

## COP27 POLICY BRIEF SERIES

# Integrated Energy Planning to End the Energy–Poverty Nexus

Clark A. Miller <sup>1,\*</sup>, Saurabh Biswas <sup>2</sup>, Wilbourne Showers<sup>3</sup>, Nalini Chhetri<sup>4</sup>, Netra Chhetri <sup>5</sup>, and BrieAnne Davis<sup>6</sup>

## Summary

Ending the nexus between energy and poverty is a critical priority for advancing just energy transitions and meeting many of the UN Sustainable Development Goals. To achieve these goals, integrated energy planning needs to attend to: (a) how energy users will use energy productively or to create tangible value; (b) the knowledge, skills, and

equipment to use energy effectively; and (c) the net value created through energy use, including benefits, costs, risks, and burdens. In this way, energy investments and projects can be designed in ways that result in high levels of societal benefit, contribute to economic growth and sustainable development, and are bankable to investors and sustainable over the long-term.

## Key Policy Recommendations

- Routinely monitor the ability of energy users to create value through energy use and the net value created after accounting for costs.
- Recognize that energy users, their uses of energy, and their contributions to economic development are diverse.
- Integrate energy development into broader planning for economic development, linking efforts to advance SDG7 initiatives to improve other SDGs.
- Ensure access to a diverse array of high-quality electrical appliances that contribute to the productive use of energy and other tangible value creation.
- Develop programmes to expand the imagination of, learning about, and opportunities for revenue-generating electricity use among users.
- Integrate the net social value of energy into assessments of the bankability of energy projects to enhance the likelihood of communities benefiting from energy investments.

# The Energy-Poverty Nexus

This study examines the conditions under which energy investments fail to lead to economic growth and sustainable development for low-income communities and how and why such failures occur. Based on results from Sierra Leone, the study demonstrates that – in order to achieve positive outcomes – energy investments need to overcome the energy-poverty nexus in communities by generating net positive social value for energy users. Policy recommendations are offered for addressing this challenge.

Ending the energy-poverty nexus is critical for advancing just energy transitions and meeting UN Sustainable Development Goals [1]. The energy-poverty nexus results from complex negative feedback relationships that occur between energy insecurity and economic insecurity. This reduces human capacities and perpetuates and even exacerbates poverty and inequality [2]. This issue is

more than just energy poverty or lack of access to energy, and ultimately undermines the ability of people to transform energy into human wellbeing and economic prosperity.

Households and businesses in low-income communities typically pay much higher fractions of their income for energy. This burdens their finances and reduces their ability to invest in contributors to sustainable development, such as education, health, and gender equality. Lower disposable income means they cannot afford high-quality, energy-efficient equipment to ease energy burdens. With low-quality appliances, they consume more energy to get the same level of service, as well as facing higher repair rates and costs. Disempowered politically, these households and businesses also often suffer from lower public investment in infrastructure and thus receive fewer and lower quality energy services. The resulting cycle of impoverishment and energy injustice significantly degrades prospects for economic growth.

*“Disproportionately high energy costs and energy insecurity severely constrain economic growth and sustainable development in Sierra Leone and low-income communities around the world.”*



PHOTO: CLARK A. MILLER, ARIZONA STATE UNIVERSITY

# Integrated Energy Planning

Energy planning often erroneously assumes that access to energy will automatically catalyse economic growth and sustainable development [3]. Unfortunately, our research in Sierra Leone, Nepal, the Philippines, and Puerto Rico suggests that the energy-poverty nexus gets in the way [4].

This research involves multiple methods, including comparative studies of urban and rural communities using household surveys in a number of countries, ethnographic research, and engagement with communities, energy companies designing community projects, and non-profit organizations.<sup>1</sup> We find that ending the energy-poverty nexus demands integrated energy planning that extends beyond energy technologies, power plants, and electricity grids [5]. Also crucial is attention to: (a) how energy users will use energy productively or create tangible value; (b) the knowledge, skills, and equipment to use energy effectively; and (c) the net value created through energy use, including benefits, costs, risks, and burdens. One approach is to coordinate improvements across multiple Sustainable Development Goals by fully integrating effective strategies to enhance food security, improve health, or promote decent work and local economic growth with clean energy technology planning and financing [6].

