Let Communities Lead

Stories and lessons on grassroots energy initiatives for sustainable futures

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Transformative change happens when the marginalized lead the march to the future




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Cover Art: Mahatma Gandhi leading the Namak Satyagrah or the non-violent civil disobedience Salt March against oppressive taxation and monopoly in salt production by the British colonial government of India. This marked a crucial threshold for participation in India's struggle for independence, making it a movement of people from all walks of life. Artwork inspired by the Gyarah Murti sculpture at New Delhi by Devi Prasad Roy Chowdhury (1899 -1975).

Photographs (from left to right): (1) A healthcare counsellor supporting a community member during a home visit – credit: Uganda Empowers; (2) Women's group monthly meeting on progress – credit: Nipun Regmi; (3) Children's education on solar energy – credit: Revolusolar; (4) Solar panels being installed in the first energy cooperative in a Brazilian favela – credit: Revolusolar.

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Executive Summary

A sustainable planet will not be a reality unless millions of poor and vulnerable people in marginalized communities around the world are capable of pursuing sustainable development goals locally. Such a pursuit is possible by leveraging shared knowledge, infrastructure and resources, including energy systems, in environmentally benign ways. The sustenance of high quality and productive energy systems, on the other hand, is conditional to the end-users deriving a high degree of social and economic value from energy services, making them invested in the system's success. Ignoring and sidestepping this critical complementarity prevents thousands of vulnerable and poor communities from adopting clean energy systems and successfully pursuing sustainable development.

A poor understanding of local sustainability aspirations undercuts global sustainability ambitions of a clean energy transition. This results largely from contemporary strategies for energy transitions that lack nuanced and explicit approaches to address the social, economic, cultural, infrastructural and governance attributes of resilient and sustainable futures in vulnerable places. In fact, most clean energy transition strategies are geared towards mitigation goals at the global scale and ill equipped to address urgent adaptations to climate vulnerabilities and enduring poverty at local levels.

This report argues for filling this key gap in pursuing local clean energy transitions and sustainable development by putting communities at the center of the solutions to intersecting challenges, and enabling them to creatively imagine and build participatory and inclusive energy systems for resilient futures. Drawing from sixteen narratives of community energy systems from around the globe, this report argues that locally planned, clean energy investments in communities can be long-term investments in food security, socioeconomic opportunities, health and shelter, climate adaptation, community resilience, security, human rights, and democracy. Realizing such co-benefits of clean energy systems, however, requires a shift from top-down design to more localized and bottom-up design:

1.Create new financial models that attribute significant value to community co-benefits.

2.Build situated knowledge and coordination capacities within and around vulnerable communities.

3.Unleash the creativity and innovation of communities to lead the fight against climate change and the transition to a sustainable energy future.

Inclusive climate action is inseparable from letting communities lead their own energy transitions

Saurabh Biswas, Davi E. François, Clark A. Miller, Mary Jane Parmentier, Netra Chettri and Witold-Roger Poganietz

I. Communities at the receiving end of climate strategies

To put it bluntly, most existing plans for cutting emissions to mitigate and adapt to climate risks ignore highly vulnerable populations, undermining their rights and capacities to pursue thriving futures. Consider the Nationally Determined Contributions (NDC) of 75 UN member states, synthesized in the NDC synthesis report[1] from September 2021. The report identifies financial, technological, and institutional strategies to climate mitigation and adaptation across diverse sectors of industry, infrastructure, and the economy, with an emphasis on accelerating adoption of renewable energy, energy efficiency, and waste-to-energy technologies. What is conspicuously missing in this 'sector' based strategy is a grounding of actions in human and geophysical place or arenas where the impacts are being felt and action needs to be situated. This points to a fundamental gap in the recognition of the challenge as a local as well as global phenomena, driven by common physical factors but manifested differently as a result of the human and social conditions of the diverse places where people live. A common consequence of this gap is the exclusion and appropriation of concerns, aspirations, creativity, and knowledge forms of those underrepresented or represented through proxies – the vulnerable and marginalized communities of the world.

Mere recognition is not sufficient, as some of the NDCs do by inviting participation of local communities, indigenous groups, and gender equity advocates in framing the problems. The innovation, imagination, and social capital of local actors in vulnerable places and situations is for all practical purposes, invalidated, as implementation plans rarely feature any roles for them.

Why should it be of any concern that the inclusion of vulnerable and poor communities and groups is limited to their participation in framing problems and not in the performance of solutions? Is it plausible that high level plans for sectors of the economy and top-down mobilization of resources for the ecosystem's health will result in mitigation and adaptation outcomes that somehow addresses the local vulnerabilities and sustainability challenges at the community level? The answer does not seem to be complicated. A sustainable planet will not be a reality unless millions of poor and vulnerable people in marginalized communities around the world are capable of pursuing sustainable development goals locally, by leveraging shared knowledge, infrastructure and resources in environmentally benign ways. This implies a need for the pursuit and realization of multiple Sustainable Development Goals (SDGs) at the community level. However, such a community level approach to the SDGs is held back by a local-global paradox – when global systems fail to translate sustainability goals to local actions, and *vice-versa*, local sustainability challenges fail to find adequate expression in global goals. The paradox manifests in many ways, resulting in strategies and actions that ignore, extract or deplete various kinds of capital at the local level (sometimes unintentionally, but, unfortunately, sometimes intentionally), instead of intentionally coordinating and empowering local innovation, creativity and values-based action.

1 https://unfccc.int/sites/default/files/resource/cma2021_08_adv_1.pdf

As an illustration of the local and global paradox in sustainability strategies, consider the interplay among the elements of three closely associated SDGs: 7 (access to clean and affordable energy), 1 (no poverty) and 8 (decent work and economic growth). Do the goals and targets harmonize in ways such that sustainable outcomes emerge in each domain? While targets[2] for goals 1 and 8 specify a range of actors by role, demography, climate vulnerability and location, targets for goal 7 are devoid of this specificity. Moreover, targets for goals 1 and 8 incorporate complementary infrastructural and social variables in interventions spanning natural resources, finances and economic arrangements, governance, entrepreneurship, creativity and innovation, targets for goal 7 are again found lacking in this nuance. Thus, as SDG 7 aims narrowly at installing clean energy systems without consideration to positive or negative implications for local vulnerabilities and opportunities, a very real scenario can emerge where SDG 7 and its target are achieved with little to no impacts on SDGs 1 and 8. Fully electrified urban slums in many parts of the world are manifestations of this paradox. If pursued independently of other local sustainable development goals, SDG 7 could lead to the creation of a zero-emission energy systems that, far from helping tackle poverty and social and economic injustices, inadvertently deepen these problems and push vulnerable communities further into harm's way. Such an outcome would be a collective planetary failure.

Transcending this paradox would mean harmonizing the sustainable development goals of people and communities with the collective need to reduce emissions and planetary harm at the global level. Plural sustainable futures at local levels add up towards a sustainable planet, yet at the same time are dependent on the strategic directions of the global systems of technology, governance and finances being sensitive to the local needs. Setting collective goals and intentions are a great start; however, it is past time that actions were designed to achieve those goals locally in the face of on-the-ground situational realities. Energy systems can no more be an end unto themselves and must be made accountable to other SDGs. Their designs and implementation must be led by concrete visions and plans to create multidimensional, multilateral benefits or 'co-benefits'.

Co-benefits can be understood as contextually defined sustainable development outcomes that enhance social, economic, and ecological well-being of the communities hosting energy projects, while advancing progress on the shared concerns of climate, biodiversity and natural resource management.

Before exploring the design choices highlighted in this collection for producing co-benefits through energy systems in vulnerable communities, let us revisit the challenges surrounding the current design paradigm or the design problem. This design problem underlies the slower than anticipated pace of universal energy access programs[3] and barriers to investments in the sector[4], as well as the limited utilization of clean energy technology for localized climate change adaptation in vulnerable communities.

II. Socio-Energy thriving futures and climate action: a design problem

Many communities around the world are distinguishable by a set of social, ecological, and economic challenges (e.g., systemic poverty, racial and ethnic discrimination, pronounced risks of natural disasters, lack of basic infrastructure, dependencies for food and fuel) and face unusually high barriers to successful integration of clean energy systems. The geospatial overlap of communities with insufficient and unreliable access to electricity and modern cooking fuels, with that of socio-economic and climate vulnerabilities tells an important story about the relationship between energy insecurity and broader social and economic insecurities.

2 https://www.undp.org/sustainable-development-goals

3 SDG7: Tracking Progress 2021 https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2021/Jun/SDG7_Tracking_Progress_2021.pdf

4 https://www.iea.org/reports/sdg7-data-and-projections

According to climate risk assessments[5,6] the five countries that suffered the worst devastation and damage due climate change in the 21st century are the Philippines, Pakistan, Puerto Rico, Myanmar and Haiti. In each case, the high socio-economic costs of climate change corresponded to either low levels of access to energy or unreliable and fragile energy systems.

The compromised capacity to power essential services in the first place and subsequently the inability to energize the recovery has prolonged suffering, causing harm over generations. Considering the geographical location of each of the countries, it does not come as a surprise that they would be highly vulnerable to the human and social costs of climate change. What prevented the planning, design and operations of energy systems that would have made the infrastructures, services and consequently the communities less vulnerable and more resilient? A possible explanation can be found in the divergences between the institutional approaches to framing climate risks and vulnerabilities, and that of clean energy transitions.

The accumulation of factors causing climate change are historical and transcends boundaries. However the manifested outcomes of disaster are acutely local, unevenly distributed and perpetuate impact through generations. Moreover, the distribution of losses from climate catastrophes, the extent and intensity of humanitarian crises, and the cascade of co-disasters is much more prevalent in places where the capacity to resist and recover is weak. Therefore, capacities for weathering, coping, recovering and resiliently pursuing sustainable futures in the face of climate change are weakened further. Remember that these capacities are already compromised due to the existing socio-economic, governance, infrastructural and technological inequities.

5 Global Climate Risk Index 2021: Who suffers most from extreme weather events? GermanWatch https://germanwatch.org/sites/default/files/Global%20Climate%20Risk%20Index%202021_2.pdf

6 Climate risk and response: Physical hazards and socioeconomic impacts. McKinsey Global Institute https://www.mckinsey.com/business-functions/sustainability/our-insights/climate-risk-and-response-physical-hazards-and-socioeconomic-impacts

Strategic directions of clean energy transitions, on the other hand, are guided largely by infrastructural goals and technological uptake targets. The premises on which the goals and targets of SDG7 and the energy plans of many NDCs are based, assume that current energy systems can be made emissions free and drive increased generation of equitable socio-economic benefits for more people. While the former is technologically plausible, the latter is severely conditional to the design of goal driven systems that incorporate technologies and social variables in mutually beneficial arrangements – a socio-energy system. Even considering merely the question of climate vulnerabilities and their socio-economic impacts, emissions reductions or net-zero energy systems at best mitigate the historical accumulation and further intensification of climate change. The strategy lacks the capability to create adaptive systems for the current deficiencies in local sustainable development outcomes, to enable capacities to cope and recover from compounded co-disasters, and to prioritize interventions that rapidly reverse the decline in the human and social condition of the most vulnerable.

So, while SDG7 and other supply side transition approaches are primarily driven by mitigation goals, these fall woefully short of adaptation goals and as a consequence, short on the other SDGs that are deeply linked to clean, adequate, well governed and people-centered energy systems – aka socio-energy thriving futures. From a vulnerability and resilience standpoint, the same fundamental inadequacy of possessing a multi-level focus prevents investments in clean energy systems from also advancing resilience to local climate impacts. In this respect, well intentioned plans, investments, and goals face a design problem in creating socio-energy thriving futures.

III. Let Communities Lead: people and planet centered design strategy for climate smart energy systems

Beginning with a shared acknowledgement and realization that mere access to clean energy infra-

structure and services are not sufficient for achieving sustainability outcomes, a better framing of socially and environmentally valuable energy systems can be embarked upon. In this report, stories from communities undertaking local clean energy initiatives demonstrate that one such framing is to *Let Communities Lead* their own sustainable energy transitions.

Letting communities lead translates to the integration of clean energy technology and investments with the social capital and capacities of the people it is meant to serve. Letting communities lead means ensuring energy systems identify and are designed to address a range of local vulnerabilities and development needs. Letting communities lead means that the planning of energy systems engages community members as stakeholders, leaders and transformation agents, rather than mere "beneficiaries" or "end users" as it is commonly assumed in business-as-usual interventions. Finally, letting communities lead begins from a shared value system of inclusive representation and respectful partnerships, where responsibilities and risks are shared equitably considering the socio-political standing of each stakeholder.

Letting communities lead their own energy transitions is a pragmatic turn necessary at this juncture, where the destruction from climate change is no more a distant tomorrow and is disproportionately ravaging lives and livelihoods of the poor and vulnerable. From a climate justice standpoint, this will be a concrete step towards the legitimization of the right to self-determine sustainable development for communities, who have historically been left out and disproportionately bear the negative consequences of fossil fuel led industrialization.

The stories in this report illustrate key design aspects of clean energy projects that result in sustained co-benefits encompassing a cluster of SDGs. While some projects started with design guidelines from stakeholders, the others demonstrate a learning curve through trials and adaptations along the project cycle. Below are the four key similarities we find across the stories:

- The rationale for energy projects is strongly situated in locally relevant sustainable development problems and climate adaptation questions (e.g., threatened livelihoods, new forms of income, drinking water and food security, lowering cost and emission burden of fuel sources).

- Finding the rationale for energy projects is a process of discovery that involves participation of a variety of actors but most importantly the community members. In addition to identifying a set of synergistic development goals, the process incorporates socio-cultural values and aspirations by supporting and complementing existing social practices (e.g., sharing and informal economies).

- Organizational, management and financial arrangements are co-designed considering the capacities and skills of participating stakeholders. This mitigates project risks, improves sense of ownership, and avoids inequitable distribution of burdens or vulnerabilities.

- An emerging quality observed in most communities engaged in co-designing energy projects is the increasing participation and engagement in deliberative community platforms, going beyond energy project decisions. This can be attributed to the intent and commitment of project sponsors to inclusive and continued engagement platforms.

The stories here provide only a peek into the massive potential of community-led transitions of local energy systems that generate co-benefits in a variety of socio-economic and environmental aspects of community life. At a collective level, not only do they contribute to the momentum of cutting current and new emissions from energy use, but help address other forms of ecologically damaging activities like deforestation, loss of biodiversity, local pollution from waste, unsustainable food production and supply, overexploitation and pollution of water resources, etc. At the local community level, the co-benefits of community-led energy systems extend to several contextual sustainability issues at the intersection of

social, ecological, and economic challenges in these communities. Otherwise, expecting the most vulnerable of populations to become party to climate goals without equitably contributing to their development aspirations is unfair and will not only be a climate disaster but a humanitarian disaster resulting from our collective moral failure. The lessons highlighted in this report point towards actions the global community must take immediately, to create opportunities that enable and empower poor and vulnerable communities to pursue just and equitable futures powered by clean energy systems.

IV. Inclusive climate strategy and empowered communities: action agenda

A majority of the 770 million people with no access to electricity and the 2.6 billion without access to clean cooking fuels[7] live in countries and regions facing high degrees of multi-dimensional poverty[8], while suffering from increased climate risks and vulnerabilities that lower their capacity to recover from a disaster[5,6]. Many more millions live under similar conditions that co-exist with underwhelming energy systems. Inclusion of the interdependent energy and sustainable development transitions in these communities is imperative to a zero-carbon future for the world. Such place-based transitions will not result from existing mechanisms that lack the reach and flexibility to engage local design needs.

This report draws the attention of the global leaders, policy makers and investors committed to clean energy transitions, offering concrete actions to fulfill aspirations of the climate agenda framed by agencies like the Intergovernmental Panel on Climate Change (IPCC) and United Nations Framework Convention on Climate Change (UNFCCC). It is also a reminder to the global body of actors emerging from the COP26 that the only strategic pathway for a sustainable transition is a fair, equitable and just transition that leaves no community behind.

Action 1: Create new financial models that account for community co-benefits

1.1. Urgently allocate and direct climate financing to projects that follow a co-benefits approach to energy sufficiency in poor and vulnerable communities around the world. Co-benefits are defined as contextually defined outcomes that enhance social, economic and ecological well-being of the communities hosting energy projects, while advancing progress on the shared concerns of climate, biodiversity and natural resourcemanagement. In other words, target a cluster of SDGs defined and measured in terms of local parameters that cumulatively and synergistically achieve global goals.

1.2. Make communities custodians of climate funds for local projects, empowering them to co-finance social-climate-energy projects with private and public entities. This can be achieved by identifying and nurturing community-based entities to support their journey towards becoming capable governance and financial stakeholders in the sustainable energy transition.

1.3. Mandate SDG based performance parameters in financial reporting for project developers, enabling monitoring and evaluation of co-benefits. Incentivize developers to include co-design activities like scoping studies and stakeholder consultations as capital expenditures to avoid quality gaps or financially burdening developers.

7 https://www.iea.org/reports/sdg7-data-and-projections

8 Global Multidimensional Poverty Index 2021:
Unmasking disparities by ethnicity, caste and gender.
http://hdr.undp.org/sites/default/files/2021_mpi_report_en.pdf

Action 2: Build situated knowledge and coordination capacities within and around vulnerable communities

2.1. Rapidly develop coordinated knowledge production infrastructure across local, regional and national levels of governance. This would enable global, national and local actors to collaborate and produce place-based knowledge on specific transition needs, learn and adapt best practices from experts, and coordinate across levels of governance to implement community-led energy projects.

