overcome these infrastructural hurdles in order to unlock the country's overall development potential. The SREP Project is an indication of aggressive efforts by the government to ameliorate the calamitous electricity situation in the country. However, implementation of the SREP's RERE Project is not cognizant of the capacity of people at grassroots level (local communities) to directly contribute to rural electrification. This is contrary to what numerous examples are revealing, such as those recorded in India, Nepal and Bangladesh. Rural communities in these countries play a pivotal role in achieving rural electrification.

Rural communities of Tanzania should also be able to take the lead in producing power from locally available resources so as to boost their efforts and initiatives to fight poverty. They can emulate the creativity of their counterparts from other developing countries where connection to the main grid is also not a readily available option. Sadly, the policy and institutional framework of Tanzania have blatantly discounted the capacity of rural communities to generate their own power, thereby denying them the support they might need. But this is probably so because of the government's lack of awareness of the prowess of rural residents to do so. On the flip side, rural residents are seemingly unaware that they can

43. Ibid.

44. Ibid.

45. Ibid.

spearhead their own development by producing power from renewable energy sources available within their communities, either on their own or with the support of other stakeholders. Rural communities from several other parts of the world can help to open up the eyes of the government, rural communities, private sector and the donor community about the potential for the Tanzanian rural residents to generate their own power from small-scale renewable energy projects. These stakeholders can also learn how to work with rural communities to achieve rural electrification by emulating lessons from other countries.

Below is an inventory of a few examples of community participation in power generation projects in rural India. A few more examples are also listed in Appendix 1, including some from Nepal and Bangladesh. The aim is to provide an evidence-based knowledge to augment the on-going government efforts geared towards enhancing energy security in rural Tanzania. The projects covered in these examples are typically small-scale, intended to provide basic energy services to rural households. Ranging from, but not limited to, biogas, improved cooking stoves, micro-hydropower, solar, and improved water mills projects, they play a critical role is reducing poverty as well as enhancing rural livelihoods, health, and education. They are customarily rooted deep within the grassroots level and vested on community-based solutions and resources, thereby typically owned by communities and effectively aligned with sustainable development efforts.

Example 1: Mlinda has invested in an affordable, community-owned solar electrification project in the Sundarbans in West Bengal, which has expanded widely to other rural areas. The project uses a community-based model by providing people with low-interest loans to afford a shared solar mini-grid. The savings that build up over time recover the costs of the mini-grid, as well as enhance rural prosperity that is evidenced in improved health and education. Mlinda uses a three-pronged approach: (1) making bank loans available in partnership with the National Bank for Agriculture and Rural Development (NABARD) to lend capital to a Joint Liability Group]; (2) adapting the technology to the user (ensuring that the design of technology is suitable for different uses like schools, public institutions, individual homes and small businesses); and (3) engaging the

community (encouraging people to form groups to build their awareness on using clean energy, understand climate change and promote new behaviours). The project partners include the government, local communities and private sector.

Source: Rocha, S. Democratising Energy Supply: Sundarbans and Purulia, India, available at http://www.mlinda.org (Accessed October 2, 2014) (n.d).

Example 2: With the assistance from Ministry of New and Renewable Energy, a local Non-Government Organisation (NGO) called 'Pragati Pratisthan' established a Bio-Oil (SVO - Straight Vegetable Oil) based decentralized power generation plant to produce electricity in village of Mokhyacha Pada located in Thane District in the State of Maharashtra. The NGO engaged a local entrepreneur to operate and maintain the SVO engine. Also, an 11 member Village Energy Committee (VEC) was formulated to implement and manage the power plant. A monthly tariff of Rs.25 for lighting was set that villagers pay regularly. The collected money is deposited in a bank account (opened specially for this purpose) of VEC to facilitate procurement of oil seeds used for producing fuel for the SVO engine and meeting other operational expenses. Also, nearly 25,000 jatropa plants were planted to ensure sustainable fuel supply and reduced fuel cost. Notably, the project implementing partners include the government, local communities and local entrepreneur.

Source: ABPS Infrastructure Advisory Private Ltd (ABPS Infra). Report on Policy and Regulatory Interventions to Support Community Level Off-Grid Projects, available at http://www.forumofregulators.gov.in (Accessed October 6, 2014) (2011).