We approach integrated energy planning in terms of a multi-level framework [1], including:

1. **Energy use for social and economic value creation** – what uses of energy translate into value for households, businesses, or communities?
2. **Socially and economically valuable energy services** – what energy services are required to produce that value?
3. **Sociotechnical systems design** – what arrangement of technologies, knowledge, and skills are required to use energy in

valuable and productive ways?

4. **Enterprises and work** – what forms of organization and labour are required to imagine, design, build, operate, and maintain sociotechnical systems?
5. **Ownership and finance** – how do financial resources flow in and through energy systems, to and from whom, and with what impacts on financial security?
6. **Policy** – what policies create and sustain value-generating energy systems?
7. **Innovation ecosystem** – what actors, relationships, and supply chains are required to foster innovative energy ecosystems that generate value for households, businesses, and communities?

## The Social Value of Energy

At the core of our approach is a straightforward but crucial idea: **energy has net positive social value when its use generates more value than the net cost for the user** [7], including both financial expenses and non-financial costs and burdens. Think about energy use like a small business: if revenue is routinely greater than costs, then business grows, allowing investment in new opportunities. So, too, for users of energy who routinely generate greater value from energy use than costs. If value creation exceeds the cost of energy, over time, then families can use the proceeds to invest in diverse improvements to their capabilities, and

<sup>1</sup> In Sierra Leone, we interviewed hundreds of households across the cities of Freetown, Bo, and Kenema as well as in a smaller, rural community. We also held focus groups in dozens of settings where public and private services were being delivered. In other countries, the authors spent months working closely in day-to-day operations with small private and non-profit renewable energy project developers understanding their practices and holding conversations with the communities where they are building projects.

by extension economic growth. For instance, in subsistence agriculture, the productive use of energy to pump water for irrigation can result in higher crop production, potentially for sale in local food markets for additional income.

Unfortunately, in far too many communities, the net social value of energy is broadly negative. In Sierra Leone, for example, we measured net negative social value from electricity use for the majority of households in four different communities: the capital, Freetown; other cities connected to the national electricity grid, Bo and Kenema; and rural Segbwema, served by a solar microgrid [8–10].<sup>2</sup> This means that, on average, in these cases the use of electricity is draining more financial resources from households and businesses than any new value they are able to create from energy use. For a small business, this would mean contraction and, ultimately, bankruptcy. Not surprisingly, we also find very low levels of electricity use,

signalling that users understand the bind that they are in and constrain their electricity use to avoid high energy bills. This means that they are unable to use energy productively, and so they lose the value that might be created. We also find few high-quality electrical appliances, high levels of appliance repairs and repair costs, frequent electricity outages and high levels of voltage and frequency fluctuation, high costs of backup electricity supply, and similar evidence of an active and detrimental energy-poverty nexus in Sierra Leone.

<sup>2</sup> The communities in our study had been connected to electricity for various lengths of time and with varying degrees of reliability. Within each community, both parameters also varied across individual households and businesses. Our surveys did not ask how long each household or business had possessed an electricity connection. Our focus was on measuring the net social value of energy for the household. Measuring trajectories in the value creation for households and businesses from electricity use over time would be a useful follow-up study.

*“Energy has net positive social value when its use generates more value than the net cost for the user”*



PHOTO: CLARK A. MILLER, ARIZONA STATE UNIVERSITY

Put simply, disproportionately high energy costs, aggregate energy burdens, and a plethora of energy insecurities are key factors that severely constrain the potential for economic growth and sustainable development in Sierra Leone – and, by extension, based on our work in other countries [11], risk doing so in other low-income communities around the world.

## Policy Recommendations

To address these challenges, we recommend national and international energy institutions looking to increase access to electricity in low-income communities adopt a number of new practices for integrated energy planning:

