Community Solar Cooperatives in Developing Countries

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Introduction

This paper provides a brief overview of recent and prospective changes in access to electricity in developing countries. These changes can contribute to the goal of worldwide electrification by 2030. One of these changes is the increasing development of community solar cooperatives that provide electricity through mini-grids, and installations on individual homes and other buildings. These co-ops are the primary focus of this paper.

There are almost a billion people who have no access to electricity, living primarily in Africa, Asia, and Latin America. That's one-seventh of the world's population. There are hundreds of millions more whose energy is unreliable, dirty, unhealthy, inadequate, unsustainable, and/or expensive – for example, kerosene, diesel, wood, and candles.[1]

Almost every country in the world has made a commitment through the United Nations Paris Agreement to significantly cut back by 2030 on their use of energy sources that emit carbon dioxide into the atmosphere.[2] (Note that the Trump administration is planning to withdraw the United States from the agreement in January 2020.[3])

These same countries have made commitments through the UN's Sustainable Development Goals program to dramatically improve the quality of life around the world by 2030, in part by ensuring "access to affordable, reliable, sustainable and modern energy for all."[4]

There are many ways in which universal access to electricity will improve the quality of people's lives – for example, creating job opportunities, reducing the workload of women by saving, on average, an hour a day that is currently spent searching for firewood, and preventing almost 2 million premature deaths per year from household air pollution. There would also be a net reduction in greenhouse-gas emissions because of lower use of biomass fuel for cooking, and the virtual elimination of kerosene and other dirty fuels as sources of heat and light.[5]

How can the ambitious goal of "electricity for all" be realized?

The broad answer is to dramatically increase the use of decentralized, renewable energy to meet the world's unmet and under-met needs for electricity. Since most people without electricity do not have access to transmission lines, the most feasible approach to providing them with electricity is through community solar mini-grids and single building installations, many of which could be organized as cooperatives.

Recent and projected progress in electrification

According to the World Energy Outlook reports of 2017 and 2018, there has been a pattern since 2000 of accelerating access to electricity for unserved and underserved populations. As alluded to above, almost 1 billion people were still without electricity in 2017, but that's a marked improvement over the 1.7 billion without access in 2000.[6] [7] Unfortunately, during this time period the "vast majority (97%) of new electricity connections" was through primarily fossil-fuel-based grid extensions. Less than 1% of new electricity access was provided via decentralized, renewable energy systems.[8]

On the bright side, the 2017 report goes on to say that between 2018 and 2030, fossil fuels will largely be replaced by renewable energy – especially solar energy – as the primary source for electricity. "The rapidly declining costs of solar PV [photovoltaics], battery technologies, and energy-efficient appliances (especially light-emitting diode [LED] lighting) are making decentralized renewable energy systems more affordable. This is particularly the case for rural and dispersed communities not served by a main grid and where it may take years for one to arrive. Decentralized systems can also be attractive in areas with grid access but an unreliable power supply."[9]

Despite the dramatic progress during the first part of the 21st-century, future "trends on energy access . . . fall short of global goals. The New Policies Scenario sees some gains in terms of access, with India to the fore. However, more than 700 million people, predominantly in rural settlements in Sub-Saharan Africa, are projected to remain without electricity in 2040, and only slow progress is [being] made in reducing reliance on the traditional use of solid biomass as a cooking fuel."[10]

Growth of solar and other renewable sources of electrification

Back on the bright side, there are a number of exciting renewable-energy options that are becoming increasingly available to rapidly expand the electrification of the world. For example,

large solar arrays are being developed across northern Africa that could eventually replace much of the remaining fossil-fuel energy of Europe. One analyst estimates that putting solar panels on 2% of the Sahara Desert could meet all of the world's electricity needs.[11] Building underwater transmission cables from the Northern Africa to Europe is quite feasible. The same is not true for transmission to the Americas. There are other examples of desert-based, large-scale solar projects in Saudi Arabia, China, the Navajo reservation in the United States, and elsewhere. Together, these systems are likely to provide a huge addition to affordable, renewable energy by 2030.[12]

Wind turbines are cheaper than solar panels in many situations, and will continue to be a critical part of any future mix of renewable-energy sources.[13]

Because of the intermittent generation of electricity by solar and wind installations, they must be supplemented by other sources of energy, energy storage, and/or long-distance transmission. Lithium-ion batteries and other means of storage are an important and increasingly cost-effective way to expand the use of renewable energy at every level, from individual buildings to large power plants.[14]

Community solar energy

Many of the close-to-a-billion people who don't have access to electricity live in fairly remote areas that are not easily connected to major power grids. As a result, large-scale renewable options don't apply to them and are not likely to in the near future because of the high cost of transmission lines.

