Comparing On and Off-Grid Renewable Energy Projects in Developing Countries: Case Studies from Kenya

This essay investigates the metrics of success for foreign renewable energy investments in developing countries. These investments have drawn attention as a way for investors to make returns on projects that are climate-friendly and also help address the significant issue of energy insecurity, especially in the rural parts of developing countries. This paper determines success both by the levels of investor returns and by the benefits gained by communities surrounding projects: especially in terms of their access to energy. The paper uses both complexity theory and a stakeholder methodology to compare Kenyan case studies of the two main renewable energy project types: a large, grid-connected windfarm and a smaller, off-grid solar project. It concludes that smaller-scale, off-grid projects may often be more successful than larger-scale, on-grid projects for both communities and investors. This is due to a number of related factors, including the added complexity of the larger projects, as well as the increased stakeholder involvement necessitated by smaller projects.

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The Kenyan Lake Turkana Windfarm covers 40,000 acres of land, making it the largest wind farm in Africa and the most significant infrastructure project in Northern Kenya since independence.[1] Yet, the project almost ended in its infancy when the World Bank decided to withdrawal its 78-million-dollar investment pledge, despite its years of preliminary research and project work. The World Bank claimed it was pulling out because it could not ensure that the electricity generated by the project would be paid for by consumers. It turned out that the rural communities surrounding the project area, who needed more access to energy, would not receive the electricity generated by the wind farm. Instead, the electricity would be funneled into the country's main electrical grid, which only connected to already-electrified far-away cities in Kenya that did not necessarily need the extra electricity.[2] How could the bank have gotten so deeply involved in the project without first assessing whether the electricity could be paid for? As the renewable energy investment market booms in developing countries, this project is just one example of many, where the flash surrounding a large project has obscured investors' views of the numerous issues that arise not only for investors but the local community as well. The question now becomes whether there is a better method for investing in these types of renewable energy projects.

Renewable Energy projects in developing countries have the potential to be a vital solution to the converging issues of climate change and energy insecurity, while offering

[1] Matina Stevis, "In Kenya, the Wind and a Dream: Nothing about this long-planned giant wind farm has been easy." *Wall Street Journal*, (May 06. 2015) http://ccl.idm.oclc.org/login.

[2] Ibid.

investors strong returns from an investment they can feel is doing a societal good.[3] However, these projects have proven to be highly complex and require in-depth contextual understandings of the target location and surrounding communities.[4] When not approached correctly, they can full short of one, or all, of the goals listed above.

In many developing countries, the majority of the population does not have reliable access to energy, especially in rural areas.[5] Many countries in Sub-Saharan Africa, for example, over 60 percent of the population, and over 80 percent of the rural population, does not have reliable access to electricity.[6] Thus, developing increased power production capabilities is essential, and governments often look to foreign entities for support in the construction and funding of energy generation facilities. Yet, the projects that were previously most often pursued, like coal plants, have fallen out of favor with both investors and governments, and energy investment in general has slowed during the covid pandemic.[7]

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[3] Farhad Taghizadeh-Hesary and Naoyuki Yoshino. "Sustainable Solutions for Green Financing and Investment in Renewable Energy Projects." *Energies* 13, 4 (2020): 788–88. doi:10.3390/en13040788.

[4] Kyeongseok Kim, Hyoungbae Park, Hyoungkwan Kim, "Real options analysis for renewable energy investment decisions in developing countries," *Renewable and Sustainable Energy Reviews* 75, (2017) Pages 918-926, ISSN 1364-0321, https://doi.org/10.1016/j.rser.2016.11.073.

[5] Odfred O. Boateng, Mobolanle R. Balogun, Festus O. Dada, Frederick A. Armah, "Household energy insecurity: dimensions and consequences for women, infants and children in low- and middle-income countries," *Social Science & Medicine,* 258 (2020) 113068, ISSN 0277-9536, https://doi.org/10.1016/j.socscimed.2020.113068.

[6] Joshua Mugisha, Mike Arasa Ratemo, Bienvenu Christian Bunani Keza, Hayriye Kahveci, "Assessing the opportunities and challenges facing the development of off-grid solar systems in Eastern Africa: The cases of Kenya, Ethiopia, and Rwanda," *Energy Policy* 150 (2021) https://doi.org/10.1016/j.enpol.2020.112131.

[7] Ibid.

Recently, as investors have taken a renewed interest in developing countries, renewable energy has become a more politically popular target for investment. Investors and governments alike can tout that they are saving the planet while providing much-needed electricity to populations without any.[8] Investors also continue to expect the rewards of monetary returns, of course. As this more popular form of energy investment has gained dominance, investors, governments, and researchers are still trying to learn how to produce the most successful renewable energy projects in developing contexts. It is important to note that the effectiveness of these projects should be measured not just for their value to investors, but for community members as well.[9] While no consensus has been reached, and the learning process is ongoing, some key takeaways can be gleaned from recent projects.

In particular, large-scale renewable energy projects in developing countries without increased grid access often fail to deliver benefits to the affected energy insecure populations and foreign investors. Smaller-scale off grid solar projects may serve as a viable alternative. Qualitative analysis of case studies of both a large, grid-connected wind farm and a small, off-grid solar project in Kenya reveals that the larger, grid connected project is prone to failures in community engagement and compliance, technology and infrastructure, and guaranteed consumers, while smaller, off grid projects can result in more successful community engagement and compliance, as well as less infrastructural or consumer payment issues.