1. **Routinely monitor the ability of energy users to create social value through energy use, as well as the net social value of energy** – doing so will not only provide evidence of the success or failure of energy projects but also allow for appropriate tailoring and targeting of energy tariffs, subsidies, investments, and policies, and even the redesigning of energy projects from users' perspectives.
2. **Recognize that energy users, their uses of energy, and their contributions to economic development are diverse** – standardized approaches to energy supply provision and pricing often fail to serve all users well, and can even negatively impact some users, which can both exacerbate poverty and constrain the potential for energy-led economic growth. Adaptability to diverse energy users is key to expanding growth from energy investments.
3. **Integrate energy development into broader planning for economic development** – to ensure that investments in and planning for energy projects are matched by parallel investments in and planning for the other elements required for improved Sustainable Development Goal (SDG) outcomes.
4. **Ensure access for small businesses and the informal economy to high-quality electrical appliances via targeted programmes, markets, standards, financing, and education** – especially for productive uses of energy and energy consumption that creates tangible economic and social value.
5. **Develop programmes to expand the imagination of, learning about, and opportunities for revenue-generating electricity use among users** – e.g., by engaging businesses and households in plans to stimulate innovation, entrepreneurship, value-added agriculture, and small business development.
6. **Link SDG7 explicitly to other SDGs** – access to clean energy technologies is not only meaningless for low-income communities; absent the ability to use energy in productive and valuable ways, it can be detrimental to economic security. Integrating energy projects into initiatives to achieve improved diverse societal and economic outcomes not only guarantees more sustained attention to ensure high-value energy use, it also raises the likelihood of achieving net positive social value of energy.
7. **Integrate the net social value of energy into assessments of the bankability of energy projects** – Net positive social value of energy at a community level reduces uncertainty in project revenue generation and thus allows for more realistic planning, tailored engagement with users, and enhanced investor returns.

# References

- [1] Miller, C., Moore, N., Altamirano-Allende, C., Irshad, N., & Biswas, S. *Poverty Eradication through Energy Innovation: A Multi-Level Design Framework for Social Value Creation*. Tempe: Arizona State University (2018). [https://ifis.asu.edu/sites/default/files/general/miller\\_et\\_al\\_2018\\_asu-ae4h\\_poverty\\_eradication\\_through\\_energy\\_innovation.pdf](https://ifis.asu.edu/sites/default/files/general/miller_et_al_2018_asu-ae4h_poverty_eradication_through_energy_innovation.pdf) [Accessed June 23, 2022.]
- [2] Biswas, S. *Creating Social Value of Energy at the Grassroots: Investigating the Energy-Poverty Nexus and Co-producing Solutions for Energy Thriving*. PhD Thesis. Arizona State University (2020). <https://www.proquest.com/docview/2445296818?pq-origsite=gscholar&fromopenview=true> [Accessed June 23, 2022.]
- [3] Energy and Economic Growth (EEG). EEG Energy Insight, “Does Energy Access Promote Economic Growth?” (2022). <https://www.energyeconomicgrowth.org/publication/eeg-energy-insight-does-energy-access-promote-economic-growth> [Accessed June 23, 2022.]
- [4] Biswas, S., Richter, J., Miller, C., Altamirano Allende, C., Parmentier, M., Chhetri, N., Chhetri, N., Dreyer, S., and François, D. “Eradicating Poverty through Energy Innovation: Co-Producing People-Centered Energy Transitions through Praxis at the Grassroots,” 25th International Sustainable Development Research Conference (2019). [https://www.researchgate.net/profile/Saurabh-Biswas-4/publication/349064079\\_Eradicating\\_Poverty\\_through\\_Energy\\_Innovation\\_Co-Producing\\_People\\_Centered\\_Energy\\_Transitions\\_Through\\_Praxis\\_at\\_the\\_Grassroots/links/601db59ea6fdcc37a8062e93/Eradicating-Poverty-through-Energy-Innovation-Co-Producing-People-Centered-Energy-Transitions-Through-Praxis-at-the-Grassroots.pdf](https://www.researchgate.net/profile/Saurabh-Biswas-4/publication/349064079_Eradicating_Poverty_through_Energy_Innovation_Co-Producing_People_Centered_Energy_Transitions_Through_Praxis_at_the_Grassroots/links/601db59ea6fdcc37a8062e93/Eradicating-Poverty-through-Energy-Innovation-Co-Producing-People-Centered-Energy-Transitions-Through-Praxis-at-the-Grassroots.pdf)
- [5] Energy and Economic Growth (EEG). Interview with Clark Miller (2021). <https://www.energyeconomicgrowth.org/index.php/blog/interview-clark-miller> [Accessed June 23, 2022.]
- [6] Biswas, S., François, D., Miller, C., Parmentier, M., Chhetri, N., and Pogonietz, W.R., Eds. *Let communities lead: Stories and lessons on grassroots energy initiatives for sustainable futures*. Tempe: Center for Energy and Society, Arizona State University. (2021). [https://www.researchgate.net/publication/356646841\\_Let\\_Communities\\_Lead\\_Stories\\_and\\_lessons\\_on\\_grassroots\\_energy\\_initiatives\\_for\\_sustainable\\_futures](https://www.researchgate.net/publication/356646841_Let_Communities_Lead_Stories_and_lessons_on_grassroots_energy_initiatives_for_sustainable_futures) [Accessed June 23, 2022].
- [7] Miller, C. A., Altamirano-Allende, C., Johnson, N., & Agyemang, M. (2015). The social value of mid-scale energy in Africa: Redefining value and redesigning energy to reduce poverty. *Energy Research & Social Science*, 5, 67-69. [https://www.sciencedirect.com/science/article/abs/pii/S2214629614001479?casa\\_token=DpT9x-OQnLOAAAAA](https://www.sciencedirect.com/science/article/abs/pii/S2214629614001479?casa_token=DpT9x-OQnLOAAAAA) [Accessed June 23, 2022].
- [8] Miller, C., Biswas, S., Showers, W., Davis, B., Chhetri, N., Chhetri, N., Parmentier, M. J., and Lansana, F. (2022) *Enhancing the Social and Economic Impacts of Energy Investments through the Use of Energy to Create Value: Final Synthesis Report of Research*. Tempe: ASU School for the Future of Innovation in Society. <https://osf.io/6k4mg> [Accessed July 31, 2022].
- [9] Miller, C., Biswas, S., Showers, W., Davis, B., Chhetri, N., Chhetri, N., Parmentier, M. J., and Lansana, F. (2022) *Enhancing the Social and Economic Impacts of Energy Investments through the Use of Energy to Create Value: Findings and Data*. Tempe: ASU School for the Future of Innovation in Society. <https://osf.io/ngp8c> [Accessed July 31, 2022].
- [10] Miller, C., Biswas, S., Showers, W., Davis, B., Chhetri, N., Chhetri, N., Parmentier, M. J., and Lansana, F. (2022) *Enhancing the Social and Economic Impacts of Energy Investments through the Use of Energy to Create Value: Data Collection Methodology*. Tempe: ASU School for the Future of Innovation in Society. <https://osf.io/crbmf> [Accessed July 31, 2022].
- [11] Biswas, S., A. Echevarria, N. Irshad, Y. Rivera-Matos, M. Parmentier, N. Chhetri, and C. Miller, “Ending the Energy-Poverty Nexus: An Ethical Imperative for Just Transitions,” *Science and Engineering Ethics*. Published Online: August 10, 2022. <https://link.springer.com/article/10.1007/s11948-022-00383-4> [Accessed Sept. 1, 2022].

