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United Nations Development Programme

PLANNING FOR IMPROVED ENERGY ACCESS AND PRODUCTIVE USES OF ENERGY

ENERGYPLUS GUIDELINES

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FOREWORD

A global consensus is emerging: without sustainable energy for all, it will not be possible to achieve sustainable development.

Expanding access to affordable, reliable, modern and sustainable energy needs to enhance agricultural productivity, spur business activities and create new job opportunities. It is also critical to ensure the provision of essential services, such as in health, education, water, sanitation and safety. These in turn lead to improved gender equality and strengthen resilience towards economically and environmentally induced shocks and disasters, including those exacerbated by climate change. As Secretary-General Ban Ki-moon rightly notes: "Energy is the golden thread that connects economic growth, increased social equity, and an environment that allows the planet to thrive."

The UN Development Programme (UNDP) takes pride in presenting the "EnergyPlus Guidelines", which are based on UNDP's wide experience in the field of sustainable energy access. The 'EnergyPlus approach', developed by UNDP's Bangkok Regional Hub for Asia-Pacific, focuses on the affordability of energy services and on improving productivity alongside more traditional energy interventions. Overall, the Guidelines focus on strengthening what have been identified as the seven key components of both energy and non-energy "value chains," which together comprise a successful EnergyPlus programme.

While sustainable energy for all is an ambitious goal, it is achievable, and these Guidelines show how to make progress towards this, such as establishing how to set a baseline for monitoring energy poverty. It helps build an integrated framework so that tracking of progress is linked to socially inclusive and gender-specific indicators that measure improved energy access and its productive uses. The Guidelines emphasize the use of public finance and policy to de-risk private investments for enhancing financial sustainability, and recommend a broader scope be taken in expanding energy access to support the improvement of education and health facilities, as well as to increase the productivity of agriculture and small and medium-sized enterprises. They further offer proven ways to stimulate productive energy uses, such as through innovative Community Enterprise Mapping.

Ultimately, the focus of our work is to help empower the poor, particularly women, by improving their living standards and accelerating social and economic progress through the expansion of affordable, reliable, modern and sustainable energy. We hope that these Guidelines serve as a useful resource for practitioners in this field to achieve this goal, and that they provide a valuable contribution to the realisation of the post-2015 sustainable development agenda.

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EXECUTIVE Summary

Most of the nearly 3 billion people worldwide who lack access to electricity or to improved cooking facilities live in the developing regions of Asia-Pacific and sub-Saharan Africa. But providing energy is not enough by itself to lift people from poverty: Equally important is going beyond basic energy needs to ensure the empowerment of the poor, particularly women, to use modern energy in ways that benefit them and their communities.

The EnergyPlus approach promotes the **productive use** of energy: for generation of equitable employment and additional income; for meeting needs of existing and new enterprises; for community needs such as strengthened security and better access to education and health care, including through electricity for street lighting, clinics and schools; and for lifestyle needs to improve living standards. In turn, the formula of **EnergyPlus = Energy Access + Empowerment** can be seen as contributing to overall sustainable human development and poverty reduction.

These *EnergyPlus Guidelines* have been developed to assist policymakers and national/local government officials, development practitioners, civil society organizations, research and financial institutions, commercial energy enterprises and others. The *Guidelines* offer comprehensive advice on how stakeholders can collaborate in designing and implementing an EnergyPlus programme.

Critically, the *Guidelines* focus on both energy and non-energy inputs to help generate development benefits, and highlight seven essential components, all designed to strengthen capacities for informed planning and decision making, drive change through leadership, and stimulate markets and investments. These components specifically focus on the interdependence of:

- Monitoring energy poverty
- Establishing enabling policies and institutional support systems as well as effective stakeholder partnerships
- Accessing public finance and markets
- Ensuring energy resource availability and forecasting demand for energy
- Initiating productive energy uses for communication, thermal applications, and mechanically-powered devices
- Facilitating energy production and services, including through access to energy-efficient end-use technology
- Scaling-up successes

Many countries already promote universal access to sustainable forms of energy, especially among the rural poor. It is the EnergyPlus approach embodied in these *Guidelines* that offers the greatest opportunity to achieve the future we want under the post-2015 Sustainable Development Goals (SDGs).

ACRONYMS

AEPC	Alternative Energy Promotion Centre
AGECC	Advisory Group on Energy and Climate Change
ASEAN	Association of Southeast Asian Nations
BLEN	Biogas, LPG, electricity and natural gas
CBO	Community-based organization
CREIA	China Renewable Energy Industry Association
CSO	Civil society organization
DREI	De-Risking Renewable Energy Investment
ESCO	Energy service company
EUEI	EU Energy Initiative
GDP	Gross Domestic Product
GEF	Global Environment Facility
GHG	Greenhouse Gas
GIS	Geographic information systems
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
IEA	International Energy Agency
IIASA	International Institute for Applied Systems Analysis
kgoe	Kilograms of oil equivalent
kWh	Kilowatt-hour
LPG	Liquefied petroleum gas
MDGs	Millennium Development Goals
MEPI	Multidimensional Energy Poverty Index
MFI	Microfinance institution
MSME	Micro, small and medium-sized enterprises
NAMA	Nationally Appropriate Mitigation Action
NGO	Non-governmental organization
NSO	National Statistics Offices
OECD	Organisation for Economic Co-operation and Development

OFID	OPEC Fund for International Development
OPEC	Organization of Petroleum Exporting Countries
PPP	Public-private partnership
PV	Photovoltaic
R&D	Research and Development
RET	Renewable energy technology
SDGs	Sustainable Development Goals
SE4All	Sustainable Energy for All
SHSs	Solar Home Systems
SME	Small and medium-sized enterprises
UN	United Nations
UNDP	United Nations Development Programme
WBCSD	World Business Council for Sustainable Development

The overarching goal of the EnergyPlus approach is empowerment of the poor through providing access to modern energy carriers and services for livelihoods, employment, entrepreneurship, building capacity and social welfare.

DEFINITION of selected terms

Energy access: 'Energy access' refers to reliable and affordable access to modern energy carriers and end-use services for households and communities. More specifically, it may be defined as having 'access to clean cooking facilities and a first connection to electricity, and then an increasing level of electricity consumption over time.'[1]

EnergyPlus: EnergyPlus refers to projects, programmes and interventions that promote basic, social (community) and productive uses of energy.

Energy poverty: This can be defined according to either a monetary threshold or energy expenditure as a proportion of household income. An expenditure of 10% of household income is usually set as the energy poverty line.[2]

Clean and improved cooking stoves: Domestic or industrial stoves designed to reduce indoor air pollution and increase the efficiency of heat and combustion. These include improved stoves ranging from basic clay structures to advanced, built-in ventilated stoves and biogas, gas or electric stoves.

Energy service companies: Any enterprise that provides some form of access to energy and associated end-use services. This includes businesses such as retailers of renewable energy and energy efficiency technologies/services, operators of energy generating infrastructure, or manufacturers of clean or improved cooking stoves.

Marginalized groups: People at risk of exclusion from the benefits of and participation in development, including national, ethnic, religious and linguistic minorities as well as the young, the elderly, the impoverished and homeless, those with disabilities, and those of different sexual orientations.

Productive uses: The application of energy derived mainly from renewable resources to create goods or services, either directly or indirectly, for the production of income or value.[3]

[1] International Energy Agency (IEA), 2011. See also the Secretary-General's Advisory Group on Energy and Climate Change (AGECC), 2010.

[2] R. Moore (2012)

[3] R. White, *GEF/FAO Workshop on Productive Uses of Renewable Energy: Experience, Strategies, and Project Development*, 18-20 June Workshop Synthesis Report (UN Food and Agriculture Organization, Italy, 2002.

Globally, an estimated 1.3 billion people lack access to electricity, while another 2.6 billion lack access to improved cooking facilities.

Cooking can represent up to 90 percent of a poor household's energy use, and the use of modern cooking fuels can reduce drudgery, particularly for women and girls.

INTRODUCTION

PURPOSE OF THE GUIDELINES

Many countries are promoting, as national development priorities, universal access to sustainable forms of energy, especially among the rural poor. Two important United Nations (UN) initiatives in recent years have provided much-needed support to energy access. The UN Secretary-General's launch, in 2011, of the Sustainable Energy for All (SE4ALL) initiative was followed by the UN General Assembly's designation of 2012 as the International Year of Sustainable Energy for All. This prompted a series of collaborative actions at the global, regional and national levels to bring together top-level leadership from all sectors — government, business and civil society — to build consensus and commitment regarding SE4ALL objectives. A second key development — the UN's announcement of the Decade of Sustainable Energy for All, from 2014 to 2024 — has sustained the momentum. This has given SE4ALL further impetus; at the same time, it has encouraged the initiation of new policies, programmes and targeted energy access interventions across regions. Goal 7 (Ensure access to affordable, reliable, sustainable and modern energy for all) of the proposed post-2015 Sustainable Development Goals (SDGs) is set to push the sustainable energy goals even further for more sustainable and inclusive development.

At this critical juncture, it is essential that all stakeholders familiarize themselves with past energy access initiatives, learning more about what works and what does not. The few practical guides available are inadequate to offer governments and other stakeholders, comprehensive advice on how they can collaborate in promoting improved energy access. These *Guidelines* have thus been designed to fill that gap, providing an overview of appropriate approaches and activities, together with a compilation of advice on planning, designing and implementing an EnergyPlus programme.

Poverty and energy access are closely linked, and expanding energy access should aim in part at poverty eradication. Providing energy is not in itself enough, however, to lift people from poverty. Measures are needed that empower the poor to use modern energy in ways that benefit them in terms of livelihoods and additional income. Moreover, productive end-uses of energy offer an effective means to alleviate poverty.

EnergyPlus access refers to projects, programmes and interventions that promote basic, social (community) and productive uses of energy. The *Guidelines* developed here provide assistance to policymakers, development practitioners, civil society organizations (CSOs), research institutions, financial institutions, venture capitalists and commercial energy enterprises seeking to engage in energy poverty issues, as well as help government departments whose mandate covers energy access. The *EnergyPlus Guidelines* adopt an approach based on many years of UNDP analysis of energy access experiences. These experiences have helped derive the important components of an effective EnergyPlus programme and outline a selection of useful implementing resources and activities, including enabling policy notes, manuals, lessons learnt from good practices, monitoring and evaluation tools, and approaches to build stakeholder partnerships and access finance.

WHAT IS ENERGY ACCESS?

The expression 'energy access' generally refers to reliable and affordable access to modern energy carriers and end-use services for households and communities. More specifically, it may be defined as having 'access to clean cooking facilities, a first connection to electricity, and then an increasing level of electricity consumption over time.'[4] Beyond access to the sources of energy themselves, this definition includes access to the means of energy generation, energy end-use services and equipment for the consumption of energy. This definition refers to both (a) improved cooking and heating solutions that use cleaner fuels and/or cleaner stoves, and (b) electric or motive power. Such types of access are also measured in distinct ways. Electricity connections are characterized in terms of their reliability, affordability, quality, sustainability and how much power/electricity they supply, while cooking-energy solutions are ranked on a scale from basic open fires to modern LPG (liquefied petroleum gas) or electric stoves.[5] Cooking-energy solutions are important because cooking can represent up to 90 percent of a poor household's energy use,[6] and poor-quality fuels as well as stoves cause indoor pollution leading to severe respiratory-related illnesses, responsible for about 4.3 million premature deaths globally each year.[7] Modern cooking fuels are also important because they reduce the drudgery of long hours spent, especially by women and girls, in collecting biomass and cooking in smoke-filled kitchens.

Globally, an estimated 1.3 billion people lack access to electricity, while another 2.6 billion lack access to improved cooking facilities.[8] Most of the energy poor live in the developing regions of Asia-Pacific and sub-Saharan Africa. Figures 1 and 2, below present those countries facing the greatest challenges in improving energy access for the poor. The top 10 countries account for nearly 64 percent of people without access to electricity and 74 percent of people without access to clean cooking facilities.

[4] International Energy Agency (IEA), 2011. See also the Secretary-General's Advisory Group on Energy and Climate Change (AGECC), 2010.

[5] For more details, see the *SE4ALL Global Tracking Framework*, p. 85.

[6] F. Lambe; A. Atteridge (2012), p. 3.

[7] IEA (2006), p. 419; S. Lim et al. (2012), WHO (2014), p. 1.

[8] An up-to-date record of these figures is maintained by IEA, and the database includes estimates for most Organisation for Economic Co-operation and Development (OECD) and non-OECD countries. The database can be accessed through the IEA's World Energy Outlook at: http://www.worldenergyoutlook.org/resources/energydevelopment/globalstatusofmodernenergyaccess/.

[9] World Energy Outlook (2013).

[10] Using data from http://apps.who.int/iris/bitstream/10665/112738/1/9789240692671_eng.pdf?ua=1 and http://www.prb.org/pdf12/2012-population-data-sheet_eng.pdf.

FIGURE 1 Top 10 countries with people lacking access to electricity[9]

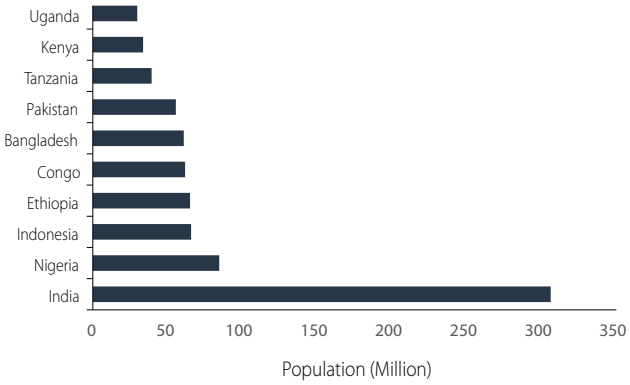
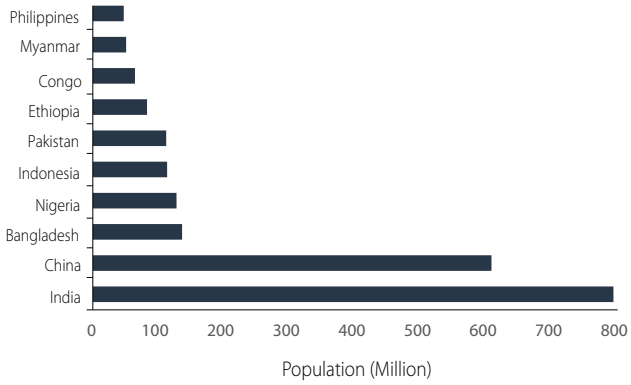


FIGURE 2 Top 10 countries with people lacking access to clean cooking facilities[10]



WHAT IS ENERGYPLUS?

The *Guidelines* promote an EnergyPlus approach. Many energy access programmes focus on providing energy sources, carriers, technologies and services without considering how this access can be used to promote wider development benefits. EnergyPlus moves a step further, aiming to ensure **productive use** of energy accessed by households, communities and enterprises, thereby contributing to sustainable human development and poverty reduction. To accomplish this, the approach focuses on both energy and non-energy inputs that combine energy services with interventions and activities that help generate livelihoods, employment, entrepreneurship and other development activities.

Thus, the overarching goal of the EnergyPlus approach is empowerment of the poor through energy access, where this also provides for cleaner energy, income generation, livelihoods and enterprise opportunities, better access to education and health, and so forth. These benefits add up to overall economic progress and human development. EnergyPlus therefore looks beyond basic energy needs to target modern energy needs of (a) the lifestyle energy end-uses, enhancing the quality of living standards through convenience, entertainment, information and communication; (b) social end-uses such as street lighting, clinics and schools; (c) productive end-uses resulting in such benefits as establishment of enterprises, creation of other income-generating and employment opportunities, and availability of irrigation pumps; and (d) productive livelihoods due to reduced drudgery, more time for learning as well as working, and opportunities for additional income generation. All these contribute to empowering the poor while building resilience to adversity by way of economic progress, increased awareness, and human and social empowerment. This understanding leads us to the following definition of EnergyPlus:

EnergyPlus = Energy Access + Empowerment

More precisely, EnergyPlus may be described in terms of the following target benefits:

Energy for public spaces and social welfare. EnergyPlus meets such social needs for energy as electricity for public spaces or electrifying health clinics and schools to improve the quality of medical and educational services. This boosts such basic human development indicators as literacy rates, lower infant and maternal mortality, and access to communication devices for communities.[11] Productive livelihoods can also be facilitated by reducing the effort and time devoted, especially among women and girls, to the drudgery of collecting biomass and cooking food in smoke-filled kitchens.

Energy for jobs and income generation. Productive uses encompass income-generating activities, including the supply of electricity for micro, small and medium-sized enterprises (MSMEs) to increase the productivity of existing activities or encourage the establishment of new types of business. Productive uses also include electricity for agricultural production and processing, or improving the energy efficiency of stoves or kilns in cottage industries.

Energy for poverty alleviation. All the above activities contribute to poverty reduction by raising incomes among the poor and providing new opportunities for equitable economic growth in local economies; at the same time, they enable users to pay the costs of energy services.

[11] For more details see Poor People's Energy Outlook 2013 (Practical Action, Rugby, 2013).

Energy access refers to reliable and affordable access to modern energy carriers and end-use services for households and communities.

OVERVIEW OF AN ENERGY ACCESS PROGRAMME

Broadly speaking, such programmes present comprehensive policy-driven efforts undertaken by governments, whether independently or in partnership with donors, Non-governmental organizations (NGOs) or CSOs. They can include better access to an electricity grid, to off-grid electricity, or to clean cooking facilities. These *Guidelines*, however, focus primarily on off-grid solutions, although the approach also recognizes the importance of grid expansion, thermal energy needs, and alignment of grid expansion needs with programmes focusing on off-grid energy access.

The *Guidelines* address seven key components of an EnergyPlus approach (Table 1). At the outset, planners should consider all these components. A given programme might have already initiated or implemented some components, in which case they only need to adopt the remaining ones. For example, without an energy-resource availability assessment, one cannot plan for energy production. Similarly, without facilitating energy production, one cannot initiate productive energy uses. But every programme does need to incorporate each and every component, for they are interdependent. Some components must be applied in sequence (e.g., attention to energy resources will precede energy production, which will in turn precede productive energy use). Others may be implemented simultaneously (e.g., monitoring energy poverty, energy resource availability and institutions for energy access).

TABLE 1 Components of the EnergyPlus approach

Type of capacity / Level of stakeholders	Informed planning and decision making	Driving change through leadership	Stimulating markets and investment
National government and industry stakeholders	Component 1: Monitoring energy poverty – The baseline and tracking progress	Component 2: Institutions and coordination of energy access	Component 3: Public finance and market incentives
Local governments, energy producers, suppliers, users and CSOs	Component 4: Energy resource availability and forecasting demand	Component 5: Initiating productive energy uses	Component 6: Facilitating energy production and services
	Component 7: Scaling-up successes		

Structured along two dimensions — level of stakeholder involved (national or local) and type of capacity needed — these programme components address (a) the capacity of stakeholders to make informed decisions about energy access, supply and use; (b) the capacity to drive change through leadership and coordination; and (c) the capacity for energy markets to viably serve the poor. Programme design must include planning, based on initial successes and impacts and on how each of these capacities may be scaled up.

A CAPACITY DEVELOPMENT PERSPECTIVE ON ENERGYPLUS

The *Guidelines* are framed within a broader energy-access capacity development perspective. The starting point for any programme activity is identifying the range of stakeholders involved in energy access, determining their roles and mandates, and establishing ways to strengthen their capacity to fulfill these roles.

