

SLURC/DPU Action-Learning Alliance

Strategic pathways to disrupt risk in Freetown

MSc Environment and Sustainable Development
Practice Module 2019-20

POLICY BRIEF N^o5

Sustainable and Equitable Energy Transitioning

Key points

- Energy poverty is an issue of distributive injustice underpinned by further injustices in recognition and policy-making procedures, which manifest in risks including fire risk, health risk, and environmental risk
- Implementation of sustainable energy solutions at the community level can address socio-environmental justice. Leveraging off existing community structures to integrate off-grid energy solutions will improve the agency of residents in informal settlements, reinforce community support networks and bolster participation through deploying and managing micro-infrastructure projects and the local scale
- Resilience of the individual and urban centre can be further strengthened by distributed energy provision, due to the design of the energy structure itself and individual access to clean energy bolstering individual coping capacity
- The government can play a key role by acknowledging the need for sustainable and equitable energy access, both through policy action and recognition

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Figure 1: Freetown, Sierra Leone's bustling capital. Sierra Leone, 2018. Photo Credit: Getty

Introduction

The UN has highlighted the importance of energy through Sustainable Development Goals 7 and 11. These target access to affordable, sustainable and modern energy and inclusive, safe and sustainable cities and settlements, respectively (UNDP, 2015a). Energy access is such a key concern because energy poverty is essentially an issue of distributive injustice underpinned by further injustices in recognition and policy-making procedures (Walker & Day, 2012; Bouzarovski, 2017; Kim, 2015). Freetown is a prime example of the detriment that unequal access to energy can manifest in, and as such, sustainable and equitable energy transitioning in the informal settlements of Freetown both aligns with the SDGs and will help disrupting risk and poverty traps.

Justice can be conceptualised as consisting of three tenets: distributive justice relates to the fair distribution of resources; procedural justice to fair decision-making; and recognition to respect and acknowledgement given to different sectors of society (Schlosberg, 2007). Cycles of poverty are underpinned by these injustices manifesting in energy poverty, leading to unsafe replacements for fuel, leading to adverse health and economic impacts for the poorest sectors of society, the vulnerable and highly exposed (Kinoti, 2018; Bouzarovski, 2017; McCarthy, 2014). Freetown does, however, have an opportunity to address these issues. Informality can be an engine for innovation; by addressing energy poverty in informal settlements through deploying community-level sustainable energy solutions, the outcomes can reach further than the simple provision of electricity, into strengthening community ties and participation. Residents will gain increased agency over their own energy supply and infrastructure, while also bolstering resilience of individuals and the community as a whole. The government plays an important role in acknowledging these processes, both through policy action and recognition (Boossabong, 2017; de Vita, 2007). These interventions are suggested to be targeted in Dwazark, Cockle Bay and Susan's Bay, as discussed in the spatial analysis section. Throughout the policy brief, the environmental justice lens will be used to analyse the energy injustice issue in Freetown.

“Access to modern forms of energy is essential to overcome poverty, promote economic growth and employment opportunities, support the provision of social services, and, in general, promote sustainable human development.”

(Karekezi et al., 2012)

1. Environmental Justice

The concept of environmental justice is based on the belief that social and environmental dynamics are essentially inter-related, often resulting in the inequitable distribution of environmental resources and negative externalities (Munro, et al., 2017). Environmental strategies are shaped by the same political economic stakeholders and continue to reproduce the disempowerment and injustice to the marginalised (ibid.). Thus, it is crucial to consider environmental justice in situations where low-income and minority settlements are impacted by greater risks than other groups (Gunnarsson-Östling & Svenfelt, 2017) and influenced by social and spatial distributions of energy poverty (Bickerstaff, 2017). In the case of Freetown, as previously discussed, the differential access and distribution of energy could form different levels of participation and recognition in the society leading to inequitable distribution of risk exposure and burdens of fire. Renewable energy cognizant of the environment not only addresses human needs by improving people’s livelihoods, but from a broader perspective works on building resilience of socio-ecological systems. Renewable energy will allow increased energy production with significantly fewer negative impacts on the environment in

the form of fuel burning pollution. The initiatives of national and local governments need to take environmental justice into account for the equitable transition of energy and efforts to reduce energy poverty. Furthermore, as part of 2030 Sustainable Development Goals, the United Nations declared SDG7 targeting “access to affordable, reliable, sustainable and modern energy for all” and SDG11, addressing “making cities and human settlements inclusive, safe, resilient” (UNDP, 2015a, p.21, 24). Establishment of the goals signifies the international effort to make resilient cities through sustainable energy and recognise the importance of including marginalised population and settlements. Analysing the energy poverty and the risk trap issues in informal settlements of Freetown through the environmental justice lens will help reaching the SDGs probing into the differential access and distribution of energy and possible solutions to tackle the problem.

