Energy Plus Approach: Myanmar Case Study

Country report 2015

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Final Version
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URBAN AND PERI-URBAN ENERGY ACCESS IN MYANMAR:

KNOWLEDGE AND OUTREACH

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by

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Asian Institute of Technology

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August 2015
Executive Summary

Energy is a prerequisite for economic, environmental and social development, making it even more important for people to be able to use clean, modern and affordable forms of energy. In the Asia Pacific region, about 800 million people lack access to electricity and about 2 billion people rely on biomass for cooking. The majority of these people live in rural areas, and globally a large number of well documented studies have been directed towards addressing energy access for rural populations. However, there are non-negligible populations residing in the urban and peri-urban areas who are still deprived of modern sources of energy, for which there are only a very few studies. This study therefore focuses on determining the energy-use pattern of the urban and peri-urban populations of Myanmar, their degree of access to modern energy and related issues. Specifically, it aims to understand their modern energy usage in relation to productive use and to identify policies for improved energy access to the poor.

Myanmar is a developing country in which a third of the total population are below the poverty line. The electrification rate in Myanmar was only 26% in 2011. Though Myanmar has achieved notable progress in achieving the Millennium Development Goals in the areas of food poverty, under-five mortality, maternal mortality and sanitation, there is much room for progress in energy-related aspects. Per capita electricity consumption is among the lowest in the world, signifying poor economic and industrial development. So far, no active policies have been introduced to improve energy access to the urban poor, nor policies promoting energy efficiency and conservation.

The study undertook assessments of the energy access of peri-urban households in Yangon through a household survey conducted in one of the city’s peri-urban areas, Shwe Pyi Thar Township. The survey aimed to understand socio-economic impact, patterns and barriers in relation to access to modern energy. To study the impact of modern forms of energy access on the economy, small enterprises were surveyed from Shwe Pyi Thar Township and East Dagon Township. Comparative analysis of the impact of modern forms of energy access on income generation, working hours and other social aspects of the two townships was also carried out.

The household survey in Shwe Pyi Thar Township showed significant rates of electricity access (81%). However, there are also illegal connections, and supply is irregular. In contrast to electricity access, the majority of the population is still dependent on biomass
(firewood and charcoal) for cooking. Negligible proportions of the population use LPG, and only as a secondary fuel. The primary reason for this is the cost of the fuel and the lack of awareness among its users about the adverse impacts of traditional fuels on their health and of the environmental and safety concerns.

Myanmar’s energy plans and policies involve increasing the generation of electricity, oil and gas to meet current demand. Recently, a National Energy Committee has been constituted, which has come up with a nine-point National Energy Policy. Though one of the points is about the promotion of renewable energy, there are no specific policies for increasing energy access to the poor, especially the urban poor.

The study also identified the barriers (policy, institutional, financial, physical, awareness) to increasing energy access:

- A number of ministries and departments are involved in planning and policy-making regarding energy-related issues that complicate the framework, not with a focus on energy access.
- High upfront costs and the associated costs of the modern energy services (electricity connection and LPG) limit access to modern, reliable and efficient sources of energy for the poor.
- The physical location and situation of the slums, which are usually narrow and crowded, hampers the installation, distribution and monitoring of modern energy infrastructures and resources.
- The lack of awareness about the benefits of modern sources of energy and the adverse impacts of traditional forms of energy on health and the environment act as one of the major barriers towards the acceptability of modern energy sources.

The study proposed some potential measures to overcome these barriers, using best practices and success stories from other countries which could be adopted in Myanmar.

GNESD activities were promoted and conducted through sponsorship and participation in an international conference and in the workshop held at Yangon.
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<tr>
<th>Abbreviation</th>
<th>Full Form</th>
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<tbody>
<tr>
<td>ADB</td>
<td>Asian Development Bank</td>
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<tr>
<td>AIT</td>
<td>Asian Institute of Technology</td>
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<tr>
<td>CNG</td>
<td>Compressed Natural Gas</td>
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<td>CODI</td>
<td>Community Organization Development Institute</td>
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<td>EDI</td>
<td>Energy Development Index</td>
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<td>EMD</td>
<td>Energy Management Committee</td>
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<td>EPC</td>
<td>Electrical Power Center</td>
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<td>EPD</td>
<td>Energy Planning Department</td>
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<td>GACC</td>
<td>Global Alliance for Clean Cookstoves</td>
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<td>GDP</td>
<td>Gross Domestic Product</td>
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<td>GNESD</td>
<td>Global Network on Energy for Sustainable Development</td>
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<tr>
<td>HH</td>
<td>Households</td>
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<tr>
<td>ID</td>
<td>Identification</td>
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<td>ICUE</td>
<td>International Conference and Utility Exhibition</td>
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<td>JICA</td>
<td>Japan International Cooperation Agency</td>
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<tr>
<td>LPG</td>
<td>Liquefied Petroleum Gas</td>
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<td>MDG</td>
<td>Millennium Development Goals</td>
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<td>MES</td>
<td>Myanmar Engineering Society</td>
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<td>MMK</td>
<td>Myanmar Kyats</td>
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<td>MOE</td>
<td>Ministry of Energy</td>
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<td>MOEP</td>
<td>Ministry of Electric Power</td>
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<td>MEPE</td>
<td>Myanmar Electric Power Enterprise</td>
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<td>MHT</td>
<td>Mahila Housing SEWA Trust</td>
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<td>MOGE</td>
<td>Myanmar Oil and Gas Enterprise</td>
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<td>MPCE</td>
<td>Myanmar Petro Chemical Enterprise</td>
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<tr>
<td>Acronym</td>
<td>Full Form</td>
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<tr>
<td>NGO</td>
<td>Non-Governmental Organization</td>
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<tr>
<td>NHA</td>
<td>National Housing Authority</td>
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<tr>
<td>UNDP</td>
<td>United Nations Development Program</td>
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<tr>
<td>UNEP</td>
<td>United Nations Environment Program</td>
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<tr>
<td>UNHABITAT</td>
<td>United Nations Agency for Human Settlement</td>
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<tr>
<td>UPEA</td>
<td>Urban and Peri-Urban Energy Access</td>
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<tr>
<td>WEF</td>
<td>World Economic Forum</td>
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<tr>
<td>WHO</td>
<td>World Health Organization</td>
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<tr>
<td>YCDC</td>
<td>Yangon City Development Committee</td>
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<tr>
<td>YESB</td>
<td>Yangon Electricity Service Board</td>
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1. Introduction

1.1 Background

Access to modern forms of energy is a prerequisite for poverty reduction and economic and human development. About a quarter of the world’s population still lack access to electricity, and 85% of these populations live in rural and peri-urban areas (Dervedet and Caubet, 2007). In the Asia Pacific region, about 800 million people lack access to electricity, and about 2 billion people rely on the use of biomass for cooking (UNDP, 2011). These people are vulnerable to the health and environmental risks caused by indoor air pollution, as they are exposed to the smoke caused by the inefficient burning of solid fuels such as unprocessed biomass, coal or charcoal. Annually about four million people die prematurely from illnesses attributed to household air pollution from cooking with solid fuels (UNDP, 2011).

Access to energy has profound implications for many development targets: achieving educational targets, improving health and living conditions, mainstreaming gender equality, and eradicating extreme poverty. However, a “minimalist approach” focusing mostly on the basic energy needs of the poor does not necessarily reduce poverty. An effective combination of improved energy services with measures that generate cash incomes or improve livelihoods (Energy Plus Approach) is necessary to break the energy–poverty cycle (UNDP, 2011).

Several studies have emphasized the importance of energy services in achieving the Millennium Development Goals (MDG) and reducing poverty, particularly in developing countries (DFID, 2002; Millennium Project, 2005; IEA, 2010). Furthermore, with the implementation of the Sustainable Development Goals (SDGs) from 2016 to 2030, energy access will be given more importance. Much of the research on energy and poverty has been focused mainly in the rural and remote areas where most of the poor live (Mercy Corps, 2011; UNDP, 2004). However, significant numbers of poor reside in urban and peri-urban areas as well, where not many such studies have been carried out, meaning that the situation on the ground is unclear. This is also the situation in Myanmar.

Myanmar is ranked 149th in the Human Development Index (UNDP, 2013) and has been listed as one of the poorest countries of the world, with a third of its people being below the poverty line. Unlike many countries, the energy access situation in Myanmar is similar in both urban and rural communities. Although Myanmar has made some notable progress in
achieving its Millennium Development Goals (MDG) in areas such as the food poverty incidence, the under-five mortality rate, the maternal mortality rate and sanitation, there is still room for progress to reach the targets for 2015 (ADB, 2012). Myanmar also has one of the lowest Energy Development Indexes (EDI) in the world, which gives an overall picture of the country’s poor energy infrastructure development.¹

One of ten Association of Southeast Asian Nations (ASEAN) nations, Myanmar held the rotating chairmanship of the group in 2014 – a first in its seventeen-year membership. Once known as Asia’s rice bowl, the UNDP (2011) found that in 2010, 24% of the Myanmar population was landless and 25% lived in poverty.

1.2 Energy scenario in Myanmar

The electrification rate in Myanmar in 2011 was 26%, three out of four people still not having access to electricity (Shan Herald, 2012). The country’s national grid connects the country’s major power stations, consisting of twenty major hydropower plants, one coal-fired plant and ten gas-fired plants, and it distributes electricity to users (Zaw. 2008). The total power generated by Myanmar’s national grid in 2012 was 10,800 GWh, a 58% increase from 2009. Yet generation is 30% below demand (Sharma, 2013). Technical and non-technical loss in the transmission and distribution system is one of the reasons that demand is not being met. This is mainly due to the low voltage and antiquated nature of the equipment (ADB, 2012). In 2010, such losses were estimated to be around 26%, down from 30% in 2003. However, it is the unauthorized use of electricity that accounts for the major share of electricity loss. Similarly, natural gas is inadequate to fulfill demand. Myanmar’s natural gas reserves amount to 7.8 trillion cubic feet and are a significant source of national revenue (ADB, 2013).

The primary fuel for cooking in Myanmar is biomass. Till 2009, firewood alone accounted for 70% of the total primary supply of fuel, and 76% of the country’s total energy is consumed by the residential sector (UNDP, 2013). This dependence occurs in both rural and urban areas, but especially among the poor. Of the total urban population, 88% still use

¹ EDI is a composite index that provides an overall picture of the country’s energy development, based on indicators of household access to electricity and clean cooking facilities and the use of modern energy for productive purposes (such as mechanical power) and public services (such as schools and hospitals) (OECD/IEA, 2012).
solid fuels for cooking (GACC, 2013) due to the fact that this fuel is cheap, as forest occupies about half (50.8%) of the country’s land area (Kyau et al., 2009).

1.3 The “Energy Plus“ Approach

Providing energy services in combination with capacity development and productive uses of energy for income generation can improve household living standards and increase the capacity to pay for energy services. This ‘Energy Plus’ approach can be used to break the energy–poverty cycle by introducing improved energy services that generate cash incomes and improve livelihoods. This is in contrast to the energy access programs that have proceeded from a ‘minimalist’ approach, which focus only on the basic energy needs of the poor and provide few opportunities to increase their incomes (UNDP, 2011).

1.4 Rationale of the study

Myanmar has recently embarked on political and economic reform, and increased energy access and more reliable energy are key priorities (Myanmar Times, 2013). The strategic interests of several countries in this process have emerged, and several prospects for development cooperation with donors, development banks and private investors have opened up. Since developing countries are undergoing rapid change from rural to urban-based economies, now is the right time to discuss the strategies and approaches needed that would facilitate the country’s transition to green growth and development through reduced poverty and urban access to sustainable energy.

The urban and peri-urban populations of Myanmar do not have full access to modern forms of energy. Yangon and Mandalay, the two largest cities in Myanmar, have average electrification rates of 67% and 31% respectively (WEF, 2013), mostly benefiting medium- and high-income households. Despite being so close to modern energy infrastructure, where grid extension and other modern energy sources would be easy and less costly, many urban and peri-urban areas do not have access to all forms of modern energy services. Data on the energy situation in peri-urban areas is also scarce.

Though both the urban and rural poor have limited access to modern forms of energy, the urban poor are involved in more energy-intensive activities when compared to
their rural counterparts (Karekezi et al., 2008). Both households and enterprises use energy for lighting, cooking, running a grocery shop, carpentry, mills and other income-generating activities. Therefore, it is important to find the links with and impacts of energy access in relation to such economic activities.

Thus, this study assesses the status of energy access in peri-urban Myanmar, reviews its energy-poverty linkages, and reviews questions of physical access to technology and other socio-economic outcomes, such as productive uses of energy and other co-benefits.

1.5 Objectives of the study

The overall objective of the study was to assess the energy access situation in urban Myanmar, and to evaluate its energy access program using an ‘Energy Plus’ framework, with a special focus on the productive usage of energy and other benefits.

Specific Objectives

1. To conduct an analysis of urban and peri-urban energy access status in Yangon, Myanmar.
2. To understand and evaluate the linkages and impacts of modern energy access on local economics mainly through the analysis of productive uses of energy.
3. To identify and develop policies, strategies and plans for modern energy access.
4. To foster potential cooperation and the exchange of knowledge and best practices.
5. To facilitate the outreach of the Global Network on Energy for Sustainable Development (GNESD).

1.6 Report structure

This report is organized as follows:

The second section introduces the study area in terms of its geographical location and demographic profile, and presents details of the urban poor. The detailed methodology used in the study is also presented.

The third section presents observations from household and enterprise surveys. It highlights the existing conditions of energy access among the urban poor, along with productive use in their enterprises. It also identifies the barriers to modern energy access for the urban poor.
The fourth section reviews key plans, policies and programs for the urban poor and evaluates whether they adequately address energy access for this population group. Strategies and examples of successful programs in Thailand that have led to increases in access to modern energy for the urban poor are also discussed in this section.

The fifth section provides conclusions and compiles barrier-specific recommendations, i.e. successful policies and initiatives, from all over the world that have supported or enabled energy access for the urban poor.
2. Methodology

The study aimed to assess key issues related to energy access in urban and peri-urban areas of Myanmar. The study mainly focused on the level of access to clean and modern forms of energy for the urban and peri-urban populations. For this, a household and enterprise survey was conducted in Yangon city.

2.1 Location and demographic profile

Yangon (Figure 1) is the largest city of Myanmar, with a total area of 598.8 sq. km. The population of Yangon is around 5 million which is triple the size of the country’s second largest city, Mandalay. Yangon has seen rapid population growth in the past decade from about 2.47 million in 1998 to 5.14 million in 2011. Average population growth in the central business area and center of the city is almost zero or negative, but there has been a 6.7% growth rate in suburban areas (JICA, 2013).

