Poor people's energy outlook 2018

PRACTICAL ACTION
Technology challenging poverty

Poor people's energy outlook 2018

Achieving inclusive energy access at scale

Praise for PPEO 2018

'*PPEO 2018* provides an excellent exploration into what it takes to deliver energy access at scale and inclusively, reflecting an evolving global understanding that is increasingly positioning off-grid solutions as critical to achieving our universal energy access ambitions more quickly, cheaply and sustainably than traditional approaches. Moreover, the report emphasizes how incredibly important gender-sensitive programming is on a number of fronts: indeed, for countries to achieve their objectives around SDG7 and reach those last-mile consumers who have historically been overlooked in energy access programmes, but also quite simply to strengthen women's empowerment, greater gender equality and improved human wellbeing. For these and other reasons, at Solar Sister we welcome the *PPEO 2018* and look forward to future editions of the report.'

Abby Mackey, Grants and Impact Manager, Solar Sister

'Building on *PPEO 2016* and *PPEO 2017, PPEO 2018* offers an excellent commentary on what will be needed to achieve energy access at scale, while also including marginalized people who are often left behind in energy policy, planning and programming. Alongside grid extension and off-grid solutions, it takes a close look at clean cooking fuels and technologies, highlighting the growing demand for alternative fuels, and the affordability gap that continues to stifle access and leave the very poorest even further behind. We welcome that *PPEO 2018* champions women as agents of change, and emphasizes the critical importance of their participation across the value chain in order to reach our global goals.'

Peter George, Director, Enterprise Development and Investment, Clean Cooking Alliance

'We consider Practical Action a reliable and impactful implementing partner within the Energising Development (EnDev) partnership. In this role Practical Action has also proven to be a strong advocate for decentralized energy solutions. EnDev wholeheartedly supports this professional advocacy role by Practical Action in the renewable energy space. The *PPEO* editions have proven to be an excellent means for bringing the need for increased energy access to the attention of a wider audience. We consider the *PPEO 2018* edition on achieving inclusive energy access at scale a useful information tool in our efforts to reach the ambitious SDG7 goals.'

Daniel Busche, Managing Director, Energising Development

'This year, as in previous years, the Poor People's Energy Outlook is critical reading, providing an important perspective on how we can quickly, cleanly and affordably close the energy access gap. By focusing on the most vulnerable, often considered the last mile, first and by being inclusive, especially of women's leadership, the Outlook supports the SEforALL movement to go further, faster together and to make sustainable energy for all a reality in everyone's lives.'

Rachel Kyte, CEO and Special Representative to the UN Secretary-General for Sustainable Energy for All

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About Practical Action

Practical Action is a development charity with a difference. We use technology to challenge poverty by building the capabilities of poor people, improving their access to technical options and knowledge. We work internationally from regional offices in Latin America, Africa, Asia, and the UK. Our vision is for a world where all people have access to the technologies that enable them to meet their basic needs and reach their potential, in a way that safeguards the planet today, and for future generations.
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Foreword

Energy access transforms lives and communities through unlocking not just power, but benefits to health, education levels, water and food security, livelihoods, gender equality and the environment. Accordingly, energy access was included as a UN Sustainable Development Goal (SDG7) and a component of the Paris Agreement on climate change. This growing momentum is critical, considering approximately 3 billion people live with inadequate access to modern, safe, affordable and reliable cooking and electricity services.

Across geographies, interventions linking poverty reduction and sustainable energy have grown exponentially as technologies improve and prices fall. Yet, progress is still slower than required for us to reach universal energy access by 2030. Some countries and especially marginalized communities remain unserved by energy policies, appropriate technologies and delivery models. 'Leaving no one behind' means recognizing that business as usual has ignored billions of the world's poorest citizens, and understanding that amplifying their voices and increasing community participation, bottom-up approaches and local ownership of interventions is critical to achieving truly universal, sustainable energy access.

PPEO 2018 explores this by highlighting the importance of solutions that integrate scale and inclusivity. While large-scale grid extension programmes have helped shift the dial on global figures, for example India's Rajiv Gandhi Grameen Vidyutikaran Yojana which features in this report, questions remain on reliability, affordability, and those still left behind. Decentralized energy access companies are key to addressing these issues, including Ashden Awards winners HuskPower, BURN Manufacturing and Off Grid Electric. Such companies transform lives through energy services for households, productive uses of energy and community services. For this reason and others, Ashden works closely with our award winners to help scale-up their work, including introducing them to finance, sharing their learning with others, and raising awareness of their work with policy-makers to help grow the sector.

Building on *PPEO 2016* (planning) and *PPEO 2017* (financing), *PPEO 2018* emphasizes the need to strike a balance between reaching energy access at scale and in an inclusive way. The report shows a mix of different energy access interventions is needed to achieve SDG7, and encourages holistic programmes to achieve scale across elements of demand, supply, policy and finance. It endorses further investment in decentralized energy access, and a focus on strategies to reach women and the poorest, most remote communities. Ashden has witnessed the importance of these elements over many years, through our award winners' experiences, and we fully support the *PPEO 2018's* call.

If we do not aim for truly universal and sustainable energy access, then we will fail on our promise to the world's poorest and most marginalized. I warmly welcome *PPEO 2018*, which holds this principle at its heart, and encourage readers to incorporate its findings into their work.

Sarah Butler-Sloss
Founder–Director
Ashden

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PPEO 2018 asks what it takes to deliver energy access at scale and inclusive of groups that are particularly vulnerable to energy poverty, including women, poor people and those living in the most remote areas. Our first thanks therefore go to the women and men in Ghana, Kenya, Nepal, South Africa, India and Peru who participated in the *PPEO 2018* research. As well as community members who benefited from the programmes, this includes a range of stakeholders, from national actors to local implementers, who gave valuable insights into the energy access programmes in these countries.

PPEO 2018 would not have been possible without the support of the local consultants who managed and undertook this country-level research. For their contributions we thank Dr Julius Ahiekpor (Executive Director CEESD, Ghana), Jechoniah Kitala (Practical Action Consulting, East Africa) and Gerald Njugi (Kenya), Bipin Basnet (Practical Action Consulting, Nepal), Kimenthrie Pillay (Director, Thrie Energy Collective, South Africa), Sanjit Behera (Practical Action Consulting, India) and Carlos Cervantes (Peru). Recognition is also due to our peer reviewers whose insights and feedback were instrumental in shaping the final report. Thanks go to Professor Vanesa Castan Broto (University of Sheffield), Julia Dowling (former Senior Programme Associate, Clean Cooking Alliance), Abby Mackey (Grants and Impact Manager, Solar Sister) and Eva Lee (Research Manager, Power for All) for their important insights and feedback. Many thanks also go to Edu Willemse (Public Relations Manager, EnDev) and Daniel Busche (Managing Director, EnDev) for their continued support and feedback. Our great appreciation also goes to Christine Eibs Singer (Special Advisor on Energy Access to SEforALL) for her invaluable commentary and contributions to the report.

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Photo captions and credits

Front cover. Remote rural communities like Daniya village in Nepal (Baglung district) demonstrate the scale of the energy access challenge. Such communities are best served by decentralized energy access solutions, including solar home systems and mini-grids. (Credit: Practical Action / Edoardo Santangelo)

Back cover. See credits for Chapters 4 and 8.

Executive summary. Girls living in rural Kenya transport goods while electricity transmission lines run over their heads. (Credit: Practical Action / Edoardo Santangelo)

Chapter 1. Electricity transmission lines run through a rural Kenyan village, while a community member below tends to her livestock. (Credit: Practical Action / Edoardo Santangelo)

Chapter 2. In rural South Africa, a grandmother and her grandson live in extreme poverty with only very basic energy provision. (Credit: Thrie Energy Collective / Kimenthrie Pillay)

Chapter 3. A *PPEO 2018* community focus group takes place in ward no. 3 of Daniya village, Nepal (Baglung district), after dark, with outdoor electric lighting illuminating the discussion. (Credit: Practical Action / Edoardo Santangelo)

Chapter 4. A Gyapa cookstoves entrepreneur in Ghana counts her earnings. (Credit: Gyapa / Relief International Ghana)

Chapter 5. A micro-hydro powerhouse in Kharbang-Baglung district. Nepal's mountainous terrain is ideal for harnessing the power of water. (Credit: Practical Action / Edoardo Santangelo)

Chapter 6. Electricity transmission lines at dusk in rural Peru. (Credit: Practical Action Latin America / Soluciones Prácticas)

Chapter 7. India has seen a huge increase in grid connections in recent years, but marginalized groups are often still overlooked. (Credit: Practical Action / Edoardo Santangelo)

Chapter 8. In Nepal, an electronics shop owner awaits customers in a village powered by a micro-hydro mini-grid. (Credit: Practical Action / Edoardo Santangelo)

Executive summary

Despite global consensus on the critical need for achieving electricity and clean cooking access at scale, a stark lack of understanding remains on robust and adaptable methods for achieving this. There is inadequate understanding about how to include the most marginalized communities: women, the poorest, and people living in the most remote areas, which risks leaving already overlooked populations further behind.

Yet hope is not lost, with examples of at-scale and inclusive energy access programmes having recently emerged. *Poor people's energy outlook 2018* learns from different energy access programmes about experiences of delivering at scale and leaving no one behind. *PPEO 2018* is the third in a suite of three that sets out a roadmap for bottom-up energy access from planning (2016), financing (2017) and delivery (this edition).

In this report we consider six case study programmes across the clean cooking, off-grid electricity and last-mile grid extension sectors, analysing actions taken around policy, finance, supply and demand and outcomes in terms of scale and inclusivity.

Evolution of programme approaches

We review energy access delivery approaches: from government-led approaches (1970s) to energy sector liberalization (1980s), and, more recently, private-sector and market-based interventions. There is an increasing recognition that, while public resources are important in delivering energy access, other sources of finance and expertise will be critical to achieve scale and the inclusion of overlooked groups.

Despite new and promising approaches to energy delivery and increasing enthusiasm around public–private partnerships, universal energy access has remained out of reach. Too often, energy access programmes that achieve scale leave the most marginalized communities behind, while programmes that specifically target such communities have found it difficult to achieve significant scale, at least in the short term.

Our approach

We do not aim to provide a one-size-fits-all route to success

Given this context, in *PPEO 2018* we review different types of programme interventions used to deliver energy access, to share learning with policy-makers, financiers and practitioners. We do not aim to provide a one-size-fits-all route to success, but rather to enable decision-makers to identify the most appropriate combination of actions, based on real-life experiences across a range of contexts and geographies.

To do this, we created a three-part assessment framework. Understanding that external contextual factors play a huge role in programme outcomes, we first considered each programme's local conditions (the 'situation analysis'), then assessed the actions taken within programmes across the dimensions of policy, finance, demand and supply, and finally reviewed programme results against scale and inclusivity objectives. For scale we are interested in the number of people reached as well as the pace of change and the sustainability of outcomes (whether access to energy is sustained over time). While understanding there are many important aspects of inclusion, we focus on gender, poverty and remoteness as key benchmarks.

For the situation analysis and to assess the outcomes (scale and inclusivity), we developed indicators and a scoring system (see http://policy.practicalaction.org/ppeo2018 for the list of indicators). The assessment framework allows us to learn lessons for future interventions, because the approach taken in design, decision-making and implementation is key to programme outcomes.

To gather information for each case study, we collected qualitative and quantitative data from global and national sources, and heard directly from stakeholders from high-level decision-makers to the women and men in rural communities involved in and benefiting from the programme on the ground.

Our case studies

Our case studies represent a diversity of approaches, contexts and geographies

We selected our case studies to represent a diversity of approaches, contexts and geographies. The clean cooking case studies (Chapter 4) are the Ghana clean cookstoves programme (2002–07), which focused on the manufacture and commercialization of improved charcoal cookstoves, and the Kenya Biogas Program (2009–18), a nationwide initiative under the Africa Biogas Partnership Programme aimed at building a commercial biogas sector from a very low starting point.

For decentralized electricity solutions (Chapter 5) we look at mini-grids through the Nepal Rural Energy Development Programme (1996–2011), which delivered

community-managed micro-hydro systems while building a network of supporting suppliers. For stand-alone systems we look at the South Africa solar home systems programme (1999–2018), which adopted a highly subsidized approach delivered through commercial companies.

Lastly, for grid extension (Chapter 6) we investigate the India Rajiv Gandhi Grameen Vidyutikaran Yojana programme (2005–15), which aimed to provide grid connections to all villages and rural households, with free connections for those at the bottom of the pyramid, and the Peru Rural Electrification Project (2006–13), which trialled a more decentralized approach to extending grid electricity access for rural communities. We also highlight seven other programmes aiming at scale and inclusivity, but which we do not assess in the same detail as the six case studies.

Performance in scale and inclusivity

Numbers of households reached and the extent to which this represented 'scale' varied across case studies. The inclusivity of their outcomes also varied; with Ghana and Nepal scoring highest overall. The public-sector led programmes (with the exception of Nepal) needed to improve their inclusivity by focusing intentionally on remote areas and actively addressing gendered needs. They often included mechanisms to target lower income groups, but these needed monitoring to ensure they reached the intended beneficiaries. The Nepal programme's decentralized approach favouring community management and oversight helped ensure benefits were enjoyed by often marginalized people.

In terms of achieving scale, the right balance of activities across the four dimensions of supply, demand, policy and finance will be determined by existing local conditions. Our situation analysis revealed that in most cases there were significant gaps in supply capacity and finance. All the programmes focused the majority of their efforts on boosting supply, while those in Nepal and Peru were arguably the most balanced across all dimensions.

In most cases there were significant gaps in supply and finance

The India and Ghana programmes achieved the greatest scale over similar time periods. The India programme achieved this through a state-led supply push, with questions remaining about quality and sustainability, and the Ghana stoves programme achieved scale through markets-driven growth of the sector. The Kenya biogas programme attempted a similar transformation although with greater challenges of affordability. The South Africa programme under-performed partly by being unable to take advantage of new technology developments, while the Nepal programme achieved good success in its context and has been built on in subsequent years. Although small scale for grid extension, the Peru programme has positive lessons in terms of decentralized decision-making, sustainability and the potential for boosting productive uses of power.

Scale and inclusivity outcomes of selected case studies

	Inclusivity score (%)	*Households served*	*% of target population reached*
Ghana – stoves	60	1,500,000	36.8%
Kenya – biogas	55	17,134	10.0%
Nepal – micro-hydro	79	57,749	4.9%
South Africa – SHSs	53	150,000	7.7%
Odisha, India – grid	36	2,865,036	53.4%
Peru – grid	42	105,048	12.8%

Scale and inclusivity: striking the balance

Despite continued focus on the Sustainable Development Goals, and the joint declaration from the High-level Political Forum 2018 pledging all countries to 'reaching the furthest behind first and ensuring that no one is left behind' (UNESCO, 2018), SDG7 progress remains sluggish. Although we have seen electricity access increase, largely through grid extension programmes, the quality of service can be poor and the hardest to reach are still often overlooked. Finance for and attention to clean cooking remains pitiful, and, while delivering access and impact, the huge potential for off-grid market-based solutions is only beginning to be achieved in a few places.

Achieving SDG7 requires planning and delivery models that integrate grid, off-grid and clean cooking

Striking the balance between achieving energy access at scale and reaching the 'last mile' must be ardently pursued if we are to achieve our global goals on the tight 2030 timeline – and it is this important balance that *PPEO 2018* explores. It will require planning and delivery models that integrate grid, off-grid and clean cooking solutions. Our findings suggest that:

- *Tackling key aspects of inclusivity head on is critical to truly leaving no one behind.* Too often, programmes overlook the most remote areas, the poorest people and the needs of women and girls. Intentionally considering how marginalized populations can be reached from the very beginning of programme design, and tracking and reporting inclusivity in programme metrics is essential. Pro-poor bolt-ons to existing programmes are not the answer.
- *Aiming for scale, while recognizing who is left behind.* We must consider the barriers to scale (in supply, demand, policy and finance) more holistically, which starts with both an assessment of the energy access context, and a better understanding of the energy service needs and priorities of rural communities across their homes, livelihoods and community services.
- *Addressing gender inequality is good for business and people.* Programmes must be designed with components that address barriers to women's participation. Evidence is growing of how this can boost company profits and empower women as active agents of change.
- *Smart use of public funds will be critical to achieving SDG7.* Private-sector companies will inevitably target the most profitable market segments first, which means public finance for well-designed producer and/or consumer subsidies, as well as other incentives and regulations, remain crucial.
- *Embracing multi-stakeholder processes at decentralized levels.* Market activation programmes help to accelerate progress by bringing key stakeholders together, while decentralized decision-making steered by clear policy guidance can help in targeting the poorest people.

Moving the dial on energy access for poor people

PPEO 2018 shows that scale and inclusivity are not mutually exclusive

The *PPEO* series is founded on decades of on-the-ground experience of the transformational power of energy access on people's health, education levels, livelihoods, gender equality and the environment. *PPEO 2018* shows that achieving energy access at scale and inclusively are not mutually exclusive. It will take a mix of different types of energy access interventions to achieve SDG7, and, even though there are challenges ahead, we have the collective knowledge and means to progress scale and inclusivity in parallel, to deliver energy access not just to more people but to all people.

1. Introduction

Three years after signing the 2030 Agenda for Sustainable Development and five years after the formation of SEforALL, we should be witnessing an era of rapid implementation. Yet robust and widely accepted methods for delivering energy access at scale for electricity and clean cooking remain poorly understood, despite global consensus on the urgent need for them. Research into understanding what works (or not) and why in building regional, national or local energy access markets, and reaching those who remain left behind, has been particularly limited.

As a result, save a few exceptions, efforts remain piecemeal and progress is painfully slow in many energy-poor countries. According to the International Energy Agency (IEA), achieving our 2030 energy access goals requires growth 4.5 times higher than the 2012–14 growth rate (IEA and World Bank, 2017). While those without electricity access fell from 1.7 billion in 2000 to 1.1 billion

The world is not on track to achieve universal energy access by 2030

in 2016, the majority of people who remain without access will be more difficult to reach than those already connected; on the current trajectory we will reach only an additional 674 million by 2030 (IEA, 2017a). The situation in access to clean cooking fuels and technologies remains dire, with an unacceptable 2.98 billion people still lacking access (IEA et al., 2018). Projections for 2030 suggest only limited progress will be made, and that 2.3 billion people will still be living without access by the time the SDGs are supposed to have been achieved (UN, 2016; IEA, 2017a).

The world is not on track to achieve universal energy access by 2030, but it does not have to be this way. The purpose of this edition of the *Poor people's energy outlook* is to illustrate how we as a global community can deliver energy access at scale, while leaving no one behind.

Despite the bleak assessment of progress, a range of success stories has indeed emerged to inspire hope. The IEA's 2018 World Energy Access Outlook notes that household electrification in Asia rose from 67 per cent to 89 per cent between 2000 and 2016, and predicts that the region will reach 99 per cent by 2030 (IEA, 2017b). Massive-scale clean cooking programmes have led to rapid shifts from the use of dangerous and rudimentary fuels to cleaner fuels and methods, in highly populated countries such as Indonesia (WLPGA and Pertamina, 2015) and China. While these are largely centrally driven, top-down examples, the off-grid solar lighting sector has seen annual investment double between 2012 and 2017, and 130 million products have been sold since 2010 (Lighting Global and Dalberg Advisors, 2018).

We must apply learning from success stories to more challenging contexts

The key to making faster progress towards our global goals will be to identify the most effective elements of these success stories and learn from, adapt and expand on them in new and much more challenging contexts. In many energy-poor countries, effective regulatory and policy frameworks to support the delivery of energy services are largely absent, and markets for energy services barely exist. This creates a 'chicken and egg' problem. Weak regulatory and policy frameworks deter potential energy service companies and the associated financial organizations from market entry, which means that competition is limited at best or, at worst, energy services are simply not provided. This squanders the potential of a competitive energy services sector to develop a skilled labour force and contribute to economic growth and improved human welfare more generally.

This challenge is exacerbated by the historical focus on the supply side of the energy sector by governments, donors and the private sector. Though we now have good templates for mini-grid regulation and are building robust integrated energy planning tools, knowledge about the factors affecting consumer demand – for example, how to ensure these clean energy solutions are affordable – remains sparse. Attracting energy service companies and financial institutions to the energy access sector depends on a significantly improved understanding of consumer behaviour and needs.

Ending energy stagnation

This edition of the *PPEO* completes a set of three reports that provides a roadmap for transformation of the energy sector to enable it to swiftly, sustainably and affordably meet the energy needs and priorities of poor men and women. Using Practical Action's Total Energy Access framework, *PPEO 2016* highlighted how vastly different the national energy plans of Togo, Kenya and Bangladesh would look if they were based on people's needs rather than pursuing the strategy of

simply expanding existing top-down plans. In the 2017 edition we built on our 2016 findings to show that a national energy mix that is affordable, more appropriate to the needs of the people, and more quickly deployable can be achieved using least cost, pro-poor approaches. *PPEO 2017* also examined the role of finance as an enabler or constraint on progress in energy access. Both editions highlight the need for a gendered approach to energy access planning which meaningfully addresses the different needs and priorities of women and men and promotes actions to dismantle the barriers faced by women.

In this edition, we consider how to achieve energy access at scale in ways which 'leave no one behind'. Our analysis covers three broad categories of intervention: clean cooking fuels and technologies, the off-grid electricity sector, and grid-based, last-mile connections. Focusing on actions for change, we aim to help governments identify the most appropriate and effective combination of actions in their specific context. Our recommendations are based on analysis of six past experiences of delivering energy access at scale. In a rapidly changing sector, we anchor our analysis in the present by also reviewing seven ongoing and promising examples.

PPEO 2018 considers how to achieve energy access at scale in ways which 'leave no one behind'

Our analysis of the scale and inclusivity of past interventions reveals diverse ambitions. At one extreme, programmes that have prioritized large-scale efforts, for example grid extension or clean fuel subsidies, have encountered problems in quality or have not been able to reach the last mile. By contrast, programmes targeting inclusivity have struggled to reach scale. Many NGO-led projects demonstrate excellent inclusion and community engagement, but benefit only a few communities at a time. This pattern has also been identified by a large review of clean cooking programmes (Quinn et al, 2018).

Given our 2030 goals, these results matter: pace is important. We know that standard approaches based on expanding fossil fuel power plants and transmission and distribution networks are slow because the construction process is slow (SEforALL and AfDB, 2017). Meanwhile approaching energy access through decentralized, renewable energy projects could deliver the Energy Access Dividend more quickly (SEforALL and Power for All, 2018).

The sustainability of energy access achievements is important, too, and may be overlooked. Experience suggests that continued access to high-quality modern energy services, for example though mini-grids in Nepal, requires ongoing attention to maintenance and governance. Similarly, there may be a trade-off between rapid grid expansion and quality of supply, for example in India (see Chapter 6). In Rwanda nearly a quarter of grid-connected households have less than four hours of power in the evenings (Bonsuk Koo et al., 2018). And while some off-grid companies take customer service and maintenance issues very seriously, others sell poor-quality products which break easily. Communities can ensure the sustainability of projects, but require support from a wider repair and maintenance supply chain that is easily accessible.