## ACKNOWLEDGEMENTS:

This research was conducted under the Energy and Economic Growth Applied Research Programme, funded by UK AID, and managed by Oxford Policy Management.

Dr Stephanie Hirmer (Oxford University) and Prof. Jim Watson (University College London) have led the curation of this policy brief series. The policy briefs underwent an anonymous (double blind) peer-review process. They were edited by Simon Patterson (Loughborough University) and designed by Sarel Greyling (Sarel Greyling Creative).

This material has been produced under the Climate Compatible Growth (CCG) programme, which brings together leading research organizations and is led out of the STEER centre, Loughborough University. CCG is funded by UK aid from the UK government. However, the views expressed herein do not necessarily reflect the UK government's official policies.



## AUTHOR INFORMATION:

<sup>1</sup>**Clark A. Miller** (Arizona State University): Writing, Conceptualization, Supervision

<sup>2</sup>**Saurabh Biswas** (Arizona State University): Conceptualization, Methodology, Investigation, Formal Analysis

<sup>3</sup>**Wilbourne Showers** (Centre for Economic Research and Capacity Building): Investigation

<sup>4</sup>**Nalini Chhetri** (Arizona State University): Conceptualization, Methodology, Investigation

<sup>5</sup>**Netra Chhetri** (Arizona State University): Conceptualization, Supervision

<sup>6</sup>**BrieAnne Davis** (Arizona State University): Formal Analysis

\*Corresponding Author: [clark.miller@asu.edu](mailto:clark.miller@asu.edu)



**CITATION:** Miller, C.A., Biswas, S., Showers, W., Chhetri, N., Chhetri, N., and Davis, B. (2022). Integrated Energy Planning to End the Energy–Poverty Nexus. Climate Compatible Growth Programme COP27 Policy Brief Series (Version 1). Available at: <https://doi.org/10.5281/zenodo.7107859>.

The views expressed in this material do not necessarily reflect the UK government's official policies.