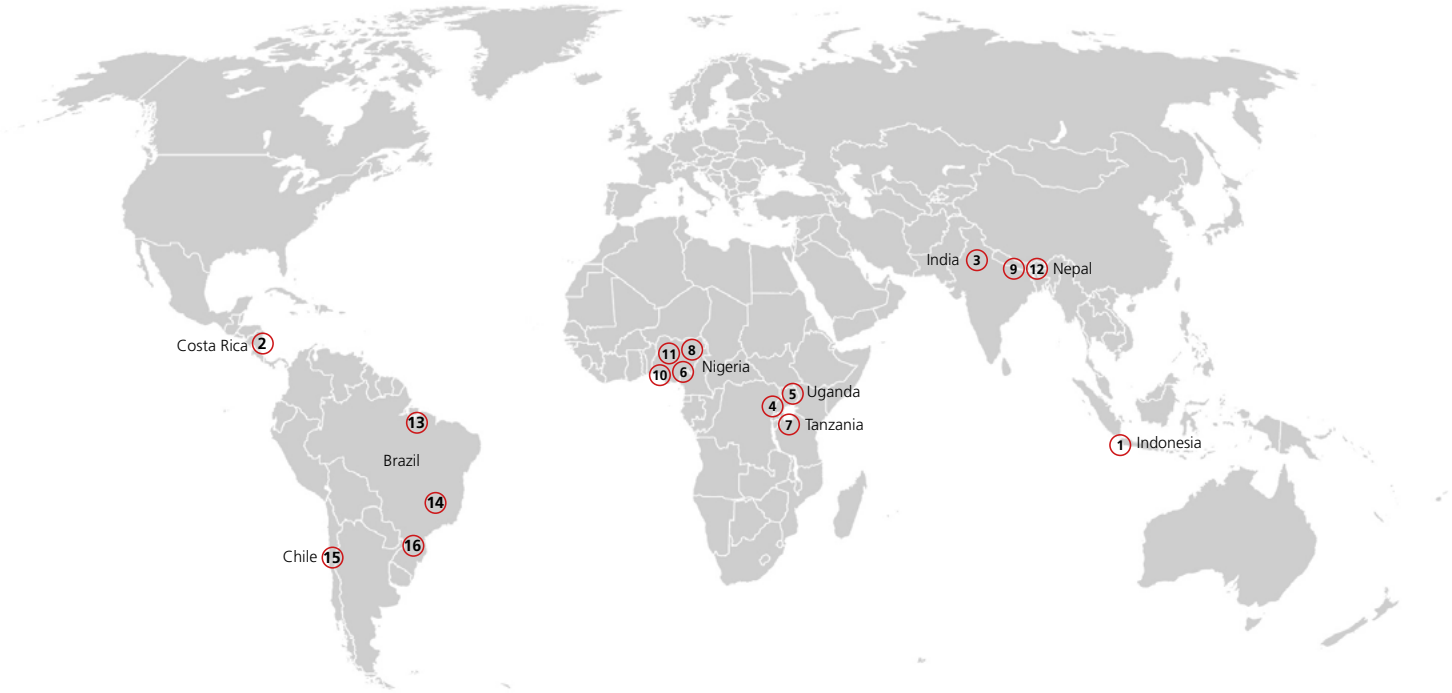
2.2. Create participatory platforms for adaptive sustainable development at local levels. Empowering local actors fosters greater public participation and ownership of the idea of sustainability. Thus, building the critical infrastructure of participatory platforms for knowledge and local governance of transitions bridges the gaps in aligning clean energy technology to social and economic justice of vulnerable groups.

Action 3: Mainstream bottom-up climate action through community led energy projects

3.1. Legitimize the rights and participation of the poor and vulnerable to act for themselves through legislations for locally determined climate action bodies. Well-intentioned actions in the past have repeatedly failed to support grassroots transitions due to their insensitivity to the local context. Actions 1 & 2 recommended above will most likely suffer the same fate unless the intention is accompanied by a shift in the global value system that valorizes top-down interventions over initiatives by local actors. Recognition of the right and legitimacy of the poor and vulnerable to act for themselves and the global community should materialize by not only decentralizing or localizing climate action, but also by devolving the financial and governance authority to act.

3.2. Modify SDG7 targets to include the imagination, creativity, and innovations of poor and vulnerable communities, explicitly cross-linking it to the localized targets of other environmental and human development SDGs. A just and equitable transition to a zero-carbon future is only possible when the imaginations, aspirations and creativity of the poor and vulnerable communities are represented and accepted at the global platform. This becomes even more critical as the COVID-19 pandemic has thwarted much of the gradual progress of the past few decades. Making SDG7 meaningfully contribute co-benefits for people and the planet requires its targets to be in sync with local realities and conditions, enabling a stronger overlap with other SDGs.

ABOUT THE VOLUME



In early 2021, the Let Communities Lead project was envisioned by the team at Arizona State University (ASU) and Karlsruhe Institute of Technology (KIT), as a continuation of their past collaborations with grassroots changemakers. The goal of the project is to advance the state of knowledge and actions for increased empowerment, local ownership, and self-governance capacities in 'community-based, energy for sustainable development' projects. To grow the network of collaborators and showcase concepts, innovations and best practices at work, a call for collaboration and contributing real world stories of sustainable change through energy projects was launched. This call asked particularly for narratives that illustrated the interplay of socio-political, technical, and organizational arrangements and capacities in the communities, leading up to implementation and operation of energy projects. Authors would narrate the beneficial outcomes being created by the energy projects in the community, while reflecting upon the processes of planning, consultations and implementation to illustrate challenges and anticipate possible negative consequences in the near and long term.

This report is a collection of sixteen such narratives of community-based clean energy initiatives, illustrating the social, economic and ecological dimensions at various stages of intervention. Each narrative is contributed by individuals or entities with direct involvement in some or all aspects of the project being narrated. Through a constructive review process, the authors and the editorial team collaborated to distill lessons from each story and present them to readers from diverse disciplinary backgrounds. Keeping the original narratives unchanged and narrated in the voice of the primary stakeholders, this collection

celebrates the innovative and entrepreneurial spirit of grassroots changemakers. Each narrative describes interlinkages between clean energy projects, community resilience and the achievement of multiple SDGs, underscoring why it is vital to **Let Communities Lead**.

The first story from the Cibodas village in Indonesia narrates the journey of a collaboration between local farmers and several entities in making Cibodas an award winning, energy independent community. Contributed by the Resilience Development Initiative (RDI) foundation, the narrative demonstrates how quality of life, agricultural, environmental and organizational co-benefits formed the core of planning and implementing bio-energy technology. A similar story describing three rural communities in Costa Rica – San Isidro, La Rita and La Alegría – highlights a different set of challenges in productive integration of biodigesters with small-scale family farming practices. Contributed by a joint team of authors from the Wuppertal Institute and Universidad de Costa Rica, it describes a cooperative learning and civic leadership approach to pursue culturally appropriate energy solutions.

The third story from the Bareilly district in northern India demonstrates co-benefits of coupling off-grid electricity with socio-economic empowerment of the community. Self-reliance through skill-based livelihoods feature as the design aspiration of the project. The team from Mrida Group, Indian Institute of Science and Manipal Institute of Technology, report how the project goes beyond energy access to create newer forms of value for the community of Tahtajpur. A similar range of co-benefits through intentional design can be witnessed in the next story from a rural community in Uganda, where a solar energy business exists primarily to finance healthcare, childcare, education and other social goals that might emerge. Helmed by the local non-profit Uganda Empowers, the value of solar electricity is multi-faceted and goes beyond the electron. However, the challenges to such enterprises are multiple and limit their social potential, as the authors of the next story describe. Contributed by the team at ENVenture, the authors reflect on their years of experience in incubating several social entrepreneurs for rural energy access in Uganda.

The next set of stories highlight a transformative co-benefit of local energy systems – empowering women through energy applications. In Aba, Nigeria, a constellation of support groups works with women led enterprises, empowering them to capitalize clean energy technologies to improve their income and create healthier living conditions for their families. In rural communities of Tanzania, women are training themselves to make data-based decisions on clean energy applications by utilizing smart meters with clean cooking appliances. In the state of Bauchi in Nigeria, internally displaced women are rediscovering dignified socio-economic integration through clean energy entrepreneurship. Authors highlight the crucial role of involving multiple entities to support the projects like Clean Technology Hub, who played a key role in all three projects in collaboration with Access to Energy Institute (A2EI) and Solar Sister. Another organizational aspect is highlighted in Dhapsung, Nepal, where women are not only the center of the benefits of an energy project but are leading its vision and implementation. Together with Digo Bikas Institute (DBI), the group of women bring their indigenous knowledge to advance democratic governance of electricity and sustainability outcomes in the community.

A high value co-benefit of community energy projects in rural areas is in strengthening agriculture. Reducing losses from post-harvest wastage has direct implications for farmer incomes and reducing emissions. Cold storage projects co-designed with users to ensure appropriate location, operations and maintenance prove to be highly effective, as the story from Emu in Nigeria shows. Similar economic and ecological co-benefits of community scale energy projects are demonstrated at Wuse in Nigeria, where thousands of commercial and residential facilities are making the

shift from diesel powered generators to cleaner electricity. Better quality electricity, higher productivity and reduced carbon footprint is achieved in both projects through meaningful partnerships that the public and private entities have built with the community.

The final stories reinforce the key message that the realization of co-benefits from energy projects is contingent upon the leadership of the community at every level of visioning, planning, implementation and operation. Community-managed electric utilities in rural Nepal have proven to be able to provide better services than the national grid while being more responsive to community needs. Critical evaluations conducted by Winrock International and Oxford Policy Management finds this to be possible due to the leadership and ownership by the community in various aspects of the business model. The values of solidarity and inclusive innovation are a key ethical foundation of such projects, a point effectively illustrated by the story from Ilha das Cinzas in the Brazilian Amazon, where the local riverbank group Associação dos Trabalhadores Agroextrativistas da Ilha das Cinzas (ATAIC) and their partners are working on food sovereignty through solar projects. Even in marginalized urban areas like the Babilônia and Chapéu Mangueira favelas in Rio de Janeiro, Brazil, co-benefits can be attributed to the democratic processes and leadership of community members. The cooperative model led by Revolusolar aims to revolutionize the energy democracy landscape for the city and the country, one favela at a time. The Solar Buin project in Chile has a similar cooperative approach and aims to foster a conducive ecosystem of finance, policy and governance to support the development of more energy cooperatives. A review of the structures and operations of energy cooperatives in Brazil, contributed by the Institute for Development of Alternative Energy in Latin America (IDEAL) and the German Cooperative and Raiffeisen Confederation (DGRV), delves into the strengths and opportunities for cooperatives to multiply and grow the co-benefits that lead to sustainable communities.
The stories presented in this report underline the values of solidarity and equitable distribution of benefits as fundamental to community-led energy projects, positioning them at the forefront of local transformations that pursue clean energy, poverty alleviation and climate justice for marginalized communities.

Biogas use for a lighting appliance. (1.1)

The power of grassroots energy innovation to transform lives in Java

COMMUNITY-ORGANIZED BIODIGESTERS IN RURAL INDONESIA SHOW THE POWER OF INTEGRATING SOCIAL AND TECHNOLOGICAL INNOVATION TO CREATE ENERGY INDEPENDENCE.

Overview

This narrative tells about the small-scale rural community-based biogas implementation in Indonesia, with a case study in Cibodas, West Java, which helps the community to convert the organic wastes from livestock and farming activities into biogas and bio-slurry. While the main activity tends to focus on renewable energy, the benefits of biogas take many forms: economy, social, and environment. The narrative also presents the success stories in implementing community-based biogas, the challenges, and how they overcome the problems.

Background and stakeholders

Cibodas Village is located in Lembang Sub-District, West Bandung Regency, West Java Province, Indonesia. The largest land use in this village is agriculture (433.72 Ha) and it has a population number of 10,112 inhabitants, 66% of those are working in livestock and farming activities (Indraprahasta and Alamsyah, 2014). Cibodas is well known for having local economic potentials in farming and livestock, especially in dairy cattle production. However, externalities produced by those activities such as unprocessed animal manure and crop waste usually ended up in the Cikapundung River. Therefore, the idea of

A community member managing a biodigester in Central Java Province. (1.2)

adopting biodigester has been emerged to solve the waste management issue while providing benefits to the Cibodas community simultaneously (Alberdi et al, 2018). This narrative explores small-scale rural community-based biogas implementation in Indonesia that helps farmers on the production of renewable energy and also livelihood in general.

The home-based biogas (BIRU) project in Cibodas started in 2011 coordinated by Yayasan Rumah Energi (YRE). The BIRU project set a clear goal to provide alternative energy based on rural communities empowerment using local potentials (Soetedjo et al, 2019; Aditya, 2020). In the beginning, this program was entirely funded by the Royal Netherlands Embassy and it was supported by the Ministry of Energy and Mineral Resources of the Republic of Indonesia and the local government. Along the way, more stakeholders were involved in this project, including the Cibodas community, private sectors and Construction Partner Organizations (CPOs). Communication among stakeholders is facilitated by YRE as a technical coordinator on site.

The key success of the Biogas project implementation in Cibodas lies in the roles of many actors – YRE, CPO, and North Bandung Cattle Farmer Group (KPSBU). KPSBU facilitated from the private sector (Rabobank Foundation) with a win-win solution financing scheme. Rabobank Foundation gives capital for upfront costs of biodigester installation while in return, cattle farmers pay by installments from cuts of their profit of milk production to the KPSBU regularly (Indraprahasta and Alamsyah, 2014). The long and good relationship which has been built between KPSBU and local farmers also contributes to the success of this project through trust, good record keeping, and as part of the market chain of the milk produced by the farmers. In addition, the technical aspect is handled by the CPO which includes the role of installing, maintaining, and controlling the quality of biodigester reactor machines. Moreover, they have an after-sales service and dedicated hotline to manage problems from users. After the installation has been carried out by the CPO, the local community operates biodigester reactors and cultivates the products and byproducts of the process, getting several benefits from biogas and bio-slurry for their daily lives.

The direct and indirect impacts

Until 2018, 775 biodigester reactors have been built in Cibodas (Alberdi et al, 2018). The most obvious impact of this project is providing alternative energy for cooking appliances, meaning that Cibodas people can save the amount of money from buying Liquid Petroleum Gas (LPG) canisters, which averagely equals three canisters in two months' expenses (Aditya, 2020). The people are also able to have alternative energy for their home lighting by using biogas, as saving to electricity usage provided by the State Electricity Company (PLN). Through these success stories, Cibodas was awarded as an energy-independent village by the Ministry of Energy and Mineral Resource of the Republic of Indonesia in 2016 (Aditya, 2020).

In addition, the bio-slurry as a byproduct of the process provides economic benefits for the Cibodas community. In the farming production system, bio-slurry plays an important role for the organic fertilizer for growing grass as food supplies for their cattle. Some bio-slurry products are also used and sold to other farmers. Another impact of this program is women empowerment through Kampung Areng's Kelompok Karya Ibu – Cibodas that has developed a business of worm farming from bio-slurry products, with members consisting of wives of farmers (Alberdi et al, 2018). These women's activities eventually led to the establishment of a waste bank that made the village cleaner and also additional income for them.

While taking advantage of the product and byproduct of biogas reaction, the overall process also can be seen as waste management systems that have benefits to the environment of West Bandung Regency. Some farmers reduced the animal manure and organic waste thrown into the Cikapundung River and. While considered minimal, converting animal manure into biogas also contributed to the reduction of local GHG emissions. Thus, the direct and indirect impact of the biogas project can take various forms (economic, social, and environment). A similar result on the benefit of biogas is also observed in Central Java (Hnyine et al 2016).

Challenges and limitations

The first challenge to deploy more biodigester in Cibodas Village is the limited land availability and its ownership. It happens not only for the installation of biodigester but also for the animal husbandry area. Some of Cibodas' agricultural land has been changed to eco-tourism resorts. To be able to install one biodigester reactor, a farmer needs at least 4-10 m^2 of the area, including space for the bio-slurry and its piping access. Not every farmer has this privilege. To overcome this challenge, people usually build biodigester close to their homes to reduce the access and the use of land.

Community member operating a biodigester. (1.3)

Profile

Resilience Development Initiative (RDI) is an Indonesia think tank that focuses on disaster and climate resilience, renewable energy systems, gender equality, children welfare, and sustainable development issues, among others. RDI plays a part in contributing to the body of knowledge on sustainable development, social issues, and resilience research studies. RDI also provides creative ideas to solve resilience issues by publishing working papers, conference proceedings, and journal papers. RDI members also actively attend national and international conferences to disseminate RDI research findings.

In addition, 82 of the biodigesters that have been installed by the government independently (different from the BIRU project) are broken. It happens because the government gave the technology to the users without planning follow-up activities, such as monitoring and maintenance of the biodigester (Aditya, 2020). This sustainability problem then became an input for the improvement of the BIRU project in ensuring the quality of after-sales service. Finally, the BIRU project has made a standard for the technical side of biodigester reactors, so the monitoring and maintenance by the CPO can be done easily and accurately. Although the BIRU project in Cibodas has contributed to alternative access to energy, there are still some challenges and limitations in this project. However, through communication among stakeholders, the solution and improvement can be found.

Acknowledgement

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Photo credit: (1.1;1.2) Indonesia Domestic Biogas Program (IDBP); (1.3) RDI

Some of the families have been using their biodigesters for as long as 10 years. (2.1)

Collaborative learning helps farmers get the most benefit out of biodigesters

LEARNING TOGETHER, IMPROVING LIVES TOGETHER: ENGAGED, TRANSFORMATIVE RESEARCH METHODS HELP COSTA RICAN FAMILY FARMERS TO MEET THEIR ENERGY NEEDS AND IMPROVE LIVELIHOODS.

Overview

How can the uptake and long-term integration of biodigesters into family farming practices be assured? A collaboration between Asobiogas, Costa Rica's biogas association, and the Wuppertal Institute is taking a transformative research approach to tackle this question. A series of mutual learning exchanges is enabling the participating families to familiarise themselves with the project, and greater understanding is being developed about the needs of biodigester users and the potential role that biodigesters can play in leading the transition to more sustainable energy and food systems in their communities.

Family farmers in Costa Rica are facing different challenges

Family farming as a way of life plays a vital role in Costa Rica's rural regions. Small farms (up to 3 ha) and mid-size farms (up to 10 ha) account for more than half the farms in the country and are the basis for food security and sustainable food systems in a country that relies heavily on imports. Family farmers grow a variety of crops, such as cassava, plantain and maize, and raise pigs and cows. While families can support themselves by selling some of their produce, and may have small additional sources of income, they still face a number of challenges including fluctuating food prices and the effects of the climate crisis. During the COVID-19 pandemic, family farmers were identified as a major focus of the government's plan for economic recovery and resilience.

The benefits of biodigesters

A variety of actors are working to strengthen the livelihoods of family farmers in Costa Rica and to promote climate-smart agriculture. Integrating anaerobic biodigestion into family farming practices has significant promise in this context. The use of biodigesters can have multiple benefits for the farming families, their communities and the country's economy. Biodigesters create economic savings by replacing liquified petroleum gas (LPG) for cooking, improve the productivity of farms, decrease water pollution caused

Emilio, Rosa María, María Solano and Ana Ramírez, biodigester owners, show the project team the layout of their family farm. (2.2), (2.3)

by animal waste and potentially reduce the use of synthetic fertilisers. In addition, the management of animal manure contributes to preserving water and soil quality and to reducing the agricultural sector's greenhouse gas emissions.