In this *PPEO*, we start by reviewing historical approaches to delivering access to electricity and clean cooking fuels and technologies at scale. We then set out the framework for analysis of the subsequent case studies which includes an adaptation of the Energy Access Ecosystem model developed and refined in *PPEO 2012* and *PPEO 2013*. In Chapter 3 we explain the indicators we have developed to capture the success of programmes in terms of scale and inclusivity. Chapters 4 to 6 consider specific approaches and experiences of energy access. Our examination of clean cooking fuels and technologies in Chapter 4 looks at programmes based on biomass stoves in Ghana and biogas in Kenya. In the off-grid sector (Chapter 5), we consider Nepal's micro-hydro programme and South Africa's

In rural Togo, a woman sews by torchlight while her child looks on. Modern energy access would allow her reliable light to sew by and electricity to power her sewing machine, boosting her productivity and income. *Practical Action / Edoardo Santangelo*

solar home systems programme. In Chapter 6 we review grid-based, last-mile connectivity programmes in India and Peru. The final chapters draw together the lessons learned and policy recommendations.

Moving the dial on energy access for poor people

A steadfast focus on delivering for the energy poor is essential

A steadfast focus on delivering access to modern energy services for the energy poor is essential. Achieving our energy objectives depends on it. So, too, does the achievement of many other SDGs (Fuso Nerini et al., 2018). Importantly, as work on the Energy Access Dividend shows, it just makes sense. Expanding energy access increases economic activity, boosts tax revenue, improves education and health care, and more. Simply put, energy access enables better lives and livelihoods, enhancing human wellbeing.

The most effective ways of delivering energy access continue to elude governments, the private sector and donor agencies. Our analysis aims to shed light on what has worked, the limitations of different approaches, and the most exciting current developments. We encourage readers to take a long look at what has worked to deliver access at scale and, with us, to think through how these examples can be adapted to the countries that need these successes most. Then together we can finally put an end to global energy poverty.

2. Approaches to achieving scale and inclusivity

The *Poor people's energy outlook* series seeks to champion energy issues from the perspectives of women and men living in energy poverty. *PPEO 2018*, explores methods to scale energy access towards universality by 2030 in an inclusive manner truly leaving no one behind, showing that there is not inherent tension between scale and inclusivity; both are achievable. We present a framework for assessing the mix of policies and processes that have successfully driven energy access, and for reviewing programme outcomes.

This chapter tracks approaches to achieving energy access at scale over time. Historic and current approaches sometimes insufficiently consider the people they are trying to serve, offering minimal benefit to the most marginalized. *PPEO 2018* addresses the balance between scale and inclusion – reaching the 'last mile'.

The Energy Access Dividend derived from quicker, cheaper and cleaner implementation approaches based on an integrated technology mix is increasingly well understood (SEforALL and Power for All, 2018). We argue that, similarly, successful

national energy access strategies must accommodate and integrate objectives of both scale (at pace) and inclusivity.

Evolution of programme design

Programme design continues to evolve at pace. Approaches to energy access have mirrored ideological shifts about development and responded to perceived shortcomings of earlier approaches. More recently developments in technology and business models, and the emergence of new companies using 'fintech' (technologies for managing financial transactions using, for example, mobile phones), have generated new ideas and expectations.

Reviews of energy access approaches have identified important differences when it comes to electricity and clean cooking (Bhattacharyya, 2012; Herington et al., 2017). Programme design in clean cooking and fuels has historically differed as stoves involve less capital-intensive infrastructure delivery.

Rural electrification in developing countries in the 1960s and 1970s was driven by large, state-led electricity system expansion programmes, implemented by ministries of energy. Such programmes were generally supported by loans and grants from multilateral development banks. During the 1980s a shift in global political discourse resulted in the retreat of the state to make way for the private sector and markets, which, it was argued, would usher in efficiencies through competitive processes. From the mid-1990s, energy sector reforms were encouraged with a belief that the experiences of the USA, UK and Norway should be replicated. It was increasingly recognized that public resources, while still required, would only be able to deliver part of the energy solution in poor, already indebted countries.

Public resources will only deliver part of the solution in many energy poor countries

Multilateral development banks and bilateral donors urged developing countries to enact energy sector reforms that involved utility privatization, the separation of generation from transmission, distribution and retail, and the introduction of competition (Eberhard and Nawal Gratwick, 2011). Partial implementation of reforms left many African countries with hybrid but still largely centralized systems (Hall and Nguyen, 2017). Liberalization was expected to attract private investment and expertise, for example in the solar off-grid sector (Northrop et al., 1996).

Governments have therefore tried to enable the private sector to invest in new generation through grid-connected renewables and expand off-grid electricity access. Private investment, particularly in fossil fuel generation plant, increased significantly to 2012 alongside a decline in fossil fuel–related overseas development assistance (Pueyo et al., 2015). Despite increased private investment in the power sector and extensive contemporary debate, private investment in renewable technologies remains substantially below the volume required to achieve universal electricity access (Brown and Cloke, 2017).

The uptake and sustained use of improved cookstoves remains disappointing

In clean cooking, national cookstoves programmes began at a large scale in the 1970s with successes such as the Chinese National Improved Stove Programme (Bhattacharyya et al., 2012). Other countries focused on stove hand-outs, with limited success in terms of their sustained use (Urmee and Gyamfi, 2014). Donor agencies and international cooperation have often focused on improving biomass stove efficiency and, recently, on health impacts (Smith and Sagar, 2014). The number and scale of programmes increased from the 1990s, yet the uptake and sustained use of improved stoves remains disappointing (World Bank, 2011). The Clean Cooking Alliance (formerly Global Alliance for Clean Cookstoves), founded in 2010, addresses key market barriers, reflecting a gradual shift towards market models. Small-scale artisan businesses producing stoves of variable but often poor quality

continue to dominate the market, however. In recent years larger producers have become established in some countries, particularly in eastern Africa.

Alongside these developments, governments have provided subsidies for clean, modern fuels and appliances. Indonesia, for example, has subsidized petroleum-based fuels, initially kerosene and more recently LPG, since the 1960s (see Box 4.3). These have often accounted for significant portions of government budgets and proved to be politically difficult to eliminate or reduce over time. Although designed to benefit the poor, research shows better-off people benefit most (Putti et al., 2015; Coady et al., 2015). As a result, these subsidies have come under significant pressure for reform.

Subsidies to improve access to clean fuels and technologies often benefit better-off people most

The environment for and approaches to energy access delivery continue to evolve. The last five years have shown the private sector struggles to achieve scale without a supportive environment. National governments must establish transparent, stable energy and financial policies and regulations that are conducive to private investment and build the foundations for new energy access markets. Fresh approaches to public–private partnerships will enable the delivery of electricity and clean cooking solutions to remote and poor communities through, for example, incentives and de-risking. Governments are increasingly active and show a willingness to intervene to create regulatory and policy frameworks and set ambitious targets (Coady et al., 2015).

Governments are doing more to encourage private investment

Despite these recent developments supporting electricity access, universal energy access remains elusive. Energy access programmes, particularly those at scale and driven by governments, often focus on supply, technology and infrastructure, frequently overlooking male bias and the tendency for richer members of a community to receive greater benefits. Thus, we need 'more careful evaluation of the dominant market-focused approach towards … meeting energy access targets in the Global South' (Brown and Cloke, 2017). Solutions are as much political as they are financial, technical or social (Ockwell and Byrne, 2016).

Assessing energy access programme design

Given this context, how can we assess the different types of programme intervention to deliver energy access? We review programmes in three thematic areas – clean cooking fuels and technologies, off-grid electricity, and grid extension – assessing the levers used and the programme results achieved. The value of this case study-led approach, with 'quantitative and qualitative analyses and cross-programme comparisons of processes and results', was recently underscored in the clean cooking sector by Quinn et al. (2018). Lessons emerge about the set of processes and actions most likely to address the twin goals of scale and inclusivity, to achieve sustainable results. Our goal is not to provide a blueprint for success, but to support decision-makers to identify the most appropriate mix of actions.

Context and local conditions: situation analysis

The activities required to accelerate energy access are sensitive to variations in the starting point, technology and the enabling environment. In *PPEO 2012*, and with revised indicators in *PPEO 2013*, we proposed an Energy Access Ecosystem framework and associated set of indicators designed to give a snapshot of the maturity of the energy access sector in a country and its potential for future growth. The situation analysis used in *PPEO 2018* builds on this.

In the subsequent chapters we show that the context, starting point and resources for energy access differ widely between countries, influencing the appropriateness of different programme actions. To ensure the continued relevance of programmes,

Our situation analysis uses indicators for supply, demand, policy and finance

policy-makers and programme designers need to adapt programmes to reflect contextual changes, for example reductions in technology costs. We review the indicators before and after implementation, discussing the conditions in which a programme was implemented and the ways the programme design responded.

Our indicators cover factors at three levels: national pre-conditions, wider market conditions, and conditions specific to a particular energy access sector. Our earlier Energy Access Ecosystem framework was applied only at the macro level, but the situation analysis we use here focuses on conditions within a particular energy access sector (improved cookstoves, a clean fuel, or mini-grids for example). Similarly, WWF-India and SELCO Foundation (2015) have adapted the Energy Access Ecosystem approach at a localized level. At the level of wider market conditions, the World Bank's RISE framework, which reflects a 'snapshot of a country's policies and regulations in the energy sector' (World Bank, n.d. a), was partly shaped by Practical Action's inputs based on *PPEO 2012* and *PPEO 2013*. Our analysis draws on several of the policy and finance indicators used in the RISE framework.

Our situation analysis uses indicators across four dimensions: supply, demand, policy and finance. More detail of indicators and methods can be found in Chapter 3, however, in brief, our indicators cover:

Supply. Indicators describing mechanisms which target the supply of technologies and services that increase energy access, for example the number of market actors supplying products, their size, and the diversity of products and services they offer to meet the needs of different segments of the population.

Demand. Indicators describing mechanisms which target demand for energy access services. A total energy access perspective considers demand across not only households, but also productive uses, for example entrepreneurship or agricultural uses, and community services such as schools and health centres.

Policy. Indicators describing policies and implementing mechanisms which establish an enabling environment for energy access, including clear regulatory frameworks, quality standards, national targets and strategies, and a clear framework for the role of different actors.

Finance. Indicators describing mechanisms which enable finance to support energy access. They cover elements of the enabling environment around tax regimes, import duties and subsidies. They may also be mechanisms designed to de-risk investments, providing investors greater confidence. Indicators include funding committed and disbursed, amounts loaned in consumer finance, and the availability of finance for entrepreneurs of different sizes.

Programme design

We similarly assess programme design using the four dimensions of supply, demand, policy and finance. This aligns with frameworks used by other organizations, including Clean Cooking Alliance (UN Foundation, 2011), Shell Foundation (Gomes, 2015) and GOGLA (2017).

The pace and sustainability of change are important factors in our discussion of 'scale'

What does success look like? Scale and inclusivity

The final part of our assessment framework reviews programme results against the objectives of scale and inclusivity. In terms of scale, we are interested in the numbers of people reached. Two secondary factors are also important: first, the pace of change, which we are able to comment on but which is difficult to assess with any common metric across case studies, and second, sustainability (whether access to energy is sustained over time), which is also crucial for maintaining the gains made in terms of scale.

For inclusivity, we focus on three aspects: gender, poverty and remoteness. These are rarely considered together, although Acumen (2018) is ahead of the curve in assessing the extent to which its investments have a poverty focus and the depth of impact on household wellbeing. While there are other important aspects of inclusivity, focusing on these three provides a snapshot of the results achieved by different programmes.

For inclusivity, we focus on gender, poverty and remoteness

As mentioned earlier, many programmes have been designed with a focus on technical issues but limited attention to gender, wealth inequalities or other aspects of inclusion. Large-scale government programmes, such as fuel subsidies, have tended to benefit the better off (Coady et al., 2015). Grid extension programmes have inevitably reached less remote areas first, and high connection fees have discouraged the poorest even when the service is available. Solar home systems sold by the private sector have been purchased by the better off first (Practical Action, 2016), despite the extent to which mobile money and PAYGO systems have extended financial inclusion. We recognize that companies need to first build their proof of concept and establish systems that then allow them to grow and achieve economies of scale. However, we must ask what more can and should be done to reach more people?

Energy programmes' embedding of gender considerations has changed over time. In the 1970s, women 'first became visible in the energy sector … as victims' (Cecelski, 2004), viewed as passive beneficiaries of improved stove programmes or simply as instrumental in the successful roll-out and uptake of energy solutions. In electricity programmes, gender has rarely been considered because benefits have been presumed to accrue to all household members.

The ways in which access to energy affects men and women differently have been increasingly recognized (Dutta et al., 2017). 'Gender audits' have successfully highlighted issues with gender-neutral approaches; notably, ENERGIA has undertaken such audits in several countries, including Botswana, Kenya, Ghana, Nigeria, Nepal, India, Zambia and Senegal. The Botswana audit revealed a limited understanding among decision-makers of the relationship between gender, energy and poverty. As a result, training was carried out, new gender-mainstreaming programmes initiated and gender-disaggregated data began to be collected. These initiatives need to be scaled up and extended to other aspects of the energy sector, as our review of gender in energy financing in *PPEO 2017* revealed. A review of energy policies in eastern and southern Africa found that only 60 per cent integrated gender; where it was mentioned, it was often in a separate chapter and without clear budgets for action or frameworks for monitoring (UN Women, n.d.).

Putting all these pieces together, the heart of our *PPEO 2018* analysis is the design of particular programmes, how these programmes are actually implemented, and the overall results achieved. This is set in a context of geography, society and economy, and of existing market and energy access conditions. The results of an intervention can also be seen in the transformation of the context for energy access, giving us a new starting point for future programmes of delivery.

Conclusion

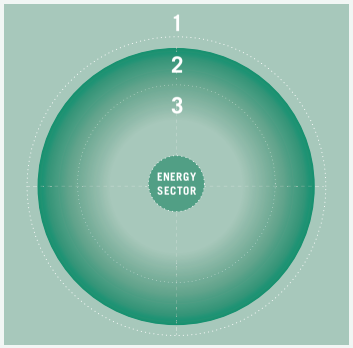
Our analysis allows us to review past programmes to extract lessons for policy-makers, financiers and practitioners. Yet we recognize that solutions must be context specific and adaptive over time as situations change. No standard recipe exists for success, especially considering the different status of subsectors within energy access markets: of solar home systems compared to mini-grids, biomass stoves or last-mile grid connections. Instead, there are approaches to design, decision-making and inclusion which have tended to lead to positive results, and it is these approaches we recommend to be as much the focus of discussion as specific interventions.

The right approaches to design, decision-making and inclusion are crucial

Our approach | Reviewing programmes to share learning with policy-makers, financiers and practitioners

SITUATION BEFORE AND AFTER

Situation helps determine ...



1 PRE-CONDITIONS
Demography, inequality, natural resources and infrastructure

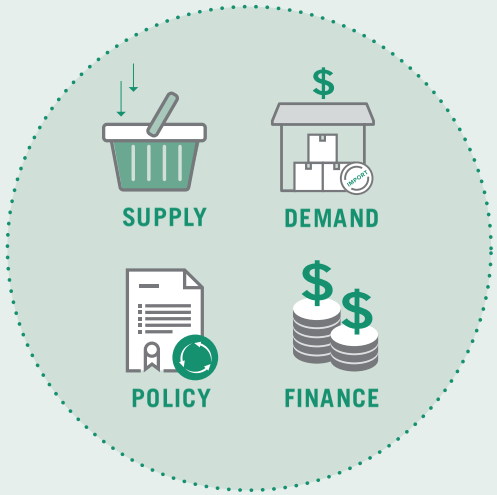
2 WIDER MARKET CONDITIONS
Supply, demand, policy and finance

3 ENERGY ACCESS CONDITIONS
Supply, demand, policy and finance for a particular energy access sector (mini-grids, cookstoves, etc.)

PROGRAMMES

... actions in a variety of areas ...

FOUR DIMENSIONS OF PROGRAMME DESIGN

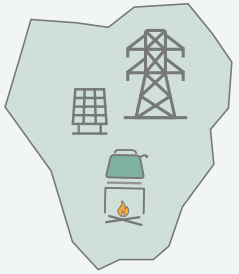


FOR AN ENERGY ACCESS SECTOR (MINI-GRIDS, COOKSTOVES, ETC.)

RESULTS

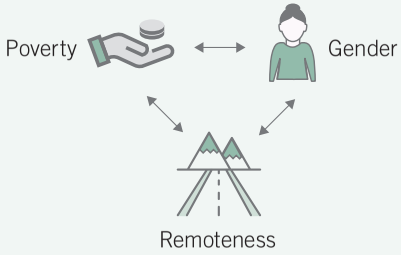
... leading to energy access results in terms of:

SCALE OF DELIVERY



ALSO CONSIDERING
- Pace of change
- Sustainability of access over time

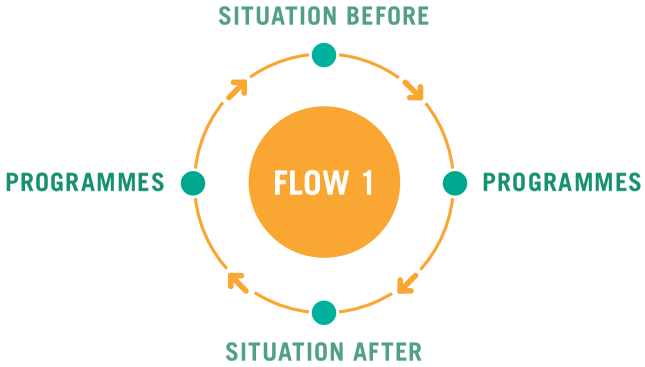
AND / OR INCLUSIVITY OF DELIVERY

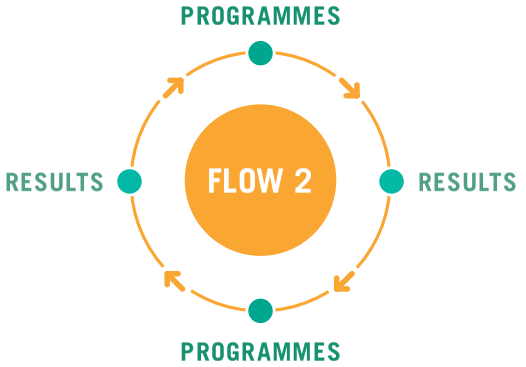


The process is cyclical, with national factors and programme results subsequently re-informing programme design.

The design of particular programmes, how these are implemented and the results achieved is at the heart of our analysis. Solutions must be context-specific and adaptive over time.

The **approach** taken in design, decision-making and implementation is critical to results achieved.





3. Methodology

Considering the huge diversity across countries and regions in terms of geography, socio-economic and political conditions, energy resources, existing infrastructure, and the status of energy access markets, a one-size-fits-all approach will not deliver results. Our assessment framework focuses on the supply, demand, policy and finance dimensions of programmes and highlights the approaches to design, decision-making and inclusion informing them. We collected data from global and national sources, and heard from stakeholders involved in each case-study programme – from high-level decision-makers to the women and men in rural communities involved in and benefiting from the programme on the ground.

In Chapter 2 we gave an overview of our assessment framework. Here we provide detail on the case studies, data sources, indicators used and their scoring, and new research we undertook for *PPEO 2018*.

Box 3.1 Key terms in our assessment framework

- **Situation analysis:** analysis of the national context and energy ecosystem before and after a programme.
- **Dimensions:** the dimensions of demand, supply, policy and finance are used in the situation analysis to describe the actions taken within a programme.
- **Programme design:** all aspects of the programme plan, including targets, actions, the delivery process, and how stakeholders are to be engaged.
- **Scale:** the number of people gaining access to a modern energy solution as a proportion of the population targeted by the programme.
- **Inclusivity:** the extent to which the programme included, as a planned and actual outcome, the people on lowest incomes, those in the most remote areas, and women.

Selecting the case studies

The integrity of our research depends on our ability to define and capture interventions clearly

In Chapters 4, 5 and 6 we present our analysis of six energy access programmes that aimed to achieve significant results and improve the performance of particular elements of the energy access market. We present two case studies in each thematic area of clean cooking fuels and technologies, decentralized electricity, and grid-based electricity, in addition to highlighting other recent programmes with innovative approaches to particular challenges.

Our research's integrity depends on our ability to define interventions clearly and capture each intervention's scope and nature. Our selection criteria were:

- clear start and end dates (even into subsequent phases);
- a variety of mechanisms implemented during the intervention's lifetime;
- well-documented outcomes.

We also considered overall balance in the diversity of approaches and contexts. Our examples are taken from different parts of the world – Africa, Asia and South America – with varying sizes of national economies and a range of energy resource options. The case studies are:

Ghana clean cookstoves programme, 2002–07 (5 years). This programme focused on the manufacture and commercialization of improved charcoal cookstoves. Initially manufactured and distributed by EnterpriseWorks/VITA, by the programme's end two off-shoot companies selling similar products had been established. For all companies, production was executed by large networks of artisans, while hundreds of retailers distributed the stoves to households.

Kenya Biogas Program, 2009–18 (9 years). This was a nationwide programme under the wider Africa Biogas Partnership Programme (ABPP), implemented by international NGOs SNV and Hivos and funded by the Government of the Netherlands. The programme's unique approach is its private-sector development methodology. ABPP aims to achieve scale and sustainability by developing a commercial, market-oriented biogas sector in Kenya, assuming that with sufficient critical mass, the market will sustain itself and donor subsidies will no longer be required.

Nepal Rural Energy Development Programme, 1996–2011 (15 years). Supported by UNDP and the World Bank, the Government of Nepal aimed to increase electricity access through community-managed micro-hydro systems. The programme was rolled out over three phases to reach 40 of Nepal's 75 districts. About half of programme costs (for system installation and other aspects, such as social mobilization and training) were covered by the donor agencies with important contributions from districts, village development committees and the communities themselves.

South Africa solar home systems programme, 1999–2018 (19 years). This programme adopted a markets-based, subsidised approach to delivering solar home systems (SHSs) in off-grid areas. The programme gave private companies rights to establish off-grid energy utilities in geographically defined concession areas in four states. Subsidies covered most of the capital costs for the SHSs (R3,500 or about US$270). The companies operated on a fee-for-service basis, where households paid a monthly fee (also subsidized) for ongoing system maintenance by the company.

India Rajiv Gandhi Grameen Vidyutikaran Yojana programme, 2005–15 (10 years). This formed part of the national government's Common Minimum Programme after the 2004 general election. The goal was to provide reliable, good-quality power to rural areas, electrifying all villages and households and providing free connections for those at the bottom of the pyramid. Grid connections delivered the vast majority of this. The programme worked through a 90 per cent government grant and a 10 per cent loan from the Rural Electrification Corporation to state governments. Our analysis considers how the programme was implemented in Odisha state, one of the states with the greatest energy access deficit.

Peru Rural Electrification Project, 2006–13 (7 years). This programme sought to increase efficient and sustainable electricity access for Peru's rural population. The project introduced a bottom-up approach for grid-connected rural electrification, with the process being driven by projects proposed and developed by local electricity companies that took responsibility for construction, financing and operation.

