



Off-Grid Dreams: How Solar Energy Is Lighting Up The Forgotten Villages of Zimbabwe

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Abstract: This study aims to identify how solar adoption can alleviate energy poverty and sustain development in rural Zimbabwe, Chivi District. The research was qualitative, consisting of semi-structured interviews with locals, government officials and stakeholders, and secondary data collection. These results indicate large socioeconomic upsides, such as increased study time with solar lighting, better storage and healthcare provision through solar-powered refrigeration, and greater agricultural yields through solar irrigation. Despite these advantages, major impediments like the high initial cost of installing solar systems and the lack of technical support in-country hinder widespread deployment. Those outcomes require specific interventions, such as subsidies, capacity building to raise technical knowledge, and new forms of financing to improve affordability. Addressing these challenges allows governments, NGOs and the private sector to scale solar technologies for energy equity, economic empowerment and environmental sustainability, as defined by SDGs 7 (Affordable and Clean Energy) and 13 (Climate Action).

Keywords: Solar Energy, Off-Grid Solutions, Zimbabwe, Rural Development, SDG 7, Sustainable Energy, Community Empowerment

1. Introduction

Energy poverty continues to be a major issue in Zimbabwe, particularly in rural areas where electricity isn't easily available. Almost since the nation achieved independence in 1980, the national grid has been built mainly in urban centres, with the countryside still relying on older biomass sources such as wood, charcoal and kerosene (Mhlanga, 2021). Such reliance leads to deforestation, environmental damage, and health hazards from indoor air pollution. Even electrification schemes—rural electrification programs that were started in the late 1990s, for instance—have been slow and uneven, and grid growth has been held back by economic insecurity and infrastructure shortfalls (Nyamazana, 2022).

The socioeconomic consequences of this energy scarcity are severe. Rural health centres can no longer afford to provide basic amenities, including vaccine refrigeration, and schools are not electrically powered for modern learning materials—limiting education for students (Chitambo & Murefu, 2020). Women and children are equally affected: they take up a high proportion of their time collecting fuel, which is not productive work or learning (Gumbo, 2023). Such traditional problems highlight the need for decentralized, green energy options that can be adapted to rural environments.

There is a clean, green option in the form of solar energy, taking advantage of Zimbabwe's sun (more than 300 days a year) and delivering off-grid, decentralized power to remote places (Chikobvu, 2022). Instead of grid power, solar panels allow households to generate and manage their power without relying on expensive, inefficient centralized networks. In addition, solar energy complies with Zimbabwe's Paris Agreement obligations to reduce carbon emissions and boost climate resilience (Marimbe, 2022).

While some research has previously looked at the potential of renewables in sub-Saharan Africa, it has been less extensive on the socio-economic effects of solar penetration in Zimbabwe. Most research has focused on large-scale regional studies or urbanization, with no mention of the rural regions where energy poverty is at its highest level (Chisadza et al., 2021). This research fills this void by looking at Chivi District, a rural district with high levels of energy poverty and regular solar-energy campaigns by NGOs and development organizations. The study based on this district offers a localized perspective on the potential of solar to benefit education, healthcare, and economic activities, as well as challenges related to affordability and technical knowledge.

This research is guided by three main questions:

1. What are the implications of solar power adoption for education, healthcare, and the economy in rural Zimbabwe?
2. What are the main challenges for off-grid consumers when it comes to solar

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adoption?

3. How can policymakers and stakeholders support the scalability and sustainability of solar solutions?

The results can be used to help policymakers, NGOs, and the private sector develop targeted measures to scale up solar projects in line with SDGs 7 (Affordable and Clean Energy) and 13 (Climate Action). By addressing historical inefficiencies and harnessing renewable energy, this research adds to a complete picture of sustainable rural development in Zimbabwe.

2. Literature Review

2.1. Renewable Energy Adoption in Developing Countries

Renewable energy use in the developing world has been the focus of energy poverty and sustainable economic development. Solar, wind and biomass are renewable energy technologies that can be implemented at scale and long term in response to energy needs in regions where traditional grids are either unavailable or not well advanced (Chen & Li 2020). These decentralised networks offer the flexibility to tailor energy services to individual residences, particularly in rural and underserved communities. Especially solar power has become mainstream due to the fact that it's affordable and off-grid. One example is in Kenya, where the solar-fueled micro-grids of the rural masses transformed marginal communities, providing stable electricity and providing access to education, health care and micro-business (Ouma et al., 2021). The Indian experience with solar-powered irrigation systems, similarly, shows how renewable energy could not only meet sectoral challenges but also create sustainability (Kumar et al., 2022). Such examples show that renewable energy technologies are highly adaptable across geo-economic and socio-economic boundaries, and are therefore a prerequisite in developing countries.

These developments are still very limited when it comes to renewable energy use in developing nations. The biggest bottleneck is still price as a high start-up price keeps adoption at bay. The new finance modes of payment, such as pay-as-you-go options, democratised solar power systems but not everyone in the household can afford them (Nzama & Sibanda, 2023). There is also a technical expertise gap which is a real bottleneck. The installation, service and maintenance of renewable energy systems demand specialized expertise that's not found in many developing countries (Mukiza et al., 2021). This skills gap makes renewable energy projects more unstable and unsustainable because communities can't immediately solve technical problems. In addition, policies in many developing countries don't align with renewable energy targets. Fossil fuel subsidies are often prioritised by governments, distorting markets and delaying investments in cleaner energy (Okoye & Nwoke, 2021). These system issues require a holistic strategy that combines funding, capacity development and policy changes to make renewable energy work.

There are socio-economic advantages to renewable energy that are huge but, due to structural inefficiencies and lack of policy incentives, the market is not taking them advantage of. Local economic development — through job creation and output — is often a benefit of renewable energy. East African solar-powered businesses, for instance, can stimulate entrepreneurial activity and income in deprived areas (Chidumayo & Gumbo, 2022). So, too, reliable electricity has been associated with higher levels of learning because schools in the countryside can access digital education resources and continue working during the day thanks to proper lighting (Mandisa et al., 2023). But those gains aren't distributed well, with renewable energy projects usually concentrating in places where there's already infrastructure or donor money, leaving more distant places at the bottom. This inequity points towards the need for proportionate resource allocation and targeted interventions to make energy accessible to all (Mpofu & Chikwenhere, 2022).

