



DEVELOPING EFFECTIVE OFF-GRID LIGHTING POLICY



GUIDANCE NOTE FOR GOVERNMENTS IN AFRICA



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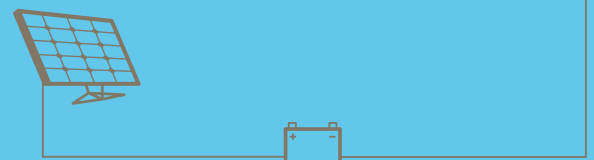
INTRODUCTION

The purpose of this report is to provide strategic advice to policymakers within governments and regulatory agencies to accelerate the penetration of efficient off-grid lighting products. It includes an industry perspective on how various policy measures could stimulate growth of the efficient off-grid lighting market, accelerate access to efficient lighting and reduce the environmental impact of fuel-based lighting.

The need for off-grid lighting products in Africa remains critical, as a large proportion of households still have no access to electrical services. In many countries, household electrification via expansion of the electricity grid fails to keep pace even with population growth. There is however strong evidence of the significant benefits of even low levels of electricity access, for lighting and other basic electricity services, on social aspects such as effective length of working days, education, safety and access to information. Growing evidence of the negative health impact of using fuel-based lighting products makes a strong case for switching to cleaner alternatives. Off-grid lighting and electrification products have already proven themselves as effective, reliable and economically efficient solutions for basic level household electrification, at far lower costs than traditional grid expansion strategies. Yet few countries have established an integrated policy framework to reduce the dependence on fossil fuels for lighting and to accelerate the penetration of efficient off-grid lighting products and thereby secure benefits that include significantly reduced health and safety impacts, decreased carbon emissions and the creation of green jobs.

By transitioning to efficient off-grid lighting, countries in Africa could secure large annual savings from reduced use of fuel-based lighting sources, such as kerosene and oils, as well as greatly reduce the greenhouse gas and other emissions associated with fuel-based lighting. The widespread use of modern off-grid lighting technologies can deliver significant socio-economic, health and environmental benefits, such as: new income-generation opportunities for small businesses; longer lighting hours, and better illumination, for studying by school children and for other productive uses in homes and businesses; and improved health and safety through reductions in indoor air pollution and in the fire hazard associated with flammable fuels.

The scope of this report is based on lessons learned from the integrated policy approach process followed in the Economic Community of West African States (ECOWAS) sub-region and other regions. The publication discusses the context and cross-cutting issues of the transition to efficient off-grid lighting, including potential benefits. It identifies best practices, proven case studies and practical recommendations for establishing a regulatory framework and policy strategies for efficient off-grid lighting promotion, including the four elements of an integrated policy approach to accelerate and ensure a successful transition.



1 THE CASE FOR OFF-GRID LIGHTING

To date, 1.3 billion people live without access to the electric grid (IEA 2013). Another one billion only have unreliable and unstable connections (IEA 2012). Both groups revert to traditional means of lighting, such as candles, wick lamps and torches. There are approximately 600 million people in Africa with no access to grid electricity, including around 465 million from rural areas and 121 million in urban areas (IEA 2011). Meanwhile, grid-extension efforts of governments fall short of population growth. The number of people on the African continent living in areas without access to the electric grid is expected to rise to about 700 million by 2030 (Lighting Africa 2013). The populations without access to grid electricity rely on polluting and dangerous sources of lighting such as kerosene lamps, candles and battery-powered torches. Fuel-based lighting is generally of low quality and expensive, impeding learning and economic productivity.

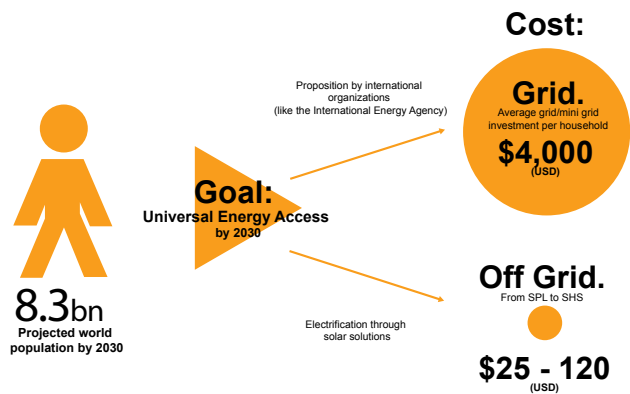
1.1 THE SUCCESS OF MARKET BASED SOLUTIONS

Lighting and cooking with traditional methods costs poor populations globally USD 23 billion a year, of which around USD 10 billion is spent in Africa (UNEP 2013b). Poor households are buying lighting at the equivalent of USD 100 per kilowatt-hour, more than a hundred times the amount people in rich countries pay. Research by SolarAid found that households at the base of the pyramid spend as much as 10% of their income on fuel for lighting (SolarAid 2014). Kerosene is not just expensive; it is also dangerous: stoves and lamps can catch fire. Indoor fumes cause 600,000 preventable deaths a year in Africa alone. Moreover, traditional means of lighting are harmful for the environment and contribute to climate change. UNEP estimates that the burning of fossil fuels for the purposes of lighting currently accounts for 90 million tons of CO₂ annually (UNEP 2015b). Additionally it is estimated that 270,000 tonnes of black carbon are emitted annually from kerosene lamps. The warming effect of these emissions is equivalent to about 240 million tonnes of CO₂, equivalent to approximately 4.5% of the United States' CO₂ emissions.

Especially connecting the rural population to the grid is logistically challenging as well as resource and maintenance intensive. Based on numbers projected by the International Energy Agency's new policy scenario (IEA 2011) investments needed to achieve universal energy access via grid-extension and mini-grids is equivalent to an average investment of approximately USD 4,000 per electrified household (A.T. Kearney and GOGLA 2014). However, technological innovation in the field of lighting, solar photovoltaics (PV) and energy storage has led to the emergence of leading edge and very cost-effective technology products that come at prices affordable to the consumers. These new products are well equipped to provide

basic energy access at moderate costs and to the benefit of consumer households. The initial purchasing costs for efficient off-grid lighting products are often higher than the purchasing costs for kerosene or candles. However, in the long run, solar off-grid lighting products are cheaper – as running costs are zero and the solar light device is a one-time cost. Typically, the investment for a mid-priced solar lantern is paid back in four to five months.

Figure 1 Scenarios achieving universal energy access



Source: Adapted from A.T. Kearney and GOGLA 2014

The rationale behind offering solar-based lighting is simple. Solar off-grid lighting products are cheaper, brighter, more efficient and healthier than kerosene lamps. Products consist of three parts: a solar panel; a battery; and at least one LED. They come in a broad range, have a battery run time of six hours or more, with a light output of up to 100 lumens. Many products also offer additional important functionality, such as mobile phone charging outlets. 'Solar kits' offer multiple light sources, as well as an external power outlet. Quality entry-level products start from as little as USD 8. The wide product range available allows different consumers to benefit from the technologies and use clean lighting products for specific purposes, including lighting households, small businesses, hospitals, or schools.

What solar lantern owners save on kerosene, they can invest in other important things like food, education for their children, healthcare etc. – in addition to a general improvement to their living standards. Under the assumption of a three-year life cycle for a solar lighting product (Lighting Africa 2012a), a household can save up to 86% of their previous energy expenses for kerosene and mobile charging. Better quality and longer lighting allows school children to study more and better. On average school children study for one additional hour per day (SolarAid 2014a). The longer hours of lighting lengthen the day and give additional productive hours to small businesses or for socialising within families and communities.

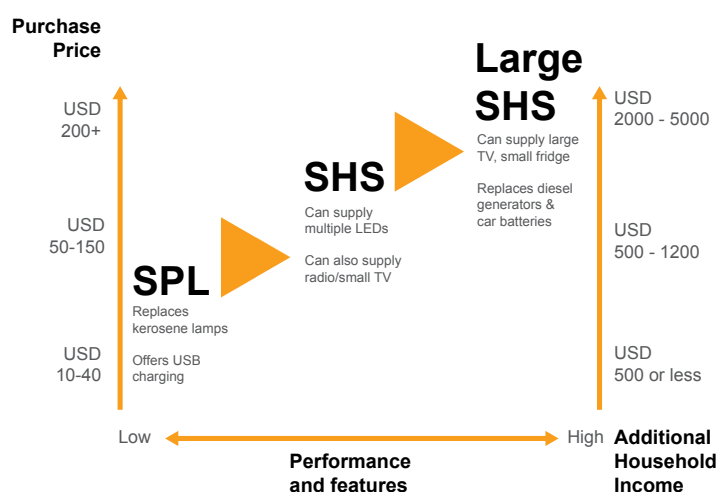
The multiple benefits for households are obvious and thus solar lighting products are highly sought after. The off-grid lighting industry is trying to meet this huge demand and market based solutions have borne first fruits. Since

2012, sales figures have tripled and the market is projected to continue to grow at rates of 55% per year (A.T. Kearney and GOGLA 2014). This means that the private sector has provided clean lighting, and in many cases also phone charging systems, to 35 million people in Africa alone (Lighting Africa 2015). The household itself carries the cost for the products and there is thus no need for the government to directly subsidise the product price. Innovative business models such as 'pay as you go' allow consumers to access products by paying small increments over time, thereby overcoming the high initial purchasing costs. For governments, solar off-grid lighting and electricity is the cheapest zero carbon route to energy access.

A full transition to clean sources of lighting would also have several macro-economic benefits. The market-based approach taken so far is proving to be a real job-booster. The industry has the potential to create an additional 500,000 jobs only in the ECOWAS region (UNEP 2014c). Additional income generated through the use of additional productive hours also leads to new sources for tax revenues. On the spending side, governments could significantly decrease their spending on kerosene subsidies, and reduced health risks will have a positive impact on the national health budget and social spending.

Lighting is only the first rung on the energy ladder. Companies among GOGLA members report that consumers are always coming back – but never for the same product. Household savings from the first solar lighting product are often re-invested into the next bigger solution. Lighting is the enabler for demand evolution, and as new technologies become available to the bottom of the pyramid, demand for bigger and more expensive systems will rise. Consumers start with an entry-level product and re-invest their savings into a bigger system. The Figure below illustrates the concept of the energy ladder showing demand progression.