Quantitative and qualitative data collection

For each case study we reviewed a range of data sources, including public datasets and those provided by national-level programme managers. We carried out comprehensive stakeholder interviews to explore subjective aspects of the programme's performance, covering the intervention's design, challenges during implementation, and adaptations made. For each case study we talked to groups of end-users in at least two villages, various supply-chain actors and financiers, and national decision-makers. We held village, district and national level workshops to get a nuanced view of the programme's implementation and to assess aspects of inclusion, such as why particular project locations were selected, how the poorest were included, and how gender issues were identified and women empowered.

Stakeholder interviews and workshops explored subjective aspects of performance

Scoring the indicators

For the situation analysis before and after the programme intervention, and for the programme's results (scale and inclusivity), we created standard indicator sets. This enabled us to make comparisons despite the differences between the case studies in energy access sector, context and programme design.

Before and after situation analysis

This analysis helps us to explore significant aspects of the national context pre- and post-implementation. As proposed in the Energy Access Ecosystem framework (Practical Action, 2012, 2013), taking a wide view of the energy ecosystem helps identify bottlenecks to progress. As with all situation analyses, the result is a snapshot of the environment in which programmes are implemented. So, while one country's environment may appear to be more supportive than another, its energy access levels may still be lower.

We draw on our Energy Access Ecosystem methodology and indicators

This edition of the *PPEO* draws on the methodology proposed in earlier editions. Our situation analysis includes a number of the Energy Access Ecosystem indicators. However, where before we applied these across all technologies, here we use them to focus on a specific energy subsector.

The situation analysis indicators were grouped into three categories. A range of indicators could have been used, but we selected those that make the framework relatively simple to replicate and that best reflect important aspects of a thriving energy access market. The indicators are grouped into:

1. The *pre-conditions* (six indicators) of the country or area in question, including demography and a range of socio-economic characteristics;
2. The *wider market conditions* (seven indicators), linking the wider economy to the energy ecosystem, including indicators such as 'ease of doing business' rating and the rate of financial inclusion;
3. The *energy access conditions* (18 indicators), such as number of energy access companies and the degree to which national policies prioritize a particular aspect of energy access.

The infographic on page 23 gives greater detail of these indicators. For a full listing of the indicators and the data sources used, as well as links with previous editions, please see http://policy.practicalaction.org/ppeo2018.

For wider economic ecosystem and specific energy ecosystem indicators, we replicate the scoring system used in our earlier Energy Access Ecosystem Index, scoring each indicator from 0 (the lowest/worst) to 3 (the highest/best). This allows a comparative view across countries for indicators that are sometimes not well reported in global data, such as the level of supply, or of capacity-building support available for energy access enterprises. In most cases, the research team arrived at a score based on agreed criteria.[1] For each dimension (demand, supply, policy or finance), scores were aggregated and presented as a proportion of the total possible score. For example, there are seven policy indicators, giving a highest possible score of 21 (7×3). If a country scored 10 points, this is shown as a percentage ($10 \div 21 = 48\%$).

Assessing the results: scale and inclusivity

Our measures for defining the success of interventions are the scale and inclusivity of impact (see the key terms in Box 3.1). We supplemented these measures with desk research and qualitative fieldwork insights, to establish a picture of the more nuanced aspects of achieving scale and inclusivity. Qualitative data revealed vital information on issues such as end-user experiences, maintenance and sustainability, engagement with marginalized communities, sales and after-sales service, and expectation versus the reality of an intervention.

Measures of scale

To provide a comparable indication of the intervention's scale we consider the total population of the target area and the proportion who already had energy access. Different programmes have quite different starting points. We look at numbers reached by the programme and by other programmes operating simultaneously (where possible).[2] Separately, we describe the quality of the service received. We do not have sufficient data to calculate the energy access tiers achieved (Bhatia and Angelou, 2015), but can gain an understanding based on, for example, the appliances communities used.[3]

Measures of inclusivity

To measure a programme's inclusivity, we reviewed the extent to which it had been successful in targeting remote areas and low-income groups and addressing gender inequalities. Each of these three aspects is measured by three indicators. Each indicator is scored and aggregated to give a composite score for each aspect and for inclusivity overall. The score is shown as a percentage of the total possible for inclusivity in the figures for each case study (and in the Chapter 7 tables). Separately, we considered the extent to which the programme considered other aspects of marginalization, but this was not part of our scoring.

Table 3.1 Inclusivity indicators – remoteness of programme beneficiaries

1	Population density	All districts in the country are ranked in order of population density. We compare the target districts' ranks with those not targeted, and score the programme according to the difference between the average ranks of the districts. If all the targeted districts have the lowest population density, the score is 10. If there is no real difference between the target districts and those not targeted, the score is 5.
2	Road density	Calculated as for population density. If all the target districts also have the lowest road density, the score is 10.
3	Electricity connections	Calculated as for population density. If all the target districts also have the lowest levels of electrification, the score is 10.

Table 3.2 Inclusivity indicators – gender of programme beneficiaries

1	Capacity building targeting women in particular	Scored 0–10 based on qualitative assessment from stakeholder interviews, considering the extent the programme works towards employing women, gives women an outlet for expression about energy services and empowers them in decision-making processes.
2	Gender targeting and empowerment activities	Scored 0–10 on the basis of the extent to which the programme has targets and detailed interventions to promote gender equality.
3	Female-headed households benefiting	Scored 0–10 on the basis of estimates of the proportion of female-headed households who benefited from the programme (generally programmes did not collect this data).

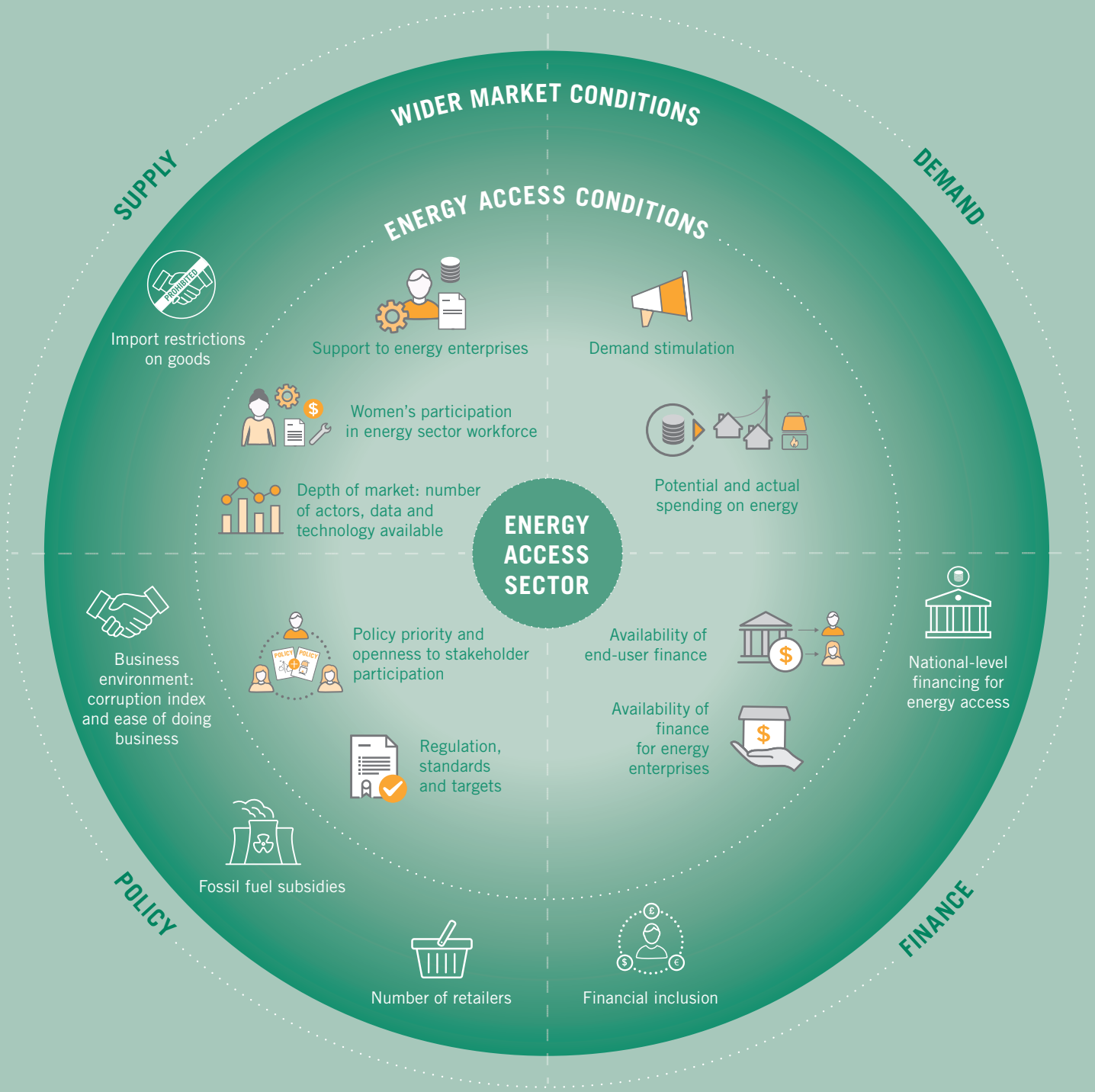
Table 3.3 Inclusivity indicators – income of programme beneficiaries

1	Capacity building targeting the poorest people	Scored 0–10 from qualitative information gathered from programme stakeholders, considering information about differential tariffs, subsidies, efforts made to reach the poorest people, and engagement of the poorest in decision-making.
2	Targeting and specific activities for poorest households	Scored 0–10 on the basis of criteria related to the inclusion of targets and detailed interventions targeting the poorest households.
3	Poorest households benefiting	Scored 0–10 on the basis of estimates of the proportion of the poorest households who benefited from the programme (generally programmes did not collect this data).

Conclusion

The methodology applied to our case studies directs us towards the end-users of energy access programmes and to the people closest to community-level delivery. First, we tried to ensure their voices and perspectives are heard, while placing these within the bigger picture of programme delivery and impact. Second, we highlight the range of different approaches adopted, considering them within their national contexts. We must be mindful not to attribute changes in the situation analysis over time to specific programme actions: many other factors were at play. However, we know that, as these programmes evolved, so did their contexts, with feedback loops informing what needed to happen next. *PPEO 2018* presents a methodology for assessing not only the scale of impact, but its inclusivity. If all programmes routinely collected and reviewed such information, we might be closer to ensuring that no one is left behind.

Situation Analysis | Considering indicators at different levels



PRE-CONDITIONS

DEMOGRAPHY

- Total national population
- Urban/rural population split
- Average population density

INEQUALITY

- Average wealth
- Wealth inequality
- Level of poverty
- Gender inequality

4. Clean fuels and cooking

Around 3 billion people lack access to clean fuels and technologies, which perhaps remains the global energy sector's biggest challenge. The SDG7 Tracking Report shows the number of people without clean cooking in sub-Saharan Africa is rising (IEA et al., 2018). *PPEO 2017* illustrated the scale of investments needed to meet people's needs and aspirations to have clean cooking fuels and solutions.

There has been some progress, however. For the first time, the multi-tier framework provides an accurate national-level picture of the penetration of different types of stoves and fuels. In Rwanda, for example, while 99.6 per cent of households cook with biomass, only 53 per cent use a three-stone fire (Bonsuk Koo et al., 2018). Sixteen per cent have adopted a 'traditional' stove and 30 per cent own an improved stove. With more reports coming soon, we will have a better basis for recognizing progress and planning future strategies. The narrative has also evolved in useful ways: from primarily being about individual biomass stoves to a broader focus on fuel/stove combinations, a wider range of fuels, distribution as well as manufacture, and a variety of financing solutions and business models.

In this chapter we examine the contrasting examples of relatively basic biomass stoves in Ghana and the clean-fuel biogas programme in Kenya, while drawing on contemporary experiences from Indonesia and Rwanda to explore learning around scale and inclusivity.

Ghana clean cookstoves programme, 2002–07

From 1989 the Government of Ghana's improved cookstove (ICS) programme promoted Ahibenso stoves and initially focused on technology, training artisans, and supporting distribution. Despite early sales success, the unit cost remained uncompetitive and the scheme folded when the initial tranche of government funding ended. By 1995 few Ahibenso stoves were on the market or in use.

Recognizing the Ahibenso stove's shortcomings, EnterpriseWorks/VITA (EWV), a division of Relief International, brought the successful Kenyan *jiko* stove design to Ghana: clay-lined charcoal stoves sold under the brand name Gyapa. The programme targeted low- to middle-income households in urban and peri-urban locations where charcoal was the preferred fuel. Berkeley Air Monitoring Group, in partnership with the Ghana Environmental Protection Agency, monitored household emissions. Gyapa stoves are 'efficient' meeting Tier 2 of the IWA tiers, and using 54 per cent less energy per minute than a wood-burning stove. In terms of emissions, as with many simple charcoal stoves, they are not very high performing. They are IWA Tier 0 for carbon monoxide, and different tests place them in Tier 1 or 2 for particulate matter ($PM_{2.5}$). Although producing just 5 per cent of the particulate emissions of wood burning cookstoves, this is still considerably higher than is safe for health (Obeng et al., 2017).

This case study examines the characteristics of the EWV programme, funded by Shell Foundation and USAID, during the decisive 2002–07 period. The programme resulted in 900,000 sales of Gyapa stoves by 2017, affecting 4.1 million Ghanaians and creating 800 jobs, rising to 1.5 million sales if we include all similar models on the market.

Table 4.1 Ghana pre-conditions

Population	19.42 million, 55% rural[1]
Average national population density	85 people per square kilometre[1]
GDP per capita (PPP current international $)	US$1,857[1]
National Poverty Incidence	39.7%[2]
Income inequality	GINI index 38.8[2]
Gender inequality index	0.573[3]

[1] Figure from 2001 in World Bank, n.d. b
[2] Figure from 1998 in Cooke et al., 2016
[3] Figure for 2005 in UNDP, n.d. a

Before and after situation analysis

In 2001 improved cookstoves were unaffordable for many people

The government's experience with Ahibenso stoves demonstrated its awareness of the importance of cleaner cooking. The national Poverty Reduction Strategy (2000) highlighted this, prompting two short-lived, public-led projects focusing on wood-fuelled stoves.[1] This created some supply capacity. However, in 2001 no financing or active demand-creation initiatives were in place. Improved cookstoves (ICSs) were unaffordable for many potential customers (Bensah et al., 2015).

The charcoal stove market has continued to grow, with a 60 per cent increase in households using charcoal as their main fuel, from 1.3 million households in 1999 to 2.1 million in 2013 (SNV, 2017). Meeting this demand, by the end of 2007, supply

indicators increased, with a huge growth in the number of supply-chain actors involved in the ICS sector (manufacturers, distributors, retailers), from fewer than 10 in 2001 to over 1,500 by 2017. New capacity-building initiatives, training centres and two stove-testing centres had been established, and policy targets for increasing ICS use were set. Work is underway towards a national-level labelling standard for cookstoves. Availability of financing had also improved, with carbon credits playing a role and a couple of financial NGOs beginning to offer consumers microcredit for energy products. The government embedded clean cooking into its targets and policies, such as the Energy for Poverty Reduction Action Plan (Ministry of Energy, 2006) and its Strategic National Energy Plan (Energy Commission, 2006). Clean cooking is part of Ghana's Nationally Determined Contribution as a means to mitigate climate change under the Paris Agreement. As in many countries, however, accurate ICS uptake data is lacking.

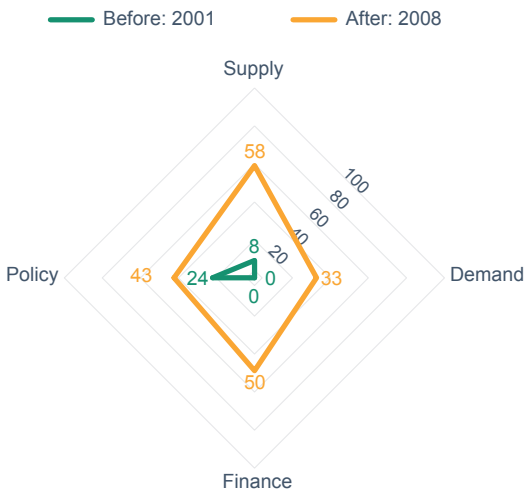


Figure 4.1 Ghana situation before and after clean cookstoves programme

The programme made strong, integrated efforts to boost supply and demand for improved cookstoves

The Ghana Alliance for Clean Cookstoves was founded in 2012 and works to strengthen local actors, build consumer awareness and hold the government to account on its policy commitments. Ghana's SEforALL Action Agenda (GoG, 2012) is strong on cooking, but identifies numerous bottlenecks that remain for both biomass stoves and LPG. ADP (2012) found that 'financing is still the major roadblock for producers to increase capacity and for consumers to purchase clean cookstoves'.

Programme activities and emphasis

The programme involved very strong, integrated efforts to boost supply and demand for ICSs. In supply, the programme identified and trained local artisans in Kumasi and Accra (78 people initially, all men), from areas known for metal and clay working. The stoves formed another product line for their existing businesses, so did not require new tools and equipment. The ceramicists and metal workers collaborated to ensure an adequate stove supply. This, according to the coordinator, was one of the programme's main success factors. Capacity-building training was also provided to 200 retailers (183 women), drawn from every Ghanaian district although the majority were in Accra and Kumasi. These retailers were already selling home appliances such as cooking utensils and LPG stoves, and were provided with information about the stoves' money-saving, health and cleanliness benefits. Prices were close to that of conventional charcoal stoves.

An intensive marketing and awareness campaign was established to build stove demand

Financing systems helped overcome some common challenges in stove supply chains. Retailers were connected with the manufacturers, provided with free transport for delivery and were given the stoves on credit, only paying the manufacturer after selling the stove. The artisans, on the other hand, received an upfront payment of up to 50 per cent to be able to purchase raw materials. This also enabled the manufacturers to supply the stoves on credit and provide a warranty to end-users in case of a broken ceramic lining.

Local metal and clay artisans were trained in stove production, which often became another product line for their existing businesses. *Gyapa / Relief International Ghana*

In parallel, EWV organized an intensive marketing and awareness campaign to build stove demand, involving renowned radio and TV presenters and live demonstrations at social gatherings and major market centres.

Box 4.1 Voices from suppliers and users of Gyapa stoves, 2018

Madam Victoria is one of the largest Gyapa retailers in Accra and has been selling the stove alongside other household and kitchen items for 15 years. *I am a single mother and have used this business to educate my child all the way through university … At one point I was selling more than 100 stoves per week, but at present it is about 30, due to competition from other sellers.*

Stove users discussed why they like these stoves. Agnes said, *I have been using these stoves for about seven years. I use half the charcoal compared to the 'coalpot' stove. This one is good for all Ghanaian meals.* The only problem they mentioned was that the liners were quite fragile and broke easily.

Gyapa was one of the first of its kind to register for Gold Standard carbon credits

To support the programme's survival and growth, EWV explored the use of carbon finance, and agreements were signed in 2007 registering the intervention as one of the first in the Gold Standard voluntary carbon scheme, with ClimateCare as the intermediary. Revenues from the sale of carbon credits bought new tools for manufacturers and subsidized the stoves' sales price, improving affordability. The US Environmental Protection Agency provided additional funding for a second phase, from 2006 to 2010, allowing further geographical expansion.

Key achievements and remaining challenges

In June 2016, ClimateCare reported that Gyapa alone had sold more than 835,000 stoves since 2007, cutting 1.86 million tonnes of carbon dioxide and creating skilled jobs for 180 artisans and 600 retailers (ClimateCare, 2016). Two trained artisans left EWV in 2006 and 2007 to establish their own enterprises registered as Toyola and

Man and Man Company Limited respectively, and have achieved significant success independently. The performance and design of these companies' stoves are similar to the Gyapa stoves, and it is estimated that between 2007 and 2017 around 1.5 million ICSs were sold by Gyapa, Toyola and Man and Man combined. They all remain operational, with Toyola reportedly dominating in terms of market share.[2]

The Ghana cookstoves programme made efforts to build the capacity of female retailers

Outcomes: scale and inclusivity

In its initial phase, around 54,000 Gyapa stoves were sold (EWV, 2018), but the programme's success is in the foundation it laid for growth, sustainability and two spin-off companies. The potential market for these stoves is primarily charcoal users, both urban and rural. It also includes those who are likely to switch to using charcoal (urban wood fuel users) and LPG users who may also buy and use a charcoal stove as a back-up. In 1999, this amounted to about 1.9 million households (SNV, 2017), hardly any of whom were using ICSs. Thus, in the initial period, the stoves reached around 3 per cent of the market.

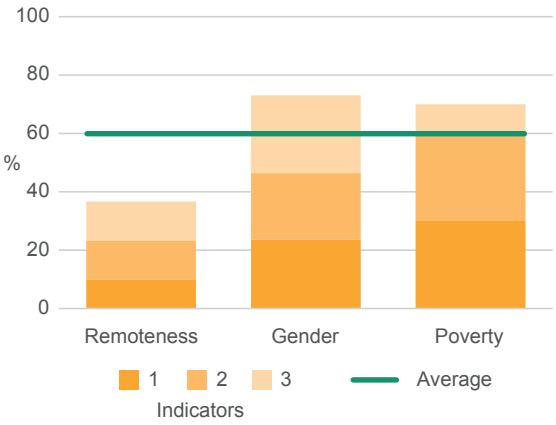


Figure 4.2 Ghana clean cookstoves programme inclusivity index

An estimated 1.5 million stoves have been sold since the programme's end, while the market size has grown to nearly 4.1 million households as a result of population growth and urbanisation. The number of households owning an ICS and using it consistently may be lower than 1.5 million, considering repeat sales are likely as stoves break after some years of use.[3] We also know that stoves are not always consistently used and stove stacking is common. Nevertheless, these numbers represent 37 per cent of the total potential market and 60–72 per cent of those who use charcoal as a primary fuel (see summary box page 32).

The programme scored highest of the three inclusivity categories on its gender efforts due to its work building female retailers' capacity, and the extent to which

Box 4.2 Inyenyeri improved cookstoves – reaching rural wood-fuel markets

In Rwanda, wood is used by 93 per cent of rural and 45 per cent of urban households to cook, causing significant health impacts and deforestation. Addressing this, Inyenyeri, supported by the World Bank, is scaling up its innovative business model and rethinking biomass cooking solutions as being about fuel supplies rather than stoves. Customers are leased a highly efficient forced-draft gasifier stove while committing to using it only with Inyenyeri's biomass fuel pellets. Urban households purchase pellets, at a cost lower than average spending on charcoal. Rural households receive the pellets and stove without cost, in exchange for supplying raw biomass.

Inyenyeri serves three or more urban households from every rural customer supplying biomass, and rural households still collect less biomass than they otherwise would. Once the system is running, biomass needs among Inyenyeri's customers are expected to decrease by 90 per cent (World Bank, 2016).