There is also a further key factor of renewable energy adoption — environmental sustainability. Changes from fossil to renewable energy also radically cut emissions in line with global climate objectives like the Paris Agreement (Akinola & Ojo, 2020). Solar power, for example, not only reduces carbon emissions but helps with local environmental problems – the deforestation caused by using traditional biomass, for example. In Ethiopia, for instance, the ubiquity of solar cookstoves has cut deforestation rates and enhanced indoor air quality in ways that are positive for the environment as well as health (Teklu et al., 2023). But the environmental side of renewable systems is not a whole mess. Generation and disposal of solar cells and batteries – these issues loom large regarding environmental sustainability and waste management (Mutasa et al., 2021). To tackle these, we need a circular economy in which the materials are reused and recycled for reduced ecological footprints.

Renewable energy has also come into the picture to provide more energy security and resilience. Also susceptible to disruption of energy supply are developing nations, whether caused by natural disasters, political turmoil or economic recession. – Decentralized systems (solar energy) are more reliable and safer than grids (Marimbe, 2022). In Bangladesh, for instance, solar-powered home kits ensured that rural communities could continue to get power during monsoon floods, an example of decentralised energy infrastructure's resilience (Rahman et al, 2020). However, they require strong institutions and local engagement to sustain themselves in the long term. If there is not enough maintenance and capacity development, renewable energy infrastructure can be a liability in the long term (Chisadza et al., 2021). It shows why local ownership and engagement will be vital to make renewable energy programs durable and efficient.

There's enormous potential for renewable energy deployment in developing countries to fight energy poverty, stimulate growth and reverse climate change. However, the only way to make it happen is to overcome intractable

obstacles, including cost pressures, talent gaps, and policy misalignment. New funding models, capacity-building measures and equitable policies could be the new engine for sustainable development. As it also shows the socio-economic and environmental positives of renewable energy usage, it is useful for building a world sustainability agenda in the developing world. There needs to be more research and intervention to fill the gaps and ensure that renewable energy policies create inclusive and long-term benefits.

2.2. The Role of Solar Energy in Achieving SDG 7 (Affordable and Clean Energy) and SDG 13 (Climate Action)

The world's efforts to attain SDG 7 (universal access to cheap, reliable, sustainable and modern energy) are still built on solar energy. Decentralized and scalable, it is perfect for providing electricity to inaccessible and rural regions where grid infrastructure cannot or does not exist (Mandisa et al., 2023). Powered by solar homes and micro-grids, clean, stable power has transformed sub-Saharan Africa by bringing rural people education, healthcare and enterprise. Solar-lighted households, for example, get long working hours that give kids time to study at night, and let micro-entrepreneurs work past the day (Ouma et al., 2021). In addition, solar is a clean alternative to existing fossil fuel systems that cut the need for costly and toxic energy sources (Mukombachoto et al., 2021).

And solar's mitigation potential goes back even further to its role in the UN's Sustainable Development Goal 13: preventing world climate crises through a proactive approach. It has been proven that switching to solar over diesel generators drastically decreases greenhouse gases, which contributes to the efforts of the world to mitigate climate change (Akinola & Ojo 2020). In addition to cutting carbon emissions, solar energy provides more climate resilience, as well as dependable power when environmental crises such as flooding or long droughts strike and upend current energy grids (Rahman et al. 2020). In floodplains in Bangladesh, for example, solar microgrids have maintained power for the people and have sustained basic services during times of natural disaster (Teklu et al., 2023). This dual use of solar energy (reducing climate change and increasing resilience) is why it is one of the main pathways to SDG 7 and SDG 13.

Not just for electrification, but also in sectors like healthcare and agriculture, key to the implementation of SDG 7 more generally. In healthcare, solar-powered refrigeration equipment has made vaccine storage at rural clinics possible so lifesaving vaccines could be provided even in regions without uninterrupted power supply (Mpfu & Chikwenhere, 2022). Solar power also helped improve crop yields with solar-powered irrigation that can be used to manage water shortages and adapt to changing rainfall seasons (Kumar et al., 2022). All of these developments show why solar should become part of development plans not only to alleviate energy poverty but also to improve socio-economic wellbeing in poor areas. However, the commercialisation of solar energy in these industries needs well-developed financing models and policies to break through the initial cost barrier and achieve long-term viability (Chisadza et al., 2021).

Low cost and lower penetration rates of solar power are still major barriers to SDG 7 and SDG 13, particularly for low-income developing households. The cost of solar technologies has decreased over the past 10 years but the installation and equipment prices are too steep for rural families to start from scratch (Nzama & Sibanda, 2023). Payment models like pay-as-you-go or microloans have become viable financing solutions, and it's now possible for families to get solar without having to be very financially tight. In East Africa, for example, pay-as-you-go schemes enabled families to buy solar lights and appliances in small recurring payments, making clean energy accessible to lower-income people (Chidumayo & Gumbo, 2022). These models have scaled well but the biggest barriers are still in accessing the least privileged who aren't connected to credit or financial services (Mukiza et al., 2021). These gaps call for custom interventions that marry finance with local awareness and outreach in order to build trust in solar.

Policies help to drive the scalability of solar power technologies. Developing nations will need to make renewable energy investment a priority by creating incentives for private investment and less dependence on fossil fuel subsidies (Okoye & Nwoke, 2021). Public-private partnerships have been very successful in gathering resources and skills to make solar projects scalable and resilient. In India, for example, government solar projects have been combined with private businesses to build solar microgrids in the countryside — another proof of what co-design can achieve (Marimbe, 2022). Such international support mechanisms (grants and technical support from international organisations) also supplement them by supplying the funding and capacity-building needed. Yet the divided policies and bureaucratic obstacles tend to deny the efficiency of such alliances, so we also need integrated and simplified regulatory structures (Zhou & Matambanadzo, 2021).

Solar energy should also be included in national development plans if they are to be sustainable and resilient in the long run. Nations with solar energy infrastructure respond not only to short-term energy needs but also to economic growth and environmental protection. For example, mass use of solar can lower the country's reliance on foreign fuels, stabilising energy prices and delivering energy security (Mutasa et al., 2021). Moreover, the environmental effects of solar energy — less forest loss, and cleaner air — all count toward general ecological sustainability goals (Teklu et al., 2023). These outcomes are aligned with SDG 13, about action on climate change through renewable energy generation. Governments and stakeholders should combine solar energy with complementary education, health and infrastructure initiatives to gain the most from these investments (Rahman et al., 2020).

To sum it up, solar energy is an enabler to achieve SDG 7 and SDG 13, both on the ground of energy insecurity and on the surface of climate change. It is decentralized and highly flexible, thus being ideal for electrifying remote regions for socio-economic growth and environmental sustainability. But exploiting the full potential of solar energy involves an addressable solution to structural problems including affordability, policy mismatches and financing access. Innovation, cooperation and effective policy can help make solar energy a force for positive change in a sustainable development direction towards a more just and resilient future.