Where capacity development comprises a central programme feature, outcomes can move away from short-term behavioural changes to focus on enabling institutions and stakeholder groups to better fulfill their mandates and roles, as well as on collaboration in the pursuit of mutual goals.

In adopting an EnergyPlus approach, it is useful to begin with a capacity needs assessment and action plan, led by appropriate national institutions and in consultation with key stakeholders and partners. An assessment should (a) emphasize self-assessment by stakeholders; (b) aim to generate ownership among participants; and (c) encourage stakeholder consensus regarding the challenges and how they can be addressed. Table 2 outlines the key questions for framing such an assessment.

A broad range of stakeholders may be involved in capacity assessments, as well as in the energy access programme as a whole. Stakeholders may come from a variety of groups, among them the following:

- **Government renewable energy or energy departments** play an important role in advising governments and other agencies on how to create a supportive policy environment. These departments can also lead new strategies for deploying thermal and renewable energy technologies, as well as for establishing or strengthening off-grid energy markets.
- **National energy industry associations** or organizations may also exist, and can have a significant role in promoting, regulating and advocating for distributed energy services, technologies, and their delivery.
- **Ministries such as planning, finance and rural development** can support energy access by ensuring adequate financing, as well as by coordinating poverty-reduction planning and activities with energy access programming.
- **Sub-national government levels** can play a variety of roles, among these (a) support for local planning and monitoring of energy infrastructure and energy usage, and (b) facilitation of government training and extension services for raising awareness, use and maintenance of energy technologies and adoption of productive uses of energy.
- **Energy producers, service companies and technology manufacturers** may at once participate in and be supported by such a programme: (a) gaining access to new markets; (b) learning how to develop, deploy and maintain new energy technologies and services; and (c) obtaining finance to support their operations.
- **Users and communities, including self-help groups, entrepreneurs and cooperatives**, can be involved by management of locally owned energy infrastructure or the operation of local energy service companies; by taking up government incentives for adopting renewable energy systems; and by learning about the costs and benefits of energy access and understanding opportunities for productive uses of energy.
- **Civil society organizations, lending and microfinance institutions**, and academic institutions can (a) identify entry points for energy access; (b) facilitate community engagement and awareness; (c) monitor government operations; (d) assist the development of local industries and small enterprises; and (e) provide microfinance for purchasing energy technologies or productive-use equipment.

TABLE 2 Considerations for planning a capacity needs assessment

Key questions	Key tasks	Aspects to consider
What triggers the capacity development process, and what will continue to drive it?	• Assess level of government, private-sector and public interest in and commitment to capacity development • Identify specific issues that highlight energy access needs and/or present opportunities • Identify regional/ international support programmes for developing and scaling-up energy access	• Government reforms, e.g., decentralization, agency restructuring • Community/public concern • Energy issue(s) related to a specific sector, e.g. health, rural poverty reduction, and/ or geographical situation, including remoteness • Policy commitments, e.g., options for community-based energy access, role of private sector and renewable energy • Degraded natural resources or ecosystem services, e.g., forests depleted from fuelwood extraction, health issues from inefficient burning • Commitments to MDGs and the post-2015 SDGs, SE4ALL objectives, multilateral environmental agreements and other global accords
What specific energy access issues, gaps or constraints could be addressed through capacity development?	• Conduct desk studies: review past reports to identify capacity issues, gaps and constraints • Conduct capacity needs assessment research, using interviews, focus groups, workshops, surveys, etc. • Assess some or all of the capacities for initiating, developing and scaling-up energy access, constraints, and assets to build on	• Country plans and studies related to energy and sustainable development issues • Energy access analysis studies • Past research on capacity needs • Review of existing capacity building programmes, their impact and gaps • Energy access case studies
What are the priorities for capacity development of target groups?	• In consultation with stakeholders, define criteria for choosing capacity development priorities • Identify priorities for changes in the enabling environment for energy access (policy, legal, regulatory systems) • Identify priority target organizations and individuals for capacity development • Conduct additional research and analysis regarding desired capacities, if needed	• Target organizations might lie within national or sub-national government bodies, the private sector and/or civil society, financing institutions, technical training institutions, etc. • Target individuals might include - politicians and senior managers; - professional, technical or administrative staff; - entrepreneurs, business people, investors; - scientists, academics, researchers and technical people; - CBO or NGO members or private citizens; or - beneficiary households

TYPES OF CAPACITY TO STRENGTHEN

Programmes may focus on a variety of specific areas, covering all of the capacities required for both government and non-government stakeholders, from national to local levels, to operate effectively. An EnergyPlus programme should focus on the strengthening of, among others:

- **Building awareness and facilitating political commitment.** This includes the capacity to increase awareness of energy access opportunities and to build broad political and social support for energy policy dialogue. Government and non-government stakeholders in the energy access field need to be able to secure political commitment at national, regional and/or local levels to support these initiatives.

- **Developing consensus and acting on a vision.** This addresses the capacity to organize and use stakeholder consultations in developing a clear direction and realistic strategies for improving energy access within broader development programmes. Government and non-government stakeholders need to be able to research the current situation regarding energy access, and to organize stakeholder consultations that focus political and public attention on energy access issues.

- **Assessing energy needs and targets.** This includes the capacity to conduct an inventory and analysis of energy needs and to develop specific energy access targets within various sectors. Programmes need to analyze technical information and stakeholder views of energy and poverty linkages; energy priorities in unserved areas and communities; unmet needs; availability and affordability of current energy sources and carriers; and projected economic, social and environmental impacts of energy access.

- **Building partnerships and evaluating policy options.** Government and non-government stakeholders need to be able to analyze various policy options and choose the most appropriate options for achieving declared energy access objectives. This involves decision criteria drawn from development and sectoral plans and stakeholder consultations, e.g., costs and social and regional development priorities. Another dimension of evaluating policy options is the capacity to engage regional and international partnerships and facilitate knowledge exchanges between countries.

- **Integrating energy access into national plans and budgets.** This includes the capacity to secure the public-sector funding needed to implement energy access activities in national development plans and policy documents, as well as to ensure integration and coordination among policy objectives and planning and budgeting processes. Government stakeholders in the energy access field need to have the capacity to develop annual and multi-year budgeting aligned with energy access development priorities.

- **Evaluating financing options.** Government and non-government stakeholders in the energy access field need to identify and assess options for mobilizing the investment resources required to implement preferred policy options. Financial evaluation involves (a) estimating the costs of proposed energy access initiatives; (b) identifying appropriate financing mechanisms; (c) securing adequate resource allocations from national budgets or contributions from development partners; (d) developing business plans for public and private sector investment; and (e) mobilizing financing.

- **Making energy service delivery more effective.** This includes the capacity to improve the effectiveness and efficiency of energy services providers, including local governments and authorities, communities and the private sector.

This should also include assessing local skill sets, developing necessary training mechanisms, designing for optimal use of renewable energy technologies (RETs), assessing market potentials, and strengthening market linkages for enhanced productive uses. The responsible authorities should be able to help improve the managerial and operational capacity of energy service providers. This involves removing barriers and addressing constraints facing national, sub-national and local government institutions and NGOs involved in service provision.

- **Measuring and monitoring energy access.** This includes the capacity to assess the results of energy access initiatives, evaluate monitoring data, and revise and adapt activities to respond in the light of this information. Government and non-government stakeholders need to be able to set up and implement processes for measuring, monitoring and evaluating the success of energy access initiatives. Where possible, these processes should be part of a broader national poverty reduction monitoring system, requiring integration of energy access indicators into common monitoring processes among multiple agencies, alignment of agency mandates and coordination of monitoring processes.

- **Research and development.** Research and development is needed to create and deploy energy technologies that are compatible with local needs and conditions.

KEY RESOURCES

The following resources provide detailed information and guidance regarding energy access, EnergyPlus and capacity development:

Towards an EnergyPlus Approach for the Poor provides a more comprehensive explanation of the EnergyPlus approach and the importance of productive uses of energy[12]

ASEAN Guideline on Off-Grid Rural Electrification Approaches presents other guidance on planning energy access programmes[13]

World Bank Renewable Energy Toolkit provides guidelines on renewable energy for energy access[14]

Measuring Capacity provides a useful reference on integrating results-oriented capacity development into programming[15]

Capacity Development Needs Diagnostics for Renewable Energy is a handbook on how to prepare a capacity assessment for the renewable energy sector[16]

Capacity Development for Scaling-Up Decentralized Energy Access Programmes presents lessons from Nepal on the role of capacity development in increasing access to modern energy services[17]

Renewable Energy for Parliamentarians: How-To Guide discusses the benefits and challenges of developing renewable energy resources, and explores the critical role the parliamentarians should play as political leaders to facilitate this process[18]

Productive Use of Energy (PRODUSE) - A Manual for Electrification Practitioners provides a simple framework and a systematic step-by-step approach with practical advice on how to plan, promote and implement productive-use components in various electrification programmes[19]

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[12] Available at: http://www.undp.org/content/dam/undp/library/Environment%20and%20Energy/Sustainable%20Energy/EnergyPlusReport.pdf.

[13] Available at: http://aseanenergy.org/media/documents/2013/04/11/a/s/asean_guideline_on_off-grid_rural_electrification_final_1.pdf.

[14] Available at: http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/EXTENERGY2/EXTRENENERGYTK/0,,menuPK:5138378~pagePK:149018~piPK:149093~theSitePK:5138247,00.html.

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[16] Available at: http://www.cleanenergyministerial.org/Portals/2/pdfs/Volume1_CaDRE_Handbook_web.pdf

[17] Available at: http://www.undp.ro/download/capacity_dev_energy_access%20full%202010.pdf.

[18] Available at: http://www.undp.org/content/dam/undp/library/Democratic%20Governance/Parliamentary%20Development/HOW-TO-GUIDE%20-%20Renewable%20Energy%20for%20Parliamentarians.pdf.

[19] Available at: http://www.produse.org/imglib/downloads/manual/euei_productive_use_manual_med.pdf.

The starting point for any programme activity is identifying the range of stakeholders involved in energy access, determining their roles and mandates, and establishing ways to strengthen their capacity to fulfill these roles.


ХУШ ОМАДЕД

COMPONENT 1: Monitoring energy poverty – the baseline, and tracking progress

Energy access has a significant impact on human development. Indeed, each of the Millennium Development Goals (MDGs) is influenced by the extent of energy access that countries have and the rate at which it is improving. This means that an EnergyPlus programme needs to be built on an integrated monitoring framework that connects changes in energy poverty levels with impacts on other aspects of development.

A monitoring framework can be constructed in three main steps and conducted over the course of an EnergyPlus programme:

- First, set a baseline of energy poverty, with adequate attention to gender and social inclusion
- Then plan clear targets and indicators for what a programme aims to achieve
- Finally, establish processes for monitoring progress related to improved energy access and its productive uses

This monitoring framework, along with the other measures that comprise a productive energy-use programme, should be applied with the broader view of raising the awareness of stakeholder groups, promoting their capacity to adapt, and contributing to improved energy access as it serves both basic and productive-use needs of the poor.

INSIGHT
Who is responsible for monitoring?

Monitoring activities will probably be undertaken at both national and local levels. Monitoring is a costly exercise, however, and it can unduly burden local governments or projects. Experience shows that monitoring is most robust when these costs can be covered by national agencies.

DEFINING ENERGY POVERTY

A clear conception of energy poverty must lie at the centre of the monitoring framework. A precise definition of energy poverty can then be used to determine a baseline of the energy poor and to set targets for moving people above an energy poverty threshold. No single accepted international definition of energy poverty exists, however, and the most appropriate definition for any given country will likely depend on the national context.

Approaches to measuring energy poverty commonly set a minimum amount of energy and energy services required for household needs of cooking, lighting and other services.[20] The exact level may include only essential uses, or it may be expanded to include a wider range of services and productive uses. Measurement may be based either on a set energy level or in comparative terms of household energy expenditure, although accurately setting this level to reflect actual household and community needs can pose a challenge.

[20] V. Modi; S. McDade; D. Lallement; J. Saghir (2005).

Energy poverty can be defined according to either a monetary threshold or energy expenditure as a proportion of household income.

Energy poverty can be defined according to either a monetary threshold or energy expenditure as a proportion of household income. An expenditure of 10 percent of household income is usually set as the energy poverty line.[21] Although it has the advantage of being relatively easy to calculate, this threshold may be unrealistic. Another possible benchmark for energy poverty line could be a minimum annual level of per-capita energy consumption of 50-100 kWh of electricity and 50-100 kgoe of heat energy, as proposed by the SE4ALL global tracking framework.[22]

Other approaches adopt a more complex set of indicators, considering energy services and measures of living standards such as health, education and Gross Domestic Product (GDP).[23] While providing a more comprehensive picture of energy needs and uses, these approaches also demand a wider range of data.

In any given case, the most suitable approach for measuring energy poverty or lack of energy access is likely to depend on resources available for data collection and the level of accuracy deemed necessary. While some approaches may be most relevant for comparison between countries, others may be more appropriate for national or local measurement and monitoring. Table 3 outlines the various approaches adopted in the literature.

[21] R. Moore (2012).

[22] Available at: http://www.sustainableenergyforall.org/tracking-progress

[23] P. Nussbaumer; M. Bazilian; V. Modi; K. Yumkella (2011).

TABLE 3 **Approaches for defining energy access**

Approach	Indicators measured	Scale	Example/source
Aggregate indices	Indicators of national economic development, energy affordability in relation to per-capita GDP, and share of modern fuels in relation to total national energy use	International	IAEA (2005)
	Multidimensional Energy Poverty Index (MEPI) measures energy poverty with respect to education, health and other living standards	International	Nussbaumer et al. (2011)
Physical access to energy services	Access to modern energy (electricity and clean cooking facilities)	International National Local	OECD/IEA (2010)
Minimum level of energy consumption	Minimum amount of energy required for basic needs	International National Local	UNSE4ALL (2013)
	Modes of final energy consumption in terms of use	National Local	Pachauri et al. (2004)
Affordability	Household energy expenditure in relation to income	National	Moore (2012)
	Use of energy up to level where demand is invariant to income	National	Barnes et al. (2011)
Total access to range of energy needs	Comprehensive range of energy needs met for households, enterprises and communities	Local	Practical Action (2013)
Access	Levels of convenience that households experience due to types of energy used	Local	Mirza and Szirmai, 2010

SETTING A BASELINE FOR ENERGY POVERTY

An energy poverty baseline helps to clarify current energy access challenges and to set programme targets. It may incorporate detailed enterprise and household data, along with broader poverty and socioeconomic indicators. This section describes the type of data needed to set an energy poverty baseline for an EnergyPlus programme and the associated monitoring and evaluation framework.

In setting this baseline, three aspects of energy availability and usage should be considered: (a) existing energy services, distribution systems and infrastructure, and the availability of end-use devices; (b) the number and location of households and other institutions without energy access; and (c) current ways in which those who are energy deprived access energy.

a) Understanding current levels of energy access involves obtaining information on energy availability and usage in a given area, as well as on factors affecting energy use and supply. This requires data regarding the following issues:

- Existing energy services, distribution systems and infrastructure (grid and off-grid systems) and the availability of end-use devices
- Location and energy characteristics of the local households and communities in relation to energy services, and their energy use patterns and practices
- Broader regulatory and institutional mechanisms that impact energy access and assess its relationship to development

Depending on which definition of energy poverty is adopted, information needed to understand current levels of energy access can include:

- Types and quantities of fuels/energy used for household and enterprise purposes
- Status of electricity access and electricity connection (e.g., pole meter, shared meter)
- Mode of energy service payment (e.g., equipment type, consumption-based)
- Availability of energy service providers
- Energy and fuel expenditure
- End-use equipment ownership among households and enterprises, including electrical appliances
- Quality and availability of energy supply
- User satisfaction and reliability of energy services
- Enterprise and household characteristics (e.g., incomes, male-headed/female- headed, social status, ethnic group).

INSIGHT
How to support the SE4ALL Global Tracking Framework

National energy agencies can help to build better monitoring frameworks by incorporating global energy access indicators into national censuses and survey instruments.

Wherever possible, demographic data should be overlaid with the foregoing energy access indicators to help identify the location of poor households and their relative proximity to different types of energy services.

b) Set energy poverty thresholds that show minimum levels of energy used for meeting cooking, lighting and other household or enterprise needs. Thresholds can comprise incremental and disaggregated levels of energy poverty, and may be used to show gradual improvements in access to energy.

Several methods are available to accomplish this, but a global standard has been set by the UN Sustainable Energy for All (SE4ALL) initiative. SE4ALL has adopted a Global Tracking Framework that defines the increasing grades of energy access, and has requested individual countries to set their own targets for the number of households that will reach each grade of access between 2013 and 2030.

The SE4ALL frameworks shown in Tables 4 and 5 have set varying degrees of energy consumption targets. They vary from a minimum annual level of per-capita energy consumption of 50-100 kWh of electricity and 50-100 kgoe of heat energy, with incremental energy consumption of up to 2,000 kWh of electricity per year for modern energy needs. Other factors are also considered, among them affordability, quality and whether the connection is legal.

Within the Framework, productive uses of electricity in small to medium-sized industries become viable at the third, fourth and fifth tiers, where low-, medium- and high-powered electrical appliances, respectively, can be used. Crucially for productive uses of energy, electricity supply needs to attain these tiers for a village as a whole, rather than just for individual households. For thermal energy, the Framework assigns the use of traditional open fires the lowest grade and extends a flexible higher grading to a range of different types of improved stoves. Criteria for measuring stove efficiency, together with further framework details, can be found in the official publication.[24]

The Total Energy Access standards devised by Practical Action present another well-recognized option.[25]

[24] Available at: http://www.sustainableenergyforall.org/tracking-progress.

[25] Practical Action (2013).

TABLE 4 **'Sustainable Energy for All' framework for monitoring access to electricity**

ATTRIBUTES	TIER 0	TIER 1	TIER 2	TIER 3	TIER 4	TIER 5
Peak available capacity (W)	-	>1	>200	>500	>2,000	>2,000
Duration (hours)	-	≥4	≥4	≥8	≥16	≥22
Evening supply (hours)	-	≥2	≥2	≥2	≥4	≥4
Affordability	-	-	✓	✓	✓	✓
Legality	-	-	-	✓	✓	✓
Quality (voltage)	-	-	-	✓	✓	✓

Programmes should explore how households or individuals cope with inadequate energy services, such as resorting to manual labour for irrigating fields or relying on inefficient methods in trades or crafts. This can help explain how poor energy access hinders development, as well as differences in ways men and women share the burden of labour in compensating for a lack of modern energy.

TABLE 5 **'Sustainable Energy for All' framework for monitoring access to improved cooking stoves**

	LOW GRADE	MEDIUM GRADE			HIGH GRADE
Attributes	Grade E	Grade D	Grade C	Grade B	Grade A
Efficiency	Self-made cookstoves or equivalent	Certified non-BLEN manufactured cookstoves			
Indoor pollution					
Overall pollution		Uncertified non-BLEN manufactured cookstoves			BLEN cookstoves or equivalent
Safety					

* BLEN: Biogas, LPG, electricity and natural gas

c) Profile the energy poor to clarify people's human development needs and energy coping mechanisms, seeking a general understanding of the relationships between energy poverty and human development.

A poverty profile sets out the major facts regarding poverty, comparing geographical variations in human development (regional, urban/rural), community characteristics (e.g., socioeconomic status, health and literacy rates), and household characteristics (e.g., household age, size and average incomes).

