Republic of Yemen
Ministry of Electricity and Energy
Rural Energy Access Project (REAP)

Executive Summary of the
Environmental and Social Impact Assessment

FINAL
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Prepared by
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Executive Summary

Introduction

Background

The National Rural Electrification Strategy (NRES) has established a methodological and institutional framework that seeks to address many critical issues in rural electrification development including appropriate policies and laws, political support, technical, engineering and financial issues. The NRES has recommended two modes for providing rural electrification services. The first mode is connecting rural areas of relatively high population density to the national grid, where the capital connection costs per household will be feasible (the NRES has considered connection cost of less than $1,000/customer to be feasible), accordingly the NRES has identified 27 service territories in 12 governorates in which 498,000 new customers could be connected to the national grid in three phases. The second mode of rural electrification will be in lower populated areas, where connection to the grid will be unfeasible, through off-grid systems. Off-grid systems will be provided in 11 governorates (8 governorates will have both modes of service and 3 governorates will only be served by the off-grid connection services) and will cover areas which have total population of 240,000 (in year 2005). The off-grid connection plans have been recommended in the Off-Grid Renewable Energy Development Strategy and Action Plan (OGREDS) which has been finalized in 2008.

The NRES has recommended delegating the rural electrification system operation to local cooperatives that will achieve community participation in the process from one hand and will form an efficient decentralized system from the other hand. Other alternative models, such as private sector operators will also be considered in places where the cooperatives are not welcomed by community.

REAP Objectives and Components

The development objectives of the proposed Project are to improve electricity access of rural populations and businesses in the selected Project areas in a financially and environmentally sustainable manner. The REAP interventions includes establishment of electricity distribution systems in 12 of the prioritized service territories in the NRES, comprising the first phase and part of the second phase of the NRES, to connect them to the national grid. The REAP will also include providing off-grid renewable energy systems to isolated rural communities in more than 50 districts. The REAP will have a technical assistance component that will include capacity building for the implementing agencies to undertake their correspondent services. This technical assistance component also includes developing LPG access strategy, which will be providing analysis of the current situation, of LPG access, and will include methods to improve this access.

The Environmental and Social Impact Assessment Objectives
This Environmental and Social Impact Assessment (ESIA) aims at identifying the potential environmental and social impacts of the REAP, and develop an environmental and social management plan for mitigation of the potentially negative impacts and for monitoring compliance with relevant environmental laws. A Resettlement Policy Framework (RPF) has also been developed to address cases where involuntary resettlement may occur.

Because of the large geographic extent of the project, and the fact that the exact subprojects will not be identified during the course of this ESIA, the ESIA will be carried out as a framework study, focusing at identifying the strategic environmental and social issues, rather than specific issues for certain subprojects.

**Legislative and Regulatory Considerations**

*Relevant Legislation in Yemen*

The Environmental Protection Law was issued in 1995 aiming at protection conservation of the environment and maintenance of its natural ecosystems. The Executive Regulations of the law has been issued by Decree of the Council of Ministers 148 for the year 2000. The Law includes certain regulations for performing Environmental Impact Assessment studies and handling of hazardous substances and wastes. However, during the preparation of this ESIA the licensing procedure for hazardous materials was not in place, therefore the Environmental and Social Management Plan (ESMP) has recommended abidance to this legal requirement when it is actively in place, but before then general best known practices of hazardous materials handling will be adopted until it is legally documented. Furthermore, because there were no hazardous waste handling and disposal sites available in Yemen during the preparation of this ESIA, the ESMP has dealt with hazardous waste issues using the Best Available Technology Not Entailing Excessive Costs (BATNEEC) concept.