Example 3: Putsil is located in the Koraput district of Orissa State. The community runs a micro hydro power generation project. It has formed a Micro-hydro committee comprising of 21 members (including six women) that manages power generation and distribution. Each household in the village is a customer. These customers are divided into six groups, whereby each group performs specific tasks such as repair, managing the catchment area, etc. Community participation is at the heart of the Putsil Micro-hydro Project. The community combines traditional values of

concern and flexibility in managing the project. Each household pays about Rs. 20 towards the project electricity fund whilst enjoying the freedom to contribute less during the lean season and more when they have the opportunity for cash income. Youth are trained to operate and maintain the plant, as well as to do power connections and repairs at households. The villagers are accessing the power largely for lighting and operating TV/Radio at night, as well as for running the mill and machines for grinding and oil extraction, lathe for woodcrafts during the day. This is an example of an electrification project solely implemented by local community members.

Source: ABPS Infrastructure Advisory Private Ltd (ABPS Infra). Report on Policy and Regulatory Interventions to Support Community Level Off-Grid Projects, available at http://www.forumofregulators.gov.in (Accessed October 6, 2014) (2011).

Example 4: The Biomass Energy for Rural India (BERI) Project at Tumkur district in Karnataka was pioneered by the Government of India in collaboration with the UNDP and GEF in 2002. It is being executed in a cluster of 29 villages that are subdivided into 5 clusters of between 5 and 7 villages. The Implementation agencies are Department of Rural Development & Panchayat Raj, (GoK) and Karnataka State Council for Science & Technology (KSCST). The project is owned and managed by the Government of Karnataka through a registered society namely BERI Society. Village Biomass Energy Management Committees (VBEMC) and Village Forestry Committees (VFC) were formed in each village at the inception of the project to ensure effective community participation. Water Users Associations (WUA) and Self-Help Groups (SHGs) (including women SHGs) were also developed to raise nurseries and prepare seedlings for the energy plantation. Regular management of the plant is controlled by the Village Samithi (committee), which is formed by 21 members with representation from the beneficiary villages. Samithi has 3 sub-groups dealing with financial management, raw material supply and power generation and management. Daily operation and maintenance of the plant is the responsibility of the staff engaged by BERI Society, whose salary is paid by the Samithi. The villagers are now able to access power for basic services like lighting, pumping drinking water, cooking, as well as economic activities such as pumping irrigation water and agro-processing. They also supply

biomass from their farmlands to the plant. This is another example of local communities teaming up with the government and international donor agencies to successfully implement a rural electrification project.

Source: ABPS Infrastructure Advisory Private Ltd (ABPS Infra). Report on Policy and Regulatory Interventions to Support Community Level Off-Grid Projects, available at http://www.forumofregulators.gov.in (Accessed October 6, 2014) (2011).

Example 5: Hosahalli village is located in the Tumkur District of Karnataka. A 3.75 kWe biomass gasification coupled to a diesel engine was installed in 1988 by the Centre for Sustainable Technology (CST) of the Indian Institute of Science (IISc). This followed discussions and meetings with the Hosahalli village communities to explain their roles, responsibilities, benefits and the need for their participation. A village committee was created to manage the systems, take decisions on operation of the units, supervise the operator, protect the forest and ensure repayment for the services. The local youth underwent training to operate and carryout minor maintenance of the systems. Entire investments in the infrastructure such as installing power generation, distribution and end-use systems (i.e., lighting, irrigation water pumps, flour mill, gasifiers, diesel engine generator, building, etc.) and raising the energy forest were catered for by CST. A mixed species forestry concept was adopted, whereby fast growing and coppicing species were planted as biomass feedstock. As revealed in this case, successful rural electrification project is being implemented by local community members in partnership with the government.

Source: Sridhar, G., Sridhar, H. V., Basawaraj, Sudarshan, M. S., Somsekhar, H. I., Dasappa, S., & Paul, P. J. Case Studies on Small Scale Biomass Gasifier Based Decentralized Energy Generation Systems. Indian Institute of Science, Mahatma Gandhi Institute of Rural Energy and Development, Bangalore (2012).

Example 6: The operation, maintenance and distribution responsibilities of micro-hydro projects in Ramgad and Karmi in the Uttarakhand State were decentralised to a local village energy committee (VEC)/Panchayat, with support from the state government that owns the projects. It was observed that the franchisee-type control (local participation in project ownership) by the community led to improved capacity utilisation, coupled

with effective leadership and technical support from the government. This model could prevent certain technical and training challenges that are typical for independent local or independent groups whilst meeting community needs. This is a model example of a rural electrification project run by local community members in collaboration with the government.

Source: Cust, J., Singh, A., & Neuhoff, K. Rural Electrification in India: Economic and Institutional aspects of Renewables. Available at http://www.eprg.group.cam.ac.uk (Accessed October 7, 2014) (2007).