How to best integrate the technology into family farming practices?

Biodigesters are not a recent technology for Costa Rican family farmers, where a typical family owns one to ten cows and two to ten pigs. The number of domestic biodigesters installed over the last two decades in Costa Rica amounts to several thousand. As in other areas of Latin America, plastic tubular designs originally designed in Asia were adapted for the local context and widely promoted by governments, universities and donor programmes. National institutions – such as the ministries of energy, health and agriculture – promoted these biodigesters and facilitated access to them at highly subsidised rates.

However, in common with other regions of Latin America, there were many challenges in terms of the operation and maintenance of the biodigesters. These included difficulties in integrating them into the daily reality of the farms' activities, as well as a lack of sustained capacity building. Consequently, there is a high rate of abandonment of biodigesters among family farmers and few families have continued to use the technology in the long term.

Taking a transformative research approach

Confidence in biodigesters is waning and their potential remains underexploited. A collaborative project between Asobiogas (Costa Rica's biogas association) and the Wuppertal Institute set out to address this challenge by investigating how to ensure the uptake and long-term integration of biodigesters into family farming practices. The project works closely with farming families in three communities (San Isidro, La Rita and La Alegría) in two different Costa Rican provinces (Alajuela and Limón).

The project follows a transformative research approach in which knowledge production and action for change are systematically intertwined by facilitating spaces for joint reflection and mutual learning by different stakeholders. The vision is for families with experience and knowhow in integrating biodigesters into their livelihoods to become drivers of transformation in their communities: their farms can become learning spaces where the families can lead and inspire.

The starting point were fourteen family farmers who have successfully integrated biodigesters into their livelihoods and have been using them for 2 or 3 years (some have been using biodigesters for up to 10 years). These families collaborated on an equal footing with researchers, local practitioners and other stakeholders. Through a series of exchanges, the families learnt about the project, and we developed a better understanding of the families' livelihoods, the different activities on their farms, the resources available to them (mostly non-monetary) and the role that biodigesters play in their activities.

Learning from each other through the exchange of experiences

These exchanges demonstrated that all the families who used their biodigesters regularly were convinced of their benefits: they perceived significant savings in terms of fuel costs (including the avoidance of travel costs for purchasing fuel) and for cleaning stables and pigsties. They all used biogas for household cooking, although few used it for other productive uses – despite the potential for biogas use in cheese and dairy processing.

We also learnt that even families convinced of the benefits of biodigesters have faced various challenges in terms of making the technology work in their daily lives. For instance, in many cases the first biodigester failed and it was only possible to achieve continuous operation and for the family to experience the benefits of the technology after the installation of a second biodigester (with improved design and installation). The motivation and persistence of families (or of single family members) was particularly important for the successful adoption of the technology. As Jafeth Garita (a young Farmer in San Isidro) told us: "*Tuvimos uno que ese prácticamente no nos funcionó. Tal vez no le dimos el mantenimiento que se debía. Después tuvimos otro que tampoco nos funcionó. Y mi papá no se dio por vencido, porque digamos … siempre creyó en eso. Siempre vio una buena oportunidad, verdad? De ahorrar más que todo dinero en gas. Y pues ya esa última vez que fue, ya cuando nos funcionó. Ya llevamos casi tres años. Sin tener ningún tipo de fallo*". "We had one [biodigester] that

Profile

Asobiogas is an association based in Costa Rica consisting of producers, professionals, students and organisations who believe in the benefits that anaerobic biodigestion can bring to sustainable development and empowerment. It seeks to contribute to the promotion of anaerobic biodigestion in Costa Rica as applied to wastewater, organic waste and landfills. It does so by articulating research efforts, supporting training and outreach activities, and leading the development, advocacy and implementation of policies and technologies in the public, private and civil society sectors and in international cooperation.

WISIONS is an initiative of the Wuppertal Institute. Since 2004, WISIONS actively supports the transition to need-oriented sustainable energy systems in the global South. Our mission is to empower individuals and communities to transform the production and use of energy so that it effectively enables sustainable development. Three activities support this goal:

- *Partnerships and Networks[1] – facilitating knowledge development and sharing among local practitioners.*
- *SEPS Energy Projects[2] – nurturing sustainable innovations and knowledge exchange. Since its foundation, SEPS has provided financial support to 98 projects and 30 exchange activities in 39 countries around the world.*
- *Research[3] – linking the work of local energy practitioners with Wuppertal Institute's transformative research approach.*

1 https://www.wisions.net/partnerships-and-networks
2 https://www.wisions.net/pages/seps-energy-projects
3 https://www.wisions.net/pages/prep-good-practice

practically didn't work. Maybe we didn't give it the maintenance it needed. Then we had another one that didn't work either. But my dad didn't give up … he always saw a good opportunity in it for saving money by replacing the use of LPG. And the last time it worked and has continued for almost three years without having any kind of failure."

However, even in these successful cases there are still possibilities for improvement: to raise awareness among the stakeholders (families and institutions) about the potential use of bio-fertiliser; to exploit biogas for productive uses; and to develop the safety and ergonomic standards of the biogas stoves and in the kitchens.

Room for improvement

Our exchanges with the families and local experts indicate that ensuring the uptake and long-term use of biodigesters in Costa Rica requires families to make changes on their farms and in their daily routines. Changes in the values and assumptions of all the actors involved (including the farmers, the suppliers and the financiers) are equally important. For instance, consolidating technical standards can significantly reduce the rate of failure associated with design and installation. Programmes promoting the technology can make use of different tools to assess its techno-economic potential as well as the needs and motivations of the beneficiaries. Moreover, such programmes can increase the rates of sustainable adoption of the technology by providing capacity building to the families and ensuring regular post-installation technical support.

We analysed and discussed our initial findings with a broader group of stakeholders comprising experts from academia, biodigester suppliers and farmers. A handbook was also developed, which focused on the operation and maintenance of tubular biodigesters.

Taking our findings to the next level

The project ultimately aims to build a multistakeholder partnership that will serve as a knowledge exchange platform to revive biogas technologies in Costa Rica. In the next steps, the findings will inform the development of capacity building activities to implement locally in the three communities, with the aim of replicating such activities in broader settings. The activities will be supported by the WISIONS pro-

All 14 families used biogas for domestic cooking, but few used it for other productive uses. (2.4)

Many Costa Rican family farmers abandon their biodigesters – how can we counter this? (2.5)

gramme[1] and will include peer-to-peer dialogues, introduction to technical concepts and procedures and hands-on training sessions. The workshops will take place on the family farms and will involve representatives of 10 to 15 families from the same community. The aim is to reach families who have never owned a biodigester, as well as those who have abandoned the technology. The next steps will also explore strategies to exploit the full potential of biodigesters, including their use in productive activities and as a reliable and sustainable source of fertiliser. We hope this will help to rebuild trust in the technology among Costa Rican family farmers and all the relevant actors in the sector.

1 http://www.wisions.net/

Key lessons

- Local champion families can lead capacity building at local level.
- Integrating sustainable energy into family farming requires a holistic approach.
- Mutual learning processes have the potential to trigger local transformations.
- Re-building trust in technology is complex! It requires that we reflect on why early approaches failed.

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Photo credit: (2.1;2.2;2.3;2.4;2.5) Asobiogas

Women in Tahtajpur tailoring at the Rajlakshmi Stitching Center established through the community fund. (3.1)

Energizing the aspirations of rural communities in Bareilly, India

OFF-GRID ELECTRICITY CREATES A VIRTUOUS CIRCLE OF EMPOWERMENT, EMPLOYMENT, ASPIRATION, AND SELF-RELIANCE.

Overview

We present an EnergyPlus intervention implemented by the Mrida Group and Infrastructure Leasing & Financial Services Limited in 2014 in Tahtajpur, India. The project involved installing community-managed solar microgrids that provided basic aspiration-driven electricity access for a token monthly payment. The collected amounts contributed to a community-managed development fund that fuelled successful ventures like a tailoring centre for women and agricultural initiatives for farmers whose spill-over benefits spread beyond the village and for several years after the original intervention became redundant.

The overall context of the community Tahtajpur and the EnergyPlus program

Modern energy is a significant driver of human development and welfare. However, merely providing access to energy is inadequate to achieve this goal. It is equally vital to couple energy access with efforts to empower people to use modern energy beneficially. This logic is at the core of "EnergyPlus", a concept first proposed by UNDP in 2012 to promote basic, social, and productive uses of energy by combining critical energy and non-energy interventions[1]. This approach has been argued as the best way to enable the successful adoption of clean energy sources while also achieving holistic human welfare and development.

We illustrate this concept through the case of Tahtajpur, a small village of 110 households on the outskirts of Bareilly in the state of Uttar Pradesh, India. Though located close to the national highway that connects

1 EnergyPlus guidelines: Planning for improved energy access and productive uses of energy, New York, NY, USA, 2015. Available at: https://www.eurasia.undp.org/content/

Bareilly and Shahjahanpur, the village lacked proper access to a basic grid-supplied electricity connection in 2014, as is evident from a survey from that time, which listed only 24 households to have had electricity access in any capacity. This left most of the households to resort to kerosene lamps for their lighting requirements. This lack of energy also corresponded with deprivations in other areas such as education, diversity in occupation, and per capita income. In the same survey, 46 percent of the villagers were found to be illiterate, and 91 percent were involved in either farm or non-farm labor resulting in a per capita income of just INR 1036.7 per month (US$ 17/capita/month). These multidimensional deprivations fed into each other and hindered the ability of the village to escape its meager circumstances.

The Mrida group, in association with Infrastructure Leasing & Financial Services Limited (IL&FS), as part of a corporate social responsibility intervention, introduced an EnergyPlus program in the village in 2014, which could recognize the community-specific bottlenecks in their desired energy-development pathways and provided an environment in which they could be removed. It did so by principally adopting two strategies – first, a bottom-up approach to decide on the exact execution of the program at every level through the formation of a decision-making committee composed of villagers and second, a payment-based mechanism for the people to avail clean energy for their desired end-use. These two strategies ensured a community-centric nature to the intervention and enabled a mechanism to generate funds for other future endeavors that could compound the benefits gained from the initial energy intervention.

The choice of energy source for the initial intervention to provide basic electricity access was a solar PV DC microgrid. Three such 240W microgrids were installed, and through them, 44 households were electrified for a token monthly payment. This payment was instituted to allow the households to realize the value and take ownership of the services from the energy system and be responsible for its maintenance. A survey was also conducted to ascertain the desired energy end-uses of the interested households, and an overwhelming majority indicated a desire for basic lighting and phone charging facility. This makes sense as 98 households in the village in 2014 possessed a mobile phone, and kerosene lamps are considered poor light sources. Therefore, each subscribed household was given two energy-efficient LED bulbs and a single phone charging port. 42 households in the village elected to not avail energy from this intervention initially, either due to unwillingness to pay the token monthly amount or being skeptical of the technology used or a perception that they would soon gain access to electricity through the main grid. Nevertheless, these households were not exempted from the overall program.

The responsibility of deciding the quantum of monthly payments and collecting it was given to the villagers through a village development committee (VDC) which was comprised of local men, women, and youth. The VDC was incentivized to collect the payments via two channels. First, the maintenance of the grids was solely funded by the payments collected. One of the VDC members was designated as an "Urja Mitra" (Electricity Friend) and was trained to do basic maintenance of the micro grid, attend to

Profile

Mrida is an enterprise which seeks to facilitate sustainable and scalable, holistic development at the Bottom of the Pyramid. It works in remote rural areas, using agriculture, energy access, skill development, health, and related interventions as entry points/development triggers to facilitate community engagement, livelihoods, women's empowerment, education among others, leading to all-around development. Mrida's objective is to bring the same rigor and financial discipline of the corporate world into the development sector, showcasing business-led social, economic and environmental impact that is sustainable as well as scalable.

Farmer growing sugarcane in Faridapur Inayat Khan in partnership with Mrida Group. (3.2)

simple matters such as changing bulbs, batteries etc., fault diagnosis in case of issues with the grid and contact a Mrida technician if the issues were serious. This member was paid a nominal amount from the funds collected. The second channel was that any surplus payments collected would contribute towards a village development fund held at a local bank. This fund could be used to better the community welfare as the VDC saw fit and would also serve as a source of micro-credit for any villager's entrepreneurial or upskilling aspirations. This was a key initiative that linked energy access to non-energy aspirations of the community.

Going beyond energy access

A significant opportunity to use this fund was created when a group of women in the village expressed a desire to learn tailoring, and later when a few of them wanted to open a tailoring center[2]. A six-month practical-cum-theoretical training was conducted followed by an advanced National Institute of Open Schooling certified course for those interested. Subsequently, the tailoring center was also established through the fund in 2015. The Mrida group also provided them with crucial market linkages outside the village and helped the business become profitable.

The spillover from this intervention was remarkable as women from the neighboring village of Faridapur Inayat Khan also expressed a desire to open a tailoring center, hoping for similar success[3]. This show of trust and interest provided a unique opportunity for the Mrida Group to shift their interventional perspective from village-level to regional-level development. This manifested not only as the tailoring center in Faridapur Inayat Khan, whose subsequent enormous success transformed it to the main tailoring center in the region, but also into other new initiatives which further compounded the spill-over effects. A partnership with roughly 110 farmers was established across other villages in the region like Kishanpur, Bhimpur Gotiya, and Urla Jagir to improve their farm productivity by providing soil, seed, and other agricultural

2 For information on other interventions, refer: https://www.mridaheartnsoil.com/il-fs

3 For more information, refer: https://www.mridaheartnsoil.com/post/rajlaxmi-stitching-centre-aprajita-vikas-samuh, and also: https://www.indiatoday.in/education-today/how-i-made-it/story/these-up-girls-are-turning-fashion-entrepreneurs-with-sewing-training-and-sending-garments-to-france-1603856-2019-09-27

Honeybee keeping training for local farmers. (3.3)

inputs through the local government operated "Krishi Vigyan Kendra" (Agricultural Knowledge Center). There are also plans currently underway to help the farmers improve their bargaining power in the market by forming a cooperative society and subsequently, a Farmer Producer Organization, with support from the Krishi Vigyan Kendra and the National Bank for Agriculture and Rural Development (NABARD).

All in all, 52 of the 86 households ended up subscribing for the electricity access from the solar PV DC microgrid before the village was electrified through the central grid, making the initial intervention redundant. Regardless, the EnergyPlus nature of the intervention ensured that its benefits compounded and permeated through the village and the neighboring villages, creating a virtuous circle between empowerment, aspiration, earning, and self-reliance for the entire region. The PV DC microgrid was used in tandem with the central grid till the batteries had residual life, but had to be written off when they died. Unfortunately, in absence of a legal contract between the Mrida group and IL&FS and the villagers, the grid could not be dismantled and be used elsewhere afterwards.

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Photo credit: (3.1;3.2;3.3) Mrida Group.

VSLAs created with the support of the UE solar profits. (4.1)

Growing solar energy and reinvesting in community wellbeing

SUCCESSFUL SOLAR ENERGY BUSINESSES CAN NOT ONLY CREATE GREEN ENERGY, THEY CAN ALSO FINANCE IMPROVED HEALTH, CHILD CARE, EDUCATION, AND OTHER COMMUNITY GOALS.

Overview

This is the story of Uganda Empowers (UE), a community-based organization located in the Lwengo district, Uganda, that has extended its community services from HIV/AIDS awareness to the commercialization of solar appliances, charity, environmental protection and capacity building of Village Saving and Loaning Associations (VSLAs). The story also presents the main challenges faced by UE to advance community services and how to overcome such challenges.

Solar Nature: moving beyond energy access

"Shooting two birds with a single stone" is an African saying which means "achieving 2 great things in one action". In 2015 November, Uganda Empowers (UE) learnt of a poor mother, Nalongo Robina, who lost her 1 year child in a fire accident resulting from a local candle which was their only source of light. This incident happened in Kasambya one of the most remote villages in Lwengo district.

When I heard of this accident as a community activist, I visited the family of Robina to say sorry and in a one-on-one communication she told me a very sad story of being HIV+ and a single mother who was trying to survive with her children on their own. I asked her why she wasn't using solar and she replied, "solar is for the rich people". Of course, I could personally understand what she meant because the situation around her home would give a clear answer that Robina couldn't afford buying even the cheapest solar on the market.

Just immediately after going back to the office, I gathered my team and introduced my thoughts and we developed an idea that would not only provide a safe source of power to rural villages but also adjust UE income to facilitate charity services.

Village children posing with donated garden tools and schoolbooks. (4.2)

So we came-up with a final plan of starting a solar project with two primary aims:

1. Providing the rest of solar benefits e.g., safe light, phone charging power, saving money, saving lives and environment, etc.
2. Generating funds to facilitate implementation of UE charity objectives.

And this is what explains "killing two birds in a single shoot". The project was named "Solar Nature" and it was also targeting to protect the environment. UE mobilized some funds and started a small solar shop, did marketing, and the first profits were directed to supporting formation of a Village Saving and Loaning Association – VSLA at Robina's village, since we found out that we can't support people like her in all of their needs.

Because we were touched by Robina's situation, UE decided to use her as an index client, so we approached the village leaders and asked them to support us to identify other vulnerable mothers, especially those living with HIV/AIDS and widows, to join the group. In an effort we call "teach a man how to fish so he can survive on his own for generations instead of giving him a fish to live for a moment"

The impacts of UE solar projects to the Lwengo community

The situation in the Lwengo community is similar to many other communities in rural Uganda: poverty is a main issue, lots of people suffer from food insecurity, disease, lack of access to quality education, shelter, water, and sanitation. This is worsened by high kerosene costs. By enabling people to own solar systems through a loan scheme, they no longer have to buy kerosene or gas and they permanently own the solar system once the loan has been paid off. Moving beyond energy access, UE through the Solar Nature project has contributed to the Lwengo community in several ways, as described below.