In these off-the-grid locations, households and businesses, and clusters of electrical consumers at the village level, can be most economically and efficiently served by electricity generated locally.

In projecting future expansion of access to electricity, the 2017 World Energy Outlook report lays out an "energy-for-all" scenario that is based on the goal of universal electrification by 2030.[15] Figuring in population growth, this scenario would mean expanding electrical coverage to more than 1 billion additional people at an approximate cost of almost $800 billion. The report concludes that over 50% of this electricity would be powered by solar energy, and less than 25% by fossil fuels. Furthermore, more than 60% of new electrical energy would be generated by mini-grid and off-grid systems. ("Off-grid" systems are defined as powering individual homes and other buildings.)[16]

Below are five examples that include community solar components, followed by a discussion of how community solar co-ops could be expanded and made more efficient so that hundreds of millions more people around the world could benefit from renewable, reliable, and locally-controlled electricity.

1. Liberia

   The recently formed Totota Co-op in rural Liberia began operating a solar mini-grid in 2018. Under a contract from the US Agency For International Development, the National Rural Electric Cooperative Association (NRECA) and Bandera Electric Co-op, one of NRECA's member cooperatives, assisted the village to organize the co-op and install solar panels, a battery-storage unit, and other equipment.[17] NRECA is also working with 12 Liberian coastal villages to expand the community solar model to them.

2. Rural India

   When Narendra Modi became Prime Minister of India in 2014, 300 million households were without electricity. At the end of 2018, every village in India was reported to have electricity, but there were still 30 million households without it. President Modi promised to electrify all of these remaining households by April 2019 through a combination of hooking them up to the national grid and through mini-grid and off-grid installations. There are mixed reports on whether or not that goal has been attained. There are also concerns about the reliability of the national electricity grid, which has a tendency from time to time to leave subscribers in the dark.[18]

   Despite these reliability problems and differing assessments of how many households are now electrified, the almost-full electrification of India is a major accomplishment. It is also worth noting that many communities have formed Village Electric Committees to oversee the operation of their solar facilities. According to one observer, "most Indian solar microgrids are democratic, with power controlled by village committees."[19]

3. The Caribbean

   Twenty-seven island countries and other territories, along with private-sector partners formed the Caribbean Climate-Smart Accelerator in 2017 to create more self-sufficient and sustainable development, including an increased emphasis on renewable energy.[20] "The central objective of the Accelerator is to help transform the region's economy through fast-tracking sound public and private investment opportunities which support climate action and economic growth, through sustainable development."[21]

Islands, big and small, face special challenges in meeting their electrical service needs. Most don't have local sources of energy, although some use wood, other kinds of biomass, hydroelectric, and geothermal energy. Importing fuel, such as diesel, is expensive and polluting. Many islands are also vulnerable to tropical storms and hurricanes which play havoc with transmission lines and other components of the electrical system. Consider the damage that Hurricane Maria caused in Puerto Rico in 2017, including the estimated loss of about 3,000 lives, and from which the island is still recovering.[22]

Solar mini-grids and single-building solar installations, for example in hospitals, provide protection against catastrophic damage and loss of life in the event of national weather and other emergencies in island communities. Mini-grids can be designed as part of island-wide grid systems that can operate autonomously when the main grid goes down.