Example 7: With the assistance of the Rotary Club-Jawhar, a local non-governmental organisation, Pragati Pratisthan, implemented a solar energy project in Jawhar Tehsil in Maharashtra State in December 2010. A total number of 64 sets of solar panel-lights were installed on the roofs of all 64 households in the village of Chondipada. Each household contributed up to Rs. 500/- to purchase a solar panel light and Rs. 3,650/- per solar panel light was paid by the Rotary Club. In addition, each household was provided with one solar lantern and one solar street light that was installed at the centre of the village. The local NGO being fully responsible for the technology transfer related to operating the electronic devices. It is also providing technical training to the village youths on assembling the solar cell units. This is an example of a rural electrification project run solely by a local community.

Source: ABPS Infrastructure Advisory Private Ltd (ABPS Infra). Report on Policy and Regulatory Interventions to Support Community Level Off-Grid Projects, available at http://www.forumofregulators.gov.in (Accessed October 6, 2014) (2011).

Example 8: Kasai village is located in the Betul District of the Madhya Pradesh State. A gasifier project has been installed in the village to save the forest fringe villages. The District Forest Officials are responsible for implementing and monitoring the programme given their role among the forest communities. The programme is holistic in that it caters to the complete community energy requirements, including fuel efficient stoves, biogas, biodiesel and biomass gasification system for electricity generation. Daily plant operation activities are managed by the Village Energy Committee (VEC)/Panchayat. The local youths have been trained to operate and maintain the plant. A 10 hectare energy plantation was established to

ensure sustainability of the power plant. Until the time this project was being studied, explorations were on-going to see if an expeller unit would be ideal to extract oil from the Jatropha oilseeds for the purpose of operating the pump sets. Operating daily in the evening hours, the plant enables the villagers to access lighting at homes and in the streets, as well as pumped drinking water. Besides, an operational flourmill, several households enjoy using music systems and colour televisions. Each household contributes Rs. 120 every month for electricity usage. Improved chulhas have been constructed in each house to conserve firewood and biogas plants installed to supply energy for cooking. This is another example of a partnership model between local community members and the government.

Source: Sridhar, G., Sridhar, H. V., Basawaraj, Sudarshan, M. S., Somsekhar, H. I., Dasappa, S., & Paul, P. J. Case Studies on Small Scale Biomass Gasifier Based Decentralized Energy Generation Systems. Indian Institute of Science, Mahatma Gandhi Institute of Rural Energy and Development, Bangalore (2012).

The successes revealed by these case studies are an evidence of a cultivation of: (1) a strong sense of local ownership, (2) training and job creation - where maintenance and operation activities are carried out by the local people, (3) an implementing approach - one that is very inclusive of the local community members and their holistic needs, (4) an enabling environment - whereby the institutional infrastructure and regulations are supportive, and (5) financing - whereby the multiplicity of team players and relevance of the off-grid electricity projects are critical for accessing a mixture of needed loans, investment and subsidies. These issues are well explained by Yadoo as captured in Appendix 2.

Conclusive Remarks and Recommendations

Community participation is widely accepted as a pre-requisite to ensuring equity and sustainability of RE [Rural Electrification] efforts. It is observed from the RE efforts in all the study countries, that local participation, whether in the form of RE distribution franchises in India, the electricity cooperatives in Nepal and Palli Bidyutt Samities in Bangladesh, [has] helped in reducing theft and distribution losses, improved billing and revenue collection efficiency and more importantly ensured stable delivery of electricity.[46]

The examples above and in Appendix 1 provide clear evidence that rural electrification can hardly succeed without active community involvement and participation. Local community participation (in installation, operational, and maintenance roles) is inherently crucial in all these examples. Whereas the SREP's RERE Project overlooks the local communities and, instead, sees other players particularly the private sector as the lynchpin of rural electrification in Tanzania, these examples provide a constructive criticism to this approach. They reveal that local communities can actually do it solely by themselves and, even better, in collaboration with the government. In several cases the private sector is not even involved, even though its strategic involvement in the context of rural settings can be very important. The examples reveal that rural electrification is best achieved in the hands of rural community players, and that the engagement of other partners depends on local conditions and realities. Community-led rural electrification also overcomes the problem of funding from multi-lateral development banks that typically lean more towards large-scale grid-based energy projects for the sake of profit making and better economies of

46. Debajit Palit & Akanksha Chaurey. Off-grid Rural Electrification Experiences from South Asia: Status and Best Practices, 2011, Elsevier, ESD-00124, doi:10.1016/j.esd.2011.07.004.

scale. Contrary to Tanzania's expectations with the SREP's RERE Project, it is nearly impossible for the private sector to invest in projects that enhance poor people's lives but, at the same time, are less commercially viable. Confronted with this scenario, it is the government's role to stir active participation of the concerned rural communities in energy projects by making them fully aware of their problem and intended solution, and encouraging their active participation with clearly defined roles and benefits. The government should strive to achieve community ownership of energy projects to warrant sustainability of the same, but also ensure that the projects are constructed and operated by the community members using locally available resources and manpower.