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[8] M. Loock, "Going beyond best technology and lowest price: on renewable energy investors' preference for service-driven business models," *Energy Policy*, 40 (January 2012): 21-27 doi:10.1016/j.enpol.2010.06.059.

[9] Judith Alazraque-Cherni, "Renewable Energy for Rural Sustainability in developing countries" *Bulletin of Science, Technology & Society* 28, 2 (April 2008): p. 105-114

This paper will first carry out a review of the relevant literature in the area of renewable energy investing, and then will go over a methodology and theory for evaluating its cases. The paper will then engage in a qualitative comparison of two key renewable energy project case studies from Kenya, and will then finally summarize key conclusions.

Literature Review

Investors in green energy projects in developing countries often view these investments as a way to secure monetary returns, contribute to the fight to mitigate climate change, and increase access to energy in energy insecure regions. Host countries see many of the same benefits, and these types of investments have ramped up in the last couple of decades as green energy has become more technologically feasible.[10] However, these investments carry significant risks. Much of the literature points to the high-risk nature of green energy finance, especially in developing countries. (Taghizadeh-Hesary 2020)[11] and (Kim 2017)[12] determine that one of the highest risks that comes with these projects is uncertainty about the willingness and ability of target consumers to pay for the energy generated. Other key risks and determinants of success are uncertain regulatory environments, poor government administrative capacity, a lack of local technical skills and knowledge, and a lack of infrastructure - especially related to

[10] Farhad Taghizadeh-Hesary and Naoyuki Yoshino, "Sustainable Solutions for Green Financing and Investment in Renewable Energy Projects."

[11] Ibid.

[12] Kyeongseok Kim, Hyoungbae Park, Hyoungkwan Kim, "Real options analysis for renewable energy investment decisions in developing countries."

electrical grid connection.[13] [14](Pinkse 2010),[15] (Looke 2010),[16] (Painuly 2001),[17] (Abba 2022),[18] and (Martinot 2001)[19] also argue that there are high levels of complexity in green energy investment projects in developing countries, largely due to the variety of involved stakeholders, which often means that these projects require greater investor involvement than typical foreign investments.

There are a variety of theories that have been developed to explain how investors choose foreign investments. In an article summarizing the key theories of foreign investment, (Denisia 2010) determined that there is no unified theory of foreign investment, but that the one most commonly used is the OLI (ownership advantages, location, internalization) theory,

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[13] David Matthaus and Michael Mehling, "Derisking Renewable Energy Investment," *Joule* 4 (December 16, 2020): p. 2627–2645

[14] Farhad Taghizadeh-Hesary and Naoyuki Yoshino. "Sustainable Solutions for Green Financing and Investment in Renewable Energy Projects."

[15] J. Pinkse and D. van den Buuse, "The development and commercialization of solar PV technology in the oil industry," *Energy Policy*, Volume 40, January 2012, P. 11-20 doi:10.1016/j.enpol.2010.09.029

[16] M. Loock, "Going beyond best technology and lowest price: on renewable energy investors' preference for service-driven business models."

[17] J.P Painuly, "Barriers to renewable energy penetration; a framework for analysis," *Renewable Energy*, 24, 1, (2001) Pages 73-89, ISSN 0960-1481, https://doi.org/10.1016/S0960-1481(00)00186-5.

[18] Z.Y.I. Abba, N. Balta-Ozkan, and P. Hart, "A holistic risk management framework for renewable energy investments," *Renewable and Sustainable Energy Reviews* Volume 160, 2022, 112305, ISSN 1364-0321, https://doi.org/10.1016/j.rser.2022.112305.

[19] Eric Martinot, "Renewable energy investment by the World Bank," *Energy Policy* 29, 9, (2001), P. 689-699, ISSN 0301-4215, https://doi.org/10.1016/S0301-4215(00)00151-8.

which employs a multilevel analysis of each these factors to explain investment decisions. [20] However, much of the literature agrees that the complexity and newness of green energy investment decisions leads investors to diverge from this standard theory. (Pinkse 2010) argues that, because traditional investors struggle with understanding the variation and novel technology involved in renewable energy investment, they tend to struggle to map existing investment frameworks onto renewable energy investments.[21] Loock (2010) argues that because of the emerging nature of the renewable energy market, investors may place less emphasis on traditional metrics used to determine investment success such as price/earnings ratio and rely more on factors such as personal relationships with project developers.[22]

These theories are largely confirmed by evidence from interviews with private investors and World Bank documents describing investment projects. Investment groups and individuals pay attention to a wide variety of metrics when making investment decisions, but environmental conditions and the local policy conditions in the region targeted for investment are of key importance, and often even outweigh traditional metrics used to evaluate investments. World Bank documents on overall green energy investment strategy and specific projects in Kenya and India reveal that the World Bank strongly prefers to invest in large-scale, grid-connected projects in areas with positive macroeconomic and policy conditions.

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[20] Vintila Denisia, "Foreign Direct Investment Theories: An Overview of the Main FDI Theories." *European Journal of Interdisciplinary Studies* 2, 2 (December 2010) **https://ejist.ro/files/pdf/357.pdf**

[21] Pinkse "The development and commercialization of solar PV technology in the oil industry."