1. Household economic strengthening

Successful formation of our first VSLA gave UE a good experiment to continue promoting solar power to generate more profits and create more saving groups. Since 2016, we now have 12 VSLAs from different villages with a total of 426 active members. Because we encourage them to work hard, save and apply for small loans to develop their farming projects, these people are now able to support their families' basic needs such as medical bills, school

A UE counsellor supporting an HIV mother during a home visiting activity. (4.3)

fees, food, clothes, and future investments as a result of increased harvests from their home garden farms.

2. Donation of farm inputs

Agriculture being the main income generating activity for many local Ugandans, Solar Nature benefits children from poor families, who recieve hoes or garden tools so they can use them during the COVID 19 pandemic to boost household garden harvests for both domestic food and commercial sales.

3. Health and well-being

In early 2020 before the lockdown, UE organized multiple health sessions including free HIV counseling, testing, referral for antiretroviral therapy and follow-up for patients. This was only possible with profit funds from the solar projects. We carried out different home visiting sessions to monitor and support treatment adherence, sanitation and general HIV positive living challenges among people battling HIV/AIDS. In addition, during the COVID-19 pandemic, solar profits have been enabling UE to distribute relief food to vulnerable families and parentless children.

4. Education

With solar profits contribution, UE was able to build and run a community Nursery and Primary school for vulnerable children whose parents died or cannot afford expensive private learning institutions.

Profile

Uganda Empowers (UE) is a community-based development organization that supports people infected with or affected by HIV/AIDS, mainly orphans, vulnerable women and the youth in Lwengo district, a rural region in Uganda. Just like other Sub-Saharan countries, Uganda is highly affected by HIV/AIDS which not only causes death but also affects the economy, education and other core developments. Since 2010 UE identified the problem and has come-up with multiple programs to improve and change some lives through domestic economic strengthening, good health, quality education, and the provision of solar power and networking.

Some of the challenges affecting the project Solar Nature

- In the effort to provide clean energy, we have faced a big challenge in serving a poor community where the majority of people struggle or cannot afford to buy solar home power.
- UE lacks enough funds to invest in stocking enough solar products and business promotional materials, and transport facilities to meet public demand, which is affecting our ability to serve more beneficiaries.
- Poor road network to reach to the end-user.
- The COVID 19 pandemic has not only affected our ability to approach buyers, but it has also exacerbated hopeless poverty in the population we are supposed to serve.

Proposed solutions to advance solar service delivery in rural communities

- UE is going to continue forming VSLAs as a way to strengthen household economy and encourage group members to buy solar with part of their savings.
- We are going to focus on writing grant proposals and call for partnerships with both local and international agencies to fund clean energy project and other SDGs.
- To ease transportation challenges, UE plan to open-up another service branch in the area where we have a wider market, and this will not only reduce the transportation costs but will also bring the services closer to the end-user.

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Final remarks

The story of Robina and the accident opened our eyes to start the Solar Nature project and this project has not only brought light to the villages of Lwengo but has also greatly enabled UE run charity goals. 55% of generated profits from every solar sale goes directly to the community development charity work where over 2,083 people have directly benefited since 2016. Once supported, we can keep offering quality solar services and carryon contributing to the other SDGs.

Acknowledgement

- To the Lwengo local authority for allowing us to operate here freely.
- To ENVenture for giving UE a financial loan to invest in more solar.
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Thank you everyone for reserving a time to read Uganda Empowers' story of clean energy and the impact it brings to the rural Lwengo populations. On my own behalf and on behalf of the entire UE team, I do appreciate this opportunity to share our clean energy story and also thank everyone for reserving a moment to it. As a growing local organization, we still have got a long way to go but we are proud that we are not where we used to be, UE therefore welcomes any kind of support or partnership to help us reach our goals.

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Photo credit: (4.1;4.2;4.3) Uganda Empowers.

New Energy Nexus Uganda team training new cohort on how to run a clean energy business. (5.1)

Financing entrepreneurs catalyzes clean energy uptake in Uganda

ENVENTURE, A PROGRAM OF NEW ENERGY NEXUS UGANDA, CONNECTS THE DOTS FOR ENERGY ENTREPRENEURS IN UGANDA BY FINANCING AND TRAINING COMMUNITY BASED ORGANIZATIONS AND VILLAGE SAVINGS AND LOANS ASSOCIATIONS.

Overview

Uganda is ranked as one of the most entrepreneurial countries[1]. However, this has not been representative in the clean energy sector. This is due to a number of factors, one being a shortage of financing. In this piece, New Energy Nexus Uganda ENVenture shares some of their insights on the status of energy access in Uganda, the effects of a decline in funding in energy entrepreneurship, a possible solution to energy access challenges and how ENVenture has been acting in this ecosystem.

1 https://www.gemconsortium.org/report/gem-2014-global-report

Energy poverty in Uganda – the context

Uganda is one of several developing countries experiencing a challenge of electricity access for more than 59% of its fast-growing population. Energy demand is primarily met by tree biomass which is used unsustainably for cooking while also depleting forest cover. Unelectrified households still use kerosene to light homes contributing to indoor air pollution, a known killer of about 40,000 in Uganda[2] and 3.8 million[3] globally every year. Progress in attaining SDG7 is slower than expected and has worsened due to the COVID-19 pandemic. It is worse for the 1.3 million refugees currently off the grid and hosted in the country (Uganda is ranked as the third largest host nation for refugees in the world[4]). Decentralized renewable energy has reduced the impact of these

2 https://apps.who.int/iris/handle/10665/246136?locale attribute=en&

3 https://www.who.int/data/gho/data/themes/air-pollution/household-air-pollution

4 https://reporting.unhcr.org/node/21740

Uganda Empowers, a New Energy Nexus Uganda awardee, installing a rooftop solar system on an off-grid rural school building. (5.2)

challenges through domestic cleantech solutions such as improved cookstoves and solar water pumps.

ENVenture – supporting and training last mile actors

This is where the New Energy Nexus program, ENVenture, is filling in the gap. Uganda is recognized as an entrepreneurial hub in Africa[5] and ENVenture is riding on this wave to create and scale energy enterprises as a solutio[6] to the energy access problem. ENVenture runs an incubation program for Community Based Organisations (CBOs) and Village Savings and Loans Associations (VSLAs) to create sustainable energy enterprises that increase accessibility of affordable energy options within last-mile communities. The program deploys a business startup toolkit comprising loan financing, capacity building and bookkeeping technology to take businesses from the idea stage to execution. ENVenture's clean energy inventory financing and technical training has extended to over 123 CBOs, created over 650 jobs (70% of which are occupied by women), and enabled over 100,000 beneficiaries to gain access to clean energy, saving up to $2.9M annually as a result of the transition to cleantech[7]. Civil society actors are amping up ableness to empower their communities on the crucial importance of energy transition and energy opportunities. These, particularly CBOs, have a close relationship with communities and are uniquely positioned to understand their energy challenges. They run community-based initiatives to co-create solutions for themselves. ENVenture employs its complementary expertise to support these *last-mile* communities which many traditional investors are not willing to support with capital largely because of the slow and low return on investment.

While global investment into renewable energy is still worthwhile, it is not enough. Foreign funding for renewable energy projects frequently experiences a mismatch between investor and beneficiaries'

5 https://www.bbc.com/news/av/business-37654937

6 https://www.powerforall.org/insights/finance/energy-access-enters-decade-of-homegrown-innovation

7 Uganda Empowers is one of the CBOs supported by the New Energy Nexus program. To know more about the work of Uganda Empowers, please read the story number 4 "Growing solar energy and reinvesting in community wellbeing" in this report.

expectations. The Global Distributors Collective[8] in 2019 pointed out three key challenges: minimum investment sizes, collateral requirements and interest rates. This has trickled down to local energy businesses as they are unable to fulfil most of these requirements.

Financing can play a vital role in subsidizing cleantech prices. Incubation and accelerator programs bridge the gap in connecting various actors along the energy value chain. Funding for energy programs and organizations should also be targeted to initiatives that generate more opportunities and impact. ENVenture, for example, creates and maintains partnerships with some of the top mission-aligned cleantech companies in the country to provide stock for the enterprises. The outcome of this is that more cleantech is dispatched, and it takes us one step closer towards an abundant world with 100% clean energy for 100% of the population in the shortest time possible. It is going to take several thousand more CBOs and VSLAs across the country to strengthen clean energy entrepreneurship ecosystems.

Challenges ahead and possible solutions

The Biomass Energy Strategy (BEST) written in 2013, is one such effort in leading rural grid electrification. The ecosystem for renewable energy systems in Uganda is full of potential. On large scale production, the government is encouraging Feed In Tariffs for hydro projects and solar farms. The private sector is seeing a rising number of associations like the Uganda Solar Energy Association which advocates for energy policy for business and the environment. Other associations are being formed, and women's organizations and think tanks are doing similar work to advocate for more women in the energy access value chain.

8 https://globaldistributorscollective.org/research-and-insights

Such a favorable business working environment will positively influence climate resilience and adaptation for an ever-increasing wave of energy entrepreneurship. What is perhaps a big need right now is a national startup policy which has been called for by key stakeholders[9], citing the agricultural sector which is particularly vulnerable due to climate change-induced long dry spells that disrupt food chains and agribusinesses.

Last but not least, we note several challenges that come with a clean energy transition. Wood fuel and/or charcoal retailers risk losing revenues because of declining demand. The wood fuel/charcoal businesses make up a thriving source of income for the local economy with its own set of value chain actors, some of whom include producers, truck transporters, and traders. This highlights the need for policies focusing on a just transition away from

9 https://innovationvillage.co.ug/private-sector-calls-for-national-startup-policy/?utm_source=rss&utm_medium=rss&utm_campaign=private-sector-calls-for-national-startup-policy&utm_source=rss&utm_medium=rss&utm_campaign=private-sector-calls-for-national-startup-policy

Profile

ENVenture is a program of New Energy Nexus Uganda. New Energy Nexus is a global network of accelerators and funders empowering diverse entrepreneurs to drive innovation and build equity with climate solutions. New Energy Nexus strives towards an abundant world with a 100% clean energy economy for 100% of the population in the shortest time possible. To make this lasting change our work must uplift communities around the globe who have been and continue to be left behind by the failed paradigm of a fossil-fuel economy. To do this we fund, connect, and grow diverse new climate entrepreneurs and innovators worldwide. We know that focusing on justice and sustainability, while enabling access to clean technology for all, will yield greater social and economic dividends. The future of clean energy is 100% for the 100%.

Annet Birungi, Founder of Safe Energy Enterprises, a New Energy Nexus Uganda awardee, in her cookstoves own production and shop. (5.3)

fossil fuels. Another challenge is that cleantech households must repay their PAYGO payment plan. Repayment is often challenging, to the extent that some risk defaulting, for some beneficiaries such as farmers who have income that is seasonal and impacted by increasingly unstable weather patterns.

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Photo credit: (5.1;5.2;5.3) New Energy Nexus Uganda, ENVenture.

A cross-section of the Aba women during one of the workshops in the community. (6.1)

Empowering women in Aba to grow their businesses via renewable energy

COMBINING BUSINESS TRAINING, MICRO-CREDIT, AND CLEAN ENERGY TECHNOLOGIES, WOMEN IN RURAL NIGERIA HAVE GROWN INCOME FOR THEIR FAMILIES AND COMMUNITY WHILE CREATING HEALTHIER LIVING ENVIRONMENTS.

Overview

The women in Aba, the commercial center of Abia State, Nigeria, previously relied on unclean, inefficient energy for their household and commercial activities. This came with various challenges including impacted health outcomes and stressed business operations. Clean Technology Hub (CTH), with the support of the Abia State government, and its renewable energy partner organizations including Solar Sister, Oolu Energy, Emel Solar, among others, executed a series of training programs and sensitization workshops on the benefits of renewable energy products and clean cookstoves, providing an opportunity for the Aba women to purchase these products and utilize them in their households and businesses.

Energy poverty in rural Nigeria

In Nigeria, there is an energy access gap, featuring a high demand for electricity which is not backed by a corresponding high electricity supply. This is worsened in rural communities where a large percentage (about 85%) are not connected to the national grid. As a substitute, households and businesses resort to the use of diesel-powered generators and other inefficient methods to generate energy, which has severe health implications and, in the worst cases, leads to death. In Aba, women are generally involved in various activities, which require the expenditure of high energy, such as cleaning, cooking, and subsistence farming. As a result of the intermittent and unfavourable energy provision from the national grid, these women rely on environment-degrading methods of generating energy to carry out their activities (kerosene and firewood for cooking, candles for light, and heat).

Advancing renewable energies in rural communities

Clean Technology Hub (CTH), a research-based incubation hub in the renewable energy sector, shifted the focus to women in rural communities. The organization aimed to create awareness of the opportunities within the renewable energy sector, and provide a linkage between women in rural communities and possible business opportunities leveraging clean technologies. CTH is doing this through a series of workshops and sensitization campaigns in various states in Nigeria - Abia, Anambra, Kaduna, Oyo, and the Federal Capital Territory (FCT), partnering with solar home systems (SHSs) and clean cook companies including Solar Sister, Oolu Energy, Emel solar, D.light, Roshen global and Asteven limited. The target is to connect rural women farmers to clean energy solutions for farm processes, provide women-owned MSMEs with renewable energy technologies for powering their businesses, empower women with ICT skills to develop and innovate clean energy solutions, and offer training and mentorship support.

In Aba, Abia state, Nigeria, Clean Technology Hub, with the support of the Abia State Government, Lighting Africa, Solar Sister, Oolu Energy, Emel solar, D.light, International Finance Corporation (IFC), and Bank of Industry (BoI), organized the "Clean and Efficient Energy Access Training and Demonstration" workshops to highlight the negative economic, health, safety and environmental consequences of inefficient fuel-based lighting to women. They also sought to catalyze the market for lighting technologies by linking women to business opportunities using clean technologies. The program reached a total of over 200 women from over 8 different communities, several of whom indicated that the single largest barrier to the growth of their businesses was the lack of electricity.

Following the Abia state programs, CTH carried out a survey to assess the impact of the workshops. From the questioned individuals, 80% confirmed they were satisfied with the training, workshops, engagements, and outreach emphasizing that they understood the benefits of these technologies for their busines-

A cross-section of some of the women in the community registering for one of the enlightenment campaigns. (6.2)

ses. About 60% of the participants applied for the micro-credit scheme available to the trainees and about 46% purchased a solar system on display by the vendors present at the launch event. 70% of the participants mentioned that they needed continuous training using the street business school on how to further start other streams of businesses utilizing renewable energy products. A large proportion of the female respondents inquired on how to further access additional financing to start and expand their businesses.

As the project lead, CTH started with a stakeholder mapping of the different value chains of women Micro, Small and Medium Enterprises (MSMEs) in the state. The stakeholder mapping involved identifying the different women-owned businesses in the community and categorizing them appropriately (based on size and business type) to help tailor CTH's efforts to the needs of each group. In addition, an informal survey was done to understand the power supply challenges of these businesswomen and identify where opportunities for growth exist. Based on the survey and pre-engagements, CTH designed a month-long program that included training, demonstration projects, and a street business school that highlighted the opportunities available to the women to transform their businesses through clean energy. The Abia state government provided the access to the women's groups and business communities through the state's small business agency and their ministry of women affairs. The IFC on the other hand funded the training and the demonstration projects for the women-owned MSMEs.

Part of the demonstration project included putting together a micro-credit scheme (based on available credit schemes from organizations like the Bank of Industry (BoI)) that allowed these women MSMEs credit finance for the purchase of batteries, solar panels, inverters, solar lamps, clean cookstoves, etc, to create awareness as well as teach these women how to start businesses and grow their businesses. Using these products in the community, the women were introduced to micro-credit schemes and MSME loans available through the Bank of Industry and the Abia state MSME agency. The Bank of Industry at the events presented opportunities such as grants and low-interest loans to the women enterprises for their businesses.

In the execution of this initiative, a slight challenge faced was the language barrier as in most of the communities where workshops and demonstrations were held, the women participants spoke only the native language. This meant that the non-native speaking partners and facilitators had barriers in communicating with the women. To address this, translators, who served as a medium between the facilitators and the participants for the program, were hired. These translators were hired from within the community and were chosen due to their proficiency in the local language (Igbo) and English. They were provided with basic background training on what was expected of them and how to effectively drive home the message. Because the hired translators were from the community, they were able to easily pass along the message.

Profile

Clean Technology Hub (CTH) is a leading hybrid hub focused on the research, development, demonstration and incubation of clean energy ideas and technologies in Africa partnering with energy sector leaders to proffer solutions to Africa's biggest climate change and energy access challenges. In addition, CTH is a start-up incubator and accelerator for inventions and innovations in clean energy, a consultancy for sustainability and energy efficiency solutions, and a driver of clean energy and climate-smart investments into Africa. The organization offers five critical services focused on addressing Africa's energy access and climate change challenges, which are: research, policy and strategy advisory, enterprise development, advocacy, and training.

Some of the products displayed by a partner company, Solar Sister, during one of the workshops. (6.3)

The initiative had high impacts within the community, especially for the women. CTH received feedback that following the program, there was a transition from the dependence on kerosene and firewood for cooking to the adoption of cleaner cooking methods which brought about a noticeable reduction in the black carbon emissions within Aba leading to better health outcomes for the women and the community. Two primary factors were identified to be reasons for the transition; the women become more enlightened on the benefits of cleaner energy, and CTH (through its partners) provided the women with affordable renewable energy and clean cooking products.

In conclusion, the income of numerous households within Aba has increased because the women are now able to contribute within their homes through income earned from their small clean energy business. Their children are also able to do their schoolwork at home as there is better and consistent lighting available in households through the introduced clean technologies.

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Photo credit: (6.1;6.2;6.3) Clean Technology Hub.

An A2EI representative teaching the women how to use the EPCs. (7.1)

Participatory data collection can help empower community change

RURAL WOMEN COMBINE SMART METERS WITH THEIR OWN OBSERVATIONS TO HELP TO ILLUMINATE COMMUNITY LIFE AND PROMOTE CLEAN COOKING PRACTICES IN TANZANIA.

Overview

Access to Energy Institute (A2EI) recently distributed 100 Electric Pressure Cookers (EPCs) to women in six selected communities in Tanzania. The EPCs were connected with smart meters to track the energy usage and identify additional parameters that contribute to the increased usage of EPCs. There are numerous health benefits to be realized from the use of clean cookstoves. This program aims to foster further adoption of the EPCs in Tanzanian rural communities.