Figure 2 Energy ladder



Source: adapted from A.T. Kearney and GOGLA 2014

Today, market growth is limited by the supply and not the demand side. The industry is struggling to meet the increasing demand due to a number of market barriers, such as: general lack of awareness for the products; missing transparency on government plans with respect to energy policies; difficult access to capital; high tax and tariff burden; and low quality products undermining consumer trust. **Many of these barriers can be overcome by creating an enabling environment in which new business would find it easier to serve the market.** Not only are incentives for a market-based transition to clean lighting and energy access missing, companies often encounter **uneven playing fields** in which environmentally and economically smarter products are struggling to, or are unable to compete, with traditional means of lighting. This is often **due to out-dated policies** that were originally adopted to support low-income households but have adverse effects in the technology landscape of today. Increased awareness among policymakers offers the unique chance to benefit from market trends. Often slight adjustments of policies and regulations can have huge impacts on the market development.

1.2 THE INTERNATIONAL POLICY LANDSCAPE

To increase attention and donor support to tackle energy poverty, the United Nations has declared the decade 2014-2024 as the Decade of Sustainable Energy for All (SE4All) and aims to reach universal energy access by 2030. Energy access is also part of the Sustainable Development Goals¹ that follow the Millennium Development Goals.

To measure the progress made towards SE4All targets, a global tracking framework has been established. Instead of using binary definitions of electricity access, the framework defines different tiers of energy access. Off-grid lighting products with a minimum lumen output and phone charging capabilities count as basic energy access².

In this international policy landscape, more and more donor governments focus their development assistance on energy access. For instance, President Obama announced an ambitious Power Africa initiative³ that provides tools and resources to accelerate energy access on the continent. Other donors continue, or scale up, their efforts, including multilateral development banks such as the World Bank Group, national governments (Netherlands, Germany, Norway, and the UK) and NGOs (Practical Action, SNV, SolarAid and others). Instead of supporting only grid-extension projects or micro-grids, the new definition

¹ More information on the Sustainable Development Goals is available here: <https://sustainabledevelopment.un.org/sdgsproposal>

² More on the concept of tiered energy access SE4All / World Bank Global Tracking Framework: http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2013/05/28/000112742_20130528084417/Rendered/PDF/778890GTF0full0report.pdf

³ More information on Power Africa can be accessed here: <http://www.usaid.gov/powerafrica>

of energy access, as well as proven success in recent years, has prompted these actors to pay attention to small-scale energy access on a household level. Countries such as Tanzania and Kenya have embraced the opportunity of market-based solutions and set incentives for solar products, such as VAT elimination. The markets in Kenya and Tanzania are growing particularly fast, allowing the private sector to deliver basic energy access to thousands of households.

They have realised that by transitioning to efficient off-grid lighting, developing countries could secure large annual savings from reduced use of fuel-based lighting sources, such as kerosene and oil, as well as greatly reduce the greenhouse gas and other emissions associated with fuel-based lighting. **Few actions can reduce greenhouse gas emissions as inexpensively and easily as a sustainable transition to efficient off-grid lighting. Yet few countries have established an integrated policy framework⁴ to reduce the dependence on fuel-based lighting and to accelerate the penetration of efficient off-grid lighting products, thereby concretely reducing health impacts and carbon emissions and creating green jobs.**

1.3 CHOOSING THE RIGHT POLICIES TO INCREASE BASIC ENERGY ACCESS

Governments that seek to reduce or eliminate fuel-based lighting can take steps now to increase access to efficient off-grid lighting products that are affordable, clean and dependable (A.T. Kearney and GOGLA 2014). Market based approaches have led to an unprecedented increase in adoption of solar lighting products. Government efforts, in cooperation with the private sector and civil society, will contribute to an increased penetration of off-grid lighting products and thus meeting the universal energy access objective.

The right set of policies at the right time will accelerate market development to the benefit of the entire society. However, policies always need to be well designed and implemented to support market development rather than undermine it. A proper analysis of the existing market is necessary in order to choose the right and most efficient steps: a country in which market activities

are still small will need to start with different policies to a country where market penetration is well advanced. While certain policy recommendations can be given to boost market development, there is no 'one size fits all' solution. For instance, consumer education campaigns may have a great positive effect in markets where products are already widely available; it would on the other hand be completely ineffective in a market that still needs to develop basic distribution channels. In addition, each country has its own unique characteristics, including strengths and weaknesses. Stakeholder consultation and engaging the private sector will inform the decision on which policy options to choose. The next chapter will present, in an integrated approach, actions policymakers should consider when trying to employ market support mechanisms. **Actions recommended will include: supporting policy mechanisms; the implementation of minimum quality standards; monitoring, verification and enforcement; as well as environmentally sound management (see more information on the integrated policy approach in Annex 1).** While recommendations are presented in a modular structure, the reader should be aware that these activities are in many cases interdependent. Whenever possible, an integrative approach should be taken, that takes into account all four key areas.

2 CALL TO ACTION: STRATEGIES TO CREATE AN ENABLING ENVIRONMENT

Governments and policymakers have a critical role to play to provide universal energy access creating an enabling environment that will allow market forces to fully unfold and deliver solar products to rural households. **Policy and regulatory changes should always be calibrated carefully, especially in nascent markets where inappropriate policies can be very distortive to market development.** Any policy or regulatory changes, government or public driven programmes or interventions should, by all means, be closely coordinated with the private sector to ensure they support the market and go hand-in-hand with industry efforts, in order to maximise efficacy and impact of the action taken.

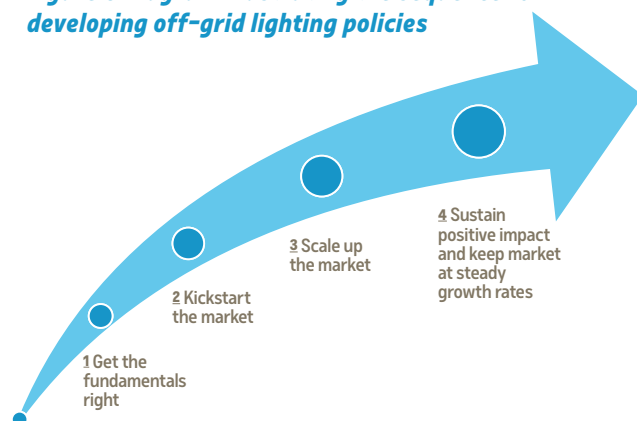
The enabling environment can, and should, grow in a natural way in conjunction with the market. There is no blueprint of consecutive steps that have to be taken. Rather, a careful analysis of the current market situation and exchange with the industry, as well as with policymakers that have some experience in the field already, will be necessary to understand which of the recommended policy actions can, and could best, be applied in the local context. Wherever possible, best practices or lessons learnt are shared for each of the policy actions below.

Quality monitoring and verification, as well as sound market analysis, will allow policymakers to understand which measures worked well and what next steps it would be ap-

⁴ The integrated policy approach was developed by the UNEP-GEF en.lighten initiative. It incorporates best practices to achieve a permanent and sustainable transition to efficient on-grid and off-grid lighting. An integrated policy approach ensures that all pertinent policy aspects related to energy-efficient lighting are considered in the development of an efficient lighting strategy. Following an integrated policy approach will significantly increase the likelihood of a successful transition to efficient lighting, leading to financial, energy and environmental benefits; it will also streamline the process for those involved in designing and implementing policies. Each country and region should determine how the elements of the integrated policy approach fit within their national or regional context and ensure that all relevant authorities and stakeholders are involved to guarantee a consensus-based process in the development of a national or regional efficient lighting strategy. See Annex I for more information.

appropriate to take. Monitoring all measures taken and analysing the impacts is key to design the next step in an efficient manner. It should therefore be an integral part of all action taken. The figure below illustrates the sequenced steps to develop off-grid lighting policies supporting market development.

Figure 3 Diagram illustrating the sequence for developing off-grid lighting policies



Source: Author's original creation 2015

2.1 STEP 1: GET THE FUNDAMENTALS RIGHT — ENGAGEMENT OF INFORMED STAKEHOLDERS AND PROPER MONITORING

At an early stage of market development, four measures in the field of supporting policies are important to creating an enabling environment, and in turn accelerating market development. Governments and other public agencies, such as rural electrification agencies, must be aware of the off-grid lighting and electricity market potential. Developing transparent energy access policies will help to develop a joint vision and mission that can be clearly communicated to the population and other stakeholders, such as the private sector. The engagement of all stakeholders in the process of developing such a strategy, as well as for the planning of concrete steps to be taken, will help to increase the impact. In particular, renewable energy associations can provide valuable feedback on the market stage and needs. Monitoring and verification should be an integral part of all steps taken by the government to track progress and to inform the planning phase for the next steps.

2.1.1 ENSURE ALL RELEVANT STAKEHOLDERS UNDERSTAND THE BENEFITS OF THE TECHNOLOGY

A major factor for the success of publicly directed efficient off-grid lighting programmes is convincing government decision makers about the overall benefits for the economy, environment and society at large. It is essential to identify and enlist a 'champion' – an individual, civil society organisation or ministry who understands the potential benefits and impact of an efficient off-grid lighting programme and who can convince other decision makers. The role of the champion within the government should fall within the mandate of the Ministry of Energy or rural energy agencies but can also be taken by other public sector organisations. Both central governmental institutions and local authorities need to be engaged in the efficient off-grid lighting programmes. The engagement with national policymakers helps ensure that national energy programmes incorporate the deployment of efficient off-grid lighting products in rural electrification schemes.

Different government organisations play a decisive role in creating an enabling environment and can also benefit from a faster transition to clean and sustainable means of off-grid lighting:

- Local authorities, in particular, often have the most insight into their local situations and implementation challenges and can provide valuable and practical information.
- Ministries of Finance can benefit from additional revenue for the government, mobilisation of foreign investment, FOREX saving from reduction of fossil fuel imports, and can help to set the right fiscal incentives to accelerate market development.
- Social and Economic Ministries can benefit from additional jobs created, local value creation, and the development of a local industry. They can be an important counterpart for the industry in leveraging public private partnerships.
- Ministries of Education can help with distribution to extremely remote communities by leveraging school networks, and thus contributing to better education of the population.
- Last, but not least, Ministers of Energy will welcome the reduction of fossil fuel imports, increased energy independence, and the provision of access. They are of importance to set the right policies overall and take a coordinating role.

Actors can use supporting evidence from studies carried out, such as the SolarAid Impact report, UNEP publications on the livelihood, health impacts, and kerosene subsidies to convey the message within the policy arena⁵.