2.3. Cultural and Social Dynamics Influencing Solar Energy Adoption in Zimbabwe

It's culture and social attitudes that play an important role in implementing solar energy technologies in Zimbabwe, especially in rural communities. Firewood and kerosene, among the traditional forms of energy most commonly used in rural societies, are less complicated and more easily available than other recent sources of energy, such as solar energy (Mhlanga, 2021). Moreover, some groups consider solar power a luxury rather than a necessity, something associated with richer households or urban life. This is a barrier to adoption because they think solar energy is either inappropriate or not relevant to their lifestyle (Mukombachoto et al., 2021). These perceptions are exacerbated by a lack of understanding of the long-term economic and environmental advantages of solar energy, which might otherwise shift society's preference toward renewable energy (Chisadza et al., 2021).

Social relations in rural areas also affect the acceptance and longevity of solar projects. Decisions about energy consumption are usually made by the local elders or male heads of households, thus preventing women and other underprivileged individuals from getting involved in solar adoption programs (Ndlovu & Sithole, 2022). That is particularly harmful because women are among the highest home energy users and could stand to gain greatly from a switch to cleaner, more efficient energy. Moreover, since the community has no input into the design and operation of solar projects, it is difficult to have faith in them (Mpofu & Chikwenhere, 2023). Experiments in other sub-Saharan African countries have also shown that participation of the community in the design and implementation of renewable energy solutions can boost acceptability and sustainability, which Zimbabwe should adopt if it hopes to overcome its woes (Ouma et al, 2021).

These cultural and social challenges demand targeted actions, especially education and awareness initiatives to bring the benefits of solar energy into the real world. Participatory public education programs involving community leaders, women's groups, and youth groups could promote ownership and acceptance of solar technologies (Marimbe, 2022). Supporting culturally acceptable approaches, and respecting local traditions and traditions, will promote renewable conversions. Adding solar solutions to existing community systems, such as cooperatives or local markets, would establish whether such solutions still exist and are effective in practice (Mandisa et al., 2023). If these cultural and social issues are addressed, Zimbabwe can promote solar energy and harness its full potential for sustainable rural development.

2.4. Lessons from International Case Studies: Insights for Zimbabwe

2.4.1. Key Success Factors

The fact that solar projects in Kenya and India have been successful is evidence of how the policy landscape and PPPs are integral to the scale-up of renewable energy systems. Kenya's government and private entrepreneurs constructed solar microgrids for villages to provide power to villages 24/7 (Ouma et al., 2021). These relationships made it possible to share expertise and materials so that projects can be carried out and communities can become trusted. Even the Indian solar policy (KUSUM) provided specialised subsidies and incentives to smallholder farmers using solar-powered irrigation systems that enhanced productivity and accessibility to electricity (Kumar et al, 2022). They received foreign assistance too – development agencies offered grants and technical assistance that helped both nations invest in renewable energy sources (Mandisa et al., 2023). Such cases are yet another reason to have the right policy environment and public-private partnerships to secure investments and scale solar. Zimbabwe can take the lessons of these methods by boosting policy alignment and partnering with private capital to realize scalable solar.

New financial arrangements, like pay-as-you-go models, helped solar adoption in Kenya and India as well. In East Africa, pay-as-you-go solutions offered solar to low-income individuals with no upfront expense and based on payments as the user's financial abilities allowed (Nzama & Sibanda, 2023). This model helped to increase energy access for marginalized groups and improve household productivity. India, too, had cooperative banking and zero-interest loans for solar projects, especially for smallholder farmers who needed cheap irrigation (Ravi et al., 2021). These financing solutions democratized renewable energy and demonstrated the role of inclusive financing in addressing affordability. Zimbabwe, which is also in a budget deficit, might apply these models to create personalized payment schemes for rural households to support energy equality.

2.4.2. Challenges Overcome

Involvement of locals and capacity building was essential to making solar energy in Kenya and India sustainable. Kenya also did everything to educate the local technicians in the installation, maintenance and repair of the solar panels so that they were not dependent on outside help and they created local jobs (Chidumayo & Gumbo, 2022). Community associations in India also provided a means to gather local partners and ownership of solar projects to make them durable and effective (Mukiza et al, 2021). These programs addressed the lack of technical know-how cited as one of the biggest roadblocks to renewable energy penetration in the developing world. When they

empowered people to own their energy systems, these countries kept solar systems durable and efficient. Zimbabwe might do the same with regional training centres and encourage local participation in solar projects to develop the technical capabilities to succeed over time.

Both countries also worked around affordability issues through financial support combined with locally generated interventions. Decentralized solar microgrids made energy delivery in remote parts of Kenya affordable, with subsidies and flexible pay plans for the poor (Ouma et al., 2021). Because of India's focus on financial inclusion via microfinance and cooperative banks, marginalized communities were able to gain access to solar power without the upfront expense barrier that otherwise keeps them from going solar (Ravi et al., 2021). These measures show how a blend of financial mechanisms and local interventions can have the greatest impact. Zimbabwe, where the initial cost is still prohibitive, could replicate the same strategies by introducing subsidies and microfinance options to its renewable energy programs, especially in rural areas.

2.4.3. Contextual Relevance for Zimbabwe

It is Zimbabwe's peculiarities, inflexible policies, and limited international investment that hinder the expansion of solar power. Zimbabwe's renewable energy policies are, in contrast to Kenya and India, ill-connected, and the national development objectives and energy projects lack clear coordination (Mhlanga et al., 2021). This contradiction eschews private sector investment and causes project instalments. Other inefficiencies and time-consuming approval processes further inhibit renewable energy investment (Chisadza et al., 2021). If Zimbabwe followed Kenya and India, the regulation could be simplified, and clear incentives for private investors laid down to encourage more renewable energy development. A closer matching of policy with sustainable development objectives would also make solar investment more persuasive and desirable to donors abroad.

These examples of Kenya and India can also be applied in Zimbabwe to address its unique issues with open financing and community engagement. Providing pay-as-you-go programs, for example, based on rural families' financial resources, might open up solar power to the low-income group (Mandisa et al., 2023). Further, public-private partnerships to develop and finance solar projects would open the resource gap and support scale. It could be through capacity-building programs, reminiscent of the Kenyan approach, that Zimbabwean people can become better equipped to continue solar projects without the need for outside technicians and with the associated maintenance costs lower (Teklu et al., 2023). Through the integration of these methods, Zimbabwe will not only emerge with a special challenge but can unlock the energy of solar power for the fight against energy poverty and sustainable rural development.