Advancing the adoption and use of clean cookstoves in rural Tanzania

The burning of firewood, as a means of cooking, contributes to deforestation and also heightens the climate change challenges globally. This is a result of the GHGs and other harmful gases that are emitted into the environment. In light of this, a lot of efforts have gone into the facilitating adoption of cleaner methods of cooking that reduce GHG emissions and the degradation of the environment.

In Tanzania, the adoption of cleaner methods of cooking is limited, particularly, in rural communities. As at 2020, the adoption of electric-powered cooking was about 0.12% in the country. Access to Energy Institute (A2EI), in an effort to identify the factors that will contribute to the uptake of clean cookstoves in rural communities, executed a project that saw the distribution of 100 Electric Pressure Cookers (EPCs) to six communities in Tanzania - three island sites around the Lake Victoria in the Mwanza region and three mainland sites in the Kagera region.

One of the primary objectives of the project was to gather data on the relation between cooking and the cost of electricity as well as to determine the factors that will lead to the uptake and usage of clean cook technologies, hence, data collection was critical to this project. This meant that the women involved in the project had to be proactive and participate actively in the project including cooking with the EPCs, filling out registration surveys, updating the cooking diaries, recording what was cooked as well as the smart meter counts, providing feedback in follow-up surveys carried out, and using the sensors provided by Nexleaf Analytics.

Aside from A2EI, three other stakeholders contributed towards the successful execution of the project – PowerGen Renewable Energy, Modern Energy Cooking Services (MECS) and Nexleaf Analytics. A2EI was involved primarily in the project implementation. The company engaged the communities, contributed the smart meters for the EPCs, and distributed the EPCs to the women in the communities. One of the most important components to the success of the project was data collection which was facilitated through the installed smart meters. A2EI analyzed the data collected and was able to draw insights and make inferences from the data. Nexleaf Analytics along with MECS supplied the pressure cookers that were distributed to the women. In addition, MECS provided a methodology for the collection of cooking data called 'cooking diaries' which helped in the documentation and collection of data around usage. Finally, PowerGen developed the mini-grid that powered the six communities and provided the necessary energy system to successfully operate the EPCs.

To facilitate the acceptance and utilization of the EPCs by the women within the Mwanza and Kagera regions, A2EI embarked on intensive community engagement activities. About six local agents within the community were engaged and trained to help enlighten other members of the community on the benefits of these EPCs. Incentives such as bars of soap and other household items were distributed to also foster trust and acceptance of the EPCs as according to past experience, it was observed that without gaining the community's trust, their acceptance and usage of such a system (or device) will be limited and, in some cases, non-existent. Following various awareness campaigns and programs, the community residents became very receptive to the EPCs. When the cookers were being distributed, the women came out in high numbers to collect to the point that it was no longer sufficient to go round.

Prior to the deployment of the EPCs in the selected communities (and even at certain times after the deployment), traditional open fire was the cooking method mostly adopted by women. This method of cooking was fueled by solid materials, including coal and biomass which release harmful particles into the air as they burn. When inhaled on a regular basis, these particles can cause diseases such as asthma, lung disease and pneumonia.

The introduction of the EPCs to the communities led to a reduction in the release of harmful gases to the environment especially during the first three months of their usage, regarded as the "honeymoon period" when the usage was particularly high. Another major challenge that was addressed with the introduction of the EPCs in the communities was the lengthy cooking time with coal and firewood. Cooking became faster as a lot less time was spent preparing/lighting the fire for cooking. Also, the flame intensity was easier to control and regulate while cooking.

Furthermore, commercial activities within the communities were boosted with the deployment of the EPCs. A large number of the women leveraged the EPCs to cook foods on a larger scale and sell to generate income for themselves and their families. Added to the commercial benefits of the EPCs, over 50% of the women emphasized that cooking with the EPCs made the food taste better than when firewood was used. Interestingly, the men and husbands in the houses became more involved in the cooking process as the process was now a lot easier. Previously, the

women always cooked for their families but with the introduction of the EPCs, their husbands were more willing to assist and become part of the process because it was easier and faster.

Overcoming barriers during project implementation

There were some challenges faced during the implementation of the project which spanned across various areas. To start with, it was difficult to reach the various communities due to the inadequate and in some cases, non-existent road networks, and because some of the communities were island sites, on each occasion of visiting those communities was particularly challenging often requiring a 3-hour boat trip by the A2EI team, which was time-consuming.

A major part of this project was the collection of data from the EPCs and so, A2EI had pre-attached smart meters to each of the 100 electric pressure cookers, which would help in tracking the energy usage of the cookers. These smart meters would be required to transfer data regularly with the help of a sound internet connection. Unfortunately, the areas where the communities were located are characterized by poor internet connectivity meaning that more often than not, the A2EI team had to move back and forth between other communities with better network connectivity to retrieve the data collected by the smart meters and then return the devices to the communities where they were being used.

In terms of governance challenges, within the six communities and in Tanzania as a whole, there was little awareness about clean cooking solutions, as well as their capabilities. There was also the misconception that the usage of electric pressure cookers required a high electricity supply. In addition, the efforts of the government in addressing these challenges through awareness creation were limited, and as such, A2EI had to undergo many detailed and simplified awareness programs for the communities on the benefits and impacts of the cooker.

Executing the community engagement activities and awareness campaigns was also difficult during the project. Some of the community residents were not always available when needed for training as they have different economic activities (including trading, fishing, farming, etc.). The fishermen go fishing every day especially during the breeding season, and most of the women (who are the main cooks of the households) go out to buy fish to take them to the market for resale. The busy schedule of the residents meant engaging them was difficult. For example, for island participants in areas within the Mwanza region, it takes a whole day to go to the mainland market (they spend 3 hours in a boat). People within this category were difficult to reach.

However, the implementation of the project was successful and provided interesting findings for engaging with communities in the area of clean cooking adoption. When analyzing the aggregate usage of the EPCs over the pilot period, the project team observed a U-shaped trend in the number of cooking events and households cooking using EPCs. In the beginning, the residents cooked relatively often, then this decreases to a low value and then begins to rise again. The initial spike was noted to be caused by the novelty of owning a new cooking appliance. During this time, the community residents were excited at having their new appliance and were experimenting with it to gain familiarity with its advantages and disadvantages in the kitchen. The period afterwards shows what happens when the novelty wears off

Profile

Access to Energy Institue (A2EI) is a non-profit, collaborative research and development institute working with the solar off-grid industry to deliver value by offering (sales and distribution) solar-powered solutions and solar appliances to small businesses and smallholder farmers.

Some of the women with the EPCs they were given. (7.2)

reflecting the fact that the women have identified the costs and benefits enough to make a decision on whether to continue usage. Towards the end of the project, the Tanzanian government enforced a policy that reduced the tariffs paid for electricity to 100 shillings (0.04 dollars). With the costs of cooking reduced, pilot users begin to use their EPCs with renewed enthusiasm and the usage spiked to higher levels than when it was newly introduced.

Although the policy decision aided the usage of the EPC in the communities as cost reduced, it was disadvantageous to the mini-grid developers, who provide the foundational power system upon which these cookers are used, as there was a significant drop in their revenue. To adapt, the developers had to limit the energy supplied to communities. There are high costs associated with setting up the mini-grid energy systems as such, so the government has to give full support to the stakeholders involved including the mini-grid developers and the community residents. Furthermore, the A2EI team recommended that studies should be done by the government to identify the optimal price point for electricity tariff that will be beneficial to both the developers, who provide energy systems to rural communities and the communities whose livelihood have now evidently become dependent on this innovative power systems.

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A2EI

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Photo credit: (7.1;7.2) A2EI.

A cross section of Solar Sister Entrepreneurs. (8.1)

Empowering formerly internally displaced women through clean energy enterprise

FOR WOMEN IN BAUCHI STATE, NIGERIA, SOLAR PRODUCTS AND TRAINING CREATE NEW ECONOMIC OPPORTUNITIES.

Overview

Solar Sister, an innovative social enterprise that empowers women with economic opportunity and clean energy, in the execution of the Women's Entrepreneurship Project initiative supported 200 formerly internally displaced women in Bauchi State, Nigeria. These women were empowered to become clean energy entrepreneurs and increase access to modern energy solutions in their communities. As new business owners, they sold over 4,000 clean energy products within the first 6 months and further educated their communities on the benefits of renewable energy solutions.

The burdens caused by internal displacement for women and girls in Nigeria

Internal displacement is an urgent issue affecting the world in present times. By the end of 2020, about 40.5 million new internal displacements occurred in the world . Even worse, more than half of the world's internally displaced people (IDP) are women and girls. In Nigeria, due to the high level of insurgency and violence, specifically in the Northeastern region, the rate of internal displacement is relatively high. The country ranks as one of the top 20 countries, with the highest rate of internal displacement, in the world[1]. The fast growth and resilience of the Boko Haram sect in Nigeria since 2009 has posed massive security challenges and disruptions to the lives of families in various parts of Nigeria.

Bauchi State, Nigeria, one of the states most affected by the Boko Haram attacks, has experienced significant internal displacement in a number of communities. Families have been displaced from their houses and forced to move to new locations and as a result,

1 https://www.internal-displacement.org/global-report/grid2021/

a lot of these people are left without a means of livelihood or any source of income.

Empowering internally displaced women with solar energy

To address these issues of internal displacement, Solar Sister partnered with Esso Exploration Production Nigeria Limited, Shell Corporation and the Nigerian National Petroleum Corporation (NNPC) to launch an initiative called the Women Entrepreneurship Project. The initiative sought to partner with internally displaced women in communities within Bauchi state, Nigeria by empowering women and strengthening community resilience. This they did by equipping the women in the communities with clean energy products (meant for resale), the tools necessary to ensure sales (accounting books, bags etc.) and relevant training to encourage sustainable livelihoods. Solar Sister, as the project lead, carried out activities such as community engagement, and the supply of the Renewable Energy (RE) technologies sold by the women. Esso Exploration Production Nigeria Limited, Shell Corporation and NNPC, as part of a joint venture, financed the initiative.

Improving living conditions and income generation with renewable energies

The excessive use of charcoal and firewood to generate energy for lighting and household cooking in these communities informed the project implementers of the need for RE technologies. Traditional cooking methods not only deteriorate women's health causing respiratory issues, heart diseases and in some cases death, but also cause damage to the environment and reduce the social well-being of the people. In addition, a lot of time is spent felling trees and gathering firewood for cooking that would have been used for other productive activities. More importantly, the domestic use of firewood contributes to forest degradation thereby increasing the incidence of global warming and climate crises.

Mary Dauda giving a community resident a solar lamp purchased. (8.2)

With the introduction of Solar Home Systems (SHS) within the community, the burning of charcoal, as well as the lighting of candles and kerosene lamps significantly reduced. Also, trading hours and the period for studying within the community were no longer limited by the availability of sunlight. Over 90% of parents reported improvement in their children's academic performance due to the availability of solar light. Furthermore, women who use solar lights within their businesses and households reported a 170% increase in light after sunset thereby resulting in increased productivity.

When the project kicked off in the state, it was easier for families to make the switch due to the immense health benefits and extended operating hours that the products allowed. This enabled these clean technology solutions and the community to function in harmony and achieve aspirations and environmental goals. The residents in the different communities where the project was implemented were experiencing the negative consequences of energy poverty. They were all underserved with limited access to the national grid, characterized by insufficient energy supply. This meant that a lot of the people used harmful fuels for lighting and cooking and coped with unhealthy alternatives to provide energy in their homes. The opportunity to switch to clean energy was mostly received with positivity.

Solar Sister designed the model for this project to target the vulnerable population and hence they had some additional support provided for the beneficiaries (e.g., mobile phones and credit, transportation allowance, and mobile phone charging system hubs for their use as well as for additional business). One of the challenges that was identified in the course of the project was the community's resentment of the beneficiaries, with some believing the beneficiaries received preferential treatment. To address this, the project has since reverted to a business-as-usual model where Solar Sister continue to offer support in terms of marketing materials, coaching, and mentoring, but the women have full control of their business and are fully accountable for its growth.

Mary Dauda, a single mother of four who resides in Yelwan Kagadama, Bauchi State is a farmer and a Solar Sister Entrepreneur. She started her clean energy business in 2018 through the Women's Entrepreneurship Project, and since then has been running a successful enterprise. Before becoming a clean energy entrepreneur, Mary struggled to grow her farming operation but now, with the extra income she earns from selling clean energy products, she owns a successful farm in the village of Garin Mallam. As she said: *"Ba muwa tare da mai gida na. Ya bar mu ya je yayi aure ya koma ya na zama da matan shi. Ni na ke zama da ,ya'ya na. Ina fama da su a nan Bauchi. Amma a yau, da zuwan Women Entrepreneurship Project, ya taimake ni. Sun koyar da ni yanda zan iya in aje riba na, in aje uwar kudi na. Har yanzu in sakura riba na in yi ajiya."* "Before now I struggled a lot to make ends meet as I am a single mother taking care of my children here in Bauchi after my husband remarried, but with the Women's Entrepreneurship Project, I have been able to support my family from the savings I get from my solar business. They also gave me training on how to differentiate my profit from my capital and also save part of my profit."

Profile

Solar Sister is a social enterprise that empowers women in rural communities with clean energy solutions and clean cookstoves to be sold and distributed. The company also provides training and other essential products that help the women empowered in effectively distributing the solar products. Since it began operations in 2010, Solar Sister has supported over 5,000 entrepreneurs enabling the distribution of over 400,000 clean energy products (including clean cookstoves and solar lamps), and has directly and indirectly impacted about 2 million people.

A Solar Sister Entrepreneur selling a clean cookstove to a community resident. (8.3)

Becoming a Solar Sister Entrepreneur both increased Mary's income and helped her to learn about the benefits of clean energy. She is now well informed about the negative health implications of using firewood to cook and about the energy expenditure savings associated with solar lamps. Mary stated, *"Rayuwa ta zama sauki saboda yanzu ina amfani da clean cookstove don girki, kuma ,ya'ya na suna karatu da fitilar solar da nake amfani da ita. Dafa abinci da dare kuma ya zama sauki saboda ina da fitilar solar da nake amfani da shi lokacin girki".* "Life has become easier because I now use a clean cookstove to cook, and my children study better with the solar lamp I use. Cooking at night has become easier because I have my solar lamp to hang in my kitchen when cooking".

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Photo credit: (8.1;8.2;8.3) Solar Sister.

Dhapsung Womens group monthly meeting on progress. (9.1)

Dhapsung solar mini grid: empowering women and community

EMPOWERING WOMEN IN COMMUNITY ENERGY PROJECTS CAN PROMOTE GENDER EQUALITY, DEMOCRATIZE ENERGY ACCESS, AND LEVERAGE INDIGENOUS KNOWLEDGE TO ENHANCE PROJECT IMPACT

Overview[1]

This story brings insight into the grassroots transformation that took place as a result of the intervention of a solar mini-grid with women at its core in the Dhapsung village in Nepal. The community owned energy system provides the pathway for transition in marginalized and off-grid communities. There is an urgent need to switch to decentralized and democratic energy systems as a hope to address climate crisis and, to invest in a sustainable future. The dynamics of community development depend on women's empowerment and being an integral part of the development process.

1 Additional information about the project in the Dhapsung village can be found in the following website from Grid Alternatives www.gridalternatives.org/dhapsung-microgrid-sindhupalchok-nepal-case-study

The socio-technical energy project at the Dhapsung village

The transition to renewable and modern energy is taking shape in Nepal. But, the process of policymaking, planning, and execution relies heavily on big corporations and their allies. The beneficiary of the modern energy system is not the marginalized but the corporations. This maintains the disparity. Democratic practice in energy development and services is not taken as a core to the energy transition and hence fails to address the real goal of SDG-7.

Dhapsung is a village with 55 households of ethnic Tamang community, located at a distance of 80 kms from Kathmandu Valley. The only road to the village is disconnected during monsoon season starting from June until September due to road blockades and landslide. If anyone falls sick, villagers must to carry people on a homemade stretcher for 2 hours to reach to nearest health service facility.

The community used a 2kW peltric set to provide its lighting needs which provided power from 5PM to 7AM until it was shattered during the April 2015

earthquake which killed nearly 9.000 people and left 22.000 injured throughout Nepal.

In September 2016, volunteers and a team from Grid Alternatives (non-profit organization based in Oakland, California) completed the installation of a 16kW solar mini-grid in the community with the help of technical assistance from Ghampower and the Digo Bikas Institute.
The system provided enough energy to the community for lighting, mobile charging, television and use of a saw machine for construction when needed. The 16kW solar mini-grid provided 24/7 reliable electricity to the community via overhead distribution lines. Following the mini grid installation, Mahila Samuha (Dhapsung Women's Group) was formed to look after the governance, maintenance, and tariff collection of the system. The Women's Group set the tariff rate for the electricity in consensus with the villagers and they agreed it was affordable. The tariff was a flat Rs.100.00 ($0.84)/Household/Month and Rs.500.00 ($4.20) for using a saw machine.

The villagers played a vital role in assisting installation, carrying materials to the village and solving technical issues by liaising with the installer. Although the villagers were not previously aware of a solar PV system, with their enthusiasm and active involvement during the installation phase with the technicians, they learnt a few basic fault detection techniques, like inverter shutdown, battery room maintenance, and solar PV cleaning techniques among others. This was part of the post commissioning training to the users and on the job training opportunity for the villagers of Dhapsung. Any impoverished community without access to electricity needs additional support along with the electricity to improve their economic status, social well-being and livelihood to make it more inclusive and just. They require relentless advocacy and intervention from local the government, Civil Society Organizations (CSOs) and community leaders to tailor the social value of energy services in the areas of training, outreach activities, market creation and resource utilization for the community.

Empowering women in the community

Digo Bikas Institute (DBI) which is a research and advocacy organization committed to promote ecological sustainability and social equity at the policy and community levels, intervened and worked to empower women in Dhapsung. At first the Women's

Dhapsung Woman preparing organic fertilizer after the training. (9.2)

Group were merely looking after the system with the help of community members, and they were reluctant to talk to outsiders. They couldn't express their needs, sorrow and share joy with others who don't speak the Tamang language. With the help of DBI, the Women's Group was introduced to other women's groups and cooperatives who started from scratch, and shared the similar story. It provided a platform to listen to their stories of failure and success, of hardship and bigotry faced by women for taking leadership in community development in a society dominated by men. Multiple visits with the women cooperatives sparked a light of enthusiasm, boosting their morale and confidence in contributing to the Dhapsung community. After a year of visits, trainings in organic vegetable farming, organic pest management, book keeping and local resource management, the Women's Group autonomously started social initiatives such as prohibiting cattle grazing in the outfields, suppressing fights and resolving arguments by initiating fines if anyone was found guilty. Along with this, the Women's Group shared their land amongst themselves, planted seeds, and were even able to sell their produce in the organic market place in Kathmandu at a good price.
The Women's Group transformation was further seen when they asked for further training on seasonal vegetable farming techniques, greenhouse tunnel, entrepreneurship and senior citizen education to enhance their livelihoods. They even started conducting video calls with DBI for regular updates.