In parliamentary democracies, the push for an enabling environment can also come from a parliament requesting ministers to implement respective regulations. The broader the coalition of support within the government, the easier it will be to implement integrative policies that complement one another.

⁵ See References section for details of these publications

2.1.2 ENGAGE ALL STAKEHOLDERS, SPECIALLY THE PRIVATE SECTOR

It is also very important to communicate with non-governmental stakeholders, such as utilities and civil society groups, and especially the private sector to generate broad support. Much of the deployment of these new technologies currently takes place without government involvement – such as through market-based mechanisms and at the initiative of individual firms, not-for-profit organisations and social enterprises. The cooperation of governments with these actors can significantly accelerate the market transition.

Thus governments should recognise stakeholders such as national renewable energy associations as key partners since they have the mandate to speak on behalf of the industry and can efficiently channel industry feedback. Associations are important to sustain balanced market development and to ensure that the positive impacts of market-based avenues to clean and efficient off-grid lighting continue to work. They can consult with the government on future policies and regulations and provide consolidated industry feedback on plans. They furthermore serve as a platform for the private sector to work together on joint objectives, such as skilled workforce (see the KEREAs example in Box 8). Renewable energy associations typically evolve as the market unfolds. Governments should engage these associations and stimulate their growth by recognising them as valid partners early on.

BOX 1 ENGAGEMENT WITH GOVERNMENT INSTITUTIONS

In 2013, SNV Netherlands Development Organisation (SNV), in collaboration with the United Nations Development Programme (UNDP), successfully engaged the private sector and academia with government institutions in Niger to develop the Roadmap for Achieving an Enabling Environment for a Sustainable Solar Market.



The engagement also resulted in the following accomplishments:

- Niger's law on Renewable Energy was put on the agenda of the Council of Ministers.
- Tax-exemption was achieved for 1.26 million solar lamps.
- APE-Solaire (the National Association of Solar Professionals) organised an official kick-off meeting with a press conference.

Source: SNV Niger 2014.

2.1.3 DEVELOP TRANSPARENT NATIONAL ENERGY STRATEGIES

For the private sector, entering a new market or expanding into a new region is a big investment. Before a company decides to invest into building up new structures, it carefully analyses the situation in the country in question to understand in which regions/population segments its products would be best placed and successful. **Critical factors for success are information on the government's energy policies and strategies.** Official energy policies and strategies will help the private sector to make an informed decision as to where its products best complement government activities. If the government is, for example, planning to extend the national grid or install mini-grids in certain regions, distributors of solar lighting products would focus its efforts on other regions. Transparent energy policies and strategies would thus lead to overall better results in terms of energy access. National energy strategies can also form part of long-term development plans for a country. This ensures long-term planning stability and a consistent policy approach from subsequent governments. Rural electrification policies and plans may also be expanded to include a role for off-grid solutions to reflect the possibility of using a stepped approach in providing access.

Although such policies are also crucial for coordination within the government, these policies are often not in place. A long term policy paper or strategy would however benefit all stakeholders by:

1. Providing the private sector with planning security;
2. Helping to inform fellow ministries about plans and allowing them to implement regulations that are conducive to the national energy policy; and
3. Providing the consumer with information on when they can expect the national grid to be functional in their area – information, which is key to making the significant purchasing decision of buying a solar light or kit.

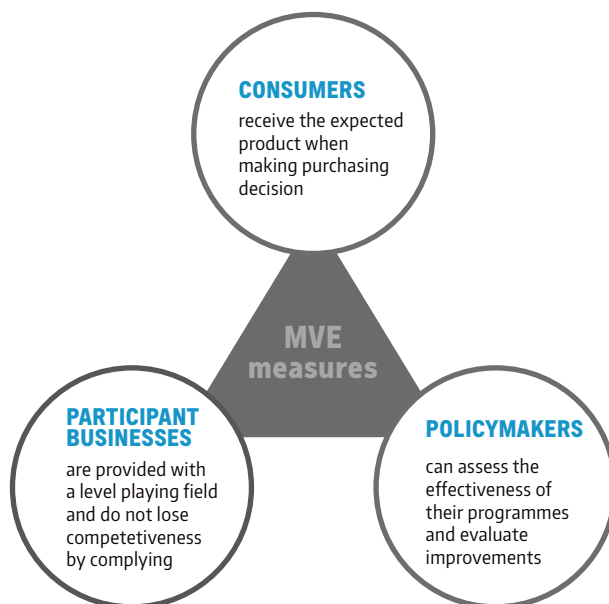
Hence, the development of a national energy policy / strategy should be a consultative process that allows all stakeholders, especially civil society, to contribute.

2.1.4 MONITORING AND VERIFICATION OF MEASURES

The efficient off-grid lighting sector is a very dynamic market that is beginning to see a constant growth. Effective monitoring of the market, and the impact of policies on it, can help to verify the success of measures and to inform next steps. In an integrated policy approach, monitoring and verification of progress is essential. Existing monitoring systems of relevant public actors (e.g. Ministries of Health) could be leveraged to monitor the impact of clean and sustainable off-grid lighting technologies.

Policymakers and programme implementers can strive to integrate monitoring, verification and enforcement activities into every aspect of their lighting and energy efficiency programmes. Knowledge sharing and peer-to-peer exchanges between countries and across regions provide effective means for promoting best practices. Governments can thereby devote more attention to existing programmes for the transfer of expertise and information. International and regional cooperation for enforcement through the sharing of testing facilities, the results of testing and professional development programmes (for laboratory and enforcement staff) is very valuable for quality assurance programmes.

Figure 4 Benefits of monitoring, evaluation, and enforcement



Source: UNEP 2012a.

2.2 STEP 2: KICK-START THE MARKET – FISCAL/FINANCIAL TOOLS THAT ATTRACT THE PRIVATE SECTOR

Three financial incentive measures have been identified as effective strategies to support the introduction of more high-quality and affordable products in the markets in African countries. All of these fiscal measures are supporting policy mechanisms.

The first measure consists of **removing duty and offering tax exemptions on imports of high-quality, efficient off-grid lighting products**. The objective is to encourage private players to invest in the efficient off-grid lighting market by eliminating the additional surtax on eligible good-quality products. Assuming that these benefits are passed along to the consumer, this makes high-quality,

efficient off-grid lighting devices more affordable. The second measure is **a reduction or elimination of kerosene subsidies in order to create a level playing field for energy-efficient lighting technologies and increase their value proposition to the consumer**. The third measure is to **facilitate access to finance in a transparent and inclusive way for companies entering the market**, as this is one of the main barriers for the growing industry.

Beforehand, it is important to underline that free giveaways and direct retail subsidies of efficient off-grid lighting products are not a viable tool to support long-term market development. They are often mistaken as an appropriate measure to initiate market development. However, giveaway programmes, as well as direct retail subsidies, undermine balanced market development. Such programmes would only provide short term benefits and should therefore only be considered in extreme situations where lighting products form an essential part of disaster relief (e.g. after natural catastrophes). In all other cases, free giveaways and reduced product costs may create an expectation that efficient off-grid technologies have low value, or that they should be heavily subsidised. This could undermine consumers' willingness to invest in the products in the same way that they might invest in other appliances that provide valuable services. This could create a culture of dependency and a lack of care for, and maintenance of, products.

2.2.1 INTRODUCE EXEMPTIONS ON VALUE-ADDED TAX AND TARIFFS

Some countries have successfully increased access to efficient lighting by reducing, or eliminating, import tariffs on efficient off-grid products, and/or by introducing, or increasing, deterrents for buying or importing fuel-based supplies and equipment (such as increased taxes on fuels, fuel-burning lanterns, wicks or candles). To document attempts that address import tariffs and barriers to entry for off-grid products, the United Nations Foundation recently set up a searchable tariff database, available through the Sustainable Energy for All Energy Access Practitioner Network ⁶.

In Kenya and Tanzania, two markets where the efficient off-grid lighting products market is growing particularly strongly, solar products are VAT- and tariff-exempted which eases market entry and allows companies to offer lower prices to consumers. As the Rwanda example shows, VAT exemptions can also be used as a tool to incentivise the purchase of quality products (see Box 2).

⁶ See link to the searchable tariff database on the Sustainable Energy for All website at <http://www.energyaccess.org/resources/tariffs-database>. By searching for tariffs by product and then choosing type of product and tariff, for example, 'solar lanterns' and 'bound', the tariff rate is listed in chart and graphic displays.

While this is a key measure, its implementation needs buy-in from the Ministry of Finance, which can be generated through supportive evidence or data. Therefore, a well-defined strategy to convince and educate the Ministry of Finance is an essential success factor.

Furthermore, note that capacity building is required to successfully implement new measures via national customs authorities. Although laws may allow for duty or tax exemptions for high-efficiency off-grid lighting products, enforcing the exemptions may be challenging if customs and duties officials are not prepared, or do not have sufficient resources, to identify, categorise and process the products that are exempted.

BOX

2

VAT EXEMPTIONS IN RWANDA

Since November 2014, the Government of Rwanda has introduced VAT exemptions on solar lighting products that are quality assured. Hence products approved by the Lighting Global Quality Assurance Program* are not charged any VAT. This gives quality products a competitive pricing advantage to low-quality products and incentivises the consumer to buy a superior product instead of spending money on a product that is likely to fail after a short period of time.

*See www.lightingglobal.org/activities/qa/

Source: GOGLA 2014

2.2.2 REMOVE SUBSIDIES ON LIGHTING FUELS

Current subsidies on lighting fuels, specifically kerosene, slow the progress of market mechanisms that have already begun to promote efficient off-grid lighting products that offer safer, more reliable, and more economical long-term solutions. The cost to consumers of inefficient lighting sources, even when subsidised, is higher than those of more efficient and unsubsidised alternatives (UNEP 2014b). Nevertheless, considerable funds are allocated to kerosene subsidies. The annual global cost of subsidies across the entire energy sector (coal, natural gas, petroleum fuels, and electricity), including negative externalities, reached USD 1.9 trillion in 2011 or 2.5% of global GDP. Petroleum fuel subsidies alone amounted to USD 879 billion (IMF 2013).