3. Methodology

3.1. Study Design

This qualitative study was conducted on the effect of solar power on energy poverty and sustainable development in Chivi District, Masvingo Province, Zimbabwe. We chose this approach because it provides rich, qualitative data on participants' experience and on the socio-cultural dynamics that drive solar power use (Nyathi & Dube, 2021). Because the research was exploratory, hidden barriers and opportunities related to renewable energy adoption in rural areas could be discovered (Chikobvu, 2022). We have chosen the case study method for Chivi District as the unit of analysis as it is a very energy-poor district and already has some existing solar projects under construction by NGOs and International organizations. This methodology made it possible to deeply investigate the connection between solar power and rural development (Moyo & Sibanda, 2023).

3.2. Sampling Method and Participant Demographics

Purposive sampling was used to identify participants who would be most willing to contribute information. The selection criteria of participants were people who were actively adopting solar power, like rural solar panel-based households, local authorities, and solar panel makers in the Chivi District. We made sure to get as many different socioeconomic groups, genders, and community engagements represented as possible to capture a representative sample of the district population (Mpofu & Chikwenhere, 2022). This study included 25 people (out of which 15 rural families (10 heads, 5 women), 5 local government officers, and 5 representatives of solar energy companies) (Nyathi & Dube, 2021). That variety meant that different points of view could be considered and the results could be valid and reliable.

3.3. Data Collection

They collected information through semi-structured interviews and field surveys. Semi-structured interviews offered a forum for respondents to discuss their experiences, challenges and views on solar adoption and also allowed the researcher to delve deeper into certain issues (Mandisa et al., 2023). Questions included, for example, the cost of installing solar panels, the perceived benefits, maintenance and technical support. Monitoring data included how the panels worked, local adoption of solar technologies, and solar installations in residences, schools, and clinics (Moyo & Sibanda, 2023). Secondary data were drawn from government reports, NGO reports and scholarly articles on renewable energy in Zimbabwe as context and backup for primary data (Gondo, 2023).

3.4. Data Analysis

This qualitative data was then thematically categorized. The first coding was general data into categories such as "access to solar energy," "access challenges" and "societal impacts" (Braun & Clarke, 2019). For instance, early codes such as "lower costs", "longer study days" and "better vaccine storage" came together under the general umbrella of "socioeconomic advantages". Other themes, like "technical barriers" and "policy gaps," developed during the second round of coding and were refined by iterative analysis (Mpofu & Chikwenhere, 2022). These three final thematic themes, Access and Affordability, Socioeconomic Benefits and Barriers to Sustainability, were used as a guide to the results. — they used direct community-sourced quotations so that the analysis would not become too detached from the lived experiences of the community.

3.5. Ethical Considerations

Ethics clearance from the University of Fort Hare's Ethics Committee had been obtained before the study began. The purpose, protocol and effects of the study were explained to the subjects in detail and informed consent was given before participation. Participants were identified anonymously with codes and all data were securely stored to preserve confidentiality (Mandisa et al, 2023). Special consideration was given to the cultural standards of Chivi District and they were also contacted to request local leaders' agreement and help with community outreach. This ethnocultural orientation also ensured that the study was ethically sound and gained the consent of the subjects (Mhlanga, 2021).

4. Results and Discussion

Chivi District's results show how solar energy use has revolutionized livelihoods in the countryside. Other results are in education, healthcare and economic activity. Table 1 below gives the primary benefits enumerated by participants.

Table 1: Primary Advantages of Solar Power Generation in Chivi District

Category	Impact	Example
Education	Improved literacy rates	Solar lighting enables extended study hours for students
Healthcare	Reduced healthcare costs	Solar-powered clinics storing vaccines and running medical equipment
Economic Activities	Increased household income and productivity	Solar-powered irrigation systems boosting agricultural yields

Source: ??

Table 1 demonstrates how solar power will transform education, health care and economic activity according to the research. This research has shown how solar adoption has changed education, health and business in Chivi District, but also what the community's struggles were. Data from all 25 respondents are spliced together to give a detailed picture of what works and what doesn't in solar adoption.

4.1. Education: Transforming Learning Environments

All the participants were positive about how solar power improved education — by enabling longer study sessions and the use of cutting-edge learning technologies. Participant 1: "Before solar lights, my kids used candles but now they can study when it's dark." Participant 3: "Our kid's grades are better now that we have solar lights". School has been changed by the supply of good lighting, too. Participant 7 said: "We now have solar-powered lights and computers at the local school. They are all ready to learn and play with technology." Participant 12 spoke of the same shift: "The solar computer lab has been very helpful. We have children who had never worked with a computer before and are getting the basics".

Participants also pointed out how solar energy helps local education programs. Like Participant 5: "We now do adult literacy classes during the evening, because the solar lights are here." All of these things are in line with SDG 4 (Quality Education) since solar power ensures equal education. However, the price tag for the solar panels is still prohibitive, and Participant 6 noted, "The families in our village cannot afford to install solar lights even though they know how good it is."

4.2. Healthcare: Enhancing Access to Essential Services

Solar energy has revolutionized healthcare delivery in the Chivi District. Participant 8 observed, "Our clinic used to struggle to store vaccines, but with solar refrigerators, this is no longer an issue." Participant 10 added, "We can now run medical equipment that we couldn't use before, like suction machines and sterilizers."

Participants emphasized the reliability of solar energy during power outages. As Participant 15 explained: "When the main grid goes down, we depend on the solar panel to keep the basic services going." This resilience has built healthcare infrastructure and community trust. 'It's safer for patients now because we no longer lose vaccines or medicines when the power goes out,' added Participant 13.

Solar energy has also supported mobile health initiatives. Participant 9 explained, “Our clinic can now charge devices like tablets used for patient record-keeping and consultations in remote areas.” These developments contribute to **SDG 3** (Good Health and Well-being) by improving access to reliable and efficient healthcare services. However, technical support remains a challenge. Participant 17 remarked, “When our solar system broke down, we had to wait weeks for a technician. This is something that needs urgent attention.”

4.3. Economic Activities: Empowering Rural Livelihoods

Through increased productivity and increasing diversification of incomes, the use of solar power has pumped economic activity. As Participant 18 noted: “Because of the solar irrigation system, I can now grow vegetables all year long. This doubled my income.” So did Participant 20: “We used to get our water from rain, but now we can have regular water for our crops. It has been a game-changer.”