[22] Loock, ""Going beyond best technology and lowest price: on renewable energy investors' preference for service-driven business models."

Environmental conditions are also considered to be important. Stakeholder compliance and risk are generally considered to be less important. The World Bank does conduct stakeholder interviews prior to investing in projects, but the questions in these interviews focus on the impact of the physical presence of the project on the community, not the investment risk posed by community members' lack of compliance.[23] [24] [25](Keeley 2018)[26] conducted a series of interviews with renewable energy investment experts and determined that private investors also prioritize local green energy policies and macroeconomic factors when looking to invest in renewable energy in developing countries. Investors even prioritize these factors over typical metrics for investment success like cost/returns ratio, which is consistent with the theory laid out by (Loock 2010).

Much of the research done in this area focuses on how investors make their decisions, so as to inform host countries of how to attract investment. More limited work has also been produced on which factors determine what renewable energy projects will actually be most

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[23] World Bank, "Lake Turkana Wind Power Project," *World Bank Project Document* (July 2009) https://documents1.worldbank.org/curated/en/149151468272057129/pdf/E29100v10EA0P10pdated0Windfarm0ESIA.pdf

[24] World Bank, "Grid-Connected Rooftop Solar Program (P155007)," *The World Bank Project Project Document* (December 2017) https://documents1.worldbank.org/curated/en/228341513976846726/pdf/ISR-Disclosable-P155007-12-22-2017-1513976832124.pdf

[25] World Bank. 2008. The World Bank Annual Report 2008 : Year in Review. Washington, DC. © World Bank. https://openknowledge.worldbank.org/handle/10986/7524 License: CC BY 3.0 IGO

[26] Alexander Ryota Keeley, Ken'ichi Matsumoto, "Investors' perspective on determinants of foreign direct investment in wind and solar energy in developing economies – Review and expert opinions," *Journal of Cleaner Production,* 179 (2018): 132-142, https://doi.org/10.1016/j.jclepro.2017.12.154.

successful. Ideally, the factors that investors use and the factors that determine success would be the same, but this is not always the case. Some research suggests that current investment strategies are ineffectual. (Wong 2010)[27] and (Martinot 2001)[28] argue that current renewable energy investment strategies can often fall short, both for investors and potential energy consumers in the target countries. This is because investors tend not to take into account issues like the functioning and evolution of renewable energy technologies or the reliability of government partners, and because investors can fail to get a full understanding of the stakeholder environment before an investment is made.[29]

Many alternative strategies have been recommended for making better green energy investments that both ensure investor returns and better support local communities in developing countries. (Cherni 2008),[30] (Painuly 2001)[31] argue that smaller, off-grid renewable energy projects often better serve local communities and can be lower-risk investments than large-scale on-grid investments in developing countries. This is because the smaller projects are actually affordable and able to reach populations without access to energy, whereas grid-connected projects often come with prohibitively expense energy costs and only reach consumers that already have access to energy.[32]

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[27] S. Wong, "Overcoming obstacles against effective solar lighting interventions in South Asia," *Energy Policy* 40 (January 2012): 110-120 doi:10.1016/j.enpol.2010.09.030

[28] Eric Martinot, "Renewable energy investment by the World Bank."

[29] Ibid.

[30] Judith Alazraque-Cherni, "Renewable Energy for Rural Sustainability in developing countries."

[31] J.P Painuly, "Barriers to renewable energy penetration; a framework for analysis."

[32] Ibid.

Another ongoing issue with current investment strategies is a lack of stakeholder involvement. Multiple kinds of local stakeholders have determinative influence on the success of renewable energy projects in developing countries. (Cherni 2008), (Painuly 2001)[33] and (Kim 2017)[34] recommend much greater stakeholder involvement in investment decisions. In-depth interviews with relevant stakeholders are recommended to understand the viability of projects. Some key stakeholders include: the RET industry (manufacturers of plant, equipment and appliances, owners of plant), consumers, NGOs, experts, policy makers (government), and professional associations. (Painuly)[35] also emphasizes that the fees consumers will be charged for the energy produced and the ability of target consumers to pay those fees should be some of the most important determining factors in investment decisions. (Hart 2022)[36] and (Kim 2017)[37] lay out more nuanced frameworks for energy investment decisions, such as real options analysis and semi-quantitative multicriteria decision analysis, that better take into account the complexity and multiple stakeholders involved in renewable energy investment decisions.

While ample literature is being produced on this subject, little has been written comparing the investment outcomes of smaller, off-grid investments to the outcomes of the

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[33] Ibid.

[34] Kyeongseok Kim, Hyoungbae Park, Hyoungkwan Kim,"Real options analysis for renewable energy investment decisions in developing countries."

[35] J.P Painuly, "Barriers to renewable energy penetration; a framework for analysis."

[36] Z.Y.I. Abba, N. Balta-Ozkan, and P. Hart,"A holistic risk management framework for renewable energy investments."

[37] Kyeongseok Kim, Hyoungbae Park, Hyoungkwan Kim,"Real options analysis for renewable energy investment decisions in developing countries."

larger scale, on grid projects that investors often prefer. Even less has been produced focusing on the joint outcomes of community benefits and investor benefits. This paper hopes to fill in the gaps, and to help identify which project types can best serve local communities and investors.