2. Current State of Energy Access

Freetown currently has high levels of energy poverty. Only 9% of Freetown’s population is formally connected to the electricity grid (as of 2011), leading many to turn to alternative power sources (SLURC/DPU Action-Learning Alliance,

2018). These alternative power sources can produce hazards; predominantly fire risk from candles or kerosene-based lighting and overloading power sources through informal connections (Vryniotis et al., 2019). Some communities already access electricity connections through group funds, such as Mafengbeh of Cockle Bay. There, the community collects money and centrally manages the electricity connection (Vryniotis et al., 2019). This shows there are already community structures in place which could be replicated more widely to access energy in a decentralised, distributive system.

3. Spatial Analysis

This map shows that a significant number of Freetown settlements suffer from high energy poverty, defined in the original research methodology as a high reliance on charcoal and biofuels as the main sources of energy in the areas, with many of the energy poverty areas also classified as informal settlements. This clearly visualises the aforementioned inequalities that manifest through exposure to the hazards, such as the instances of fire outbreaks shown on the map, which are generally concentrated in the areas of energy poverty, and mostly in informal settlements. Keeping in mind the limitations of the data available (particularly the lack

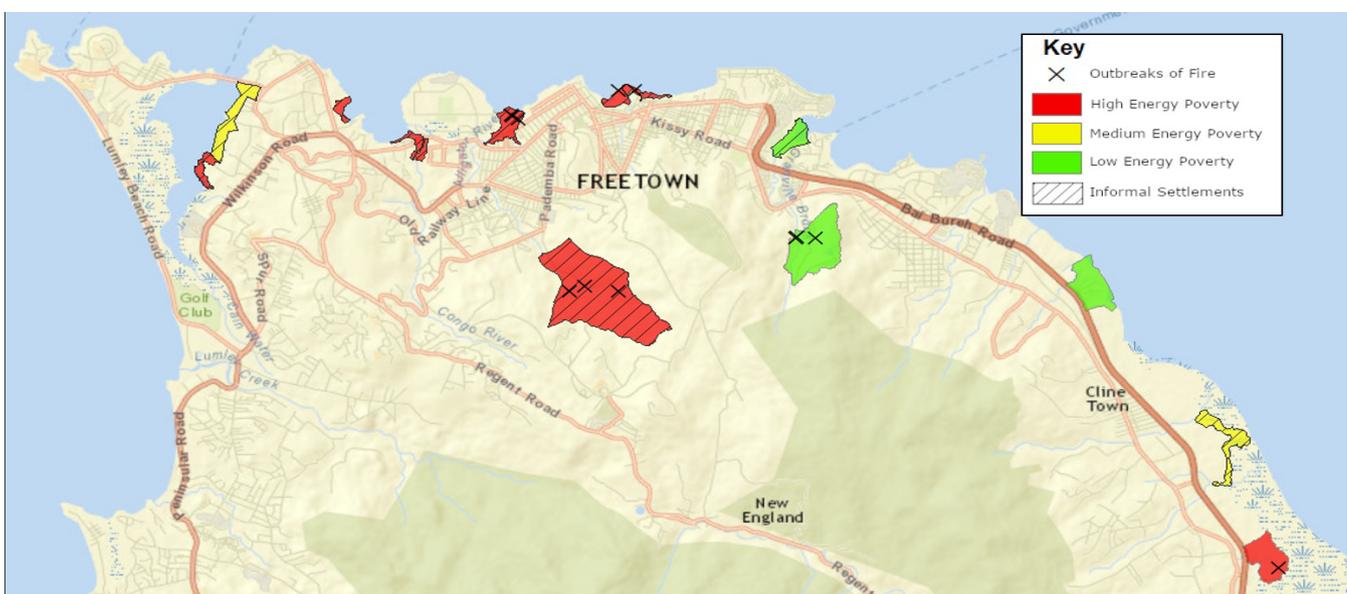


Figure 2. GIS-produced map of Freetown, highlighting areas of energy poverty, informal settlements, and fire outbreaks from the 15 settlements included in Urban ARK’s ReMapRisk (data from: ReMapRisk Freetown)