As exemplified by Mlinda in India, the government can assist communities to solicit commercial sources for funding energy projects. In cases where communities are too poor to afford per unit price of power, the government can provide subsidies for a limited time period and on the express underwriting by the community to conserve surrounding forest acreage and community policing of forest assets.[47] The government actually recognizes that the purchasing power of at least three-quarters of the population is very low, which makes people depend on wood-fuel for cooking and kerosene for lighting, that in turn generate negative consequences to the environment and the quality of life (mostly in rural areas).[48] Though economically poor, rural Tanzanians can provide other forms of capital contributions to electrification projects in their areas as their counterparts in other parts of the world are doing. In Nepal, for example, subject to their low income levels, rural communities have contributed 20 per cent of the total cost of grid extension in various forms, including labour.[49] The strong sense of ownership among the villagers involved in the pico hydro power plant in Nepal is reflected in their hard work and participation, such as carrying equipment, organizing

47. Debnath Shaw. Securing India's Energy Needs: The Regional Dimension, Center for Strategic and International Studies (CSIS), Washington D. C. (2005).

48. Ministry of Energy and Minerals (MEM), no. 23.

49. Annabel Yadoo & Heather Cruickshank. The Value of Cooperatives in Rural Electrification. Elsevier, Energy Policy. DOI:10.1016/j.enpol.2010.01.031 (2010).

all the local building materials, and building the power plant.[50] Also, given the difficulties around rural electrification especially in terms of access and finance, subsidies by the government and donor community would be significantly effective in guaranteeing organized community bodies and even private investors to at least break even. This is especially important for mini/micro grid projects that are usually denied finance by commercial banks for several reasons.[51] The primary reasons include perceived technological and financial risks and lack of profit-making history by the entrepreneurs involved.

Rural electrification projects should never be implemented in isolation but should rather be integrated to much wider long-term holistic community development objectives.[52] To be holistic, a package of such community projects can include a smokeless metal stove and a pit latrine for each household, access to clean drinking water from taps, and a non-formal education project for mothers and out of school children.[53] This greatly improves local participation and commitment to the success of such projects because of the cross-cutting benefits that in turn enhance the overall positive outcome in terms of development of each village, family and person. The examples also reveal that community in consultation with other stakeholders (mainly the government) can agree on the per unit price to be paid by each consumer and can manage bill collections, with the entire proceeds going to repair, maintenance and accretion of capital. The local distributor must ensure a frequent and stable power supply to make it worthy for the consumers to effectively utilize the power for wide-ranging

50. Zahnd Alex, Haddix McKay Kimber, & Richard Komp. Renewable Energy Village Power Systems for Remote and Impoverished Himalayan Villages in Nepal. Proceedings of the International Conference on Renewable Energy for Developing Countries (2006).

51. Debajit Palit & Gopal K. Sarangi. Renewable Energy based Mini-grids for Enhancing Electricity Access: Experiences and Lessons from India, International Conference and Utility Exhibition 2014 on Green Energy for Sustainable Development (ICUE 2014) Jomtien Palm Beach Hotel and Resort, Pattaya City, Thailand, 19-21 March 2014 (2014).

52. Zahnd Alex, et al., no 50.

53. Ibid.

benefits, thereby adopting the electricity culture and also finding it rational to pay their bills in a prompt manner. In fact, a research conducted in Sunderban Islands (India) revealed that community members were appreciative of the changes that electricity has brought on them and were willing to pay a higher tariff.[54]

In addition to helping rural communities to run their own energy projects based on locally available renewable resources, it is also clearly observed from the aforementioned examples that the corresponding use of simplified technology contributes to making such projects more effective and sustainable. Fortunately, the government also acknowledges that consideration needs to be on the application of appropriate technologies that are affordable, environmentally sound and well adapted to local needs.[55] As stated in one of its policy statements on renewable energy, the government is also committed to fostering inclusion of environmental considerations in all renewable energy planning and implementation, and enhance co-operation with other relevant stakeholders.[56] However, both technological and environmental considerations within the broad spectrum of electrifying rural areas are rendered rather futile in the grand scheme of things in the absence of effective community leadership and participation. The government needs to not overstep or downplay the potential of approximately three-quarters of the Tanzanian population (rural residents) in fostering their own change and development for the overall national development achievements. In fact, It is advised that people have to be encouraged and galvanized to participate in a national energy mission, including energy conservation and environmental protection.[57] Relatedly, it is emphasized that rural agents must be well integrated in all steps of the projects, from initial financing operations to start-up and operation and