4. The Sahel Region of Africa

Along the southern edge of the Sahara Desert is a huge savanna region called the Sahel. At over 1 million square miles, it is one-third the size of the Sahara. "The Desert to Power Program . . . seeks to make use of this massive swathe of territory to develop 10,000 megawatts (MW) worth of solar energy to provide electricity to 250 million people – including . . . 90 million people off-grid."[23]

5. Kenya

Kenya has a much higher distribution of electricity than most Sub-Saharan African countries. Approximately 75% of Kenyans have access to electricity from grid and off-grid sources, according to the World Bank. [24] The Kenyan government wants to increase that to 100% by 2022.[25] The Kenya National Electrification Strategy (KNES) references mini-grids, independent solar power plants, and off-grid technology as options to utilize. About 49 million people live in Kenya, and most of them are in rural areas. [26]

One of the options being pursued is a private sector partnership between Azuri, Unilever, and local community residents. In this program, households and businesses purchase solar kits via a rent-to-buy system. Purchasers make monthly payments for 18 months, and then they own the kits outright. The kits come in various sizes, from a single light set-up, to one that can power multiple lights and other appliances, including a television. Another feature of the distribution system is that local community residents are trained to sell, install, and maintain the kits. Thus, there is a direct, local employment impact, as well as the indirect economic, social, health, and educational benefits resulting from increased access to energy.[27]

This Azuri/Unilever model has excellent potential to be adapted for the development of community solar projects in other developing countries.

Advantages of, and challenges to, community solar co-ops

Listed below are the advantages of, and challenges to, community solar co-ops as means to rapidly expand electrical services in developing countries.

Advantages

- They are relatively inexpensive to install and operate.
- They can be rapidly ramped up
- As mini-grids and clusters of single building installations, they can operate independent of large-scale transmission grids
- Panels and other components are easy to transport, install, and maintain.
- Consumer costs can be based on usage.
- Decisions are made by locally elected boards.
- They generate jobs and new business activity.
- They improve the quality of everyday life and health.

Challenges

- There is a shortage of champions for solar community cooperatives in the international community.
- Even though they can operate self-sufficiently once formed, there are difficulties in accessing start-up capital for them.
- There is often a lack of local expertise for sourcing materials, setting up local systems, and providing ongoing monitoring and support services.

However, none of these challenges are insurmountable.

Despite the success of community solar co-ops in some developing countries, there is not nearly enough support for expanding this approach to help meet the goal of universal access to electricity by 2030. Three of the co-op entities in the best position to promote and assist community solar co-op projects are the International Co-operative Alliance, the US-based National Rural Electric Cooperative Association, and the World Organization of Credit Unions (WOCCU). The former two organizations are clearly supportive of the approach, but neither appears to be taking a strong leadership role in promoting it. WOCCU could also be an important advocate for community solar co-ops by encouraging and assisting credit unions, savings and credit cooperative organizations, and other financial cooperatives around the world to provide financing for these co-ops.

Other potential champions and sources of financing include the World Bank, the United Nations Development Program, and various bilateral development programs such as the United States Agency for International Development, the Swedish International Development Agency, the UK's Department for International Development, the Canadian International Development Program, and major foundations, and business partners. Despite the fact that many of these organizations are already providing assistance to electrification in developing countries, none are actively championing the expansion of the community co-op model.

As both India and Kenya are demonstrating, national initiatives to provide universal electrification within countries appear to be a very effective strategy for expanded coverage. This is clearly a way to mobilize action for universal electrification, including the development of community solar co-ops. And, yet, there are not enough of these national models. The proliferation of these models would benefit greatly from support by the international organizations mentioned above.

For a historical perspective, it is useful to look at the rural electric cooperative movement in the United States. In addition to the strong demand for electricity by rural residents, the second biggest factor setting the stage for the rapid growth of these co-ops in the 1930s and 1940s was the provision of low-interest loans by the Rural Electrification Administration (REA) established by the Roosevelt administration in the mid-1930s. Today, about 1,000 rural electric co-ops provide electricity to 40 million people in rural and suburban communities throughout the United States. Similar loan programs, both national and international, could be established during the next decade to accelerate electrification in developing countries.

Conclusions

There are two key conclusions of this paper. Community solar cooperatives are already in place in some developing countries, and could be expanded rapidly to provide electricity in many more. However, unless the expansion of these co-ops becomes a much higher priority of the international cooperative community and of international development organizations, the huge potential for these local, democratically run, renewable energy providers will not be realized.

Endnotes

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