Programmes should explore how households or individuals cope with inadequate energy services in terms of enterprises and productive activities in which they are able to engage. For example, they may resort to manual labour for irrigating fields or crop processing, or rely on inefficient methods in trades, skills or crafts. Such information can help explain how poor energy access hinders development, as well as explain differences in ways men and women share the burden of labour in compensating for a lack of modern energy. Among other things, as energy access becomes increasingly available, it becomes possible to better understand how improved access can contribute to women's empowerment. While the above may not represent a critical step in setting a baseline, particularly where resources are limited, such information nevertheless can offer a richer understanding of how energy access influences development. In turn, this can be used for advocacy and coordination with stakeholders outside the energy sector.

PLANNING ENERGY ACCESS INDICATORS AND TARGETS

Baseline data reveal a range of indicators that a programme can use in measuring its impacts and setting its targets.

Depending on programme needs, a variety of frameworks can be used in constructing indicators. These may be designed to address institutional, social, economic, productive-use and environmental dimensions, while taking into consideration technical aspects of viability and capacity.

Indicators can also be constructed to reflect impacts at international, national and local levels. At their broadest, indicators at an international level provide a benchmark of progress and reveal relative changes between nations. National- and local-level indicators offer more comprehensive views of the results, and help to generate evidence needed to convince policymakers and donors of the positive impacts of energy access interventions or, alternatively, to determine how inclusive such interventions have been.

Table 6 below shows a framework of possible indicators. These indicators reflect the type of information needed when collecting baseline data.

MONITORING PROGRESS DURING IMPLEMENTATION OF AN ENERGYPLUS PROGRAMME

The indicators described above provide a framework for monitoring an EnergyPlus programme. However, a process is also needed to help decide when and how monitoring activities should be conducted. This includes determining what type of information is to be gathered, how it can be gathered, and how the results can be used to provide feedback on programme activities.

Gathering information. A formal survey may be designed to collect quantitative data, while informal methods of information collection such as discussions with beneficiaries and stakeholders, may also be used. Beyond any narrow use for programme purposes, wherever possible, data collection should be integrated into national statistics, including databases. This means strengthening existing national statistic systems, including census and periodic surveys and databases, rather than establishing parallel ones.

Institutional capacity. Information collection is often best conducted by relevantly mandated national institutions, whether National Statistics Offices (NSO), planning agencies or energy ministries/departments/divisions. EnergyPlus programmes are best placed to focus on building the capacity of these institutions by integrating energy access-related information gathering into existing surveys.

Monitoring progress. A monitoring system should set different monitoring levels and identify appropriate indicators for measurement at different scales. Results-based monitoring provides a standard system of performance evaluation which, apart from activities and inputs, typically focuses on programme performance at the outcome, output and impact levels. An example is given in Table 7.

General questions for preparing an energy poverty profile

- Does energy poverty vary widely between different areas in the country?
- How is energy poverty correlated with factors such as income, gender, age, household characteristics and fuel price?
- What proportion of energy poor are income poor and vice versa?
- What are the main sources of income among the poor?
- What productive uses of energy (e.g., tailoring, carpentry, mobile charging) are the poor engaged in?
- To what extent are the rural poor engaged in agriculture and in off-farm employment?
- To what public services do the poor have access? What is the quality of these services?
- Can the poor access formal or informal credit markets?
- What assets (e.g., land, housing) do the poor own? How secure is their ownership?
- Is environmental degradation linked to energy poverty?

Adapted from Haughton and Khandker (2009).

Gender-oriented and socially inclusive indicators

The indicators for the baseline need to be developed in such a way that they also collect information by gender, by social group (e.g., ethnic minorities) and by economic group (e.g., relatively affluent and poor). The baseline information collected from household surveys can inform and update the planning and design of the EnergyPlus programme, as well as contribute to and monitor energy access to the energy poor, including women and relatively disadvantaged social groups. Many indicators and national surveys are likely only to disaggregate female-headed from male-headed households. However, detailed information regarding gender roles becomes more apparent through case studies and qualitative studies that look at the generation and use of energy and how it affects the different roles of men and women.

TABLE 6 **Sample framework and indicators for an energy access baseline**

	Geographic indicators	Energy service indicators	Energy use and affordability indicators	Policy indicators
Macro-level indicators	• Total number of households, disaggregated by varying degrees of energy access (aligned with the SE4All Global Tracking Framework). • Comparison between overall energy access statistics and national human development indicators (proportion of the energy poor that live below the poverty line, are rural/urban, are literate, etc.).			
National energy access indicators	• Availability of electricity from a central grid system (number of districts, villages or by geographic area) • Number of mini- or micro-grids and how many households they supply • Distribution chains for cooking stoves and energy technologies	• Number of energy service companies in operation • Annual sales rates of energy technologies and cooking stoves • Number of independent power producers in operation serving communities	• Average household incomes in areas with/without energy access • Number of households with reliable, affordable access to electricity • Number of households using improved cooking stoves • Number of schools and health clinics with electricity	• Government subsidies available to improve energy affordability • Availability of feed-in tariffs for independent power producers to sell energy back to a grid • Fiscal incentives of low-interest loans through local/Grameen banks with riskmitigation measures • Guidelines and regulations for off-grid renewable energy installations • Monitoring mechanisms for effectiveness of programmes
Community and household indicators	• Reliability of electricity supply across specified areas (by hours per day and peak capacity) • Number of households located in areas without energy services • Incidence of related respiratory diseases across areas	• Capacity of energy systems to meet local demand • Existence of local manufacturers and suppliers of fuels and stoves, credit financing mechanisms, etc. • Availability of maintenance and support services by companies and service providers	• Monthly or seasonal energy expenditures as a proportion of household income • Number of microfinance institutions operating and providing loans for energy technologies or improved cooking stoves • Proportion of microfinance borrowers who are women	• Ease of doing business for energy service companies (efficiency of local planning and approvals).
Productive-use indicators	• Number and types of enterprises using some form of energy (disaggregated by area and form of energy used) • Access to electricity for schools, health care, clean water, and public services	• Local availability and affordability of energy-consuming devices • Microfinance institutions lending to energy-consuming enterprises • Local banks lending to energy service companies	• Household sources of livelihood, and number of working members, educational status • Local businesses and industry, labourforce participation by sector, etc. • Gender parity in the workforce, social and economic stratification of the society • Delegation of household labour between men and women (measured in hours per month)	• Coordination between government/donor energy programmes and other rural development programmes • Operation of government funding mechanisms available to support productive use of energy • Availability of Independent testing centres, national standards or international norms followed for off-grid RETs, to ensure quality assurance of market products

Communicating results. Monitoring helps to determine whether a programme is succeeding. Disseminating this information allows the relevant management team to steer the programme, and contributes to internal and external knowledge management. Such activities also inform subsequent scale-up planning as well as provide advice to policymakers on how current policy affects the availability and affordability of energy services.

TABLE 7 **Sample template and indicators for progress reporting**

INDICATOR	BASELINE	TARGET
PROGRAMME IMPACT: Increased use of modern energy for productive purposes by increasing number of households		
Proportion of households using energy for productive purposes	2014: 25% of households in rural areas have been using energy for productive purposes	2020: 75% of households in rural areas with energy access have been using it for productive purposes
OUTCOME: Increased number of households and communities have access to sustainable energy		
Number of households in a target area that have affordable electricity supply for at least 16 hours a day and use improved cooking stoves	2014: 50% of households in rural areas have access to electricity and use improved cookstoves	2020: 100% of households in rural areas have access to electricity and use improved cookstoves
Number of enterprises in a target area with reliable electricity access	2014: 10% of businesses have reliable connections	2020: 65% of businesses have reliable connections
Number of woman-owned enterprises using electricity	2014: 2% of enterprises are woman-owned and have reliable connections	2020: 30% of enterprises are woman-owned and have reliable connections
OUTCOME: Renewable energy service companies are able to viably operate and maintain energy services		
Number of energy technologies operational within a target area	2014: 0 mini-grids are built and maintained	2020: 1,000 mini-grids are built and maintained
Number of outlets in a target area distributing improved cooking stoves and renewable energy technologies	2014: 20% of villages have at least one enterprise distributing renewable energy products	2020: 100% of villages have at least one enterprise distributing renewable energy products
OUTCOME: Financial institutions offer loans to energy service companies and productive uses of energy		
Number of financial institutions providing loans to energy service companies	2014: 0 institutions provide loans	2020: 20 institutions provide loans
Number of financial institutions able to access risk-guarantee facilities	2014: 0 institutions able to access facilities	2020: 20 institutions able to access facilities

KEY RESOURCES

UNDP Handbook on Planning, Monitoring and Evaluating for Development Results presents an overview of how to construct a comprehensive monitoring and evaluation framework. This handbook covers planning, stakeholder engagement, operationalizing the framework, management and quality assurance[26]

Mainstreaming Gender in Energy Projects: A Practical Handbook is an in-depth guide on how to integrate gender into programme planning[27]

The Sustainable Energy for All *Global Tracking Framework*[28]

Monitoring the Effectiveness and Access to Energy by the Poor[29]

Impact Monitoring and Evaluation of Productive Electricity Use – An Implementation Guide for Project Managers provides assistance on how to design an impact M&E system[30]

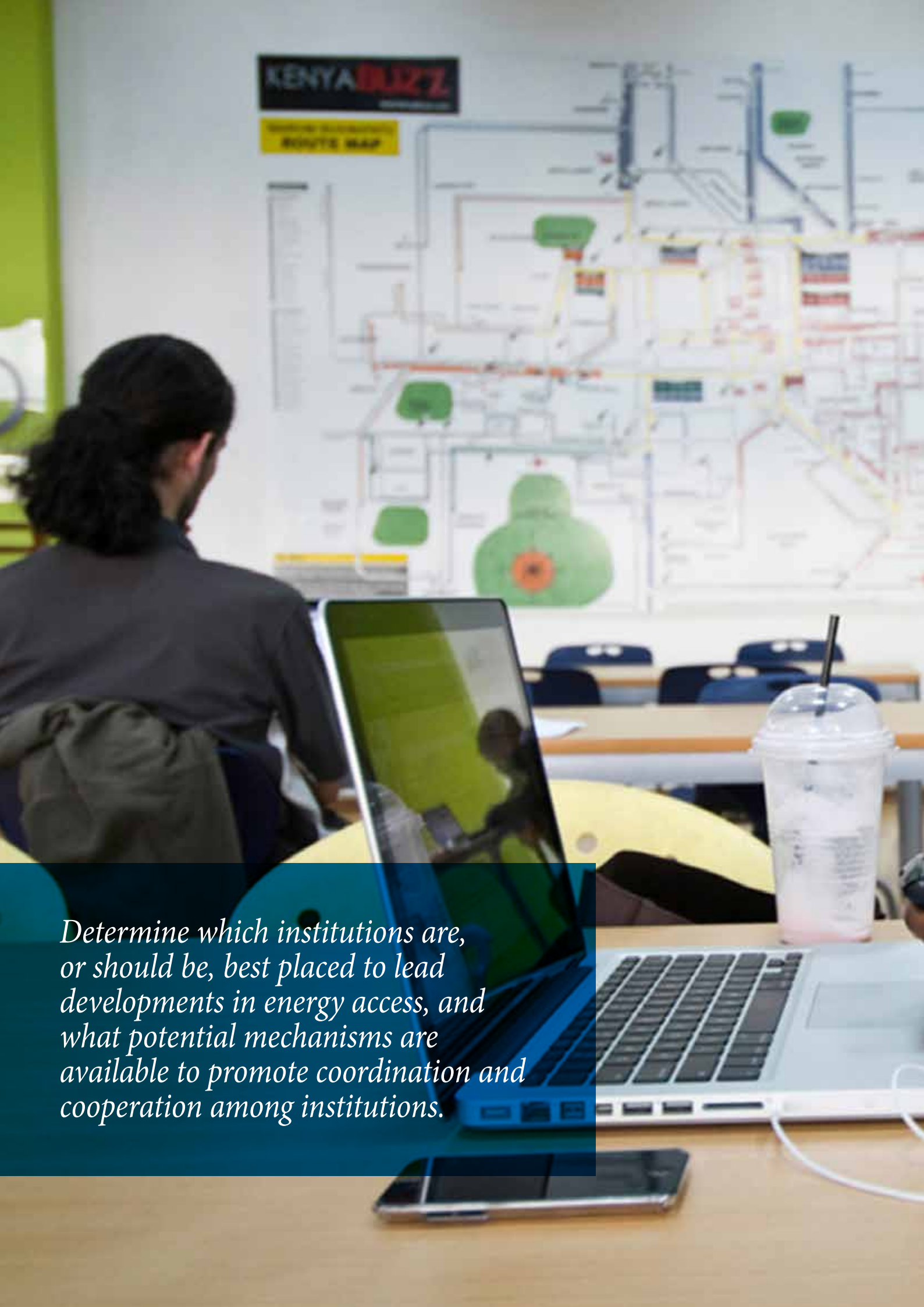
[26] Available at: http://web.undp.org/evaluation/handbook/index.html.

[27] Available at: http://www.energia.org/fileadmin/files/media/DropBox/Module1/Mainstreaming_gender_in_energy_projects_A_practical_Hand_book.pdf.

[28] Available at: http://www.sustainableenergyforall.org/tracking-progress.

[29] Available at: http://www.energia.org/fileadmin/files/media/en-072009_nathan_kelkar.pdf.

[30] Available at: http://www.produse.org/imglib/downloads/PRODUSE_study/PRODUSE%20Impact_ME%20Guide.pdf.



Determine which institutions are, or should be, best placed to lead developments in energy access, and what potential mechanisms are available to promote coordination and cooperation among institutions.

Policies and programmes from outside the energy sector often omit energy access considerations or may fail to recognize useful avenues for coordination; for example, industry or business development programmes must include targets to meet electricity needs.

COMPONENT 2: Institutions and coordination of energy access

At national level, government and non-government institutions can have different roles in expanding energy access and productive uses of energy. This section outlines some of the potential roles that these stakeholders can play. Key considerations include (a) determining which institutions are, or should be, best placed to lead developments in energy access; and (b) what potential mechanisms are available to promote coordination and cooperation among institutions.

ALIGNING NATIONAL ENERGY INSTITUTIONS AND THEIR ROLES

Various types of national institutions need to be involved, either in assuming leadership roles in facilitating expansion of energy access or in advising on policy and other governance issues. These can be government institutions, perhaps energy agencies or departments, or they may be non-government, non-profit energy institutes or industry associations. In many cases, these institutions may even play complementary roles in regulating and promoting energy access.

Renewable energy institutes, research organizations or industry associations are often well placed to promote and advocate for the expansion of renewable energy. Where they exist, such institutions often have an in-depth knowledge of local energy access challenges and realistic opportunities for market expansion, as well as direct experience in dealing with regulatory controls. Furthermore, they may represent a wide range of industry stakeholders and can be more flexible than governments in finding innovative energy-access solutions. In some circumstances an industry association, for example, may be well suited to adopt the role of defining and applying industry-wide standards and specifications for renewable energy technologies or clean cooking stoves. A research institute, on the other hand, may make an ideal body for undertaking research and advocacy around policy issues or socioeconomic factors that inhibit energy access and productive uses of energy. Such an organization may also be capable of leading an EnergyPlus programme by piloting and implementing the work of expanding energy services to the energy poor and facilitating the uptake of productive uses.

In other circumstances, government agencies might be better equipped to assume these roles if independent organizations are not capable of carrying them out themselves. Regardless, government agencies would retain oversight of monitoring the accountability and transparency of whichever body is delegated the role of leading the renewable energy and energy access agenda. Ultimately, capacity development assessments can incorporate, as one key focus, the task of delegating appropriate institutions for these roles.

Case studies: Renewable energy and energy access institutions

CHINA: LEADERSHIP OF AN INDUSTRY ASSOCIATION

China Renewable Energy Industry Association (CREIA), is one of the first completely business-led and self-financed associations in China. The association is administered by the Ministry of Agriculture and operates as a bridge between government and operators in the rural energy market for a range of energy technologies (solar, biogas, etc.). It has a base of more than 1,000 members and, among other services, keeps members informed about technology and market developments. CREIA is involved in policy formulation, is responsible for developing industry standards for products being sold in the market, and plays a lead role in channeling communication between China's renewable energy companies and organizations in other parts of the world.

For more information see:
http://www.carei.fi/en and
http://www.martinot.info/Cases/China_RE_GEF.pdf.

NEPAL: COORDINATION AND QUALITY ASSURANCE THROUGH AN INDEPENDENT GOVERNMENT ORGANIZATION

The Alternative Energy Promotion Centre (AEPC), a government institution under the Ministry of Environment, Science and Technology, has the objective of developing and promoting renewable and alternative energy technologies in Nepal. It operates independently of the Ministry and has an executive board comprising representatives from government, industry and NGOs. It is responsible for promoting renewable energy, providing quality assurance, formulating policy and implementing programmes. AEPC serves as a national focal point for resource mobilization and a coordination centre for government, donor and CSOs. Its work in establishing distributed energy systems in Nepal has made it a leading example of how government institutes can facilitate, research and promote energy access for the poor.

For more information see:
http://www.aepc.gov.np/
http://www.snap-undp.org/elibrary/Publications/Case10-REDP_Nepal.pdf.

LEADING POLICY DEVELOPMENT FOR ENERGY ACCESS

Institutions that assume these leadership roles may also take some responsibility for shaping policies that affect energy access. A wide range of energy policy components can be engaged in helping to fashion an enabling energy access policy environment. These comprise a combination of national planning, sector policies, legal and regulatory controls, and fiscal policies. One can approach this area of endeavour by ascertaining the capacity of national institutions to influence the policy environment. Table 8 outlines some of the important policy areas that institutions may have to address. Each of these issues can be understood in isolation or assessed in terms of their overall coherence and existing conflicts or bottlenecks.

TABLE 8 **Identifying policy barriers to energy access**

	Energy policies	Other related policy areas
National planning	• Does strategic planning include targets for improving energy access among the energy poor? • Does planning for energy access coordinate with priorities regarding productive use and rural industry development in other ministries? • Do national plans and monitoring frameworks distinguish between impacts on men and women?	• Do land management and climate change adaptation strategies incorporate access to distributed energy technologies or energy-efficient cooking stoves to reduce ecosystem degradation? • Do other sector infrastructure development policies (e.g., education, health, rural development) set energy access targets?
Renewable energy and energy efficiency policies	• Is the energy sector dominated by government power producers, or is it a competitive market opened to private companies? Are these controls supportive or inhibitive for renewable energy service companies? • Does the national energy efficiency programme target shifts from traditional to energy-efficient cookstoves? • Do renewable energy and energy efficiency programmes target cottage industries or small-scale enterprises as well as large-scale industries? • Are small-scale enterprises included and able to participate in national carbon market/trading schemes?	
Regulation	• Do standards for renewable energy technology specifications protect consumers from inferior products? • Do policies enable generation of renewable energy at different scales as well as feeding it into the grid? • Do guidelines exist for setting 'fee for service' rates by micro- and mini-grid operators? • Do policies attract and sustain the transmission and distribution of power from small-capacity renewable energy installations?	• What are the approval procedures (e.g., for site permits and licensing) for energy infrastructure? Which ministries or departments are involved, and how efficient and affordable is this process for renewable energy service companies?
Fiscal policies	• Do feed-in tariffs allow small and medium-sized renewable energy power producers to sell excess electricity back to local grids at adequate prices? • Do government grants target and support women's needs or women-owned enterprises? • Do government schemes target households, small industries, productive uses, etc., for incentivizing energy efficiency initiatives?	• Do national budgets include spending for off-grid energy infrastructure? • Do subsidies allocated directly to fossil fuels or indirect government spending compromise competitiveness of renewable energy technologies? • Does taxation on imports of renewable energy technologies make them prohibitively expensive and uncompetitive?