54. Kirsten Ulsrud, et al. The Solar Transitions Research on Solar Mini-grids in India: Learning from Local Cases of Innovative Socio-technical Systems. Elsevier, ESD-00117, doi:10.1016/j.esd.2011.06.004 (2011).

55. Ministry of Energy and Minerals (MEM), no. 23.

56. Ibid.

57. Debnath Shaw, no. 47.

maintenance procedures.[58] One of the problems that hindered solar mini-grids efforts in Senegal was poor involvement of local authorities and local people.[59] However, caution that the typical community- or NGO-centric nature of mini/micro grid projects imply that they lack an organized delivery model contrary to the utility-driven, national grid-based projects.[60] The challenge is, therefore, to ensure that implementation of mini/micro-grid projects entails a structured approach that accompanies clarified roles and responsibilities of different stakeholders and differentiated responsibilities for operation, maintenance, and management. It is also important for policy and regulatory procedures to shield local communities implementing off- and mini/micro-grid projects from falling prey to opportunist/unscrupulous entrepreneurs who aim at making profit without considering other factors of community interest.

A number of the benefits and impacts related to different delivery models for decentralized rural electrification have been identified. Some of them - in connection to ownership, training and job creation, implementing approach, dissemination and scaling up, enabling environment and financing - are highlighted in Appendix 2.[61] These correlate well with the examples covered in this paper and will provide further insights to Tanzania's rural electrification efforts. Yadoo further advises that hybrid business models could be established so as to exploit the different comparative advantages existing among a multitude of stakeholders. As shown in Figure 2, Yadoo gives a sample hybrid business model that can be applied to mini-grid development. This model recognizes local (rural) communities as important actors in the process of power generation.

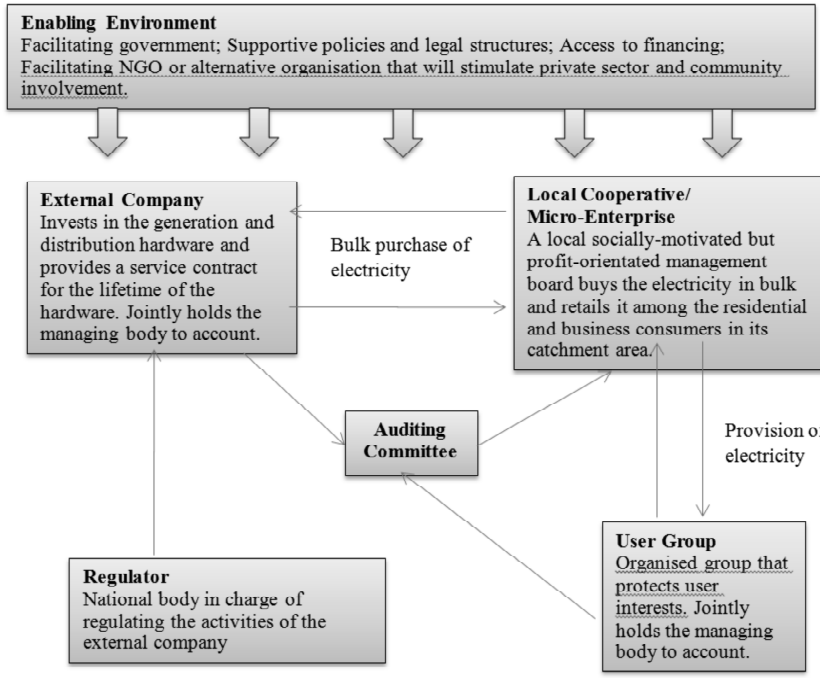
58. Kirsten Ulsrud, et al., no. 54.

59. Ibid.

60. Debajit Palit & Gopal K. Sarangi, no. 51.

61. Annabel Yadoo. Delivery Models for Decentralised Rural Electrification: Case Studies in Nepal, Peru and Kenya. International Institute for Environment and Development, London (2012).