Yangon was Myanmar’s political capital until the government moved its capital to Nay Pyi Taw, 335 kilometers north of Yangon, in 2005. Yangon is governed by the Yangon City Development Committee (YCDC), which was formed under the provisions of the Yangon City Development Law of 14 May 1990 (Phu, 2012). The city has four districts (Eastern, Western, Northern, Southern) comprising 33 townships. Yangon is considered the economic center of Myanmar, as it accounts for approximately 22% of the country’s GDP (Interim Country Strategy, Myanmar, 2013).

45.6% of the urban population in Myanmar lives in slums (UNHABITAT, 2013). UNHABITAT has identified 65 poor urban areas of Yangon, and around 40% of the total population of Yangon has been identified as poor and very poor, lacking full access to basic facilities (Phu, 2012). Rapid urbanization and development in Yangon is an important pull factor for people residing in the rural areas to migrate to Yangon, causing stress on the existing infrastructure and resources. Figure 2 shows squatters’ tents near Shwe Lin Ban industrial zone in Shwe Pyi Thar Township in Yangon.
The study area includes Shwe Pyi Thar Township (Figure 3) in Yangon City. This township has industrial zones with dense populations, illegal settlements, poor energy access status compared to other townships, but also the potential for future urban development. The total population of Shwe Pyi Thar is 223,445 (YCDC, 2014).

(Source: ELEVEN, 2014)
2.2 Information collection and compilation

Building upon the approaches of GNESD’s earlier study on Urban and Peri-Urban Energy Access (UPEA), this study focuses on the energy access status and the applications of energy for lighting, cooking and productive uses. The study was conducted as follows.

2.2.1 Review of literature

A review of relevant literature was carried out using data and information from government offices, official statistics, reports and publications. This literature was mainly referred to obtain background information and to understand the status of energy access and its impact on productive uses and poverty alleviation. Information about the policies and plans of the government was obtained mainly from the published reports of the Ministry of Energy, UNDP and JICA.
Information from the literature has been used throughout the report. For example, the current scenario of energy access in Myanmar was discussed earlier, while information about the barriers to energy access and plans and policies regarding energy access are discussed later.

2.2.2 Data collection

The survey of the urban poor was conducted in Shwe Pyi Thar Township adjoining Yangon. 150 households and 70 enterprises were surveyed (in Shwe Pyi Thar and East Dagon) during the periods from December 2013 to January 2014 and from May 2014 to July 2014. Shwe Pyi Thar Township was specifically selected for the survey as it has a dense population, illegal settlements and industrial zones. A questionnaire survey, formal and informal interviews and direct observation were used for data collection.

The questionnaires were designed separately for households and enterprises (Annexes 1 and 2). Both standardized and checklist-based questions were used. Information about the respondent’s monthly income, occupation, type of housing unit, energy used for lighting and cooking, monthly expenditure on the fuels they use, problems faced, barriers to clean energy access etc. were the key points of the survey. Questionnaires in Burmese were also used for the ease and convenience of the respondents and were later translated.

Random sampling was used to identify households and enterprises to avoid any bias that might have arisen when individual households or enterprises were considered as a sample. Respondents above 18 years of age were selected.

Data on energy usage patterns, fuel preferences, the reasons behind them and the use of energy for income-generating activities among the urban poor were not available in the literature. Thus, the survey was conducted to gather all the relevant information about energy access to the urban poor along with productive uses of energy.

Limitations

The respondents were reluctant to share information about their incomes and expenses. As many respondents worked as daily wage workers, their monthly income was not regular or consistent. The assessment overcame this hurdle by asking respondents to estimate the previous month’s income and expenses on fuel consumption.
2.2.3 Facilitation workshop with key stakeholders

As a part of stakeholders’ engagement, a workshop with key stakeholders (e.g. government agencies, utility providers, representatives of national and international organizations and academia.) was held to discuss energy access issues and develop innovative approaches for improved energy access. The workshop was jointly conducted with the Myanmar Engineering Society (MES) and the Myanmar Peace Center (MPC). The objectives of the workshop were:

- To provide details of work done on energy access in Myanmar.
- To obtain feedback from relevant stakeholders on:
  - Updating the status of energy access (modern energy) to the urban poor in Myanmar
  - Barriers to improving energy access to the urban poor
  - Measures to address the barriers to improved energy access
- To obtain information on policies to improve energy access to the urban poor.
- To be an outreach activity for GNESD.

2.2.4 Outreach

As an outreach activity under the project, a poster presentation and a special session of GNESD was held at the International Conference and Utility Exhibition (ICUE) held on 19-21 March, 2014 in Pattaya, Thailand. Presentations made by Mr Emmanuel Ackom and Ms Xiao Wang regarding the activities of GNESD are provided in Annex 4.

The workshop conducted at Yangon provided another opportunity to present the activities of GNESD. Details of these were presented in the workshop report (Kumar et al., 2014).
3. Survey results and energy access: discussion

As explained in Chapter 2, members of 150 random households from Shwe Pyi Thar Township were interviewed to obtain household energy access data, and personnel from seventy enterprises were interviewed to gather data regarding energy access and its impact on income generation and other benefits. Based on the household and enterprise survey, both qualitative and quantitative analysis of the data was carried out, the results being presented in the following sections.

3.1. Results of the household survey

This section explains the findings from the 150 household surveys. The findings describe economic status, awareness about fuel use, type of fuel use, etc. in the households surveyed representing the urban poor.

3.1.1. Socioeconomic characteristics of the urban poor

The following subsection explains the socio-economic characteristics of the urban poor of Shwe Pyi Thar Township.

3.1.1.1. Age, gender and education of the respondents

Around two thirds of the respondents of the surveyed households (150) were male i.e., 91, of which the majority were in the 41-60 age group. Table 1 presents the age group of the respondents.

<table>
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<tr>
<th>Respondent’s Age</th>
<th>Total</th>
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<td>≤ 20</td>
<td>2</td>
</tr>
<tr>
<td>21-40</td>
<td>56</td>
</tr>
<tr>
<td>41-60</td>
<td>70</td>
</tr>
<tr>
<td>61-80</td>
<td>19</td>
</tr>
<tr>
<td>&gt;80</td>
<td>3</td>
</tr>
</tbody>
</table>

Table 1: The profile of the respondent’s age

Table 2 presents the level of education of the respondents, which clearly shows that more than 80% of the respondents have attended high school.

3.1.1.2. Occupation and income

The people living in informal settlements are usually the lower-income working class, mostly engaged in agriculture or casual labor (Interim Country Report, 2012-2014). This was also observed in the slums of Shwe Pyi Thar Township, where about a third of the population
Table 2: Level of education of the surveyed households

<table>
<thead>
<tr>
<th>Level of Education</th>
<th>Number</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary School</td>
<td>49</td>
<td>32.7</td>
</tr>
<tr>
<td>Secondary School</td>
<td>49</td>
<td>32.7</td>
</tr>
<tr>
<td>High School</td>
<td>25</td>
<td>16.7</td>
</tr>
<tr>
<td>College</td>
<td>27</td>
<td>18</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>150</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

earned their livings as vendors (grocery shops, stores etc.). Around 27% are daily wage laborers, who worked as construction workers, painters, carpenters or in industries. 18% of the population worked as car/taxi drivers and tricyclers, and the remaining population (20%) worked as technicians, security guards, fishermen, in government services etc. Figure 4 presents the occupations of the respondents in Shwe Pyi Thar Township.

![Figure 4: The percentage of the occupations of the respondents](image)

According to JICA (2012), households can be divided into groups based on their incomes. Group I consists of households with an average monthly income of less than 100,001 MMK\(^2\) that are classified as low-income households, while groups II and III consist of households with average monthly incomes from 100,001-150,000 MMK and 150,001-200,000 MMK respectively, and are classified as a middle-income households. Households

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\(^2\) Exchange rate: 1 USD= 963.001 Burmese Kyat [May 6, 2014].
with average monthly incomes of more than 200,000 MMK are high-income households. Based on the JICA classifications, the incomes of the households surveyed have been tabulated in Table 3.

Table 3: Monthly income of the surveyed households

<table>
<thead>
<tr>
<th>Monthly Household Income (MMK)</th>
<th>Average Monthly Household Income (MMK)</th>
<th>Total Number of Households</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤100,000</td>
<td>88,913</td>
<td>46</td>
<td>30.7</td>
</tr>
<tr>
<td>100,001-200,000</td>
<td>164,480</td>
<td>77</td>
<td>51.3</td>
</tr>
<tr>
<td>&gt;200,000</td>
<td>312,962</td>
<td>27</td>
<td>18</td>
</tr>
</tbody>
</table>

A majority of the households fall into the low- and middle-income categories and, according to the respondents, their monthly incomes are just sufficient to fulfill their basic needs.

3.1.1.3. Housing Ownership and Housing Type

More than two thirds of the slum dwellers own their houses, while about 17% live on rented land and about 7% live in an illegal settlement, that is, on government land or private land. These working for the government are given accommodation by the government and can reside on land owned by the Yangon City Development Committee (YCDC), as shown in Figure 5

Figure 5: Housing ownerships of the surveyed households

The majority of those living in the slums are in the low-income category, and most of the slum dwellers were observed to reside in very crowded areas. As shown in Figure 6, a
The majority of the houses are built from bamboo and wood, and the roofs are made of nipa palm, which is locally available and relatively cheaper than bricks and zinc sheets. Only 7% of the total surveyed houses were found to be built of bricks with zinc roofs. Figure 7 shows wooden and bamboo houses in the surveyed area.

3.1.2. Access to electricity

3.1.2.1. Household access to electricity

In spite of the urban setting, it was observed that 18.7% of households in Shwe Pyi Thar Township did not have access to electricity. The reasons behind this were the high upfront costs, the lack of documents like housing registration grant cards or identity cards, and the lack of a letter from the ward office to apply for electricity connection by the Electric Power Center (EPC) under the Yangon Electricity Service Board (YESB), given that they tend to be illegal slum dwellers.
The current electricity tariff in Myanmar is such that the price is constant at 35 kyat (less than US$0.04) per unit for households using under 100 units (kilowatt hours) per month. It increases to 40 kyat per unit for those using between 101 and 200 units a month, and to 50 kyat for those using more than 200 units a month.

3.1.2.2. Electricity connection status

Of the households with access to electricity, almost all of them obtained it legally from the utility company (98%) and only few (2%) obtained it illegally by tapping electricity before it reaches the meter box in a neighbor’s home. The initial connection fee for a legal connection through EPC varied from between 100,000 MMK and 300,000 MMK depending on distance from the grid. The connection used was three phase meter. Compared to the legal connection, connection through neighbors cost around 15,000 to 20,000 MMK, which was comparatively cheap. Connection through EPC involved using a metered system, and users paid 35 MMK per unit up to 100 units per unit for power consumption, whereas users of illegal connections paid a fixed amount of 7,000 MMK a month for lighting and watching television to their neighbors. Table 4 lists electricity tariffs in Myanmar and the consumption patterns of the households surveyed.

Table 4: Electricity tariffs and consumption patterns in the households surveyed

<table>
<thead>
<tr>
<th>Unit Consumption (kWh)</th>
<th>Cost per Unit (MMK)</th>
<th>Percentage of Households’ Consumption (%)</th>
<th>Surveyed Electricity</th>
<th>Average Monthly Electricity Consumption per Household (kWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤100</td>
<td>35</td>
<td>28.3</td>
<td>91</td>
<td></td>
</tr>
<tr>
<td>100-200</td>
<td>40</td>
<td>70.8</td>
<td>130</td>
<td></td>
</tr>
<tr>
<td>&gt;200</td>
<td>50</td>
<td>0.8</td>
<td>228</td>
<td></td>
</tr>
</tbody>
</table>

3.1.2.3. Source of lighting in households without electricity

Households without access to electricity were found to use candles (11%) and LED light (3W) powered by a battery (4 Ah, 6V) as a source of lighting (Figure 8). On average,

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households used the system for six hours a day. According to these respondents, the system was supplied to them for free by an unidentified NGO. A local battery-charging service provider collects the battery every morning for charging and delivers it to the users in the evening. For this service, the users are charged 100 MMK per day.

Using the system for six hours daily would consume less than 1 kWh of electricity per month. If these households were connected to the grid and consumed the same amount of electricity, they would pay 35 MMK per month. However, their current monthly expenditure for charging the battery is about 3000 MMK. This way, they were spending significantly more each month due to lack of access to grid electricity.

3.1.2.4. Secondary fuel for lighting

The survey found that households with electricity access also used candles and batteries as secondary energy sources for lighting. These were mostly used during blackouts and brown-outs. As electricity generation in Myanmar is dependent on hydropower, there is a problem with the regular supply of electricity, especially during the dry season. Residents reported that the electricity supply was unreliable and, during the period of survey, they suffered load shedding up to six hours a day. However, sometimes load shedding lasted for up to twelve hours or even more. As shown in Figure 9, during load shedding, 21% of households preferred to use candles, 71% used LED charge lights and 1% used generators. The remaining 7% used batteries for lighting as well as watching television.

Figure 8: Battery powered LED light used in a household in Shwe Pyi Thar Township
(Source: Field Survey, 2014)
3.1.2.5. Electrical appliance ownership

The survey indicated that households with access to electricity owned basic electrical appliances like televisions, fans, rice cookers and electric kettles, implying that electricity is used for daily activities such as entertainment, comfort and cooking. The use of appliances such as washing machines, refrigerators, computers, etc. was minimal. Table 5 presents the electrical appliance ownership of the households surveyed in Shwe Pyi Thar Township.

Table 5: Electrical appliance ownership of the households surveyed in Shwe Pyi Thar Township

<table>
<thead>
<tr>
<th>Electrical appliance ownership</th>
<th>Percentage of households (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Television</td>
<td>80.7</td>
</tr>
<tr>
<td>Video player</td>
<td>79.3</td>
</tr>
<tr>
<td>Fan</td>
<td>76</td>
</tr>
<tr>
<td>Electric kettle</td>
<td>70.7</td>
</tr>
<tr>
<td>Electric oven</td>
<td>73.3</td>
</tr>
<tr>
<td>Electric rice cooker</td>
<td>79.3</td>
</tr>
<tr>
<td>Refrigerator</td>
<td>8</td>
</tr>
<tr>
<td>Electric iron</td>
<td>79.7</td>
</tr>
<tr>
<td>Washing machine</td>
<td>3.3</td>
</tr>
<tr>
<td>Computer</td>
<td>2.7</td>
</tr>
</tbody>
</table>

3.1.3. Energy used for cooking

This section presents information about the type of fuel and stoves used for cooking. Factors such as the availability and affordability of fuel influence decisions on fuel use.
3.1.3.1. Cooking fuels

Figure 10 gives data on the primary fuel used by respondents for cooking. A majority of the houses that cooked food used biomass for cooking, that is, charcoal (40%) and firewood (18.7%), as the primary fuel. Around 38% of households used electricity for cooking, that is, a rice cooker or other electric appliances (Figure 11), while 3.3% did not cook at home but purchased food from shops and restaurants. It should be noted that none of the households used LPG as the primary fuel for cooking. 1% of households used LPG as a secondary fuel.