Fuel subsidies are routinely criticised for failing to achieve their intended goals and not reaching the poorest consumers. According to the International Monetary Fund (IMF), the richest 20% of households in low- and middle-income countries capture six times more in total fuel product subsidies (43%) than the poorest 20% of households (7%) (IMF 2013). Additionally, fossil-fuel subsidisation inflates true demand through artificially low prices, which inad-

vertently distorts markets, impedes progress towards more efficient and cleaner solutions, and runs contrary to sound environmental and human health policies.

Subsidy reforms on kerosene need to be pursued to enhance the growth of the market for efficient off-grid lighting products. However, any changes in kerosene subsidy may affect other end-uses, notably cooking, and thus measures must be taken to proactively minimise any unintended consequences. Subsidies could therefore be phased out gradually parallel to market development. Clean, and modern, lighting technologies will help to reduce the dependency of the population on kerosene. As the demand for kerosene shrinks, governments can make significant savings on money spent on subsidies and continue to reduce kerosene subsidies.

2.2.3 FACILITATE ACCESS TO FINANCE ACROSS THE SUPPLY CHAIN

Access to capital, especially working capital, is a key constraint for the industry when scaling up. Today the market is limited by the supply not the demand side. Partnerships between financiers and suppliers need to be developed to increase the supply of capital from conventional and non-traditional institutions. Often the lack of a sound business environment inhibits investment in off-grid lighting⁷. Governments can improve finance and market conditions by supporting transparent and equitable legal systems for financial transactions and for recourse in the case of non-compliance or corruption.

To encourage and support supply chains⁸ that make available and distribute efficient off-grid lighting products, components and services where needed, financing for the private sector is essential. This could include: credit for product imports; a FOREX facility (to access foreign exchange funds); capital equipment loans; microfinance for distributors⁹ and other financial instruments. Governments can work with financiers and investors, or private sector associations, to better understand business needs and to explore potential avenues to facilitate access (A.T. Kearney and GOGLA 2014).

⁷ According to the OBIN report, the most problematic factor for business in Africa is "access to financing", closely followed by "corruption" (Stiftung Solarenergie 2014).

⁸ See, for example, Dalberg 2013.

⁹ See description of the Lighting Rural Tanzania project, implemented by ARTI with support from the World Bank and the Rural Energy Agency, at <http://arti-africa.org/projects/lighting-rural-tanzania/>.

BOX 3 FINANCE FACILITY IN ETHIOPIA – LIGHTING AFRICA

Access to finance all along the supply chain is a key bottleneck impeding the sale and distribution of off-grid lighting products across Africa. Using funds provided by the World Bank, the Government of Ethiopia, with support from Lighting Africa, established a USD 20 million financing facility in 2013 to address this issue.

The fund is administered by the Development Bank of Ethiopia (DBE) and provides foreign exchange-denominated working capital to private sector enterprises to allow them to import qualifying products, including solar products that meet Lighting Global's Quality Standards. Microfinance Institutions (MFIs) can also access this credit line for household-level loans for qualifying product purchases.

In its first 18 months of operation, this facility enabled over 300,000 quality-verified solar lighting products to be imported, providing 1 million Ethiopians with access to modern energy services.

Source: Lighting Africa 2015.

Public support to facilitate access to finance across the supply chain should be structured in a way that leverages commercial investments and doesn't unintentionally result in a reduction in private investment. Reporting and monitoring should be efficient without putting too much burden on companies. It is further important to understand that public money used for direct retail subsidies is not a sustainable way of initiating market development. De-risking commercial money or other public-private partnerships can on the other hand lead to interventions that support sustainable market development.

BOX 4 EXPERIENCE WITH A RURAL ELECTRIFICATION AGENCY IN WEST AFRICA

Through the Lighting Lives in Liberia programme, the Rural and Renewable Energy Agency of Liberia collaborated with Lighting Africa to enable Niwa Solar to enter the country's off-grid lighting market. Highlights of the initiative include:

- The programme enjoys zero per cent import duty and VAT for solar off-grid products and focuses on bridging importer/reseller financing in order to build up local resellers through competitive selection.
- The programme is funded by grants from the Global Environment Facility (GEF) and the Africa Renewable Energy Access Trust Fund (both administered by the World Bank).
- The Rural and Renewable Energy Agency of Liberia is responsible for project implementation from 2012 to 2016.

Source: NIWA and World Bank 2014

2.3 STEP 3: SCALE UP THE MARKET

Once first companies have entered the market and there is a critical mass of capacity to supply products, policymakers can contribute to scale up the market. After a period of modest growth, the period of scaling-up is essential in delivering efficient lighting products to a maximum number of households. It is the period in which a small market evolves into a mass market. At the consumer level, this means that products are not only purchased and used by early adopters, but are used on the broader consumer level.

To scale up the market faster, four measures can be taken. The first measure is to **ensure the dominance of quality products** in the market. The second measure is to **create awareness** for the benefits of solar lighting among the population. The third measure is to **encourage the development of local skills** to support the market growth. Finally, the fourth measure is to **leverage public private partnerships** to the benefit of both sides. These measures are detailed in the section below and are all supporting policy mechanisms. When properly designed, all of them have the potential to help ensure that products promoted adhere to minimum energy performance standards.

2.3.1 ENSURE PRODUCT QUALITY THROUGH PROMOTION OF INTERNATIONALLY ACCEPTED MINIMUM STANDARDS

Ensuring quality in the market is essential to sustain growth. Poor quality products undermine consumer trust in the technology at large, especially in nascent markets. Quality assurance can be achieved via minimum energy performance and quality standards -e regulations focused on the quality of products. Minimum energy performance and quality standards for products are used to establish minimum desired performance and methods to test the quality characteristics of products. Product performance specifications based on these standards can be used for bulk procurement programmes, voluntary or mandatory labelling schemes, and for buyers' selection of products. It is important that any minimum energy performance and quality standards are harmonised with internationally accepted standards. Standards that are defined only at national level risk being more a barrier than a support to a prospering and sustainable market environment.

In West Africa, for example, ECOWAS is adopting a Technical Specification for Off-Grid Lighting Products as part of its Regional Efficient Lighting Initiative. These in turn will be implemented by each of its member countries replacing existing national standards. The new standards are based on the International Electrotechnical Commission (IEC) technical specification IEC/TS 62257-9-5¹⁰ and the World Bank/International Finance Corporation's Lighting

¹⁰ Recommendations for small renewable energy and hybrid systems for rural electrification – Part 9-5: Integrated system – Selection of stand-alone lighting kits for rural electrification

Global program, which runs a voluntary quality assurance programme through which manufacturers can qualify their products to meet programmatic requirements.

The promotion of quality standards for efficient off-grid lighting products is best done by connecting quality requirements to market incentives, such as VAT exemptions. As a stand-alone measure it can be supported by a mandatory or voluntary labelling and certification programme, whereby labels are placed on the packaging to provide end-users or distributors with information about the product's light output and performance. Business-to-business communications can have positive impacts on quality in the market (for example, Lighting Global standards). A consumer-facing label would add great value, however it is also costly to implement and requires a substantial budget for consumer education.

that allows government to access information on key energy performance characteristics such as rated run time, battery capacity and photovoltaic power. These labels inform and empower end-users to make educated choices and motivate suppliers to deliver quality products.

The Lighting Global test method was adopted by the International Electrotechnical Commission (IEC) as part of its body of product testing standards. The test method was incorporated into its technical specification, IEC TS 62257-9-5:2013²¹. For the benefit of harmonising standards, it is recommended that national standardisation bodies consider adopting the Lighting Global framework for all quality assurance of off-grid lighting products.

Quality assurance can also take place further down the line with qualified technicians that can provide appropriate after sales services. Accrediting vendors that are only re-selling quality products are another opportunity to provide guidance to customers on where to buy a product (see case study below).

BOX 5 **STRUCTURE AND MAIN COMPONENTS OF THE LIGHTING GLOBAL QUALITY ASSURANCE (QA) FRAMEWORK**

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graph TD
    A[OFF-GRID LIGHTING QA PROGRAM] --> B[TEST METHODS & QUALITY STANDARD]
    A --> C[TESTING & VERIFICATION]
    A --> D[MARKETING COMMUNICATION]
  
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Source: Lighting Africa 2015.

The minimum quality standards developed by Lighting Global define requirements for participating private sector entities for truth-in-advertising, durability, quality, lumen maintenance and warranty terms. As of January 2015, these standards have the following requirements (Lighting Global, 2015a):

- **Truth-in-advertising:** Advertising and marketing materials accurately reflect tested product performance.
- **Durability:** Product is appropriately protected from water exposure and physical ingress and survives being dropped.
- **System quality:** Product passes a visual wiring and assembly inspection.
- **Lumen maintenance:** Product maintains at least 85 per cent of initial light output after 2,000 hours of operation.
- **Warranty:** A one-year (or longer) retail warranty is available.

The minimum quality standards developed by Lighting Global for participating manufacturers and distributors of efficient off-grid lighting products include truth-in-advertising, which requires truthful and accurate consumer facing labelling of the product. It is a voluntary programme

BOX 6 **KEREA VENDOR ACCREDITATION**

With the objective of reducing market spoilage and increasing consumer confidence in solar PV in Kenya, KERA is implementing a voluntary accreditation framework for solar PV businesses. The process consists of:

- Developing a criterion for accreditation of renewable product and service providers that would be based on conditions such as businesses adhering to an agreed upon code of conduct, selling a certain quality of products and having certain verifiable technical capacity/skills.
- Promoting the accreditation system to solar PV businesses countrywide and providing guidance on what they need to do to meet the accreditation criteria.
- Receiving applications from interested businesses and implementing the auditing and testing process for these businesses. This would include testing of randomly selected products, visits to selected installed systems to check design and installation standards.
- Promotion of accredited businesses, engineers or technicians to the public and potential markets through branding and/or providing their details to the public through press, media, awareness campaigns and the KERA website.
- Developing and implementing sustainable process of regular and continuous monitoring and verification which would include a feedback/complaints desk.

For off-grid lighting products and solar kits, only business selling / manufacturing Lighting Global accredited products will be eligible.