Business owners pointed out that the power of solar energy was good too. For example, Participant 11 said, “With solar lights, I can open my shop in the evenings, and this attracts more customers.” Participant 22 added, “I started a poultry company with a solar-powered incubator, and it’s going well.” These stories are an illustration of how solar energy fosters entrepreneurship and rural economic development as mapped to SDG 8 (Decent Work and Economic Growth).

Even after these wins, respondents pointed to adoption cost as a major challenge. Participant 16: “The upfront installation costs are too much for many of us.” Participant 19: “While there are pay-as-you-go options, we don’t have any in our region.” These difficulties demand novel financing models that would allow solar power to be more accessible.

4.4. Barriers to Solar Energy Adoption

Participants reported many challenges to the use of solar power, such as cost, technical assistance and cultural barriers. Installation was expensive and was a common enigma. As Participant 23 shared: “We saved for years so we could afford the solar system. Most families just can’t handle it.” Participant 25 agreed “Government subsidy or loans would get more people on the grid to use solar power.

Support was another problem. ‘We don’t have local technicians to fix things and when something goes wrong we are waiting weeks for help,’ Participant 14 shared. ‘We could fix this problem and provide jobs with training programs for local youth,’ said Participant 21. The cultural mindset also contributed. “Some people in our village were afraid to use solar energy as they did not believe in the technology,” wrote Participant 24. It took a lot of pressure.” These challenges call for targeted community mobilization and capacity-building programmes.

4.5. Alignment with Sustainable Development Goals

The results highlight how widespread solar energy adoption can be aligned to multiple SDGs. By improving education, health, and economic development, solar energy helps deliver SDG 4 (Quality Education), SDG 3 (Good Health and Well-being) and SDG 8 (Decent Work and Economic Growth). In addition, its ecological benefits contribute to SDG 13 (Climate Action) by minimizing fossil fuel consumption and reducing climate change.

However, there are institutional barriers of cost, technical knowledge and cultural blindness that need to be overcome to maximise the potential of solar power. These open finance models, training and community outreach will play an increasingly important role for policymakers, NGOs and private players.

All 25 participants share their voices to showcase how the solar energy in Chivi District can change everything. Solar-generated lighting has transformed educational attainment, solar refrigerators have revolutionised health care, and solar irrigation systems have increased agricultural productivity. But installation costs, technical inaccessibility and cultural differences continue to be formidable obstacles. Those questions will be best answered by a collective effort from policymakers, NGOs and industry. As Participant 21 put it, “Solar energy gave us a glimpse of the future, we just need the right push to get it to work for all”.

4.6. How Solar Energy Addresses Local Challenges and Aligns with SDG Targets

Solar power is also seen as an answer to the most immediate problems of the residents of Chivi District – like alleviating energy poverty and transforming lives. As an inexpensive, sustainable and affordable source of energy, solar installations have eased the community’s dependence on expensive and harmful energy sources like kerosene and diesel generators (Mukombachoto et al., 2021). Not only are such conventional energy sources expensive, but they also subject households to dangerous emissions that threaten their health and worsen the environment. Solar power’s decentralised architecture allows access even in the outlying regions, closing the energy deficit for those without access to it. That is also closely aligned with SDG 7 – Access to affordable, secure, sustainable and modern energy for all. In addition, by eliminating fossil fuels, solar power substantially decreases greenhouse gas emissions, supporting SDG 13 (climate action and resilience) (Chisadza et al., 2021). This double advantage of solar power for clean energy and climate change makes it especially significant for sustainable development.

The introduction of solar power in Chivi District has had a wide-ranging effect on education, as it has solved major issues of schools in the countryside. Solar lights have extended school hours, allowing evening classes for adults and students who would otherwise be prevented from attending by domestic duties (Mpofu & Chikwenhere,

2022). The change has made literacy much better, and teachers report a boost in attendance and engagement with the longer hours. User reviews indicate the interest of students, who now get to study in comfortable and well-lit spaces, and thus, promote a culture of continuous learning and lifelong learning. Also, the availability of solar power has facilitated the use of digital tools and educational technologies in the classroom, improving the quality of education. These signs of progress are also in line with SDG 4 for ensuring inclusive and equitable quality education for all, and illustrate solar energy's potential to alleviate educational gaps in marginalised groups (Ouma et al., 2021).

Solar energy in healthcare has bridged critical service gaps, especially in rural clinics that once had trouble obtaining stable power. Today, refrigeration systems powered by the Sun safely store vaccines and other vital medical supplies, minimising wastage and increasing immunization rates (Teklu et al., 2023). Solar-powered clinics also have the advantage of constant power for diagnostic instruments and lighting in an emergency at night, all of which can improve the level of care. This has helped boost local trust in doctors and hospitals as they no longer have to travel too far for quality care. In addition, solar energy's role in saving clinics money has allowed resources to be redirected to other important activities such as purchasing medications and hiring new staff. These advancements are in line with SDG 3 — to lead healthy lives and foster well-being across all ages (Mandisa et al., 2023). Healthcare advances made possible by solar power illustrate the full scope of its impact on personal and public health.

The economic activities of Chivi District have also received an impressive boost with the implementation of solar energy. Particularly useful for farmers has been solar-powered irrigation, which has diminished reliance on unstable rainfall and enhanced crop yields (Kumar et al., 2022). These systems have allowed farmers to farm all year round, diversifying crops and enhancing the nutritional status of their households and villages. Also, solar power has made it cheaper for farmers to operate them — they no longer have to rely on expensive diesel pumps. Likewise, entrepreneurs of small enterprises report higher efficiency thanks to solar-powered devices and longer hours as a result of dependable lighting (Mpofu & Chikwenhere, 2022). These economic benefits are compatible with SDG 8, focusing on decent work and economic growth, and the capacity of solar to stimulate entrepreneurial activities and employment in rural regions. In providing sustainable economic activity, solar power not only makes homes more prosperous but also helps develop the economy of the area as a whole.

The ecological advantages of solar energy use in Chivi District are also quite substantial as it would also help in eliminating dependence on traditional biomass fuels like firewood and charcoal. These energies have long fuelled forest and ecosystem destruction, making the region especially susceptible to climate change (Mutasa et al., 2021). Solar cookstoves and lights reduced biomass usage, encouraging forest conservation and improving ecosystem resilience. In addition, the renewable power of solar panels has improved indoor air quality and reduced respiratory diseases linked to kerosene and wood stoves. These goals are linked to SDG 15, the protection, restoration and sustainable use of terrestrial ecosystems. The ecological benefits of solar energy usage show that it is key to sustainability locally and globally, thereby further strengthening its connection with SDG 13 more broadly.