MECHANISMS FOR COORDINATION AND COOPERATION

Ministries from outside the energy sector need to make energy access issues part of policy and planning activities. This is especially necessary in effectively facilitating end-user uptake of productive uses of energy. It is here that EnergyPlus programmes can coordinate with programmes undertaken by local economies, enterprise activities, health and education services, and agriculture and animal husbandry practices.

Various actions may be undertaken in pursuing such mainstreaming activities:

- **Identify key target policies and programmes.** Policies and programmes often omit energy access considerations or may fail to recognize useful avenues for coordination among sectoral ministries. For example:
  - Industry or business development programmes must include targets to meet electricity needs
  - Education planning must support school electrification
  - Rural health programmes must address clinic electrification
  - Gender equality programmes must include opportunities for women's health and enterprise development initiatives
  - Agriculture development programmes must include energy access targets for productivity improvement, extension services and value addition

- **Participate in government coordination mechanisms.** Use mechanisms that function at various levels of government to support inter-ministerial or inter-agency planning and policy development platforms.

- **Support development of joint action plans.** Joint action plans are a key resource for ensuring that (a) programmes under separate ministries/agencies support one another; (b) key activities are aligned and conducted in a coordinated manner; and (c) overlaps in activities and spending are avoided.

- **Cooperate to develop joint information products.** Research and advocacy materials are useful tools for communicating with other ministries and for highlighting the importance of coordination. These materials can be further developed and used to prepare joint information products that explore relationships between sectors and opportunities for cooperation.

These approaches to mainstreaming energy access across government agencies can also build institutional capacity, and can be strengthened through joint capacity-development plans. A comprehensive capacity assessment can help to identify these coordination gaps and linkages, and to determine entry points for strengthening their capacity to work together.

The assessment must also include such issues as (a) ease of technology transfer; (b) capacity building; and (c) dissemination measures, including sharing of experiences at national, state and district levels, involving key government and non-government implementing agencies, local entrepreneurs, industries and training institutions.

KEY RESOURCES

'Governance of Change: Unlocking the Potential', Chapter 4 of *Energy for a Shared Development Agenda: Global Scenarios and Governance Implications*[31]

Evaluating Renewable Energy Policy: A Review of Criteria and Indicators for Assessment investigates criteria and indicators used to evaluate renewable energy deployment policies[32]

Design and Performance of Policy Instruments to Promote the Development of Renewable Energy: Emerging Experience in Selected Developing Countries discusses the lessons on policy design, implementation, and performance emerging from the experience in six developing countries[33]

Technical Discussion Paper on General Energy Access in the ECOWAS Region presents an overall profile of modern energy services in the ECOWAS region and gives recommendations for appropriate policies and approaches for promoting sustainable access to modern energy services[34]

[31] Available at: http://www.sei-international.org/mediamanager/documents/Publications/SEI-ResearchReport-EnergyForASharedDevelopmentAgenda-2012.pdf.

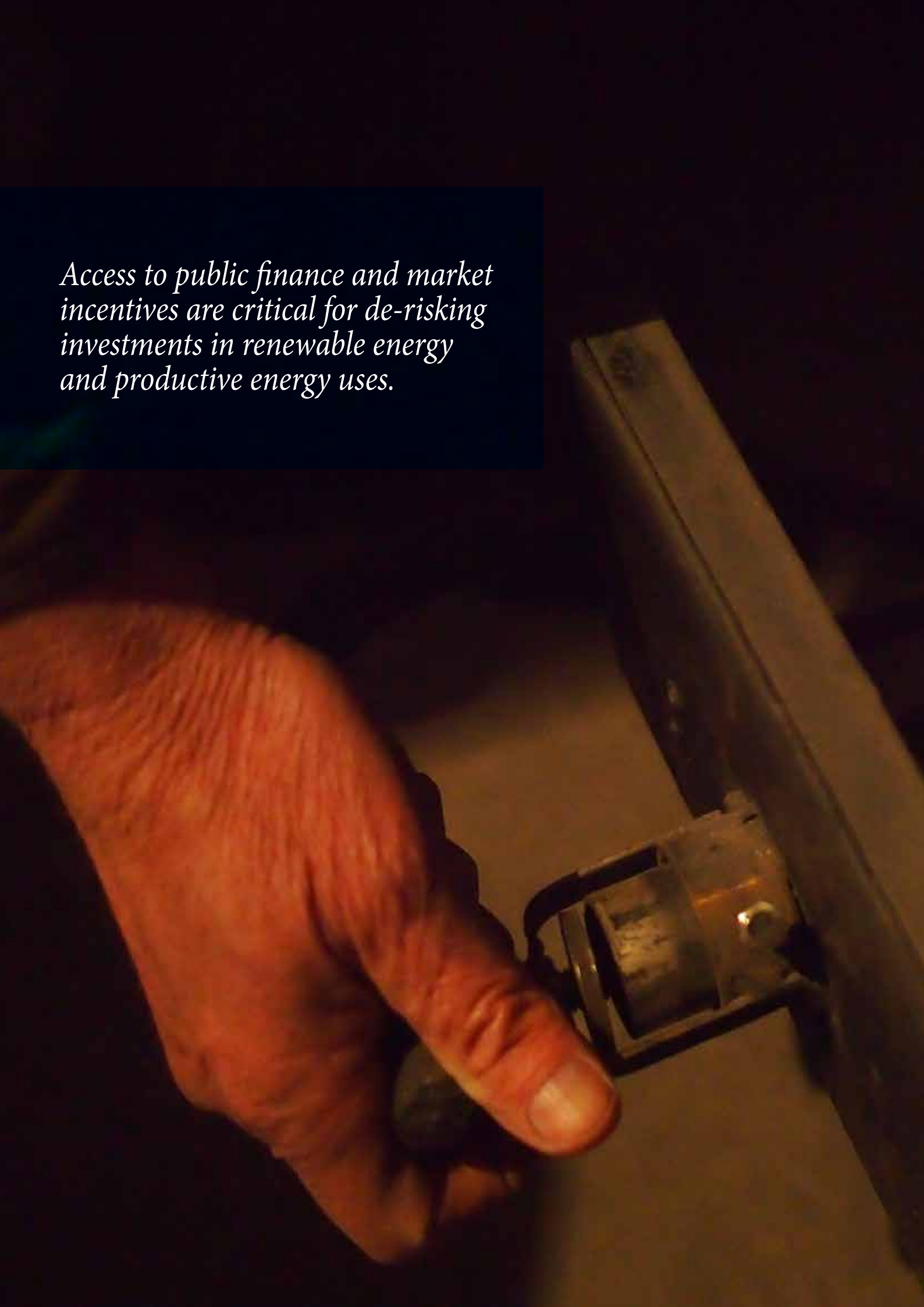
[32] Available at: http://www.irena.org/DocumentDownloads/Publications/Evaluating_RE_Policy.pdf.

[33] Available at: http://siteresources.worldbank.org/EXTENERGY2/Resources/DiscPaper22.pdf.

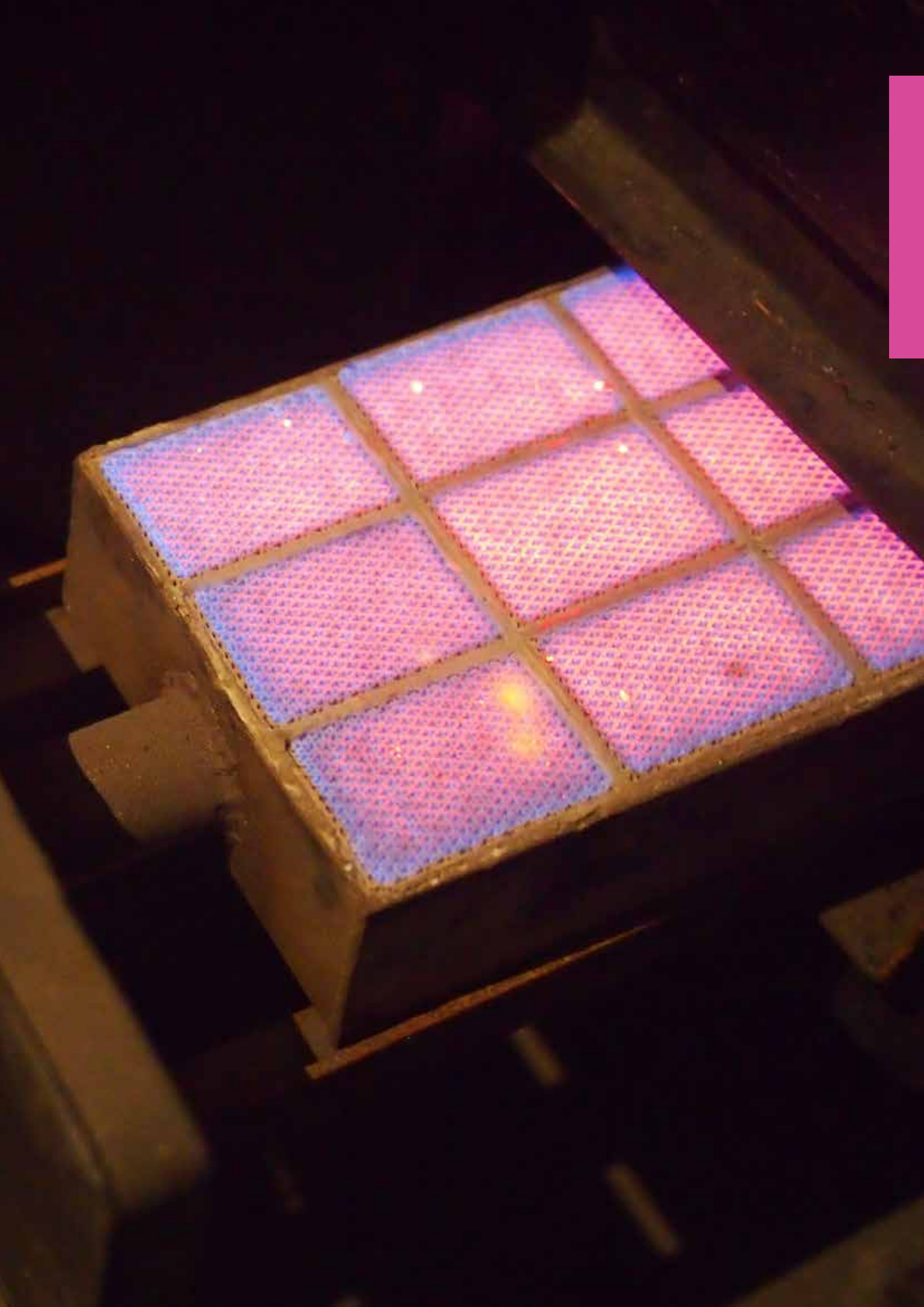
[34] Available at: http://www.uncsd2012.org/content/documents/164Consolidated_Document_General__Energy_Access_FInal%20%282%29.pdf.

INSIGHT
Ways to shape policy and decision-making

Promoting a country's rural or renewable energy use requires an institute capable of analyzing the impacts of energy and national development policy and, upon that basis, recommending or advocating for improved policy options. Data from programme monitoring is among the most effective ways of incorporating energy poverty issues in government decision-making, identifying where government policies and investment can have the most impact on expanding energy access. Effective materials can be used to influence internal ministry operations, or can be used by ministers to bring issues to the attention of legislatures.



Access to public finance and market incentives are critical for de-risking investments in renewable energy and productive energy uses.



COMPONENT 3: Public finance and market incentives

Central features of energy access policy and programmes, as well as of policy management and coordination, include financing and creating market incentives. When fiscal incentives effectively support the needs of energy producers, suppliers and users, energy markets for the poor more surely emerge with little or no direct government interventions. However, setting up these conditions is often a complex and highly political affair.

In addressing these issues, programme strategy can begin by considering the types and relative effectiveness of public and private financing available to support rural energy markets. Such a review may be followed by assessment of the barriers inhibiting access to, and the effectiveness of, such financing. Where necessary, it may be appropriate to seek ways to persuade governments to create the enabling environment, for example, by making the business case for greater investment.

TYPES OF PUBLIC FINANCING

In almost all cases, public financing is a vital component in supporting (a) the construction of energy generation/distribution infrastructure, whether on-grid or off-grid; (b) the start-up or expansion of energy service companies; and (c) investments in productive uses of energy in poor or remote areas. This type of financing can derive from a range of sources, including government spending, fiscal policies, donor programmes, and even corporate social responsibility investments. These funding models can include the following:

- Direct spending through ministries from budget allocations to meet national development targets
- Money allocated from a central budget and made available to communities through a designated authority (e.g., funds can be collected through taxation of revenues from the main national electricity suppliers and diverted to dedicated ministerial trust funds for use by communities)
- Contributions from international donors such as the Organization of Petroleum Exporting Countries (OPEC) Fund for International Development (OFID), private-sector or non-government organizations, probably in conjunction with parallel government spending
- Sources of funding from climate finance under a Nationally Appropriate Mitigation Action (NAMA) linked to rural electrification[35]
- Subsidies applied in the form of direct reductions in product costs, or through alternative measures such as offering risk guarantees to protect investments made by lending institutions when they decide to finance off-grid energy service delivery or infrastructure projects

[35] The Guidance Paper on 'Finance Structure and its Management for a Rural Electrification NAMA' has been released to facilitate greater access to electricity by rural communities through the provision of climate finance under a NAMA; http://www.undp.org/content/dam/undp/library/Environment%20and%20Energy/MDG%20Carbon%20Facility/Guidance%20Paper%20-%20NAMA%20Financing%20for%20Rural%20%20Electrification.pdf.

The most common challenge in making public finance effective is to ensure that it is accessible to the poor and that it complements and incentivizes the lending opportunities offered by private finance institutions.

- Subsidies — in areas where it is possible to generate excess electricity and connect to national or local grids — to fund off-set or to increase feed-in tariff rates, these tariffs then being paid to communities or local energy producers when selling surplus energy back to the main grid. They can be reinvested in the community directly, or they can help to encourage investment by reducing the high up-front technology investment costs for companies and reducing risks to lending institutions

Each of these funding models offers both advantages and disadvantages, and each is more relevant to some circumstances than others. In many situations, multiple financing schemes, proper combinations and sequencing are needed to target a range of stakeholders. Beyond the energy sector, funding is also often extended by the government to support the improvement of education and health facilities or to increase the productivity of agriculture and SMEs. Each mechanism may be used to identify entry points for renewable energy and energy efficiency technologies and interventions.

Financing, where available, is likely to be accessible to companies and consumers through a confusing or unclear range of government programmes, with both overlaps and gaps for areas when finance is needed. The most common challenge in making public finance effective is thus to ensure that it is accessible to the poor and that it complements and incentivizes the lending opportunities offered by private finance institutions.

Local institutions — whether government, energy service companies, livelihood support institutions or microfinance institutions — can offer a means for allowing national grant programmes to reach the poor. This level of localized delivery can also help ensure that the delivery mechanisms, criteria and conditions are accessible to their target institutions, companies and consumers.

FISCAL AND INDUSTRY POLICIES THAT AFFECT ENERGY ACCESS

Policies regarding such issues as energy subsidies, market incentives, trade barriers to renewable energy and energy efficiency technologies, and quality standards for such technologies can have significant impacts on energy access and markets. Any issues with such policies should be addressed by dedicated energy access strategies or programmes. These measures are often worthy of review.

Energy subsidies and market incentives

Energy subsidies frequently comprise a complex matrix of both direct and indirect government spending on energy infrastructure, energy markets and fuels. They may either help to promote renewable energy, energy efficiency and off-grid energy technologies, or else make these less cost-competitive compared with traditional fuels or energy sources or energy technologies. Direct subsidies may be more evident in government budgets and cover expenditure in areas such as reduced fuel or energy prices, spending on energy infrastructure, or tax incentives or waivers for energy-related goods and services. Indirect subsidies are less apparent and can include financing of low-interest loans for energy infrastructure development or financial compensation for loss-making government power producers.

The UNDP publication on De-Risking Renewable Energy Investment (DREI) presents a framework to determine the most cost-effective public measures and market incentives for promoting renewable energy investment. For example, market incentives such as feed-in tariffs make a useful tool for promoting renewable energy where solar-, hydro- or wind-powered installations are connected to a grid. These tariffs encourage power producers to sell excess electricity to a grid and be paid for that energy either by the government or a power producer/retail company. In recent years, the mechanisms

Supplying low-quality or otherwise inadequate products can undermine their affordability among the poor and can have devastating long-term effects on consumer attitudes and willingness to change existing energy-use behaviours.

for managing this purchasing process in several countries have started to use Renewable Energy Certificates, which require companies that produce power from carbon-emitting sources to buy and resell, at a set rate, a prescribed percentage of the total electricity they generate from renewable energy producers. This effectively allows renewable energy to be cross-subsidized by power producers without requiring government subsidies. Along similar lines, energy efficiency certificates (e.g., energy performance certificates in the UK and energy savings certificates in India) enable incentivizing of interventions in energy efficiency by the industries.

Trade barriers

In many countries, import taxes are applied collectively across a category of goods, such as electronic products, and can include by default imported renewable energy and energy efficiency technologies. Alternatively, some countries have recognized the booming renewables market, and seek to apply specific taxes to heavily imported renewable energy technologies such as solar Photovoltaic (PV) panels. These taxes can inadvertently place a burden on energy markets and force energy service companies to increase prices, to the extent that products become unaffordable for the poor.

Policy reviews of this issue may seek to determine how such price increases affect retail prices of products and to consider how these increases compare to existing energy expenditures by the poor, or how they compare with other, less sustainable energy alternatives. This kind of review may profitably begin by consulting the Energy Access Practitioner Network's *Import Tariff and Barriers to Entry Database* (http://energyaccess.org/resources/tariffs-database), which provides a summary of current country tax rates for imported renewable energy technologies.

Quality and specification standards

The quality and specifications of renewable energy and energy efficiency technologies, among others, determine their ease of operation, which shapes consumer perceptions as well as durability, i.e., whether or not products last long enough to recoup up-front costs. In other words, quality and specification standards affect energy technology markets by shaping consumer confidence in energy products and by affecting the prices of products available in the market. Supplying low-quality or otherwise inadequate products can undermine their affordability among the poor and can have devastating long-term effects on consumer attitudes and willingness to change existing energy-use behaviours. These quality requirements and standards are thus key considerations for both domestic manufacturers and importers and should be adopted early in any energy access policy strategy or programme.

A government or industry body needs to be delegated responsibility at the institutional level for setting and drafting the required standards. Important criteria for these standards include stipulations that they are not so restrictive as to prohibit affordable renewable energy and energy efficiency technologies from entering the market, while ensuring that the types of products entering the market fit the needs of local consumers. Importantly, the entity that manages these regulations should remain separate from the institution responsible for promoting the adoption of such technologies. Oversight powers can be delegated to a separate department, perhaps under a ministry for industry or trade, to develop these standards and monitor the quality of products entering the marketplace. This separation helps to avoid conflicts of interest and to ensure that energy departments are not given incentives to decrease product standards to promote high consumption volumes of renewable energy and energy efficiency technologies.