The stoves produce a higher heat and faster cooking times than traditional stoves, requiring a shift in consumer behaviour (Accenture, 2018). Following customer feedback, Inyenyeri switched entirely to the Mimi Moto stove, whose stove designers have also made adjustments to adapt to local conditions. The company has had some issues maintaining a steady supply of fuel, and has had to experiment with pricing models, adopting a simple pay-as-you-go system in 2018 (Jagger and Das, 2018). Despite some growing pains, Inyenyeri's approach is potentially transformational. It provides a viable solution for reaching the rural wood-burning market segment others find almost impossible to access.

the stoves were affordable for women as customers. We should note, though, that it did not set targets in terms of gender, nor did it seek to be transformative of established gender roles. The programme made efforts to ensure stoves were accessible to the poorest customers through, for example, carbon finance which helped reduce prices. Focusing on charcoal-buying customers in urban and peri-urban locations, the programme scored lowest on 'remoteness'.

Few in the cookstoves sector are successfully managing to sell wood-burning stoves to rural households. The approach taken by Inyenyeri in Rwanda provides an innovative example (Box 4.2).

Ghana: key findings

For a programme that started as an NGO-led activity, the experience of the improved charcoal stoves sector in Ghana has been very positive. Its transition to commercial viability, the emergence of two independent companies, and the increase in numbers and capacity of market-chain actors has helped the sector grow considerably. It worked systematically to address barriers that often impede cookstove markets by focusing on, among others, building capacity, smoothing financing challenges, and running an effective demand-creation programme.

Despite improving on traditional cooking practices, the Gyapa stoves are of variable quality and relatively low performance, with limited health impacts. For richer consumers, Gyapa stoves compete with the government's promotion of LPG; however, it is clear that a strong foundation now exists for future developments in the biomass stoves sector.

Kenya Biogas Program, 2009–18

Kenya's clean cooking sector is dynamic, yet a major challenge remains among rural firewood users

Kenya's clean cooking sector is active, with improved charcoal stoves widely used and available in urban and peri-urban areas, and LPG gaining in popularity. The cooking sector as a whole has a diverse set of businesses enterprises, including women-owned and gender-informed business models, innovative customer-financing models, and dynamic behaviour change efforts. Yet a major challenge remains among rural firewood users: in 2012 only 2 per cent were estimated to own an improved stove (GVEP and GACC, 2012), despite *PPEO 2016* showing rural households' strong demand for better, cleaner cooking solutions, including gas or electricity.

Kenya has had biogas technology since the 1950s, with various promotional efforts made by government and development partners since the 1980s. More recent policies recognize the importance of switching to cleaner fuels, with the Energy Policy (Ministry of Energy, 2004) pledging for the first time to promote domestic

Table 4.2 Kenya pre-conditions

Population	38.6 million,[1] 68% rural
Average rural population density	46 people per square kilometre[1]
GDP per capita (PPP current international $)	US$2,272[2]
MPI Poverty Index	0.226[3]
Income inequality	GINI index 48.5[4]
Gender inequality index	0.616[5]

[1] KNBS, 2009
[2] Figure from 2009 in World Bank, n.d. b
[3] Figure from 2009 in UNDP, n.d. a
[4] Figure from 2005 in World Bank, n.d. b
[5] Figure for 2010 in UNDP, n.d. a

and institutional biogas. A feasibility study by ETC Group (2007) found that a high proportion of the estimated 2,400 existing biogas plants were operating below capacity or had fallen into disuse, with only 30 per cent fully operational.

This case study documents the two phases of the Kenya Biogas Program (KBP), from 2009 to 2018. The KBP has significantly increased the number and quality of plants, building 17,134 by the end of 2017, benefiting some 103,000 people (KBP, 2018a). It is part of the wider Africa Biogas Partnership Programme (ABPP) operating in five countries.

ABPP adopted a private-sector development methodology to achieve scale and sustainability through a commercial, market-oriented biogas sector. It assumes that with sufficient critical mass, the market will eventually be self-sustaining without the need for subsidies.

Before and after situation analysis

Before the KBP was launched, the sector was very small with few suppliers of biogas systems for the whole country. There was only ad hoc training and little finance available specifically for these relatively expensive systems. Hardly any women were involved in biogas supply chains, in any capacity. In terms of demand, only the few communities where systems had been installed were aware of the technology. On average, rural households in Kenya spend a relatively high proportion of their income on fuel.

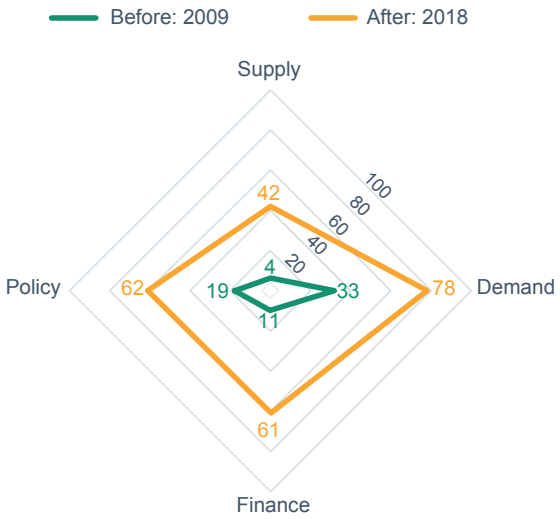


Figure 4.3 Kenya situation before and after KBP

Before the KBP was launched, the sector was very small with few suppliers of biogas systems for the whole country

The potential of biogas was recognized in policy in 2009 and government had begun to make provisions and set targets, but without specific supporting policies, standards or financing. Progress has been made since then to fill these gaps and increase stakeholder engagement.

By 2018 the sector has grown substantially. Supply has improved but much remains to be done, including boosting private investment for enterprises, increasing the number of retailers selling the systems, improving affordability, and tackling difficulties in engaging women in supply chains. Demand has improved, particularly through marketing hubs engaging with different agricultural sectors. Carbon finance has provided an additional source of revenue, and a donor-promoted, results-based approach has encouraged new entrants to offer end-user finance.

Programme activities and emphasis

Phase I had a larger focus on end-user awareness raising, to build confidence in the technology through training in usage and maintenance. In phase II, the programme sought to boost demand through 22 biogas marketing hubs which are associated with particular agricultural sectors such as dairy, coffee and tea farming cooperatives, and savings and credit organizations (KBP, 2018b).

The KBP also focused on developing the supply chain and its supporting services. This included training 577 masons (39 of whom were women) in construction

of biogas plants (KBP, 2013). Around 240 are still working within 82 registered companies. KBP also worked to improve the quality and efficiency of services by accrediting masons, and helped them form an association which supported the programme in defining a set of standards and assessment guidelines. Some different technologies have become available in Kenya and adopted in the KBP, with prefabricated plants rising in popularity compared to fixed dome models.

Addressing affordability within the programme was essential. A plant costs KSh50,000–100,000 (US$500–1,000). One company quoted US$690 for its cheapest model (including a subsidy of US$30), a 6 cubic metre single-household system. During phase I, the programme itself subsidized the cost. During phase II it offered results-based incentives to financial institutions that could provide loan packages to farmers, helping to spread the costs with the aim of supporting the programme to survive and grow without subsidies. However, recent research found that only 18 per cent of customers in Kenya had used a loan to acquire their biodigester (Clemens et al., 2018). KBP is also registered for carbon credits which are aggregated across the programme.

The programme sought to address gender issues with specialist support from ENERGIA, the International Network on Gender and Sustainable Energy, which held a workshop for the ABPP in 2010. This is in a challenging context with very few women involved across the biogas value chain, and particularly few in construction and installation. As consumers, women farmers may be less likely to own sufficient cattle or be able to access credit. With ENERGIA, the programme produced a gender mainstreaming guide to support non-specialists to integrate gender across the programme: from activity design to decision-making processes, monitoring and evaluation (ENERGIA, 2010). KBP made efforts to train more women masons, sought to reach women customers, and to encourage their participation and leadership in the national biogas users' association.

Key achievements and remaining challenges

The KBP has been instrumental in creating a larger market system for biogas

The KBP has been instrumental in creating a larger market system for biogas, with clearer paths for finance and capacity building and a stronger policy framework. Biogas users felt they had a more reliable cooking experience while also generating some heat to warm the house and saving two to three trees per household annually. Eye and respiratory problems were reportedly reduced. Women saved time because feeding the biogas system with manure and water took less time than collecting firewood. Many of these benefits we found were confirmed in recent surveys by Clemens et al (2018). In a 2016 user survey (KBP, 2016), 95 per cent said they used bio-slurry (the sludge left over after gas production) on their farms and 84 per cent reported an improvement in their crops. Farmers said, *I spend less now on fertilizer* and *the bio-slurry has reduced problems I used to have with caterpillars and other pests*. Farmers also reported that they would appreciate greater support on how to best use bio-slurry, to maximize its potential on their farms.

A number of challenges remain, particularly around affordability. At current costs, the market potential for biogas plants between 2019 and 2023 is estimated at around 38,000 but, technically, there is scope for around 172,000 (ETC Group, 2007). This was calculated based on the number of rural families owning two or more stabled cows of sufficient quality and some regular income from formal employment to afford a system. This could therefore be an underestimate of the real market size. However, many farmers we spoke to suggested the need for price reductions through subsidies, further tax breaks or import duty reductions (which already exist for prefabricated models). Farmers perceive biogas digesters as only for the better off. In addition to

In Kenya we spoke to farmers using biogas plants installed under the KBP. They all reported an improvement in their farms' productivity and a reduction in their use of firewood since they started using biogas. The female farmers we spoke to noted that this made cooking less time-consuming for them. One commented that her social status had been elevated since she started using biogas. *Hivos*

installation costs, appliances using biogas (burners, lights and even small generators) are expensive. The affordability challenge is particularly acute for women who are on average poorer and less able to access credit. The industry has also struggled to involve women across the value chain.

A second challenge relates to quality, with demand reportedly having slowed as some poor-quality construction affected the systems' reputation. Around a quarter (23 per cent) of biodigesters constructed in phase 1 were not operational by 2016 (Clemens et al 2018). As a result, in phase 2, the ABPP is placing more emphasis on quality control. It has stepped up efforts in consumer education to ensure people contract certified, qualified contractors, and on after-sales service and warranties.

An affordability challenge remains, particularly for women

Outcomes: scale and inclusivity

The programme has so far installed 17,134 plants, benefiting around 103,000 people, and estimates there is technical scope for around 172,000 plants. This means it has reached around 10 per cent of the potential market.

In terms of inclusion, the initial feasibility study (ETC Group, 2007) recommended the programme focus in five priority districts which were sufficiently densely populated, with adequate water and relatively

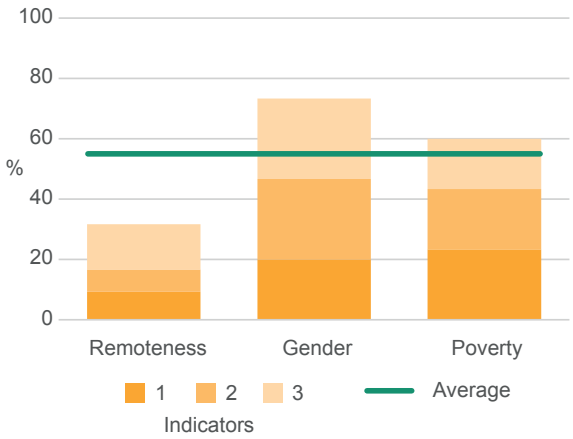


Figure 4.4 KBP inclusivity index

Box 4.3 LPG cooking in Indonesia – fuel switching through subsidy reform

Keen to replace kerosene cooking with cleaner alternatives, the Government of Indonesia supported The Kerosene-to-Liquid Petroleum Gas Conversion Programme (2007–12). This programme distributed over 50 million LPG starter packages (ESMAP, n.d.), consisting of hardware and subsidized 3 kg LPG cylinders, to households and micro-businesses, largely in urban areas. To ensure quality, the Ministry of Industry developed national standards for the stoves and other equipment (Thoday et al., 2018). Provincial authorities provided support by facilitating the substitution of kerosene sales licences for LPG licences.

The programme worked at an impressive pace: the original target of distributing 42 million starter packages by 2012 was achieved in 2010. Yet, despite remarkable success in replacing kerosene with LPG as the country's main cooking fuel, some 40 per cent of households (around 24.5 million), mainly in rural areas, continued to rely on traditional biomass for cooking in 2013 (World Bank, 2013a).

While the fuel-switching policy continues, the expansion of LPG for cooking has slowed since the programme's end, with 7 million LPG starter kits distributed between 2012 and 2015. In 2018 the universal subsidy for LPG, which benefits wealthier households disproportionately, is expected to be restructured to target lower income households (Thoday et al., 2018).

high numbers of zero-grazing units (where cattle are penned). The programme later adopted a wider geographical focus, concentrating instead on particular agricultural value chains: dairy, coffee and tea, and their associated farmer cooperatives. KBP therefore does not score particularly highly in terms of remoteness because these areas, though rural, are not as isolated as some of Kenya's most dispersed communities. We have noted the programme's difficulties around targeting the poorest and, while the programme proactively tried to engage women, it started from a low base.

Kenya: key findings

As *PPEO 2016* and *PPEO 2017* note, rural Kenyan communities would like to leapfrog from using biomass to access clean cooking fuels. Yet a significant affordability gap remains. The KBP pursued a sensible strategy: to work with farmers who have livestock and water resources, but also, through their cooperatives, potentially greater resources in terms of financing and access to extension services. While technology has improved and the sector's capacity in Kenya has grown substantially, continued efforts are required to reduce costs and consider how subsidies could help reach poorer consumers. Subsidies have played an important role in promoting clean fuels in some countries, for example in Indonesia; however, there is a danger that wealthier households will benefit disproportionately. Box 4.3 highlights the advantages and challenges of clean fuel subsidies as used for LPG in Indonesia.

Conclusion: the challenge of reaching rural wood-fuel users at scale

This chapter has illustrated some ongoing challenges in clean cooking and fuels. Ghana and Indonesia both focused on a market segment which is arguably easier to reach: urban consumers who already buy fuel. A key element of success in Ghana was its focus on strengthening links between manufacturers and retailers, while boosting supply and demand.

Growing evidence across the sector demonstrates the value of engaging and empowering women as value-chain actors and consumers. While both case studies tried to address this, there is clearly further scope for transformational action.

The KBP and Inyenyeri (Box 4.2) examples tackle the difficult market segment of rural households who collect, rather than purchase, fuel. The biogas programme worked closely with agricultural value chains, a decision which is bearing fruit, with the KBP having worked hard to activate the market from a very low initial base.

The two case studies have attracted relatively small amounts of finance, largely as grants with a small results-based finance element in Kenya, and the use of carbon credits on the voluntary market in both programmes. Low levels of finance across the clean cooking and fuels sector have been, and continue to be, a barrier to further growth. Closing the affordability gap, especially for non-biomass fuels, may require the injection of public funding as well as new business models (such as that of companies like Inyenyeri).

Growing evidence demonstrates the value of engaging women as value-chain actors and consumers

Ghana case study | Clean cookstoves programme, 2002–2007

LAID A FOUNDATION FOR GROWTH, SUSTAINABILITY AND SPIN-OFF COMPANIES

OUR FINDINGS

KEY TAKEAWAY: SCALE
A 30-fold increase in stove sales since 2007.

KEY TAKEAWAY: INCLUSIVITY
Made efforts to ensure stoves were accessible to poor households. Gender-sensitive in its design, but not gender-transformative. Rural firewood users were not the intended market.

BASIC PROGRAMME INFORMATION

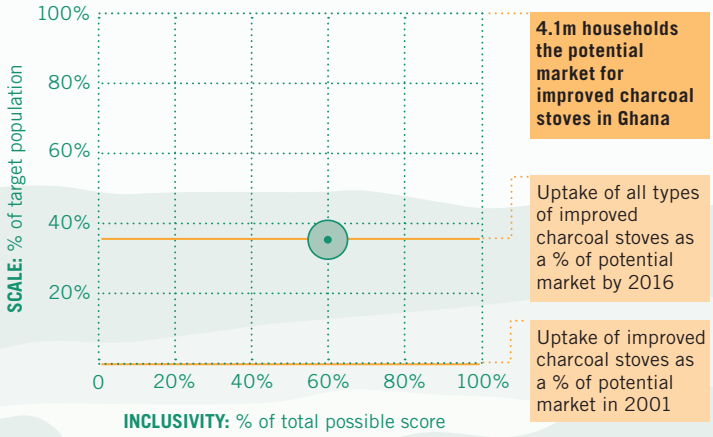
FOCUS
To build a sustainable market for charcoal ICSs, and to reduce indoor air pollution in 40,000 urban and 5,000 rural homes through the uptake of Gyapa ICSs.

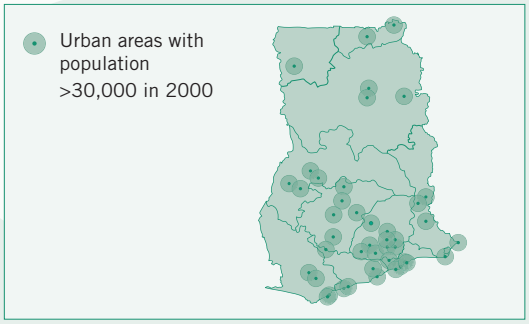
LOCATION
Nationwide, focusing on charcoal and potential charcoal users, which are low- to middle-income households in urban and peri-urban areas.

NUMBER OF BENEFICIARIES
Estimated 1.5 million households since 2002 through Gyapa and its spin-offs, Toyola and Man and Man: 37% of the potential market.

KEY STAKEHOLDERS
EnterpriseWorks/VITA (EWV), Shell Foundation, USAID.

PROGRAMME RESULT





Kenya case study | Kenya Biogas Program, 2009–2018

INSTRUMENTAL IN CREATING A LARGER MARKET SYSTEM AND STRONGER POLICY FRAMEWORK FOR RURAL BIOGAS

OUR FINDINGS

KEY TAKEAWAY: SCALE
A market system developed but so far has reached just 10.0% of the potential market for rural domestic biogas.

KEY TAKEAWAY: INCLUSIVITY
Clear and intentional gender-sensitive activities, but faced difficulties in targeting the poorest, remotest communities.

BASIC PROGRAMME INFORMATION

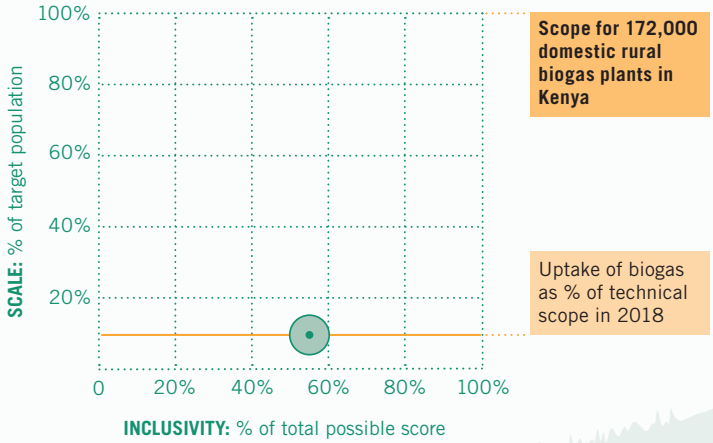
FOCUS
Developing a commercial, market-oriented biogas sector serving rural farmers.

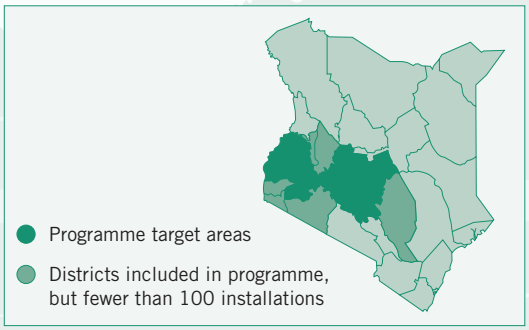
LOCATION
An initial focus in five priority districts, but later changed strategy to target dairy farmers, and coffee and tea cooperatives.

NUMBER OF BENEFICIARIES
17,134 biogas plants benefiting some 103,000 people.

KEY STAKEHOLDERS
Programme funded by Netherlands Ministry of Foreign Affairs and implemented by Hivos and SNV as part of a wider Africa Biogas Partnership Programme.

PROGRAMME RESULT





5. Decentralized electricity access

Off-grid and mini-grid solutions are estimated as the least cost option to supply electricity to most people living in remote areas; in sub-Saharan Africa, for example, nearly three-quarters of people in remote areas would be most affordably served by off-grid and mini-grid systems. Yet of all new connections worldwide between 2012 and 2016, only about 6 per cent were off-grid connections, from all sources (REN21, 2018).

The off-grid solar sector (from basic lights to home systems) has grown impressively since 2010 and now provides improved access to more than 360 million people. Over 130 million devices have been sold, with an average of 60 per cent year-on-year growth. Investment has increased with over US$500 million raised in the last two years (Lighting Global and Dalberg Advisors, 2018). Challenges remain, however. Growth is concentrated: just five countries accounted for over 50 per cent of sales in the second half of 2017 (GOGLA et al., 2018).[1] Growth has slowed since 2016, indicating the market's fragility and susceptibility to external shocks, such

Decentralized electricity solutions will play a central role in delivering universal access

as droughts. Service levels are relatively low: of the 72.3 million people reached in the second half of 2017, 39.1 million reached Tier 1 access and just 2.1 million reached Tier 2.

Since 2010 mini-grids have also been successfully deployed across Africa and Asia. India is the fastest growing market, with 206 mini-grids installed in the last 12 months. The 2018 pipeline suggests the market's size may more than double, with around 35 large projects (over 100 kW) announced, and numbers are likely to be higher when smaller mini-grids are accounted for (REN21, 2018). Again, considerable challenges remain. A lack of market intelligence hinders investment and viable business models are still being developed. Most countries have policy and regulatory gaps, for example around tariff setting, licensing and what happens if the grid comes (AfDB et al., 2016).

Decentralized electricity solutions will play a central role in delivering universal access, as a result of technology improvements and cost reductions, business innovation, increasing investment and an increasingly supportive policy environment. Emerging consensus suggests a mix of grid, mini-grid and stand-alone solutions is needed. This chapter looks at case studies from South Africa and Nepal to explore what public service delivery approaches have achieved, and we ask how we might achieve inclusivity at scale through a combination of public and private approaches.

Nepal Rural Energy Development Programme, 1996–2011

For universal access, a mix of grid, mini-grid and stand-alone solutions is required

Nepal's extraordinary hydropower potential has been recognized for many years and is, even now, underutilized (UNDP, 2012). Developments began in the 1960s (Sarangi et al., 2013) and expanded in the 1980s and 1990s through donor-funded programmes and government financial incentives. Serious challenges relating to system operation, maintenance and tariff recovery remained. These were exacerbated by a lack of coordination and standardization, and a shortage of companies providing parts or technical services (Sovacool and Drupady, 2012).