Source: KERA 2015

There are some considerations that should be noted before establishing minimum quality standards for efficient off-grid lighting:

- Standards should be scheduled allowing sufficient time for compliant products to be made widely available in the market.
- Where possible, harmonisation of standards is an advantage, and thus using existing, widely referenced standards such as Lighting Africa standards can be an advantage.
- The initial costs of compliant products may exceed those of inefficient products. Governments may, therefore, consider combining standards with measures to lower the price, such as a VAT exemption on compliant products.
- The mandatory energy performance and quality standards may not be readily attainable by the local manufacturing industry (if it exists); therefore, adequate preparation time must be built into the market transformation¹¹.
- Quality assurance programmes should be supported by other policy options and market surveillance activities such as monitoring, verification and enforcement to reach their full market potential.

2.3.2 RAISE AWARENESS FOR SOLAR LIGHTING BENEFITS AMONG THE POPULATION

Public information campaigns designed by government agencies or utilities are effective tools to raise awareness, as well as educate and mobilise the public and influence social or individual behaviours, attitudes, values and knowledge on the benefits of efficient off-grid lighting. Informed consumers will be more likely to seek out and participate in efficient off-grid lighting programmes.

Accurate information helps consumers understand the long-term impact of using the improved products on their health, safety and household expenditure. Community events are excellent ways to interact directly with consumers and to encourage them to make environmentally responsible choices in their daily behaviour. Participants will spread the message to their peers - family, friends and neighbours.

¹¹ "For example, in Kenya, the regulatory authority had rightly identified the lack of qualified technicians as a leading cause for the failure of SHS [solar home systems]. A law was enacted to rectify this real problem, i.e. SHS companies require qualified technicians to operate. It was a good law, but by the time it came into effect, there were very few trained technicians nationwide and, indeed, few training institutes to increase the numbers. It was a good law but there was a gap in the strategy to effectively achieve this." Nana Nuamoah Asamoah-Manu, IFC, personal communication during peer review process, 2014.

Demonstration projects that are coordinated with awareness-raising campaigns show how efficient, high-quality off-grid lighting products can be used in applications familiar to the target audiences. They are an excellent opportunity for public-private partnerships to offer users hands-on experience with good-quality off-grid lighting products and systems. Demonstrations can be simple, portable displays for short-term use, larger-scale installations in a public space (such as a school or clinic) or lighting systems installed throughout a community. Demonstrations can be coordinated with government procurements and bulk procurements, thus serving as a way to increase early demand for off-grid lighting products and systems.

Pairing demonstrations with various means of evaluation gives all parties additional evidence of the benefits of modern lighting¹². Tools could include: user surveys; measurement of amount of light and hours of use; and summaries of initial and operating costs, showing how to calculate a return on investment. Results of demonstrations can show governments the value of the new technologies and increase demand for products among consumers.

Other media, such as radio programmes or in-person community health presentations, can also deliver safety information and introduce information about safer off-grid products. These kind of 'above the line marketing' efforts will not reach the consumers living in rural areas, but will help to increase the general awareness among the population for products and help to spread the word.

Key governmental institutions that can play an active role in a communications and awareness-raising programme on efficient off-grid lighting include:

- Ministry or Department of Energy, which has oversight on national energy policy and strategies, and whose support of an efficient off-grid lighting programme is crucial.
- Rural electrification agencies, which incorporate efficient off-grid lighting in their energy access programmes.
- Ministry of Environment, which has high interest in programmes that reduce CO₂ emissions and also is involved with sustainable end-of-life treatment of spent lighting products.
- Ministry of Health, which can inform other policymakers and the public about the impact of efficient off-grid lighting on health and safety, and also can support collection and recycling schemes for spent lighting products to minimise exposure and health risks to workers and users.
- Ministries of Finance, Trade, Labour and Industry, which can apply fiscal policies to facilitate the market transformation for efficient off-grid lighting products.
- Ministry of Education, which can encourage parents to procure efficient off-grid lighting products for their children to be able to study at home in the evening, and can support teachers and administrators who can participate in spreading the word about the risks of fuel-based lighting and the benefits of efficient off-grid lighting.

¹² For an example of a creative, community-based demonstration project that had a strong evaluation approach, see SunnyMoney 2014.

- Local and regional authorities, which interact directly with consumers and can provide them with valid arguments and facts on the benefits of efficient lighting, and on the proper handling of efficient off-grid lighting products and components (such as batteries).
- Customs authorities, which exercise authority in monitoring, verification and enforcement schemes to ensure the energy efficiency and quality of imported lighting products.
- Political leaders, who can champion and facilitate enabling legislation if they are well informed about the goals and benefits of efficient off-grid lighting.

To promote the penetration of quality products in the market, campaigns should work with companies that are distributing quality-verified products and also educate the population to distinguish a quality product from a low-quality product.

BOX 7 AWARENESS RAISING CAMPAIGNS – LIGHTING AFRICA

As part of their consumer outreach activities, the joint IFC-World Bank Lighting Africa program has developed engaging and entertaining educational materials, including radio and TV spots, posters, and comic books to raise awareness of, and trust in, solar lighting products among potential consumers. These materials explain what solar lighting products are, how they work, their use and maintenance, their benefits and how they transform lives. They can be adapted to feature available quality-verified products and to inform consumers and retailers where they can purchase reliable solar products locally.

These materials compliment the road shows that the program carries out in rural villages on market days during awareness raising campaigns. These shows feature product demonstrations, fun quizzes, dance performances and a chance to test solar lighting products first-hand.

In Kenya, Lighting Africa's consumer education campaign also imbedded key consumer messages into one season of 'Makutano Junction', a popular 'edutainment' soap opera, as well as conducting annual campaigns to encourage urban residents to gift solar lighting products to their rural relatives.

Source: Lighting Africa 2015

2.3.3 ENCOURAGE DEVELOPMENT OF LOCAL SKILLS TO SUPPORT MARKET GROWTH

Local skills are key for building sustainable markets. Savvy entrepreneurs that know how to develop their business are the foundation of a lasting and scalable distribution network can also deliver reliable after-sales services. The

required skill set is often not part of the curricula of secondary schools, but could be facilitated through innovation incubators or similar institutions. Training centres for electrical technicians should consider including the necessary skill set for reliable technical training.

Governments should encourage training and make it part of the curricula for technicians and entrepreneurs in close coordination with industry needs. Training could take place in cooperation with the private sector (see Box 8). National institutions need adequate preparation time to provide structures to meet new provisions of regulations. This is a prerequisite for regulations to be efficient¹³.

BOX 8 KENYA RENEWABLE ENERGY ASSOCIATION (KERA) TRAINING FOR TECHNICIANS

With support from various donors, the Kenya Renewable Energy Association (KERA) has helped to develop trainings for solar technicians and equipped training institutions with the necessary materials to train technicians properly. To make the two-week training more affordable to technicians, the cost of the training is subsidised. In a second step, KERA seeks to work with training institutions for electrical technicians to ensure their curriculum reflects the provisions of the regulation so that all future technicians will have the right skill set for solar lighting when they leave any electrical training institution.

Source: Interview with KERA 2015

2.3.4 LEVERAGE PUBLIC PRIVATE PARTNERSHIPS TO INCREASE MARKET PENETRATION

Partnerships between the public and private sector can in many ways help to increase the market penetration of clean and efficient off-grid lighting. Local or state governments can for example include off-grid lighting as an eligible product class for economic development incentives. By opening up their networks to companies, government institutions can be of support to reach new consumers. Endorsement of solar products by government representatives can also have a very strong effect on the population. SunnyMoney successfully partners with Ministries of Education to leverage national school networks

¹³ "For example, in Kenya, the regulatory authority had rightly identified the lack of qualified technicians as a leading cause for the failure of SHS [solar home systems]. A law was enacted to rectify this real problem, i.e. SHS companies require qualified technicians to operate. It was a good law, but by the time it came into effect, there were very few trained technicians nationwide and, indeed, few training institutes to increase the numbers. It was a good law but there was a gap in the strategy to effectively achieve this." Nana Nuamoah Asamoah-Manu, IFC, personal communication during peer review process, 2014

to increase awareness for solar lighting and to reach consumers in low-income households and benefits from the involvement of head teachers that are trusted within communities. Schools benefit from the initiative as the better lighting allows students to extend their studying hours after night fall (see Box 9).

BOX 9 **DISTRIBUTING EFFICIENT OFF-GRID LIGHTING PRODUCTS VIA SCHOOLS**

The international charity SolarAid uses a business-based approach to sell solar lights in Africa through its social enterprise, SunnyMoney. SunnyMoney's field teams visit schools to explain and demonstrate the benefits of off-grid lighting products to head teachers. The head teachers then demonstrate the solar lights to their students and ask them to inform their parents when they go home. The parents subsequently purchase their first solar lights from SunnyMoney's field teams at the schools. By building trust and awareness in solar lights through head teachers at schools, more students and their parents are reached and convinced to procure the solar lights.

In Zambia, SunnyMoney provides access to clean, safe, bright solar lights across the country's Southern, Eastern and Copperbelt provinces. With support from the Ministry of Education, SunnyMoney works closely with district education boards to arrange head teacher meetings, bringing groups together to learn about solar lighting so they can offer their students and communities the chance to purchase a solar light. Through SunnyMoney Zambia's trade and dealer networks, the teams sell lights through retail outlets, cooperatives and large agri-businesses as well as local shops and agents. SunnyMoney is seeking to further develop and expand this area of work in order to provide better access and availability to solar lights across the country.



A SUNNYMONEY AGENT AND CUSTOMER

Source: SolarAid, 2014b.

Through a successful partnership with the national tea development agency, Barefoot has been enabled to provide thousands of workers on tea plantations with clean energy access (see Box 10).

BOX 10 **INDUSTRY EXPERIENCE ON PARTNERSHIPS TO ATTRACT PRIVATE SECTOR PARTICIPATION IN KENYA**

Barefoot Power* is a business that assists people in developing countries to access affordable renewable energy. One of its biggest successes was to engage with the Kenyan Tea Development Agency (KTDA) and secure a partnership with Unilever. Under the partnership, the housing provided to KTDA workers was outfitted with solar home systems. Barefoot Power also benefited from an enabling framework of reduced duties in Kenya. The partnership increased the volume of products provided from a target number of 10,000 homes to 12,600 homes (a 26% increase in installation).

**<http://www.barefootpower.com/index.php/about-us>*

Source: Interview with KERA 2015

Public-private partnerships could also be co-financed with funds from bilateral donors, development banks, the Global Environment Facility, the Green Climate Fund or other multilateral tools created under the United Nations Framework Convention on Climate Change (UNFCCC). These tools include Nationally Appropriate Mitigation Actions (NAMAs) or the Clean Development Mechanism (CDM). The best option for countries considering financing via these tools is to aggregate demand for modern off-grid lighting technology across a larger region¹⁴.

