Promoting Sustainable Energy Development through Access, Renewables and Efficient Technologies: An Evidence Gap Map

EGM Brief – May 2024

CURRENT PROGRESS TOWARDS SDG7

Sustainable Development Goal 7 (SDG7) aims to ensure sustainable energy for all through universal access to energy and clean cooking, the adoption of renewables and an increase in energy efficiency. Halfway through the implementation of the SDGs, progress towards this goal is mixed. The share of populations with access to electricity in low- and middle-income countries (L&MICs) has risen 10% in the past decade. Yet this progress has been concentrated in select countries with a focus on urban areas, with 72% of the world's rural poor still without access to electricity, most of which reside in Sub-Saharan Africa. Progress has also been partly eroded due to global trends in energy pricing as a result of the COVID-19 pandemic and the Ukraine-Russia conflict. Where electricity has been provided, this does not equate to the use of renewables, with non-renewable energy sources making up much of the electricity supply.

DEVELOPMENT OF THIS EGM

Alongside the mixed progress towards SDG 7, SEforALL had identified a need for a resource that could provide the sector with the latest rigorous evidence on the causal effects of sustainable energy interventions on environmental and social outcomes. In turn, while 3ie had previously worked on specific areas of energy access and efficiency, they recognised the need to explore the sector more comprehensively due to its increasing importance for development.

To ensure that efforts to promote sustainable energy are able to utilise the most rigorous and updated evidence available, this project, tendered by SEforALL and co-funded by SEforALL and 3ie, is the first to systematically search for, screen and populate an Evidence Gap Map (EGM) on sustainable energy.

Our EGM is a global public good that provides researchers and policymakers with easy and quick access to the rigorous evidence base on the effects of sustainable energy interventions in L&MICs. With the large costs associated with conducting impact evaluations and other forms of research, EGMs can save time, effort and resources by reducing research duplication and providing examples of how interventions and study designs have been utilised in the field. With this evidence base and the key findings presented in this brief, the limited resources available to address SDG 7 can be used more cost-effectively. EGMs can also help guide evidence-informed policymaking by highlighting where evidence exists and where gaps may be filled through future research and evaluation investments.

THE EGM FRAMEWORK

The interventions and outcomes framework for this EGM was developed based on consultations with SEforALL, sector experts and 3ie's previous synthesis work on energy access and efficiency. The interventions and outcomes selected cover a set of activities and goals that align with the three outcome targets of SDG 7: access, efficiency and renewable energy. Interventions were divided into four domains: legal and regulatory framework and policies; financial incentives and market enabling activities; electrification and energy infrastructure; and information and capacity development. This way, the categorisation of each intervention is based on the mechanism to improve sustainable energy, which could cover one or all outcome targets of SDG 7. The outcomes of interest were grouped into three domains: intermediate/behaviour change outcomes; energy and environmental outcomes; and socio-economic and community welfare outcomes.

SEARCH PROCESS AND RESULTS

In July 2023, we systematically searched 22 academic databases and 29 grey literature sources, including websites from specialist organisations and research repositories in international development. We supplemented the search by tracking the citations of included studies during September 2023. From the search, we identified a total of 144,393 records. We removed duplicates and screened these records based first on their title and abstract and then their full text. We ultimately included a total of 703 studies in the map: 668 impact evaluations (IEs) and 35 systematic reviews (SRs).

The online map can be accessed here.

CHARACTERISTICS OF THE EVIDENCE BASE AND IMPACT EVALUATIONS

The evidence base on sustainable energy has grown rapidly, with nearly half of the studies having been published in the past three years (2021–2023). In terms of SDG 7's outcome targets, access, efficiency and renewable energy, were evaluated in near equal numbers of evaluations, with interventions often covering more than one target at once.

The body of evidence is also concentrated around four intervention categories: *sustainable upgrades*; *other energy regulations and policies*; *subsidies and other transfers*; and *on-grid systems*. We were unable to identify any IEs on *insurance and other risk guarantee instruments*; *push and pull finance*; and *advocacy and diplomacy interventions*. The evidence on outcomes was also concentrated around a few groups, with three-quarters of IEs reporting at least one outcome measure on: energy net savings or consumption; *income, savings and expenditures*; *health status, comfort and wellbeing*; *energy security*; and *air quality/pollution*.

The evidence base is geographically skewed: nearly half of the IEs evaluated an intervention conducted in China or India. In terms of the regional evidence, East Asia and the Pacific is the largest, followed by Sub-Saharan Africa, South Asia and Latin America and the Caribbean, respectively. Europe and Central Asia and the Middle East and North Africa were the only regions with fewer than 20 IEs. We were also unable to identify studies for the countries with the most pressing electrification needs: in Burundi, Central African Republic, Chad, Democratic Republic of Congo, Malawi and South Sudan, fewer than 20% of people have access to electricity, yet we did not find evidence on on-grid electrification or off-grid electrification interventions for these countries.