of data available on fire outbreaks), this spatialised data leads us to conclude the following areas may be best targeted:

Dwazark, the largest settlement in terms of land area, showed high energy poverty as well as the highest number of fire outbreaks in the analysed settlements. The combined influences of high energy poverty and the informal nature of the housing worsen the risks from solid fuel use, making it a key target for action in sustainable energy access. Less than 25% of the population has access to electricity and above 75% use fuelwood or charcoal for cooking. The potential consequences of this in terms of health and hazards will be further discussed in the section below.

Susan's Bay, as another informal settlement with high energy poverty, suffers many of the same issues as Dwazark. Furthermore, the road infrastructure in the area is severely lacking, making it very difficult for emergency teams to respond to outbreaks of fire in the area. As the 2017-2018 report on understanding urban risk traps in Freetown outlines, energy use patterns and housing arrangements in Susan's Bay are reflective of other informal settlements with high energy poverty. 15.6% of households used electricity for lighting but 70% used flammable kerosene; 93% of households used charcoal and firewood for cooking and heating water.

Cockle Bay has an existing community-based system for securing access to energy that was previously mentioned; this could be leveraged further in grounding a decentralised energy system in the existing community structure, similar to case study II, below. The area had medium energy poverty - a better situation than many other settlements, particularly informal settlements in Freetown. This suggests that there could be value to investigating how this community energy access system may be replicated or adapted to other settlements in Freetown, particularly Dwazark and Susan's Bay as above.

4. Drivers & Pressures

Root Causes of Energy Poverty

Sierra Leone's civil war prompted large-scale relocations to Freetown. As a result, a third of the country's population is based in Freetown (Marah, n.d.), leading to extreme pressures on the city's capacity, both spatially and in terms of integrating these new residents into the city's social and political structure. This rapid and

unplanned urbanisation has resulted in large informal settlements with high levels of energy poverty. The civil war also led to a large-scale destruction of infrastructure in the city, worsening the situation. Sierra Leone also suffered from the Ebola virus outbreak in 2014, which led to a large amount of government investment being diverted to healthcare, exacerbated by the country's weak healthcare capacity (Anderson & Beresford, 2016). The government has not prioritised addressing energy poverty in urban areas (see governance section). These underlying issues produce risk across Freetown, and particularly in informal settlements where levels of energy poverty are high, and there are high concentrations of marginalised groups.

In 2013, the UNDP together with Sierra Leone Red Cross Society and Sierra Leone Office of National Security joint-published the Vulnerability and Capacity Assessment Report, which clarified that disaster incidences are often caused by human activity; a social construction of vulnerability. The variation in access to energy across Freetown form of "energy segments", manifesting in variable levels of participation. For example, residents able to afford stable grid electricity or private electricity generators can use these to generate income, have higher education attainment and health outcomes (Bouzarovski & Petrova, 2015). Those who do not have such conditions/access suffer from the lack and in cases produce risk by trying to remedy their access through unsafe illegal connections (Vrynio-tis et al., 2019; Babourkova, cited in Allen, 2017). These potentially hazardous methods of building individual resilience can

actually reduce the resilience of the area as a whole; by providing better energy access these situations should be reduced. In addition, researchers found that due to the complicated underlying factors such as the attitudes, beliefs and values of local populations, people do not recognise or establish the link between their activities and hazards/disasters. Lack of government regulation, law enforcement and low environmental awareness contribute significantly to disasters and a high degree of energy access disparities (VCA, 2013).