The NRES has recommended issuing an Electricity Law that regulates rural electrification, establishing a new independent Rural Electrification Agency (REA), setting tariffs in order to meet service costs and establishing a financing mechanism for covering implementation costs. The proposed law mentions that decisions on public benefit of land needed should consider the Law of Acquisition for Public Use. Chapter twelve of the proposed law is regulating rural electricity in the country, where it indicates that REA shall be established, it shall enjoy independent financial and administrative authority and shall have the authority in all legal acts including the conclusion of loan agreements with donors and different regional and international organizations and to act on them in accordance with the law. Establishing REA shall be according to a Republican Decree that is expected to be officially issued during December 2008. Article 4 of the Decree states that among REA tasks is enhancing and applying the construction and design standards for rural electricity service providers and specifying good performance standards including maximum voltage drop, maximum voltage output, maximum line losses, and allowed proceeds for service providers.
Law 39 of 1998 (Law 39) concerning Cooperative Societies and Unions is the organizational and legal reference for all cooperatives and cooperative unions in the Republic of Yemen. This law is seen of relevance to the REAP because one of the important models proposed for the service delivery in rural areas are the electricity cooperatives. Article 142 stipulates that a decree of establishment under appropriate line Ministry shall be developed and forwarded to the Ministry of Social Affairs and Labor for approval and issuance. A draft ministerial decree was developed by Ministry of Electricity and Energy (MEE) for the establishment of Cooperative Societies for Electricity & Energy Services for Rural Areas. The decree stated the objectives of establishing the cooperatives and the key tasks and responsibilities for the Cooperatives to fulfill the objectives, which includes producing and distributing power to all population in its geographic territories, other commercial products related to electric power and providing electric power services with minimum cost and high quality in according to efficient management and sound economy.

International Conventions

Yemen has ratified many International conventions that have relevancy with the project. From the International Labour Organization (ILO) conventions, Yemen has ratified around 30 conventions that regulate labour standards and work conditions. The last ILO convention was ratified by Yemen in August 2008 and it is about the Seafarer’s Identity Document Convention. The oldest Yemen ratification returns to year 1976 and is about the Weekly Rest (Industry) Convention.

Yemen has also signed Stockholm Convention on Persistent Organic Pollutants (Signed: 12/05/2001; Ratified: 01/09/2004), which is a global treaty to protect human health and the environment from chemicals that remain intact in the environment for long periods, become widely distributed geographically and accumulate in the fatty tissue of humans and wildlife. The Convention requires signed parties to take effective measures to phase out equipment containing PCBs by the target year 2025 and make determined efforts to achieve environmentally sound management of waste containing PCBs by 2028 at the latest.

World Bank Safeguard Policies

The World Bank safeguard policies that are triggered by the REAP are OP 4.01 on Environmental Assessment and OP 4.12 on Involuntary Resettlement.

According to the World Bank Operational Policy on Environmental Assessment (OP 4.01) the REAP is classified as an environmental Category B, as a project that could have potential adverse environmental impacts on human populations and the environment. However, potential environmental impacts are site-specific and reversible that can be mitigated with the implementation of an environmental and social management plan. The Bank Operational Policy OP 4.12 on Involuntary Resettlement was the guideline that was followed in drafting the RPF that was prepared as part of the project in order to set a framework for the needed actions and policies that might be needed in case any of the
Project Description

On-grid Systems

The on-grid systems proposed under the REAP comprise electrification infrastructure, and the associated institutional set-up, in 12 of the prioritized service territories of the NRES. The REAP interventions includes construction of about 96 km 33 KV transmission line, 2,569 km of 11 KV lines, 7 substations (33/11 type of 5 MVA) and secondary equipment including transformers low voltage conductors and meters. This infrastructure is expected to serve 206,776 new consumers during the coming fifteen years.

Off-grid Systems

The off-grid areas targeted by the REAP cover more than 2,299 villages in 56 districts located in 11 Governorates. The planned off-grid systems include systems that would be operated through renewable energy sources including Photovoltaic (PV) systems and Wind Hybrid Systems (WHS). Namely the following types of systems shall be provided off-grid areas:

- Solar Lamp (SL) which comprise a PV panel, a charging battery and a small bulb. This system is considered suitable for the poorest households in villages of low density. The OGREDS has specified that the SL system is suitable for villages with 50-100 households with reasonable economics and for villages less than 50 households for low economics.

- Solar Home Systems (SHS) which usually comprise a PV panel, a battery, wiring, safety features such as fuses and disconnect switches, battery charge controllers, low voltage disconnects and meters for measuring current and voltage. The SHS system is available in different capacities; it could provide power is sufficient for meeting electricity needs for lighting and entertainment (TV and radio) for individual households. The SHS is considered suitable for low density rural settlements in the range of 100-450 households.

- PV systems that would be provided for isolated public facilities including rural health centers, schools, mosques and military checkpoints. These systems are of different capacities that would be suitable for different illumination, cooling and communication purposes.