A majority of the respondents were not aware of the potential use of LPG. Those who knew seemed concerned about safety factors, such as possible fire hazards, as they lived in bamboo and wooden houses. Those using LPG as a secondary fuel used it on special occasions when they had to cook in bulk. The reason for this can be attributed to the high cost of LPG.

Among those households that use biomass as a cooking fuel, around 80% used clay stoves, whereas 20% cook outside in open fire cooking stoves (Figure 12). Significant amounts of smoke were noticed while cooking. Respondents were not very concerned about switching to cleaner technologies, as the fuel was easily accessible, and people were habituated to the traditional way of cooking and were reluctant to change. There appears to be a lack of awareness about the potential health and environmental impacts of the smoke emanating from the fuel and stoves they use.
3.1.3.2. Availability of cooking fuels

Cooking fuel was easily available in the market in Shwe Pyi Thar Township. A majority (97.3%) of households bought firewood and charcoal from the market, but 1.3% used a door-to-door service (Figure 13), and 0.7% collected it from the nearby yards and roadsides. Those who used LPG as a secondary fuel bought it from nearby LPG outlets.
3.1.3.3. Affordability of cooking fuels

Slum households in Shwe Pyi Thar Township were heavily dependent on charcoal, electricity and firewood as their primary fuel for cooking. Those people who were not able to afford LPG, electricity and charcoal relied on firewood as the cheapest source of fuel. The price they were paying for firewood was 122 MMK per kg.

Large numbers (40%) of households used charcoal as a primary source of fuel. Though charcoal was almost three times as expensive than firewood (368 MMK per kg), many people preferred to use it, as there was comparatively less smoke emission and it was easy to use. Those who used firewood still used charcoal as their secondary fuel.

The use of traditional fuels like wood and charcoal eliminated the need for expensive modern devices like LPG and electric stoves and did not add to households’ financial burdens, making them more popular than modern fuels like LPG.

LPG is the most expensive cooking fuel for the residents of Shwe Pyi Thar Township, though its price is not constant. However, the upfront costs of the LPG system are high at around 50,000 MMK. This inhibits the majority (66%) of respondents from using LPG. Other reasons include lack of awareness, safety concerns, etc. Figure 14 lists the reasons for the relatively lower popularity of LPG among the urban poor based on the survey.
3.1.4. Household energy expenses (for fuels)

The main source of fuel for lighting is electricity. Besides electricity, candles, battery-powered LED lights and generators were used as backup during load shedding and by those who do not have a grid connection. On average, electricity expenses accounted for around 3.5% of the total income of the households (this included the cost of electricity used for cooking as well) followed by batteries (3%), generators (2.5%) and candles (1.5%).

For cooking, the fuels used were mainly charcoal and firewood. Though Myanmar is well endowed in biomass, on average, households spend around 6% of their total income on firewood and charcoal. Spending almost 10% of income on energy is high for households. One of the reasons for the greater expenditure on energy could be the use of inefficient stoves and appliances.

3.2. Energy access to the enterprises of Yangon City

To determine the productive use of energy in peri-urban Yangon, samples from Shwe Pyi Thar and East Dagon townships were selected. There were about 1326 enterprises in Shwe Pyi Thar Township (YCDC, 2013), which included restaurants, small tea shops, grocery stores, salons, tailoring shops, copying shops, internet cafe, mobile service centers, battery-charging centers, electric shops, stationaries, computer shops etc. The main objective
of the enterprise survey was to establish the impact of modern forms of energy on the local economy through the analysis of productive uses of energy.

Fifty samples of enterprises from Shwe Pyi Thar were selected for a comparative analysis of productive uses with and without modern energy access using samples from East Dagon Township (with lower electricity access).

3.2.1. Types of enterprises surveyed

The selected enterprises include small tea shops, restaurants, grocery shops, salons, tailors, stationery shops, electronic shops, computer and copying shops, internet cafes, etc. Table 6 summarizes the type and number of the selected enterprise.

Table 6: Types of the surveyed enterprise

<table>
<thead>
<tr>
<th>Type of the enterprise</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Restaurants and tea shops</td>
<td>15</td>
</tr>
<tr>
<td>Tailors</td>
<td>8</td>
</tr>
<tr>
<td>Grocery stores</td>
<td>10</td>
</tr>
<tr>
<td>Salons</td>
<td>8</td>
</tr>
<tr>
<td>Computer and copying shops</td>
<td>7</td>
</tr>
<tr>
<td>Electronic shops</td>
<td>7</td>
</tr>
<tr>
<td>Others (welding, carpentry shops, stationery shops, internet café etc.)</td>
<td>15</td>
</tr>
</tbody>
</table>

Figure 15: Productive use of energy: charcoal (left) and electricity (right) used as sources of energy

(Source: Field Survey, 2014)
The survey results indicate that both men and women were equally involved in income-generating activities. Most of the men were involved in running the electronic shops, mobile repair shops, welding shops, internet cafes etc., whereas women were involved in tailoring, beauty salons, grocery shops etc. This shows that women are equally involved in income-generating activities in the slum areas of Yangon city.

3.2.2. Electricity access to the enterprises of Yangon Slums

All the enterprises in Shwe Pyi Thar Township that were surveyed had access to electricity. 98% of the enterprises had grid connection, while the remaining 2% used generators. Out of the 98% grid-connected enterprises, 76% used single phase meter and 24% three phase meter. In the case of the latter, the cost per unit of electricity is 75 MMK for up to 500 units. The consumption patterns of these enterprises are tabulated in Table 7.

By contrast, none of the enterprises in East Dagon Township had access to grid electricity. However, the grid connection poles were (currently) being installed in the township. These enterprises used community generators to supply power for their day-to-day jobs.

Table 7: Electricity consumption pattern of the enterprises surveyed in Shwe Pyi Thar Township

<table>
<thead>
<tr>
<th>Units of Electricity Consumed</th>
<th>≤100</th>
<th>100-200</th>
<th>&gt;200</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage of enterprises having Single Phase Meter (%)</td>
<td>8.20</td>
<td>28.57</td>
<td>38.78</td>
</tr>
<tr>
<td>Percentage of enterprises having Three Phase Meter (%)</td>
<td>2.04</td>
<td>12.24</td>
<td>10.20</td>
</tr>
</tbody>
</table>

3.2.3. Alternative energy used for lighting in the enterprises of Yangon

Blackouts and brown-outs are very common in Myanmar. From the survey it was found that load shedding in Yangon ranged from half an hour to five hours. The situation becomes even worse during the dry season, as much of the electricity generation in Myanmar comes from hydro-power plants. Therefore, consumers always kept a backup power system for use during power outages.
As a backup, batteries (12V, 40 Ah) were most commonly used besides diesel generators. On average, sixty liters of diesel were consumed by the enterprises per month.

3.2.4. Energy used for cooking in the enterprises of Yangon

To analyse the energy used for cooking in the enterprises, fifteen restaurants and tea shops were selected from Shwe Pyi Thar and East Dagon Township.

A majority of the enterprises in Shwe Pyi Thar Township used charcoal (18%) as a cooking fuel, followed by LPG (16%) and firewood (10%). In East Dagon Township, only charcoal and firewood were used as cooking fuel. Fuel consumption depends on the business in the particular month. Thus, respondents gave approximate monthly consumptions, which are tabulated in Table 8.

Table 8: Cooking fuel consumption pattern of the enterprises surveyed in urban Yangon

<table>
<thead>
<tr>
<th>Cooking Fuel</th>
<th>Percentage of enterprise (%)</th>
<th>Average monthly consumption (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charcoal</td>
<td>18</td>
<td>45</td>
</tr>
<tr>
<td>LPG</td>
<td>16</td>
<td>7</td>
</tr>
<tr>
<td>Firewood</td>
<td>10</td>
<td>78</td>
</tr>
</tbody>
</table>

3.2.5. Impacts of modern energy access on enterprise operations

The survey indicated that the use of modern forms of energy like electricity and LPG had a positive impact on incomes, working hours, time consumption and safety. Selected enterprises in Shwe Pyi Thar Township, where 98% of the enterprises were connected to grid and 16% use LPG, were compared with enterprises in East Dagon township where none of the enterprises was connected to grid nor used LPG in order to highlight the impacts of modern energy access.

a. Income

The monthly income of each enterprise depended upon the type of enterprise, location, demand for the products etc. The income range in Shwe Pyi Thar Township was more than that of East Dagon Township, where the source for electricity is either battery or generators and the source for cooking fuel is charcoal or firewood. About 34% of the enterprises in Shwe Pyi Thar Township had monthly incomes above 300,000 MMK, while all the enterprises surveyed in East Dagon had monthly incomes below 300,000 MMK. This
comparison of the incomes of the enterprises surveyed in Shwe Pyi Thar and East Dagon townships respectively is presented in Figure 16, and the average incomes are shown in Table 9.

![Figure 16: Monthly income of the enterprises surveyed in Shwe Pyi Thar and East Dagon Townships](image)

Table 9: Average monthly income of the enterprises surveyed in Shwe Pyi Thar and East Dagon Townships

<table>
<thead>
<tr>
<th>Income range</th>
<th>Shwe Pyi Thar township</th>
<th>East Dagon township</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Percentage of enterprise (%)</td>
<td>Average Monthly Income (MMK)</td>
</tr>
<tr>
<td>≤100,000</td>
<td>20</td>
<td>61,000</td>
</tr>
<tr>
<td>100,001-300,000</td>
<td>46</td>
<td>228,260</td>
</tr>
<tr>
<td>300,001-500,000</td>
<td>26</td>
<td>448,461</td>
</tr>
<tr>
<td>&gt;500,000</td>
<td>8</td>
<td>1,500,000</td>
</tr>
</tbody>
</table>

b. Working hours and sales

Enterprises in Shwe Pyi Thar Township were found to have longer working hours than those in East Dagon Township. Welding, carpentry shops, salons and tailoring shopkeepers responded that they were able to work till late in the evening in bright light, which has increased their productivity. Similar observations were noted with the grocery shops and stores, which could stay open till late in the evening, giving them higher sales and
income. But, in the case of East Dagon Township, grid electricity was not available, and generator and battery operating hours were limited. These were constraints for longer working hours and increased income.

c. Social impacts

According to respondents in the enterprises, electricity had a positive impact on their day-to-day lives. According to them, they have access to information and entertainment, and can charge and operate mobile phones, thus easing communication. Safety at night has also increased, reducing the threat of theft.

3.3 Barriers to modern energy access

Barriers to access to modern forms of energy include status, circumstances, mechanisms or initiatives that impede or delay the supply of and demand for energy. This section discusses the barriers to the energy access for the poor in Myanmar.

3.3.1 Barriers to electricity access

Based on the literature, workshop discussions and surveys, the following barriers were identified which need to be addressed if energy access is to be improved.

a. Illegal status of the households

Due to their illegal status, slum settlements are not subject to the formal mechanisms of service delivery. To obtain an electricity connection, applicants need to provide some legal documents such as proof of identity, housing registration card and recommendation from the ward office along with the application. If those living in informal settlements fail to provide the legal documents, the supply agency cannot provide the electricity connection. Thus informal settlements are usually deprived of legal electricity services because they cannot provide legal documents, even when they can afford to pay for the services.

From the survey, it was found that lack of legal documents was the major cause of the households not having a legal electricity connection.

b. Institutional and policy barriers

There is also the issue of policy fragmentation in the energy sector in Myanmar. Many government organizations are involved in energy and electricity planning, creating overlapping responsibilities and a confusing situation. The lack of coordination among the
sectors involved further complicates the process (UNDP, 2013). The complicated government system acts as a barrier to increased energy access.

There is no specific policy targeted at facilitating energy access to the urban poor. There is no legal and regulatory framework for energy efficiency, nor a central and dedicated organization for these activities in Myanmar (UNDP, 2013), though an energy efficiency and conservation master plan is under preparation.

c. Financial barriers

The high upfront costs of electricity connection and the use energy-efficient appliances are the main financial barriers to energy access for the urban poor. Due to their poor economic status and informal settlements, slum dwellers are not able to pay for the meters, wires and cables.

In Myanmar, although the cost of electricity per unit is 35 MMK/kWh up to 100 units, the upfront cost is around 300,000 MMK, which for many households is too high (Bodenbender et al., 2012). From the survey, it was found that the inability to pay the upfront costs was the second reason for not having a grid connection.

d. Physical barriers

For any household or enterprise to obtain a grid connection, the necessary electrical infrastructure in the form of a pole must exist within 300 ft. of the household or enterprise. During the survey, it was observed that many slum settlements were situated far from such infrastructures, as a result of which they were not eligible to apply for a legal electricity connection.

Slum settlements in urban areas are usually congested, with very low per capita space, and are also unsafe, tending to affect the installation, distribution and monitoring of electricity. Due to the lack of monitoring, rates of the unauthorized use of electricity are high.

Underdeveloped transmission lines for electricity supply represent another barrier to electricity supply. The long distances over which power is transmitted and extensive theft from the distribution system are two other issues that have exacerbated losses (ADB, 2012).

3.3.2 Barriers to LPG access

The survey results clearly indicate that although Myanmar exports natural gas to its neighboring countries, the use of LPG, even in cities, is not high. Charcoal and firewood are
much more significant sources of power. The barriers to the access and use of LPG in the Yangon slums are discussed below:

a. High cost per unit of LPG cylinders

The price of LPG cylinders fluctuates in Myanmar. Though the country is endowed with natural gas, due to the lack of suitable technology it imports gas from Thailand, Japan, China, etc. As the import tax policy changes, so does the price. In general, the initial cost of buying a 5 kg cylinder is around 20,000 MMK, and the cost of a gas stove is more than 20,000 MMK. The survey results showed that 66% of respondents said that they could not afford the upfront costs of LPG, which therefore acted as one of the major barriers to the urban poor using LPG for cooking.

b. Awareness and perception barriers

Many people are less aware of the negative impacts of the smoke generated by firewood and charcoal and are not ready to switch to the cleaner technologies. Moreover, about 23% of respondents did not have any idea about the use of LPG.

It was also found that many were not ready to desert their traditional cooking methods and leave the traditional way of cooking as they preferred the taste of food cooked over charcoal and firewood to that cooked using LPG. These fuel preferences were impeding the demand for and supply of LPG.

c. Physical barriers

The physical nature of the slums is such that they are usually congested and overcrowded, with a lack of proper ventilation. Besides, a majority of the people in Yangon slums live in wooden and bamboo houses. The risk of fire was therefore a concern for about 30% of respondents. About 6% responded that the LPG outlets were far away and that they had problems getting the cylinders refilled, whereas charcoal and wood were easily available through a door-to-door service.