To address this, the government began to plan more strategically, developing programmes such as the Rural Energy Development Programme (REDP), implemented from 1996 to 2011, with funding from UNDP and the World Bank. The programme installed community-owned and managed micro-hydro systems providing electricity for household lighting and appliances, with a secondary focus

Table 5.1 Nepal pre-conditions

Population	23.15 million,[1] 86% rural[2]
Average rural population density	32.5 people per square kilometre in mountain districts, 167 people per square kilometre in hill districts[3]
GDP per capita (PPP at current international $)	US$1,285[4]
MPI Poverty Index	0.35[5]
Income inequality	GINI index 43.8[6]
Gender inequality index	0.710[7]

[1] CBS, 2016
[2] CBS, 2003
[3] Figure from 2001 in World Bank, n.d. b
[4] Figure from 1996 in World Bank, n.d. b
[5] Figure from 2006 in OPHI, 2017
[6] Figure from 2003 in World Bank, n.d. b
[7] Figure from 1995 in UNDP, n.d. a

on productive uses (Sovacool and Drupady, 2012). It installed 454 micro-hydro systems across 40 of the country's 75 districts, reaching nearly 58,000 households (600,000 people) (AEPC, 2011). The private sector acted as contractors responsible for installation and maintenance services.

Before and after situation analysis

In 1996 the micro-hydro sector was at a nascent stage. Government was beginning to give greater policy emphasis to rural, off-grid electrification. Pilot projects had demonstrated some willingness to pay. The supply side remained weak, since few companies had the skills to deliver installation and maintenance. Subsidies had been available since 1989 but other finance elements, such as private-sector investment or microfinance, were not present. To help plan more strategically, in 1996 the government established the Alternative Energy Promotion Centre (AEPC), giving it responsibility for coordinating rural and renewable energy.

By 2011 the energy access landscape had changed considerably. REDP was one of a number of interventions working in parallel that helped shape wider energy policies, such as the 2006 Rural Energy Policy and the 2009 Renewable Energy Subsidy Policy. Sector-wide stakeholder collaboration, initially established under REDP, has continued. Demand has increased through continued investment in electricity-using forms of economic activity. The sector as a whole continues to attract finance from communities, government, donors and the private sector, although raising sufficient finance remains challenging. The wider supply chain for micro-hydro installation, technical skills and maintenance has grown significantly.

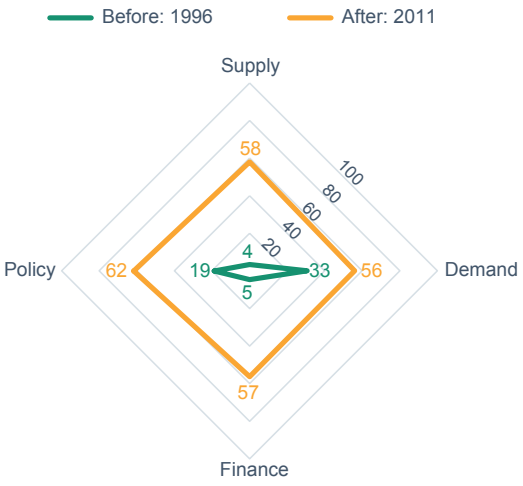


Figure 5.1 Nepal situation before and after REDP

Programme activities and emphasis

REDP was deliberately targeted at some of Nepal's poorest and most remote areas. Districts and villages were selected based on hydropower potential, poverty levels and distance from the grid. The programme was designed to connect whole communities, including poor and marginalized groups, with tariffs agreed by communities and often adjusted to ensure affordability for the poorest. Decentralized decision-making helped ensure activities were tailored to local needs.

Community mobilizers were assigned to each village for six months prior to micro-hydro construction. Mobilizers sought to develop the skills of community-level organizations, raise awareness, provide training in productive uses, and ensure empowerment of vulnerable groups.[2] Funds were provided to take advantage of the improved availability of electricity, boost incomes, provide power for schools or clinics, and to support environmental schemes. Communities themselves decided how to use these resources.

Separate community organizations were formed for men and women with representatives serving on the micro-hydro functional groups (MHFG) to oversee

REDP's governance, decision-making and implementation was decentralized

Community ownership of electrification projects allows a higher level of decentralization and builds local capacity and skills. As a result of this community member's participation in the social cooperative that manages the Grindi Khola Micro Hydro Village Electrification Project (in Kharbang village of Baglung district), she has now taken on a role at the local council. *Practical Action / Edoardo Santangelo*

Many companies that participated in REDP continue to operate in Nepal's growing energy access sector

installation and operation. Once established, MHFGs were encouraged to formalize as cooperatives; they became system owners responsible for financial management, such as setting tariffs and collecting fees. A smaller users committee managed day-to-day operations and basic maintenance.

Installations were funded with a central government grant covering about 50 per cent, local government contributing 10 per cent, communities about 20 per cent through in-kind labour, land and construction materials, and a further 20 per cent in cash either upfront or through a bank loan (UNDP, 2012).

Rural Energy Service Centres were a focal point for installation and maintenance. The centres were run by private companies contracted to source components, install systems and provide maintenance services. REDP built private-sector capacity to play this role through soft loans and technical support. The AEPC developed technical specifications and quality standards, provided training and pre-qualified businesses to undertake work. Many companies that participated in REDP continue to operate in Nepal's growing energy access sector in micro-hydro and other technologies.

Key achievements and remaining challenges

Communities demonstrated significant commitment to and ownership of the systems. As the Assistant Country Director for UNDP commented: *community participation was so intensive that the Maoist insurgency did not have much effect on REDP energy projects … Field visits became very difficult … but the micro-hydro functional groups were not affected. The Maoists allowed the projects.*

Bam Bahadur Thapa, the chief operator of the Grindi Khola Micro Hydro Village Electrification Project, stands proudly in the micro hydro power house in Kharbang village, Baglung district. This system has operated since 2002, now serving 972 households and 35 businesses and community facilities. *Practical Action / Edoardo Santangelo*

Estimates of the REDP's net benefits range from US$1.60 per US$1 invested in the programme to, at the household level, a return of US$8 per month against costs of US$1.40 (Sovacool and Drupady, 2012). We visited the Grindi Khola mini-grid in Baglung district, where a 90 kW system has operated since 2002 with 972 households, at least 35 small businesses and community facilities gaining access. The service generally satisfied stakeholders, and over time use has increased from just lighting to televisions, mobile charging, laptops and rice cookers, and to productive uses such as furniture making, grinding crops and metalworking. Kerosene use has virtually been eliminated.

Capital costs per kW reduced by a third under the REDP

Unit costs associated with the programme reduced over time. This partly reflected economies of scale, reducing capital costs by a third from US$3,300 per kW in 1996–98 to US$2,200 in 2005–06 (Clemens et al., 2010). Capacity development costs also decreased from US$14,000 per kW in 1996–98 to only $2,400 per kW in 2005–06 (Clemens et al., 2010), reflecting reduced investment in community mobilization.

The REDP has had its shortcomings. Sovacool and Drupady (2012) highlight:

- technical challenges regarding micro-hydro design and siting, and a lack of trained staff, supplies and maintenance expertise;
- economic performance with low load factors and, despite efforts, insufficient linkage to income-generating activities. Some communities struggled with tariff collection;
- institutional challenges, including AEPC's limited capacity, and insufficient funding for long-term maintenance and capacity development;
- social challenges, with the better off benefiting more from subsidies due to greater electricity use. Scheme design and management sometimes sparked conflict over use of water resources.

Outcomes: scale and inclusivity

REDP ensured an active role for women through women-only community groups

At the 2001 census, 23 per cent of households in the 40 target districts were electrified, and by 2011 this had risen to 50 per cent. The REDP brought electricity to 57,749 households (600,000 people), which represents 5 per cent of un-electrified households in the target districts in 2001. A similar number of households was reached by micro-hydro through the Energy Sector Assistance Programme in these districts.[3] Others were reached by grid extension.

REDP targeted the most remote districts, with the lowest electrification rates, that were unlikely to benefit from grid expansion in a five-year timeframe. Mechanisms for targeting the poorest districts, communities and households were strong. Its approach ensured poor households' participation in the planning, oversight and management of community-owned systems. The programme's insistence on community-level women-only groups and the gender balance of the MHFGs ensured an active role for women.

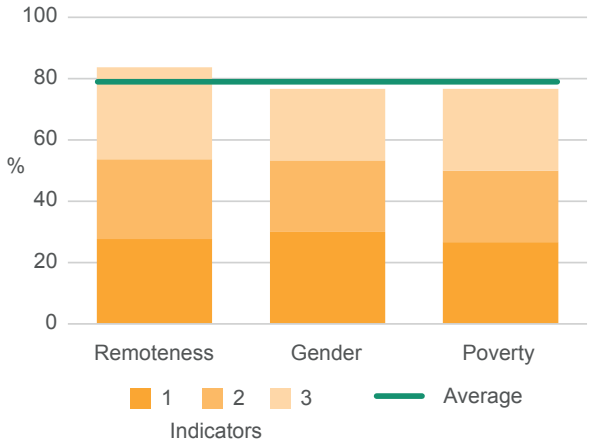


Figure 5.2 Nepal REDP inclusivity index

The REDP was intended to achieve sustainability through strong community ownership, investment in income-generating activities to boost demand, and sustained subsidies. This approach partially succeeded – community ownership remains strong but funding support is still required for community mobilization and sustaining capacities for maintenance. Some MHFGs have stopped meeting and some community organizations stopped collecting tariffs. More recently, there is a risk of grid encroachment; significant potential exists for micro-hydro systems to connect to the national grid, but new mechanisms are needed to make this work (Kumar et al., 2015).

Nepal: key findings

REDP shows how public service delivery mechanisms can target the poorest

The REDP shows how public service delivery mechanisms can be targeted to deliver energy access to the poorest districts, communities and households. Extremely strong community mobilization, an innovative financing mechanism that pooled donor grant and loan funds with national, district and community resources, and community ownership and oversight contributed to high levels of buy-in and better chances of long-term sustainability. Decentralized programme management, combined with an innovative community-level management structure and differential tariffs, ensured the programme effectively reached poor and marginalized groups.

Among the ongoing constraints are a lack of finance and demand. Inequalities remain, with richer households being able to take most advantage of electricity supplies, and a lack of consistency in how differential tariffs for the poorest are applied. Despite limited finances and, until recently, a lack of political stability, the Government of Nepal continues to put significant efforts into supporting mini-grids, with the REDP acting as a demonstration of what is possible. Building on a highly innovative, community-centred model, Nepal continues to find creative solutions to challenges and refine mechanisms to ensure inclusivity and sustainability.

South Africa solar home systems programme, 1999–2018

In 1990 only 35 per cent of South Africa's population had electricity access. Addressing historic inequalities through grid extension was prioritized by the post-apartheid government, and by 2002 over 70 per cent of households were connected. In 1999 the Integrated National Electrification Programme (INEP) launched an off-grid solar programme, aiming to bring solar home systems (SHSs) to 300,000 households over five years, to accelerate access for more remote households (Lemaire, 2011; World Bank, 2015b). The programme selected companies to operate in six concession areas in 16 districts. Tenders for delivering 1,000–3,000 SHSs at a time were issued as part of a rolling programme (Castalia Ltd, 2015). Programme guidelines stipulated the size of SHSs: towards the lower end of Tier 2 (Bhatia and Angelou, 2015) supplying a minimum of 170 Wh/day for 90 per cent of the time.

Table 5.2 KwaZulu Natal province pre-conditions

Population	9.58 million, and 57% rural[1]
Average rural population density	101 people per square kilometre[1]
GNP per capita (national)	$7,700[2]
MPI Poverty Index (national)	0.039[2]
Income inequality (national)	GINI index 57.8[1]
Gender inequality index (national)	0.62[2]

Note: The programme was concentrated in KwaZulu Natal and, as such, data for the province is a better reflection of the context for the programme than national-scale data.
[1] Figure from 2001 in World Bank, n.d. b
[2] Figure from 2001 in UNDP, n.d. a

Before and after situation analysis

By the early 2000s, 40,000–60,000 SHSs had been installed commercially in South Africa. However, sales volumes fell after an Electricity for All campaign led communities to expect the grid soon (World Bank, 2015b). National policies were prioritizing energy access, but not off-grid solutions. Marginalized communities were considered, but policies did not include specific gender dimensions. Spending on candles, kerosene and firewood in the absence of electricity represented a relatively high proportion of incomes.

In 2018 South Africa's SHS sector remains relatively small. While the number of renewable energy actors and investment in the sector have grown, this has fallen far short of Africa's leading off-grid solar markets. Despite some improvements in the policy environment through, for example, greater focus on promoting international standards and product

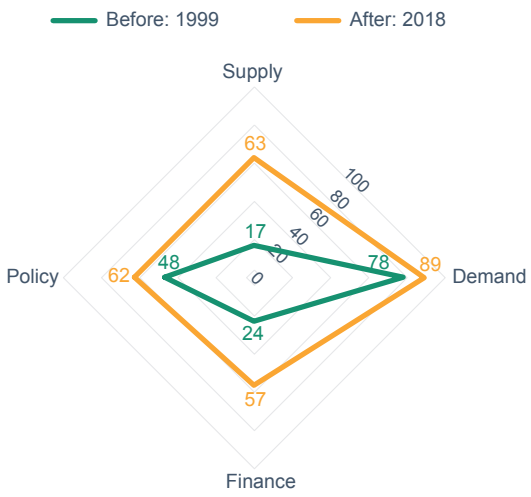


Figure 5.3 South Africa situation before and after the solar home systems programme

South Africa's SHS sector remains smaller than Africa's leading off-grid solar markets

The aim was to make off-grid systems affordable to households by heavily subsidizing end-user costs

testing, overall the policy framework remains inadequate to achieve universal access. Although the government has continued to invest heavily in energy access, off-grid sector subsidies have fallen behind those for grid extension (Castalia Ltd, 2015).

Programme activities and emphasis

The solar home systems programme was not primarily designed to build a market, but to deliver access to off-grid households, making systems affordable by heavily subsidizing end-user costs. This approach was driven by a desire for perceived fairness in end-user subsidies between on- and off-grid consumers, and a perception that limited ability to pay would cause a commercial approach to fail. SHSs were considered an interim solution, to 'temporarily give deep rural communities access to limited electricity until such time that grid connections are possible' (Department of Energy, 2012).

Following a competitive process, six companies won concessions, giving them a five-year exclusive right to access government subsidies for SHS installation. Subsidy was set at 80 per cent of capital costs. Concessionaires financed the remaining 20 per cent of the cost and installed and maintained systems for 20 years in exchange for revenue from monthly user fees. Many users were eligible for grants to help cover monthly charges, paid by municipalities to the companies under South Africa's Free Basic Electricity policy (World Bank, 2015b). Companies were also required to sell clean fuels to help meet household cooking needs, although this component was very limited in reality.

The programme did not have any gender empowerment objectives

Over the programme's lifetime, globally the performance of quality-verified SHSs has improved dramatically, with prices dropping rapidly. The programme failed to take advantage of these developments. Initially, it was prescriptive about technical specifications. Panels had to be 50 Wp[4] – enough for four hours of lighting, mobile phone charging and a small appliance such as a DC television (Bhatia and Angelou, 2015). One of the concessionaire companies, Remote Area Power Supply, developed a specific SHS design in 2001; while there was some innovation over time (Clark, 2005), essentially the same technology is still being used (interview with Robert Atkinson, NuRa manager 2001–04). In addition to the basic package, customers could upgrade their system with DC appliances, though these were more expensive than widely available AC appliances.[5]

The companies marketed their services through 'energy stores', at pension collection points and community meetings. Recruitment of skilled staff was difficult; companies ran staff development programmes, with at least one woman we interviewed progressing from an unskilled cleaning job to managing an energy store. The programme as a whole did not have any gender empowerment objectives or mechanisms for concession companies or beneficiaries.

The programme suffered due to a lack of detailed planning and government commitment. Ambivalence regarding the approach led to a scaling back of original plans. The grid continued to expand rapidly, including in the concession areas, and, once connected, households could not afford both charges and requested their SHS be removed.

Local and central government failed to provide predictable subsidy payments, with payments delayed and some municipalities withdrawing the subsidy entirely, rendering business models unviable. Neither was the concession model fully compliant with state procurement legislation. Consequently, only small areas were approved for subsidized installations each year, crippling the concessionaires' models and limiting their impact (World Bank, 2015b). A well-intentioned programme was severely hampered by the static nature of its design, preventing adaptations within a rapidly changing context which presented both serious challenges and huge opportunities.

Key achievements and remaining challenges

The programme brought benefits to its users, with households saving money on lighting costs (Energy Research Centre, 2004; Azimoh et al., 2015). Better quality lighting helped children's evening study, improved security and reduced fire risks. Some enjoyed better access to information and entertainment.

Box 5.1 KwaZulu Natal former SHS customer, a grandmother looking after household of 7

We had our system from 2014. In 2017 we had it removed when grid electricity came. It was good for lighting and cell phone charging, but now I have a TV, radio, lights, fridge, a kettle and a stove, for the same money as the old system.

The programme was hampered by its static design within a rapidly changing context

However, a majority of end-users said systems did not fully meet their needs and were disappointed by the quality of the system. End-users often did not understand how to use systems effectively, leading to tampering and product failure (often the battery). The impression that an SHS is an 'inferior technology given to the poor' (Prasad, 2007) contributed to low levels of satisfaction (Azimoh et al., 2015).

The programme's impact is unlikely to be sustainable. All concessionaires are financially vulnerable (Wlokas, 2011; Azimoh et al, 2015). By 2013, three of the six concession-holding businesses were no longer operational as a result of non-payment by customers (up to 30 per cent) and local municipalities withdrawing subsidies. Fixed rules in the tender contracts have prevented companies from taking advantage of improving technology and cost reductions in the sector globally. It has been hard to respond to requests for higher powered systems or demand from grid-connected households wanting to use their SHS as a back-up during blackouts. The programme has also suffered from a lack of transparent information about grid extension plans and updated lists of households registered as 'indigent' (the main SHS customers).

Outcomes: scale and inclusivity

The programme failed to reach its target of 300,000 systems, with just 150,000 SHSs installed by the end of April 2017 (Department of Energy, 2017), and only around 60,000 still operational (World Bank, 2015b). This number is in further decline as systems fail and people give systems back. At most 500,000 people benefited. At the 2001 census, 51 per cent of households in the 16 target districts were electrified, rising to 82 per cent by 2016 (Nesstar, n.d.). By 2016, just 1.5 per cent of households in the target districts reported using solar systems.

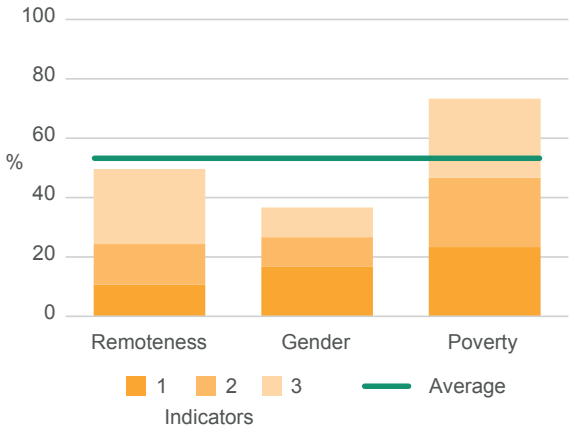


Figure 5.4 South Africa SHS inclusivity index

In terms of inclusivity, the programme was strongest on poverty, because it was linked to the government's overall energy subsidy programme for those

End-users had the impression that SHS was an inferior technology given only to the poor

The programme is one of very few to provide a similar level of subsidy for on-grid and off-grid connections

registered as indigent. However, this focus was weakened by municipalities abandoning subsidy payments owed under the Free Basic Electricity policy. The programme achieved its lowest scores for gender, with no activity addressing the challenges women might face in accessing or benefiting from it. In terms of remoteness, the target districts were not those with the most scattered populations, because the aim was to build a viable customer base.

South Africa: key findings

The programme was one of the first attempts to engage the private sector in delivering off-grid electricity. Its design in terms of technical specifications, the process for selecting concessionaires, and the mix of public and private funding to install and maintain SHSs was innovative at the time. The programme remains one of very few programmes to provide a similar level of subsidy for both on-grid and off-grid connections. Yet the static nature of its design, poor planning and limited government support all undermined concessionaire business models.

By not seeking to build a market, the programme missed a major opportunity to improve electricity access through private-sector participation and investment. If companies had been allowed to source the best products at the best prices from anywhere in the world, these products would have been far more attractive to customers. If companies had been allowed, or even incentivized, to serve customers with unreliable connections under the grid as well as poorer customers in more remote areas, then the programme could have improved electricity access for far more people. Private investment could have played a major role, reducing the cost per off-grid connection for government.

Box 5.2 Kenya Off-grid Solar Project

Kenya is the beacon of success in delivering solar home systems through the market, led by companies like M-KOPA. To date, nearly one million units have been sold. However, the market serves the easiest to reach first and, in some parts of the country, SHSs are not available at all.

The Kenya Off-grid Solar Access Project (KOSAP) demonstrates a new approach to overcoming such inclusivity issues through the use of public funding for market development. The World Bank has lent US$150 m to the Kenyan government for a variety of SHSs, cooking and mini-grid projects targeting 14 underserved counties and aiming to connect 600,000 households as well as community facilities with off-grid solar. These counties were chosen because of their low economic indicators and low population density (KPLC, 2018), meaning off-grid solutions are more cost-effective than grid extension.

Through KOSAP, a fund manager will be chosen to implement a results-based financing approach for solar lighting and clean cooking, looking to incentivize companies to develop operations in these areas. In addition, a local currency debt fund will support financing needs for companies delivering off-grid electricity solutions to these 14 counties.

While it is too early to draw conclusions, the KOSAP design, utilizing public, government funding to attract private-sector operators to underserved areas, is an innovative and interesting design to watch for replication across underserved, remote and marginalized areas.

Conclusions: off-grid public–private partnerships for inclusivity and scale

Our decentralized electricity case studies highlight the need for strong government commitment, thorough planning and budgeting, coordination among stakeholders, and effective mechanisms for policies and programmes to adapt to changing circumstances. They highlight the advantages and limitations of public service delivery approaches.

Nepal's REDP shows how public approaches can achieve inclusivity, using a variety of techniques such as decentralized programme management and differential tariffs to target the poorest districts, communities and households. South Africa's solar home systems programme shows how programmes can link with existing mechanisms, such as the 'indigent' register, to ensure subsidies are pro-poor. Although the concession model did not succeed in South Africa, a modern version of this approach may play a role in delivering inclusive access in future.

Above all, financing and sustainability challenges in Nepal and South Africa suggest that reaching universal access with minimal private-sector participation and investment requires a level of sustained public funding which is challenging for many governments and simply not possible for others. Market-based approaches have consistently outperformed public-sector delivery when it comes to achieving scale in the off-grid sector. For example, Kenya's market-based approach led to the sale of 3.15 million quality-verified solar lights and home systems between 2015 and 2017, and over half of these systems delivered Tier 1 access or above (GOGLA et al., 2018). The KOSAP programme is now trying to bring this to more remote areas (Box 5.2). Further research, experimentation and innovation is needed to understand how countries might bring together the market's ability to achieve scale and the public sector's ability to reach poor and marginalized groups.

Market-based approaches consistently outperform public-sector delivery when it comes to achieving scale in the off-grid sector

Nepal case study | Rural Energy Development Programme, 1996–2011

DECENTRALIZED DECISION-MAKING AND STRONG COMMUNITY OWNERSHIP AND OVERSIGHT

OUR FINDINGS

KEY TAKEAWAY: SCALE
Fairly large-scale in the context of mini-grid programmes (delivering 454 systems), but still only benefiting 3.8% of all households in the target districts.