Figure 2. Sample hybrid business model for mini-grid development



Source: Yadoo, A. Delivery Models for Decentralised Rural Electrification: Case Studies in Nepal, Peru and Kenya. International Institute for Environment and Development, London (2012).

Also, it would certainly be important for the government to deliberately undertake social marketing campaigns to raise the awareness of rural residents about their own ability (and in collaboration with others) to bring about rural electrification. In the process, the government should clearly show them how this can be achieved with, for the most part, locally available resources and how such initiatives would transform their lives in a holistic manner. The government should also select pilot villages and establish demonstration off-grid electrification projects in collaboration with the local communities for surrounding rural communities to visit and learn from. Pilot projects are essential for the dissemination and scaling up of off-grid electrification projects in that they boost the awareness of

community members and provoke their uptake of similar projects.[62] This initiative should also be accompanied with baseline studies to be able to gauge community development over time based on the impact of the community-led rural electrification projects. The baseline studies should also collect feedback from the communities and share various testimonials to further educate the relevant community members. All the way through, the government should provide capacity building as well as project development assistance to the rural communities implementing rural electrification.

Apparently, the potential for local community activeness in spearheading rural electrification is vast in Tanzania, such as in the strong sense of national community that is typical of Tanzanians despite their ethnic, economic, religious, and geographical diversities. Tanzanians residing in both rural and urban areas greatly value community and togetherness; and this is a key factor for community collaboration in rural electrification efforts and initiatives. Various examples of community unity in development activities are also conspicuous among the Tanzanians. Among these include micro-financing through the Savings and Credit Cooperative Organizations (SACCOS), whose members usually reside within the locality in which the SACCOS operates and comprise individuals and organizations.[63] SACCOS offer saving and credit services to enhance self-employment and income generation activities with the ultimate goal of fighting poverty. SACCOS in Tanzania are relatively more sustainable than other types of micro-finance institutions. This is mainly because SACCOS loans are generally noted for having high repayment rates because borrowers understand that the loans are made possible by the savings of the community and are, therefore, aware of community pressure and close follow-up in the case of defaults.[64] This example shows that community engagement in rural electrification is possible and, interestingly, the modus operandi of SACCOS might actually be boosted or tailored to drive the related initiatives. Another crucial example is observed in the decentralisation of

62. Ibid.

63. Ian Shanghvi, no 42.

64. Ibid.

forest management on the forest resource base and livelihoods in Tanzania using Joint Forest Management and Community Based Forest Management programmes. While attempting to improve the livelihoods of forest communities from alternative income generating activities so as to conserve the forests, the two programmes are rooted in community management in collaboration with the village governments. In some cases, small groups of individuals within rural communities have managed to make enormous changes for the majority with the primary objective of enhancing human development. In fact, a success in this area is evidenced in rural electrification in Tanzania. With support from the Barefoot College of India and the UN Women, six Tanzanian women were trained in solar power engineering in India and have now managed to install a solar electricity system for the three small villages of Chekeleni, Nitekela and Mjimwema in southern Tanzania.[65] The women were trained to assemble the equipment while in India, which was then purchased and delivered to Tanzania by UN Women. Following the success of the programme, the Indian Government is going to fund establishment of a solar energy training centre in Mtwara.[66]

Equipment is currently being procured locally to ensure that the entire community can benefit from their own solar system. Villagers pay toward the costs of their equipment and its maintenance in instalments over five years. These funds also ensure the women engineers receive a monthly stipend for their work. Households that sign up to the initiative pay an initial deposit of 20,000 Tanzanian shillings (roughly 12 dollars) and then monthly instalments that amount to around 60,000 shillings (approximately 37 dollars). They receive one 20-watt solar panel, one 12-volt battery, one cell phone charger and three nine-watt lamps per household. Tangible benefits include savings on the cost of kerosene (a saving of about 1,000 shillings per month) and charging cell phones at the local market. There are also fewer health and safety hazards because highly flammable kerosene is no longer needed.

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65. Inter Press Service. Mothers Light Up Homes in Rural Tanzania, available at http://www.ipsnews.net/2014/06/mothers-light-up-homes-in-rural-tanzania/ (Accessed October 9, 2014) (2014).

66. Ibid.

Another positive impact of the lighting project has been the increase in women's voice and independence. At least four of the nine members of the Village Energy Committees are women and in Nitekela the committee chair is also a woman. Financial, leadership and governance training is enabling them to plan and lead effectively, while simultaneously working towards sustainability. All three Village Energy Committees are now formally registered community organisations with their own bank accounts. Many of these women have also become role models.