Combining technology use with indigenous knowledge

Villagers in Dhapsung were facing problems with a reliable water supply for drinking and irrigation usage, as the source was drying up. They even envisaged the need for a secured water supply for drinking and irrigation to increase their yield. They identified a perennial local water source and suggested gravity flow to preserve the mini-grid's power for some other end uses if necessary. This shows community's awareness and familiarity with the technology and the virtue of their indigenous knowledge. The identified water source was one of the many local water sources that was disrupted by the hydropower plant being under construction. This particular source was fought for and preserved for community use by the initiation of the community.

Combining on- and off-grid electricity use

The community was connected to the national grid in September 2020. The existing distribution line which was being used for the solar mini-grid was used for this connection, instead of using a different distribution line, leaving the 16kW mini-grid unused. The national power system was unreliable and the community suffered frequent power breakdowns. The community wanted to use the existing mini-grid during power outages but they didn't have the tech-

Profile

Digo Bikas Institute (DBI) is a research and advocacy organization committed to promote ecological sustainability and social equity at policy and community level. DBI is working to promote democratic energy systems owned and operated by the community and working on issues of climate justice, rethinking development and liaising with local governments to promote sustainable urban and rural development by advocating and implementing sustainable infrastructure, open public space and human centric town developments. Our research work aims to build evidence for bringing positive policy change. We empower and engage a critical mass of informed citizens through our education and trainings. We use different approaches to achieve our vision and mission, which include research and analysis, seminars and conferences, education and training programs, correspondence and fact finding missions, public consultations and legal interventions, network building and international solidarity, joint campaigns and media. Please visit our website (www.digobikas.org) to know further about DBI's work.

Exchange visit of Dhapsung Women's Group to Women Cooperative in Panauti. (9.3)

nical know-how of using it along with the grid. These kinds of scenarios exist everywhere in Nepal where after some years of mini-grid operations, national grid extensions become more feasible. DBI in consultation with the Rural Municipality and funds from the German Embassy proposed a prosumer model for the mini-grid. This is a grid-connected model where the community uses the electricity when needed and sells the extra energy to the national or local grid, thereby providing aid to the community's effort to foster economic development. However, the policy regarding community scale prosumer model is not in practice and donor agencies lack planning in converting community owned microgrids into prosumer models, from the planning to execution phase. Regardless, the 16kW Mini-grid is currently used to power a few lights at the nearby school, which is <1% of current capacity of mini-grid.

DBI with the help of a grant obtained from Germany Embassy will connect the existing 16kW Mini-grid with the national grid and showcase a prosumer and democratic energy system owned and operated by the community. The project is currently paused due to a landslide around the area and no access byroad.

Putting community members and their knowledge at the center of energy access

The short-term projects like ADB's South Asia Sub-regional Economic Cooperation (SASEC), UNDP's Renewable Energy for Rural Livelihood (RERL), World Bank's Mini-grid Energy Access project (MGEAP) lack long term vision, community centered, inclusive, and sustainable approaches, focusing only on the technical aspect. When such projects phase out, the system is left lifeless resulting in pseudo accomplishments of SDG goals and indiscreet depletion of local resources. The climate crisis is taking its toll on vulnerable communities who don't have the slightest idea of the climate crisis, what's going on around them, who is responsible for the catastrophe they are facing and why is it happening. It's a grave irony that the climate victims are women and children in the remote parts of Nepal and the global south. However, if every other community is connected to share the stories and have an equal stake in the development process and meeting SDG goals, in consultation with the communities with regards to their indigenous knowledge, permaculture history and values, there is hope. This is the immediate action that needs to be proliferated worldwide for meeting SDG goals in a democratic way.

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Photo credit: (9.1;9.2) Nipun Regmi;
(9.3) A Cooperative member (name not available).

An attendant filling up crates to be stored in the cold storage facility, Emu, Imo State. (10.1)

Reducing post-harvest losses and growing farm revenue through cold storage

SOLAR-POWERED COLD STORAGE FACILITIES IN THE EMU COMMUNITY, NIGERIA, ENABLE FARMERS TO SELL MORE PRODUCE AT MARKET, EARN HIGHER INCOMES, AND LOWER CARBON DIOXIDE EMISSIONS.

Overview

In the Relief market, Emu Community, Imo State, Nigeria, the farmers and traders are burdened with frequent crop spoilage as a result of limited and ineffective storage facilities. Cold Hubs, a Nigeria-based renewable energy company, in response to the post-harvest loss challenge faced within the Emu community spearheaded the deployment and management of a solar-powered walk-in cold room within the community. Since installation, the system has been well received by the community having over 45 frequent monthly customers.

Post-harvest losses due to inadequate storage facilities

In the Emu community, Imo State, Nigeria, agriculture is an important aspect of the residents' culture. Approximately, over 50% of the community population is engaged in agricultural activities primarily farming and fishing[1]. The major challenge faced by the farmers within the Emu community is the issue of post-harvest losses. Based on research carried out by Cold Hubs in 2017 on post-harvest losses experienced by farmers in the community, it was discovered that a large percentage of these losses are due to the unavailability of adequate storage facilities to effectively store these crops thereby enabling a longer shelf life. The farmers in the community rely on sun drying for storage, which is highly ineffective and unsanitary, given that the crops are mostly spread on the ground to dry. The unavailability of appropriate storage facilities affects the income of farmers, as damaged crops mean that farmers have to resort to selling their crops for far less than the actual price in order to minimize total losses incurred.

1 Interview with Mr. Nnaemeka Ikegwuonu, CEO Cold Hubs.

Cold storage facilities to reduce post-harvest losses

To address this problem, Cold Hubs, a solar-powered cold storage technology company, installed a solar-powered cold storage facility within the community to enable farmers to store their crops adequately. The installed solar-powered cold storage facility is a walk-in facility made up of 120mm insulating panels installed to retain cold. The facility is solar-powered as such, energy is captured by the solar panels, mounted on the roof-top of the cold room and stored through the use of high performing batteries. The farmers place their produce in clean plastic crates which are stacked inside the cold storage facility. The facility has the capacity to store approximately 2 to 3 metric tons of perishable food which is equivalent to 150 units of a plastic crate, which weighs about 30 Kg (0.03 tons), stacked in rows. The facility maintains a cool temperature of 4 to 6 degrees Celsius, extending the freshness of the harvested fruits, vegetables, and other perishable food for up to 21 days.

Engaging with the community members

Before installing the cold storage within the Emu community, which is the first community where it was installed, Cold Hubs engaged in various activities to inform, educate and build the trust of rural farmers as well as to ensure they understand the economic benefits of these solar-powered cold rooms for their livelihoods. To start with, Cold Hubs organized community awareness campaigns to sensitize the community residents (farmers) on the need for solar-powered cold storage facilities as it helps in providing a clean solution to the reduction of crop loss. Subsequently, in conjunction with the community, an appropriate site where the facility was to be installed had to be selected. Cold Hubs had continuous meetings with the market union for about six months to resolve some community tension, which resulted based on a difference in opinions of the community members regarding if the best use of the selected land is a cold storage facility. In addition, Cold Hubs sought to reach a consensus with the market union around providing land for the deployment of the cold storage facility. The Cold Hubs team had to present and assure the community of the benefits of the cold storage system, providing previous success stories to buttress their point, before a consensus was eventually reached.

The company worked closely with community leaders and stakeholders to identify an appropriate area with adequate road networks. Furthermore, to get the appropriate clearance required before the project deployment, Cold Hubs had to meet with and convince the traditional leaders and youth within the Emu Community, who are the custodians of the land eventually selected for the project, to provide the land for the development of the system.

The site selection was a major challenge for the deployment of the cold storage systems which required consensus-building and active community participation and cooperation. The awareness campaigns featured the distribution of pictures, flyers, and glossaries in local community languages, and various levels of engagements that included youth and women groups who retail the produce from the farms. Other active stakeholders are the market union, who manage the day-to-day operations and ensure community cohesion, particularly within the market area. The company had to work through identified community champions to educate the different community groups on cold storage's benefits, and engage in a physical demonstration of the benefits of cold storage, ensuring that this translates to identifiable benefits for the entire community.

Profile

Cold Hubs is a renewable energy company that sells, distributes, installs and maintains cold storage facilities across various communities in Nigeria in order to address the issue of post-harvest losses faced by farmers. Since it began operations, Cold Hubs has deployed over 50 cold storage facilities in 32 different sites in 22 states in Nigeria.

An aerial view of the solar-powered cold storage in the Relief Market. (10.2)

Advancing cold storage facilities in Nigeria

Aside from the cold storage installed in the Emu Community, Cold Hubs has deployed over 50 cold storage facilities in 32 different sites in 22 states in Nigeria. One factor that has contributed to the achievement of this feat is adequate financing. Cold Hubs has received financing from impact investors, and international financing organizations including U.K. Agency for International Development (UKAID), All On Energy, and the U.S. Agency for International Development (USAID). The deployment of the cold storage for the Emu community in the Relief market, a major food and livestock market located in the Imo State of Nigeria, was financed by Factor[e] Ventures, an impact investor in Nigeria.

The deployed solar-powered cold storage has immense benefits on the climate condition, particularly relating to the emission of CO_2 in the atmosphere, in the community and Nigeria as a whole. The alternative, diesel-powered cold storage facilities, would lead to an increase in GHG emissions particularly carbon emissions which will potentially degrade the health of the community residents. Also, there is a significant increase in the income generated by the community as a result of the increase in jobs created through the management and maintenance of the cold storage as well as the income realized from harvested crops that would have otherwise been wasted.

The cold room increases the available food within the community and further curbs the rampant issue of malnutrition in this community. Presently, the cold room has 45 monthly customers out of which 30 are regular customers. However, the creeping problem is that the facility is not sufficient for all the 100+ farmers and traders selling perishable foods in the Relief market and there is, therefore, the opportunity for more cold storage facilities (which is being planned for).

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Cold Hubs

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Photo credit: (10.1;10.2) Cold Hubs.

A part of the 1MW mini-grid installed by GVE in the Wuse Market, Nigeria community. (11.1)

Creating Nigeria's first 100% solar-powered marketplace

SOLAR ENERGY CAN DISPLACE UP TO 3,000 DIESEL GENERATORS IN ONE OF THE BUSIEST TRADING CENTERS IN WEST AFRICA, CREATING A BETTER MARKET EXPERIENCE, INCREASED MARKET ACTIVITY, AND GREATER COMMUNITY RESILIENCE TO CLIMATE CHANGE.

Overview

The Wuse market community in Nigeria suffers from intermittent electricity supply which affects the business operations of the community. To address this, the community partnered with Green Village Electricity (GVE), the largest mini-grid developer in Sub-Saharan Africa, to develop a 1-megawatt interconnected (with the national grid) solar hybrid mini-grid within the market community. The mini-grid is expected to improve business operations, foster longer operating hours, increase productivity and improve security within the market community. In light of this, about 5000 businesses within the community will be positively impacted as a result of the electricity provided by the mini-grid.

The Wuse market and the lack of adequate electricity supply

Wuse market, located in Abuja, the capital city of Nigeria, is one of the busiest and highly concentrated trading centers in West Africa. The market community is made up of over 5,000 active traders who engage in various economic activities ranging from the sale of food commodities to the sale of fashion accessories to the sale of household items. The common challenge every segment of the community faces is the intermittent electricity supply, from the national grid, which has made it difficult for the traders to effectively operate and grow their businesses in the market. The majority of the complaints have come from tailors within the market and the storekeepers, who make use of and operate the cold storage rooms. As a result of the intermittent power supply from the grid, these business owners rely on self-generation of energy through diesel-powered generators to power their shops and continue with service provision as well as the preservation of perishable goods.

The solar hybrid mini-grid in the Wuse market

In light of the issues highlighted, the market community sought an affordable and reliable source of electricity that ensures the sustainability of their businesses. The interconnected solar hybrid mini-grid project, developed by Green Village Electricity (GVE) set out to address the energy gap experienced by the Wuse market community as well as totally phase out the use of diesel-powered generators thereby transitioning the market into Nigeria's first 100% solar-powered market community.

Multiple stakeholders and their roles

The structural elements facilitating the successful deployment of this project include the engineering and technological systems, mobile money integration driving financial inclusion, and essential partnerships with relevant stakeholders including the Rural Electrification Agency (REA), Abuja Electricity Distribution Company (AEDC), Green Village Electricity (GVE), Clean Technology Hub (CTH), and Wuse Market Traders Association (WUMATA). In October 2019, the mini-grid developer, GVE along with the electricity distribution company, AEDC, and the market community representative, WUMATA signed a tripartite agreement for the first private sector-led solar hybrid interconnected mini-grid system in Nigeria. The 1MW photovoltaic (PV) solar hybrid system set out to provide uninterrupted power to the centrally located market.

In the early months of 2020, before the COVID-19 lockdown, GVE deployed the first phase of the project which powered a few blocks of shops at the market. The market community was so receptive to the pilot phase and consented to the full deployment of the project. However, due to disruptions in the supply chain and business operations caused by COVID-19, the full deployment of the project was delayed but has since resumed. The project was financed through the AEDC who received a US1.06 million grant from the United States Trade and Development Agency (USTDA) who supports studies and the development of solar plants in market communities. GVE manages the mini-grid system, providing alternative electricity to the market community when the electricity from the main grid is disrupted.

There was an eagerness within the community to have the remainder of the market electrified which led to the cooperation of the community with the developers and other stakeholders involved in the project. The community continues to provide prompt and valuable feedback on the operation of the system to the developers. The market leaders also played a huge role in this project as they acted as community gatekeepers; raising awareness and building trust in modern energy within the community. To foster community participation and strengthen trust, the project team constantly engaged with the market community utilizing inputs from them through each phase of the project.

Displacing diesel-powered generators

Prior to the deployment of the pilot, the Rural Electrification Agency (REA), the government agency leading rural electrification efforts in Nigeria, conducted a baseline survey and energy audit to ascertain the existing market condition, load requirements, expenditure on grid-electricity, expenditure on alternatives

Profile

Green Village Electricity (GVE) is a foremost distributed renewable energy supply company providing clean, sustainable and reliable energy to unserved and underserved rural communities across sub-Saharan Africa. GVE focuses on the installation, construction and maintenance of mini-grids across rural communities in SSA. In addition, the organization provides energy consultancy services as well as the retail and distribution of solar equipment. Since its inception in 2009, GVE has installed over 14 mini-grids in different communities with a cumulative capacity of 4.54MWp impacting over 11,000 households and businesses.

to grid-electricity and the projected impact of electricity reliability on economic activity. With the installation of the interconnected solar hybrid mini-grid, over 3,000 diesel-powered and petrol-powered generator sets used daily in the market community are expected to be displaced, thus leading to a significant reduction in carbon emissions in the country's capital as well as reduced air pollution. This also comes with a significant decrease in noise pollution associated with generators.

Up to 3,000 diesel generators can be displaced by solar energy in the Wuse market. (11.2)

Connecting climate adaptation and energy access

Nigeria, like many other countries, is currently experiencing the harsh impacts of climate change which include warmer temperatures, erratic rainfall, and extreme weather events. This project in Wuse market is a timely response to climate change as it increases the community's capacity to adapt to the impacts of climate change, as well as advancing affordable and sustainable energy (SDG 7). It has been estimated that this 1 MW solar power plant can cut down carbon emissions by almost 1,000 tonnes per annum, significantly reducing the environmental carbon footprint of the community.

The Wuse interconnected mini-grid project is driven by a policy and project development outlook via the Energizing Economies Initiative (EEI). The EEI, developed by the Federal Government of Nigeria, through the REA, deploys off-grid electricity solutions to economic clusters across Nigeria through private sector developers such as GVE. The EEI initiative seeks to address both the economic and environmental development of communities like the Wuse market community through two objectives: (i) Increase energy access and economic growth by providing clean, reliable, and affordable power to economic clusters across Nigeria, such as markets, shopping complexes, and agricultural/industrial clusters. (ii) Promote the deployment of clean energy solutions to areas with the potential for high impact on the economy[1]. No burdens and negative consequences have emerged from the initial use of the mini-grid by the market community.

A budding tailor, Ali, who was part of the traders who enjoyed the pilot deployment of the system at the heart of the market, explained that the mini-grid connection has been beneficial for business. He is now able to operate his tailoring machines for extended periods despite the varying weather conditions. He also emphasized that the monthly cost of electricity has been significantly reduced as there were high costs associated with the use and maintenance of a fuel generator including the increasing costs and the volatile prices associated with petrol, as well as the high cost of the maintenance.

[1] www.rea.gov.ng/energizing-economies

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Photo credit: (11.1;11.2) Clean Technology Hub.

Focus group discussion with CREE-served community during research. (12.1)

Communities and the grid: the effectiveness of community management of local distribution systems in Nepal

LOCAL COMMUNITY MANAGEMENT OF RURAL / SMALL TOWN DISTRIBUTION SYSTEMS IS POSSIBLE AND CAN PROVIDE BETTER LEVELS OF SERVICE THAN TRADITIONAL UTILITY-MANAGED OPTIONS.

Overview

The Nepal Electricity Authority (NEA) manages its rural electricity distribution systems using two different models – a standard utility model run by the Distribution and Consumer Service business group (NEA-DCS) and a community-managed utility model run by Community Rural Electrification Entities (CREEs). An EEG-funded research project, led by Winrock International, has revealed interesting findings suggesting CREE-managed distribution systems provide a better level of service to rural communities than DCS-managed ones. In particular, CREEs appear to be more service-oriented and more responsive to rural consumers' needs.