One of the major drivers of the occurrences of energy poverty in Freetown is the governmental failure in recognising spatial and social injustice. When resources are distributed unevenly in relation to geographical variations and restrictions, it is crucial for the authority to decide where to reallocate and redistribute the resources and who should be prioritised (Bouzarovski & Simoncock, 2017). Cycles of energy vulnerability also involve spatially reinforcing mechanisms associated with the practices undertaken by disadvantaged households. For example, burning charcoal will lead to indoor air pollution which can negatively impact health, leading to money spent on medicine, and further poverty (Kinoto, 2018; Knight, 2014; Reeve et al., 2013). Spatial inequalities in energy vulnerability are thus a clear case of injustice because those living in certain localities are arbitrarily disadvantaged in their ability to attain essential energy services. While all energy poverty might be considered a form of energy injustice, this injustice is most severe if it is spatially concentrated in localities of relatively poor health.

Based on existing literature and governmental reports, the risks of energy poverty were categorised into five sections in this policy brief, which are air quality, fire risk, socioeconomic factors, environmental impacts and logistical barriers (Kayguzuz, 2011; VNR Report on SDGs in Sierra Leone, 2019; Renewable Energy Policy of Sierra Leone, 2016). The adverse risks associated with high energy poverty are unequally distributed across population in Freetown, especially in Dwazark and Susan's Bay, and across demographics. The vulnerable groups identified in energy poverty problems in Freetown are younger children and newborns, low income groups who live in disaster-prone areas, and urban residents who live in informal, unmapped settlements. Women who traditionally cook at home have higher exposure to these hazards (Ziervogel, 2017;



Figure 3: Living at risk in Freetown, Freetown, 2018. Photo Credit: Slurc.org

Meerow & Newell, 2019).

The below is a consideration of some of the hazards and risks discussed and any particularly affected populations:

Poor Air Quality Solid fuel based cooking and heating (such as firewood, coal, charcoal, animal dung) produces indoor air pollution - affecting children owing to less developed immune systems, particularly younger children and newborns, women if they live in a household where they cook more, and people with existing respiratory illnesses (Taylor & Nakai, 2012).

Fire Risk Freetown features a high density of buildings in many informal settlements, using low quality materials which are prone to catch fire. A lack of road infrastructure and distance from fire hydrants hinders emergency responses, lowering any coping capacity and thus magnifying risk. Electricity theft in Freetown can cause sparking - those not connected to the grid, with highest energy poverty levels and lowest income households are most impacted (Twigg et al., 2017).

Socioeconomics Purchasing or collecting fuel for cooking/heating can be costly or time-intensive - particularly affects lowest income households, those in work/education (Konteh, 1997). Poor lighting conditions may reduce the productive hours for education of children and business for the adults of the family (Kinoti, 2018).

Environmental Impact Harvesting firewood, charcoal production etc. can cause environmental degradation, often rapid and sometimes irreversible.

Logistical Barriers

The often unmapped nature of informal settlements means that illness from air pollution data can be incomplete and emergency response for fires delayed, exacerbating risk (Acemoglu, 2014). Lack of data from urban zones makes it difficult to identify areas for action.

5. Government Landscape & Development Plan

5.1 Government Landscape

The government of Sierra Leone has been developing goals and policies for a sustainable energy transition, especially encouraging renewable energy solutions. Sierra Leone National Energy Strategic Plan (2009) is a plan for the implementation of

the National Energy Policy. With the plan and the policy, they started recognising the importance of renewable energy and including them in the framework. The strategic plan sets increasing access to modern energy for poverty reduction in off-grid areas as its second objective and prioritises decentralized solar power supplies for the basic needs of rural areas. Also, as Sierra Leone is a member country of ECOWAS (Economic Community of West African States), its 2015 National Renewable Energy Action Plan (NREAP) was published for the implementation of the Renewable Energy Policy of ECOWAS (EREP). The national plan targets grid-connected renewables, off-grid in rural areas, domestic cooking energy and solar water heaters. The modern fuel alternatives of LPG, biogas, solar cookers etc. are suggested as well. In 2016, the Ministry of Energy launched the Renewable Energy Policy and it aligns with NREAP, mandating the planned strategies. Meanwhile, Freetown City Council (FCC) presented Transform Freetown which entails the goals and plans of Freetown City Council's district plan. The plan will be completed after the publication of Ministry of Planning and Economic Development's National Development Plan. The goals of the plan can be summarized into four groups: Resilience, Human Development, Healthy City and Urban Mobility.