Theory and Methodology

This paper utilizes combined complexity theory and a theory of stakeholder involvement to evaluate case studies of renewable energy projects in Kenya. Complexity theory in project investment posits that actors do not always behave rationally or reach an ideal market outcome when investing in complex energy infrastructure projects. This is the result of numerous conflicting stakeholders and unforeseen barriers that necessarily compose such complex projects.[38] Identifying the issue with project outcomes is the first step to utilizing this theory. The issue here is that large-scale, grid-connected renewable energy projects can often fail to meet investor or community expectations. The next step in the case study section of this paper will be gathering information and analyzing the structural and stakeholder influences on these projects that can help clarify why large-scale grid-connected renewable energy projects can fail.

Stakeholder involvement theories have been developed to emphasize the importance of identifying and analyzing the interests of relevant stakeholders at each stage of an investment project.[39] This includes influences from government, construction companies, local

[38] Sarah Hafner, Aled Jones, Annela Anger-Kraavi, Jan Pohl, "Closing the green finance gap – A systems perspective*," Environmental Innovation and Societal Transitions*, 34, (2020): 26-60, ISSN 2210-4224, https://doi.org/10.1016/j.eist.2019.11.007.

[39] Z.Y.I. Abba, N. Balta-Ozkan, and P. Hart,"A holistic risk management framework for renewable energy investments."

communities, investors, and more, and multiple theories cited in the literature review above pay special attention to the importance of taking into account stakeholders in renewable energy projects.[40] This process should to lead to better project outcomes for all involved parties. This theory nicely complements the theory of complexity.

This paper will conduct an in-depth analysis of the stakeholders and structural barriers influencing project outcomes for both investors and communities in two case studies of renewable energy projects in Kenya. The first project is a large-scale, grid connected windfarm in the Lake Turkana region of Kenya whose investors did not adequately take into account the various potential structural and stakeholder issues with the project. This large project also necessarily involved many more of these barriers because of its scale. The second case is a series of smaller, off-grid solar projects conducted in rural communities in Kenya. These projects had significantly less structural and stakeholder complexity, and entailed greater stakeholder analysis on the part of investors, and so were more successful. Both projects were sponsored by the World Bank, which allowed for greater access to investment documentation and thus more thorough analysis.

Case Study One: Lake Turkana Wind Farm

Case studies from Kenya reveal how large-scale, grid connected renewable energy projects often result in numerous roadblocks to investor and community success, while smaller scale off-grid projects result in better outcomes. First, the Lake Turkana Wind Farm Project in Kenya is an example of how large-scale on-grid projects can fail communities and investors. For

[40] J.P. Painuly, "Barriers to renewable energy penetration; a framework for analysis."

investors, this project resulted in community dissatisfaction, infrastructural issues, and, most seriously, problems with grid connection and energy consumers. For the Kenyan communities living near the project area, they were unable to access any of the energy produced by the project, yet suffered environmental impacts and strain due to land-rights controversy.

Background

The Turkana Windfarm is a large-scale renewable energy project in the rural Turkana valley of Kenya. The land was chosen for its open area and strong winds blowing off of Lake Turkana.[41] Strategy for the project began in the late 1990s, but the project did not begin construction until 2014. The project is the biggest wind farm in Africa, and the largest joint public-private investment in Kenya.[42] It is held up by the Kenyan government as a key component of its "Vision 2030" development strategy.[43] The goal of this strategy is to make Kenya a medium income country by 2030.[44]

The involved private companies were KP&P Africa (A Dutch company), Vestas Wind Systems (A Danish Wind Turbine manufacturer), Aldwych International (a British company) and

[41] Matina Stevis, "In Kenya, the Wind and a Dream: Nothing about this long-planned giant wind farm has been easy." *Wall Street Journal*, (May 06. 2015) http://ccl.idm.oclc.org/login.

[42] Zoe Cormack & Abdikadir Kurewa, "The changing value of land in Northern Kenya: the case of Lake Turkana Wind Power," *Critical African Studies*, 10,1 (2018): 89-107, DOI: 10.1080/21681392.2018.1470017

[43] Cecilia Theresa Trischler Gregersen, "Local learning and capability building through technology transfer: experiences from the Lake Turkana Wind Power project in Kenya," *Innovation and Development* (2020) DOI: 10.1080/2157930X.2020.1858612

[44] Zoe Cormack & Abdikadir Kurewa, "The changing value of land in Northern Kenya: the case of Lake Turkana Wind Power."

Sandpiper.[45] The public investors are The Norwegian, Dutch, and Finish governments, and the main financer is now the African Development Bank.[46] The World Bank was the original main financer, and Google had previously committed to purchasing $40,000 worth of wind turbine shares, but both pulled out of the project.[47] The Lake Turkana Wind Project was finally completed in 2017. The total cost was roughly $865 million. It consisted of 365 turbines and covers 40,000 acres of land.[48] However, for many reasons, the project proved not to be a strategic investment, which lead some investors to receive limited returns, and lead others to lose their money entirely by pulling out.

Investor Concerns

Many factors inherent to the Lake Turkana Wind Farm's large scale, its reliance on the grid, and the investors' lack of relevant contextual research and preparation inhibited the project's success. For investors, this meant a lack of adequate returns. Key issues that investors faced included legal trouble related to community dissatisfaction, infrastructure and grid issues, and a lack of paying consumers.