Electrification in Nepal and the role of Community Rural Electrification Entities

Nepal has a relatively high electrification rate, with 94% of its urban population and nearly 89% of its rural population having access[1]. The Nepal Electricity Authority (NEA), Nepal's quasi-governmental utility, is responsible for the generation, transmission, distribution and sale of electricity in the country. Electricity distribution systems (the localised sections of the grid between transmission lines and consumers) are managed either directly through NEA's own Distribution and Consumer Services (NEA-DCS) offices (a traditional utility-based model) or via forming Community Rural Electrification Entities (CREEs) – electricity distributing entities registered by community-based organisations at the district level through the Community Rural Electrification programme. CREEs can either take the form of NGOs (registered at the District Administration Office) or co-operatives (registered at the District Co-operative Division).

1 World Bank (2019), based on latest SE4ALL database figures found here: https://data.worldbank.org/indicator/EG.ELC.ACCS.UR.ZS?end=2019&locations=NP&start=1996&view=chart.

CREEs are responsible for the operation and maintenance of distribution systems under the NEA Community Electricity Distribution By-Laws 2003. Most CREEs emerge as a result of new grid expansions (though in some cases, existing distribution systems are handed over to them). Once a CREE has submitted an official request, the Community Rural Electrification Department (CRED), which sits under NEA, initiates a survey and estimates the cost. Community members deposit a 10% share of the total budgeted costs through the CREE prior to work starting (the remaining 90% is released by the Government as a subsidy).

While the CRED installs step-down transformers and the entire distribution system, the CREE implements the household connections and also carries out repair and maintenance work (on a needs-based and periodic manner, as per NEA standards). NEA-DCS offices are engaged in technical monitoring and provide technical training to CREE staff.

A CREE purchases bulk electricity from NEA at a reduced rate and then sells it to consumers at or below NEA national consumer tariffs[2] (at present, most charge the same as NEA-DCS). A bulk electricity meter is installed (to measure the total amount consumed by the CREE's customers), and both the CREE and NEA take monthly meter readings. CREEs are expected to cover all management and repair and maintenance costs from the net income generated from selling electricity (with individual households or enterprises having their own individual meters to provide the basis for billing by the CREE). NEA remains responsible for any transmission losses up to the transformer whereas CREEs are responsible for any distribution losses thereafter.

The role of communities in CREEs

In terms of organisational structure, a general assembly (of community members) sits at the top of each CREE. The general assembly elects an executive committee comprising of a chairperson, vice-chairperson, secretary, treasurer and executive members. Under the executive committee there are different functional units to perform daily tasks such as accounts and administration, distribution line repair and maintenance, meter reading, promotion of productive use of electricity and so on. In order to maintain a reliable supply of electricity to the CREE customers, there is generally also a transformer sub-committee for each transformer feeder area.

Community members elect executive committee members for a fixed term, as defined in the bylaws.

Profile

Winrock International is a recognized leader in U.S. and international development, providing solutions to some of the world's most complex social, agricultural and environmental challenges. Winrock's mission is to empower the disadvantaged, increase economic opportunity and sustain natural resources. Winrock is a non-profit organization that implements a portfolio of more than 140 projects in over 46 countries. Winrock International has been working in Nepal to increase access to clean energy through public awareness raising and capacity building since the establishment of Renewable Energy Program Support Office (REPSO) in 1997.

Oxford Policy Management's (OPM) mission is to help low- and middle-income countries achieve growth and reduce poverty and disadvantage through public policy reform. The Winrock International research reported here was funded by the Applied Research Programme on Energy & Economic Growth programme (EEG), managed on behalf of the UK Foreign Commonwealth and Development Office by OPM. EEG's overall purpose is to build a body of evidence around how sector reforms, innovative technologies and practicable actions can be used to help maximise the economic impacts of larger scale energy projects in sub-Saharan Africa and South Asia, and to bring benefits of modern energy services to poorer people.

2 Which apply to all DCS grid connections, rural or urban.

They also participate in periodic preventative maintenance on distribution lines (bush-cutting and replacing insulators, for example), as well as participating in electrical safety awareness campaign organized within their community/locality.

Assessing the performance of CREEs

The Applied Research Programme on Energy and Economic Growth, funded by UK AID and managed by Oxford Policy Management, supports a research project[3], led by Winrock International Institute for Agricultural Development, that is examining the relative performance of electricity distribution systems managed by NEA-DCS versus CREEs. To analyse which model has better outcomes, five geographic areas have been selected, and two communities within each (one with a traditional utility-managed distribution system and one with a community-based system) are being studied.

District	CREE location / ward number	DCS location / ward number
Rupandehi	Pragatinagar, Butwal 11	Devinagar, Bhutwal 11
Syangja	Biruwa 1	Bhirkot 3
Tanahu	Bhimad 9	Bhimad 8
Dhading	Siddalek 7	Siddhalek 2
Parsa	Paterwa Sugauli 2	Paterwa Sugauli 4

3 https://energyeconomicgrowth.org/index.php/publication/working-paper-exploring-different-models-electricity-distribution-system-management

Initial results suggest that CREE management systems offer several advantages over the NEA-DCS model. In particular, CREEs appear to be more service-oriented and more responsive to consumers' needs. This may be because CREEs cover only their local community. Due to the small operational area and the community ownership structure, CREEs are more active and tend to possess more detailed knowledge and information. In contrast, NEA-DCS offices are concentrated in cities, staff (including technicians) cover much larger areas, and there seems to be no direct communication or relationship between staff and consumers. A summary of key benefits of the CREE approach includes:

- **Quick and easy connections:** CREEs seem to provide quicker and easier power connections for new customers.
- **Timely repair and maintenance:** While frequent unplanned power interruptions and voltage drops were found to be occurring in both NEA-DCS and CREE locations, there are fewer issues in CREE areas.
- **Simpler bill payments:** In CREE areas, consumers can pay their electricity bills during meter readings or at an office counter situated within their locality, so they do not have to travel far. In contrast, the NEA-DCS bill payment process is more time consuming with most customers still having to visit the nearest NEA-DCS office counter to pay their bill, which may be some distance away and can involve time-consuming travel.

Saw mill at Biruwa Bazar connected to the grid. (12.2)

Cement Block making at Biruwa Bazar. (12.3)

- **Reduced electricity theft and safety hazards:** In addition to seemingly providing better services, stealing electricity through 'hooking' – attaching wires to distribution system cables – appears to be much less of a problem in CREE localities than NEA-DCS ones.

Challenges faced by CREEs and future opportunities

Although most CREEs are operating smoothly, those serving particularly small communities (less than 500 people) tend to have problems with financial viability. A preponderance of domestic customers consuming very low amounts of electricity (typically less than 20kWh per month and charged at the lowest tariff rate) combined with an absence of businesses (who tend to use more and are charged at a higher tariff) means that such CREEs struggle to generate enough revenue to cover costs. Recently the Government instructed the NEA to provide the first 10 kwh per month for domestic consumers for free and there is an on-going discussion about possibly extending this further to cover the first 20kWh per month[4]. This is an effort to help low income households but one which is causing additional problems for CREEs, who see income reduced but the bulk price they pay for electricity from NEA remaining unchanged. Talks are underway at the moment to try to resolve this issue. Going forward Nepal is moving towards a surplus of electricity generation as new hydropower projects come on line, meaning supplies should become more reliable and possibly cheaper. Electric cooking is being promoted as an alternative to biomass and wide take-up would do much to improve the financial viability of CREEs, providing a higher baseload and associated revenue.

Nepal currently has over 300 CREEs serving around 535,000 households[5] or roughly 11% of the rural population. Their apparent higher performance than DCS-run distribution systems in terms of connection provision, timely maintenance, bill payment and lower electricity theft levels would suggest they merit more consideration as a preferred route for the management of rural distribution systems.

4 https://kathmandupost.com/money/2021/08/03/government-tells-electricity-authority-to-work-on-tariff-waiver-scheme

5 See https://naceun.org.np/

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Photo credit: (12.1;12.2;12.3) Winrock International.

Local assembly before COVID-19 pandemic. (13.1)

Solar energy enhances food sovereignty for riverbank families in the Brazilian Amazon

PARTICIPATORY, SOLIDARY AND INCLUSIVE ENERGY INNOVATION IS ADVANCING SUSTAINABLE LIVELIHOODS AND PRODUCTIVE SUPPLY CHAINS

Overview

This narrative tells the story of a community-based energy project in the community Ilha das Cinzas, which is a well- and self-organized community in the Brazilian Amazon. The community members through their association lead and are the main actors of the project, in which solar systems will be designed and implemented to improve quality of life and food sovereignty of the 50 local families living in the community. The project is funded by the Honnold Foundation and has the support of local and international partners to plan and execute all project activities.

The context of the community Ilha das Cinzas

The community Ilha das Cinzas is located on an island surrounded by the Amazon River in the Brazilian State of Pará. Fluvial transport is the only way to reach the community, which has no access to the electricity grid and has limited access to additional basic services like drinking water and basic sanitation. In the community live 50 families, which historically occupy the island, live in stilt houses and engage in activities like fishery and the extraction of fruits from the forest. The pulp of the acai fruit is the food base of the families as well as a means to earn a living.

Seeking to improve living conditions in the community, the local families founded in 2000 the community-based organization Associação dos Trabalhadores Agroextrativistas da Ilha das Cinzas (ATAIC). Since its foundation, ATAIC has been working to improve local living conditions in terms of education, community participation and organization, health care, basic sanitation and production for local food security and commercialization of surplus. The community and its association ATAIC are recognized in the region as an innovative example of participatory governance and sustainable development of riverbank people.

However, the lack of electricity for basic human needs (e.g. illumination, communication, food processing

and water pumping) and production is still a concern. Among the 50 families, 10 have solar systems installed in their homes, but the systems are not working properly. Consequently, most of the families still relying on diesel generators with high operational and environmental costs. On average, the generators supply 3 hours of electricity per day.

It is within this context that ATAIC together with local and international partners (detail below) received support from the Honnold Foundation to develop the project "Solar energy for food sovereignty of riverbank families". It is the families and their association that are leading the project, and was a stipulation when applying for funding with the Honnold Foundation, which focuses on community development through off-grid solar energy projects. The project was approved in 2020 and is expected to be completed in two and a half years.

The socio-technical energy project

The project was designed to have high participation of community members in all project phases as well as to integrate energy access with multidimensional needs and aspirations of the community. In this way, the community members are the main actors and beneficiaries of the project. Also, the project will promote capacity building of community members, the use of electricity for basic needs and production as well as basic sanitation. In particular, the following activities will be conducted.

- Re-adequation and technical assistance to the solar systems already installed in the community (10 households) that are not working properly.

- Design and installation of 40 additional solar systems for the families that are still relying on diesel generators. These systems will be used for basic needs, water pumping and/or production, like irrigation and fertilization (using treated sewage) of acai palms plantations and for processing the acai fruit using electric mixers.

- Design and installation of a solar system in the community center, which will provide electricity for meetings after sunset, refrigerate fish and process the acai fruit.

Community centre with solar panels. (13.2)

Sewage treatment at the community Ilha das Cinzas. (13.3)

- Capacity building of community members, especially women and young, for the installation, operation and maintenance of the solar facilities

- Promotion of exchange experiences with other communities.

Main project goals

Successful transfer of project management and operation to local governance: at the end of the project, the community members should be able to run and operate all solar systems that will be installed and keep the productive chains improving without the support of external agents. This will be achieved by the capacity building, assembles and meetings that will occur along the period of the project.

Food sovereignty and quality of life: the project was designed to improve food sovereignty and quality of life of the 50 families living in the community. This goal will be achieved by using solar energy systems for basic human needs and to increase local production/consumption of acai.

Solidary and inclusive community model: the community Ilha das Cinzas is already known in the region as a model of solidarity and inclusivity of community members to overcome local challenges. This will be strengthened by all activities to be conducted in this project. The dissemination of best practices, project results and knowledge and capacity building will be essential to achieve this goal. The achievement of this goal is of relevance to developing new socioeconomic dynamics based on solidarity in the Amazon region, with the potential to be adapted and transfer to other similar communities in the region.

Profile

The Associação dos Trabalhadores Agroextrativistas da Ilha das Cinzas (ATAIC) is rooted in women movement and is a community-based organization funded in 2000 by the community members of Ilha das Cinzas. The leadership of ATAIC is composed of the own community members, women and men. All activities conducted aim to benefit and improve the quality of life of the local families and to promote integration with other communities to replicate/learn best practices in the Brazilian Amazon.

The role of ATAIC and project partners

ATAIC coordinates and is the main executor of the project. To successfully execute the project activities, ATAIC counts on the support of local and international partners. These are: (1) Embrapa Amapá (Brazil), which is the largest Brazilian agricultural research corporation and has been working with ATAIC in previous projects to improve living conditions and productive chains in the community; (2) Laboratory of Renewable Energies of the Federal University of Amapá (Brazil), which is responsible for the technical design of the solar facilities; (3) Center for Energy and Society of the Arizona State University (USA) and (4) Institute for Technology Assessment and Systems Analysis of the Karlsruhe Institute of Technology (Germany), which will promote the social value of energy in the community, aiming to increase benefits and reduce risks of electricity access.

Main challenges

The main challenges currently faced by the community to advance the project activities refer to the impacts and social restrictions imposed by the COVID-19 pandemic in the region. Since the project was conceived to have a high participation of community members (the main actors of the project), many practical activities in the community cannot take place as long as the pandemic lasts. It is also difficult for the local and international partners to visit the community in 2021. To deal with this challenge, ATAIC has adopted a peer-to-peer approach and visiting family-by-family seeking to advance on the project decisions that need input from the families. Digitalization is one additional and new challenge for the community and the pandemic has forced ATAIC to adopt online banking and the internet for communication with local and international partners. ATAIC and local and international partners are keeping regular and virtual meetings to reflect and advance the project in this hard time of the pandemic.

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Photo credit: (13.1;13.2;13.3) Marcelino Guedes

Revolusolar team training community members in solar energy. (14.1)

Revolusolar: solar revolution in Rio's favelas

"THE SOLUTIONS FOR THE CITY OF RIO WILL COME FROM THE FAVELAS" – LOW-INCOME SOLAR COOPERATIVES HAVE ENORMOUS POTENTIAL TO DELIVER SUSTAINABLE ENERGY, GROW COMMUNITY CAPABILITIES, AND SO MUCH MORE.

Overview

This narrative tells the story of Revolusolar, a non-profit organization based in Rio de Janeiro that promotes the sustainable development of low-income communities through solar energy. In 2021, Revolusolar built the first solar energy cooperative in a Brazil's favela. The model harmonizes with collectivity, cooperation and self-management traditions of Rio's favelas, and it is designed to be replicable in other communities in Brazil and Latin America.

Revolusolar and the first solar energy cooperative in a Brazil's favela

Revolusolar is a non-profit association that was created inside a favela in Rio de Janeiro, by a group that brought together a Belgian (member of Ecopower renewable energy cooperative in Europe and Rescoop), the president of the residents' association, a local electrician and researchers. The motivation for this union was to solve a historic pain in the community: the recurrence of serious problems related to the access to electricity. In addition to being very expensive, energy services are also of poor quality for this population, with several blackouts, which causes a feeling of injustice and powerlessness. The community, however, has at the same time an enormous capacity to generate its own energy through the abundant sun that radiates over its roofs. In addition, it is composed of single-family buildings, unlike what usually occurs in richer parts of the city. Such factors allied to the evolution of photovoltaic technology created the context for Revolusolar to be possible.

The idea then became to bring affordable energy to the residents of Babilônia and Chapéu Mangueira favelas through distributed generation. The regulation of this modality started in Brazil in 2012 and was updated in 2015, allowing for the cooperative model. Since Revolusolar's foundation, in 2015, the dream was to form a cooperative, because in addition to shipping more families and solving economic and technical problems of individual installations, it harmonizes with the traditions of the community of collectivity and cooperation. However, until 2020 we did not have the organizational maturity, structure and resources for that. As a result, we have been carrying out small projects in individual facilities, professional training courses and workshops for children's education. Finally, at the beginning of 2020, Revolusolar began the development of the first solar energy cooperative in favelas in Brazil - which will start operating in August 2021, and will benefit 35 local families from two favelas.

To ally the project with the sense of community, we have invited the members to decide the cooperative's name. The name chosen, Percília & Lúcio Cooperative of Renewable Energy, is a tribute to two historical community leaders from the two favelas. Percilia was the first female president of Babilônia's residents' association and the founder of a famous school in the favela. Lúcio was the president of Chapéu Mangueira's residents' association and the founder of Federation of Favelas in Rio de Janeiro.

To foster community engagement and autonomy, we have developed our own methodology for sustainable development through solar energy – the Solar Cycle, which involves, in addition to installations, professional training for solar installers, environmental education for children and youth. The formation of a local team capable of installing and maintaining the systems is essential for the project's long-term success and the creation of local autonomy. Thereby, it generates employment and local income as the solar energy market grows exponentially in Brazil and generates thousands of jobs (so far there are about 300,000 new jobs created, according to the Brazilian Association of Photovoltaic Solar Energy), which is very important in the context of high unemployment rate and economic crisis in the country. Children's

Revolusolar: democratizing solar energy access in Rio's favelas. (14.2)

Solar panels are installed in the first energy cooperative in a Brazilian favela. (14.3)

education also strongly contributes to the continuity of the project in the long term, and to the engagement of the families, for the Solar Energy Revolution. Savings on electricity bills is the main direct economic benefit of the solar cooperative project. Electricity tariffs rose 106% in the last decade in Rio de Janeiro, far above inflation in the period. With their own generation of solar energy, the cooperative beneficiaries can save up to 90% of energy expenses, allowing reinvestment in leisure, culture and education.

All these measures, in addition to directly impacting the lives of these residents, also contribute to achieving the UN Sustainable Development Goals. Such as 7 (accessible and clean energy), as they make photovoltaic systems accessible, 4 (quality education) as they promote a schedule of environmental activities in the daycare, 11 (sustainable cities and communities), as they democratize access to clean energy, 13 (action against global climate change) as solar panels avoid the use of energy from fossil fuels, which promotes the emission of greenhouse gases and 8 (decent work and economic growth) as that offer professional training to favela residents.

It is in this perspective that Dinei Medina, a community leader of Babylon's community and Revolusolar's ambassador says, *"as soluções para a cidade do Rio virão das favelas"* "the solutions for the city of Rio will come from the favelas". This is just a pilot project that we intend to replicate to other communities that are experiencing similar difficulties, and have similar potential to generate their own energy.