KEY RESOURCES

De-Risking Renewable Energy Investment introduces an innovative framework to assist policymakers in developing countries to cost-effectively promote investment in renewable energy[36]

Financing Options for Renewable Energy and Energy Efficiency, Module 19, Sustainable Energy Regulation and Policymaking Training Manual, UNIDO[37]

[36] Available at: http://www.undp.org/content/dam/undp/library/Environment%20and%20Energy/Climate%20Strategies/Derisking%20Renewable%20Energy%20Investment%20-%20Full%20Report%20%28May%202013%29%20ENGLISH.pdf.

[37] Available at: http://www.unido.org/fileadmin/user_media/Publications/Pub_free/training_manual_on_sustainable_energy_regulation_and_policymaking_for_Africa.pdf.

Matching the current and future energy needs of users and the local energy resource availability is important as any misalignment results either in wasted energy production capacity or insufficiency from unmet demand.

Affordability of energy access is often the dominant factor shaping energy choices among the poor.

COMPONENT 4: Energy resource availability and forecasting demand

This component and the remaining three outlined in these Guidelines deal with the local, area-specific aspects of energy access. They focus on the implementation of projects to inform stakeholders about how to lead and stimulate interventions/activities in energy production, supply and use among particular communities or districts.

A range of criteria can be applied in the selection of sites for implementation. Among them, some of the important ones are resource availability, community needs, ease of improving access, ability of markets to expand without government intervention, and geographic variation. A programme may select a series of sites within a particular area, or a limited number of sites across a range of districts or geographical areas. Selecting a greater variety of sites allows for testing programme models in differing contexts, but can also entail greater implementation costs than with communities located in proximity to one another; one of the biggest challenges an EnergyPlus programme faces is the need to address the basic and productive-use needs of communities that are thinly distributed over large areas.

For specific sites, an initial step is assessing the energy needs of users and energy resource availability within that area. This includes a process of (a) estimating the potential energy production and generation capacity from available resources; and (b) forecasting in detail how energy demand is likely to grow in future, with attention to productive-use needs. In general, it is important that energy supply and demand match each other and grow in sync, as any misalignment results either in wasted energy production capacity or insufficiency from unmet demand.

ENERGY PRODUCTION AND GENERATION CAPACITY

The first step is to determine, given locally available resources, how much energy can be generated and supplied for communities within some specific area. Above this limit, energy (fuels) may need to be imported to meet outstanding demand.

To determine what energy resources are available for electricity generation, surveys are commonly conducted to identify potential locations of commercially viable solar, wind, municipal or agro-waste, animal waste and hydropower resources. Biomass from agricultural residues or forests may also offer a viable fuel source, but will be limited to sustainable levels of harvesting. While information on the amount of energy that can be generated from these resources is not often easy to gather, data may be available through either national government or international databases. Where information is not locally available, a limited range of data on renewable energy resources may also be found through the International Renewable Energy Agency's *Global Atlas* (http://irena.org/globalatlas/) and the *Renewable Energy Map* (http://www.esmap.org/REMAP), a resource made available by a contributing partner, the Energy Sector Management Assistance Programme.

Costing energy supply options

Affordability of energy access is often the dominant factor shaping energy choices among the poor. Energy access solutions must be cost-competitive with existing household and enterprise uses, and calculating these costs requires a thorough knowledge of energy infrastructure costs as well as existing expenditures on energy by the poor.

The first consideration is estimating what the costs would be for government or private investors to expand grid infrastructure, and how these costs compare to alternatives. Such information, particularly regarding the cost of grid expansion, is likely available through government energy departments, utilities or energy service providers. Second, a programme must ask whether the costs of infrastructure will be covered by government spending, or whether operators are expected to recoup these costs through user payments for energy services. Prioritizing decisions over which type of energy infrastructure to invest in is ultimately a policy decision and depends on availability of government or private finance to invest in such infrastructure.

However, such planning must also be accompanied by an assessment of user ability and willingness to pay for energy services. Such assessments can best be determined by comparing average incomes with their current energy expenditures and with the costs of energy from different types of resources. Customers engaging in productive uses of energy can help cross-subsidize basic household consumption by the poor. Two useful tools (see Table 9 below) provide an overview of how to assess overall energy infrastructure costs and how to measure household fuel expenditures.

Selecting energy technologies

As a general principle, programmes should avoid selecting specific types of energy technology without first establishing which energy resources are compatible with a given area. For example, improved cookstove designs can involve a range of styles and functions depending, among other things, on the type of fuel used, the quantity and type of food normally prepared, and whether the stove is also used for indoor heating. Similarly, solar PV systems are available for any scale of use, from lanterns that provide lighting only or units that can also charge mobile phones and small appliances, to medium-sized household-managed systems or larger systems that can serve multiple households. General considerations may include:

- Availability of resources such as water with adequate flow and gradient, solar in terms of number of sunny days, dung quantities from livestock population, wind regime in terms of frequency and duration
- Cost efficiency of energy technologies and expected period for recouping investment
- Accessibility of technologies for supply and maintenance
- Ability of technologies to provide enough energy to meet user demand
- Suitability of technologies for the types of use to which they will be applied
- Social and cultural preferences for types of technology and product models

FORECASTING ENERGY DEMAND

Aside from assessing energy resource availability, it is necessary to forecast demand for energy by communities in the near- to medium-term, matching targeted energy supply with growth in user energy requirements. This involves an initial estimation of their current basic, social and productive-use needs, based on historical trends, along with an assessment of productive-use applications, new enterprise development, and income level that can determine affordability and willingness to pay among the different social strata.

The outcome of an energy demand forecast is therefore an important factor in deciding (a) whether adequate renewable energy resources are both available and suitable; (b) how much energy generation systems need to be able to produce; and (c) whether alternate sources of fuel may need to be sourced.

Energy demand forecast

Various types of forecasting models attempt to answer different questions regarding future energy-sector developments. These models can comprise both a top-down approach (based on economic relationships at a macro level) and a bottom-up approach (based on technological and local factors at a micro level).

Many models provide analysis and information that focus on various aspects of energy planning, among these the effects on climate change, effects due to climate change, system operation stability, and demand forecasting. Table 9 presents a few of the more common models, together with their key characteristics and sources of related information.

The graphs (Figure 3) show how the Long-range Energy Alternatives Planning (LEAP) tool forecasts demand for various energy resources for lighting purposes in two Cambodian provinces. These show the total energy consumed, broken down according to fuel type.

FIGURE 3 Energy demand forecast (sample output from LEAP)

Programmes should avoid selecting specific types of energy technology without first establishing which energy resources are compatible with a given area.

TABLE 9 **Selected tools for energy costing, planning and demand forecast**

Tool	Developer	Characteristics	Source
Energy Costing Tool	UNDP	Estimates the amounts and types of energy investments required to meet the Millennium Development Goals (MDGs)	www.undp.org
Energy PLAN	Aalborg University, Denmark	Optimization of a national energy system operation on a short-term basis	energy.plan.aau.dk
ENPEP-BALANCE	Argonne National Lab, USA	Complex energy systems analysis	www.dis.anl.gov
HOMER	National Renewable Energy Lab, USA	Design of off- and on-grid electrification options using hybrid renewable energy systems	www.homerenergy.com
LEAP	SEI	Integrated energy and environment analysis	www.energycommunity.org
MESSAGE-Access/ ENACT	IAASA	Energy access and demand projections	www.iiasa.ac.at
OSeMOSYS	KTH, SEI and others	Open-source long-run energy planning and demand forecast	www.osemosys.org
RETSCREEN 4	Natural Resource, Canada	Energy production, life-cycle costs and GHG emission reductions for various energy-efficient and renewable energy technologies	www.retscreen.net
TIMES/MARKAL	IEA-ETSAP	Integrated Energy and Environment Analysis	www.iea-etsap.org
TRACE	WB-ESMAP	Decision support for optimization of energy consumption in cities	www.esmap.org/TRACE

Adapted from Stockholm Environmental Institute (SEI) [online].

With any model, information inputs include a wide range of factors. These can be categorized according to two main areas: (a) macro socioeconomic factors; and (b) community energy needs.

Socioeconomic factors

These factors provide input to a model forecasting how the energy consumer base and consumer preferences are expected to change over extended periods of time. Contextual factors include:

Demographic factors. These include projections of increased demand caused by population growth and income growth. Projections are based on historical trends and incorporate variations in types of fuel used as households become wealthier, something known as 'energy stacking.'[38]

Geographic factors. Geographic variation should be incorporated in a model, considering climate impacts as well as social and cultural practices. Variations affect the demand for and use of different types of fuel while shaping types of resource available.

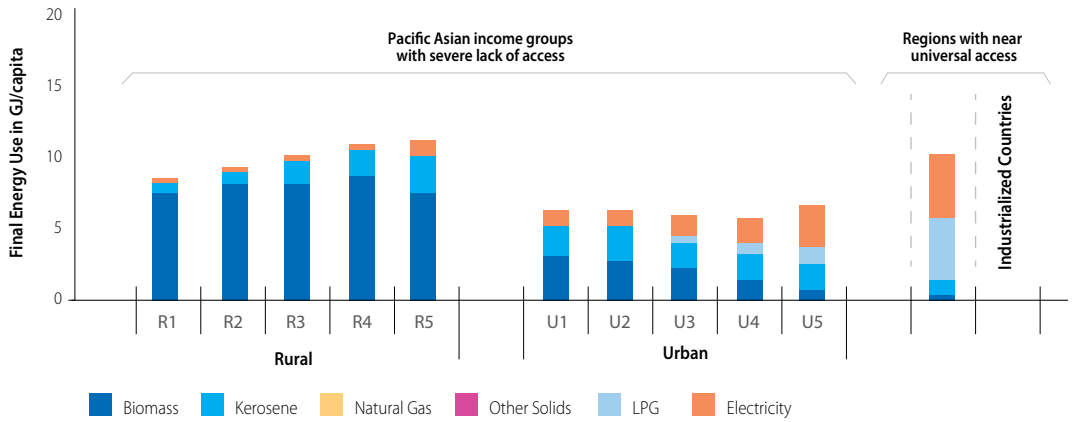
Economic factors. These include forecasts of expected trends in such economic statistics as GDP, consumer price indices, national income, and income distribution. These statistics are strong indicators of likely growth in both household consumption and in productive use and industrial energy use and its distribution across segments of society.

Policy factors. Such considerations help to assess the impacts of government policy and regulation, including taxes and subsidies. Although difficult to forecast accurately, trends expressed through long-term government planning show priorities for supporting different aspects of the energy sector.

[38] B. Van der Kroon; R. Brouwer; P. van Beukering (2012).

[39] International Institute for Applied Systems Analysis (IIASA), 2012.

FIGURE 4 Variations in residential energy use by region (rural/urban) and income (income quintiles)[39]



Many domestic uses of energy by women are also productive uses of energy, particularly for home-based income-generating activities.

Community energy needs assessment

Constructing a baseline of current community energy needs is essential to forecasting future energy demand. Needs are usually determined by the consumption of energy resources available for the community and the income level of the population that demands those resources. This assessment will reveal the quantity of energy required, considering productive-use requirements, as demand for energy grows. New enterprises and their productive-use needs will also have to be assessed.

Energy needs can be understood as referring to basic and lifestyle uses, as well as to social and productive uses. The first category includes such uses as domestic cooking, lighting, entertainment, cooling/heating, appliances and communication. The second category includes such public uses as street lighting and electrification of schools or health clinics, as well as uses in business, industry and agriculture. Unmet demand is also assessed and factored in.

Data are used to define the type of technology or energy sources used, in what quantities, at what costs and for what purposes (e.g., lighting). This is best accomplished through primary surveys of households, small businesses and other consumers. The following three categories outline the type of information needed:

Basic needs and lifestyle uses. Most households have the same basic energy requirements for cooking and lighting. Lifestyle energy end-use needs, on the other hand, are meant to enhance quality of life measured in terms of convenience, entertainment and enhanced access to information and communication. Consumption levels vary with income and affordability. Choices made by households regarding the use of energy resources provide information about affordability and willingness to pay for each resource.

Analysis structures the results according to consumer income level, as users tend to switch from one type of energy service to another based on purchasing power and, at times, according to ready availability or lack of a service. Energy consumers typically fall into different income strata, with results structured accordingly. The diagram below (Figure 4) provides an example of residential energy data classified by rural/urban and income quintiles.

Public uses. Public services and facilities include street lighting in the evenings, water pumping for water supply to the village, and energy for schools, local clinics and social centres. Given that the whole community uses these public services and facilities, their associated costs are borne by all households through village funds or local government budgets, which usually include subsidies.

Public uses are not directly related to the income level of each household, but to the overall income of the community. Rising populations and incomes are two macroeconomic factors behind growth in demand for energy for public uses.

Productive uses. Productive uses of energy have a compounding effect on income generation, livelihoods, employment opportunities and subsequent energy demand. In other words, funds invested in productive uses may create other benefits that in turn lead to increased use of energy services.

For this reason, programmes should assess the socioeconomic impacts of productive uses of energy promoted in a community. The main analytical tool in this regard is an economic impact assessment of planned productive-use activities. Such analysis evaluates the economic impact of the productive uses that the population experiences from a particular energy resource or technology.

This measurement should also take into account the fact that many domestic uses of energy by women are also productive uses of energy, particularly for home-based income- generating activities.

Available methodologies cannot yet quantify these indirect benefits. Nevertheless, programmes can anticipate several types of potential enterprise energy use and understand how energy access, or lack of it, will affect them.

- Automating manual activities. Some existing uses, for example, manual pumping of water for agricultural irrigation or grinding grain, consume no form of electricity or modern energy, relying instead on non-mechanized tasks and manual labour or animal power. These tasks may be improved by automating manual processes, which requires upgrades to processing equipment as well as new forms of energy.

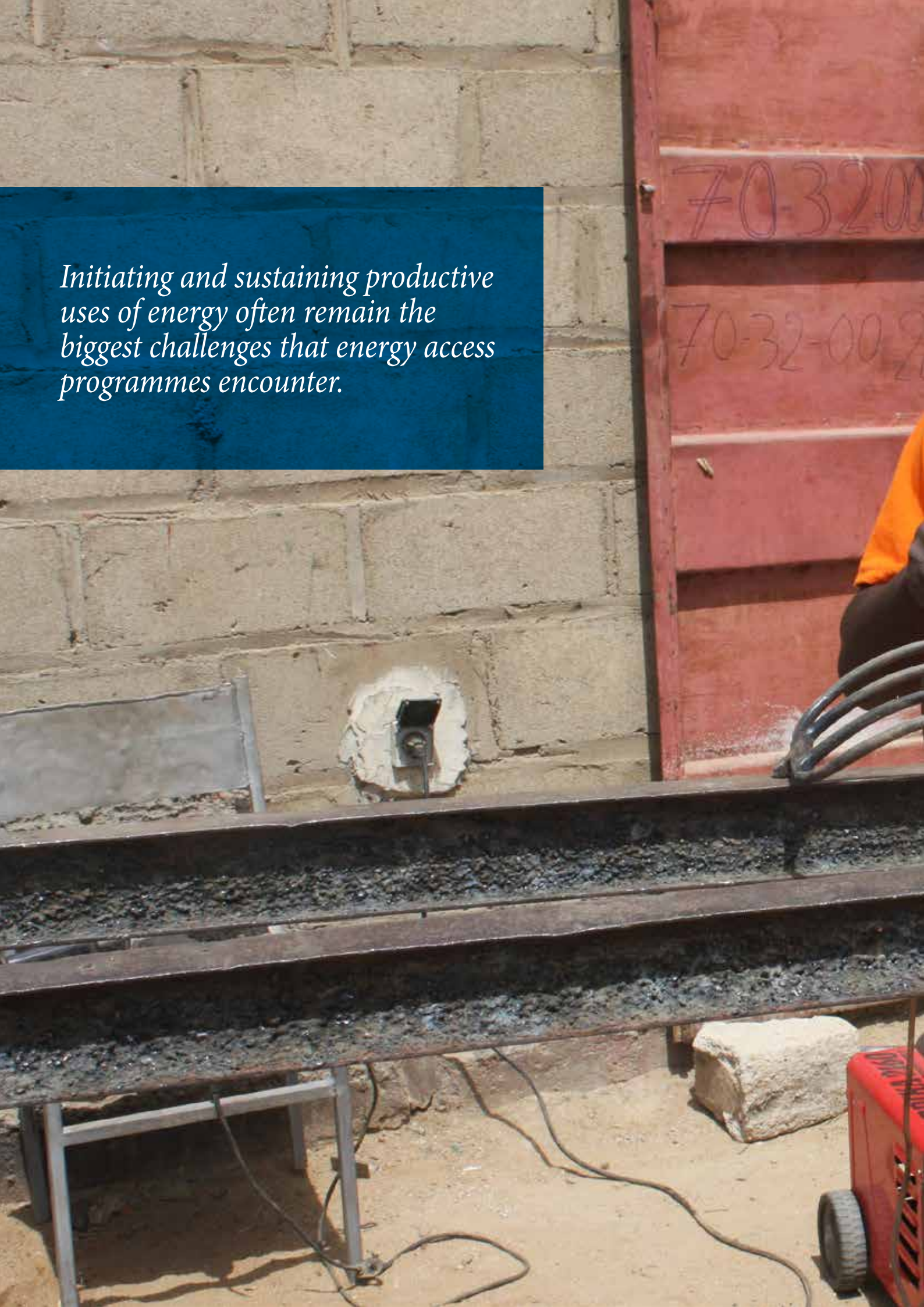
- Converting existing activities to renewable energy (fuel switching). Some uses, such as diesel generators for electricity generation or kerosene for lighting in shops and street stalls, currently depend on expensive fossil fuels. Such activities could benefit from conversion to renewable energy-based electricity.

- Initiating new productive activities. Opportunities for new productive activities can also arise through improved energy access. For example, households might use available natural-resource commodities and agricultural produce and process them in new ways to create value-added goods. Locally extracted logs, for instance, can be turned into sawn lumber. Availability of electricity in a community can also attract enterprises from neighbouring locations to shift operations to that community.

- Integrating energy efficiency. Both existing as well as new productive activities can be encouraged and supported to install energy-efficient technologies. Installation of energy-efficient motors or modern commercial cookstoves could result in energy savings as well as cost reduction.

The compounding effects of energy access

Replacing three-stone fireplaces with efficient cookstoves reduces both the cost of buying wood and the drudgery and time spent in collecting it. It also improves air quality at home by reducing smoke emissions, which promotes improved health and quality of life. Both quality of life and productivity are enhanced where the time and human energy saved from drudgery can instead be directed to pursuits such as education, recreation and income generation.



Initiating and sustaining productive uses of energy often remain the biggest challenges that energy access programmes encounter.

COMPONENT 5: Initiating productive energy uses

Demand for energy, together with willingness and ability to pay for it, can prove a powerful driver in stimulating expansion of energy services for the poor. This component focuses on how to make productive use of energy a central aspect of energy access planning, while encouraging communities to play a leadership role in promoting local energy markets.

On the one hand, energy use and income-generating activities spiral upward together: Productive uses can promote increased productivity and reduced labour, while concomitant increases in income in turn make energy use more affordable. Whatever the advantages of such reciprocal effects, however, initiating and sustaining productive uses often remain the biggest challenges that energy access programmes encounter.

Productive-use activities for the most part lie outside the mandate of an energy agency or programme. This means that efforts are needed to coordinate with rural development, enterprise development or agriculture departments in government. Conversely, rural development departments should rely on the involvement of energy agencies to help assess, plan and coordinate community energy needs.

An EnergyPlus programme can anticipate this need for coordination by planning for potential productive-use activities. Generally, this will involve (a) exploring what types of enterprise might be established; (b) identifying opportunities to initiate productive-use activities, and planning to provide them with necessary capacity and other associated support; and (c) laying a foundation for cooperation with other development stakeholders.