First, investors did not do enough to consider the concerns of local Kenyan communities or garner their compliance. This led to ongoing tensions and legal concerns that interfered with

[45] Ibid.

[46] Ibid.

[47] Matina Stevis, "Lake Turkana Wind Farm Project in Kenya Battles Headwinds," *The Wall Street Journal* (May 6, 2015) https://www.wsj.com/articles/lake-turkana-wind-farm-project-in-kenya-faces-headwinds-1430881511?mod=article_inlinz

[48] Zoe Cormack & Abdikadir Kurewa, "The changing value of land in Northern Kenya: the case of Lake Turkana Wind Power."

the project. The World Bank did document prior interview research with local villages. However, the interviews were broad and did not go in-depth on key issues such as land rights, who would have access to the electricity, or who would be involved in project implementation. Communication with communities was also not on an ongoing basis. [49] As a result, the windfarm was then built on land that had previously been communal, and the project-owners required a local village to move without compensation. In response, local indigenous activists formed the Sarima Indigenous People's Land Forum' (SIPLF) in 2015 to contest the project, and the legality of the project's land acquisition was called into question in a case in the high court in Muru in 2015.[50] The court issued an injunction which temporarily delayed construction of the project. Local activists attempted to physically blockade the project area in order to prevent work from being done on the wind farm and to enforce the injunction. This led to significant project delays and costs. [51]

These delays were inherent to the large-scale nature of the project, because a sizeable project that demanded extensive land use would unequivocally have disruptive effects on the communities living near the land. Another issue that increased dissatisfaction among the public was the project's grid connectivity. Since the wind farm was connected to the grid, the electricity generated would feed back into the general grid rather than supplying the

[49] World Bank, "Lake Turkana Wind Power Project."

[50] Ibid.

[51] Sofía Ávila-Calero, "Lake Turkana Project in Indigenous Territories, Kenya," *Atlas* (8/18/2019) https://ejatlas.org/print/lake-turkana-project-in-indigenous-territories

communities nearest to and most impacted by the wind farm. Thus, surrounding communities had incentive only to hinder, rather than help, the development of the project.

The social issues triggered by these types of large-scale projects were only the beginning of the typical challenges that it faced. Large-scale, on-grid infrastructural projects require significant infrastructure to both be built and be connected to the grid, which can present many roadblocks and extra costs for investors. Like many developing countries, Kenya lacked much of the supporting infrastructure for this type of project. This hindered progress and cost investors. The project entailed significant unforeseen infrastructural work. The wind turbine blades that Vestas Wind Systems originally planned to use for the project turned to be much too large for the nearest Kenyan port to handle, and so the project had to be redesigned to use turbines that were about half of the original size.[52] This increased the project timeline and the redesigns incurred costs. In addition, roads needed to be built from the port to the project location to transport the wind turbine blades on, as well as from other major cities in Kenya to transport workers and materials.[53] Rehabilitation of the main road from the port to the project location alone cost investors an extra 30 million US dollars.[54]

The most significant infrastructural issues, however, involved the electrical grid. The majority of Kenya's population does not have reliable access to energy, which stems largely from a lack of access to the electrical grid. This project did not take into account or prepare for

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[52] Matina Stevis, "In Kenya, the Wind and a Dream: Nothing about this long-planned giant wind farm has been easy."

[53] Ibid.

[54] Mette Dalgliesh Olsen and Thomas Westergaard-Kabelmann, "Socio-economic study of key impacts from Lake Turkana Wind Power (LTWP)"*QBIS (*June, 2018)

the extension of Kenya's current electrical grid. Additionally, the project did not reach the old grid, and there were project delays while the new windfarm was connected to the grid. This extra transmission line cost investors an extra 150 million Euros, and its construction delayed the operability of the wind farm for two years.[55] These costs, again, were inherent to the large-scale, grid connected nature of the project in a country that did not already have the necessary supporting infrastructure.

Even if these types of projects are successfully built and connected to the grid, there can be extreme difficulty for investors when trying to find adequate paying consumers. Even after the project was run to the new grid in Kenya, it only connected to cities in Kenya with access to electricity, and so there were not enough consumers to pay for the excess energy production. Even though the majority of Kenya's rural population does not have reliable access to energy, the new project would not reach any of these new communities without electricity. Thus, the energy insecure consumers located nearby the new project would not be given new electricity access, but a long and costly grid extension was run to the pre-existing electrical infrastructure in big cities. Thus, the energy produced by the wind turbines would not reach new consumers who would be in need of energy and willing to pay. This was the major reason that the World Bank cited for pulling its 78 million dollars out of the project, and then Google cited for pulling 30 million out of the project.[56] The Kenyan government had to promise to cover the cost of the excess energy in order for the African Development Bank to step in as an investor. This very

[55] Ibid.

[56] Ibid.

common and substantial issue of ensuring consumer tariffs plagues large-scale projects such as this in developing countries that rely on grid access. The numerous added costs and complications that resulted in investors failing to receive adequate returns reveal the ways that large-scale, on-grid projects can inhibit the success of foreign investors in renewable energy projects in developing countries.

Local Community Concerns

Large-scale, grid connected projects often produce little to no positive outcomes for surrounding communities, and this proved to be true in the case of the Lake Turkana Wind Farm. Even though the project was touted as part of Kenya's plan to reduce energy insecurity, especially in rural areas, communities near the project gained no extra electricity from the project. Instead, they faced social upheaval, environmental disruption, loss of land, and forced dislocation.