Figure 4: Studying by the light of a solar lantern. Kychom, Sierra Leone. Source - makingitmagazine.net/?p=5954

5.2 Governance through Environmental Justice Lens

The policies address and prioritise solving the energy poverty problem in the rural areas offering strategies as off-grid solutions. However, the goals and policies fail to acknowledge the same problem occurring in the urban informal settlements.

Concentrating only on the rural and remote areas illustrates the lack of distributive justice, secluding the settlers in the area from the opportunities energy could bring. Also, through the lens of procedural justice, the voices and contexts of the energy poor, originally intended beneficiaries of the policies, in informal settlements were marginalised in the process of decision making. Furthermore, Sierra Leone has been highly dependent on biomass fuel like fuelwood or charcoal; the use of these fuels accounts for over 80% of total national energy consumption (UNDP, 2012) and it is an important micro-industry offering significant economic activity sites for many people (Munro, et. al., 2017). The ambitious goals set for transitioning to modern alternative energy such as LPG reflects the lack of recognition justice within the policies. A hasty energy transition could negatively affect the livelihoods of many citizens of Sierra Leone. Also, the promotion of LPG in the country is questionable through the lens of recognition justice. This fossil fuel is usually promoted as a rather environment-friendly alternative energy in the country by major foreign private corporations. Companies like Total and BP (locally branded as National Petroleum) have been pushing the energy change in the past few years and they would benefit from the switch of household energy to import dependence as the profits move from the rural communities to the multinational companies (ibid.). Therefore, when looked through epistemological focus, the idea and promotion of LPG in Sierra Leone does not value the stance of local people. In terms of distributive and procedural injustice, the initiatives of the local government are also missing the marginalised population. Despite the prevalence of fire risks within the informal settlements of Freetown, the initiatives for disaster resilience do not recognise fire as a hazard. Furthermore, health is one of the primary goals, including targets in decreasing maternal mortality, non-communicable conditions such as diabetes, mental health and hypertension. However, it disregards health problems informal settlers have to suffer from the air pollution. The exclusion of their opinions and stances limits the range of viewpoints and knowledge which could result in critical implications for the final formulation and impacts of the policies.

5.3 Recommendation & Opportunities

Taken together, the recognition of the urban informal settlements is largely absent

in the governance landscape of Sierra Leone. For off-grid energy development, the informal settlements of Freetown should be included; as the energy poverty problem is impacting diverse aspects of life such as economy, health and exposure to fire risks, it would benefit them just as much as the rural areas. Also, gradual energy transition is needed considering the context of the population highly dependent on fuelwood and charcoal industries. Moreover, the development plan of the local government needs to consider and include the problems that the marginalised people in the informal settlements of Freetown are facing. Fire risks and air pollution caused by the current energy mix could be addressed in the Resilience cluster of the plan, and respiratory health issues which many women and children are more susceptible to could be added to the Healthy City plan. Renewable energy development should be considered as a main initiative to tackle such problems and it could be augmented through collaboration with NGOs to strengthen environmental justice.

6. Case Studies. What is Applicable?

Lessons can be learned from studying experiences which can be replicated in Freetown.

6.1 Case Study I Solar Light Lamping in Kibera, Kenya (Kinoti, 2018)

Setting & transferability to Freetown

Example of a public-private partnership supplying pico-solar solutions to informal settlement of Kibera, Nairobi, Kenya. Residents are exposed to risks resulting from poor lighting facilities in the households; reliance on paraffin lamps



Figure 5: Villagers in rural Myanmar learn how to make energy efficient stoves. Photo credit: UNDP

negatively affects the environment, health and education of school-going children and elders in the family. The lamps produce noxious fumes not only increasing their risks of contracting respiratory and eye diseases, but also posed a variety of other risks, such as the risk of fire outbreaks. Freetown informal settlements along the coast have similar structures of energy use, particularly as regards lighting, and suffer similar health risks from the use of kerosene and coal. This case study, because it focuses on pico-solar systems, would be particularly relevant for the densely populated settlements in Freetown. The observed benefits to health and education would be transferable and scalable, but require a public-private partnership to launch the project.