SCOPING POTENTIAL PRODUCTIVE USES

Initially, for many communities, energy uses will likely be directed to household income-generating activities using available resources and skills. Over time, users may progress to larger, organized micro-enterprises that offer employment for other households. Eventually, small businesses that produce more specialized and industrialized goods or services may emerge.

In these early stages, EnergyPlus programmes can estimate the scope of potential activities or enterprises that might arise. Often the easiest way to make this assessment is by looking at neighbouring towns or villages that already have good energy access. That said, even villages in close proximity to one another might need to pursue different industries due to different geographic or economic circumstances, and any programme will benefit from undertaking a Community Enterprise Mapping exercise.

Community Enterprise Mapping

Community Enterprise Mapping is a detailed feasibility study that should be undertaken before any income-generating activity is initiated. It involves collecting information regarding (a) established enterprises in the area; (b) existing and potential natural and physical resources; (c) local and external markets; (d) available skills sets, labour potential, and individuals

For a programme to promote or facilitate opportunities for potential productive uses, it may be easiest to begin by working with existing local enterprises that are interested and willing to convert from their current forms of energy use to clean and efficient energy services.

with the potential to develop as producers/entrepreneurs; and (e) local products of strategic advantage. More specifically, the mapping can include:

- **Natural resources.** What materials and resources are readily available for transformation into value-added products through additional processing before selling?
- **Existing products.** What income-generating activities already exist? Do they use some form of energy? If so, what type of fuel is used, and can this be improved upon?
- **Existing enterprise programmes.** Are there existing initiatives that promote enterprise development? How do these initiatives address energy use, and can their approach be improved?
- **Inputs for new activities.** What materials, labour, skills and technologies are needed for new productive-use activities? Do communities have access to these inputs? Are communities eager to engage in such activities?
- **Gender impacts.** How do productive-use opportunities differ for men and women respectively? How will these impact gender roles and labour within a household?
- **Market connectivity.** What other services (e.g., roads, water, information, and communication technologies) would be needed for any particular productive activity?
- **Market demand.** Is there a market for the proposed products? Are there activities in surrounding areas that might pose a threat in terms of competition and pricing? Are there activities in nearby areas with which communities can cooperate to reduce costs and improve distribution?
- **Investment and risks.** What level of capacity support will communities need to initiate productive uses? Can an EnergyPlus programme meet these needs, or is additional support necessary?
- **Access to finance.** What sources of finance are available to the producer/entrepreneur? Are lending institutions (banks, microfinance institutions, cooperatives) accessible and able to invest in productive-use activities?

Non-local businesses

Local businesses often need significant capacity building in order to develop the knowledge and skills needed to run new or improved income-generating activities. Such activities risk being unable to sustain themselves due to challenges that households or individuals encounter in managing a business, developing adequate technical skills, having access to finance or finding accessible markets.

Non-local businesses, on the other hand, are small to medium-sized enterprises that operate in neighbouring areas but are unable to expand because of poor energy access. Once they are able to begin operating in new communities, these businesses bring several advantages, which can be accounted for in the process of scoping productive-use activities:

- They require less capacity support to begin operations than do new local businesses
- They are already equipped with a range of different skills and can train local workers
- They offer employment opportunities without the need for households to learn how to manage a business
- They have wider exposure to local and distant markets for both sourcing of materials and distribution of goods and services
- They bring innovation and capital for investment in equipment, materials and training.

Potential productive uses of energy

Agriculture and livestock
- Mechanical power for water pumping, transportation and crop processing
- Electric water pumps for irrigation, fish and shrimp farming
- Agricultural processing (threshing, grinding, freezing, oil expelling)
- Dryers for meat, fish, edible flowers, herbs and spices
- Grain milling (electric or hydropower)
- Sugarcane processing
- Coffee pulping
- Milk collection and chilling centres
- Electric fencing for grazing management
- Shearing and carding equipment
- Lighting and cooling for poultry farms
- Veterinary services

Industrial or commercial use
- Operating general stores, hotels, restaurants, bakeries
- Workshops (electronic repair, mechanics, carpentry)
- Rubber drying
- Soap production
- Silk reeling (using electricity or heat produced from biogas)
- Silkworm rearing
- Cotton ginning
- Timber milling
- Textile dyeing and dry cleaning
- Carpentry (saws, drills, routers)
- Tailoring (irons, sewing machines)
- Welding and looming
- Sewing and weaving
- Handicraft production
- Woodworking
- Coconut-fibre processing (for ropes and mats)
- Processing, cutting and polishing of minerals and stones

Uses of thermal energy
- Kilns for firing pottery and brick-making
- Improved efficiency of bakeries
- Local eateries

Mechanically powered uses (non-electric)
- Improved water mills for grinding

Water-related
- Water desalination and purification
- Water pumps for potable water and irrigation
- Ice making

Hospitals and clinics
- Lighting for improved and longer operating hours
- Space cooling and heating
- Water pumping, heating and sanitation
- Refrigeration of medicines, including vaccines
- Powering of medical equipment (x-ray machines, electro-cardiographs, etc.)
- Sterilization of medical equipment
- Radio and telecommunications equipment for contacting doctors and obtaining emergency services

Education centres
- Lighting for improved and longer operating hours
- Powering of audio-visual equipment, including computers
- Space cooling and heating

Energy production and public services
- Battery charging
- Community street lighting
- Community centre lighting

Communication
- Radio and television broadcasting
- Internet and telecommunication centres (used by farmers, e.g., to check market prices and obtain information on good farming practices)
- Photo and photocopying services
- Education materials via television and Internet
- Navigational equipment[40]

[40] Adapted from White (2002).

Prioritization of potential enterprises

Referring to the information and analysis described above, a programme can, in coordination with relevant rural development organizations or programmes, begin to prioritize potential types of productive-use activities. Table 10 presents examples of how different types of enterprises may be prioritized.

PLANNING AND INITIATING PRODUCTIVE USES

Once potential industries and productive uses have been identified, a programme can develop a plan for promoting or facilitating those opportunities. It may be easiest to begin by working with existing local enterprises that are interested and willing to convert from their current forms of energy use to clean and efficient forms of energy services.

Beyond these opportunities, targeted productive-use promotions can be initiated. Table 11 below presents a general outline describing the phases and steps of an integrated livelihood-energy access project. These project activities can be aligned with energy-demand forecasting studies and undertaken in parallel with other programme components, including promoting energy service delivery and access to finance and markets.

TABLE 10 **Prioritizing enterprises**

Community characteristics	Potential productive-use activity
Remote, with low agricultural productivity and low household income	Indirect use of electricity for small-scale skills-based crafts
Remote, with low agriculture productivity and rich natural resources	Improved processing of natural resources and non-timber forest products
Areas with high agriculture productivity and access to urban markets	Agricultural processing enterprises, processing of fresh produce for nearby markets, commodities for urban markets such as stone crushing or brick-making, rural telecommunication or computer training centres
Rural market centres	IT and financial services (for remittances), recreational services (TV and video halls), computer education
Areas with tourism potential	Telecommunication services, hotels and lodging, recreational activities

Considerations in productive uses

Within this project framework, a number of issues, either explicit or implied in the activities, require consideration.

Institution building. Appropriate community-level institutions are required to operationalize the rules and responsibilities for shared or joint income-generating activities. Responsibilities may include business administration, managing material inputs, or sales. It may be possible to integrate existing local institutions into similar local structures that manage or oversee energy service delivery systems (for more on this, see Component 6 below).

Community mobilization. Strong social capital in the community is essential to the success of the initiative. A comprehensive community mobilization process will help ensure the willingness and commitment of community members to work together for inclusive development based on equality and equity.

This cooperation is a condition of successfully mobilizing individual assets such as land and skills, as well as community-owned property such as river and mines, for the benefit of all. The building of social capital encourages households and entrepreneurs to work in informal groups, cooperatives or private companies, enabling them to share knowledge, skills and provide organizational support for enterprise activities, as well as common services such as schools and health centres.

Gender and social inclusion. Energy uses entail different requirements and development benefits for men and women, as well as for poor and marginalized groups. Women and marginalized groups often risk being left out of energy access initiatives. Promoting productive-use activities can take these considerations into account with a selection of targeted questions:

- ***Energy needs.*** What are the respective energy needs of men, women and marginalized groups? Are these needs met by a programme's energy access solutions?
- ***Access to information.*** Do women and men have equal access to information about the energy service and productive uses?



TABLE 11 **Steps for productive-use planning and initiation**

Feasibility and initial planning	
1. Conduct community enterprise mapping, taking stock of existing economic activities 2. Identify opportunities for coordination with ongoing programmes 3. Confirm the types of productive uses that will be supported 4. Define the scope of interventions to support these activities 5. Map out local stakeholders and their roles	
Programme design	
1. Identify key bottlenecks in enterprise activities 2. Assess the scale of replicability for productive uses 3. Develop a plan of productive energy-use promotion activities	
Implementation	
Foster energy services	1. Raise awareness of productive uses among energy service providers and financial institutions 2. Encourage energy service providers to act as technology facilitators 3. Consult with energy service providers on options for productive use-friendly tariff system
Technical assistance to enterprises	1. Define the target group and assess their training needs 2. Define a training strategy with partner institutions 3. Design and deliver technical training courses
Facilitate access to finance	1. Take stock of existing financial institutions 2. Assess hurdles that inhibit loan applications 3. Define measures for improved access to loans 4. Monitor and evaluate loan performance
Raise awareness of productive uses	1. Define desired messages and target groups 2. Select communication channels and run promotional activities
Monitoring and evaluation	
Following the guidance set out in Component 1 above: 1. Set indicators, targets and collection of baseline data 2. Monitor institutions and partners 3. Assess impacts and feedback results into planning processes	

Source: Adapted from Productive Use of Energy – PRODUSE: A Manual for Electrification Practitioners.

Comprehensive funding support will need to cover both low-cost renewable energy technologies and equipment needed for productive uses.

- ***Decision-making.*** Do both women and men make decisions during project planning and design?

- ***Construction and maintenance.*** How are the tasks of building and operating the energy system distributed between women and men? Who performs the skilled and unskilled work respectively?

- ***Training and payment.*** Do women and men have equal access to training and to paid work in the project, as well as to other perceived benefits?

- ***Productive use.*** Are both women and men able to use energy for small-scale economic and domestic uses? Do women and men have equal access to credit, information, training, raw materials, land and other resources needed for energy access and entrepreneurship? What are the implications for energy availability and distribution of benefits?

- ***Ownership and managerial control.*** Do both women and men have ownership and/or managerial control over the operation of the energy service and the productive-use enterprise?

- ***Benefits.*** What are the practical and strategic benefits of the energy service and of the participation process for women and men, as perceived by each group?

Consumer awareness. Most communities living without sustainable access to energy are unfamiliar with its potential uses and affordability. Thus consumer demand in off-grid electricity markets needs to be stimulated through improved awareness of products and services.

Awareness-raising activities can include initial surveys of consumer needs and interests. This information can help to identify which products best meet consumer needs. Some will be more compatible with existing heating and cooking preferences, for example, or electricity might be needed for devices that are most in demand.

Ongoing capacity support. To sustain growth and momentum in a community, some mechanism is needed to maintain support to households and entrepreneurs in helping them to acquire and access new skills, knowledge, technology, finance and markets. Such support is needed if producers/entrepreneurs are to continue running their businesses profitably, and it can address issues of product enhancement, innovation, business literacy, and branding and marketing.

FINANCING PRODUCTIVE USES

For productive uses of energy to get started, communities and entrepreneurs often need initial funding or capital for purchasing equipment and covering early operational costs. Microfinance institutions (MFI) play a central role in enabling end-users to acquire energy technologies and services that meet their basic energy needs, as well as equipment for productive uses such as pumps, mills, grinders and other basic equipment. MFIs may also grant flexible loan repayment schemes that align with income generated from the use of this equipment.

To stimulate MFI involvement, an EnergyPlus programme needs to focus on various capacity-building efforts. These can include teaching management and field staff about the benefits of energy access and potential productive uses of energy, and training staff to understand loan requirements and calculate costs, savings and loan repayment periods. This capacity support can be strengthened by establishing partnerships among MFIs, energy service companies and livelihood support institutions so potential customers can more easily find

While existing enterprises may already have links with local merchants who can facilitate connections with buyers for their goods, new enterprises need to create these linkages. One way to build these is through a value-chain approach.

financial support when needed. This relationship will also help MFI field staff to introduce households to energy and end-use technologies, as well as to potential income-generating devices and activities.

In addition to private financing, national energy access, agriculture, enterprise, rural and local industry development programmes may offer grant schemes that can support larger investments in business equipment and setup costs. At policy levels, this can mean looking for ways to integrate productive-use activities into funding that may only be targeted toward supporting energy access, or assisting industry development grants to adequately support the types of industries/enterprises in which communities are able to participate. In addition, such grants can be used as risk-guarantee funds to encourage private-sector banks to lend to these enterprises at lower interest rates and with favourable repayment schedules.

Alternatively, where financial needs for small businesses are relatively low, local funding options may be available. With community-managed energy access initiatives, enterprise development trust funds can be established under a community energy infrastructure management board, and they can extend grants or loans to households in need of capital to start small enterprises. In some cases, energy service companies have also taken the initiative in offering equipment for productive uses, for example, solar lantern rental services providing electronic equipment as part of their overall service and rental package. Together, these options can perhaps be used to build comprehensive funding support that covers both low-cost renewable energy technologies and equipment needed for productive uses.

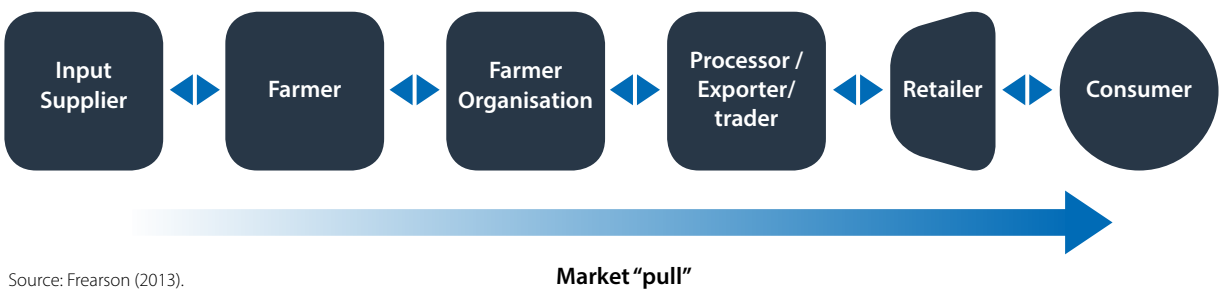
INTEGRATING CROSS-SECTOR COLLABORATION

Any activity aiming to stimulate productive uses of energy relies fundamentally on its integration with other government or non-government rural development or industry development programmes that support community enterprises and local businesses. Potential areas for coordination or collaboration are outlined under specific issues as follows:

Comprehensive skills development for productive uses

Opportunities for local-enterprise activities generally require programmes to train and equip community members with new skills. These include technical knowledge for specific industries, as well as skills in business management that cover basic accounting, administration and marketing. Branches of government that specialize in enterprise development or

FIGURE 5 **Market access**



Source: Frearson (2013).

national industry development programmes make ideal partners for coordination. Besides providing a wealth of experience, they may also offer opportunities for training activities, workshops and exposure visits to understand practices established elsewhere.

Complete access to equipment and materials

New enterprise activities often require new equipment, whether for processing and manufacturing or for services like printing or vehicle maintenance. Access to and maintenance of this equipment can be costly and time-consuming for entrepreneurs. Additionally, enterprises generally require a wide range of inputs that may not be readily available, or which can help to further transform and add value to traditional products. Yarn for looms and sewing machines, for example, requires dyes and needles; pottery can be glazed in improved kilns; and sawn timbers can be treated to prevent rotting and insect infestation. Identifying supply chains for such materials, equipment and maintenance is a critical part of any enterprise or industry development programme with which energy access activities need to coordinate.

Holistic approach to market access

While existing enterprises may already have links with local merchants who can facilitate connections with buyers for their goods, new enterprises need to create these linkages. One way to strengthen or build these is through a value-chain approach, which identifies the various stages where value is added to products. For example, the value chain, depicted in Figure 5 below, involves suppliers, producers, producer organizations, traders, retailers and consumers. As their respective capacities are strengthened, market demand begins more effectively to drive supply from start to finish. Each stage has its own capacity needs, and a wide range of private and government stakeholders can be engaged with it in addressing these needs.

Local government leadership

Normally, local governments are responsible for the decentralized planning and management of local-level projects and programmes for the district/province. By virtue of their mandates, they also have the authority to lead coordination, integration, and monitoring and evaluation of activities on the part of government and donor-funded projects and of NGOs. These bodies can have crucial roles in local planning of energy services, as well as in mobilizing local resources for producing synergistic outputs and impacts.

KEY RESOURCES

Productive Use of Energy – PRODUSE: A Manual for Electrification Practitioners provides useful resources for community enterprise development planning[41]

Mainstreaming Gender in Energy Projects: A Practical Handbook is a guide to integrating gender into programme planning[42]

Pro-Poor Value Chain Development: Private Sector-led Innovative Practices in Ethiopia discusses capacity support for improved value chains[43]

Impact Monitoring and Evaluation of Productive Electricity Use – An Implementation Guide for Project Managers is a guide to the design of impact evaluation for productive electricity use[44]

Integrated Sustainable Rural Development: Renewable Energy Electrification and Rural Productivity Zones provides stakeholders in beneficiary countries and donor organizations with a holistic way of tackling rural energy access and rural poverty by setting an integrated infrastructure for energy and income generation.