KEY TAKEAWAY: INCLUSIVITY
Targeted remote areas and ensured strong engagement from women and poor households, from planning to implementation.

BASIC PROGRAMME INFORMATION

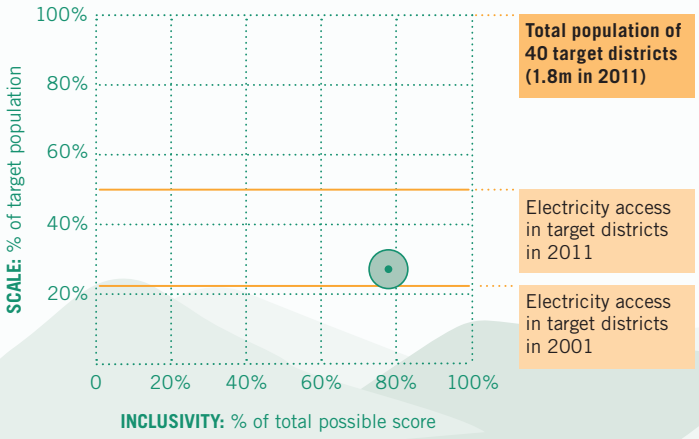
FOCUS
Community-managed micro-hydro systems providing household lighting and power for small appliances, with a secondary focus on productive uses such as milling.

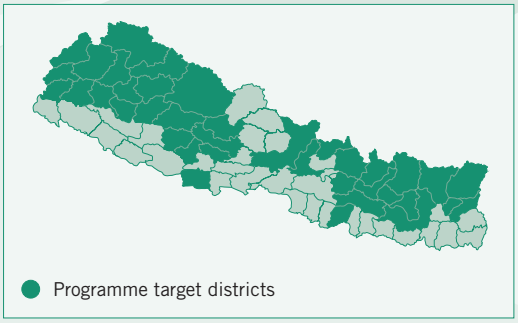
LOCATION
Targeted 40 out of 75 districts.

NUMBER OF BENEFICIARIES
57,749 households or about 600,000 people.

KEY STAKEHOLDERS
Government of Nepal, UNDP and the World Bank.

PROGRAMME RESULT





South Africa case study | SHS programme as part of the Integrated National Electrification Programme, 1999–2018

ONE OF THE FIRST ATTEMPTS TO ENGAGE THE PRIVATE SECTOR IN DELIVERING OFF-GRID ELECTRICITY

OUR FINDINGS

KEY TAKEAWAY: SCALE
By 2016 just 1.5% of target district households reported using SHSs, with many failed systems being returned by customers.

KEY TAKEAWAY: INCLUSIVITY
Achieved greater parity between grid and off-grid subsidies and removed up-front costs for poor households, but did not address the challenges women might face in benefiting from the electricity.

BASIC PROGRAMME INFORMATION

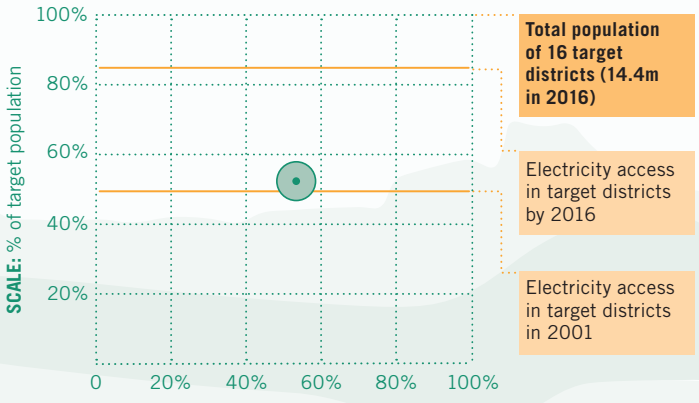
FOCUS
To accelerate access to electricity for households in remote communities as an interim measure before grid connections could be extended.

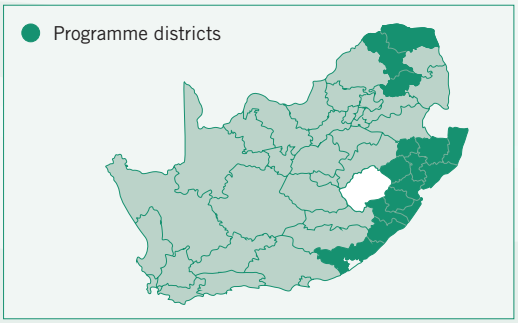
LOCATION
Concessions in 16 districts in four provinces.

NUMBER OF BENEFICIARIES
150,000 SHS installations providing at most 500,000 people with basic electricity access (although only 60,000 are thought to be still in use).

KEY STAKEHOLDERS
Delivered by six private companies contracted by the government.

PROGRAMME RESULT





6. Grid extension

Grid extension has been the critical driver behind the increase in global electricity access from 83 per cent in 2010 to 87 per cent in 2016. It continues to be the main way governments seek to improve energy access. Of all new connections in Africa between 2012 and 2016, 94 per cent came from grid extension (IEA, 2017b). For the top 20 SEforALL high-impact countries, '90 per cent of trackable finance went to development of national electricity infrastructure' (SEforALL et al., 2017). The quality of electricity service that grid extension provides is variable, with blackouts common. Poorer people often cannot afford a connection or use more than a minimal amount of electricity.

Forecasts suggest grid extension will retain an important role in helping to achieve the 2030 goals, especially as part of integrated plans that also promote mini-grid, off-grid and clean cooking solutions. In this chapter we explore how well programmes in India and Peru have reached the last mile, and the quality and affordability of services provided.

India Rajiv Gandhi Grameen Vidyutikaran Yojana programme, 2005–15

Grid-based rural electrification has been on India's policy agenda for decades, with programmes launched as early as 1950 (Bhattacharyya, 2012). Initially, programmes focused on ensuring each village had a connection and on energy for irrigation. In the late 1990s, the focus shifted to household electrification (Banerjee et al., 2015). A number of schemes were launched to improve access for the poor, with efforts accelerating from 2000.

The scale of the challenge in India is immense. In 2001 only 43 per cent of the population had electricity access (Government of India, 2011). By 2016 half a billion people had gained access, with the electrification rate reaching 82 per cent. To achieve 100 per cent, a further 239 million people need to be reached. The pace of change has accelerated, with new connections increasing from 28 million between 2000 and 2012 to 41 million in 2016. This trend puts the country on track to achieve universal access by the early 2020s, although the grid's quality of electricity service is variable and in some cases very poor.

RGGVY was the first such programme in India to prioritize electricity for households below the poverty line

Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY) was the first rural household electrification programme to operate nationwide and to prioritize provision of electricity to households 'below the poverty line' (BPL), which it connected for free. It merged all ongoing Ministry of Power rural electrification programmes and focused on transmission, distribution and household connections (with no additional generation), aiming to electrify villages of over 100 households.[1] BPL households needed to be registered and recommended for a connection by village councils. Those 'above the poverty line' (APL) could connect for a fee. We focused our analysis on the programme's operations in Odisha state, which was among the most energy poor (Jain et al., 2015).

Table 6.1 Odisha state pre-conditions

Population	36.8 million, 85% rural[1]
Rural population density	204 people per square kilometre[1]
GNP per capita at purchasing power parity	US$1,589[2]
Proportion or population 'below the poverty line'	46.4%[3]
Multidimensional poverty index	0.339[4]
Gender-related development index	0.524[5]

[1] GoI, 2001
[2] Figure from 2005–06 in UNDP, n.d. a
[3] MSJE, 2005
[4] 2005
[5] Hausmann et al., 2006

Before and after situation analysis

Before 2005 electricity provision in Odisha was top-down involving few actors. Initiatives to extend access were poorly planned and access rates were low – only 19 per cent in 2001. The Director for Regulatory Affairs at Odisha Electricity Regulatory Commission commented, *There was no targeted scheme to tackle rural electrification before RGGVY, and area prioritization was carried out by the influence of politicians* (interview, March 2018). By 2015 the government had prioritized access more highly and funding had increased. New guidelines, standards and programmes followed. Tariffs have remained affordable for the vast majority and new public awareness campaigns have boosted demand.

In 2005 only a handful of microfinance organizations and small and medium-sized enterprises were lending for energy-related technologies, but by 2015 microfinance

and local bank financing for off-grid energy had increased. New companies and cooperatives have entered the energy access market, both on-grid and off-grid, playing a variety of roles.

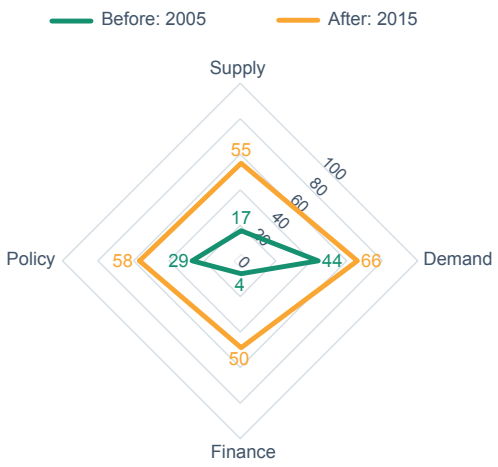


Figure 6.1 Odisha situation before and after RGGVY

Programme activities and emphasis

The RGGVY was undertaken by state-owned and private distribution companies, following approval of their plans by the national Rural Electrification Corporation (REC). A three-tier quality-control system monitored the standard of the works. To reach rural communities the idea was to work through local companies, NGOs or individuals operating as franchisees and authorized representatives of distribution companies (Indian Power Sector, 2012). Franchisees managed meter reading, issuing bills, collecting payments and basic maintenance. A franchisee training programme was provided by the Ministry of Power, aiming to reach 30,000 people nationwide. Franchisee recruitment and support was accompanied by an awareness campaign to reduce losses through theft.

Where grid extension was not cost-effective, the REC issued work orders to State Renewable Energy Development Agencies to construct off-grid solar systems. Funds for this were only allocated in 2008, with the first project approved in 2010, and no funds released until 2013. No targets were set for this element of the programme (MoP, 2014).

Funds for RGGVY's off-grid component were slow to be allocated and released

Key achievements and remaining challenges

Programme evaluations found electrification's biggest impact was increased study time for school children. They also point to the growth of small businesses, better access to mass media and communications, and slightly improved health services (Parikh et al., 2013; TERI, 2013; PEO, 2014). End-users described other benefits, including improved roads (built to transport equipment), reduced theft and wild animal threats due to increased lighting as well as reduced emigration. School attendance improved, people felt better connected to local and national events through television, and income-generating activities could continue after dark.

Box 6.1 A village stakeholder in India describes the benefits of electricity connection

We got electricity in 2011 … Among all the government welfare schemes, this one is life-changing. This enabled light in our lives. Life is much better now. (Village goat farmer, aged 65)

Despite the programme's extraordinary achievement in terms of new connections, challenges remained in extending the grid and ensuring the quality of electricity services. In the initial design phase, decisions were taken without consulting villages, leading to errors in design and cost estimates (Tripathi, 2014). Activities were delayed by slow processes for acquiring land and obtaining road permits, and further complicated by the need to run transmission lines across challenging terrain. At village level, updating lists of BPL households – which had not been updated since 2002 – caused delays. Even after lists were updated, some households were not included, leaving them unable to

Challenges remained in extending the grid and ensuring the quality of electricity services

gain access. The envisioned franchise system did not attract many participants, and the National Planning Commission had to recommend that distribution companies hire staff to take readings and collect payments (PEO, 2014).

Costs were high due to a shortage of required materials, high contractor charges, and states sometimes failing to waive taxes on materials. The quality of materials and equipment was also challenging; for example, electricity meters often failed after six to eight months. While distribution companies replaced meters they could not accurately charge customers, instead charging a flat fee which was unaffordable to BPL customers.

Transmission and distribution infrastructure was not upgraded to handle demand increases as a result of new connections. Around 11 per cent of transformers in Odisha burnt out and another 9 per cent were stolen. Systems to repair damage were slow. There was not enough investment in additional generation capacity to support greater demand, leading to low and fluctuating voltage and unreliability due to load-shedding blackouts. One study found 17 per cent of rural households in Odisha had a connection but only a Tier 0 supply, while a further 39 per cent were only in Tier 1 (Jain et al., 2015).[2] Efforts to promote the productive use of electricity and raise awareness of income-generating opportunities ended because supply problems meant productive use applications were not viable. The National Planning Commission found that although incomes increased, benefits were no bigger than for unconnected villages (PEO, 2014).

The lack of experience, guidelines or targets for the off-grid component prevented its effectiveness

These issues affected uptake. Jain and colleagues (2015) found that only 10 per cent of the unelectrified in rural Odisha had no connection available to them: 70 per cent had *chosen* not to connect, either because connection fees or tariffs were unaffordable or supply was unreliable.

The programme's off-grid component brought power to very few villages. The National Planning Commission found minimal examples nationwide and there were no records of this in Odisha (PEO, 2014). As mentioned, although projects were sanctioned, no funds were disbursed until 2013 (MoP, 2014). The lack of experience, guidelines or targets for this element prevented its effectiveness.

Outcomes: scale and inclusivity

Odisha's 2005–06 Demographic and Health Survey (DHS) found that 45 per cent of households had electricity access (IIPS/India and Macro International, 2007), and the 2011 census found only 43 per cent were using electricity for lighting (Government of India, 2011). RGGVY programme reports state that as of March 2014, 2,865,036 BPL households (Department of Energy, n.d.) had been connected in Odisha – around 30 per cent of households and 53 per cent of households un-electrified in 2005. By 2015–16 the DHS found that 85 per cent of households in Odisha were electrified (IIPS/India and ICF, 2017); however, 17 per cent had a connection weaker than even Tier 1 access. The real access rate for Odisha was therefore lower than the figure for household connections.

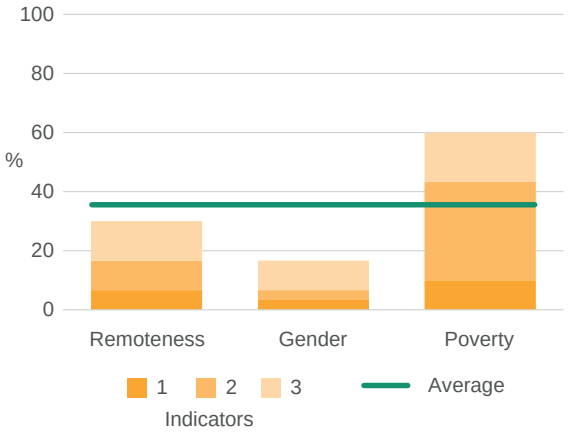


Figure 6.2 Odisha RGGVY inclusivity index

There are also concerns about the financial viability of distribution companies, given low

tariffs and usage. Revenues may be too low to cover the cost of billing, payment collection, operation and maintenance in the long term (Khurana and Banerjee, 2015). By contrast, in Vietnam the grid was extended in parallel with efforts to boost institutional generation capacity, in order to ensure a reliable, quality electricity service (Box 6.3).

The programme scores best for its poverty focus. As of March 2012, 89 per cent of connected households were BPL and received a free connection (MoP, 2014). Low-quality supply and the absence of support for productive uses limited the programme's impact on poverty, however. Some people were left off BPL lists, while others could not afford tariffs, especially when meters failed and flat tariffs were applied. Some people who did not qualify as BPL could not afford connection fees (Willcox et al., 2015).

Box 6.2 A village stakeholder in India describes some of the problems they faced with RGGVY

Electricity came to our village in 2011 but still 21 per cent of households do not have electricity although they are in poverty. They were not included in the below the poverty line list.

In terms of remoteness, although there were efforts to reach the entire state, some areas were left out; villages under 100 households were excluded and others were missed due to the programme's limited off-grid component. The map (see summary box page 54) shows that some districts moved closer to universal access than others where less than 50 per cent of unelectrified households were reached. The programme had no explicit gender focus in its policies or targets and ran no gender-focused activities. The extent to which female-headed households were reached is unclear because these data were not collected.

Villages under 100 households were excluded and others missed due to RGGVY's limited off-grid component

Box 6.3 Expansion of grid connections in Vietnam

In 1975 Vietnam launched a long-term electrification programme, resulting in an increase in electricity access from 2.5 per cent in 1975 to 96 per cent in 2009. Eighty million people gained access (World Bank, 2011: xi).

Initially priority was given to economically productive connections, especially for agriculture, which ensured demand and revenues from tariffs were higher than in India. Steadily increasing access between 1975 and 1993 gave the government time to build institutions capable of ensuring high-quality electricity services were provided (ADB, 2011: 4). New household connections from 1994 to 1997 soared from 14 per cent to 61 per cent (World Bank, 2011: xi).

In Vietnam, unlike in India, the grid developed with supply and demand increasing in sync. The system developed in phases, evaluating progress and reassessing priorities before expanding the type and quality of connections in the next phase (World Bank, 2011: xii).

India: key points

RGGVY achieved huge numbers of household connections, with improved lighting leading to better education and safety outcomes. However, programme delivery was poorly organized. Delays were frequent, quality was compromised, costs overran, and operations and maintenance were neglected. Without a mechanism for stakeholders to work together to address these issues, distribution companies were left to resolve challenges, leading to a less desirable outcome than planned, especially for the poorest or most remote communities.

Subsequent programmes have sought to build on RGGVY's success in achieving new connections and to address outstanding issues relating to supply and quality of electricity services.

The REP's decentralized design process was intended to lead to more efficient use of government subsidies to connect rural households

Peru Rural Electrification Project, 2006–13

When the Rural Electrification Project (REP) was launched in 2006, Peru's electrification rate was 80 per cent overall, but only 40 per cent in rural areas (World Bank, n.d. b): one of Latin America's lowest rates. Electricity sector reform began in the early 1990s with the Electricity Concessions Law, which unbundled and privatized state-owned utility Electroperú,[3] giving responsibility for electricity distribution to a mix of state-owned and private companies, and obliging them to provide electricity to all households within 100 metres of the existing grid.

The REP was designed by the Ministry of Energy and Mines and the World Bank. Unlike previous centrally planned electrification programmes, under the REP distribution companies designed their own activities and submitted these for ministry approval and funding. A dedicated unit under the Department for Rural Electrification (in Spanish, DGER) provided coordination and technical assistance. This decentralized design process was intended to lead to more efficient use of government subsidies to connect rural households (World Bank, 2017).

The ministry covered project capital costs and provided subsidies of up to US$800 per connection. Households did not pay connection fees, which were regarded as part of the capital cost.[4] Users consuming less than 100 kWh per month paid subsidized tariffs, with higher subsidies again for less than 30 kWh.[5]

The REP had five components: 1) to provide new connections for households, businesses and public facilities, using both on-grid and off-grid systems; 2) technical assistance for rural electrification; 3) a pilot programme to promote productive uses; 4) a small hydro financing facility;[6] and 5) project management. Capital investment in grid extension (US$118 million) absorbed most of the US$131 m budget.

Table 6.2 Peru pre-conditions

Population	27.9 million, 25% rural[1]
Population density	21.8 people per square kilometre[1]
GNI per capita purchasing power parity	US$7,460[1]
MPI Poverty Index	0.069[2]
Income inequality	GINI 51.7[1]
Gender inequality index	0.442[3]

[1] Figure from 2006 in World Bank, n.d. b
[2] Figure from 2008 in UNDP, n.d. a
[3] Figure from 2005 in UNDP, n.d. a

The central government also rolled out a centralized rural electrification programme which, between 2007 and 2012, implemented 628 projects including 55 transmission lines and 299 rural distribution systems (Dasso and Fernandez, 2015).

At the start of the REP, the energy ecosystem was more supportive than in other case studies

Before and after situation analysis

At the start of the REP, the energy ecosystem was more supportive than in other case studies. Grid electrification systems were well established with many competent ecosystem actors. There was, however, a low level of women in the sector's workforce, and distribution companies had insufficient expertise in off-grid technologies and promoting productive uses of electricity. Our supply indicators do not adequately capture distribution companies' improved capacity over time. New demand-creation activities ran under the REP programme and grid-based power

affordability increased slightly. Grid electricity costs were reasonable for the average household (less than 5 per cent), while unelectrified households spent only a little more (8–10 per cent of their incomes) on energy, and this has not changed.

In the policy arena, although there were national plans committed to rural electrification, no clear targets were set. The biggest changes over time were the introduction of solar product standards and new testing laboratories. New subsidy and tariff policies contributed to making REP possible. Gaps remained in terms of multi-stakeholder participation in policy. New forms of finance have become available: for example with commercial banks participating in the first renewable energy auction for hydropower plants, and new credit lines becoming available from KfW and the Inter-American Development Bank.

Figure 6.3 Peru situation before and after REP

Programme activities and emphasis

REP focused heavily on supply-side support, including technical assistance to distribution companies. Projects were prioritized based on economic viability: costs and expected revenues. Communities could ask their local distribution company to be included in grid extension plans they put forward. Communities needed to have more than 1,000 households, and costs per connection needed to be within the subsidy cap of US$800. This incentivized distribution companies to select locations relatively close to their existing network.

For the off-grid component, consultants were contracted to support distribution companies. Solar home systems of 60–80 Wp were installed through nine projects, reaching 7,100 households (7 per cent of all those reached). The criteria were that at least 400 households should be served, with a 90 per cent end-user price subsidy available.

The programme also invested US$2.8 m through 14 NGOs to promote the productive use of energy, run marketing campaigns, and provide advice through local, multi-stakeholder institutional support platforms.

Key achievements and remaining challenges

A World Bank (2017) study found that incomes of households connected under REP rose by 30 per cent and that better-off households benefited most. Women took on additional income-generating activities and were able to work more at night, while spending less time collecting water or wood. In focus groups, people described the benefits of no longer having to buy kerosene, candles or batteries. For larger appliances, such as televisions, powered by car batteries, people no longer needed to travel to towns to recharge the batteries, which needed replacing every one to two years. People felt at less risk from fire and less excluded from national life or economic opportunities. They felt the programme should have included street lighting as well as household connections.

The incomes of households connected under REP rose by 30% on average

Box 6.4 End-user perspectives on the REP in Peru

The situation is something else. Press your button [switch] and go to the kitchen. There is no need to walk with your flashlight. Now I have my colour TV. I have my team [sound]. This week we are coordinating with my wife to have a refrigerator.

We have not felt that there has been any discrimination between men and women. It was for everyone. Those who did not get them is because they were far from service.

Rural villagers, La Ancajima, Piura

Businesses increased electricity use fourfold and households threefold

Many households invested in appliances, though there were concerns about increasing electricity bills. Most households used 12–30 kWh per month. Users would have liked more advice from distribution companies about how to manage electricity use to keep bills down. Unscheduled power outages occurred but not frequently.

The productive uses component resulted in 21,111 enterprises and families adopting electricity-powered equipment. Businesses more than quadrupled electricity use, and beneficiary households tripled electricity use. Users would have invested even more if 3-phase supply were available, which is needed to power large motors. Nationwide, women made up 30 per cent of the beneficiaries of this component and half the beneficiaries in the rural highlands (World Bank, 2015a, 2017). Wealthier people benefited most, since they had the resources to invest in productive use technologies and thus take most advantage of electricity availability.