2.4 STEP 4: SUSTAIN THE POSITIVE IMPACT AND KEEP MARKET AT STEADY GROWTH RATES

Once several companies are in the market and successful in building sustainable distribution chains, sales will continue and an increasing number of people reached. In a sustainable market consumers have the choice between different products and brands. Healthy competition between private sector players stimulates innovation and leads to a constant increase in services provided. To ensure the market keeps on track and to sustain the overall positive impact on society, it is important to **strengthen monitoring and enforcement structures for quality assurance**. This will ensure quality products continue to dominate the market and prevent copy-cat products from undermining consumer trust. As more consumers are using solar lighting products, the question of collection and recycling of spent products becomes more important.

¹⁴ For guidance on developing national and regional off-grid efficient lighting strategies and off-grid lighting financing proposals, refer to: *Achieving the Global Transition to Energy Efficient Lighting Toolkit (UNEP 2012a)*
Guidebook for the Development of a Nationally Appropriate Mitigation Action on Efficient Lighting (UNEP 2013c) CDM methodology: *AMS-III.AR.: Substituting fossil fuel based lighting with LED/CFL lighting systems—Version 2.0 (UNFCCC 2012)*

The private and the public sector should jointly think about appropriate ways to tackle the issue of recycling for spent products and **provide infrastructure and regulation for the environmentally sound treatment of products.**

2.4.1 STRENGTHEN ENFORCEMENT AND MONITORING OF QUALITY ASSURANCE PROGRAMS

The success of a sustained market transition to efficient off-grid lighting depends on a well-functioning system of monitoring, verification and enforcement that is capable of ensuring full compliance with quality standards:

- Monitoring (market surveillance) is a measurement process to check product efficiency. It involves measuring performance claims against a nominated standard in a consistent manner, using accurate instrumentation applied by qualified staff in controlled conditions.
- Verification is the measurement process whereby declarations of conformance by lighting suppliers are confirmed.
- Enforcement is the action taken by programme administrators or other responsible parties against suppliers of non-compliant products, as a result of finding fault through either monitoring or verification.

The key factors to consider for a successful monitoring, verification and enforcement scheme for efficient off-grid lighting products are:

- Custom officers should have the capacity to distinguish a quality product (that may be eligible for tax exemptions) from a non-quality product. Counterfeits are increasingly being imported and undermine market development. Low quality products that copy the look and feel of quality products should be dealt with when the products are crossing customs.
- It is critical to have ready access to an experienced, accredited laboratory with sufficient capacity and the ability to turn around test results quickly. For example, Lighting Global has a Test Laboratory Network comprising five accredited laboratories in various locations (including Nairobi, Kenya), which can provide testing services for most African countries without local testing facilities.
- Countries or laboratories could establish mutual recognition agreements, to avoid duplication of facilities and expenses, undue delays and unnecessary costs. For example, once a product has been approved by an accredited laboratory, it could be accepted across borders and not be required to re-test.

- Sanctions for non-compliant product suppliers (or in-country parties that may circumvent the system) should be available to allow the enforcement authority to respond quickly and in a cost-effective manner. Sanctions can include: giving notification of non-compliance and identifying a correction period for minor transgressions; de-listing products from a qualified products list or registry; public notice of violations; and legal actions (including suspension and fines).
- Where sanctions are necessary, they should be sufficient to outweigh the benefits of non-compliance in order to be an effective deterrent.
- The enforcement framework should include a clearly defined appeals process, to allow parties the opportunity to defend the compliance of their products.

2.4.2 PROVIDE INFRASTRUCTURE/REGULATION FOR PROPER RECYCLING OF SPENT PRODUCTS

Environmentally sound management of efficient off-grid lighting products covers the life cycle of products in terms of their impact on the environment. To optimise the benefits of efficient lighting products, it is important to minimise the environmental impacts that occur during manufacture¹⁵, use and disposal. From a life cycle perspective, replacing fuel-based lanterns with efficient off-grid lighting products reduces CO₂ emissions from fossil fuel burning. However, the disposal of spent (no longer useful) efficient off-grid lighting products should follow the principles of pollution prevention, and be consistent with global international policies that reduce and safely manage potentially hazardous waste, such as the Basel Convention on the Control of Transboundary Movement of Hazardous Wastes and Their Disposal and the Minamata Convention on Mercury.

Policymakers should consider how to develop a legal framework for environmentally sound, end-of-life management, making this a national priority and ensuring coordinated law enforcement. Policy and legislation must be carefully drafted and implemented before the establishment of formal collection channels and recycling facilities. National regulators, in their efforts to implement a comprehensive lighting policy, can prioritise efforts to: make key stakeholders aware of the benefits of environmentally sound disposal of spent lamps and batteries; develop and adopt national regulation for environmentally sound disposal of spent lamps and batteries; develop and implement national collection systems for spent lamps and batteries; and assist the private sector to develop and establish commercially viable recycling and disposal facilities for spent lamps and batteries, where possible.

¹⁵ For more information, see Alstone et al. 2014.

Successful recycling programmes depend on high volumes. If the volume of off-grid lighting products remains low, then some off-grid products (such as LED lamps) may be integrated into a broader e-waste effort that could cover computers, televisions, radios and mobile phones (SolarAid 2014a). 'Take-back' or 'buy-back' programmes and reverse supply chains also could be explored, in cooperation with industry or consumer associations, in areas with sufficient volumes of product in use by consumers (see Boxes 11 and 12).

BOX 11 INDUSTRY EXPERIENCE WITH COLLECTION AND RECYCLING

Some off-grid lighting manufacturers (including d.light) are considering plans to collect and recycle spent products. In countries that do not have a recycling programme, the following practices can be followed:

- Import products that do not contain hazardous materials or ones that can be treated along with other electronic appliances at end of use.
- Avoid or reduce the use of hazardous materials in upstream production. For example, d.light uses lithium-polymer batteries instead of lithium acid or lithium-ion batteries.
- Communicate to manufacturers the need for products that are designed so that any components that must be treated as hazardous waste (such as batteries) can be easily separated at end of use.
- Encourage manufacturers and distributors to consider life cycle cost analyses and to reduce as much as possible the energy embodied in the manufacturing process.

Source: Interview with KREA 2015

On one side, the environmentally sound management of efficient off-grid lighting products has significant advantages. Among other benefits, it incentivises manufacturers and other stakeholders to ensure maximum possible service life. It also ensures a national obligation to conform to global international policies that reduce and safely manage hazardous waste, such as the Basel Convention on the Control of Transboundary Movement of Hazardous Wastes and Their Disposal and the Minamata Convention on Mercury. In addition it ensures the health and safety of product users and the community and allows recycling of the spent products for the production of useful items.

On the other side, major constraints of environmentally sound management programmes for efficient off-grid lighting products are the need for sustainable funding for implementation, adequate enabling legislation and implementation and enforcement of a comprehensive collection scheme.

A non-profit association, AMBILAMP, was launched on behalf of the major lamp manufacturers in Spain in 2005, specifically for the collection and treatment of lamp and luminaire waste in accordance with the European Union's Waste Electrical and Electronic Equipment (WEEE) Directive of 2005. In 2013, the AMBILAMP International Academy for the Recycling of Light was created to provide expertise for establishing environmentally sound management systems for spent lighting products in developing and emerging countries. Initiated by the UNEP-GEF en.lighten initiative, with the support of their private sector partners, AMBILAMP builds on the experience for collection and recycling of lighting products that already exists in Europe and in countries outside of the European Union. It provides training to policymakers around the world.

BOX 12 INDUSTRY EXPERIENCE WITH HANDLING OF SPENT PRODUCTS

Industry experience with handling spent products has identified the following points for consideration:

- Governments need to consider implementation of policies on hazardous waste (hazardous material, handling of products and disposal of batteries).
- Manufacturers have a responsibility to design programmes for collection and recycling of off-grid lighting products.
- The recycling value of off-grid products may be financially viable, but economies of scale should be sought to reduce recycling costs per unit.
- Within the appropriate international legal conventions, transboundary shipments of spent off-grid lighting products within a region could be considered, to increase volumes and to make efficient use of facilities.
- A commercial recycling facility, East African Compliant Recycling, operates in Nairobi, Kenya, to serve the region, including Ethiopia. It may possibly roll out to Nigeria, too. The company works with local communities and the informal sector to collect lighting wastes. Its facility also handles a variety of e-waste products.

Source: Interview with Lighting Africa 2014.

The key factors for successful environmentally sound management programmes, from the perspective of product suppliers of efficient off-grid lighting products, are reflected in GOGLA's Industry Opinion on Lifecycle and Recycling (see Box 13). This statement indicates that all activities of GOGLA members should consider the principle of 'extended producer responsibility'. 'Producer' is defined as one of the businesses putting the efficient off-grid products on the market (manufacturers, traders, wholesalers and retailers).

As one possibility, extended producer responsibility schemes offer various benefits. It relieves the local government of the financial, and in some cases, operational burden of the disposal of the waste/products/material; it encourages companies to design products for reuse, recyclability and materials reduction; and it promotes innovation in recycling technology. However, extended producer responsibility schemes are difficult to implement and ambitious.

With respect to governments, their recommended role for a successful environmentally sound management of efficient off-grid lighting programmes is to take the lead in establishing extended producer responsibility programmes through:

- Developing the required regulatory frameworks.
- Developing waste treatment standards and facilities.
- Developing market surveillance programmes.
- Collecting data on programme performance.
- Establishing lighting performance standards for product longevity and toxicity.
- Certifying and maintaining a list of qualified lighting product recyclers.
- Supporting participation by relevant parties and the public. For example, private sector firms should be encouraged to manage the collection systems and the recycling/recovery operations for spent lighting products.