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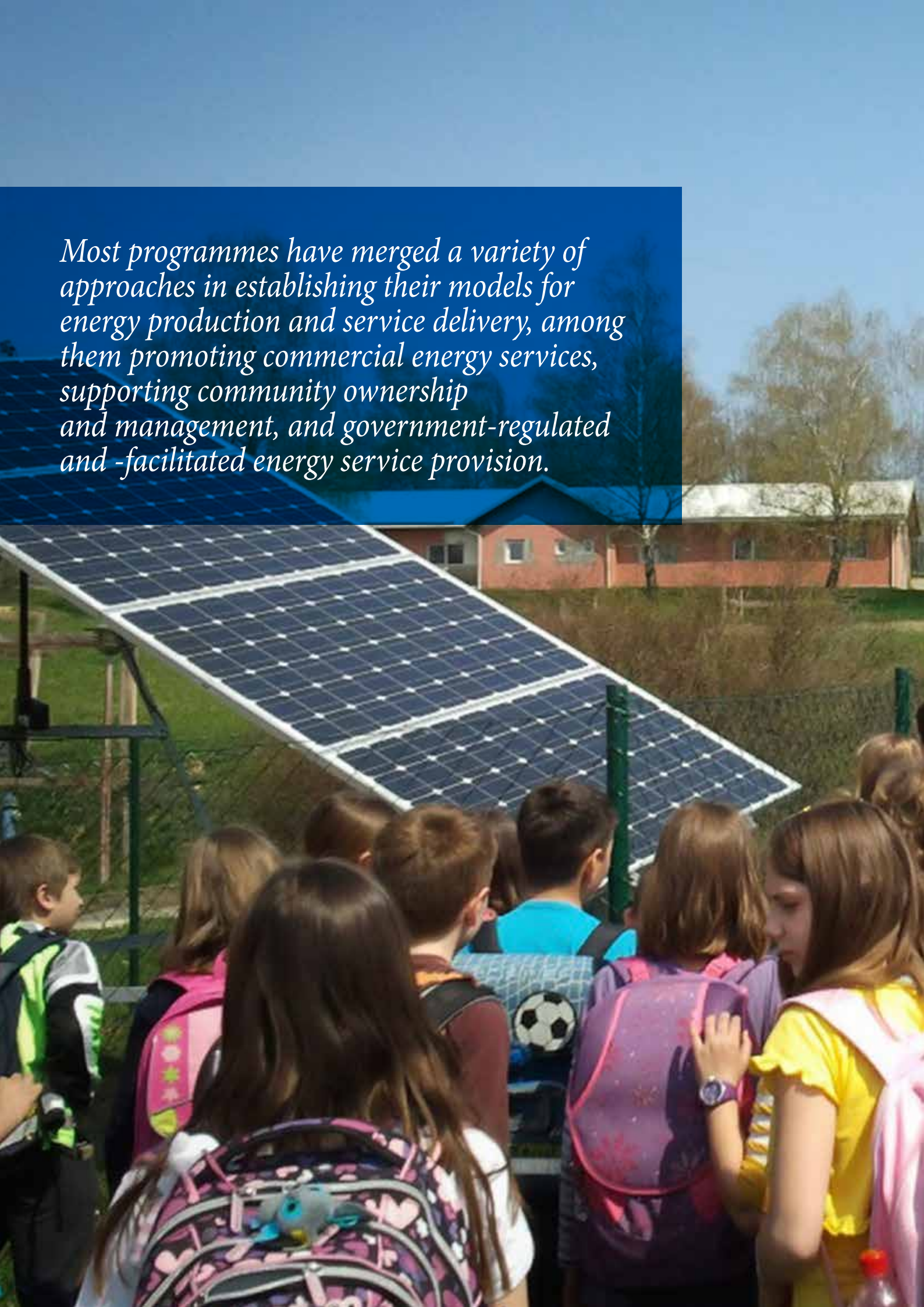
[41] Available at: http://www2.gtz.de/dokumente/bib-2011/giz2011-0462en-productive-use-energy.pdf.

[42] Available at: http://www.energia.org/fileadmin/files/media/DropBox/Module1/Mainstreaming_gender_in_energy_projects_A_practical_Hand_book.pdf.).

[43] Available at: http://www.snvworld.org/files/publications/pro-poor_value_chain_development_-_private_sector-led_innovative_practices_in_ethiopia.pdf.

[44] Available at: http://www.produse.org/imglib/downloads/PRODUSE_study/PRODUSE%20Impact_ME%20Guide.pdf.

Most programmes have merged a variety of approaches in establishing their models for energy production and service delivery, among them promoting commercial energy services, supporting community ownership and management, and government-regulated and -facilitated energy service provision.



Energy uses entail different requirements and development benefits for men and women, as well as for poor and marginalized groups. Women and marginalized groups often risk being left out of energy access initiatives.

COMPONENT 6: Facilitating energy production and services

This section focuses more specifically on how to develop the energy production and service delivery system required to provide actual energy access and services. Three important aspects of this endeavour are described:

- Selecting appropriate models for energy production and service delivery
- Developing stakeholder capacities to participate in energy production and service delivery
- Building capacity among energy producers/suppliers and lending institutions to meet financing needs

DEVELOPING MODELS FOR ENERGY SERVICE DELIVERY

A country's economic and energy context, including the needs and demands of the energy poor and the available renewable energy resources and technologies, as well as access to energy efficiency technologies, will determine which type of energy service delivery systems are most needed. For example, given mountainous Nepal's hydropower potential, micro-hydro plants have become the dominant solution to community electricity access. In low-lying Bangladesh, on the other hand, PV solar home systems (SHSs) and solar lantern rental services are proving the products of choice for consumers.

In practice, most programmes have merged a variety of approaches in establishing their models, among them (a) promoting commercial energy services; (b) supporting community ownership and management; and (c) government-regulated and -facilitated energy service provision.

These three approaches, including factors to consider when deciding which models to pursue, are further discussed:

Existing and potential energy services

Information about community energy needs and potential generation capacities is a necessary prerequisite in deciding which model of energy production and service delivery to expand or initiate. Preparing a monitoring framework might have already provided much of this information, though at this stage more detailed information can be gathered to assess the services available to specific communities:

- What energy production and service companies are already accessible to communities?
- What supply services do they offer and what modalities do they use for service delivery?
- Do these services provide for the basic, social and productive-use needs of the communities?
- Is the quality of energy provided by the service adequate, affordable and reliable?
- Do their products or services reach the poor and marginalized, and do they provide for the energy needs of women?

- Is there scope for expanding these services and tapping additional indigenous energy resources?
- Are the products, services or prevailing costs affordable in comparison to traditional fuels that may also be used?
- Are any local-level institutions responsible for local (decentralized) planning and management?
- What are people's perceptions of energy services? What are their priorities, willingness to participate and pay, views regarding the quantity and quality of energy supply, and preferred end-use technologies and services?

Promote commercial energy services and independent power producers

Promoting independent, commercial energy service companies and energy producers is one model for consideration. Two broad approaches may be taken to such energy services: (a) production, marketing and installation of modern and efficient energy devices for individual consumers; and (b) installation and operation of systems for energy (electricity) production and/or distribution to communities.

These approaches can include producers and suppliers ranging from local MSMEs that are producing and distributing clean or improved cooking stoves or distributing solar PV panels or efficient motors, through to medium-sized companies investing in energy infrastructure such as micro-hydro power plant construction and/or operation.

Conventional energy distribution services have well-established markets and delivery models. In contrast, smaller enterprises dealing with clean and efficient energy systems generally lack proven business models for servicing remote or low-income areas, and this uncertainty deters investment. Increasingly, however, smaller energy service companies are developing their own innovative solutions to energy access in contexts where users have a limited ability to pay for the services. These businesses often seek to reduce up-front material costs for consumers by collecting payments through ongoing service fees. Where consumers need make no initial outlay, perceived risks of spending money on unfamiliar services is less daunting and allows them to assess for themselves whether or not the costs of improved energy access are worthwhile and affordable.

Community -owned and -managed projects

Community-managed energy services are sometimes adopted when it is appropriate to provide villages with electricity generated using a single source, for example, a micro-hydro plant, a biomass-powered generator, or a solar mini-grid. However, they can also be managed by private enterprises. This approach is usually led by a national energy institution that engages communities, establishes and trains local management groups, and sets up local funds to enable the management group to collect service fees and cover running costs.

Crucial aspects of this approach include community mobilization, ownership and capacity development, and ownership needs to start being built from the outset. This level of community engagement provides a relatively easy entry point for integrating productive uses of energy, but it also needs to consider sources of financing and is likely to be heavily dependent on government investment or support.

Some projects may be profitable enough to contract private operation and maintenance support, or to attract lending-institution or private investment. This is especially true where mini-grids can be connected to a national grid (which supplies an inadequate quality of electricity), and government-regulated feed-in tariffs can be paid to producers for excess energy

sold to the grid. This is also the case where good anchor tenants are available, or where such tenants can be attracted to the locality by assurances of reliable and adequate supply. In other cases, government technical support and oversight may be necessary to maintain energy generation and transmission infrastructure.

Government-led energy services

A country's political, economic and geographic context can mean that it is most appropriate to use government oversight to manage and regulate the operations of energy service companies. This may be necessary where, due to overwhelming challenges — e.g., a remote and sparsely populated consumer base — there has been total market failure of commercial energy services.

In such scenarios, governments can respond by grouping villages into clusters and tendering out the authority to access those clusters to a selected energy service company. Such companies can then be required to meet performance and service delivery standards. The cluster size must be such that business operations are large enough to be profitable, while also meeting the higher transaction costs of doing business in remote areas. Such an approach can be heavily dependent on the State, or it can pursue a public-private partnership modality, and it has the advantage of reaching the energy poor in areas that would otherwise not be commercially viable.

STRENGTHENING STAKEHOLDER CAPACITIES FOR ENERGY SERVICE DELIVERY

Local governments, energy service companies, livelihood support institutions and communities are all involved in EnergyPlus programmes, and each brings with it a variety of roles and capacity development needs. The summary below looks at the potential roles each may have and the types of capacity support an EnergyPlus programme needs to provide:

Local government

Local government participation often involves coordinating the planning of small-scale energy services with other rural or industry development activities, as well as facilitating relationships between communities and energy service companies, supporting the uptake of productive uses of energy, and monitoring and evaluation.

In some cases, higher levels of government may take on planning responsibilities, while lower, village levels of government will be better placed to facilitate community engagement. Depending on the extent of their respective powers, ways these levels of government may be involved in expanding energy access include:

- Leading and facilitating stakeholder engagement, consultations and cooperation
- Planning the development of local energy-resource use based on household, community and enterprise needs
- Facilitating communication and coordination between energy access activities and local industry or rural development activities
- Assisting communities in planning new industry or enterprise ventures
- Coordinating agricultural or forestry extension services and integrating uses of energy into their activities
- Public-awareness efforts to build consumer understanding of the potential uses and benefits of improved energy access

Where appropriate, capacity development support may be needed to enable local governments to carry out these activities. Support should involve a range of departments within the local government, moving beyond those responsible only for energy access.

Similarly, capacity development support to local governments should also consider the holistic linkages between government agencies and, for example, private-sector and community groups. This can help to establish standard practices and operating procedures that improve the integration of energy access into other areas of local governance. It is too often the case that local governments are expected to perform many functions, but are not given the requisite resources, authority or capacity development support to perform these functions effectively.

Communities

Community capacity support is especially needed where community-managed energy services are established. Capacity development in these contexts may involve (a) establishing and training a management entity; (b) enabling the entity to administer and financially manage the energy infrastructure and service; and (c) creating a base of skilled technicians with the capacity to monitor and perform basic maintenance of energy infrastructure.

Key considerations when undertaking this work include:

- Community involvement, including possible ownership, should be supported at the outset of any project. This includes encouraging communities to articulate their own needs for capacity development support.

- Capacity development activities can require up to 50 percent of the human and financial resources needed to make a community-managed project successful.[45]

- Capacity development support that targets the capacity needs of communities should not be conceived in isolation. For example, even community-managed energy projects must observe national regulatory frameworks and safety standards, and communities therefore need the capacity to engage with relevant government agencies on these and other matters.

- Women and marginalized groups must be given adequate involvement in the management and decision-making process. Otherwise, they are likely to be excluded from the benefits of energy access.

Community mobilizers also represent an important stakeholder group, one that can facilitate community engagement and awareness-raising while connecting households with financing schemes and income-generation activities. They may be sourced through local NGOs or other organizations already working in the area.

Energy producers and service companies

Capacity development for energy service companies will address a variety of areas. Primarily this will involve reaching out to existing energy service companies or potential new entrepreneurs and negotiating ways in which they can collaborate with an EnergyPlus programme. Specific capacity support may also focus on the following measures:

- Developing technical skills needed to build, operate and manage energy production and services, including installation, distribution, managing supply and billing/payment collection

[45] UNDP (2012c).

User payments for energy services will not cover the required initial investment costs of energy infrastructure but are crucial for long-term cost recovery and maintenance.

- Compliance with regulatory requirements and operational standards
- Managing product supply chains to provide repairs, parts replacement, maintenance services and disposal of any components that might contain noxious chemicals
- Applications for loans or subsidies to finance business start-up and investment costs
- Marketing and public communication activities to raise awareness among local consumers

FINANCING ENERGY PRODUCTION AND SERVICES

An energy service model can only function if it is complemented by a financing strategy that ensures capital is available to energy service companies seeking to enter the market. This strategy will vary according to whether it involves private-sector investment or whether it is community-owned, and it may use a number of funding sources, both public and private. These sources are likely to pursue investment opportunities in a variety of ways and will require different types of support from the project.

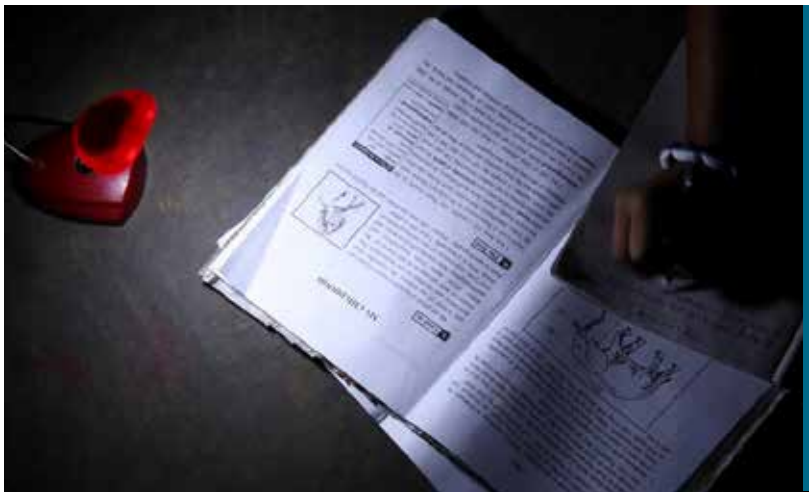
End-user financing

If energy services are to prove sustainable, users must make some form of payment for services. Payments can be accounted for during investment planning by applying a variety of models, among them up-front payment for energy technologies, rental fees for use of energy technologies, or conventional metering for mini-grid access. These payments will not cover the required initial investment costs of energy infrastructure but are crucial for long-term cost recovery and maintenance. Flexible payment models in accordance with income stream may need to be considered for households or micro-enterprises with seasonal income.

Private investment

In contrast to government financing programmes, lending and investment from private-sector institutions such as banks or private equity firms is mostly influenced by an institution's understanding of the energy sector and perception of associated risks. The most effective ways to overcome related hurdles include raising awareness among lending institutions on the opportunities that exist in supporting energy access, and training them in how to assess the viability of loan requests. This can be demonstrated with participating communities or energy service companies, which can practice applying for and securing a loan as well as guiding collaborating lending institutions through the risk assessment process.

Governments can also commit to offering risk guarantees to lenders, which means governments agree to back the losses of any loan where borrowers default on repayments.



KEY RESOURCES

Case studies with examples of each model of energy service delivery:

Renting Lighting Services: Paying for the Service and Not the Hardware describes private-enterprise energy services in Lao PDR[46]

Energy to Move Rural Nepal Out of Poverty: The Rural Energy Development Programme Model in Nepal discusses community-managed micro-hydro projects in Nepal[47]

Power to the People: Solar Energy for a Better Quality of Life, Social Equity and Socioeconomic Growth in the Philippines looks at government-coordinated service provision in the Philippines[48]

Transforming On-grid Renewable Energy Markets presents an overview of how feed-in tariffs can be used to make energy infrastructure investments viable[49]

[46] Available at: http://asia-pacific.undp.org/content/dam/rbap/docs/Research%20&%20Publications/environment_energy/energy-plus/EE-2012-Case14-Sunlabob.pdf.

[47] Available at: http://asia-pacific.undp.org/content/dam/rbap/docs/Research%20&%20Publications/environment_energy/energy-plus/EE-2012-Case10-REDP_Nepal.pdf.

[48] Available at: http://asia-pacific.undp.org/content/dam/rbap/docs/Research%20&%20Publications/environment_energy/energy-plus/EE-2012-Case1-ACCESS.pdf.

[49] Available at: http://web.undp.org/gef/document/UNDP_FIT_Port_TransformingREMarkets_15oct2012.pdf.

EnergyPlus meets social needs for energy (electricity for public spaces, electrifying health clinics/schools to improve the quality of services) as well as income-generating activities.

THE ENERGYPLUS APPROACH – Integrating six components

As we have seen, the EnergyPlus Approach focuses on expanding energy access for the poor by ensuring that access goes beyond serving only basic energy needs. It also promotes productive energy uses for income generation, community needs, and lifestyle needs for improving living standards.

To accomplish this, the approach focuses on both energy and non-energy inputs that combine energy services with measures that help generate livelihood improvements and other development benefits. Productive uses of energy include meeting social needs such as electricity for public spaces, health clinics and schools to improve the quality of medical services and enhance education standards. These are needs that relate to basic human development indicators, including higher literacy rates, lower infant and maternal mortality, and better access to communication devices for communities, as well as better security, particularly for women and children. Productive uses also encompass income-generating activities and include supply of electricity for MSMEs to boost productivity in their existing activities or support the founding of new types of businesses. This can also involve using electricity in agricultural production and processing, or improving energy efficiency of stoves or kilns in cottage industries. Similarly, entrepreneurial activities can be built around energy systems providing modern fuels for cooking/heating. All of these activities contribute to poverty reduction by raising incomes among the poor and providing new opportunities for equitable economic growth in local economies, as well as enabling users to pay for the costs of energy services.

To realize the benefits of energy access and productive uses, it is equally important, as suggested above, to implement a set of non-energy interventions in addition to providing access to energy services. Mere provision of energy will not automatically result in such outcomes as productive-use applications in enterprises or agricultural operations. Support systems need to be established, including (a) institutions for accessing technologies and finance; (b) capacity-building programmes targeting entrepreneurship development, skill building and awareness creation; (c) market development activities linked to market access, demand assessment, packaging, branding and so forth; and (d) effective supply chains for sourcing materials and services.

Figure 6 below presents a conceptual framework for the proposed EnergyPlus approach. The individual steps involved in accomplishing the EnergyPlus outcomes are classified as 'energy value chain' and 'productive-use value chain,' which represent the two respective types of intervention (energy and non-energy).

ENERGY VALUE CHAIN

1. **Demand-supply assessment planning.** Conduct a detailed assessment of supply potential in terms of local energy resources and the energy production capacity, and match it with the current and forecast demand for energy carriers and services for basic, lifestyle and productive-use applications.

2. **Technology selection/development.** Select appropriate technologies with an emphasis on energy efficiency, for energy production and productive use that are robust, mature and match with local energy resources, productive-use applications and, more importantly, the most cost-effective solutions.

3. **Energy service delivery mechanism.** The energy service delivery model must be efficient, effective and equitable. The proposed business model can follow the PPP (public-private partnership) framework. Its purpose is to integrate the efficiency of the private sector, the social obligation and institutional strength of the government organizations, and the concerns and participation of community organizations. This model is most appropriate for energy production and distribution enterprises. This model is also expected to integrate support mechanisms for enabling creation of livelihood opportunities and EnergyPlus enterprises.

4. **Energy technology support services.** Create or enhance a supply chain for renewable energy and energy efficiency technologies and services, and a grid interconnection to enhance livelihoods and contributing to improved access to health, education and community services.

5. **Enabling policy.** Facilitate policy, regulatory and financial support (including risk sharing and/or guarantees) for decentralized renewable energy, energy efficiency and livelihood improvement applications. It is essential to promote supportive policies and regulations that work to create incentives and greater certainty for all participants in the EnergyPlus process.

6. **Institutional support**. Bring together various players, including government support schemes, business incubator networks,[50] financiers, impact investors and extension service providers, to provide support and scale-up for EnergyPlus projects.

7. **Finance (project and end-uses).** Obtaining the required financial support for EnergyPlus implementation is crucial. This could come from national budgets, government grants, multilateral agencies and international donors. It is also necessary to tap low-cost bank finance from financial institutions to support investment needs. Microfinancing can play a crucial role in providing financial support to household-based enterprises, livelihood opportunities and very small-scale productive-use enterprises.

8. **Community mobilization and governance.** Facilitate dialogue with key stakeholders (e.g., government bodies, CSOs, private technology companies, enterprise development institutions, financial institutions, retailers, agro-based enterprises, farmer networks) to promote synergies with ongoing efforts, build complementarities and ensure sustainability of collective efforts.