Evidence

The pilot scheme provided a solar kit including a lamp, battery and mobile phone charging system to be used for 8 months. The assessment was conducted through interviews at the end of this period through Social Return on Investment & Best of Practice Impact frameworks. 200 people from interview group who had zero access to electricity, completely replaced the use of paraffin with solar lamps for lighting. Respondents with electricity used the solar lamps 65% of the time in a month when there was no power, or unstable supply. Primary benefits cited by them –

- Respondents with no electricity, claimed savings from not having to buy paraffin @Ksh 25 per day, adding to Ksh 9000 per annum
- One of the respondents explained that from the third month after replacing the use of paraffin with solar, medications for respiratory allergies were not purchased again. Daily tablet cost was Ksh 40. Savings accrued from improved health
- Extended family business hours by women increased income by 15-20%, while men also used the lighting in their retail shops in the slum to get extra sales hours
- Increased hours available for study by children and elders enhanced the household's long-term social and economic health

Financing

Beneficiaries of the project would pay an affordable deposit and subsequently pay in equal weekly installments. The installments were set at only Kshs. 150.00. Non-defaulter households enjoyed a loyalty discount of a waive off from the last

two instalments. Alternatively, if one could afford it, lamps were available for cash purchases at discounted prices Structured as a public-private partnership with government backing.

Mechanisms to leverage for Freetown

The original goals of Kibera solar lighting project were improved academic performance and improved livelihoods, which the study shows were achieved in the range of the pilot project. Government subsidies would be required to scale further, but the evidence does show that the benefits to livelihoods and education from solar lighting are present.

6.2 Case Study II Social Enterprise for Rural Electrification: The CCS Model in Sierra Leone (Munro et al., 2016)

Setting & transferability to Freetown-Energy for Opportunity's Community Charging Station is a model combining for-profit and non-profit approaches to disseminate electricity throughout rural Sierra Leone. Most of rural Africa relies on kerosene, battery powered lanterns, and, to a lesser extent, candles for light. Candles and kerosene 'are typically expensive and often both dangerous and environmentally harmful' (Lighting Africa, 2010, p.14); they produce toxic smoke and create household fire and burn hazards (Chaurey and Kandpal, 2010). This case study was a rural-based pilot project and as such would need to be transferred to an urban environment, but as the design is based around community hubs, would be applicable to those informal settlements with stronger community ties, such as Cockle Bay. The project itself shows a replicable financing model and forms a revolving community development fund.

Evidence

Social enterprise approach where Stateled or NGO efforts have struggled.

- A small solar-powered kiosk is constructed next to a central communal structure such as a market or community centre
- The kiosk serves as a hub for the charging of mobile phones and the rental and sale of solar-powered rechargeable LED lanterns and solar home systems
- The LED lanterns rival the cost of battery-powered lights and kerosene, but provide a much higher lumen output and have no adverse health effects
- Visible benefits will include reduction of energy poverty and improved energy access, health, safety and economic benefits

Financing

Initially funded through non-profit finance, but self-sustaining through purely for-profit principles. Charging, lantern rental, maintenance and resupply of lighting products, all handled through for-profit principles with the revenue recycled into operations. Excess profit is then used to fund future community projects such as solar installations on health clinics and schools, water purification systems and streetlights. Therefore, the system runs based on the continued requirements from the community.

Mechanisms to leverage for Freetown

The structure of this project, linking the design to community structures is a good example of how renewable energy can be put in community hands to ensure local-level participation and resilience. The funding structure, particularly in forming a revolving community development fund is very interesting as most other projects seen would require ongoing government subsidies. The implementing agency which helps generate awareness and installation knowledge is also key for maintenance and local capacity-building reasons.

6.3 Case Study III Environment, Climate Change, Energy and Disaster Risk Reduction (UNDP, 2017)

Setting & transferability to Freetown

This project focused efforts towards disaster risk reduction and climate change adaptation, particularly at the community level, through energy access and gender engagement. Women in general from the remote and rural areas of Myanmar are not only affected due to their roles in the household and community, but from poverty, access to healthcare, illiteracy and a lack of participation in community decisions. The recommendations of this policy brief, particularly those focused on participatory justice, could leverage the gender-inclusive design of this case study. This programme deployed multiple projects, with special attention to social justice, particularly gender inclusion through mechanisms including participatory planning. Much like the requirement in Freetown, environmental risk was a key consideration in the project design. The project also focused on building capacities for implementation amongst national focal agencies, regional, district and/or township administrations and local community and civil society partners, including women-focused organizations, which is a key route to embed and scale such projects.