BOX 13

EXAMPLE OF AN INDUSTRY ASSOCIATION STATEMENT

GOGLA Industry Opinion on Lifecycle and Recycling (April 5, 2014, Cologne, Germany)

"Management of end-of-life electrical and electronic equipment (WEEE) is recognized as a huge challenge not just for business, but also for governments, environmental and human rights groups throughout the world." (Compliance and Risk Newsletter)

"Solar-based off-grid lighting technologies already substitute the use of non-rechargeable batteries for lighting, thereby considerably reducing the problem of electronic waste. The benefits of off-grid technology will be maximised if all aspects are considered over the full product lifecycle. While bringing light and energy to non-electrified areas of the world, the members of GOGLA are committed to the following values all driven by the intention to preserve the environment and avoid or minimize any hazardous waste contamination:

1. The principle of the extended producer responsibility (the producer is the entity putting the product on the local market)* should accompany all activities of GOGLA members.
2. Therefore the members are committed to:
 - a. Develop products that can be easily maintained and repaired. Spare parts need to be made available;
 - b. Strategies to implement proper take-back and recycling should be envisaged in countries of operation;
 - c. Identify synergies in the use of standard resources and materials to facilitate separation during recycling and reuse;
 - d. Avoid the use of hazardous substances and find alternatives for them, if technically possible. If this is not possible, incentives for collection of the parts containing these hazardous substances should be developed.
3. The members will align their efforts to approach ministries, non-governmental organizations and all other relevant stakeholders to create the awareness, that the use of modern off-grid technology, like all new electronic products, should be accompanied by the creation of an environmental sound management of the products at the end of their useful lifetime.
4. The members will join forces within GOGLA and with other industries in the area of awareness creation towards end consumers that proper treatment of electronic waste is of value for human health and the environment.
5. The members will look for synergies with other industries in identifying possibilities for common collection and recycling activities."

**based on the definition of the WEEE Directive
Source: GOGLA 2014*



3 CONCLUSION

This report has given an overview of the benefits of off-grid lighting and ways **for the government to seize market opportunities by creating an enabling environment.** If government and the private sector work together, the market can grow at a higher speed and thus provide more households with basic energy access and clean lighting facilities faster. In partnership with the private sector (manufacturers, distributors and industry association) and civil society organisations, **policymakers could design sound policies and benefit from the current trend in the off-grid lighting market to create new opportunities for job creation and economic growth and reduce the negative impact on the environment.**

To this end, the report has identified best practices, case studies and practical recommendations for the establishment of regulatory framework and policy strategies for efficient off-grid lighting. The key steps are to: get the fundamentals right; kick-start the market; scale up the market; and sustain the positive impact. Based on a careful analysis of the state of the market in the country, governments can plan, take action and establish a sound off-grid lighting policy framework to accelerate market growth.

While the structure of the publication follows these sequenced steps, there is no blue print for the creation of an enabling environment. Policies have to be designed in response to local context and not follow a 'one-size-fits-all' logic. **Through an integrated approach, policymakers can chose different activities to implement related to the respective situation** in-country. Policymakers can develop tailored supporting policies and mechanisms in their countries, but should follow an integrated approach in which policies complement one another.

As mentioned in earlier sections, the success of a rapid market development for efficient off-grid lighting depends, in part, on the selection and **combination of complementary policies to meet the needs of a country.** The mechanisms and measures presented in this report range from fiscal mechanisms, such as VAT and tariff exemptions or the phase out of kerosene subsidies, to the promotion of minimum quality standards and the environmentally sound management of spent products. An energy policy can help to set the framework for these mechanisms to complement each other.

In a second edition of this report, tactical advice and concrete next steps could be given. The tactical toolbox could provide policymakers with further ideas and guidelines for the implementation of respective policies. This would however require additional research and thus resources.

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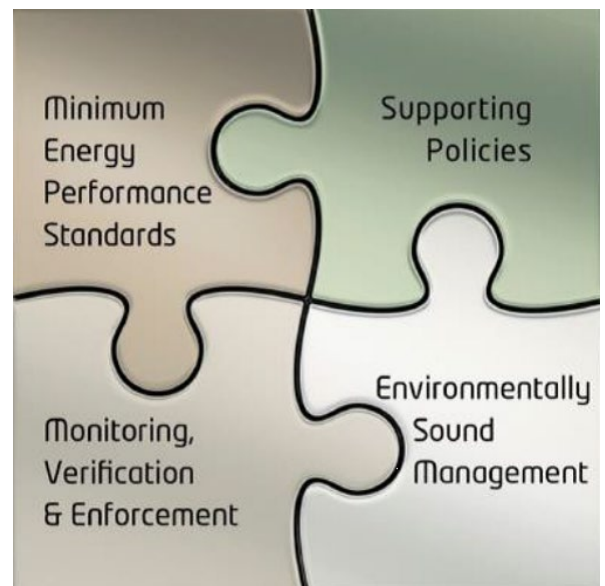
5 ANNEX I: UNEP INTEGRATED POLICY APPROACH

The growth of regional and local markets for efficient off-grid lighting in Africa can be sustained via an integrated policy approach that includes four elements: supporting policy mechanisms, the implementation of minimum energy performance and quality standards, monitoring, verification and enforcement, as well as environmentally sound management. The integrated policy approach for efficient lighting has been developed with input from international experts and applied by more than 27 developing countries globally, through the UNEP en.lighten initiative. In detail below are the actions need to be taken in the field:

- Designing and establishing supporting policies, including economic and market-based instruments, fiscal instruments and communication strategies to persuade consumers to change their behaviour. These include: awareness raising, promotion and education (to mobilise public support and change societal and cultural attitudes and behaviours regarding energy-efficient lighting); certification and labelling (to encourage manufacturers of efficient products to inform consumers about the energy benefits of their products); reduced taxes on off-grid lighting products; and demonstration programmes (to introduce and evaluate efficient off-grid lighting approaches).
- Setting minimum energy performance and quality standards that specify the energy efficiency requirements and other key characteristics that affect the energy demand and use that off-grid lighting products must meet before they can be sold. This can help prevent the market entry of low-quality products that would not deliver the many energy-saving and other benefits of good-quality lighting products, and help to identify any products that should be phased out. Minimum energy performance standards should be developed through a transparent and consultative stakeholder process.
- Designing and implementing monitoring, verification and enforcement measures in every aspect of the lighting programme, to allow for product quality surveillance systems and to ensure that products comply with the established minimum energy performance standards. This can help to avoid the challenge of a large proportion of low quality, low-cost products entering the market. If the quality of off-grid lighting products is not monitored, verified and enforced, the consequences include: slower progress towards achieving environmental and poverty-alleviation goals; reputational risks to the efficient off-grid lighting industry; end-consumers' lack of confidence in modern lighting products and possible reversion to use of fuel-based lighting; and the increased difficulty and cost of engaging in outreach to consumers in order to overcome mistrust and other barriers.

- Engaging in environmentally sound management of efficient off-grid lighting products to reduce their impact on the environment. From a life-cycle perspective, replacing fuel-based lanterns with off-grid lighting products reduces carbon dioxide (CO₂) emissions from fossil fuel burning. However, sustainable end-of-life schemes for spent products (especially batteries and the mercury in compact fluorescent lamps) are needed, and should follow the principles of pollution prevention and environmentally sound management, including extended producer responsibility.

Figure 5 Integrated policy approach for a transition to efficient off-grid lighting products



Source: UNEP 2015

6 ANNEX II: ESTIMATED POTENTIAL BENEFITS FROM A MARKET TRANSITION TO EFFICIENT OFF-GRID LIGHTING

COUNTRY	Number of Off-Grid Households 17	Annual Savings - Low Scenario (US\$)	Annual Savings - High Scenario (US\$)	Annual CO2 Savings (tonnes)	Kerosene Savings (litres)	Candle Savings (tonnes)	Annual Household Savings, Low to High (US\$)
Afghanistan	5,662,000	408,261,000	554,074,000	749,000	288,167,000	17,000	61 to 83
Algeria	133,000	9,674,000	13,388,000	23,000	8,665,000	-	60 to 83
Angola	3,062,000	217,501,000	270,955,000	756,000	290,608,000	16,000	61 to 76
Argentina	415,000	20,167,000	27,226,000	80,000	30,692,000	1,000	42 to 57
Bangladesh	14,488,000	800,537,000	1,095,519,000	2,248,000	864,529,000	14,000	46 to 63
Belize	7,000	679,000	946,000	2,000	623,000	-	80 to 112
Benin	1,350,000	211,044,000	286,413,000	352,000	135,438,000	8,000	133 to 180
Bhutan	55,000	5,697,000	7,937,000	14,000	5,223,000	-	90 to 125
Bolivia	295,000	25,544,000	25,978,000	6,000	2,394,000	6,000	74 to 76
Botswana	167,000	14,561,000	16,666,000	14,000	5,323,000	3,000	74 to 85
Brazil	467,000	37,065,000	51,656,000	88,000	34,036,000	1,000	69 to 97
Burkina Faso	2,589,000	227,588,000	306,693,000	458,000	176,241,000	10,000	74 to 99
Burundi	1,830,000	248,803,000	307,238,000	174,000	64,906,000	31,000	114 to 141
Cambodia	2,165,000	177,062,000	248,037,000	321,000	123,648,000	2,000	68 to 96
Cameroon	2,000,000	217,160,000	285,472,000	512,000	196,988,000	11,000	92 to 121
Cape Verde	5,000	784,000	1,066,000	1,000	489,000	-	125 to 170
Central African Republic	855,000	90,292,000	123,564,000	148,000	56,885,000	3,000	88 to 120
Chad	2,369,000	222,213,000	240,629,000	79,000	30,441,000	44,000	84 to 90
Chile	80,000	7,618,000	10,739,000	14,000	5,322,000	-	84 to 119
China	931,000	69,868,000	98,007,000	145,000	55,612,000	1,000	66 to 93
Colombia	366,000	29,484,000	41,091,000	70,000	27,074,000	-	70 to 98
Comoros	84,000	6,628,000	9,152,000	19,000	7,220,000	-	68 to 95
Congo, Dem. Rep.	12,006,000	1,084,578,000	1,169,838,000	390,000	150,073,000	216,000	81 to 87
Congo, Rep.	840,000	56,625,000	74,896,000	139,000	53,502,000	3,000	57 to 75
Costa Rica	9,000	826,000	1,157,000	2,000	677,000	-	81 to 114
Cote d'Ivoire	1,963,000	234,469,000	278,791,000	198,000	73,620,000	35,000	99 to 118
Cuba	64,000	5,171,000	7,206,000	12,000	4,748,000	-	70 to 98
Djibouti	91,000	11,390,000	15,273,000	22,000	8,458,000	-	107 to 143
Dominican Republic	121,000	12,384,000	17,436,000	23,000	8,930,000	-	90 to 127
Ecuador	240,000	18,744,000	26,085,000	46,000	17,732,000	-	68 to 95
Egypt, Arab Rep.	435,000	10,812,000	13,377,000	74,000	28,390,000	-	20 to 25
El Salvador	125,000	10,089,000	14,060,000	24,000	9,264,000	-	70 to 98
Equatorial Guinea	33,000	3,265,000	4,116,000	11,000	4,062,000	-	81 to 102
Eritrea	882,000	46,950,000	64,148,000	135,000	51,925,000	1,000	44 to 60
Ethiopia	17,179,000	956,547,000	1,319,407,000	2,370,000	911,372,000	15,000	46 to 64
Fiji	20,000	1,848,000	2,329,000	3,000	1,100,000	-	76 to 96
Gabon	137,000	11,817,000	13,059,000	13,000	4,860,000	2,000	72 to 80
Gambia, The	321,000	31,188,000	33,745,000	11,000	4,288,000	6,000	87 to 94
Georgia	2,000	45,000	54,000	-	169,000	-	16 to 19
Ghana	1,665,000	307,013,000	422,243,000	422,000	162,137,000	9,000	157 to 216