3.4 Recommendations from stakeholders

The following were the important observations and recommendations made by the participants who were surveyed and the stakeholders who participated in the workshop on improving energy access in the urban areas of Myanmar:
Though policies are being formulated promoting energy efficiency and conservation, there are no specific policies related to promotion of energy access for the urban poor.

The installation costs and expenses of obtaining legal electricity connection were high for consumers.

High and fluctuating prices for LPG, fire hazards and a lack of awareness of LPG were factors impeding uptake of LPG.

The price of energy-efficient products on the market is high.

The issues related to what should be done or being done to cope with the increasing energy demand and to provide energy access to the poor were observed to be as follows:

- There is a demand for a consistent and regular power supply rather than pricing.
- There is a need for private-sector participation in all energy policies and implementation processes.
- There is a need for capacity-building at the local level.
- The production of energy equipment should be encouraged.
- Awareness programs at the local level are very important.
- Encouraging off-grid electrification would assist in promoting energy access.

### 3.5 The “Energy Plus” approach for peri-urban Yangon

In addressing energy access issues, the “Energy Plus” approach aims to use the ability of the poor to utilize energy for productive purposes. These productive uses of energy could be in handicrafts, small-scale enterprises (knitting, etc.) and other activities intended to provide additional incomes to the poor that will allow them not only to pay for accessing and using energy services but also improve their quality of life.

UNDP (2011b) provides detailed guidelines with the aid of seventeen case studies on the application of the Energy Plus approach in developing countries through a variety of energy service modalities that have been used. In order to ensure the success of this approach in Myanmar, however, a number of barriers and issues need to be addressed. Some of them have been highlighted by means of the survey results and the discussions with stakeholders relating to government policies, financing, awareness, and physical environment. The involvement of women, though not emphasized very much in the survey and discussions, has been found to be very important in promoting energy access, as energy services have potentially significant impacts on women’s lives, and they are also the principal energy users.
In the context of peri-urban energy access, the “Energy Plus” approach could be promoted by taking note of the following with regard to financing (UNDP, 2011b):

- Providing government and donor financing for energy access projects, for example, through equipment subsidies. This means that energy access should be a priority initiative for the energy ministry, and donor financing could be directed through the development banks and other development agencies and NGOs.

- Micro-financing, which has been a quite successful model in many developing countries. The cases of Bangladesh and Sri Lanka clearly indicate the potential for promoting solar home systems and other renewable energy technologies through micro-financing using the support of international institutions.

- Through the productive uses of energy, which can make energy (services) more affordable for end-users. In the enterprises survey in the two Yangon townships, it was observed that average incomes were much higher when there was access to electricity.
4. Myanmar’s energy plans and policies

Improving energy access in Myanmar has been one of the major development targets for the government of the country. Total demand for electricity almost doubled from 2000 to 2010, but its generation did not increase significantly (KPMG, 2013). The Government of Myanmar is aware that access to energy can have a huge impact on the country’s socioeconomic development. It has drawn up a national target to expand electricity supply at 8.5% per year to reach 15,000 MW by 2020 (UNDP, 2013).

Being a largely agricultural country, biomass-based fuels are currently being used as a major fuel in Myanmar. In 2011, 76% of the total primary energy supply of 14.056 MTOE was fulfilled by biomass, followed by 8% by crude oil and petroleum products, 10% by natural gas, 3% by coal and lignite and 3% by hydroelectricity (IEA, 2012). Due to the country’s rapid economic growth and structural changes in society, the household sector accounts for the largest share of energy consumption in Myanmar. The household sector consumed 10.464 MTOE of energy, about 80% of final energy consumption (IEA, 2012). Therefore, it is necessary to prioritize the residential sector in order to examine and then lower energy consumption.

To achieve the target, various plans and policies have been formulated. The following section describes the institutional framework and energy policies in Myanmar.

4.1 Institutional framework for energy policy and planning

In Myanmar, the Cabinet and National Energy Management Committee are the primary decision-making bodies on energy and environmental affairs (UNDP, 2012). Seven ministries in Myanmar are responsible for energy matters, with the Ministry of Energy (MOE) being the focal point for overall energy policy and coordination. Figure 17 shows the framework of the Ministry of Energy. The Ministry is mainly responsible for the exploration and production of crude oil and natural gas, the refining and manufacturing of petrochemicals, and the transportation and distribution of petroleum products (MOE, 2013). Besides the MOE, the Ministries of Electric Power, Mines, Forestry, Science and Technology, Education and of Co-operatives all play important roles in Myanmar’s energy policy (ERIA, 2013).
The key institutions in the overall energy sector in Myanmar and their scope are shown in Figure 18.

Figure 18: Energy sector institutions in Myanmar (Ko Ko Latt, 2015)

The Ministry of Energy focuses on the oil and gas sectors, while renewable energy development is handled by a number of ministries. It is not clear which ministries would deal explicitly with issues regarding energy access.
4.2. Energy-related plans and policies

Myanmar’s energy policy is mainly targeted towards maintaining energy independence by increasing the indigenous production of available primary energy resources through intensive exploration and development activities. Electricity is considered a major source of energy for the economic development of the country. Therefore, in 2006 the Myanmar Government announced plans to wean the country off its reliance on gas for electricity generation and make hydropower the sole source of electricity by 2030. The plan is to develop 24 hydropower plants of capacity varying from 48 MW to 7,100 MW, with a projected 23,300 MW of electricity being generated in this way by 2030 (ERIA, 2013). Figure 19 shows primary energy use in 2000–2013, the share of biomass being significant.

![Figure 19: Myanmar primary energy during 2000–2013 (Ko Ko Latt, 2015)](image)

Figure 20 shows that energy consumption in the residential sector is significant at about 74%. Per capita energy and electricity consumption, however, are very low (especially compared to the ASEAN average) at about 0.21 toe and 180 kWh respectively. However, the government has set a target of 100% electrification by 2030.

![Figure 20: The sectoral energy share (Ko Ko Latt, 2015)](image)

Besides conventional sources, the government also aims to increase the share of natural gas and other renewable energy sources, especially solar and wind, in the generation mix, while reducing the share of oil and coal (Myint and Aung, 2013). Other areas include expanding the grid to rural areas and promoting energy efficiency (UNDP, 2013). Other policies include prioritizing domestic energy requirements and increasing private participation in the energy sector. Myanmar has also adopted Agenda 21 for sustainability and development (UNEP, 2013; see box below).
Some of Myanmar’s major policies, targets and plans that are aimed to increase energy access in the country are tabulated (Table 10) with their description (UNDP, 2013). The table indicates the significance in this regard of private-sector participation, renewable energy, energy conservation and energy efficiency, energy pricing policy, research and development, etc., and it also forecasts energy demand.

Table 10: Major plans, policies and targets of the energy sector in Myanmar

<table>
<thead>
<tr>
<th>Name</th>
<th>Year</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Petroleum Act</td>
<td>1934 [Amended 1937 and 1946]</td>
<td>To consolidate regulations concerning the importation, transport, storage, production, refining and blending of petroleum and petroleum products.</td>
</tr>
<tr>
<td>Electricity Act</td>
<td>1948 [Amended 1967]</td>
<td>To declare the statutory powers and functions of the state’s electricity boards and generating companies with the goal of providing the rational use of the production and supply of electricity.</td>
</tr>
<tr>
<td>Myanmar Electricity Law</td>
<td>1984</td>
<td>To maximize the rational generation, production, transmission, distribution and usage of electricity.</td>
</tr>
<tr>
<td>Private Industrial Enterprise Law</td>
<td>1990</td>
<td>To avoid environmental pollution in the face of rural development and industrialization and to promote the use of energy in the most economical manner.</td>
</tr>
<tr>
<td>Forestry Law</td>
<td>1992</td>
<td>To prevent dangers of destruction to the forest and biodiversity and to conserve and establish forest plantations (partially for fuel wood supply).</td>
</tr>
</tbody>
</table>

Agenda 21

In order to integrate sustainability into development and the everyday consideration of individuals, households, communities, corporations and governmental agencies, Myanmar has formulated and adopted Myanmar Agenda 21. Its goals include:

- Increasing energy and material efficiency in production processes;
- Reducing wastes from production and promoting recycling;
- Promoting the use of new and renewable sources of energy;
- Using environmentally sound technologies for sustainable production;
- Reducing wasteful consumption;
- Increasing awareness of sustainable consumption.

(UNEP, 2013)
The government set up a National Energy Committee in 2013, which drew up a National Energy Policy in early 2015. The nine-point policy document announced by the Myanmar President’s office is shown in Table 11.

Table 11: Nine Points of National Energy Policy

1. To implement short term and long term comprehensive energy development plan based on systematically investigated data on the potential energy resources which are feasible and can be practically exploited, considering minimum impact on natural environment and social environment
2. To institute laws, rules and regulations in order to promote private sector participation and to privatize State Energy Organizations in line with State Economic Reform Policy
3. To compile systematic statistics on domestic demand and supply of various different kinds of energy resources of Myanmar
4. To implement programs by which local population could proportionally enjoy the benefit of energy reserve discovered in the areas
5. To implement programs on a wider scale, utilizing renewable energy resources such as wind, solar, hydro, geothermal and bio energy for the sustainable energy development in Myanmar
6. To promote Energy Efficiency and Energy Conservation
7. To establish R, D, D&D (Research, Development, Design and Dissemination) Institution in order to keep abreast with international practices in energy resources exploration and development works and to produce international quality products in order to manufacture quality products and in order to conduct energy resources exploration works in accordance with international standard
8. To promote international collaboration in energy matters
9. To formulate appropriate policy for energy product pricing meeting economic security of energy producers and energy consumers

Source: http://www.myanmarpresidentoffice.info/en/?q=issues/energy/id-4827

4.3 Policies related to the development of energy access in urban areas in Myanmar

Myanmar’s plans and policies are generally targeted at increasing overall energy access in the country. However, improvements to energy access in urban areas of Myanmar
are tied to national targets, which do little to take the urban poor into account. Some initiatives are targeted at improving energy access in urban areas.

In 2011, approximately 26% of the population had access to grid-connected electricity in Myanmar. Even then, large differences exist in electrification rates between different income groups and across states. Yangon has the highest electrification rate of 67%, followed by Nay Pyi Taw (54%), Kayar (37%) and Mandalay (31%) (WEF 2013).

The existing problem of low voltage supply and load-shedding in the urban areas of Myanmar has hampered economic activities. This can be attributed to the poor and antiquated infrastructure and the lack of human resources to supply reliable and sufficient energy (ERIA, 2013). Existing power plants and transmission lines are not maintained regularly, and excessive theft of electricity has increased the losses. Planners have tried to respond to such obstacles by relaxing the rules, allowing cooperatives to supply power, and in 2002 launching an “Energy Thrift” campaign following the establishment of a Supervisory Committee for Utilization of Power and Fuel (UNDP, 2013).

Another initiative was to allow private-sector participation in the energy sector. In 2005, the government allowed private enterprises to supply electricity whereby small businesses can generate and distribute power directly to consumers under the Yangon City Electricity Supply Board law. However, the program was impeded due to the higher retail costs of privately energy compared to subsidized electricity from the national grid (UNDP, 2013).

There is a huge difference in electrification rates between different income groups and regions, posing a huge challenge for supplying electricity (ERIA, 2013). During the dry season, the lower socio-economic neighbourhoods in Yangon receive as little as one hour of power per day, while those in the wealthier suburbs receive six to twelve hours (ERIA, 2013).

Policies related to energy access in Yangon

In response to the current rapid urbanization of Yangon city, a strategic urban development master plan for the city was formulated in March 2013. The overall objective of the master plan is to enhance strategic urban development and administrative capacity-building (JICA, 2013).
The development vision for 2040 also includes a plan for power supply to realize a stable electric power supply of high quality and sufficient quantity to ensure advanced urban functions. The plan aims to achieve this by (JICA, 2013):

- Reducing power loss
- Decreasing voltage fluctuations
- Constructing grid networks for the transmission and distribution line in greater Yangon
- Capacity-building of organizations and institutions for creating and maintaining the electrical power system
- Saving limited exhaustible resources and reducing greenhouse gas emissions.

The price of energy resources and technologies for the poor is depriving them of modern energy access, as many are not able to afford the upfront costs and associated costs of using LPG or electricity connection. The monthly incomes of the poor were just sufficient to fulfil their basic needs. Also, the survey and literature reviews (UNDP, 2013; ERIA, 2013; Myint and Aung, 2013) indicate that there are no dedicated energy projects or policies specially targeted at the urban poor of Myanmar in order to improve their access to energy.

The reason for the lack of policies and plans targeted at the urban poor can be attributed to political instability in the country. Myanmar has recently embarked on political and economic reform, and increasing energy access is a key priority. New plans and policies are being formulated to increase energy access, improve people’s lifestyles and the country’s economy. In this scenario, the following strategies can be considered as providing an enabling environment that will expand modern energy access and services to the poor.

- Myanmar should focus on creating a detailed and comprehensive energy database and energy plan (Myint and Aung, 2013). The country’s institutional framework is complicated, and there is lack of reliable data, hampering the planning process. Thus the government should formulate an integrated energy plan in collaboration with all stakeholders. This would help it identify those areas that need attention. A detailed and comprehensive energy-sector assessment would also help in acquiring statistics that can be used to determine the energy-saving potential in Myanmar.
- Myanmar should establish an appropriate legislative and institutional framework to deliver the developed plan. The roles of the regulatory authorities should be harmonized. Clear responsibilities should be given to the departments and ministries
responsible for planning and decision-making regarding energy-related issues to avoid responsibilities overlapping. To aid this, technical assistance and training programs should be encouraged for decision-makers and staff at all levels.

- There is a strong need to create public awareness about energy issues in Myanmar. The participation and empowerment of stakeholders in the decision-making process by providing sufficient information and obtaining feedback should be encouraged. The government should act as a catalyst in inducing a knowledge-based approach on the part of the public. People should understand issues related to energy and change their behavior accordingly. This would help the government gain public support while changing and updating plans and policies. For example, awareness of the efficient use of energy would help reduce the wasteful use of energy and the imbalance in Myanmar’s energy demand and supply structure (WEF, 2013).

- Energy extraction projects and infrastructure should meet social and environmental standards. This not only helps achieve sustainable development but also helps attract foreign investment in energy projects, which in turn helps in increasing energy access.

- The government should impose technology standards in energy equipment (UNDP, 2013). This not only regulates appliance quality but also makes efficient use of the available energy, ensuring financial benefits for consumers.