Even with these successes, it will still be difficult to scale solar adoption so it can meet its full potential in solving local challenges and driving SDG goals. Price is another obstacle, especially for low-income families who can't afford to pay the upfront cost of solar despite savings over the long run (Nzama & Sibanda, 2023). In some cases, pay-as-you-go financing plans relieved this strain, but they're patchy and many homes are still outside the solar pie. Also, technical concerns related to the repair and upkeep of the solar system are still present and the rural populations lack the capacity and infrastructure to maintain the system for the long term (Mukiza et al., 2021). These issues need a specific intervention through government subsidies, capacity building, and local service centres for users of solar power. These efforts would not only make solar energy more scalable, but also it would be viable in a way that will allow it to continue to address critical problems of areas such as Chivi District.

Overall, solar power has proved to be a game changer in solving local problems of Chivi District ranging from better access to education and healthcare to economic development and sustainability. Its compatibility with various SDGs, including SDGs 3, 4, 7, 8 and 13, make it an attractive catalyst for rural holistic development. But getting solar power to scale requires a sustained push across the barriers of access and viability. Through innovation, partnership and appropriate policies, solar energy will move forward in the quest for a better and more just future for the people of Chivi District and beyond.

5. Limitations and Future Research

5.1. Limitations of Solar Energy Projects in Chivi District

Solar projects in Chivi District are revolutionary but have certain limitations that prevent them from scaling up and maintaining. A lack of affordability is still one of the biggest obstacles since many rural households can't afford the upfront investment in panels and equipment. While the funding options include new forms of financing, such as pay-as-you-go schemes, these are not well-known in Zimbabwe and adoption rates are low. It might be addressed with subsidies or government-subsidized micro-loans for poorer families, making solar energy a real possibility for more families.

Technical maintenance is another major bottleneck to solar adoption in the Chivi District. A lack of certified local technicians means that if systems break down, they aren't immediately repaired and may need an outside expert. This obstacle points to the need for effective capacity-building programmes to train communities to be able to operate and maintain solar systems on their own. Pieces of training could be provided and local support centres could be set up to create a talent base of technicians on-site, with less need for third-party providers.

Even the environment makes things difficult, such as how well solar panels work during the rainy season when less sunlight comes into play for power generation. This is where technological innovation is needed to produce more resilient systems to varying weather patterns. Alternatives that mix solar power with other renewables like wind or biomass might ensure a more reliable source of energy.

Those limits remain the responsibility of policy and institutional mechanisms. Streamlined regulatory procedures and private-sector incentives might facilitate scale in solar projects. Secondly, solar energy deployments in general rural development, like education and infrastructure construction, will make for a better holistic solution to energy poverty. Solving these issues head-on will help Chivi District solar power projects perform to their full potential in transforming rural livelihoods.

5.2. Comparison of Findings with Other Studies in Similar Contexts

The Chivi District study was not unlike other studies in countries in the developing world, like Kenya and India. The Solar microgrids of Kenya are transforming rural Africa to deliver stable electricity for people in rural areas and enhance education and healthcare. School buildings – in Kenya, for example – that use solar energy report higher student numbers and better grades due to having lighting for studying in the evenings and access to digital tools (Ouma et al., 2021). Similarly, rural health centres with solar panels improved services in the refrigeration of vaccines and the running of diagnostic equipment. Such developments are similar to those in Chivi District where solar-powered lighting and medical infrastructure have also closed crucial service gaps. But Kenya's success in scaling up solar is a result of strong policies and investments in renewable energy infrastructure that Zimbabwe is still missing (Nzama & Sibanda, 2023).

India is another example of how solar power can transform the world – at least, the farm. Solar-powered soil irrigation allowed Indian farmers to overcome water deprivation and achieve maximum yield by making crops available during the dry season (Kumar et al., 2022). It has not just improved food security but has also boosted household incomes by saving us from paying for expensive diesel-powered pumps. On the other hand, though solar irrigation is now getting popular in Chivi District, it is only partially adopted due to budget and lack of technical support for its maintenance. Furthermore, India's total subsidy and other government schemes like the Kisan Urja Suraksha evam Utthaan Mahabhiyan (KUSUM) scheme helped increase the adoption of solar for smallholder farmers (Ravi et al., 2021). These policies have a lot to teach Zimbabwe, where similar subsidies have yet to support the scale of solar projects.

What differentiates Zimbabwe from them is that renewable energy schemes are integrated through public-private partnerships. In Kenya, partnerships between government, private investors and development agencies have helped solar micro-grids get off the ground in record time and electricity get to even the poorest households (Mandisa et al., 2023). These collaborations have also left room for new financing models, such as pay-as-you-go, that have reduced solar power for the less fortunate. The same is true of India which has harnessed the expertise of the private sector to establish a renewable energy sector, thus creating domestic manufacturing and employment opportunities (Moyo & Sibanda, 2023). Meanwhile, in Zimbabwe, due to bureaucratic impediments and an unsustainable economic situation, it has failed to bring major private investment into its solar projects. That collaboration has held back solar scale-up and has deprived rural areas of the sustainability that would otherwise make sustainable energy viable (Mutasa et al., 2021).

The policy climate of Zimbabwe is another that separates it from others. In contrast to India, where renewable energy policies were well aligned with national development targets, the energy policy in Zimbabwe was not coherent and consistent, and preferred investments in fossil fuels to sustainable ones (Chisadza et al, 2021). In India, for example, while ambitious targets for renewable energy production and financial support for solar power deployment exist, there are no full policies that promote investment in renewables in Zimbabwe. Not only does this policy gap prevent solar projects from getting financing, but it also discourages foreign donors and private investors looking for stability and a sense of clarity in regulations (Mhlanga et al., 2022). With the Indian model of proactive policy making, Zimbabwe could build the infrastructure needed to take solar energy up and align with the wider agenda of sustainable development.

In spite of such differences, there is much that the struggles of these countries share in common that can be helpful for Zimbabwe. Kenya and India, for instance, had been in a deep pit at first with their solar affordability, especially for the poor. But novel finance systems like micro-loans and local savings plans have been able to get around it. In Kenya, pay-as-you-go models have given rural residents solar power without any upfront cost and India's cooperative bank offered farmers zero-interest loans for solar panels (Ravi et al., 2021). These methods illustrate the power of financial inclusion to scale up solar power — a lesson Zimbabwe can build into its renewable energy strategy so that even the most marginalised communities can benefit from the technologies.