9. **Revenue models for sustainability.** Productive-use component of the EnergyPlus project is expected to help sustain the system through tariff revenues, with enterprises and businesses possibly being charged higher rates than households or even being the anchor tenants. Productive-use applications of energy for income-generating purposes could be a way to increase utilization as well as revenue, and thereby ensure income and financial sustainability of systems.

[50] Business incubation is a combination of business development processes, support infrastructure and people designed to nurture new and small businesses by helping them to survive and grow through the difficult and vulnerable early stages of development.

10. **Capacity development and awareness-raising.** Effective stakeholder partnerships are an essential element in the success of the EnergyPlus programme. These stakeholders may come from the public and private sectors, the community, international organizations, Research and Development (R&D) institutions, and NGOs, among others. The process requires both capacity needs assessment and capacity-building programmes.

11. **Monitoring and evaluation.** Set up and implement processes for measuring, monitoring and evaluating the success of EnergyPlus initiatives. Most importantly, identify appropriate indicators for measurement at different scales. Results-based monitoring is a standard performance-evaluation system that, apart from activities and inputs, focuses on programme outputs, outcomes or impact levels.

12. **Knowledge management and exchange.** Create a knowledge base from case studies of EnergyPlus projects, lessons learned, step-by-step descriptions of processes from inception to completion, success stories, manuals on capacity development, business models and financial plans. This can facilitate knowledge exchange among the energy access community both within and between countries, while also promoting stakeholder cooperation.

PRODUCTIVE-USE VALUE CHAIN

1. **Access to energy efficient end-use technology.** Important first activities of this value chain include identifying, developing and deploying key productive-use technologies for enterprises and livelihood improvement application packages, as well as connecting with business incubators and impact investors of productive-use EnergyPlus project activities.

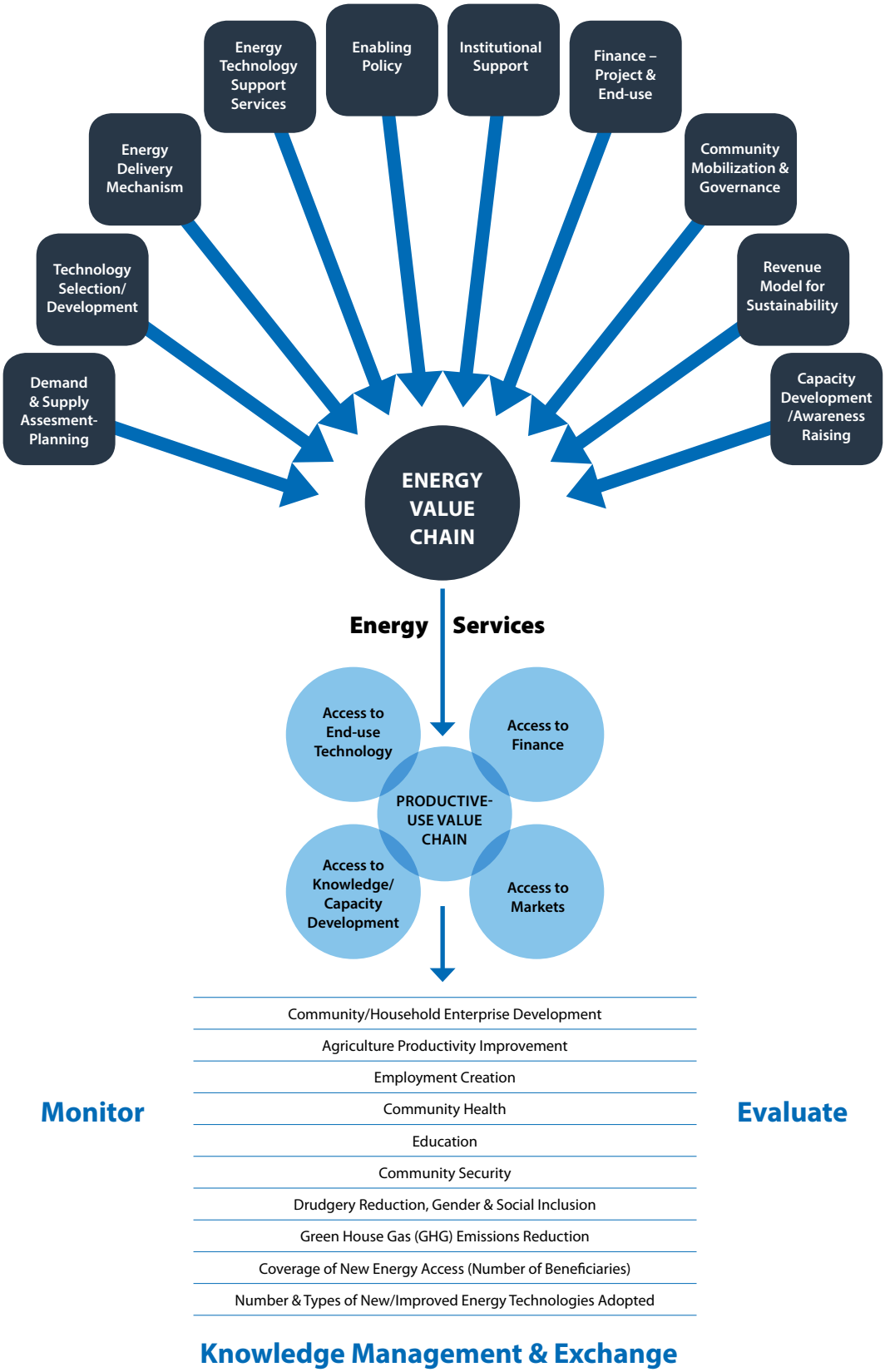
2. **Access to knowledge/capacity development.** Capacity needs assessment should include evaluating local skill sets, needed training mechanisms, design for optimal use of productive-use technologies, market potentials, and market linkages for enhanced productive uses. Appropriate capacity and entrepreneurship development programmes need to be designed and implemented.

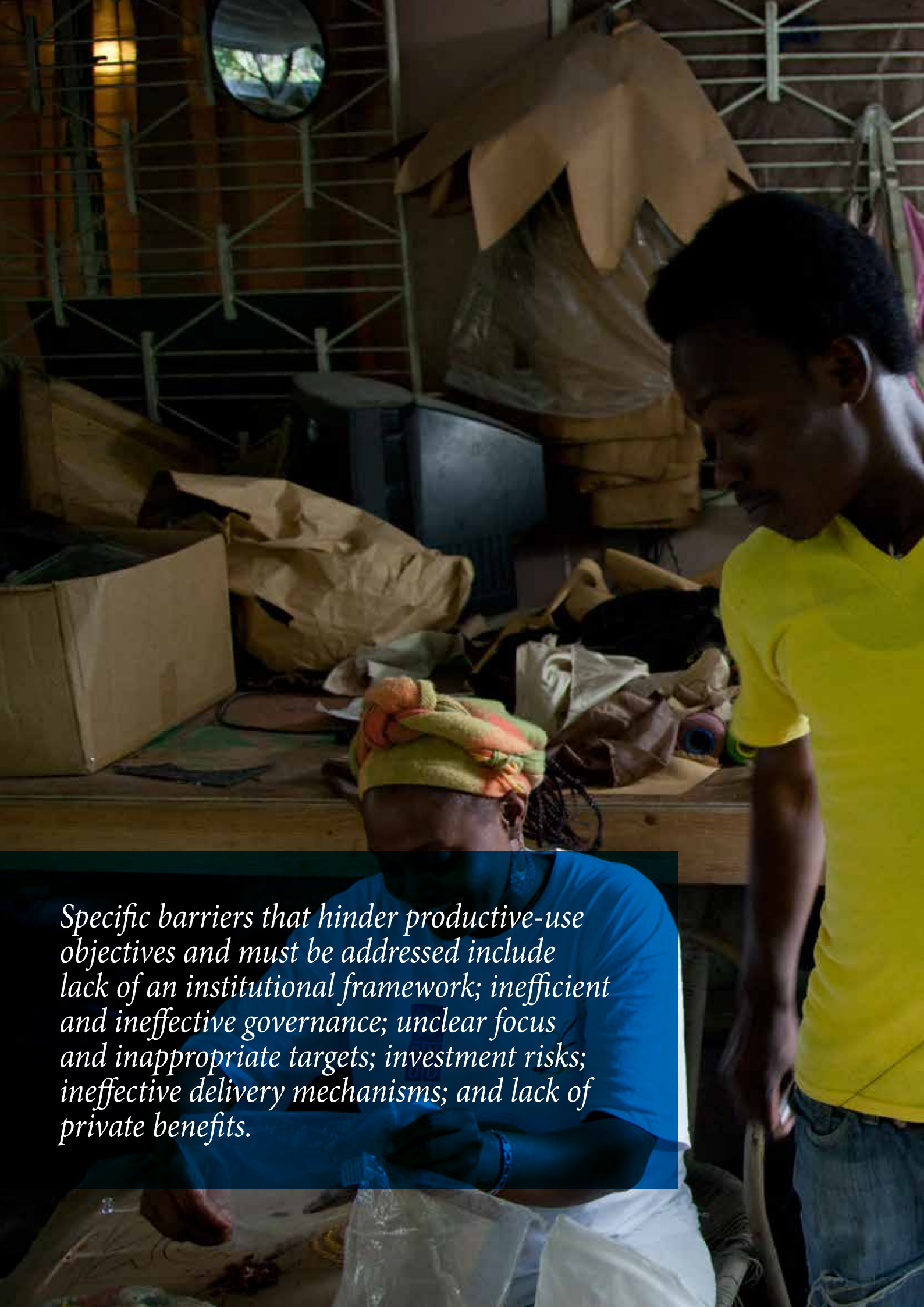
3. **Access to finance.** Provide information on sources of finance available to the producer/entrepreneur. Seek access to lending institutions (banks, microfinance institutions and cooperatives) able to invest in productive-use activities.

4. **Access to markets.** One critical need is adequate and efficient access to markets for the outputs of productive-use enterprises. Physical access with better roads, communications and transport facilities is the first link to the market. Equally important is access to markets through better-quality products, packaging and branding. A third important need is improved knowledge regarding demand potential and consumer needs. Capacity-building and skills-development programmes need to address these matters, while ensuring the availability of local market development and support institutions.

5. **Monitoring and evaluation.** Conduct impact audits to assess how productive uses have promoted and impacted livelihoods while also reducing poverty and enhancing human development. Appropriate indicators that are observable, quantifiable and reportable must be developed and used for monitoring and evaluating.

FIGURE 6 The EnergyPlus approach





Specific barriers that hinder productive-use objectives and must be addressed include lack of an institutional framework; inefficient and ineffective governance; unclear focus and inappropriate targets; investment risks; ineffective delivery mechanisms; and lack of private benefits.



COMPONENT 7: Scaling-up successes

Many initial site-implementation activities are likely to be undertaken for a limited selection of communities, and energy institutions face persistent challenges in expanding their efforts to new areas, villages or districts. What then can an EnergyPlus programme do to expand energy services and productive-use activities to other areas, and how can it help businesses from a pilot site reach new areas?

The answers to these questions lie in a review of the criteria for selecting a successful EnergyPlus programme or EnergyPlus components, and then deciding what components should be included in any given scaling-up plans.

First, it is necessary to define exactly what it is a programme plans to scale-up. Areas to engage may include:

- At the policy level, adopting lessons learned regarding institutional structures and cooperation, and identifying agencies to lead further policy reform
- Supporting new provinces or villages by maintaining political and financial commitments to allow new beneficiaries to encounter and learn from earlier activities
- For businesses, refining energy service delivery models to achieve financial independence, with an emphasis on highlighting and promoting successful business innovations

With this in mind, a number of considerations can prove useful in structuring a scale-up plan.

CRITERIA FOR SELECTING AND REFINING A SCALE-UP MODEL

The transition from a small set of project sites to a large number of similar projects is not simple. The process often begins by selecting successful projects or aspects of a programme, and it is important to select sample projects that have succeeded in more than one location and affected a sufficiently large population.

Ideally, an EnergyPlus programme can draw these successes together into a 'packaged solution' that amalgamates local renewable energy resources, modern technologies, productive-use applications, enabling policies, efficient local institutions and inclusive business models.

Inevitably, however, the nature of given sites varies, and replicability may be inhibited by differences in resource potential; market access; access to microfinance, costing and pricing; economies of scale; entrepreneurship skills; access to trained human resources; market potential; and local willingness to participate.

Challenges posed by this kind of variation can be overcome through a robust selection process for those successes proposed for scaling-up. Effective selection criteria for successful models include:

- **Resource efficiency.** Use robust and mature technologies
- **Demand.** Adopt affordable energy services for low-income households and potential enterprises

Large-scale EnergyPlus scale-ups need a robust implementation mechanism that aims to achieve time-bound targets and overcome various challenges.

- **Operability.** Have the capacity to meet users' total energy needs, including productive uses
- **Sustainability.** Demonstrate proven longevity with well-documented lessons learned
- **Financial viability.** Demonstrate a sufficient degree of financial independence and equitability
- **Governance.** Achieve political support and align with local or national priorities

Scaling-up also depends on the size, location, scale and scope of the project. Infrastructure for heavy energy systems such as mini-hydro or off-grid solar PV require scale-up efforts to focus on government support and financing. Scaling-up of energy products such as solar home lighting systems and lamps, on the other hand, can be better stimulated by promoting business innovation and creating enabling market/policy environments.

Barriers to successful scaling-up

Experience suggests that most energy access projects fail because of certain specific barriers. Challenges arise, for example, because of inadequate regulatory policies, institutional inefficiency, a lack of large-scale finance, unclear objectives or poor delivery mechanisms. Additionally, since EnergyPlus projects go beyond simple energy access to place equal emphasis on productive uses for achieving human development, it is equally important to address barriers that hinder these productive-use objectives. Specific barriers to consider include:

- **Lack of institutional framework.** Institutions able to operate on national and local levels are essential to implement, manage, coordinate and monitor government policies and programmes. Surprisingly, many countries lack competent institutions that can provide this kind of leadership for energy access and productive use.
- **Inefficient and ineffective governance.** Bureaucratic inefficiencies typically result in delayed approvals and release of funds, ineffective monitoring, favouritism and low-quality outputs. Such inefficiencies lead to poor motivation among people involved in implementation and typically overshadow the social and economic objectives of a programme.
- **Misdirected focus and targets.** Many government energy access programmes have been unsuccessful because they lacked clear focus and appropriate targets. For example, technology-focused programmes that promote solar PV or improved cookstoves have dissemination as their primary objective and measure success by number of units deployed or capacity installed, without assessing viability, service quality or impacts on poverty.
- **Investment risks.** Low affordability, risks of default and limited profit-making opportunities lead investors to treat these projects as risky and unviable. Finding large-scale finance or securing risk guarantees from government and donor funding or de-risking of the investment environment can be crucial to overcome this perception. Additionally, EnergyPlus programmes are designed to provide information that governments and development partners want to know, but do not help communicate with investors. Detailed reporting and monitoring of site-level project costs and operations within a programme can be transformed into accurate investment proposals that allay these fears and demonstrate investment needs and returns.

- **Ineffective delivery mechanisms.** Robust energy service models need to incorporate the entire process of energy supply, including local infrastructure, repair and maintenance, managing new connections, billing and payment collection, monitoring and reporting.

- **Lack of private benefits.** Energy access programmes tend to be successful to the extent that individual households accrue perceived and real benefits. Poor rural households need to recognize the health or time-saving benefits of shifting from free biomass to priced electricity and cooking fuels.

COMPONENTS OF A SCALE-UP PLAN

Large-scale scale-ups need a robust implementation mechanism that aims to achieve time-bound targets. Specific recommendations for designing regulatory policies, programmes, institutional structures, financing (including microfinance), multi-stakeholder partnerships, local delivery mechanisms, market development, entrepreneurship development, incentive schemes, capacity building and a prioritized set of productive energy-use opportunities can be elaborated in a scale-up plan that covers:

Institutions for programme support. Provide for the establishment of dedicated national and regional institutions for implementing programmes related to energy access.

Multi-stakeholder partnerships. These include planning and coordinating long-term commitments from governments, energy organizations/utilities, technical institutions and R&D organizations, industries, entrepreneurs, financial institutions, donor agencies and NGOs.

Capacity development framework. As discussed above, multiple stakeholders at different levels are involved in implementing EnergyPlus programmes: stakeholders at the national, regional/state and local government levels as well as from public-sector organizations, financial institutions, energy service companies (ESCOs), small-scale private-sector industries, NGOs and households. Capacity development programmes may pursue information dissemination, awareness campaigns, sensitization programmes or training programmes.

Promotion of an enabling regulatory framework. Pass energy supply regulations capable of recognizing and promoting pro-poor, user-friendly objectives:

- Applying universal service obligations to energy service providers
- Flexible and affordable connection, disconnection and reconnection policies
- Provision for establishing distributed energy generation systems and flexible access to the grid for local institutions
- Enabling the creation of dedicated energy access funds to support programme implementation
- Providing tax incentives for establishing off-grid and micro-grid power generation systems
- Supporting capacity development through education, training and awareness programmes

Dedicated energy access funds or other financing solutions. Achieving the necessary financial support for programme implementation can be crucial. Energy access finance could channel contributions from national budgets, government grants, transferred energy subsidies, and multilateral agencies and donors into single, targeted energy access funds.

Processes for fostering expansion of energy service companies. Highlight and build on processes, models and innovations that allow successful energy services to expand, as well as new services to emerge and replicate these innovations.

Social entrepreneurship development. No single key presents itself for helping or motivating rural households to take up income-generating activities. However, creating a large pool of educated entrepreneurs who are concerned about for-profit yet socially responsible business is one resource that can be useful in promoting rural businesses on a large scale. These entrepreneurs will only emerge with dedicated support, and it is important to pursue channels that help them to establish and sustain businesses that support the poor.

KEY RESOURCES

Guidance Note: Scaling up Development Programmes provides an overview of scaling-up activities[51]

From Gap to Opportunity: Business Models for Scaling-Up Energy Access discusses opportunities for making a profitable business of extending energy access to the poor[52]

National Programme for Renewable Energy Sources-Based Integrated Rural Development: National Scaling-Up offers a good practical example of scaling-up renewable energy-based rural development model at national level[53]

[51] Available at: http://www.undp.org/content/dam/undp/library/Poverty%20Reduction/Participatory%20Local%20Development/ScalingUP_guidancenote(Jan2013)_web.pdf.

[52] Available at: http://www.ifc.org/wps/wcm/connect/ca9c22004b5d0f098d-82cfbbd578891b/EnergyAccessReport.pdf?MOD=AJPERES.

[53] Available at: http://europeandcis.undp.org/uploads/public1/files/vulnerability/Senior%20Economist%20Web%20site/Final_Draft_-_National_Program_for_RES_based_Rural_Development.pdf.

Government and non-government stakeholders need to be able to analyze various policy options and choose the most appropriate options for achieving declared energy access objectives.

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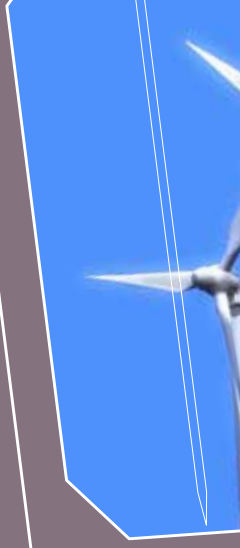

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