- In order to increase energy access to the poor, the primary focus should be on meeting their energy needs for domestic use. Though Myanmar has a policy of expanding energy access and electrification for domestic use, the current trend in the country is mainly focused on exports of available resources such as oil and gas, and domestic demand is still not being met (UNDP, 2013). However, expanding domestic provisions may mean that the country must forgo some export revenue. In addition, financing the development of domestic infrastructure will require a deep initial investment, necessitating public–private partnerships (WEF, 2013).

- The electricity supply in Myanmar is subsidized. The production and distribution costs are higher than what consumers pay. Thus, the state electricity companies have low revenues, which explains why electricity supply and infrastructure are not maintained. This also explains the problems involved in attracting investments. Energy subsidies are provided to improve access to energy for the poor. However, subsidies are commonly of greater benefits to higher income groups, who can afford higher levels of fuel consumption. A majority of the poor fail to benefit from such
schemes, as many lack electricity and/or natural gas connections (ADB, 2013). Thus, Myanmar should focus on reforming and updating its current subsidy policies and on targeting the poor. To this end, poor households should be identified and special schemes such as direct cash transfers, life-time rates or energy coupons be provided. This helps improve access to modern energy for the poor (WEF, 2013).

- One of the major reasons for the lack of access to electricity and LPG is the lack of finance. The higher upfront costs of obtaining a new connection and the associated costs limit the ability of the poor to obtain modern energy services, even though they may be able to pay the monthly costs of energy. The poor do not have cash reserves for such fees or lump-sum purchases. In such cases the provision of loans and financing to cover the upfront costs should be encouraged.

- The results of the surveys showed that a majority of households are using fuel-inefficient stoves and that people are not prepared to change their traditional way of cooking. The inefficient burning of wood and charcoal leads to higher fuel consumption and also has harmful impacts on health. Thus establishing enterprises to produce improved cooking stoves could be useful for the urban poor. For this, start-up and working capital loans should be granted to the service providers. This could lead the urban poor to use a comparatively cleaner technology and could act as a transitional phase for people to switch to modern energy sources like LPG. These kinds of start-ups should be gender-inclusive, encouraging the involvement of local communities, and especially women, as they are more involved in cooking activities.

Besides, Myanmar should also consider implementing some of the strategies which have been successful in neighboring countries, such as Thailand. These are discussed below.

4.4 Comparative studies on neighboring countries

Thailand and Myanmar are both members of the Association of South East Asian Nations (ASEAN). The two countries have comparable land areas and populations (Thailand: 513,120 km² and 67.1 million; Myanmar 676,578 km² and 60.1 million). In 2012 per capita Gross Domestic Product (GDP) was about $850, compared to $1,015 in Cambodia, almost $1,400 in the Lao PDR, and more than $5,500 in Thailand. However, the population without access to electricity in Thailand is around 1%, while the official electrification rate in Myanmar is 13%, and a majority of households (95%) depend on solid fuels such as wood and rice husks.
for cooking and heating in (UNDP, 2013). The political and administrative situations in the two countries differ.

Sector wise, national energy consumption in Myanmar is dominated by the household sector (74%), followed by the transport sector (10%). The electricity sector is dominated by hydroelectricity (61 percent of supply in 2010) in Myanmar, while in Thailand, natural gas-based electricity generation has the largest share (more than 70%).

In terms of private-sector participation in electricity generation, private enterprises have been allowed to supply electricity since 2005 under the Yangon City Electricity Supply Board Law, and small businesses can generate and distribute power directly to consumers (UNDP, 2013). Of Thailand’s total installed generating capacity of about 33,680 MW in 2013, 55.43% came from independent power producers and power imported from neighboring countries (EGAT Annual Report, 2013).

Household energy in Yangon comes mainly from charcoal and fuelwood, and only about 3% of people do not cook at home. In Bangkok, use of LPG and electricity is high, and a much higher percentage of households do not cook in their homes.

**Success strategies and best practices in Thailand**

With 99% electrification, Thailand is a good example of energy access in peri-urban areas. The state of energy access in slum areas is relatively better than in other developing countries due to the implementation of plans, policies and programs by the government. This section describes the effective policies that have enabled energy access to the poor to be increased in Thailand (AIT, 2012).

1. **Quasi-housing identity**

   The passage of the Housing Registration Act of 1992 has enabled the urban poor who encroach on public lands and settle their own communities to have access to basic utilities. In this Act, housing registration is divided into permanent and temporary housing registration. Permanent housing registration is provided for houses which have been constructed in accordance with the Building Code of 1979. Permanent registration is defined as “the housing registration that a register issues for a house built in public lands or
encroached on public forests or a house constructed without complying with the building code of 1979”.

The Act allowed the urban poor to have the quasi-households ID which not only helped them apply for legal energy services like electricity and water but also reduced illegal electricity connections.

2. Electricity pricing policies

The cost of energy services is one of the major driving factors in energy access. Therefore the introduction of innovative pricing policies is necessary to encourage the use of modern forms of energy among poor communities. Thailand has such pricing policies, which reduce the burden of the costs of electricity to the people based on monthly electricity consumption. Six measures have been launched since 2008. The summary of measures initiated from 2009 that are still applicable are listed below:

Measure 2-Measure 6 (February 2009-present)

These measures are applicable for two household groups:

a. Owners or tenants of houses or residential units who use less than 90 units per month are exempted from electricity charges.

b. Tenants of flats or apartments who use less than 90 units per month and whose monthly rent is less than 3,000 baht are charged by calculating the average electricity consumption of all residential units that have a month rate of less than 3,000 baht (excluding energy adjustment charge and value added tax). The electricity charged is deducted from the average amount of calculated electricity charge.

3. Permitting grocery shops to sell LPG cylinders

In Thailand, domestic supply of LPG can be sold by grocery stores. Customer pays a onetime deposit for the cylinder and the cost of the refill of the gas. Customers are allowed to swap the brand of cylinder if they want to.

LPG distribution shops are required to obtain permission from the Department of Energy Business (DOEB). There are requirements and code of practices laid down by the DOEB regarding the transport, storage, use and safety of LPG for occupiers, suppliers and traders. According to a Decree of the Ministry of Energy of 2006, shops distributing LPG
need to be isolated (300 m away from adjacent buildings) and built from refractory materials. However, this is not required from grocery shops, which are therefore not allowed to sell cylinders of more than 15 kg.

This government provision has eased consumers' problems in obtaining LPG cylinders near their homes.

4. Slum upgrading and public housing projects

The Community Organization Development Institute (CODI) and the National Housing Authority (NHA) were involved in slum upgrading projects. The urban poor were upgraded by improving their existing living conditions or relocating them elsewhere. They were even given help to obtain permanent residence and housing identification.

Section 3.3 listed the barriers to modern energy access for the urban poor in Yangon based on the literature and especially on the household and enterprise surveys. Though further recommendations of ways to address the barriers are presented in Section 5 (Table 12), the specific circumstances existing in Myanmar in comparison with neighboring countries are briefly presented below.

The barriers to modern energy access in Myanmar are poverty and subsistence needs, conflicting priorities, the lack of resources and policy fragmentation.

- Firewood collection and charcoal production for cooking and heating place stress on Myanmar’s rainforests and mangrove habitats, and as noted earlier more than 74% of the country’s energy needs is in the household sector. This is not comparable to Thailand.
- The focus in Myanmar’s energy sector is primarily on producing crude oil and natural gas for export, and energy access is not a high priority. In Thailand, however, the reserve margin in the electricity sector is about 15%.
- There is a lack of financial resources to promote energy access. For example, it is difficult to obtain international financing and investment in the energy sector related to energy access. More than 50% of Thailand’s electricity generating capacity comes from the private sector and imports from neighboring countries.
- In terms of policy formulation and regulation, there are a number of government agencies involved in energy and electricity planning.
5. Conclusion and Recommendations

The conclusions of the study are given in terms of the specific objectives:

(a) To conduct an analysis of urban and peri-urban energy access status in Yangon, Myanmar, and to understand and evaluate the linkages and impacts of modern energy access on local economies, mainly through an analysis of the productive uses of energy.

As noted by participants in the workshop held at Yangon, this is probably the first ever study on the urban poor in Myanmar, one that was able to identify the status of modern energy access among the urban poor in Yangon. The major conclusions were as follows:

- About 18% of the slum dwellers had completed their college education, and about 35% were employed as vendors. 76% of houses were privately owned, and about 93% were of wood or bamboo structure. About 18% had monthly household incomes greater than 200,000 MMB (1US$ = approx. 1000 MMB).

- Electricity access:
  - Though the majority (81%) of the households surveyed had access to electricity, they were not satisfied with the supply, as they had to face long hours of load-shedding, especially during dry season.
  - Less than 1% of households consumed more than 200 kWh per month.
  - Where there was no access to electricity, households mainly used candles and battery-powered LED lamps for lighting.
  - Some households were not eligible to apply for electricity connection even if they could afford it because of their illegal status, as they were not able to provide the necessary documents like identity cards, housing ownership cards or recommendation letters from the ward office.

- Cooking energy:
  - No households used LPG as primary fuel. The main reason for this was attributed to the high upfront costs and safety concerns.
  - About 59% of the households surveyed were dependent on biomass (charcoal and firewood) because they were easily available and affordable compared to other sources of energy.
  - Charcoal was the main fuel, though it was much more expensive than firewood.
Modern energy usage in the enterprises surveyed in two townships in Yangon (one with access to electricity and the other without) clearly indicated increased productivity and income from extending working hours and saving time and other social benefits in the enterprises that had access to modern energy.

- The average incomes of enterprises in the township with electricity access were more than 300,000 MMB in 40% of the enterprises surveyed, while this value was zero in the township with no access to electricity.
- Welding, carpentry shops, salons, tailoring shops, grocery shops and stores could work for longer hours where there was access to electricity.
- The other major observation was that access to information and entertainment and charging mobile phones was possible in the township with access to electricity.
- Safety at night was observed, which had resulted in a reduction in thefts.

(b) To identify and develop policies, strategies and plans for modern energy access and to foster the potential cooperation and exchange of knowledge and best practices.

Given the information regarding the status of energy access in Myanmar obtained from previous literature and surveys, cases (examples) have been taken into account in identifying plans and policies to increase access to clean energy for the urban poor. To promote access to modern energy services, problems with their adoption were noted in terms of policy, physical, institutional and awareness barriers. Measures to address these barriers, along with examples from other countries, are listed in Table 12. Barrier-specific recommendations have also been listed, based on the surveys and discussions with stakeholders at the consultation workshop in Yangon.
<table>
<thead>
<tr>
<th>Barriers</th>
<th>Recommendations/suggestions to overcome the barrier with examples</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Policy barrier</strong></td>
<td>(a) A number of ministries are involved in energy-related issues, and each ministry has its own plan and activities. A coordinated approach is necessary for the design and implementation of activities to promote modern energy access to the urban poor. &lt;br&gt; (b) There is a need for detailed and comprehensive energy access assessments. A database with facts and figures about the urban poor, their needs and energy use patterns should be created and their needs should be addressed. &lt;br&gt; (c) Energy policies targeted at the urban poor with a special focus on clean energy access should be formulated. The policies should also encourage the efficient use of energy and the use of renewable sources.</td>
</tr>
<tr>
<td>• No specific policies, plans and programs targeting energy access to the urban poor.</td>
<td><strong>Example: Integrated National Electrification Program (INEP), South Africa</strong> <em>(Bekker et al. 2008)</em>&lt;br&gt; A White Paper on energy policy was introduced in South Africa in 1998, which emphasized providing affordable energy services to the urban poor by improving energy governance and through economic stimulation. The Energy Policy White Paper focused on the introduction of competition into the electricity supply industry by introducing independent generation, transmission companies, distributors and operators. &lt;br&gt; It also emphasized an integral approach to household energy problems and the installation of</td>
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<td></td>
<td>the solar photovoltaic system in places that are too remote in order to increase the energy access.</td>
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<td></td>
<td>Basically, the success behind the electrification program was due to the widespread energy policies and the effective role of the government in encouraging the private sector to invest in electrification programs.</td>
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<tr>
<td>Illegal settlement</td>
<td>Temporary registration numbers and ID cards should be provided to people in informal settlements so that they can obtain access to basic services like electricity and water.</td>
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<td></td>
<td>Example: <em>Quasi-housing identity in slum areas of Thailand</em> (AIT, 2012)</td>
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<tr>
<td>Financial barriers</td>
<td>A flexible financing structure and funding mechanisms tailored to the poor should be encouraged. Subsidies, loans and micro-credits should be created to enhance energy affordability for the urban poor.</td>
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<td></td>
<td>Example: <em>Slum electrification in Ahmedabad</em> (ESMAP, 2011)</td>
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<td></td>
<td>Ahmedabad is the biggest city of Gujarat and ranks seventh in India. The city is well connected by rail, roads and air to the important cities of India.</td>
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<td></td>
<td>Like many other cities in India, it also has slums which lack basic services. The slum</td>
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</table>
The electrification project in Ahmedabad was initiated in 2001 under the Slum Networking Project (SNP) of the Ahmedabad Municipal Corporation (AMC), through which basic services such as sanitation, road, streets lights and water facilities were provided.

After the success of the SNP, slum electrification was initiated at popular demand, which was facilitated by SAATH and MHT (Mahila Housing sewa Trust), two NGOs, and was financially supported by USAID. In the first phase, the pilot project was launched in the five beneficiary slums of the SNP, where the USAID grant enabled electrification of 700 households, with each electrified household receiving a legal private meter and a compact fluorescent bulb.

In the second phase, an additional 2000 households were electrified, and the funds were used to provide electricity connection subsidized for three years.

In 2004, the period of the USAID grant ended and the project came to an end, but the slum electrification program continued. By 2008, the project had successfully scaled up to include all 710 slums in Ahmedabad.