In an unequal city like Rio de Janeiro, where 1/4 of the population lives in favela, with inadequate infrastructure and an inaccessible energy service, the savings expected with the cooperative project are only possible due to the existence of a regulatory framework for distributed generation since 2012 in Brazil (know in the country as 'Electrical Energy Compensation System'), in addition to an 85% reduction in the costs of photovoltaic technology since 2009. However, the government's disregard for favelas impedes the growth of solar energy use in these communities. Currently, there are no direct government incentives for projects like ours. We have the support of the private sector and Brazilian and international social and environmental foundations, including the International Cooperatives Alliance. For the scalability of the model, we understand that there are capital

Children's education promoted by Revolusolar. (14.4)

restrictions, which can be neutralized with government incentives or private hybrid capital financing mechanisms, which involve, in addition to donations, some repayment by the beneficiaries (with part of the savings in the electricity bill that are having – including this repayment model we are validating with the new pilot project of the cooperative).

Our vision for 2030 is to replicate this model in other communities in Brazil and Latin America. To reach this scale, new collaborations with key international actors will be essential.

REVOLUSOLAR

Local children's school where Revolusolar installed solar energy. (14.5)

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Photo credit: (14.1;14.2;14.3;14.4;14.5) Revolusolar

Citizens engaged in the project Solar Buin 1. (15.1)

People power: decentralizing energy one community solar system at a time

ORDINARY PEOPLE BUILT THE FIRST COMMUNITY SOLAR PROJECT IN CHILE. UNLEASHING THE CREATIVITY AND IMAGINATION OF BOTTOM-UP SOLAR INNOVATION IS CRUCIAL TO TACKLING CLIMATE CHANGE AND DEMOCRATIZING ENERGY

Overview

In 2017 the first community solar plant was constructed in Buin, Chile and was financed by 100 motivated citizens. The project aims to promote local generation of solar energy, to democratize it and to empower citizens. Among the main lessons learned from this project, the need to create financial instruments, educational practices in energy and cooperative projects, and the dialogue with local authorities to promote the importance of involving citizens in energy participation and decision-making in order to promote energy transition, can all be highlighted.

Solar Buin 1: the energy transition needs citizen participation

Solar Buin 1 is the first solar plant entirely financed by citizens in Chile. The power plant was installed in 2017 in Buin, a city of Santiago, and was financed by about 100 people motivated to promote local and decentralized solar energy, in the hands of the citizens. Each investor could contribute to finance the power plant with about US$ 70, since the objective was that no one would be prevented from participating in the project due to lack of capacity to invest. Solar Buin 1 has a 10kW power capacity and provides renewable energy for the institute of environmental education Instituto del Medio Ambiente (IDMA). Although the power plant was established under a distributed generation law for self-consumption that did not require shared production, the plant continues to produce electricity for the IDMA institute and generate net-billing, which in Chile is equivalent to about 60% of the kWh-value consumed from the grid.

The energy cooperative ENER Metropolitana manages the plant since its first operation, carrying out the financial operation and delivering to the citizens about 10% of their investment each year plus an annual

profitability, equivalent to 2% + CPI[1]. A service contract of 10 years was established between the cooperative and IDMA, in which IDMA pays an adjustable annual fee. The management of the Solar Buin 1 is a voluntary work of three members of ENER cooperative. In this way, the 100 citizens that financed the power plant do not need to manage it.

Solar Buin 1 is an innovative Project for Latin America. Particularly in Chile, solar energy has been developed mainly on a large scale and by large energy corporations – mainly by foreign capital -, while less than 2% of the solar energy correspond to distributed generation[2]. In other words, citizens are not yet significantly participating in the energy transition. Although there is a regulation that allows shared generation – the lack of knowledge, financing mechanisms and investment capacity are part of the main barriers to promoting citizen energy. Also, although solar energy has improved its profitability, the economic priority of many people is related to solving basic needs. Although Chile is an OECD country, it is among the 10 most economically unequal countries in the world, according to the Gini coefficient[3]. With the high level of privatization of basic needs, such as health and education, the possibilities for investing in renewable energies are still scarce for most of the citizens.

In the case of Solar Buin 1, Ener Metropolitana has been able to assume several administration costs on a voluntary basis. In 2018, a study has conducted to evaluate how the project could achieve economic sustainability. As a result, the study showed that it would be necessary to install about 1 MW of solar energy for the business model to be economically sustainable. The barriers that the cooperative has identified include a lack of financing to have a working capital to allocate resources for expenses such as dissemination, management and administration of new citizen investment projects. Likewise, the non-existence of or appropriate instruments such as the creation of guaranteed funds that allow safeguarding the investments made in the event of adverse situations (e.g. economic crisis due to Covid pandemic).

In addition, in order to expand the capacity of installed solar power plants, it would be necessary to invest in capacity building with interdisciplinary capabilities, along with maintaining a process for evaluating new customers, which considers technical aspects (such as available space and electricity consumption) and financial (ability to pay, contract models best suited to the client's profile).

At the socio-political level, it is still very important to promote education and dialogue with local authorities regarding the importance of engaging citizens in energy participation and decision-making processes. Although there is a ministerial policy that promotes the development of renewable energies at the municipal level (such as the Energy Comuna program), there is usually a tendency to maintain the logic that promotes energy development in the hands of large energy corporations, delegating the citizen participation in a minor role, such as customers or consumers of solar energy. In this way, it is of high relevance to promote energy literacy, so that citizens become

Profile

Energía Colectiva is a non-profit organization whose objective is to promote citizen participation in energy transition in Chile. We seek to articulate different actors to facilitate access to knowledge, capacity building and to promote discussion around the development of public policies that promote local, ecological and democratic development as guiding principles of a society based on renewable energies. Our main lines of action are Articulation, Education, Capacity building, Collective financing and Citizen advocacy.

1 IPC: "Consumer Price Indices"; „Índices de Precios del Consumidor" is an indicator that is generated monthly by a government agency, and accounts for the increased cost to consumers. In simple terms, it accounts for the increase in the cost of living (inflation) for an average consumer based on an average family consumption.

2 Comisión Nacional de Energía (CNE), 2021

3 Banco Mundial, Índice de Gini – Chile, 2017

Solar panels installed on the roof of IDMA. (15.2)

aware of the importance of assuming an active role and demanding policies in favour of citizen energy.

The analysis of the aforementioned needs and challenges allows us to conclude that in order to improve the internal capacities similar projects to Solar Buin 1, it is essential to make alliances with organizations and stakeholders interested in promoting citizen participation in the energy transition. Also, it is important to collaborate in the development of promotional financial instruments such as the guaranteed funds, as well as to promote the exchange of successful experiences in carrying out citizen investment projects. In order to articulate and continue promoting new community energy projects, a group of people from the ENER cooperative formed the Non-governmental Organization Energía Colectiva, whose objective is to promote citizen participation in the energy transition, articulate different actors to disseminate access to knowledge, create capacities in communities and promote discussion around the development of public policies that promote local, ecological and democratic development as guiding principles of a society based on renewable energies.

Finally, regarding the current distributed generation policy in Chile (Law 21,118), although it is possible to recognize the notion of shared energy, it still needs to be aligned with the possibilities and desires of citizen democratization. Beyond the clearly unsatisfactory injection price, the lack of incentives for a larger population and the almost non-existent policies and instruments for broad citizen investment, the collective work achieved to make Buin Solar 1 a reality shows that not only large capitals demand space in shaping the future of energy in Latin America.

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Photo credit: (15.1;15.2) Cooperativa ENER Metropolitana

Founding cooperative members of COOBER on the inauguration date of the cooperative's plant. (16.1)

Community cooperatives stepping up to the energy transition challenge

RENEWABLE ENERGY COOPERATIVES PROMOTE DECENTRALIZED AND PARTICIPATORY ENERGY GENERATION IN BRAZIL.

Overview

The debate around the decentralization and diversification of the Brazilian electricity matrix is crucial to ensuring access to reliable, sustainable and modern energy for all in the country. It is in this context in which renewable energy cooperatives can play a major role. In this narrative, we present the story of three energy cooperatives making history in the country by becoming active actors in the energy transition: COOBER, Coopsolar and Coopervales[1].

The Brazilian electricity context

Brazil's social and economic development increases the energy demand and the challenge of establishing an energy infrastructure capable of serving the country. In 2020, renewable energy sources were responsible for 84.8% of the Brazilian electricity matrix, which represents a high value compared to the 23% of the world average[2]. The main highlight is the hydraulic generation, which corresponds to 65.2% of the internal supply[3]. However, a large part of the national hydroelectric potential is available in very sensitive regions, in both environmental and social terms.

This scenario drives the country to a very sensible energy security context since its electricity generation is highly dependent on one type of source large-scale generation. Therefore, the discussion on energy security requires rethinking this model. Efforts must be focused on diversifying and decentralizing the Brazilian electricity matrix.

Distributed generation of energy is defined as electricity generation from small plants located close to the consumption center and connected to the distribution network. Distributed energy generation was regulated in Brazil in 2012, when the National Electricity Energy Agency (ANEEL) published the REN 482/2012 resolution. The resolution established a

1 The Percília & Lúcio Cooperative of Renewable Energy is one additional example of a cooperative that is making history in Brazil by being the first energy cooperative in Brazilian Favelas. Details about it can be found in the story 14 "Revolusolar: solar revolution in Rio's favelas" in this report.

2 https://www.epe.gov.br/sites-pt/publicacoes-dados-abertos/publicacoes/PublicacoesArquivos/publicacao-601/topico-588/BEN_S%C3%ADntese_2020_PT.pdf

3 Ibidem

Cooperavales plant under construction, located in the city of Arroio do Meio in Rio Grande do Sul. (16.2)

net-metering scheme, in which prosumers (producers-consumers) can inject their surplus energy into the grid generating energy credits in a one-to-one scheme (each exported kWh generates credits of one kWh). In November 2015, the regulation was revised and ANEEL published REN 687/2015, which made possible the execution of shared distributed generation projects through consortia or cooperatives.

Energy cooperatives for distributed generation

Shared distributed generation cooperatives are made up of individuals who voluntarily wish to join forces to generate their own or simply to consume energy from a renewable source. By definition, a cooperative is an autonomous and voluntary association of people with the aim of meeting common economic, social and cultural needs and aspirations through a jointly owned and democratically controlled enterprise. As they are very flexible organizations, cooperatives proved to be a good option to respond to current social and environmental challenges that include the generation of renewable energy at a local and decentralized level. The Brazilian Renewable Energy Cooperative (COOBER)[4] was the first distributed generation cooperative, as regulated by REN687/2015, to be established in the country. COOBER was formed by a group of 23 friends in 2016, in the municipality of Paragominas, Pará - Northern region of Brazil. COOBER's constitution was inspired by the UN's SDGs (Sustainable Development Goals), in particular, objective 07: "Ensure access to affordable, reliable, sustainable and modern energy for all".

This group of friends set into operation, with their own investment, a 75 kWp ground-mounted solar energy plant in a land donated by the Paragominas city hall. The group is made up of teachers, self-employed professionals, rural producers, doctors, among others. Most of them already had some previous experience with cooperativism, which made it easier to build the group's structure and motivation.

In the Northeast region of the country, a very prominent initiative is the Solar Energy Cooperative (Coopsolar)[5]. Coopsolar was incorporated in 2019 in the municipality of Pitimbú, in the state of Paraíba. However, Coopsolar's history began in 2017, when one of the founding members participated in a workshop promoted by the Organization of Brazilian Cooperati-

4 https://energia.coop/mapa-de-iniciativas/cooperativa/cooperativa-brasileira-de-energia-renovavel-coober/

5 https://energia.coop/mapa-de-iniciativas/cooperativa/coopsolar/

ves (OCB) and by the German Cooperative Confederation (DGRV). During this workshop he heard for the first time about the shared generation of renewable energy through cooperativism and saw from there a great opportunity to become an active actor in the energy transition in the country.

In January 2019 the cooperative was established. For the construction of the power plant, one of the members leased his own land at a good price so the cooperative could build the system there. Another member, who owns a renewable energy company, provided the equipment at cost price. That was how, as of May 2020, the 22 cooperative founders of Coopsolar started to receive solar energy credits, generated by a shared 75 kWp plant, in their energy bills. With the success of the first power plant, in 2021 Coopsolar connected to the grid a second 75 kWp power plant in the city of Lucena and has currently two other plants under construction.

Moving to the southern region of Brazil, in the state of Rio Grande do Sul, in 2019, a group of four friends, members of a financial cooperative, began to develop the idea of collectively generating solar energy. When they heard of COOBER's pioneering initiative, they contacted one of its founders to ask questions and get some advice. By the end of 2019, the Vale do Taquari Renewable Energy Cooperative (Coopervales) was established by a group of 22 people driven by a common goal: to generate energy in a clean and sustainable way, benefiting the collective. In August 2020, also with their own investment and with the availability of land from one of the cooperative's members, that the group put into operation, in the city of Arroio do Meio, a 72.5 kWp solar power plant. As Magnor Genezini (one of the founders of Coopervales) said: "The idea, besides meeting a need for energy in associates' homes, conveys people's desire to do something positive in the communities where they live, spreading knowledge and seeking to innovate people's behavior"[6].

6 https://www.proinst.com.br/post/proinstconstr%C3%B3i-primeira-cooperativa-ga%C3%BAcha-de-energias-em-arroio-do-meio

Cooperavales' members at 2020 assembly and on a site visit at the power plant that have just started operation in that occasion. Credits: Coopervales

Either COOBER, Coopsolar and Coopervales share a common motivation: to generate clean and sustainable energy collectively and at a more affordable price. In addition, the three cooperatives sought to benefit both their local communities and society in general, being an example and inspiration for future initiatives.

Profile

Institute for the Development of Alternative Energy in Latin America (IDEAL) is a private non-profit organization based in Florianópolis (SC), which has been promoting renewable energy and energy integration policies in Latin America since 2007. IDEAL was born with the purpose of creating a large movement in defense of renewable energies and energy efficiency, making it possible, through society's awareness, to establish a regional energy integration policy committed to the future of humanity.

DGRV – the German Cooperative and Raiffeisen Confederation is the national apex organization and top-level auditing confederation of the cooperative sector in Germany. Since more than 40 years, DGRV is engaged in international development cooperation. In more than 30 partner countries, DGRV provides consultancy and helps to develop cooperative systems and structures aiming at a sustainable development of the cooperative sector. Cooperatives are a proven organisational and legal form for cooperation in various ways, from which the individual members as well as the entire committed community benefit. Cooperatives and their members represent ethical values such as honesty, transparency, social responsibility and mutual solidarity. The principles of self-help, self-administration and self-responsibility as introduced by F.W. Raiffeisen are of crucial importance.

It is important to note that these community projects only became possible after the regulation allowed the development of shared distributed generation projects in Brazil. This fact highlights the importance of thinking about and developing policies and regulatory frameworks that support and encourage the development of community initiatives for renewable energy.

Challenges to advance energy cooperatives in Brazil

However, just a regulation is not enough for initiatives such as COOBER, Coopsolar and Coopervales to form and develop with security and stability. These initiatives, at the time of their formation and later in the operation and maintenance of the project, shared not only the motivations, but also the challenges. These challenges involved:

- Lack of knowledge of the cooperative business model. In Brazil, the cooperative business model is more well known in the southern region due to European influence in that region. In other parts of the country, the model is not very disseminated.
- Many projects begin from volunteer time and self-engagement to structure and run a co operative initiative. Therefore, due to other commitments from the participants, many projects do not go past the concept phase;
- Lack of knowledge about the possibility of shared energy generation, which often generated mistrust and poor engagement during the project development.
- Lack of financing options that are appropriate for the business model;
- Lack of technical and legal understanding to prepare the business model and calculate the technical economic feasibility of the project;
- Difficulties in the relationship with the power distribution company during the process of connecting the plant to the electricity network and in offsetting credits and;

Coopsolar's 75 kWp shared solar power plant located in Pitimbú, Paraíba. (16.3)

Cooperavales' members at 2020 assembly and on a site visit at the power plant that have just started operation in that occasion. (16.4)

- Regulatory instability due to the revision process of the distributed generation regulation (REN 482/2012), which is going on since 2018 and it is not completed yet up to the publication of this document in November 2021.

Overcoming challenges

These observations highlight the importance of also thinking about actions that fill these gaps. Examples of actions are developing financial support systems for community energy projects, guiding and supervising power distribution companies in connection and credit compensation procedures, ensuring legal and regulatory security for the projects, and promoting accessible information on the subject. These are some of the steps that need to be taken to let community initiatives to lead with autonomy and solidity to become protagonists of energy diversification and decentralization in the country.

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Photo credit: (16.1) COOBER; (16.2;16.4) Coopervales; (16.3) Coopsolar

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The Center for Energy and Society at Arizona State University was established to put people at the center of the conversation about the future of energy. Over the next few decades, a global energy revolution will fundamentally transform energy systems and infrastructures all over the planet. Our job at the ASU Center for Energy & Society is to understand those implications and ensure that they are fully accounted for in the decisions made by energy business and policy leaders between now and 2050 as they redesign the world's energy systems. The International Energy Agency estimates a total cost for a global energy revolution of something like $70 trillion. What will humanity get out of that investment? Is a carbon-neutral energy system the best that we can do? Or can new energy systems also improve environmental, health, and economic justice; catalyze resilience, thriving, and sustainability for the world's diverse communities; and reduce global inequalities? Can we, through energy innovation, contribute to making cities that are more livable and lives that are more worth living? We believe we can. **https://energy-and-society.org/**

The Institute for Technology Assessment and Systems Analysis (ITAS) from the Karlsruhe Institute of Technology (KIT) investigates scientific and technological developments with a focus on their impacts and possible systemic and unintended effects. It produces analytical knowledge and assessments of sociotechnical developments in order to provide policy and design options for stakeholders. The research covers ethical, ecological, economic, social, political-institutional, and cultural questions, ending up in providing comprehensive sustainability assessment. Major goals are provision of knowledge for the design of sociotechnical systems and the organization and observation of discursive processes on open and controversial questions. A particular research topic relevant for the Let Communities Lead initiative and investigated at ITAS refers to the energy-poverty nexus, which encompasses and goes beyond the concept of energy poverty, widely used in the energy access sector. While the concept of energy poverty focuses on the lack of access to modern and affordable energy services and on strategies aiming to overcome this limitation, the energy-poverty nexus represents a sociotechnical approach that investigates systematically the interlinkages between energy access and the societal and institutional causes of poverty. **https://www.itas.kit.edu/**