COUNTRY	Number of Off-Grid Households 17	Annual Savings - Low Scenario (US\$)	Annual Savings - High Scenario (US\$)	Annual CO2 Savings (tonnes)	Kerosene Savings (litres)	Candle Savings (tonnes)	Annual Household Savings, Low to High (US\$)
Guatemala	571,000	49,832,000	52,406,000	11,000	4,304,000	11,000	75 to 79
Guinea	1,949,000	193,837,000	211,316,000	68,000	26,071,000	37,000	89 to 96
Guinea-Bissau	253,000	24,545,000	26,535,000	9,000	3,382,000	5,000	87 to 93
Guyana	43,000	3,641,000	5,089,000	8,000	3,146,000	-	75 to 105
Haiti	1,899,000	152,910,000	155,545,000	37,000	14,321,000	37,000	69 to 71
Honduras	296,000	25,023,000	25,981,000	6,000	2,232,000	6,000	73 to 76
India	60,655,000	2,600,177,000	3,374,612,000	15,016,000	5,775,489,000	105,000	36 to 47
Indonesia	13,125,000	488,445,000	633,014,000	2,871,000	1,104,053,000	20,000	31 to 41
Iran, Islamic Rep.	255,000	4,564,000	5,375,000	40,000	15,201,000	-	15 to 17
Iraq	1,037,000	27,473,000	32,640,000	228,000	87,608,000	1,000	21 to 25
Jamaica	46,000	5,250,000	7,394,000	10,000	3,740,000	-	100 to 142
Kazakhstan	151,000	3,529,000	4,426,000	26,000	10,079,000	-	20 to 25
Kenya	7,590,000	761,181,000	1,064,594,000	1,674,000	643,771,000	12,000	87 to 122
Kiribati	12,000	969,000	1,219,000	2,000	583,000	-	66 to 83
Korea, Dem. Rep.	6,162,000	347,297,000	486,405,000	635,000	244,329,000	4,000	47 to 67
Lao PDR	665,000	42,357,000	58,627,000	99,000	37,951,000	1,000	53 to 73
Lebanon	425,000	24,385,000	33,859,000	54,000	20,612,000	-	48 to 67
Lesotho	315,000	32,778,000	38,446,000	29,000	10,904,000	5,000	87 to 102
Liberia	770,000	74,169,000	79,978,000	27,000	10,295,000	15,000	86 to 93
Macedonia, FYR	30,000	2,264,000	3,155,000	5,000	2,079,000	-	66 to 93
Madagascar	3,890,000	376,453,000	398,211,000	141,000	54,044,000	83,000	83 to 88
Malawi	3,367,000	269,113,000	364,901,000	500,000	192,409,000	11,000	67 to 91
Malaysia	192,000	12,574,000	17,186,000	42,000	16,148,000	-	56 to 78
Maldives	-	13,000	13,000	-	2,000	-	88 to 92
Mali	2,030,000	191,658,000	205,169,000	71,000	27,150,000	39,000	85 to 90
Marshall Islands	3,000	250,000	314,000	-	150,000	-	66 to 83
Mauritania	563,000	56,170,000	61,304,000	20,000	7,530,000	11,000	89 to 97
Mexico	1,522,000	113,215,000	156,251,000	324,000	124,742,000	2,000	64 to 89
Micronesia, Fed. Sts.	10,000	810,000	1,019,000	1,000	487,000	-	66 to 83
Mongolia	98,000	6,365,000	8,872,000	15,000	5,848,000	-	57 to 80
Montenegro	78,000	8,230,000	11,621,000	14,000	5,463,000	-	92 to 131
Morocco	70,000	4,268,000	5,844,000	12,000	4,568,000	-	50 to 69
Mozambique	3,505,000	279,182,000	297,286,000	104,000	39,931,000	58,000	72 to 76
Myanmar	7,985,000	508,884,000	704,348,000	1,185,000	455,940,000	8,000	53 to 73
Namibia	336,000	32,569,000	37,542,000	31,000	11,599,000	5,000	82 to 94
Nepal	1,257,000	102,018,000	141,931,000	215,000	82,691,000	1,000	67 to 94
Nicaragua	432,000	37,421,000	39,221,000	8,000	3,260,000	8,000	75 to 78
Niger	2,759,000	222,413,000	309,464,000	468,000	179,870,000	3,000	67 to 93
Nigeria	21,149,000	1,432,962,000	1,751,965,000	5,517,000	2,121,924,000	118,000	58 to 70
Pakistan	9,897,000	885,231,000	1,226,912,000	2,002,000	770,059,000	13,000	73 to 101
Palau	-	4,000	6,000	-	4,000	-	80 to 111
Panama	104,000	8,790,000	12,249,000	21,000	8,069,000	-	74 to 103

COUNTRY	Number of Off-Grid Households 17	Annual Savings - Low Scenario (US\$)	Annual Savings - High Scenario (US\$)	Annual CO2 Savings (tonnes)	Kerosene Savings (litres)	Candle Savings (tonnes)	Annual Household Savings, Low to High (US\$)
Papua New Guinea	866,000	98,935,000	139,158,000	189,000	72,867,000	1,000	100 to 141
Paraguay	17,000	1,617,000	2,254,000	4,000	1,484,000	-	80 to 112
Peru	696,000	54,854,000	76,373,000	134,000	51,407,000	1,000	69 to 96
Philippines	5,424,000	632,296,000	885,975,000	1,325,000	509,590,000	9,000	101 to 142
Qatar	2,000	78,000	107,000	-	80,000	-	40 to 55
Russian Federation	735,000	44,973,000	62,692,000	107,000	41,331,000	1,000	54 to 75
Rwanda	2,034,000	184,533,000	251,239,000	325,000	125,013,000	7,000	76 to 103
Samoa	2,000	186,000	234,000	-	112,000	-	66 to 83
Sao Tome and Principe	16,000	1,544,000	2,014,000	4,000	1,500,000	-	83 to 109
Saudi Arabia	75,000	1,097,000	1,292,000	10,000	3,657,000	-	12 to 14
Senegal	1,300,000	242,680,000	333,407,000	339,000	130,410,000	7,000	158 to 217
Sierra Leone	1,069,000	100,259,000	107,048,000	37,000	14,304,000	21,000	84 to 89
Solomon Islands	77,000	10,272,000	13,512,000	12,000	4,415,000	-	110 to 145
Somalia	1,847,000	121,374,000	167,993,000	283,000	108,743,000	2,000	55 to 76
South Africa	1,654,000	161,913,000	187,073,000	154,000	57,151,000	27,000	82 to 95
South Sudan	1,850,000	201,451,000	280,597,000	480,000	184,616,000	3,000	93 to 131
Sri Lanka	618,000	36,007,000	49,314,000	117,000	45,069,000	1,000	51 to 70
St. Lucia	1,000	68,000	81,000	-	56,000	-	43 to 51
Sudan	4,168,000	644,495,000	910,492,000	1,082,000	416,011,000	8,000	134 to 189
Suriname	7,000	568,000	791,000	1,000	521,000	-	70 to 98
Swaziland	191,000	20,061,000	23,595,000	18,000	6,598,000	3,000	88 to 104
Syrian Arab Republic	574,000	29,042,000	40,046,000	72,000	27,846,000	-	42 to 58
Tajikistan	179,000	15,536,000	21,632,000	32,000	12,364,000	-	72 to 100
Tanzania	7,557,000	832,791,000	1,145,998,000	1,250,000	480,732,000	29,000	92 to 127
Thailand	235,000	23,224,000	32,671,000	44,000	17,114,000	-	87 to 122
Timor-Leste	199,000	16,324,000	22,869,000	30,000	11,383,000	-	68 to 96
Togo	924,000	85,295,000	115,395,000	164,000	62,925,000	4,000	77 to 104
Tonga	5,000	470,000	606,000	1,000	242,000	-	77 to 99
Uganda	6,517,000	682,813,000	867,440,000	827,000	318,125,000	29,000	90 to 114
Ukraine	772,000	52,991,000	73,862,000	127,000	48,683,000	1,000	60 to 84
Uruguay	9,000	902,000	1,274,000	2,000	603,000	-	86 to 121
Uzbekistan	197,000	20,619,000	28,791,000	47,000	18,017,000	-	90 to 127
Vanuatu	39,000	4,704,000	6,249,000	5,000	1,840,000	-	101 to 134
Venezuela, RB	94,000	8,438,000	11,758,000	20,000	7,744,000	-	78 to 109
Vietnam	836,000	80,573,000	112,487,000	184,000	70,946,000	1,000	84 to 117
Yemen, Rep.	2,130,000	68,575,000	86,189,000	426,000	163,733,000	3,000	26 to 33
Zambia	2,130,000	190,443,000	204,657,000	69,000	26,626,000	38,000	80 to 86
Zimbabwe	1,800,000	153,780,000	164,574,000	56,000	21,729,000	31,000	77 to 82
Totals:	277,850,000	20,090,991,000	25,983,650,000	49,691,000	19,103,456,000	1,301,000	

Source: UNEP, 2015b. Each national savings estimate shown is based on the average, national end-user price for kerosene. In countries where kerosene is subsidised, the benefit accruing to the nation will be higher. For methodology, see <http://map.enlighten-initiative.org/>.



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