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</table>

**Physical barriers**

- The slum settlements in urban areas are usually congested and unsafe, which normally

(a) Slum upgrading could be a major stepping stone towards achieving the national goal of development. To this end, the government should work closely with community-based organizations and slum dwellers using an integrated approach to the development of housing, infrastructure and the

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4 In the local language, SAATH means ‘together’. This is a local NGO which facilitated the program.
<table>
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<tr>
<td>affects the installation,</td>
<td>environment as a whole.</td>
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<td>distribution and monitoring system.</td>
<td>(b) Maintenance of distribution and transmission lines, with an effective monitoring system to prevent the unauthorized use of electricity, is recommended.</td>
</tr>
<tr>
<td>• Underdeveloped transmission lines for the electricity supply are one of the key infrastructural barriers to</td>
<td>(c) Increasing the number of LPG outlets and mobile LPG delivery should be promoted to increase LPG access to the urban poor.</td>
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<tr>
<td>electricity supply. The long distances over which power is transmitted and extensive theft from the distribution</td>
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<td>system are two other issues that have exacerbated losses (ADB, 2012).</td>
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<tr>
<td>• Lack of access to LPG cylinder outlets is another barrier to clean energy access.</td>
<td><strong>Example: Jawaharlal Nehru National Urban Renewable Mission (JNURM), India</strong> (Dhingra et al. 2008)</td>
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<td>The Jawaharlal Nehru National Urban Renewable Mission (JNURM) was an initiative of the Government of India during 2005-2006. It worked to renovate and upgrade infrastructure development in the cities and urban agglomerations. It made use of the available resources encouraging community participation in the fast-tracked planned development of identified areas. It also had plans and programs for the urban poor using an integrated development approach towards slums, housing and infrastructure, and environmental improvement.</td>
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<td><strong>Example: TOTALGAZ LPG Distribution by Mobile Retail Dealers</strong> (ESMAP, 2012)</td>
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<tr>
<td></td>
<td>90% of the total population of Bangladesh relies on biomass for cooking and increasing deforestation with associated health and environmental impacts were nothing new. The lack of access to cleaner cooking technologies was one of the major challenges to development and well-being in Bangladeshi society. The people who were willing to use cleaner technologies like LPG lacked a</td>
</tr>
</tbody>
</table>
Barriers | Recommendations/suggestions to overcome the barrier with examples
---|---
reliable supply and found it inconvenient to collect the refilled cylinders.  
To address these issues, the 1996 Energy Policy opened up LPG marketing to private companies, enabling firms like TOTALGAZ to distribute gas to households and businesses. TOTALGAZ started the Mobile Retail Dealers (MRDs) project in 2005 with the aim of increasing LPG use among urban households and small and medium size businesses without gas connections.  
Prior to the start of the project, TOTALGAZ conducted a market survey, which uncovered a demand for home-delivered LPG cylinders from the households and small businesses like restaurants. TOTALGAZ trained the MRDs, who were provided with the bicycles and rickshaws to deliver a 12 kg LPG cylinders in accordance with customer demand.  
The project’s main innovation was the distribution of free burners and regulators to first-time consumers, enabling TOTALGAZ to secure new customers while increasing the number of LPG users in the process.  
The project proved successful in reducing the dependence on traditional biomass fuels, with positive impacts on the health and living standards of the people and increasing the sales of LPG. Consumers were saved the tedious and time-consuming process of collecting the refilled cylinders. At the same time, new job opportunities were created as MRDs.  
The success of the project has seen it expanded to other urban areas of Bangladesh in Rajshahi, Khulna, Chittagong, Barisal, Sylhet and Rangpur.
<table>
<thead>
<tr>
<th>Barriers</th>
<th>Recommendations/suggestions to overcome the barrier with examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Awareness barrier</td>
<td>Community-based organizations and NGOs could be mobilized to raise awareness among slum settlements of the health, economic and safety impacts of using legal and cleaner technologies.</td>
</tr>
<tr>
<td>• Poor economic conditions and</td>
<td></td>
</tr>
<tr>
<td>unsafe or unauthorized energy use</td>
<td></td>
</tr>
<tr>
<td>practices damage health and reduce</td>
<td></td>
</tr>
<tr>
<td>the financial benefits of cleaner</td>
<td></td>
</tr>
<tr>
<td>energy sources.</td>
<td></td>
</tr>
<tr>
<td>Example: COELBA Community Agent Project, Salvador, Brazil (ESMAP, 2011)</td>
<td></td>
</tr>
<tr>
<td>Salvador is the third largest city</td>
<td>Salvador is the third largest city in Brazil and has more than 350 informal settlements containing 800,000 people. Rapid and unplanned urbanization has led to various urban problems like unemployment, poor living conditions and limited access to basic services. Illegal use of electricity was one of the major problems of the slums.</td>
</tr>
<tr>
<td>Illegally connected households</td>
<td>Illegally connected households were accustomed to high levels of electricity consumption due to the use of low-efficiency light bulbs, faulty connections and refrigerators in poor condition. Houses in informal settlements constructed with no ventilation and natural lighting required the constant use of fans and electrical lighting.</td>
</tr>
<tr>
<td>were accustomed to high levels of</td>
<td></td>
</tr>
<tr>
<td>electricity consumption due to the</td>
<td></td>
</tr>
<tr>
<td>use of low-efficiency light bulbs,</td>
<td></td>
</tr>
<tr>
<td>faulty connections and refrigerators</td>
<td></td>
</tr>
<tr>
<td>in poor condition. Houses in</td>
<td></td>
</tr>
<tr>
<td>informal settlements constructed</td>
<td></td>
</tr>
<tr>
<td>with no ventilation and natural</td>
<td></td>
</tr>
<tr>
<td>lighting required the constant use</td>
<td></td>
</tr>
<tr>
<td>of fans and electrical lighting.</td>
<td></td>
</tr>
<tr>
<td>In order to address the inefficient</td>
<td>In order to address the inefficient use of electricity and power losses and to ensure legal electricity access to these low-income communities, the Companhia de Electricidade do Estado da Bahia (COELBA) Community Agent Project was initiated. This is an electrification and energy efficiency initiative for low-income areas. The project was funded by COELBA in partnership with the AVSI Foundation, an Italian non-profit organization involved in slum upgrading. Other project implementation partners included Cooperação para o Desenvolvimento e Moradora Humana, a local</td>
</tr>
</tbody>
</table>
### Barriers

<table>
<thead>
<tr>
<th>Barriers</th>
<th>Recommendations/suggestions to overcome the barrier with examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>slum upgrading and community development organization, and several local community associations.</td>
<td>The objectives of the COELBA Community Agent Project were to invest in customer relations through the mediation of agents embedded in communities, to reduce commercial losses from non-paying legally connected customers, to reduce the number of illegal connections, to adjust the energy consumption of low-income consumers to their ability to pay, and to use a combined approach involving information and energy efficiency improvements delivered by community agents. These initiatives went together with increased utilization of government subsidies and reliance on an intermediary NGO to reach customers and the company. Community associations in intervention areas were key components of the project, guaranteeing the implementation and monitoring of activities with a high level of community participation, including the selection of community agents to be hired by the project.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Institutional barriers</th>
<th>(a) A well-defined institutional structure responsible for undertaking the energy access and energy efficiency problems of the urban poor should be established.</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Multiple government agencies are involved in the planning</td>
<td>(b) Capacity development of existing authorities, service providers and community development organizations to improve energy access services to the urban poor.</td>
</tr>
<tr>
<td>and policy-making system of the energy sectors. This creates</td>
<td><strong>Example: FOKUS: Strategic planning effort informed by monitoring and evaluation in Sweden (IEA, 2011)</strong></td>
</tr>
<tr>
<td>overlapping of responsibilities.</td>
<td></td>
</tr>
<tr>
<td>Barriers</td>
<td>Recommendations/suggestions to overcome the barrier with examples</td>
</tr>
<tr>
<td>-------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>• Lack of coordination among the bodies creates confusion and complicates the process.</td>
<td>FOKUS is the strategic planning process used by the Swedish Energy Agency (SEA). Created in 2006, it formulates the vision, sets priorities, and identifies the short and medium-term goals of the programme for energy RD&amp;D, innovation and commercialisation. To achieve those goals, it targets a wide range of measures ranging from basic research and support for large-scale demonstration plants to product development. The process covers six themes, for each of which a “Development Platform” is established to guide the programme through the involvement of stakeholders (predominantly industry). The strategies and priorities resulting from using FOKUS are then translated into yearly implementation plans for the SEA. Activities and results are reported yearly to the government. Funding is allocated largely through planning groups and studies with the help of stakeholder representatives or other advisory bodies. Regular peer reviews are undertaken to ensure quality and relevance. Besides top-down planning, FOKUS identifies bottom-up opportunities for researchers and entrepreneurs. It supports innovation and product development projects, which are evaluated on the basis of business plans, commercial prospects, and relevance in the fields of technology and energy. The process helped to define coherent priorities and optimize investment with further improvements, particularly with regard to co-operation with other national and international actors. Moreover, the program demonstrated a strong collaborative approach, as stakeholder involvement was organised through the development platform that provide guidance to the program.</td>
</tr>
</tbody>
</table>
To facilitate outreach by the Global Network on Energy for Sustainable Development (GNESD).

To facilitate the outreach of GNESD, activities were held in two major locations:

(i) During the International Conference and Utility Exhibition (ICUE), held in Pattaya in March 2014 and attended by more than 300 participants from more than ten countries. GNESD brochures and posters about GNESD were made available to the participants. GNESD was a sponsor of this event, and gained wide publicity.

(ii) During the workshop held at Yangon in June 2014, attended by more than twenty participants, information and activities about GNESD were presented.

As observed during this study, there is lack of studies of modern energy access in Myanmar. The majority of people in the slums use biomass in traditional stoves. A study of the efficiency of the existing stoves and of their modification to improve efficiency should be conducted with the involvement of the local community in order to encourage the acceptance of cleaner technologies among the poor.
References


26. Lipu, M.S.H., Jamal, T. and Miah, M.A.R. (2013), Barriers to Energy Access in the Urban Poor Areas of Dhaka, Bangladesh: Analysis of Present Situation and


42. UNDP (2013), Accelerating Energy Access for all in Myanmar, United Nations Development Program.


Annex 1: Sample questionnaires used for household survey in peri urban Yangon

Date of interview ------------------------------------------
Survey No. ------------------------------------------
Respondent name ------------------------------------------
No: of wards ------------------------------------------
Townships ------------------------------------------

Section 1: General Information

1.1 Age of the household: --------------------------

1.2 Gender: Male (1)/ Female (2) □

1.3 No: of household’s members: □ male □ female Total □

1.4 Education: Illiterate (1)/ Primary school (2)/ Secondary school (3)/
High school (4)/ College or higher education (5) □

1.5 Land ownership: □
(1) Government land/ (2) Private land/ (3) freehold land/ (4) others-------------------

1.6 Housing ownership: □
(1) Private ownership / (2) landlord ownership / (3) rental dweller/ (4) government ownership /
(5) illegal dweller / (6) others -------------------

1.7 Housing type: □
(1) Single unit house/ (2) wooden house/ (3) apartment/ (4) bamboo house (5) others -----------

1.8 Respondent employee:
(1) Small private business/ (2) wage laborer/ (3) government service/ (4) dependent/ (5) driver /
(6) food vendor / (7) others -------------------

1.9 Total respondent family income level per month (MMK/ month):
---------------------------------
1.10 Household monthly income expenditure on basic need

<table>
<thead>
<tr>
<th>No</th>
<th>Basic Need</th>
<th>Expenditure (MMK/month)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Food and drinking water</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Electricity</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Cooking</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Transportation</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Health</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Education</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Water supply</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Rent</td>
<td></td>
</tr>
</tbody>
</table>

**Section 2: Electricity use for lighting and other purposes**

2.1 How much KWhr/month are consumed for?

---------------------------------

2.2 How much money expenditure on KWhr/month?

---------------------------------

2.3 Which energy source is used for lighting?

- [ ] EPC
- [ ] Private small generator
- [ ] Battery Charger lamp
- [ ] Kerosene lamp
- [ ] Candle light

2.4 Is household able to afford to use electricity on its income. [ ]

YES (1)/ NO (2)

2.5 How much money the household spends on the electricity bill per month?

---------------------------------

2.6 What is the satisfaction level of the household regarding their electricity access?
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Strongly dissatisfied</td>
</tr>
<tr>
<td>1. The amount of electricity supplied by the system</td>
<td>1</td>
</tr>
<tr>
<td>2. Hour of electricity supply</td>
<td></td>
</tr>
<tr>
<td>3. Electricity bill</td>
<td></td>
</tr>
<tr>
<td>4. Electricity supply quality</td>
<td></td>
</tr>
<tr>
<td>5. Safety of electricity supply</td>
<td></td>
</tr>
</tbody>
</table>

2.7 How many hours of electricity are provided to the household per day?

- [ ] 24 hours
- [ ] 12 hours
- [ ] 8 hours
- [ ] No service
- [ ] Other ---------------

2.8 List the priority for using electricity per household

- [ ] Water pumping
- [ ] Lighting
- [ ] Cooking
- [ ] Washing machine
- [ ] Air-conditioning
- [ ] Refrigeration
- [ ] Watching television
- [ ] Others ---------------

2.9 How much does household pay for?

- [ ] Battery charger lamps --------------- (kyat/month)
☐ Candle light  ------------------- (kyat/month)
☐ Others  ------------------- (Kyat/month)

2.10 How is electricity accessible in your home?
☐ Meter connection from EPC
☐ Neighboring
☐ Other  -------------------

2.11 How many hours face the blackout problem?
☐ Summer season --------hours ☐ rainy season--------hours ☐ winter season --------hours

Section 3: Energy use for cooking

3.1 Which type of fuel relies on cooking?
☐ LPG
☐ Firewood
☐ Charcoal
☐ Electricity
☐ Other  -------------------

3.2 How much fuel do you consume on cooking per month?
   1. Fuel type  -------------------  2. Quantity  -------------------

3.3 How much money expenditure of fuel for cooking?
   1. Fuel type  -------------------  2. Amount  -------------------

3.4 How many hours consume the time for cooking?
   1. Fuel type  -------------------  2. Time  -------------------

3.5 How do you acquire LPG?
☐ Door to door delivery service
☐ LPG outlet
☐ Grocery shop
☐ Others

3.6 How do your acquire charcoal?
☐ Buy from market
☐ Collect from somewhere  -------------------
If you acquire other fuel instead of charcoal, please specify the type of fuel and how you acquire it.

Type of fuel -----------------------

☐ Buy from market
☐ Collect from somewhere -----------------------

3.7 What is your satisfaction level of fuel for cooking?

Fuel type -----------------------

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Strongly Dissatisfied</th>
<th>Dissatisfied</th>
<th>Neutral</th>
<th>Satisfied</th>
<th>Strongly satisfied</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Availability of fuel</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>2. Fuel cost</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Smoke emission</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Safety and reliability of fuel</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Taste of food</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3.8 Increase LPG is not used at all, what is the reason for the same?

☐ High upfront cost of installation
☐ High refill cost
☐ Have no ID/ or required documents ----------------
☐ Other, please specify ------------------

3.9 What is your view on LPG price?

☐ Expensive
☐ Cheap
☐ Increasing
☐ Decreasing
☐ Difficult to pay

3.10 How is the LPG supply?

☐ Reliable
☐ Not reliable
3. 11 Which size of LPG cylinder you use? Why? Please give the reason.