Evidence

Some of the projects which were key interventions were:

- Building disaster-resilient communities through strengthening disaster risk management institutions, systems, networks and mainstreaming DRR into development planning
- Strengthening Sustainability of Protected Areas in Myanmar
- Poverty Environment Initiative (PEI) Programme - Land Use Policy and Environmental Impact Assessment
- Access to energy in rural areas

Financing

Funding from various agencies like United Nations Development Programme (UNDP), Bureau for Crisis Prevention & Recovery (BCPR), Global Environment Facility (GEF), Wildlife Conservation Society (WCS) and other Donor agencies. Total worth US\$ 16.33 million.

Mechanisms to leverage for Freetown

The project design of this case study is very applicable for our purposes as it focused on inclusion in the design by using participatory planning mechanisms, such as community consultation and participatory decision-making elements of the FPIC (Free, Prior and Informed Consent). The goals of the project also explicitly highlighted gender inclusion from the start, and linked the monitoring and evaluation of the project to this.

7. Existent Solar Energy Projects in Freetown

Currently 23 organisations are working with solar energy in Sierra Leone (DFID, 2019; Lighting Africa, 2018; Renewables Sierra Leone, 2019). Three of those projects are being deployed across several countries in Africa with the help of international development organisations such as the World Bank and DFID.

Both the World Bank and the UK DFID projects work with the private sector and the Sierra Leone government to increase the market offer of renewable energy technology (Lighting Africa, 2018; DFID, 2019). In Sierra Leone we found 11 associations working with solar energy, but their scopes include other cities besides Freetown. Some are working with the Ministry of Energy on implementing street lighting and hospital power stations, others provide training and education. The specific projects in Freetown are using



Figure 6: Mini Grid under development in Sierra Leone. Sierra Leone. 2019. From: <https://www.green-buildingafrica.co.za/>

solar energy for water pumps and street lighting, financing renewable energy courses and as a private sector energy organisation, developing a new renewable energy market (Renewables Sierra Leone, 2019). Despite the large number of NGOs working in Freetown and Sierra Leone, we were not able to find significant improvements towards sustainable energy and equal access in urban settlements in Freetown.

However, NGOs can function as a bridge between grassroots organisations and government structures (Banks et. al., 2015), increasing their impacts in society and achieving community goals. Future projects working in Freetown towards energy access might benefit from collaboration with ongoing projects, both from the government and NGOs, in terms of knowledge, funding and community involvement.

Recently, the president of Sierra Leone announced that with close collaboration of the private sector 145 mini grids will be implemented to bring energy to rural settlements by 2022 (AllAfrica, 2019). In the next section we will explain the benefits of off-grid technology and why we consider it a suitable solution for fighting urban energy poverty.

8. Off-grid Energy Options

8.1 Increased Agency and Economic Benefit

Off-grid systems of renewable energy are a practical and cost-competitive option to accelerate access to electricity in

Freetown. Off-grid options are decentralised and able to provide independent energy at levels and at times that meet the needs of urban Freetown. These technologies are relatively easy to install in homes and shops, and scalable to the neighbourhood level (Runsten, Fuso, & Tait, 2018). Diverse stakeholders such as local businessmen and the private sector could be attracted and engaged in the off-grid energy initiatives, increasing vitality of socio-economic development in Freetown (International Renewable Energy Agency, 2019). Decentralised energy gives individual citizens the agency to gain access to stable electricity.

Sustainable and equitable energy transitioning can bolster urban resilience, providing energy to those without access, or without safe access, thereby allowing improved economic opportunities as well as favourable health outcomes, growing individual adaptive capacity. A recognition of this is reflected in Arup's City Resilience Framework, which outlines adequate and affordable energy supply as a key requirement of resilience (Rockefeller Foundation, 2014).