There are also lessons from the social aspects of solar adoption. Community-based groups have been essential in the dissemination of solar energy and technical assistance to support system upkeep in Kenya (Ouma et al., 2021). Such bottom-up operation has created ownership and trust among users which have led to the longevity of solar power initiatives. India, too, has spent on training courses to develop local capacity for installation and repair of solar arrays, creating employment and addressing technical problems (Mukiza et al., 2021). Similarly, Zimbabwe's solar energy projects have not had the support of communities, with most users ill-equipped to sustain their systems and know what they're missing. Having community engagement policies and capacity-building programmes as part of the renewable energy infrastructure in Zimbabwe would make solar projects more long-term sustainable.

In short, the Kenyan and Indian cases can be compared to the rest of Zimbabwe to study the successes and failures of the penetration of solar energy. Although the efforts in Chivi District to use solar energy to overcome energy poverty and empower livelihoods are welcome, there is still much to be done in policy, financing and technical assistance. With lessons from these countries – public-private partnerships, new models of financing and policies tied to sustainable development – Zimbabwe can scale up solar projects faster. Not only will these efforts help reduce local energy poverty but will contribute to the world's SDG targets for a cleaner and more equitable future for rural areas.

5.3. Limitations and Implications for Policymakers

While there is a no-brainer about solar power in Chivi District, some of its limitations limit its full potential and hinder penetration. Of the main issues we are dealing with today is the upfront cost of solar energy systems which is prohibitive for most low-income customers. User stories also often talk about the expense of buying and setting up solar panels, even in pay-as-you-go options. Even though these types of finance have lightened the burden on some, they are not generalisable and generally leave out the most vulnerable groups of people who do not have access to formal credit (Mukiza et al., 2021). That cost-exclusion fuels injustice by leaving the most underprivileged communities unable to avail themselves of clean energy options. The maintenance and spare parts costs also deter adoption as a lot of households cannot pay the expenses.

Also, there are technical problems, such as how to keep the solar panels up and running. Small towns such as Chivi District don't have qualified technicians, so system repairs are delayed and the overall cost goes up (Mutasa et al., 2021). These inequities are further compounded by a lack of training programmes and community service centres, leaving communities to draw on outside help that is time-intensive and costly. Participants have complained that technical support hasn't been readily available and that they can't trust solar power as a solution. These technical constraints also point to capacity-building projects to train communities to take care of the solar system themselves.

Another big obstacle is the fractured regulatory framework for renewable energy in Zimbabwe. Policies have a lag and are often inconsistent and don't correspond to national development objectives which frustrate investors and decelerate solar projects' growth (Mhlanga et al, 2022). The bureaucracy and long approval timelines further inhibit private industry from joining, which also restricts the range of public-private partnerships that are essential for financing and delivering large-scale solar. Comparison with other countries like Kenya and India suggests that smooth regulatory regimes and unambiguous policy incentives are key to accelerating renewable energy deployment (Chisadza et al, 2021). This lack of frameworks in Zimbabwe makes solar energy programmes subject to inefficiency and poor performance.

Such constraints highlight to policymakers the need for targeted interventions to make solar energy solutions accessible and viable. To solve affordability, governments and stakeholders will need to introduce subsidies or grants for the lowest-income households. These subsidies can make solar a great deal less expensive and less expensive for people in need. Even flexible payment options such as longer-term pay-as-you-go could help break the financial squeeze on indigent populations (Nzama & Sibanda, 2023). And policymakers would have to think about how to tap international sources of financing such as climate finance to buy into the cost of panels and increase their scale.

Technical barriers can be tackled as well through capacity-building programmes. Local governments and development agencies should prioritise the creation of rural training centres for solar installations, maintenance and repair (Mpofu & Chikwenhere, 2022). Not only would such programmes give locals knowledge about solar power management, but they would also create jobs, adding to socio-economic growth in general. Also, local technical support groups must be configured so they can respond promptly without recourse to external engineers. If policymakers invest in capacity development, they can make solar power sustainable and local.

Reforms in the regulation space are needed to open the door to solar adoption. The governments must speed up approvals and come up with comprehensive policies to encourage private investments in renewables (Mutasa et al., 2021). This includes giving tax concessions and other economic incentives to lure in capital and pushing for the creation of public-private partnerships. What Kenya and India have taught us is that renewable energy policies should be accompanied by national development targets to be coherent and effective (Ouma et al, 2021). Consistent regulations will not only attract investment and technical know-how but will also give a solid platform to scale up the use of solar power in Zimbabwe.

The final option is for policymakers to consider solar energy as part of more overall rural development. That's by connecting solar energy with the work to increase education, healthcare and agricultural productivity, so their impact can be shared across a range of sectors. For instance, subsidies for solar irrigation systems could also help with water shortage and food security, while solar lighting in schools could improve learning (Kumar et al., 2022). Through a multidimensional approach, policymakers can maximise the use of solar energy and make sure it falls within the scope of Sustainable Development Goals (SDGs) such as SDG 7 (Affordable and Clean Energy), SDG 13 (Climate Action) and SDG 1 (No Poverty).

Solar energy has great potential to solve pressing issues in Chivi District, but only when efforts are made to overcome affordability, technical and policy hurdles can it be fully deployed. It requires a combination of financial incentives, capacity development, regulatory reform and integrated development planning by policymakers. When we overcome these constraints, solar can offer a long-term, low-carbon solution to Zimbabwe's SDG targets and create socio-economic resilience.

The conclusions of this study are relevant for the global development processes, particularly the achievement of international climate goals and sustainable energy systems. Solar power plants in the Chivi District reflect the small-scale model to meet the goals envisioned by the Paris Agreement and Green Climate Fund. Through converting the rural economy away from conventional biomass fuels and onto renewables, the research highlights Zimbabwe's potential to play its part in world action on greenhouse gas reductions. This deforestation and fossil fuels reduction are allied to the Paris Agreement's objective to limit global warming to below 2°C through the use of cleaner energy sources.

Global funding sources, including the Green Climate Fund, are crucial for scaling up these kinds of initiatives. The initial installation costs of solar panels are still an expensive obstacle, but specific financing through international funds might alleviate affordability concerns for low-income households. In addition, the Green Climate Fund could support capacity-building programmes to make solar technologies technically sustainable. This is also tied in with its aim to encourage emerging economies to use climate-ready technologies, making solar a long-term attractive option for villages.