3.12 What type of cooking stove do you use?
- LPG stove
- Natural gas stove
- Open fire stove
- Clay fixed stove
- Other, please specify in detail

3.13 What is your satisfaction level of your cooking stoves on your experience?

<table>
<thead>
<tr>
<th>Cooking stove type</th>
<th>Strongly Dissatisfied</th>
<th>Satisfied</th>
<th>Neutral</th>
<th>Satisfied</th>
<th>Very satisfied</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less fuel consumption</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Less smoke emission</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cheap cooking stove price</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time saving</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clean and good for health</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Annex 2: Sample questionnaires used for enterprise survey in peri-urban Yangon

Date:  
Questionnaire No:  
Interviewer name:  
Township:  

A. Basic Information (Enterprise and Owner)

<table>
<thead>
<tr>
<th>Q1.</th>
<th>Enterprise name</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Q2.</th>
<th>Enterprise location</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Q3.</th>
<th>Enterprises approximate age (or year of establishment)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Q4. Owner information

- Name
- Male/Female
- Age
- Highest level of education
  - None
  - Primary education
  - Secondary education
  - University level education

- Personal income (monthly) from the business (enterprise)
  - Less than 100,000 Kyat
  - Between 100,001-150,000 kyat
  - Between 150,001-200,000 Kyat
  - More than 200,000 Kyat

- In what ways has the presence/absence of modern energy affected your personal income?
  
  __________________________________________________________
  __________________________________________________________
  __________________________________________________________

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Q5. What is the enterprise’s line of business?

<table>
<thead>
<tr>
<th>Manufacturing</th>
<th>Service sector</th>
<th>Home-based</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carpentry</td>
<td>Hairdressing</td>
<td>Knitting</td>
</tr>
<tr>
<td>Welding/metal worker</td>
<td>Restaurant (please specify )</td>
<td>Weaving</td>
</tr>
<tr>
<td>Tailor shops</td>
<td>Grocery shops (please specify )</td>
<td>Others, please specify</td>
</tr>
<tr>
<td>Sawmill</td>
<td>Electrical repair shops (please specify )</td>
<td></td>
</tr>
<tr>
<td>Tailor shops</td>
<td>Communication service (photocopy, telephone etc.) (please specify )</td>
<td></td>
</tr>
<tr>
<td>Blacksmith/locksmith</td>
<td>Others, please specify</td>
<td></td>
</tr>
<tr>
<td>Others, please specify</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Q6. How many days per week is the enterprise usually in operation?

___________________________________________________________________________

Q7. Currently, how many people work for this enterprise (including you)?

- No. of male workers __________
- No. of female workers __________
- No. of permanent workers __________
- No. of temporary workers __________

Q8. What are the main products of your enterprise?

___________________________________________________________________________

Q9. Whom do you sell majority of your products to?

- Private individual __________
- Retailers __________
- Exported __________
- Small companies __________

68
B. ENERGY

Q10. Which of the following energy sources does this enterprise use? Multiple entries are possible.

<table>
<thead>
<tr>
<th>S.N</th>
<th>Energy source</th>
<th>Q11. For which purpose the energy is used for?</th>
<th>Q12. How much does this enterprise spend MONTHLY on the energy source? (in kyat)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Electricity</td>
<td>Lightning, Cooking, Operating equipment</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Diesel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Petrol</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Kerosene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>LPG</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Natural gas</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Biogas</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Firewood</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Coal/charcoal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Rechargeable batteries</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Others, specify____________</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Q13. How important is modern energy (e.g. electricity, LPG/natural gas) for this enterprise’s operation?

- Not important
- Important
- Very important
- Can’t operate without it

Comments (Why/why not)
___________________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________

B1. Electricity Use

Q14. Does this enterprise use electricity from the grid?

- No, go to Q15
- Yes, go to Q16

Q15. Why is the enterprise not connected to the grid? Multiple entries possible

- There is no grid available in the area
- Grid is available but connection has not been established. Please explain

___________________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________
• Electricity is not needed for the enterprise’s operation
• The enterprise cannot afford the connection/consumption fee
• Other reasons

_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________

Q16. Since when (how many months/years) was the enterprise connected to the grid? What is the voltage, and how many hours a day you use the electricity?
  • Connected since___________
  • Voltage connection___________
  • Total hours a day___________

Q17. Does this enterprise have its own connection, or is it connected through another enterprise/household connection?
  • Own connection
  • Other connection (specify) -

_____________________________________________________________________
_____________________________________________________________________

Q18. What was the initial cost of installation of electricity?
  • Installation charge_____________________________
  • Total cost (including wiring, sockets, switches etc.)_______________________

Q19. How do you pay for electricity consumption?
  • KWh meter
  • Fixed payment (equipment type)

Q20. How much do you pay monthly for electricity consumption?

___________________________________________________________________________

Q21. How is the quality of electricity supply?

___________________________________________________________________________

___________________________________________________________________________
### B2. Other energy source used

<table>
<thead>
<tr>
<th>S. N</th>
<th>Energy source</th>
<th>Q22. Since when (how many months/years) this enterprise has been using the energy source</th>
<th>Q23. How much do you consume monthly?</th>
<th>Q24. How many hours per day you use the energy source?</th>
<th>Q25. Where do you obtain the energy source?</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Diesel</td>
<td>Liters</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Petrol</td>
<td>Liters</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Kerosene</td>
<td>Liters</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>LPG</td>
<td>Cylinders (size)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Natural gas</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Biogas</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Firewood</td>
<td>kg</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Coal/charcoal</td>
<td>kg</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Rechargeable batteries</td>
<td>capacity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Others, specify</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### B3. Energy for enterprise lighting

**Q26.** What kind of lighting devices does the enterprise use and for how many hours per day?

- Incandescent bulb, quantity______, power______, No. of hours/day______
- Fluorescent tube, quantity______, power______, No. of hours/day______
- Solar lamp, quantity______, size______, No. of hours/day______
- Kerosene lamp, quantity______, size______, No. of hours/day______
- Other (specify)______, quantity______, power/size______, No. of hours/day______

**Q27.** How do you think electricity affects this enterprise’s operations? Multiple entries possible.

- Extended working hours
- Higher sales
- Improved security
- No effect
- Others (specify)____________________________________________________________________________________________________________________________________________________
C. Productivity and income generation

Q28. Hours of operation

<table>
<thead>
<tr>
<th></th>
<th>Opening Hour</th>
<th>Closing Hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before connection to the electricity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(modern energy)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>After connection to the electricity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(modern energy)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Q29. Employees

<table>
<thead>
<tr>
<th></th>
<th>Total working hours of the employee in a day/or month</th>
<th>Average wage (kyat) of the employee in a day/or month</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before connection to the electricity</td>
<td>Male_________</td>
<td>Male_________</td>
</tr>
<tr>
<td>(modern energy)</td>
<td>Female_______</td>
<td>Female_______</td>
</tr>
<tr>
<td>After connection to the electricity</td>
<td>Male_________</td>
<td>Male_________</td>
</tr>
<tr>
<td>(modern energy)</td>
<td>Female_______</td>
<td>Female_______</td>
</tr>
</tbody>
</table>

Q30. If they work more hours, what is the benefit? If they work less hours, how do they spend the extra time?
___________________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________

Q31. How much does the enterprise roughly spend in a month in the following expenditures?

<table>
<thead>
<tr>
<th></th>
<th>Rent (equipment, space etc.)</th>
<th>Materials (goods)</th>
<th>Water</th>
<th>Salaries and wages</th>
<th>Communication and transportation</th>
<th>Maintenance and repair</th>
<th>Energy-related (electricity, LPG etc.)</th>
<th>Others (specify)</th>
</tr>
</thead>
</table>
Q32. Sales and revenue

<table>
<thead>
<tr>
<th></th>
<th>Average value (kyat) of sales in a day/or month</th>
<th>Average revenue (kyat) in a day/ or month</th>
<th>Total gross revenue of the enterprise (monthly)</th>
<th>Total gross expenditure of the enterprise (monthly)</th>
<th>Net income of the enterprise (monthly)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before connection to the electricity (modern energy)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>After connection to the electricity (modern energy)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Q33. Production

<table>
<thead>
<tr>
<th>Item produced: (e.g. a pair of trousers)</th>
<th>Avg. production per day (e.g. 2 pieces)</th>
<th>Avg. production time per unit item produced:</th>
<th>Avg. unit price of the item produced:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before connection to the electricity (modern energy)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>After connection to the electricity (modern energy)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

D. Barriers and challenges

Q34. What are the barriers/challenges faced by your enterprise for its growth and development?

- Lack of entrepreneurial ability
- Lack of technology
- Low levels of education and training
- Limited markets for products
- Lack of space and infrastructure to expand operations
- Lack of electricity (or other energy sources)
- Uncertainty of informal sector
- Others (specify)

_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________

Q35. Please indicate the financing source of your business

- Own resource
- Personal loans from relative/family/friend
- Partnership
- Commercial banks/micro-credit
- NGOs
• Money-lenders
• Others (specify)

_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________

General Question
Q1. No. of enterprises (manufacturing/service) established in the area due to availability of modern energy services.
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________

Q2. How do you see your business grow after electricity access (only if electricity access was made later)?
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________

Q3. How do you see your business grow if electricity was available (if there is no access to electricity)? Give reasons. For example:
• It impacts your income, how? (give reasons)
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________

• It benefits health, how? (give reasons)
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________

• It has social benefits, what? (explain)
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________

• Other reasons, please explain
Annex 3: Sample questionnaires used for the semi-structured interviews with the participants in the workshop

The questionnaire aims to understand the process of electricity connection to the urban poor in Yangon with a specific focus on understanding the barriers faced by utilities in providing electricity/LPG to the urban poor.

**About the organization**

1. Name of the organization:
2. Date of establishment:
3. Number of employees:
4. Name of the representative:
5. Position:
6. Type of organization
   a. Government
   b. Private
   c. Joint venture of government and private entity
   d. Others, please specify ............................................
7. Spatial jurisdiction of the organization
   a. Covers the entire region
   b. Covers part of the region
8. What are the key goals/objectives of the organization?

9. What are the key functions of the organization?
Getting a new electricity/LPG connection

10. What is the procedure that a household needs to follow in order to get a new electricity/LPG connection?
   a. Steps
   
   b. Documents to be submitted

11. What are the criteria used to sanction a domestic electricity/LPG connection for a household?
   a. Legal status of house
      Yes …… No
      
   b. Affordability level of household
      - Ability to afford initial infrastructure cost of wirings, meters etc.
        Yes ………. No…………
      - Ability to pay security deposit and other upfront charges
        Yes ………. No …………
      
   c. Ability to pay monthly bills
      Yes ……No ……
   d. Presence of the main electricity infrastructures near the house
      Yes ……
      No ……
   e. Others, please specify
      ……………………………………………………………………………………………………………………………
      ……………………………………………………………………………………………………………………………

12. What is the time duration within which you have to provide the connection/respond to the applicant?
**Electricity/LPG connection for poor households**

13. For poor households, those who live in informal settlements, do you have a different provision to apply for the electricity/LPG connection?

   Yes…… No……

   a. If yes, please mention
      
      a. The steps

      b. The charge: ………………………………………………………………………

      c. Documents required

   d. Others

   e. Do the sanctioning criteria also change in their case? Are some criteria related to their case?

   b. If no, then confirm if your policy is to
      
      a. Treat poor households in a similar manner as higher income households and therefore have same procedure for all to get a new connection
         
         i. Yes ……. No ……

      b. Have same approach for all despite the legality of their residential status
i. Yes ……. No ……
c. Have same sanctioning criteria for all
   i. Yes ……. No ……

14. In general, what are the **common barriers** faced by your organization in providing electricity/LPG connections to the poor especially, the informal settlements?
   a. Legal status of their residence (inability to produce the required documents)
   b. Quality of their residence (temporary shelters using inflammable construction materials, etc.)
   c. Their inability to pay for initial cost of connection and other upfront charges
   d. Their liability to pay monthly electrical bills
   e. Non-availability of main electricity infrastructures around urban poor pockets
   f. Others, please specify.

15. Are there any monitoring mechanisms for electricity/LPG connection for the urban poor?
    Yes ……. No ……
    If yes please specify:
    ……………………………………………………………………………………………
    ……………………………………………………………………………………………

16. Do you have a focused strategy/program/scheme to provide electricity/LPG access to the urban poor?
    Yes……. No……
    If no,
    a. Are you planning to formulate such strategies/program?
       Yes ……. No ……
    If yes, please give details
    ……………………………………………………………………………………………

17. Describe the strategies/programs and the specific actions implemented to improve electricity/LPG access to the urban poor.
Biofuel Sustainability: Case studies from Latin America, Africa, Asia

Emmanuel Ackom, PhD
GNESD
UNEP Risø Centre
DTU Management Engineering

ICUE 2014 – International Conference and Utility Exhibition on: Green Energy for Sustainable Development, Pattaya City, Thailand

Outline of today's presentation

Background on the GNESD network (facilitated by UNEP)

Biofuel sustainability: case studies
  ➢ Brazil, Senegal, Kenya, Thailand, Argentina
  ➢ Agro-ecological zoning
  ➢ Potential residue availability from current agricultural practices
  ➢ Concluding comments
  ➢ Acknowledging our donors/sponsors

What is GNESD?

GNESD:

launched at the World Summit on Sustainable Development (2002)

is a global knowledge network involving 10 Centres of Excellence and Network Partners.
Objectives of GNESD:

Knowledge network

Policy analysis on environmentally benign energy systems and services that:

- can help achieve Millennium Development Goals
- are not harmful to human health;
- do not conflict with our food supply;
- result in poverty alleviation and
- achieving sustainable development in member countries

Centres of Excellence from developing countries

- Energy Research Centre, Univ. of Cape Town, (South Africa)
- AFREPREN (Kenya)
- ENDA-TM(Senegal)
- Mediterranean Renewable Energy Centre MEDREC (Tunisia)
- Asian Institute of Technology (Thailand)
- TERI (India)
- Energy Research Institute (China)
- Fundación Bariloche (Argentina)
- CENBIO/Univ. of São Paulo & CENTROCLIMA/Fed. Univ. of Rio de Janeiro (Brazil)
- Molina Centre on Energy and Environment, Mexico

How GNESD works ...

- Network Centres cooperate through activity based working groups
- Multi-regional (or country) efforts and cross learning
- Annual assemblies, teleconferences etc
- A steering committee provides strategic direction and oversight
- Management structure
- UNEP affiliated secretariat based in Denmark
Biofuel Sustainability: Case studies

GNESD centres involved & studied countries

- COPPE / CENBIO/CentroClima
  - Brazil

- Energy, Environment, Development
  - Senegal

- AFREPRES/FWD
  - Energy, Environment and Development Network for Africa
  - Kenya

- AIT
  - Thailand

- Pakistan Institute of Technology
  - Argentina
**Major ENVIRONMENTAL criteria**

- Net GHG balances
- Land use change
- Net energy balances
- Water use
- Biodiversity
- Soil quality & health
- Pollution (air, water, soil)
- etc

Sources: Hill et. al, 2006; Searchinger et. al, 2008; Williams et. al., 2009; Ackem et. al., 2010

**Major SOCIAL principle & criteria**

- Avoidance of competition with food
- Consultation & communication with local communities
- Compliance with national laws and ratified international laws on employment conditions and workers’ rights
- Bioenergy production shall not take place on contested lands.
- e.t.c....