Decentralised energy can be beneficial for the economy through creating jobs around installation and maintenance of solar panels. For example, separate agencies including cooperatives and local communities may take the opportunity to establish divisions within the utility, which will greatly enhance the participation and power of communities (Zerriffi, 2011). Resilience is improved through the design of the system itself: off-grid energy systems are more disaster risk resistant, and through increasing adaptive capacity of newly connected residents through their increased economic capital and health outcomes.

As per the IFRC's Vulnerability and Capacity Assessment of Freetown, the hardship experienced by the poorest sections of society mean that "community participation will be low if individual households do not see direct gains from the [disaster risk reduction] project to their livelihood" (VCA, 2013). This principle should be considered in the design of off-grid energy: by putting agency for energy in the hands of the community, economic benefits, control and participation will flow directly to the community, thereby increasing engagement.

8.2 Creating a Self-sustaining Cycle

Capacity of the local community must be built as this is crucial in creating a self-sustaining cycle, ensuring that the local community will be able to continue without much outside intervention. Ignoring the social and cultural issues of the targeted communities would be a major flaw in the strategy, as in order to achieve long-term sustainability, community engagement is necessary. Some of the main barriers faced by off-grid energy solutions is the lack of awareness among prospective users, unavailability of different energy options in order to cater to the needs of different users, and limited dissemination of the off-grid solutions. Projects conducted in Mexico have highlighted the importance of not only understanding the product but also playing a sound role in operations and maintenance (Urmee & Md, 2016). This is only possible through education and skill-building workshops which will build the capacity of the local community, integrating these skills into the community structure. This has also been proven to enhance the sense of ownership among the community, further encouraging them to become invested in the off-grid scheme and therefore greatly contributing towards sustainability.

Successful off-grid energy promotion requires a well-developed and targeted plan to take into account cultural norms, as in communities such as those in Freetown it is important to first identify the decision-maker in a family or community. Another factor to consider is the age-group that needs to be targeted, for instance in Ghana the younger group between the ages of 25-45 were found to be more receptive to the new technology and willing to uptake. This was an overlapping factor for the particular Ghanaian project as these younger community members also happened to be the more educated individuals. General community members in Freetown will hesitate to try new innovative technologies, therefore focusing on respected individuals in the community such as village leaders/elders or teachers and making them the early adopters of the decentralised energy will build trust in the technology and encourage the rest of the community to follow. By engaging the community and having comprehensive dialogues with them, the community's specific needs can be identified, thus adhering to the precise demands, allowing for a more successful implementation (Urmee & Md, 2016).

Community participation is a social process which helps in lessening injustice; it follows the grassroots or bottom-up approaches to problem-solving, and therefore is crucial towards not only the success of a project but also its long-term sustainability. In informal regions, community participation is an active process where beneficiaries not only benefit from it but also influence the direction and execution of the project, while simultaneously making the community members more invested in the project by increasing a sense of belonging, reducing conflict and generating lasting support.

Conclusion

The policy brief uses environmental, social and political lenses to analyse the energy scenario of Freetown, including spatial distributions of energy poverty, related hazards and the root causes and drivers, taking into account various justice issues and putting forward potential strategic pathways to address the issue. Energy poverty is an issue of distributive injustice underpinned by further injustices in recognition and policy-making procedures. The varying distribution of wealth, access to resources and governmental intervention across Freetown has led to an unfair dissemination of energy access and hence injustice across the city. These injustices manifest in the form of health risks, fire risks and environmental risks.

Key lessons can be learned from case studies, including the design of community engagement (CCS model in Sierra Leone) and the far-reaching consequences of solar light projects in Kibera, Kenya. Implementation of sustainable energy solutions at the community level can address socio-ecological justice, especially when integrating community engagement with the project. Leveraging off existing community structures to integrate off-grid energy solutions will improve the agency of residents in informal settlements, reinforcing community support networks and bolstering participation through deploying and managing micro-infrastructure projects at the local scale. This will enhance the resilience of individuals and urban centres in Freetown. The government will play an important role in acknowledging these processes, both through policy action and recognition. Therefore, addressing energy poverty in the settlements of Freetown will require a detailed understanding of the interdisciplinary factors that make up the current energy situation.

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