Large-scale on grid projects demand significant land control by foreign investors. Lake Turkana Wind Project has caused significant stress, grievance, and controversy over land rights for local communities surrounding the project location. The land that the wind turbines were built on was previously considered to be communal. Numerous pastoral communities, including the Rendille, Samburu and Turkana, used it for grazing,[57] and the village of Sarima was located

[57] Zoe Carmack, "How Kenya's mega wind power project is hurting communities," *The Conversation* (September 3, 2019) https://landmatrix.org/media/uploads/how-kenyas-mega-wind-power-project-is-hurting-communities.pdf

on a portion of the plot.[58] The Rendille community's Galgulame coming of age ceremony was also performed on the land.[59] However, the local government effectively privatized the land so that it could be leased to the wind farm in trust.[60] Thus, the project-owners were able to forcefully relocate the village of Sarima without compensation.

In addition, many local pastoral communities felt that the land had been privatized and sold illegally, with no benefit to them. This led to the formation of the activist group mentioned above: The Sarima Indigenous People's Land Forum, as well as the aforementioned lawsuit. These types of land issues related to local communities not receiving the benefits of a project, while incurring the costs, are unique to such large-scale projects that connect to a grid that ends up serving consumers far away from the rural area the project itself is located in.

Large-scale on grid projects are also very disruptive to surrounding communities in developing countries. The construction of the wind farm has been a deeply disturbing force that has fostered social tensions and conflict within local communities. Local communities compete over who should have access to benefits, jobs, and compensation from the project, and those with power inevitably find ways to profit from the project at the expense of those with less power.

This village of Sarima became overburdened when a large number of Kenyans moved to it looking for work associated with the wind farm, which resulted in poor sanitary and living

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[58] Zoe Cormack & Abdikadir Kurewa, "The changing value of land in Northern Kenya: the case of Lake Turkana Wind Power."

[59] Ibid.

[60] Ibid.

conditions for inhabitants. Locals also say that this influx of men looking for work has fostered a growing, exploitative prostitution industry.[61] These tensions also extend to concerns about the complicity of elites. The decision of the county government to privatize the land and lease it to the project in the first place is resented by many living in the community.[62]

Finally, large-scale on grid projects generally only generate electricity for communities already connected to the grid in developing countries, despite investors claims and possibly even beliefs that they will be increasing energy access for energy-insecure populations. This leaves surrounding communities disappointed and left-out. Not only did members of nearby Kenyan communities often not benefit monetarily from the project, they also were unable to glean the benefits of the electricity generated by the Wind Farm. Ironically, the project's location near energy insecure communities was touted as part of the reasoning for the windfarm's construction and location. However, like many large-scale grid-connected projects, this wind farm was unable to reach the energy insecure communities it ostensibly intended to help.[63] This case reveals the ways in which these large-scale renewable investment projects in developing countries can both fail and place undue stress on local communities.

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[61] Ibid.

[62] Zoe Carmack, "How Kenya's mega wind power project is hurting communities."

[63] Mette Dalgliesh Olsen and Thomas Westergaard-Kabelmann, "Socio-economic study of key impacts from Lake Turkana Wind Power (LTWP)."

Case Study Two: Kenya Off-Grid Solar Project

Background

Kenya is the leading markets in Africa for solar electrification[64], and a key World Bank-funded project in Kenya is the Kenya Off-Grid Solar Access Project (K-OSAP).[65] This project was started in 2017 and focuses on generating access to electricity for 14 key communities in Kenya without grid connection. The project will serve about 1.3 million people in 277,000 communities.[66] Each mini-grid would supply 100-700 prospective users, and about 20-300kW of electricity.[67] The World Bank partnered with a solar electrical supply company to draw a combination of private and public investors for the project.[68] Implementation is ongoing.

Investor Concerns

Smaller, off-grid renewable energy projects entail a lot less complexity and more cooperation with local communities than their-large, on-grid counterparts, which can have

[64] Natascha Wagner, Matthias Rieger, Arjun S. Bedi, Jurgen Vermeulen, Binyam Afewerk Demena, "The impact of off-grid solar home systems in Kenya on energy consumption and expenditures," *Energy Economics*, 99, 2021, https://doi.org/10.1016/j.eneco.2021.105314. (https://www.sciencedirect.com/science/article/pii/S0140988321002206)

[65] World Bank, "Kenya Off-Grid Solar Access Project."

[66] World Bank, "World Bank Approves $150 million for Kenya to Provide Solar to Underserved Northeastern Counties," *World Bank Press Release* (July 26, 2017) https://www.worldbank.org/en/news/press-release/2017/07/26/world-bank-approves-150-million-for-kenya-to-provide-solar-energy-in-underserved-northeastern-counties

[67] World Bank, "Kenya Off-Grid Solar Access Project."

[68] World Bank, "World Bank Approves $150 million for Kenya to Provide Solar to Underserved Northeastern Counties."

numerous benefits for investors. These include cheaper and easier installation and maintenance, government support in payment, and ensured consumers.

The technology of small off-grid solar projects is significantly less costly, less difficult to transport, and less difficult to implement than large-scale on grid projects. Building solar mini-grids is significantly cheaper than extending the grid to many rural communities. The estimated per capita cost of grid extension to rural communities in Africa is US$487.7, whereas the per capita cost of off-grid installation is US$92.3.[69] Materials are also much more transportable and do not require the construction of roads or other jobs.