Sources: ILO, RSB, GBEP

**Brazil**

**Agro-ecological sugarcane production**

**Key Criteria:**

- Environmental aspects, technological potential and productivity
- Exclusion of pristine ecosystem i.e. Amazon and Pantanal biomes, Upper Paraguay River Basin.
- Avoiding conflict with food production
- Preference for direct precipitation/rainfall over full irrigation
- Degraded pastures
Brazil AEZ: south-south learning

• Agro-ecological zonings - a likely baseline for issuing permits/license for energy crop production in Brazil

• Brazil’s experience with agro-ecological zonings provides valuable lessons for consideration and learning in other developing countries. E.g. COGEN Africa (with UNEP, GEF and ADB).

• Agro-ecological zonings avoids competition of land from food and fuel purposes, as well as the prevention of the use of pristine ecosystems for biofuel production

• The Brazilian experience shows how policies could be effectively be applied in a complementary fashion to achieve maximum benefits. E.g. coupling command and control (i.e. zoning laws) with use of economic incentives (i.e. public development banks, international dev’t agencies)

Agro-ecological zoning (AEZ) for bioenergy crop: Senegal

• The mapping process lead to some very interesting findings beyond what policy makers had anticipated. For e.g. it was found out from the mapping exercise that 3-5 million ha exist for Jatropha compared to NJP otherwise thought ambitious target of 321,000 ha.

• Lack of scientific rigour pertaining to the choice of Jatropha by policy makers as the selected bioenergy crop compared to other candidates

• The mapping avoids competition of land from food and fuel purposes, as well as the prevention of the use of pristine ecosystems for biofuel production

• Lack of coordination at the local level involving private initiatives and NJP teams. Additionally, streamlining national institutional roles in bioenergy.

• Effective implementation strategy having clear principles & conditions for processing, distribution and use of the biodiesel is required.

Senegal – AEZ
Potential for liquid biofuels in Kenya

- Key driving factors for Kenya’s interest in biofuels
  - 25% of import bill goes to vehicular transportation fuel
  - Rising fuel cost
  - Increase in no. of vehicles

![Graph showing the increase in non-renewable transport fuel cost over years.]

Agro-ecological mapping for bioenergy crops: Kenya

![Map showing agro-ecological areas in Kenya.]

Adapted from Muok et al. 2010.

Thailand - a key player in liquid biofuel production in Asia

![Graph showing the production of biofuels in different regions of Asia from 2001 to 2011.]

Thousand tonnes oil equivalent
**Thailand – major feedstocks for biofuel production**

![Graph showing feedstock use over time](image)

**Thailand Policy – Alternative Energy Dev't Plan (AEDP) 2012-2021**

![Graph showing production targets](image)

**Argentina –**

- Biofuels in Argentina from soybean – also remains a ‘double edge sword’
  - On the one hand earnings from soybean exports have revitalized some agricultural communities ie. Santa Fe, Cordoba and Buenos Aires. On the other hand there has been displacement of rural populations due to increased mechanization of agricultural practices. Also displacement of other crops and traditional animal husbandry.
  - Glyphosphate use in soybean cultivation has intensified resulting in increased environmental and health concerns.
  - Emphasizes the need for careful analysis on both positive and negative impacts of biofuels as the basis for policy formulation and implementation.
  - The need for land use planning and zoning for bioenergy cultivation nationally.

86
Argentina

2nd Gen biofuel from agricultural residues

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Maize</td>
<td>Stalk</td>
<td>2.3E+07</td>
<td>1.5</td>
<td>2.9E+07</td>
<td>5.8E+06</td>
<td>6.8E+06</td>
<td>4.3E+08</td>
</tr>
<tr>
<td>Rice</td>
<td>Straw</td>
<td>1.2E+06</td>
<td>1.5</td>
<td>1.6E+06</td>
<td>3.2E+05</td>
<td>3.5E+07</td>
<td>2.4E+07</td>
</tr>
<tr>
<td>Sorghum</td>
<td>Stalk</td>
<td>3.6E+06</td>
<td>2.62</td>
<td>8.1E+06</td>
<td>1.6E+06</td>
<td>1.8E+08</td>
<td>1.2E+08</td>
</tr>
<tr>
<td>Sugarcane</td>
<td>Bagasse</td>
<td>2.5E+07</td>
<td>0.3</td>
<td>4.6E+05</td>
<td>3.8E+05</td>
<td>4.1E+07</td>
<td>2.8E+07</td>
</tr>
<tr>
<td>Wheat</td>
<td>Straw</td>
<td>1.9E+07</td>
<td>1.2</td>
<td>1.5E+07</td>
<td>3.0E+06</td>
<td>3.4E+08</td>
<td>2.3E+08</td>
</tr>
<tr>
<td>Barley</td>
<td>Straw</td>
<td>3.0E+06</td>
<td>1.7</td>
<td>4.3E+06</td>
<td>8.6E+05</td>
<td>9.5E+07</td>
<td>6.5E+07</td>
</tr>
<tr>
<td>Oats</td>
<td>Straw</td>
<td>6.6E+05</td>
<td>2.0</td>
<td>1.1E+06</td>
<td>2.2E+05</td>
<td>2.5E+07</td>
<td>1.7E+07</td>
</tr>
<tr>
<td>Rye</td>
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<td>5.0E+04</td>
<td>2.0</td>
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<td>1.7E+06</td>
<td>1.1E+06</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>1.2E+07</td>
<td>1.3E+09</td>
<td>8.9E+08</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Potential contribution of 2-Gen bioethanol to national transportation fuel consumption

Brazil
- Ethanol: 8-21%; BTL: 4-12%

Senegal
- Ethanol: 33-89%; BTL: 8-22%

Kenya
- Ethanol: 14-38%; BTL: 8-23%

Thailand
- Ethanol: 25-69%; BTL: 6-15%

Argentina
- Ethanol: 14-39%; BTL: 13-34%

Summary - Experiential Lessons

- Agro-ecological mapping/zoning should be the preferred baseline for issuing permits/license for energy crop production in developing countries
  - Criteria should encompass environmental, social and economic issues

- Comprehensive biofuel (bioenergy) sustainability policy integrated into national development plans, where appropriate

- Biofuels derived from sugar cane and non-food based feedstock including residues were preferred options

- Increased support regarding 2nd Generation biofuels from agricultural residues:
  - research and development
  - access to finance, policy mechanisms i.e. mandates, blending targets, tax incentives etc
Acknowledgement – donor gov’ts/organizations

GNESD secretariat wish to thank:

- Government of Germany;
- Government of Denmark;
- Government of France;
- Government of Italy;
- Government of the United Kingdom;
- UN Foundation;
- UNDP (supported Energy Access activities & outreach activities in the RET theme)
- UNEP

THANK YOU

Emmanuel Ackom, Programme Manager,
UNEP Riso Centre
Email: emac@dtu.dk

Brazil
2nd Gen biofuel potential from agricultural residues (2010) - GNESD

<table>
<thead>
<tr>
<th>Crop</th>
<th>Residue</th>
<th>Prod</th>
<th>RPR</th>
<th>Res.</th>
<th>Sustain. Res.</th>
<th>Biochem. Eth</th>
<th>BTL (Diesel)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>type</td>
<td>(tonnes)</td>
<td>dry wt.</td>
<td>20% extraction</td>
<td>hydro. &amp; ferm. (low) (litres)</td>
<td>F-T (low) (litres)</td>
<td></td>
</tr>
<tr>
<td>Maize</td>
<td>Stalk</td>
<td>5.5E+07</td>
<td>1.5</td>
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<td>Rice</td>
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<td>2.2E+06</td>
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<tr>
<td>Sorghum</td>
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<td>5.1E+07</td>
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<td>Wheat</td>
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<td>Sugarcane</td>
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### Senegal

2nd Gen biofuel from agricultural residues

<table>
<thead>
<tr>
<th>Crop</th>
<th>Residue</th>
<th>Prod</th>
<th>RPR</th>
<th>Res. Sustain.</th>
<th>Biochem. Eth</th>
<th>BTL diesel</th>
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</thead>
<tbody>
<tr>
<td>type</td>
<td>(tonnes)</td>
<td>dry wt.</td>
<td>20% extraction</td>
<td>hydro. &amp; ferm. (low)</td>
<td>F-T (low)</td>
<td></td>
</tr>
<tr>
<td>Maize</td>
<td>Stalk</td>
<td>1.9E+05</td>
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<tr>
<td>Millet</td>
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<td>5.6E+06</td>
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<tr>
<td>Coconut</td>
<td>Husk</td>
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<td>6.1E+02</td>
<td>6.7E+05</td>
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<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>8.6E+05</td>
</tr>
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</table>

### Kenya

2nd Gen biofuel from agricultural residues

<table>
<thead>
<tr>
<th>Crop</th>
<th>Residue</th>
<th>Prod</th>
<th>RPR</th>
<th>Res. Sustain.</th>
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<tbody>
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<td>type</td>
<td>(tonnes)</td>
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<td>20% extraction</td>
<td>hydro. &amp; ferm. (low)</td>
<td>F-T (low)</td>
<td></td>
</tr>
<tr>
<td>Maize</td>
<td>Stalk</td>
<td>3.2E+06</td>
<td>1.5</td>
<td>4.1E+06</td>
<td>8.2E+05</td>
<td>9.0E+07</td>
</tr>
<tr>
<td>Millet</td>
<td>Stalk</td>
<td>5.4E+04</td>
<td>3.0</td>
<td>1.4E+05</td>
<td>2.8E+04</td>
<td>3.0E+06</td>
</tr>
<tr>
<td>Rice</td>
<td>Straw</td>
<td>8.0E+04</td>
<td>1.5</td>
<td>1.0E+05</td>
<td>2.0E+04</td>
<td>2.3E+06</td>
</tr>
<tr>
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<td>Stalk</td>
<td>1.6E+05</td>
<td>2.62</td>
<td>3.7E+05</td>
<td>7.3E+04</td>
<td>8.0E+06</td>
</tr>
<tr>
<td>Wheat</td>
<td>Straw</td>
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<td>1.2</td>
<td>5.2E+05</td>
<td>1.0E+05</td>
<td>1.2E+07</td>
</tr>
<tr>
<td>Coconut</td>
<td>Husk</td>
<td>4.4E+04</td>
<td>0.6</td>
<td>4.0E+04</td>
<td>7.8E+03</td>
<td>8.6E+05</td>
</tr>
<tr>
<td>Barley</td>
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<td>1.7</td>
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<td>2.0E+06</td>
</tr>
<tr>
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<td>Bagasse</td>
<td>5.7E+03</td>
<td>0.3</td>
<td>4.3E+03</td>
<td>8.6E+04</td>
<td>9.4E+06</td>
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<tr>
<td><strong>Total</strong></td>
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</tbody>
</table>

### Thailand

2nd Gen biofuel potential from agricultural residues (2010) - GNESD

<table>
<thead>
<tr>
<th>Crop</th>
<th>Residue</th>
<th>Prod</th>
<th>RPR</th>
<th>Res. Sustain.</th>
<th>Biochem. Eth</th>
<th>BTL diesel</th>
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<tbody>
<tr>
<td>type</td>
<td>(tonnes)</td>
<td>dry wt.</td>
<td>20% extraction</td>
<td>hydro. &amp; ferm. (low)</td>
<td>F-T (low)</td>
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<tr>
<td>Maize</td>
<td>Stalk</td>
<td>4.5E+06</td>
<td>1.5</td>
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<tr>
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<td>4.0E+07</td>
<td>8.1E+06</td>
<td>8.9E+08</td>
</tr>
<tr>
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<td>Stalk</td>
<td>5.4E+04</td>
<td>2.62</td>
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<td>2.7E+06</td>
</tr>
<tr>
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<td>Bagasse</td>
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<td>0.3</td>
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<td>1.0E+06</td>
<td>1.1E+08</td>
</tr>
<tr>
<td>Wheat</td>
<td>Straw</td>
<td>1.1E+03</td>
<td>1.2</td>
<td>1.1E+03</td>
<td>2.2E+02</td>
<td>2.5E+04</td>
</tr>
<tr>
<td>Cocoa</td>
<td>Pods, husk</td>
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<td>1.0</td>
<td>6.5E+02</td>
<td>1.3E+02</td>
<td>1.4E+04</td>
</tr>
<tr>
<td>Coconut</td>
<td>Husk</td>
<td>1.3E+04</td>
<td>0.6</td>
<td>7.0E+05</td>
<td>1.4E+05</td>
<td>1.5E+07</td>
</tr>
<tr>
<td>Coffee</td>
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<td>2.1</td>
<td>8.7E+04</td>
<td>1.8E+04</td>
<td>1.9E+06</td>
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<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.8E+07</td>
</tr>
</tbody>
</table>

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Share Knowledge to Increase Energy Access

– GNESD Energy Access Knowledge Base

21 March 2014

What's missing?

- Dead knowledge vs. Living knowledge
- Cultivate knowledge is just the start
- Share the knowledge is an important step
- Manage the knowledge effectively

A platform for energy access knowledge sharing

- Lack of access to practical and timely knowledge
- We need a platform to help facilitate the knowledge management process
- Gaps in the existing group of energy database
- The GNESD knowledge base developed to fill in the gap
Background of GNESD knowledge base

- Initiated at Vienna Energy Conference 2011.
- Covers Asia, Africa and Latin America.
- On-going collection of good examples of energy access initiatives
- Continuous contributions from 9 Member Centres of Excellence
- Welcome external volunteer contributions

What does GNESD knowledge base offer?

- Knowledge sharing ≠ Information sharing
- Knowledge sharing is synergistic: communication, collaboration and learning process
- The GNESD energy Access Knowledge Base provides users with an informational platform to spread innovative ideas and share successful experiences.
- Including policies, projects or programmes that led to increased access to energy services for households, communities or small scale businesses.
- Easy access to well-structured and searchable information on energy access

Methodology

- Energy access definition adopted
- Specific demand oriented
- A predefined template
- Quantitative data
- Qualitative analysis of socio-economic implications and poverty alleviation impacts
- The composite indices help understand the underlying context, causes of access change, financial and other resource requirements of each case.
How to use it?

- Map function
- Search function
- Browse without registration
- Register as a user
- Fill in the case template
- Peer review
- Publishing approved cases

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