Some construction delays occurred as a result of time taken for distribution companies to design, and government to approve, projects. There were also delays in certifying work for quality, and heavy rain caused seasonal delays. Planning was hampered by a lack of information about the location of households and the need to coordinate with rural electrification schemes run by regional governments.

Finally, changes in senior personnel negatively affected the programme. The unit within the Department for Rural Electrification responsible for coordination and technical assistance had no director from 2009, leading to delays in getting work approved. There were also leadership changes at some of the distribution companies, some of which were politically influenced. These did not, however, lead to cost overruns, with prices fixed under contracts.

Outcomes: scale and inclusivity

The REP operated in 48 of Peru's 196 provinces. At the time of the 2005 census these were home to 13.8 million people, of which 25 per cent were unelectrified (according to the 2007 DHS survey). The programme reached 105,048 households (446,715 people), businesses and public institutions (including 2,900 schools), representing 3 per cent of the provinces' population, or 13 per cent of those unelectrified. By the 2011 Demographic and Health Survey, the target provinces' electrification rate had risen to 80 per cent (INEI/Perú, 2012).

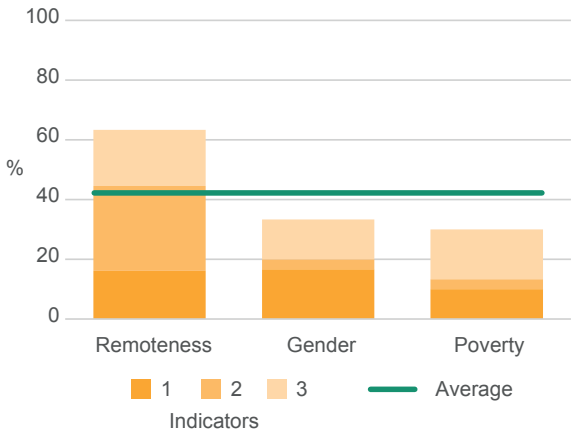


Figure 6.4 Peru REP inclusivity index

The programme formed part of a broader rural electrification drive, in which the state invested US$898 m. From 2007 to 2012, electricity coverage in rural areas increased from 29.5 per cent to 63 per cent, with the REP contributing six per cent.

There were no clear targets for reaching indigenous communities. As with RGGVY, the programme had no explicit gender focus in its policies, targets or activities, and its reporting did not disaggregate by gender. Women appreciated the greater security provided by street lighting, which helped enable their increasing social engagement after dark (World Bank, 2013b). A study of the parallel, centrally driven electrification programme found the introduction of electricity increased rural women's incomes by 30 per cent while men's incomes remained unchanged (Dasso and Fernandez, 2015).

The subsidy cap per connection meant that while new areas were reached, these tended to be larger communities close to the existing grid. The SHS component reached more remote and smaller communities, but delivered only 7 per cent of new connections. In April 2011 the World Bank approved funding for a second phase of the project with similar modalities, but aiming to reach smaller communities, farther from the grid.

The tariff structure with subsidized tariffs for low-consuming households made electricity affordable for rural families. This was the main mechanism through which REP had a poverty focus. The productive use element of the project brought most benefits to wealthier people.

Peru: key points

The REP helped distribution companies build capacity to plan and implement projects extending services to new communities, independently of central government. The incorporation of a productive uses element helped ensure demand and adequate revenues. However, it is clear that REP tackled easy-to-reach communities and households already in a position to capitalize. The SHS component was implemented in a limited way. In 2017 the programme closed down, and rural electrification has since been planned and implemented by central government without a productive uses element and with reduced opportunity for distribution companies to apply their local knowledge and thus bring efficiencies. Challenges in reaching more remote communities and dispersed households remain.

REP tackled easy-to-reach communities and households already in a position to capitalize

Conclusion: the limits of grid extension in reaching the last mile

Grid extension programmes play a vital role in delivering electricity access. The India programme had extensive geographical reach and a clear poverty focus in serving BPL households. The Peru programme aimed to build distribution companies' capacity to reach rural communities and effectively promoted productive uses, with women's income increasing.

In neither programme were gender issues mainstreamed, which was a missed opportunity. In India, benefits were undermined by poor-quality supply, and greater coordination with community-level actors would have improved planning and efficiency.

Both cases illustrate the challenges of reaching remote communities. Both recognized the need for integrating off-grid components but did not implement these effectively or at sufficient scale. It was expected that off-grid activities could be delivered through the same teams and mechanisms as grid extension, which was problematic. Delays were caused by a lack of expertise in planning such work, with no targets being set and limited political will to ensure success. These programmes illustrate that reaching the last mile with grid extension remains expensive and challenging, requiring new capacities and approaches for integrating off-grid components.

Reaching the last mile with grid extension remains expensive and challenging

India case study | Rajiv Gandhi Grameen Vidyutikaran Yojana, 2005–2015

AN EXTENSIVE CENTRALIZED PROGRAMME WITH THE AMBITION TO ELECTRIFY ALL OF INDIA

OUR FINDINGS

KEY TAKEAWAY: SCALE
Achieved significant scale but issues of sustainability and quality of electricity remain.

KEY TAKEAWAY: INCLUSIVITY
Provided free connections for those registered as below the poverty line (BPL), but the off-grid component's failure left remote villages out.

BASIC PROGRAMME INFORMATION

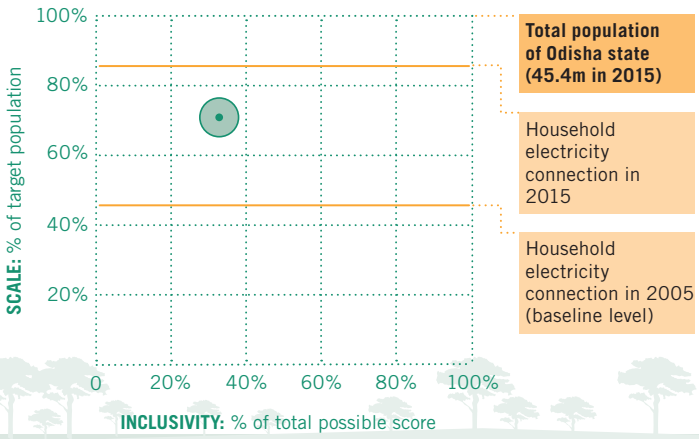
FOCUS
Provision of electricity to BPL households, but only in villages of 100 households or more.

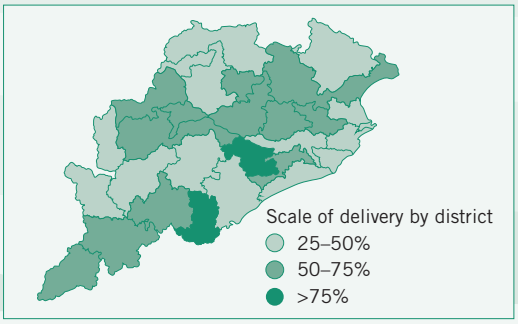
LOCATION
Nationwide, but we focused on Odisha state.

NUMBER OF BENEFICIARIES
In Odisha state 2,865,036 BPL households were connected, as of March 2014. However, for one in six, the very poor quality of this connection meant almost no level of energy was actually delivered.

KEY STAKEHOLDERS
Led by the Government of India, implemented through private and state-owned distribution companies.

PROGRAMME RESULT





Peru case study | Rural Electrification Project, 2006–2013

ENCOURAGED RURAL DISTRIBUTION COMPANIES TO EXTEND THEIR SERVICES TO NEW COMMUNITIES

OUR FINDINGS

KEY TAKEAWAY: SCALE
Reached new communities in the context of strong inequalities between electrification rates in rural vs urban areas. Overall, scale fairly limited.

KEY TAKEAWAY: INCLUSIVITY
Targeted remote and unelectrified provinces, but only the easiest to reach within that. Boosted livelihoods, but did not tackle gender disparities.

BASIC PROGRAMME INFORMATION

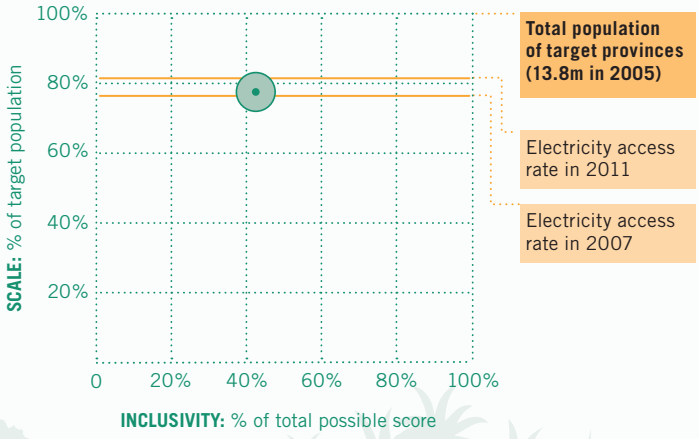
FOCUS
Electrification of rural households through decentralized distribution companies unlike previous centrally planned electricity programmes.

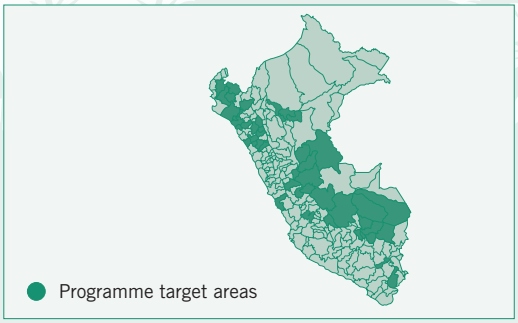
LOCATION
Operated in 48 of Peru's 196 provinces.

NUMBER OF BENEFICIARIES
105,048 households, businesses and public institutions or 446,715 people, representing 20% of the provinces' unelectrified population.

KEY STAKEHOLDERS
Peruvian Ministry of Energy and Mines, World Bank (loan funds) and GEF (grant).

PROGRAMME RESULT





7. The search for inclusivity at scale

Using case studies, *PPEO 2018* has explored whether scale and inclusivity (in terms of remoteness, poverty and gender) can be achieved together and, if so, what tools and levers are used. Over the last 15 years, large-scale grid extension programmes in India and elsewhere have driven global electricity access improvements. Yet for many countries with large access deficits, especially in sub-Saharan Africa, this approach is not economically feasible or technically advisable given existing alternatives. Alternative approaches that involve building markets for off-grid solutions have been gaining traction and may perform better on inclusion. In future, strategies which integrate grid, mini-grid, off-grid and clean cooking solutions are needed. Many will seek to achieve inclusivity at scale, at the lowest cost, through a combination of private and public-sector delivery approaches.

The SDG7 Tracking Report (IEA et al., 2018) and the *Energy Access Outlook* (IEA, 2017b) show the transformation still required to achieve our 2030 goals.

Strategies are needed that integrate grid, off-grid and clean cooking solutions

PPEO 2016 and *PPEO 2017* revealed the shift needed in terms of integrated, bottom-up planning and redirection of investment. However, these reports did not consider how to combine accelerated progress with inclusivity, which we address in this *PPEO*.

In this chapter we review different routes to inclusivity and scale, and how to combine the two. Are scale and inclusivity mutually exclusive or could both be achieved simultaneously?

Routes to inclusivity

Every case study had at least some inclusivity objectives, with varying outcomes. Overall, the public sector-led grid extension programmes performed less well on inclusivity and needed greater focus on remote areas, improved action to address gender issues, and carefully designed mechanisms to target lower income groups (see Table 7.1).

Table 7.1 Inclusivity design objectives and programme activities of case studies

	Inclusivity score (%)	*Remoteness*	*Gender*	*Poverty*	*Households served*
Ghana – stoves	60	×	✓	~	1,500,000
Kenya – biogas	55	~	✓	~	17,134
Nepal – micro-hydro	79	✓	✓	✓	57,749
South Africa – SHSs	53	~	×	✓	150,000
India – grid	36	~	×	✓	2,865,036
Peru – grid	42	×	×	✓	105,048

× programme did not contain any objectives or major activities to address this aspect
~ programme had objectives but no clear actions, or actions had very limited impacts in this aspect
✓ programme set objectives and carried out clear actions to address this aspect

Remoteness

Governments invariably prioritize scale over inclusion

Nearly all case studies sought a balance between serving remote areas and reaching as many people as possible. However, it was the area of inclusivity where most scored poorly. When faced with a choice between scale and inclusion, governments invariably chose scale. Nepal was the only programme that deliberately sought to target remote communities, where decentralized decision-making helped ensure remote communities within districts were not overlooked. The programme in Peru was also well targeted in terms of the selection of target areas, but focused on the 'low-hanging fruit' of serving larger communities within this.

In India, villages as small as 100 households were eligible, although pressure to maximize numbers of connections inevitably meant the easiest to reach were prioritized. Similarly in South Africa, SHS concession areas had to be far from the grid, but also have sufficient number and density of eligible poor households. This left those in the most remote areas unserved and caused problems when the grid expanded into concession areas. There is an increasing recognition of the challenge of effectively integrating grid and off-grid systems within planning, programmes and as they interact within the same geographies. The programmes in India and Peru both planned off-grid components, but these were poorly designed and unsuccessful.

The clean cooking programmes in Ghana and Kenya were designed to accelerate market growth, and targeted customers considered to have the greatest commercial

potential – who were not in remote areas. Many stove programmes seek scale by focusing on charcoal-burning, fuel-buying urban and peri-urban customers, leaving the more challenging wood-burning rural populations behind. Biogas has potential here since it does not rely on population density or regular external maintenance. However, it does require feedstock and water, which are not always available in more remote areas, and access to significant capital or finance to cover initial construction of the digester.

The private sector can be incentivized to serve remote rural areas

The private sector can be incentivized to serve remote rural areas. The KOSAP programme in Kenya (Box 5.2) is an example of a programme designed to do this. Similarly, in the remote Lake Zone of Tanzania, a successful results-based financing programme led to sales of 38,000 SHSs, and eight out of 10 participating companies remain active in the zone even after the programme closed in 2014 (Hankins, 2017).

Gender

Three case studies incorporated gender-focused approaches. In Nepal, community mobilizers sought to ensure that women were empowered to play an active role in management and oversight through women-only groups and equal representation on micro-hydro functional groups. In Kenya the programme produced new guidelines and country-specific action plans on women's inclusion with support from ENERGIA. In Ghana the programme empowered retailers, the majority of whom were women.

By contrast, neither of the grid extension programmes nor the SHS programme in South Africa recognized that women might have difficulties in accessing or benefiting from the programme, or sought to empower women. In India and South Africa, programme evaluations did not address gender, and gender-disaggregated data was not collected.

The programmes that addressed gender issues had challenges in the extent to which they were able to address deep-seated inequalities. The Nepal programme partially succeeded through women's engagement in decision-making and access to income generation and finance, but the extent to which this had a broader, sustained social impact is difficult to assess. The programme in Ghana worked with existing gendered roles (men as artisans and women as retailers) rather than challenging them. The Kenya programme, despite significant efforts, acknowledged challenges and slow progress. It was implemented in a context where women's engagement in biogas was low, with men playing leading roles as both suppliers and buyers, and women farmers less likely to own sufficient cattle or be able to access credit.

If we are to ensure energy access programmes address women's needs and priorities, we must continue challenging investors, planners and decision-makers at all levels to do more to mainstream gender. Strong global messaging needs to filter down to national programmes and to those involved in design and evaluation. Programmes must be designed with components that address barriers to women's participation. Such components need clear plans, budgets, targets and monitoring mechanisms to ensure meaningful implementation.

Programmes must address barriers to women's participation

There are examples of programmes which have successfully championed gender empowerment. Such programmes have found it boosts businesses (see Box 7.1). Hart and Smith (2013) and Gray et al. (2017) highlight a range of examples from the solar lighting and cookstoves subsectors. Innovation is still needed in other energy access subsectors. Implementing agencies should themselves be aiming for

Box 7.1 BURN Manufacturing in Kenya – women's empowerment on the route to scale

BURN Manufacturing, producing Kenya's best-selling Jiko Okoa stove, and with sales of over 400,000 since 2013 (BURN Manufacturing, 2018a), has prioritized gender equity in its workforce. BURN employs women at all levels and in all types of roles across the company, with women comprising 54 per cent of the workforce (BURN Manufacturing, 2018b). A grant from the Clean Cooking Alliance's Women's Empowerment Fund in 2016 helped the company explore the best route to sales in rural areas, finding that providing finance to women's savings groups, and woman-to-woman marketing were the most effective tactics (Women Deliver, 2018).

gender equality in their teams and pay structures, while also building capacity to deliver effective gender-focused approaches. Only then will women's full potential as active agents of change be unlocked, supporting the delivery of energy access and benefiting equally from it.

Poverty

Careful design, implementation and monitoring of subsidy mechanisms can ensure inclusion of the poorest

Four out of our six case studies had a poverty focus: more than prioritized gender or remoteness. A range of different approaches to targeting were used. The India and South Africa programmes used existing official citizen registers to target beneficiaries. While a high proportion of poor households was reached, lists were inaccurate, with some of the most deserving left out. The approach also created a 'cliff edge' between those qualifying and those not. In India very few 'above the poverty line' households participated in the RGGVY because of the high costs they had to pay, being ineligible for subsidies.

In Nepal and Peru, poor households were included by being charged lower tariffs that made electricity affordable. In Nepal these were fixed by local committees. In Peru, as in many countries, lower tariffs were charged for lower quantities of electricity with costs covered through cross-subsidy, charging heavier users higher tariffs to compensate. Unusually, customers were not charged a connection fee at all, helping to overcome a major barrier to access. In Peru and Nepal, evaluations showed higher income households benefited most since they were in the best position to capitalize on electricity to boost incomes.

In the clean cooking examples, poorer households were targeted by improving affordability. Stoves in Ghana were designed and priced to ensure they were widely affordable and would quickly deliver savings in fuel costs. Carbon finance helped lower prices. For biogas, finance schemes were established to spread the costs, and technology innovations helped bring capital costs down, but biogas is overall more expensive ($690 for a basic installation) and affordability remains a challenge.

Lower income groups need more support to take advantage of electricity

All these mechanisms for delivering subsidies – using existing citizen registers, charging lower tariffs and improving affordability to target poor households – have a role to play in ensuring inclusion of the poorest, but should be carefully designed, implemented and monitored. Citizen registers are only useful if kept up to date. Graded classification by income level combined with a tapered subsidy can avoid 'cliff edges' and help ensure all groups can afford a connection. The hurdle of high connection fees has been addressed in many grid extension programmes through subsidies or spreading the costs across monthly bills. Lower tariffs for lower levels of consumption, or for the poorest households, can work but should be implemented consistently, based on clear guidelines, to be perceived as fair. Lower income groups need more support, financial and technical, to take advantage of the new availability of electricity

Table 7.2 Strength of programme actions in demand, supply, policy and finance dimensions

	Supply	*Demand*	*Policy*	*Finance*	*Model*
Ghana – stoves	✓✓	✓	~	✓	Market-based, with donor funding and INGO-led (initially)
Kenya – biogas	✓✓	✓	~	✓	Market-based, with donor funding, INGO-led
Nepal – micro-hydro	✓✓	✓	✓	✓✓	Public-sector led with strong community participation
South Africa – SHSs	✓	~	×	~	Public-sector led with support from concessionaires
India – grid	✓✓	×	×	~	Public-sector led
Peru – grid	✓✓	✓	✓	✓	Public-sector led with support from distribution companies

Note: In 'finance' we are considering the extent to which the programme sought to leverage different types of finance from a variety of sources.
✓✓ strongest aspect of the programme
✓ programme included activities in this area
~ programme paid some attention to this area, but only marginally or with marginal success
× programme had no activities or focus in this area, or its objectives in this area were abandoned, or downgraded significantly during implementation

to boost their incomes if they are to benefit as much as – or more than – higher income households.

Routes to scale

We reviewed the actions that each programme took to achieve scale by addressing supply, demand, the policy environment and access to finance, and assessed how the wider energy access situation changed over time. These drivers vary depending on the technology being promoted and whether the model is market-based or public-sector led (see Table 7.2). The two case studies that achieved the greatest scale were very different: India, with a public sector-led programme, and Ghana, with market-based stove sales achieved beyond the initial phase of the project.

Supply

Supply is the quantity of a product that producers are willing and able to supply to the market at a given price. It was low at the outset in all countries except Peru, and a major programme focus everywhere.

The clean cooking examples were market based, supporting the private sector to sell products and services. This involved working through existing artisans and distributors, reducing costs for companies and removing bottlenecks in the supply chain through, for example, free product transportation, concessional working capital for retailers and upfront payments for artisans. South Africa's programme initially sought to subsidize concessionaires to deliver at scale, but only a limited set of tenders were actually offered.

The grid extension programmes also focused heavily on supply. Control was held centrally but planned and implemented by local distribution companies. In India, plans to involve a wider range of stakeholders as franchisees in meter reading, maintenance and collecting payments failed to attract many participants. The programme had to overcome bureaucratic delays and shortages of materials, while challenges linked to the quality and reliability of electricity supply continued.

Grid extension programmes traditionally focus heavily on supply, with less consideration of demand

Demand

Increased demand leads to the increased viability and sustainability of mini-grids

Demand is the quantity of a good or service that consumers are willing and able to buy at a given price. Demand creation through consumer awareness campaigns or investment in productive uses of electricity was a feature of all programmes except in India. The South Africa case illustrates the damaging effects of negative social perceptions of SHSs being an 'inferior, interim' technology, and is evidence of an insufficient consumer awareness effort.

In Peru and Nepal, demand creation focused on increasing productive electricity use, thus boosting incomes and subsequent ability to pay for electricity. In Kenya, too, biogas was marketed through agricultural cooperatives and linked with the productive benefits of using the slurry. In Nepal, communities were able to access loans for productive use technologies. In addition to financial support, promoting productive uses requires boosting supply of, and raising awareness about, the types of appliance available, how to access them and how to build sustainable businesses using them. This issue is attracting more attention in the mini-grid sector, because increased demand leads to increased viability and sustainability of mini-grids, enabling the model to be scaled.

Policy

An enabling policy environment creating supportive conditions is instrumental in scaling up

Policy changes were not a major focus area for our case studies, but often a change of policy was the programme's foundation in the first place or a cause of its limited impact. In South Africa, policy barriers relating to national procurement rules prevented the programme being rolled out at the scale originally envisaged. On the other hand, Peru's 2006 Electrification Act ruled that household connection costs should be borne by the distribution company, not the household, and that tariffs should cross-subsidize between higher and lower consuming customers. In some cases the overall policy environment was already quite positive, but in others it became more supportive over the programme period. In Nepal the experience of the programme itself helped shape national policies for rural energy and renewable energy subsidies. An enabling policy environment creating supportive conditions, can therefore be instrumental in scaling up.

Finance

Access to finance relates to whether customers, producers and governments have access to the type of capital (e.g. public funds, grants, equity, loans and consumer finance) needed to purchase and/or supply energy access products and services. *PPEO 2017* highlighted the affordability gap between the costs of delivering energy access in remote rural locations and communities' willingness to pay as well as the need for improved access to finance, especially for women. Many of those issues are echoed here, with affordability and access to finance cited as major barriers to growth.