Small-scale off-grid projects are also far more likely to secure new consumers who are willing to pay for energy, as opposed to consumers who are already connected to electricity. This project has assured consumers who will pay the cost of electricity production, which was the missing piece that led numerous investors to fall through on the Lake Turkana Wind project. The requirement of in-depth interviews before and during the course of the project with community members who would be housing the solar products ensured to investors that electricity users were interested and willing to pay the fee, which thus ensure the return on investment.[70]

In addition, the government was willing to subsidize the tariffs in order to ensure uptake of the project in the generally poor, rural areas.[71] Thus, though the targeted electricity

[69] Natascha Wagner, Matthias Rieger, Arjun S. Bedi, Jurgen Vermeulen, Binyam Afewerk Demena, "The impact of off-grid solar home systems in Kenya on energy consumption and expenditures."

[70] World Bank, "Kenya Off-Grid Solar Access Project."

[71] Joshua Mugisha, Mike Arasa Ratemo, Bienvenu Christian Bunani Keza, Hayriye Kahveci,

users are poorer than city-dwellers who would be connected to the grid, their willingness and ability to pay the electricity prices will actually be better ascertained than for a large-scale on-grid project. These small, off-grid projects have much less potential for unforeseen complications and increased costs, but a better assurance of community and government support, which increases the likelihood of stable returns.

Community Concerns

Off-grid, small-scale projects have numerous clear benefits for communities, including real increases in electricity access, community compliance, and other external social and health benefits. In off-grid or mini-grid projects, communities that house the projects actually have access to the generated electricity. The World Bank projects were focused on rural communities in Kenya who would not otherwise have access to electricity: the 14 key counties of Garissa, Isiolo, Kilifi, Kwale, Lamu, Mandera, Marsabit, Narok, Samburu, Taita Taveta, Tana River, Turkana, Wajir and West Pokot. Together, these counties consisted of at least 1.2 million households without access to electricity. Thus, the communities that the project was being built in would actually benefit from the resulting generation of electricity, rather than being displaced for the purposes of a project that would serve consumers who already had grid connection.

Smaller off-grid projects have the potential to be much more effective in securing community compliance and preventing unrest, because the project must be definition be built in collaboration with the community. In the solar project in Kenya, The World Bank was

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"Assessing the opportunities and challenges facing the development of off-grid solar systems in Eastern Africa: The cases of Kenya, Ethiopia, and Rwanda"

required to engage in thorough interviews with stakeholders before and throughout the course of the project, because they needed the compliance of the individuals and communities whose homes the solar technology would be placed in.[72] These interviews were thus fundamentally different from those conducted for the Turkana project, because they required ongoing cooperation with communities, not just preliminary information about possible concerns. This ensured that communities were involved in the process of electrical implementation, and so not only gained access to electricity, but did it on their terms. These off-grid solar projects, thus far, show high rates of community satisfaction and cooperation.[73]

These smaller off-grid projects also have both direct and indirect social benefits for the work and livelihoods of the communities they serve. These benefits are built into the community-focused framework for developing off-grid projects in community members' homes. This is demonstrated through numerous community benefits stemming from this off-grid solar project. Directly, as part of the project's continued upkeep and integration with the community, the World Bank supported hands-on system upkeep training for local technicians and produced practical handbooks on system upkeep to be distributed to villages.[74]

Indirectly, evidence shows increased access to information technology, such as TV, radio, and other technologies that improve education and social connection in these

[72] World Bank, "Kenya Off-Grid Solar Access Project."

[73] Natascha Wagner, Matthias Rieger, Arjun S. Bedi, Jurgen Vermeulen, Binyam Afewerk Demena, "The impact of off-grid solar home systems in Kenya on energy consumption and expenditures."

[74] Joshua Mugisha, Mike Arasa Ratemo, Bienvenu Christian Bunani Keza, Hayriye Kahveci, Assessing the opportunities and challenges facing the development of off-grid solar systems in Eastern Africa: The cases of Kenya, Ethiopia, and Rwanda."

communities.[75] Case studies from Kenya also show that access to off-grid solar allows provides communities with business opportunities. For example, some businesses' productivity doubles or triples when they are able to use electrical tools or equipment due to off-grid solar. When rural agricultural and fishing companies have access to off-grid solar, they are able to refrigerate their products and increase their shelf life.[76] Thus, these projects can uniquely facilitate business opportunities and economic growth in rural areas.

There are also numerous air-quality and health benefits that accrue from these off-grid solar projects. The off-grid solar projects are able to replace unclean coal and solar burning in Kenyan households, which decreases pollutants and toxic materials inhaled by consumers. One study found that households in Kenya that implemented off-grid solar had a liter monthly decrease in kerosene use, which lead to 37 kg carbon dioxide equivalent greenhouse gasses per year.[77] In addition, the solar projects offer a cheaper source of electricity for hospitals and clinics than the generators that are currently used.[78] Overall, smaller-off grid projects are built upon cooperation with local communities, and connectedly end-up better increasing these communities' energy security, as well as giving them numerous associated benefits.

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[75] Ibid

[76] Ibid.