Within *sustainable upgrades*, the largest intervention category in the map, over 100 IEs evaluated the effects of improved cookstoves. This makes cookstoves the most evaluated technology, and clean cooking the most common energy use among IEs. Though only one-third of IEs reported the energy source used by the intervention, modern renewables were the most common source. Solar energy was used in over half of all studies which focused on a modern renewable source.

We identified a variety of study designs across IEs, dominated by fixed effects estimations (including difference-in-difference designs) and randomised controlled trials.

WHAT CAN WE LEARN FROM SYSTEMATIC REVIEWS?

We critically appraised the 35 reviews in the map against international standards for conducting and reporting SRs. Eight were appraised as having high or medium confidence. These SRs evaluated *electricity sector reforms*, access to *on-grid electrification*, and mostly *sustainable upgrades* and the use of improved cookstoves. The eight SRs provide the following conclusions. However, readers are encouraged to explore the original reviews for details on their methods and findings. They should be mindful of the caveat that, in some cases, evidence from the SRs was insufficient to draw strong policy conclusions.

Energy management reforms: There is not enough evidence to conclude that market-based electricity sector reforms are effective on electrification rates and other intermediate indicators of these reforms' causal chain. Indicators of supply and investment may be an exception, which showed some positive effects across studies with either a global focus or a particular focus on Latin America.

On-grid systems: Top-down interventions do not generally improve access to electricity in informal settlements across L&MICs. Community participation, tenure security and political commitment may be relevant factors that could improve service delivery across L&MIC contexts.

Sustainable upgrades: Interventions aimed at improving household indoor air quality and health, mostly improved cookstoves, can: (i) reduce particulate matter and carbon monoxide concentrations at the individual and kitchen levels; (ii) reduce respiratory and ocular symptoms among women; and (iii) reduce the risk of low birth weight, the incidence of burns in children and acute lower respiratory infections among children living in high-altitude settings in Latin America

USING THE EGM

These findings from SRs form the basis of our recommendations for policymakers when considering designing or implementing interventions on *energy management reforms*, *on-grid systems* or *sustainable upgrades*.

Across the high and medium confidence SRs, there were a number of additional suggestions for future research on sustainable energy:

- Mixed method evaluations in understudied contexts could help untangle answers around context-specific barriers or facilitators to intervention effectiveness
- The incorporation of cost data into evaluations would allow for exploration of cost-effectiveness analysis across studies
- The utilisation of similar key outcome measures would allow for a more comparable evidence base

Based on the IEs identified, we can also highlight a number of priority areas for **future evaluations**:

- Absolute intervention gaps: *insurance and other risk guarantee instruments*, *push and pull finance*, and *advocacy and diplomacy* are the three intervention categories where no rigorous evidence currently exists
- Geographical gaps: This includes countries with low electrification rates for which we identified no electrification evaluations: Burundi, Central African Republic, Chad, Democratic Republic of Congo, Malawi and South Sudan. There are also 101 L&MICs for which we identified no IEs
- Technologies beyond improved cookstoves: This applies to activities where the energy use is not clean cooking, such as those related to health and education

The commissioning of future synthesis work may consider focusing its attention to areas with large numbers of IEs, but no recent high or medium confidence SRs, such as *energy targets and enforcement mechanisms, financial regulations and investments, other energy regulations and policies, subsidies and other transfers*, *energy pricing,* and *off-grid systems.*

Stakeholders are also encouraged to utilise the filters in the online map to interact with the evidence and identify additional gaps in areas of particular interest to them.

Given the large number of evaluations identified in the past three years, maintaining a 'living' EGM where the evidence base is updated periodically is likely to become an asset to help the sector access the most up-to-date resources. In the shorter term, the EGM will immediately be utilised as these results will inform an SR to address questions around the effects of a subset of interventions on specific outcomes of interest. We encourage decision-makers in the energy sector to access, use and disseminate this evidence to inform their next steps.

UPCOMING SYSTEMATIC REVIEW

In tandem with the Evidence Gap Map, SEforALL and 3ie are conducting a Systematic Review to delve deeper into the effectiveness, barriers, and facilitating factors of off-grid interventions designed to increase energy access. This initiative seeks to provide a nuanced understanding of the dynamics shaping off-grid energy access solutions, offering invaluable insights for policymakers and practitioners alike.

Through a rigorous synthesis of existing evidence, the Systematic Review aims to uncover actionable findings that can inform the design and implementation of off-grid energy initiatives going forward. The results of this research will be available in the coming months, serving as a catalyst for dialogue and action within the sustainable energy community.