Source: Inter Press Service. Mothers Light Up Homes in Rural Tanzania, available at http://www.ipsnews.net/2014/06/mothers-light-up-homes-in-rural-tanzania/ (Accessed October 9, 2014) (2014).

The observations in the preceding section reflects that Tanzania's energy policy and institutional arrangements need to find more space for local community participation in rural electrification initiatives. The inventoried examples reveal that decentralized electrification without local participation is unlikely to yield the desired nation-wide impact in Tanzania, especially for the rural communities. The constraints facing the widening of the supply of grid electricity to the rural Tanzanian communities can be significantly addressed by making the off-grid electrification initiatives inclusive of the local community. Therefore, carefully crafted stakeholder engagement approaches that are centrally inclusive of rural communities need to be designed, tested and implemented to suit specific community conditions and realities to counteract poverty and foster sound human development. Existing potentials and testimonies of community-level activeness in spearheading rural development need to be exploited and utilized effectively. More lessons could be acquired from elsewhere to increasingly fortify the process of decentralized rural electrification in Tanzania, without disregarding the positive and negative experiences of various African countries.

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APPENDIX 1

Additional Examples of Decentralized Rural Electrification from Nepal and Bangladesh

Country: Nepal
Partners: Government, local communities and private sector

Description: A Community Electricity Distribution By-law was passed in 2003 to permit any organized rural group to purchase electricity in bulk from the grid and retail it amongst its users after the Nepal Electricity Authority (NEA) could not afford to reach out to rural residents. The CBOs are responsible for any non-technical losses (i.e., theft) occurring within their areas. The bylaw has also made it possible to build community-led new rural electrification infrastructure. NEA provides up to 80 per cent of the capital investment, while communities contribute the remaining 20 per cent of the total cost of grid extension in the forms of labour, household donations, bank loans, or loans and grants from the local village and district development committees. This new delivery mode has forged a creative relationship between the State, private sector and local communities. It is popular for its lack of corruption and circumvention of costly international contracting that involves bulk procurement deals. Moreover, through the CBOs, transparency of the electrification process has improved, decision making has been localized, and the space for dialogue on rural electrification issues has widened up. Also, members from around 17 rural electric cooperatives and user groups have been able to establish the National Association of Community Electricity Users in Nepal.

Source: Annabel Yadoo & Heather Cruickshank. The Value of Cooperatives in Rural Electrification. Elsevier, Energy Policy. DOI:10.1016/j.enpol.2010.01.031 (2010).

Country: Nepal
Partners: Government and local communities

Description:The Nepal Hydro Electricity developed a pico hydro power plant in 1990s that generated 200 Watts from a small river stream. The purpose was to supply electricity to remote villages that had identified lighting as their basic energy service demand as part of their first exposure to electricity.

The village pico hydro power plant committee has selected a few people from each village to undergo training in operating and maintaining the power plants, and to alert the project implementer of problems they cannot handle. The local villages assume full management of the power plants. The villagers have a strong sense of ownership as evidenced in the hard work they put into carrying of the equipment, organizing all the local building materials, and building of the power plant. This strong sense of community ownership ensures long-term sustainability of the project. Each family pays a fee of 15 Nepali Rupees for maintenance, security and repair costs. In turn, each of them accesses electricity for lighting and warming water, which saves them from spending too much time on collecting firewood and, similarly, from degrading the environment.

Source: Zahnd Alex, Haddix McKay Kimber, & Richard Komp. Renewable Energy Village Power Systems for Remote and Impoverished Himalayan Villages in Nepal. Proceedings of the International Conference on Renewable Energy for Developing Countries (2006).

Country: Bangladesh
Partners: Government and local communities

Description:Critically acclaimed as one of the most successful rural electrification programmes in developing countries, the Rural Electrification Board (REB) has effectively increased electricity access in rural parts of Bangladesh. Working together with rural communities, the REB establishes local electrical cooperatives namely Palli Bidyut Samities (PBSs) that are responsible for developing and distributing electricity. While each PBS develops an electrification master plan for its own operational area, the PBS members (the rural consumers) take part in decision making through representation in the PBS governing body. The PBSs are independent and

privately owned, but are under the direct regulatory control of the REB who oversees their financial sustainability, procurement processes and management effectiveness to ensure that the PBSs are absolutely successful. Through this arrangement, electricity is now supplied to the villagers' homes and irrigation pumping stations.

Source: Annabel Yadoo & Heather Cruickshank. The Value of Cooperatives in Rural Electrification. Elsevier, Energy Policy. DOI:10.1016/j.enpol.2010.01.031 (2010).