[77] Natascha Wagner, Matthias Rieger, Arjun S. Bedi, Jurgen Vermeulen, Binyam Afewerk Demena, "The impact of off-grid solar home systems in Kenya on energy consumption and expenditures,"

[78] Joshua Mugisha, Mike Arasa Ratemo, Bienvenu Christian Bunani Keza, Hayriye Kahveci, Assessing the opportunities and challenges facing the development of off-grid solar systems in Eastern Africa: The cases of Kenya, Ethiopia, and Rwanda."

Conclusions

These two case studies in Kenya are exemplary of the two key types of renewable energy projects that are pursued in these developing countries. In-depth analysis of outcomes for both investors and local communities reveals that, though off-grid solutions are not perfect, they can often secure better outcomes for investors and communities because they require increased stakeholder involvement and prove to be a cheaper way of increasing energy access than expanding the grid. This leads to some key broader observations.

One is that large-scale on grid solar projects should not always be consider be considered the default or best option for renewable energy projects in developing countries. Investors often prioritize large-scale on-grid projects, despite evidence that they may not always be the best option.[79] This is especially important to consider because these two types of investments may be mutually exclusive. Case studies from Bangladesh and Indonesia show that rural communities throughout the developing world may often reject off-grid projects because they believe that agreeing to such a project may prevent them from receiving grid access.[8081]

Large-scale projects like the wind farm in Kenya get a lot of press coverage and incentivize communities to wait from grid connection. However, these projects often face difficulties or do not end up being connected to rural communities, and so waiting ends up failing the

[79] Ibid.

[80] Damian Miller and Chris Hope, "Learning to Lend for Off-Grid Solar Power: Policy Lessons from World Bank Loans to India, Indonesia, and Sri Lanka." *Energy Policy* 28, 2 (2000): 87–105. doi:10.1016/S0301-4215(99)00071-3.

[81] Laura Hellqvist & Harald Heubaum, "Setting the sun on off-grid solar?: policy lessons from the Bangladesh solar home systems (SHS) programme," *Climate Policy*, (2022) DOI: 10.1080/14693062.2022.2056118

communities. Even if the project is effective, its connection to rural communities may not be reliable, and so off-grid solar would still make a goof backup option.[82] This trade-off in consumer willingness to accept projects should be considered by investors, and the potential that the good of an off-grid project may outweigh that of a large-on scale project should not be discounted.

So, many of the key cost and effectiveness benefits of off-grid projects highlighted by the case studies in this paper should seriously be considered by investors looking to put money into renewable energy projects. On-grid projects likely will not fail in every instance, and their scale can certainly lead to certain benefits, but a current investing culture that prioritizes them should be reconsidered. Large-scale projects should certainly not always be considered the default or preferred investment option. Country and stakeholder context should always be taken into account. When the specific context is taken into account, off-grid projects can often be the best option.

Next, stakeholder involvement is key to ensuring that communities receive the most possible benefits, but also ensure that investors have guaranteed consumers who will ensure returns on projects. Numerous research studies have predicted that this stakeholder involvement is key to producing better investments[83][84][85], and recommend specific questions

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[82] Miller, Damian, and Chris Hope. "Learning to Lend for Off-Grid Solar Power: Policy Lessons from World Bank Loans to India, Indonesia, and Sri Lanka."

[83] J.P Painuly, "Barriers to renewable energy penetration; a framework for analysis."

[84] Eric Martinot, "Renewable energy investment by the World Bank."

[85] Kyeongseok Kim, Hyoungbae Park, Hyoungkwan Kim,"Real options analysis for renewable energy investment decisions in developing countries."

that should be asked in ongoing interviews. Off-grid solar projects must be implemented into individual homes and communities, and thus require both initial and ongoing understanding, consent, and cooperation from local communities. These requirements ensure that investors communicate with consumers thoroughly and regularly. Thus, consumers feel understood and also have their needs met, while investors are guaranteed consumers that will pay for their product. This type of stakeholder involvement would be beneficial for any renewable energy project, but because it is required for off-grid solar projects, that project format seems to have more successful outcomes. This does not mean that off-grid projects are best in every instance, but that they should be strongly considered by investors. On-grid, large-scale projects could also benefit from this stakeholder engagement, even if it is not technically required for project implementation.

The World Bank has had some proven success with off-grid projects in Asia[86] that could be replicated on a larger scale in Africa. The K-SOP project In Kenya proves the model can be effective on a smaller scale, and could potentially increase in size to great effect. Investors should thus more thoughtfully consider off-grid solar projects as an alternative to large-scale on grid projects as investment opportunities, or at least consider a framework for increased stakeholder engagement for large-scale on-grid projects.

This piece contributes an in-depth comparative analysis between the two key types of renewable energy projects that foreign investors often focus on in developing countries: on-grid and off-grid investments. This project is unique in its focus on successful outcomes for both

[86] Miller, Damian, and Chris Hope. "Learning to Lend for Off-Grid Solar Power: Policy Lessons from World Bank Loans to India, Indonesia, and Sri Lanka."

foreign investors and communities surrounding these projects, as well as the connections between the two. This project was limited in that it only addressed two case studies, both within the same country, and that its evaluation was strictly qualitative. Development of more broad studies including more varied projects and a more specific quantitative framework for comparison could serve to determine still better insights into how to promote the joint success of both investors and communities in foreign investments in renewable energy projects in developing countries.

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