National governments were the most significant funders in our electricity case studies, with those in Nepal and Peru part-funded through overseas development assistance. The cookstoves and fuels programmes were entirely supported through development assistance as well as accessing some carbon finance. Government funding attracted co-investment. In Nepal, communities themselves covered 40 per cent of the cost of micro-hydro installations through a combination of in-kind support and loans. Private companies co-invested alongside the government in Peru and South Africa. Local government contributed its own funds in Nepal and took out loans to cover 10 per cent of the costs in India.

All case studies involved subsidy. Market-based cookstove programmes used supply-side subsidies which sought to reduce marketing and logistics costs.

All countries except Ghana subsidized end-user prices through either grants, soft loans or 'social' tariffs.

Combining the right levers for scale

All our case studies focused heavily on supply, but a balanced approach is needed to achieve scale. This balance depends on the technology being deployed and the national context. It was only the clean cooking programmes and, partially, micro-hydro in Nepal that intended to be self-sustaining and grow further after the end of the programme. However, even where the aim is solely large-scale delivery within a programme, focusing solely on supply can lead to future problems with sustainability of impacts (as is the case with low electricity consumption in many grid extension programmes). Awareness about what a technology can deliver was a key issue in some cases, as were barriers linked to affordability. The Nepal and Peru programmes have been pioneering in addressing demand and affordability through promoting productive uses, and the Kenya programme through working with agricultural cooperatives.

The Nepal and Peru programmes addressed demand and affordability by promoting productive uses

For the cookstove and household solar sectors, there is a degree of consensus among practitioners around the interventions needed for scale. Issues are different again for clean fuel markets, which are by their nature fast-moving consumer goods.

- *Supply*: technical support to companies, including staff training, CEO mentoring and assistance with investment readiness. In clean cooking, this needs to be balanced with ongoing technology and design improvements.[1]
- *Demand*: below the poverty line and above the poverty line public awareness campaigns with targeted messaging for particular groups, as in the behaviour change programmes for clean cooking in Kenya, Bangladesh and Nigeria (Evans et al., 2017), and the new Clean Cooking Alliance resource hub (CCA, n.d.).
- *Policy*: tax incentives, enforced quality standards, and a clear, stable regulatory environment designed specifically for particular technologies or fuels.
- *Finance*: improved access to finance for consumers and companies through results-based financing (EnDev, 2017), concessional lending, and other approaches that reduce risk or transaction costs. Greater patient capital is needed in clean cooking and fuels to help establish strong markets.

Beyond these actions, there is a need for greater collaboration between public and private actors to achieve scale. Governments need a better understanding of what motivates or prevents private-sector engagement, as for example in Power for All's market activation work in Nigeria (see Box 7.2).

For the more nascent mini-grid sector, solutions are being sought to implement viable business models that will build towards scale. There is some consensus that solutions should include:

We need greater collaboration between public and private actors to achieve scale

- *Supply*: technical support in areas such as engineering, business advice, legal compliance and market scoping.
- *Demand*: investment in productive use appliances and awareness raising to boost demand and ability to pay, which may also improve inclusion.
- *Policy*: clear policy and regulatory frameworks covering tariffs, streamlined licensing processes and other regulatory issues, such as what happens in case of future grid extension.
- *Finance*: improved access to grants, subsidies, concessional loans, foreign-exchange risk mitigation and other risk-mitigating instruments, such as guarantees or insurance.

Box 7.2 The Power for All campaign and Nigeria's off-grid taskforce

With 75 million people living off-grid in 2014, Nigeria has Africa's largest energy access deficit (SEforALL, 2017). Off-grid sector challenges include low consumer awareness, limited private-sector capacity, commodification, lack of access to finance, and inconsistently enforced taxation. Before the Power for All campaign, it was hard to resolve such issues due to low understanding and support for off-grid solutions. There was limited collaboration between government, the private sector and other stakeholders.

The Power for All campaign worked with and through a broad coalition of partners. It supported the set-up of the Renewable Energy Association of Nigeria to act as the voice of the off-grid private sector. It raised awareness of and built support for off-grid solutions among government stakeholders. It engaged civil society organizations as champions, advised investors on entering the market, and called for a new multi-stakeholder taskforce to drive change. Launched in February 2018, the taskforce has more than 30 members and five working groups addressing priority barriers: taxation, consumer awareness, end-user financing, market data, and quality and certification.

The campaign successfully built support for off-grid solutions and established a new mechanism for collaboration. This has dramatically improved Nigeria's chances of addressing off-grid barriers. It has led to increased interest from companies in entering the market, and from government and aid agencies in supporting the market.

Inclusivity at scale: consensus and debate

As *PPEO 2016* and *PPEO 2017* outlined, to achieve scale and reach the last mile, there is a need to accelerate the transition from grid-centric approaches towards integrated plans combining grid, mini-grid, off-grid and clean cooking solutions. By redirecting resources from grid extension into other solutions, governments can accelerate energy access progress, attract higher levels of private investment, and reach more people at lower cost. This approach is not common but there are some countries showing dynamic leadership, such as Togo (see Box 7.3).

Some have assumed that simply promoting off-grid solutions will, by their very nature, mean more inclusivity. Our case studies show this is not guaranteed, and inclusivity has to be actively pursued in the off-grid and clean cooking sectors, just as it does on-grid. A number of businesses are now demonstrating that promoting women's empowerment is a key part of the route to scale (see Box 7.1).

There remains debate on a number of vital issues, including the best use of public funding to grow markets to scale and reach the 'last mile'. Public funding and subsidies that build markets, enable policies, increase consumer awareness and go direct to companies or fund activities that reduce companies' costs or risks can help address many issues without distorting consumer behaviour. End-user price subsidies, some argue, should only be introduced in the final phases of a programme, to minimize market distortion (GOGLA, 2017). This, however, does not address the question of how to serve the poorest and most remote areas quickly and equitably. What financial incentives (including results-based finance) should be used to accelerate market growth is also debated, with the East African Community considering whether VAT and tariff exemptions on solar products can be applied equitably.

Inclusivity has to be actively pursued in the off-grid and clean cooking sectors, just as it does on-grid

As with household solar, debate still rages on some vital issues in the mini-grids sector. This includes the complex issue of if and how tariffs should be set. Where fixed universal tariffs are set for both grid and mini-grid customers, mini-grids may be economically unviable in more remote areas and deter market entrants who cannot afford to supply at the universal tariff rate. On the other hand, such tariff regimes can provide opportunities for cross-subsidy between different groups of consumers. These issues require careful consideration to ensure goals of both scale and inclusivity are achieved.

Box 7.3 Togo CIZO initiative – national-scale integration of off-grid solutions

Most of the 3 million people (out of 8 million) in Togo without electricity access live rurally, distant from the national grid. In 2017 the Togolese government announced an energy strategy which, in line with *PPEO 2017* modelling, seeks to achieve much of its short-term electrification through off-grid solutions.

The government's CIZO initiative (meaning 'lighting up') aims to electrify 2 million people in remote areas by 2022 through solar home systems (SHSs). UK-based company BBOXX was awarded a contract to deliver 300,000 SHSs over five years, through the relatively high rates of mobile phone penetration (66 per cent) and advances in information and communication technologies used in off-grid solar products (Clover, 2017).

The Togolese government is using the state-run postal service as a network of mobile money agents and is putting in place a major training programme for 2,500 solar technicians (Agence Ecofin, 2017).

By creating a favourable environment for investment, a public fund of about US$15 m aims to leverage over US$100 m in private investment (Clover, 2017). Promisingly, in a pioneering deal worth US$4 m, a local bank has provided debt finance for the first tranche of systems (African Review, 2018).

Conclusion: planning for scale and inclusion

Given finite resources, governments face trade-offs. Most obviously, grid extension delivers a (slightly) higher level of energy service, but at a higher cost per person, while household solar delivers a lower capacity service (although at Tier 2 or 3 this may be sufficient to meet needs), at a lower cost per person to potentially larger numbers. There is also a trade-off between scale and inclusivity whether on-grid or off-, since reaching the poorest or most remote costs more than serving higher income, less remote areas. It is increasingly apparent that this trade-off does not hold true for addressing gender issues, which, if done well, can boost sales and profits. It is clear that, in order to meet universal energy access goals, large-scale energy access programmes need to become more inclusive, meeting the challenge to reach new areas and tackle gender inequality. Smaller, more inclusive programmes need to reach greater scale.

For this, off-grid solutions need to be pursued with as much attention, budget and political will as grid extension, and clean cooking and gender considerations must be brought into the mainstream in terms of planning and financing. Greater attention is needed on questions of demand, supported by policy and finance, to balance the focus on supply.

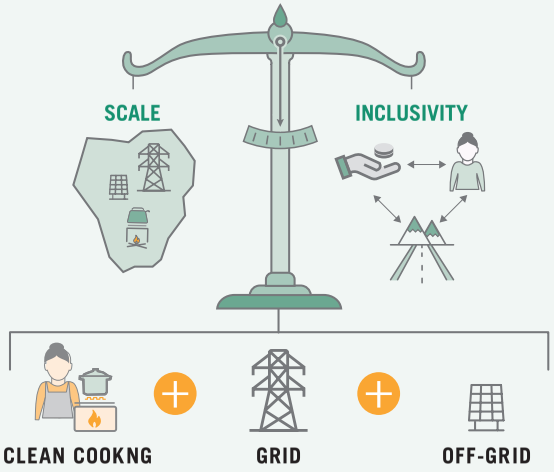
No blueprint exists to achieve this, nor should it. What is important is the process of decision-making. Planning should address questions of inclusivity from the outset, and a phased approach may be needed, allowing learning and adapting over time (as in Vietnam). National strategies will need components that are technology- and geography-specific, involving adequate preparatory research, engagement with potential market participants, and decentralized decision-making, including poor communities themselves. Now is the time for an ever greater focus on those who will otherwise remain unserved in 2030 and beyond.

Clean cooking and gender considerations must be mainstreamed in planning and financing

Striking the right balance | Achieving energy access that is both inclusive and at scale

1 Universal access

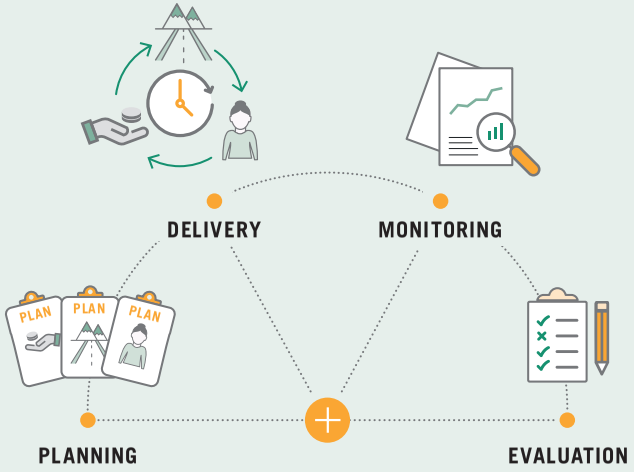
Achieving universal energy access that leaves no one behind requires a **mix of programmes considering both scale and inclusivity.** Planning and delivery models need to integrate grid, off-grid and clean cooking solutions.



We must achieve a better balance in order to progress these two objectives in parallel.

2 Leaving no one behind

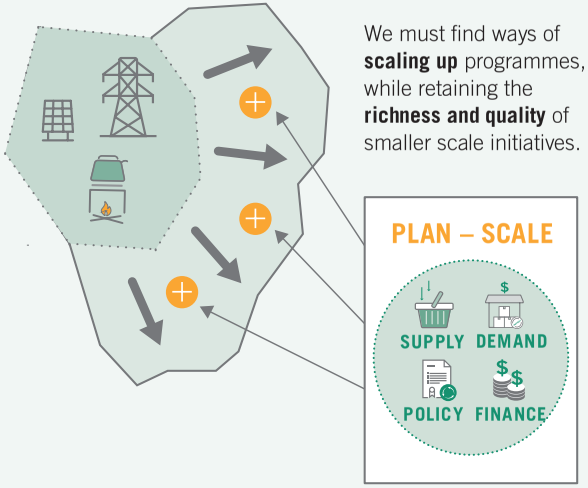
Reaching the 'last mile' requires a concentrated focus, with sufficient, targeted finance, dedicated staffing and tailored processes. Measures of programme success should reflect not just numbers of connections, but aspects of remoteness, poverty and gender.



Addressing inclusivity should be a driver of success.

3 Addressing barriers to scale

Reaching scale requires a holistic approach, working not only on the volume and quality of supply, but on blockages in finance, weak demand and policy shortcomings.



Market activation approaches bring stakeholders together to address barriers to scale.

UNDERSTANDING THE CONTEXT IS CRUCIAL FOR STRONG PROGRAMME DESIGN

Planning for scale and inclusion requires better understanding the Total Energy Access service needs of rural communities and a good mapping of the context to help generate a range of appropriate delivery models.

ADDRESSING GENDER INEQUALITY IS GOOD FOR BUSINESSES AND PEOPLE

Gender-sensitive and transformative approaches can boost company bottom lines and enable women's full participation in the attainment and enjoyment of SDG7.

SMART USE OF PUBLIC FUNDS WILL BE CRITICAL TO CLOSING THE AFFORDABILITY GAP

Because private-sector companies target the most profitable market segments first, public finance for well-designed subsidies and regulations remains crucial.

EMBRACING MULTI-STAKEHOLDER PROCESSES AT DECENTRALIZED LEVELS

Bringing the right stakeholders together can improve trust, stimulate new markets and, together with a clear policy steer, ensure a focus on reaching marginalized groups.

ADAPTING TO THE CHANGING ENVIRONMENT IS KEY FOR SCALE AND SUSTAINABILITY

In a dynamic sector where innovations in technology and new opportunities arise rapidly, programmes need to learn and adapt to sustain progress.

8. Conclusions and recommendations

Three years since the signing of the Sustainable Development Goals, the High-level Political Forum 2018 saw all countries reaffirm commitment to 'reach the furthest behind first and ensure that no one is left behind' (UNESCO, 2018). Although there has been progress on electricity access, largely through grid extension programmes, the quality of service can be poor (as found in Odisha, India). Clean cooking remains astoundingly under-prioritized and off-grid markets remain concentrated in a few countries. We remain far from 'reaching the furthest behind first' – or even at all. Ensuring inclusion and scale work together to achieve energy access is key to attaining our global aspirations, and it is this duo of requirements that *PPEO 2018* addresses.

Tackling key aspects of inclusivity head-on

Too often, large-scale programmes fail to adequately plan for inclusion. Areas are neglected because the population is too scattered or the terrain too challenging. Programmes may be designed to reach a segment of poor people but rarely the poorest,

and the additional barriers women face in accessing or using energy often remain overlooked, underestimated or simply ignored. Grid extension programmes have often ignored gender inequalities seeing households as an ungendered unit. As our examples show, off-grid programmes are not *necessarily* more inclusive than grid extension.

Off-grid programmes are not necessarily more inclusive than grid extension

Addressing these shortcomings requires proactive and deliberate consideration from the beginning (as in Nepal). Adding pro-poor 'bolt-ons' to existing programmes is not the answer (for example in India and Peru). A concentrated focus, sufficient finance, experienced staffing, and tailored processes are needed to achieve inclusive outcomes. Evidence from clean cooking (for example Box 7.2) and off-grid programmes is increasingly demonstrating the value of being gender-sensitive in both boosting company bottom lines and having a greater impact on the ground. Addressing inclusivity should be a driver of success, with programme metrics reflecting not just the number of connections, but aspects of remoteness, poverty and gender.

Aiming for scale, while recognizing who is left behind

To achieve scale in delivery we must aim for a balanced approach that holistically considers the barriers to scale: not only in supply, but also addressing blockages in finance, weak demand and policy shortcomings. This needs to start from both an assessment of the energy access ecosystem, and an understanding of the energy services that rural communities actually require at home, in their livelihoods and for community services.

Market-driven approaches, encouraging the private sector to take up and expand elements of the market, have brought dynamism and sustained growth especially in clean cooking (as in Ghana) and off-grid electricity. Market activation programmes can be powerful in bringing stakeholders together to galvanize action and ramp up progress to the next level (see Box 7.3). However, it is clear that private-sector companies will seek the most profitable market segments first and will not deliver where it is unprofitable, which means public finance as well as other incentives and regulations are needed. Our case studies featured examples of citizen registers, lowering tariffs and other means of improving affordability, and all involved subsidies of some description: either for suppliers or directly to end-users. Although these need to be carefully designed to ensure benefits reach those for whom they are intended, subsidies will undoubtedly be essential to achieving SDG7.

Similarly, decentralizing key elements of decision-making to local levels (as in Peru and Nepal) can encourage inclusivity; raising considerations beyond purely cost, about which communities would benefit and the selection of local-level implementing partners. Finally, an inflexible approach can become a barrier to scale (as in South Africa). Programmes must adapt to new conditions over time and as technology improves.

Transforming lives through energy

Our meetings with community stakeholders around the world reminded us of a simple truth: access to modern energy services transforms lives. It can be a catalyst for women's leadership (Nepal), reduce household wood-fuel burden and save trees (Kenya), and boost local businesses (Peru). All of us in the energy access sector – decision-makers, financiers and practitioners – have an obligation to do more to ensure poor communities truly benefit from initiatives. This means not only good programme design, but also following processes to ensure programmes involve the right people and organizations, and that experiences are learned from and programmes adapted over time. This may be hard to track and measure, but that is no excuse for failing to act. Adopting such approaches will bear fruit in accelerating the rates of progress towards our global goals, transforming lives along the way.

Notes

Chapter 3

1 A full listing of these scoring criteria is available from http://policy.practicalaction.org/ppeo2018.
2 In South Africa, for example, many people in the target districts were reached with grid electricity while the SHS programme was working to reach more remote communities in the same districts.
3 We look at numbers of people who gained access to the technologies programmes promoted. The electricity access People were provided ranged from Tier 2 SHS in South Africa to potentially higher tier mini-grid power in Nepal and grid power in India and Peru, which generally achieves Tier 2–3 in rural contexts. As lower tier solutions, the biomass improved cookstoves reviewed in Chapter 4 would not meet the criteria for the SDG 'energy access' definition, while the biogas cooking solutions are regarded as 'clean'.

Chapter 4

1 These were the Council for Scientific and Industrial Research's Institute of Industrial Research (CSIR-IRR) improved woodstove project and the Volta River Authority (VRA) climate stove initiatives in the early 2000s.
2 Information from personal contacts. Bensah et al. (2015) report sales per month for Gyapa of 11,000 and Toyola of 30,000. By 2018 Man and Man were still selling around 6,500 per month.
3 The liner breaks but can be replaced. The metallic outer part of the stove lasts far longer. A study carried out on Toyola stoves found that 93 per cent of the total sold were still in use (Ashden, 2011).

Chapter 5

1 The five markets are India, Kenya, Democratic Republic of Congo, Uganda and Ethiopia.
2 The six *mul mantras* were: 1) organizational development for community-based organizations; 2) capital formation to help fund the micro-hydro project; 3) community capacity building for construction and system maintenance; 4) environment management to mitigate potential negative environmental impact; 5) technology promotion to encourage use of the system; 6) women's empowerment to ensure women benefited.
3 The Energy Sector Assistance Programme ran in parallel to the REDP between 1999 and 2012, and reached 90,000 households with some overlap in districts targeted (FCG International, 2017).
4 Watt peak (Wp) is the output power achieved by a *solar* module under full *solar* radiation (under set standard test conditions).
5 For a short time DC fridges were offered, but hardly any were sold as they cost almost four times the price of an AC equivalent and required installation of a larger system.

Chapter 6

1 'Village electrification' was defined as the presence of basic infrastructure allowing the potential for all households to be connected, with at least 10 per cent of households actually connected, and public places such as schools, municipal *panchayat* offices and health centres connected.
2 The framework of tiers applied by the Council on Energy, Environment and Water (CEEW) in its work differs in some respects from the World Bank ESMAP framework, but at Tiers 0 and 1 there are few appreciable differences. A comparison is set out in Jain et al. (2016).
3 Peru's pre-reform public service system was organized into vertically integrated power utilities, with two of them – Electroperú and Electrolima – providing about two-thirds of Peru's electricity services through the national interconnected system, Sistema Eléctrico Interconectado Nacional (SEIN) and nine regional companies providing the rest to isolated power systems (Vagliasindi and Besant-Jones, 2013).
4 This arrangement was brought in by the Rural Electrification Law passed in 2006 and was not envisaged in initial project planning. It increased the overall cost of each connection to the project and was one of the reasons that fewer households were reached than planned (World Bank, 2015a).
5 This is paid for through a surcharge of consumption of over 100 kWh per month.
6 This component was cancelled in the end. Instead, and separately, the government launched an auction system for electricity generation from renewable sources including small hydro.

Chapter 7

1 As highlighted by the CEO of the Clean Cooking Alliance, Dymphna van der Lans, at the Deep Dive session on cooking at the 2018 SEforALL Forum.

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Poor people's energy outlook 2018

Energy access for all has been enshrined in the 2030 Agenda for Sustainable Development (SDG7) and the Paris Agreement on climate change and there is now widespread acceptance of the great wellbeing and development benefits energy access unlocks. Nevertheless, a lack of understanding about the best methods for delivering electricity and clean cooking at scale remains – and many of the most marginalized people are still left behind.

Key to ramping up progress on our global goals will be identifying the most effective elements of success stories that have arisen, learning lessons from these programmes, and adapting them for different and complex contexts. Building on *PPEO 2016* (planning) and *PPEO 2017* (financing), *Poor people's energy outlook 2018* examines six case study programmes across the clean cooking, decentralized electricity and grid extension sectors, to explore how to reach energy access at scale in an inclusive way. The report demonstrates that a range of energy access interventions is needed to achieve SDG7, and encourages holistic programmes that achieve scale across elements of demand, supply, policy and finance.

The world is not on track to achieve universal energy access by 2030 – but we still have an opportunity to change the direction we are heading in. *PPEO 2018* illustrates how we as a global community can deliver energy access at scale, while truly leaving no one behind.

'By focusing on the most vulnerable, often considered the last mile, first and by being inclusive, especially of women's leadership,* PPEO 2018 *supports the SEforALL movement to go further, faster together and to make sustainable energy for all a reality in everyone's lives.'
Rachel Kyte, CEO and Special Representative to the UN Secretary-General for Sustainable Energy for All

'Alongside grid extension and off-grid solutions,* PPEO 2018 *takes a close look at clean cooking fuels and technologies, highlighting the growing demand for alternative fuels, and the affordability gap that continues to stifle access and leave the very poorest even further behind.'
Peter George, Director, Enterprise Development and Investment, Clean Cooking Alliance

'*PPEO 2018 *emphasizes how incredibly important gender-sensitive programming is for countries to achieve their objectives around SDG7 and reach those last-mile consumers, but also quite simply to strengthen women's empowerment, achieve greater gender equality and improve human wellbeing.'
Abby Mackey, Grants and Impact Manager, Solar Sister

'The PPEO editions have proven to be an excellent means for bringing the need for increased energy access to the attention of a wider audience.'
Daniel Busche, Managing Director, Energising Development

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