APPENDIX 2

The Impact of Different Delivery Models for Decentralized Rural Electrification

Ownership

- It is important to engender a strong sense of local ownership to obtain local support and buy-in for the project, and for users to take responsibility for a system's maintenance (where required).
- It can help if users participate in the planning and decision-making process and contribute their own funds towards the initial set-up costs.
- Obtaining community consensus during the planning stage could strengthen a community's ability to resolve disputes in future, as well as increase local buy-in.
- External facilitation may be required to ensure that decisions are taken on the basis of well-informed judgements.
- If communities are too poor to provide an initial payment, they could be asked to provide unskilled labour or 'sweat equity'; this does not necessarily detract from sustainability.
- Ownership is only important if a community's sense of responsibility for the system increases; thus, perceived ownership is often more important than legal ownership.
- It can be advisable to spread ownership over a wider set of stakeholders to improve the accountability of the management board.

Training and job creation

- It can be beneficial to train local people to operate and carry out the maintenance of their electricity system as fully trained mechanical or electrical engineers do not often live within easy reach.
- The creation of well-functioning technical support networks can also improve sustainability.

- The installation of a new electricity system can often create jobs.
- Training may be required to raise knowledge about renewable energy off-grid options among communities, governments, potential financiers and entrepreneurs.
- Communities may require managerial as well as technical training.

Implementing approach

- Systematic and national level approaches tend to be far more effective in creating sustainable, scalable systems and improving the institutional environment.
- Awareness of renewable energy off-grid electrification options may need to be raised among national and regional energy planners. Regional and district level off-grid electrification master plans can raise awareness and improve planning systems.
- Local buy-in could be increased if communities play an active role in the planning of their electricity system; however, care should be taken to ensure that participation is inclusive.
- Energy planning should be transparent and non-partisan; where relevant, representatives from different political parties could be consulted during planning.
- Detailed and realistic work-plans should be drawn and community expectations managed so as to prevent a subsequent loss of trust. Plans should be tailored to a community's specific desires and requirements.
- Projects should be demand-led although a community mobiliser can often assist in increasing local motivation to instigate a project and drive it forward. Few communities contain the strong leadership and proactivity required to see their project through from conception to completion without any external assistance.
- Community mobilisation is essential for instilling a sense of responsibility for the system within the community and it can also be used to stimulate benefits in other development spheres.

Dissemination and scaling-up

- The use of pilot projects and demonstration sites can boost awareness (and reduce scepticism) of off-grid technologies. Greater familiarity can encourage others to install an off-grid electrification system.
- Showcasing their system can give a community pride and strengthen their sense of responsibility for its upkeep.

Enabling environment

- Supportive institutional infrastructure and regulation is required for projects or programmes to be sustainable, scalable and replicable.
- An enabling government can be one that is non-interventionist during the implementation stage, yet consistent and transparent in terms of policies and regulations.

Financing

- A mixture of loans, investment and subsidies is often required to develop off-grid electricity systems yet it can be difficult for local entrepreneurs and rural communities to gain access to commercial financing.
- Partial loan guarantees or access to longer term credit lines may be required to raise the amount banks or MFIs are willing to lend and to facilitate loan repayments.
- Social investors have provided loan or equity financing for rural energy businesses, yet the investment process can be slow and arduous, particularly as due diligence cannot rely on standard assessment procedures in the absence of credit histories.
- It is extremely difficult to make carbon financing economically viable for rural electrification projects.

Source: Annabel Yadoo. Delivery Models for Decentralised Rural Electrification: Case Studies in Nepal, Peru and Kenya. International Institute for Environment and Development, London (2012: pp. 30-40).

The Government of Tanzania is making creditable strides to scale up its renewable energy sectors. One of the initiatives includes preparation of the Scaling-up Renewable Energy Programme (SREP) Project document in 2013. The aim is to promote clean energy for domestic end-uses like cooking and lighting. A spectacular feature of the SREP Project is its particular consideration to scale up rural electrification. However, related efforts and strategies condone the contribution of rural communities to achieving this goal. Most of the attention and support is focused on the private sector as the core driver of rural electrification. Examples from rural India reveal that rural communities are actually the lynchpin of rural electrification. Drawing from these examples, this paper argues that decentralized electrification without local participation is unlikely to yield the desired nation-wide impact, especially for the rural communities. This suggests that the energy policy and institutional arrangements of Tanzania need to find more space for local community participation in rural electrification initiatives. Existing potentials and testimonies of community-level initiatives in spearheading rural development in Tanzania need to be exploited and utilized effectively in the realm of rural electrification.

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