Additionally, the research supports SDGs 7 and 13 by providing examples of how decentralized renewable energy can foster access to energy and climate resilience. Solar adoption also enhances socio-economic development by reducing energy poverty, facilitating education and assisting in economic growth in the long run, in line with the larger agenda of sustainable global progress. This solar power project's success in Chivi District could be used as a role model for other developing nations to experience the same problem and demonstrate the need for synergistic relationships between the local administrations, donors, and the private sector.

To make the most of these results, Zimbabwean policymakers need to engage in the global climate talks and push for greater investments in renewable energy sources. That would bridge the gap between regional and international commitments and ensure that rural people get access to clean and equitable energy resources.

5. Future Research and Recommendations

5.1. Scaling Up Off-Grid Solar Projects to Other Regions

Off-grid solar power in Chivi District is proof of how off-grid energy projects can bring an end to energy poverty and foster sustainable development in the rural setting. Developing these schemes in other parts of remote Zimbabwe is the next step to broadening access to clean and safe energy. States like Mwenezi and Gokwe, for example, that are suffering from similar grid connectivity challenges and energy poverty, could benefit greatly from installing solar microgrids and household solar panels (Mukombachoto et al., 2021). In addition, policymakers and stakeholders must prioritise target areas identified based on energy needs assessments and ensure that solar schemes are localised to meet the socio-economic and environmental circumstances of each location. A phased rollout with community participation and pilot schemes can enable solar projects to scale down and be sustainable.

Scaling up can use some of the lessons of Chivi District such as community mobilization, capacity building and financing strategies. Establishing early trust with local leaders and stakeholders will ensure that solar is delivering what the community wants and needs (Mpfu & Chikwenhere, 2022). What's more, growing collaborations with foreign development agencies, NGOs and private-sector financiers can also deliver the technical and financial infrastructure for scale-up. When emulated and scaled up from the successes in Chivi District, off-grid solar could have a positive impact on other rural areas of Zimbabwe to address energy poverty and support national development agendas.

5.2. Policy Frameworks to Support Sustainable Energy Initiatives

Support for solar energy projects' growth and sustainability requires a robust policy environment in Zimbabwe. There needs to be holistic, unified policies by policymakers to focus on the evolution of renewable energy, as well as national and international sustainability objectives. Financial rewards, regulation and institutional reinforcement are critical elements of this sort of model. To lower the cost of solar power to low-income households and encourage private investment, the government could provide subsidies or exemptions, for instance (Nzama &

Sibanda, 2023). These are all things that could significantly increase the cost and availability of solar energy, particularly in rural areas where energy poverty is highest.

It's also vital to make it easier to regulate and establish an environment favourable to renewable projects. Expensive approval times and bureaucracy have long hindered investors and kept solar installations in Zimbabwe on the shelf (Mutasa et al., 2021). Making these processes easier and putting in place simple procedures for project approvals will help solar projects be deployed faster and attract private investment. Then, public-private partnerships must be further promoted by capitalizing on the resources and know-how of both industries to expand solar adoption.

There are also institutional support systems — capacities-building programmes and technical assistance — for securing solar projects' viability. Policymakers must put a premium on building training centres so local communities are taught how to install and repair solar systems (Moyo & Sibanda, 2023). Not only do these projects extend the life of the solar panels, but they also create jobs in a wider socio-economic way. If these areas are well framed in a policy environment, then Zimbabwe will have a cleaner and more inclusive energy future.

5.3. Future Research Areas

Further research should focus on filling the holes in solar energy adoption, as well as looking for new ways to expand its influence and scale. There is promising research underway for advanced solar technologies like high-efficiency modules and energy storage systems. Research might focus on whether next-generation solar systems would be feasible in rural Zimbabwe, both economically and in terms of access to and reliability of electricity (Teklu et al., 2023). Investing in local fabrication and assembly of solar panels may also be instructive for ways to save money and jobs in the renewable energy industry.

One more area of research that needs to be done is developing new forms of financing that could address low-income household affordability constraints. Pay-as-you-go models and community savings schemes were a success elsewhere but need to be further modified and tested in Zimbabwe (Ravi et al, 2021). Such research could gauge how well such models reached the most marginalised populations, and how to build them up elsewhere. Research on the role of microfinance institutions and cooperatives in the adoption of solar energy might also provide insight into how to scale up access to clean energy.

Third, and perhaps most important, the socio-economic effects of solar adoption in specific areas, like education, healthcare, agriculture, etc. Long-term studies that measure the results of solar schemes in the long term are likely to provide information on their viability and wider impacts on rural development (Chisadza et al., 2021). The information can be leveraged to inform policymakers and stakeholders in creating more efficient and productive solar projects, responsive to the wishes and needs of communities and national and global sustainability goals.

6. Conclusions

This research provided evidence of how solar power can transform energy poverty and sustainable development in Zimbabwe. In education, healthcare and business, solar energy has brought an extraordinary change in the living standards of Chivi District. The solar lights made the students remain in school longer which enabled increased literacy and teaching. And in medicine, solar power has enabled services like vaccine refrigeration and night-time lights in rural hospitals to be strengthened. Then there is solar-powered irrigation that has increased farm productivity and household income, and it has proven to spur economic growth. These objectives are consistent with various SDGs (eg, SDG 3 – Health and Well-being), SDG 4 – Education Quality and SDG 13 – Climate Action).

Despite these successes, barriers like cost, limited technical know-how and unclear regulations slow down solar adoption. Multilayered strategies are needed to overcome these challenges and scale solar in Zimbabwe. Low-income households can be helped with subsidies that cut the upfront price of a solar installation, and capacity-building programmes give residents access to maintenance and repair skills. We also need regulatory reforms to make things simpler and drive investments into renewable energy projects.

Public-private collaborations and global collaborations, including with the Green Climate Fund, can be critical to scaling up solar. These partnerships can raise funds, provide technical assistance and develop new financing arrangements such as pay-as-you-go to access solar power for disadvantaged communities. Decentralized solar microgrids can also deliver clean, reliable power to very distant regions.

Solar's modularity and scale make it the only technology to respond to the various demands of rural and marginalised communities in Zimbabwe. Solar energy can be effectively rolled out to other parts of the world if structural barriers are overcome and stakeholders work together. With the right combination of initiatives, Zimbabwe could be a pioneer in the adoption of renewable energy and represent the way to sustainable development with clean energy.

In short, solar power is not only power — it's the engine of empowerment, fairness and resilience. Its capacity to reduce energy poverty and stimulate long-term growth makes it an important part of the future of Zimbabwe. Solar energy could revolutionise not only Chivi District, but the country as a whole with bold, concerted efforts and can help to make Zimbabwe greener, fairer and more inclusive.

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