- Wind Hybrid Systems (WHS) associated with Diesel Generator. This system usually comprise one or more (typically 3) wind turbines, auxiliary small diesel generator (for balancing low wind periods) a battery bank for energy storage, an inverter with a flexible power range, wiring, safety metering tools. This system is considered suitable for villages with relatively high load demand (villages of more than 150 households but
preferably for villages of more than 400 households) where wind speed and blowing hours could be reliable for the operation of wind turbines.

The REAP interventions in off-grid areas include provision of 20,000 off-grid systems, in which most of them are expected to be from the SHS type as they could serve large number of households.

**REAP Budget**

The total estimated budget for the REAP is US$ 115.8 millions, which will be provided by the International Development Association (IDA) of the World Bank, the Agence Francaise de Developpment (AFP), the Islamic Development Bank (IDB), the GOY, the United States Agency for International Development (USAID) and the The Government of Germany. The breakdown of the REAP budget and the contributions of different agencies is shown in Table E1 below.

**Table E1: Breakdown of REAP Budget (Figures in million US Dollars)**

<table>
<thead>
<tr>
<th>Financing Agency</th>
<th>Contribution in REAP Budget (Million US$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>WB/IDA</td>
<td>25.0</td>
</tr>
<tr>
<td>AFD</td>
<td>47.1</td>
</tr>
<tr>
<td>IDB</td>
<td>25.0</td>
</tr>
<tr>
<td>GOY</td>
<td>10.2</td>
</tr>
<tr>
<td>USAID</td>
<td>5.0</td>
</tr>
<tr>
<td>Government of Germany</td>
<td>3.5</td>
</tr>
<tr>
<td>Total</td>
<td>115.8</td>
</tr>
</tbody>
</table>
Project Alternatives

No Project Alternative

There will be many environmental benefits from the REAP project that could over-weigh its limited environmental impacts, in addition to achieving many developmental and socio-economic benefits. Therefore the no-project alternative is not an environmental/social requirement.

Location Alternatives

Generally there are few environmental constraints for locating substations, wind turbines and distribution lines. If these constraints were followed during the implementation of the project there will be no environmental objection on selecting sites for locating different utilities.

Renewable Energy Alternatives

If economics and technical aspects, in a particular village, do not favor wind systems, it is recommended to us solar energy systems. However, if mitigation measures recommended in the ESMP were implemented there would be no major environmental concerns for using WHS.

Service Providers Alternatives

The study of the project operation models alternatives revealed that a “one size fits all” model is not appropriate or applicable to the Yemeni context. Each of the different alternatives, namely Electric Cooperatives, private sector/ private contractors and NGOs/CDAs/User association have its own strengths and weaknesses. The proposed models for each of the service territories depended on the tribal conflict history in the area as well as on the previous case studies and service providers experiences. Cooperatives were recommended for the areas which are relatively stable conditions, social cohesion and those who have previous successful experience in cooperative both in electricity and in other sectors. This for instance was found to be the case in Al Hodiedah – 3, Lahj – 2, Ad Dhale – 1, Taiz – 1, Ibb -1 and Abyan – 1. In other places recommendations were made for two models, namely cooperatives and private contractors working under the supervision of REA. In these places, previous private contactors models proved successful (like the case in Al Mahweat). The same is also applicable to Amran – 1, Hajjah – 1, Dhamar – 1. Sana’a places and Al Baida
sites with no formal electricity service are found to be of more sensitivity to the issues of conflict. Cooperative model was seen to be inapplicable to those communities with plenty of conflicts among tribes and between tribes and the Government. The recommended model for those area is a partnership where a private contractor work under direct supervision from REA.

**Description of Baseline Environmental and Socioeconomic Conditions**

**Project Area**

The REAP shall be implemented in 15 Governorates which cover most of Yemen; therefore the project area has various characteristics, topography and climate according to different locations. Generally the project area could be classified, in its nature, to two main categories:

- Highlands including most of the project governorates, namely Ibb, Al Mahawet, Sanaa, Dhamar, Amran, Ad Dhale, Raimah, Al Baida, most of Taiz, most of Hajjah, most of Abyan and most of Lahj. Highlands are characterized by elevated topography, mild weather and relatively high depth of groundwater.

- Lowlands including Al Hodiedah, Al Mahra, Hadramout and parts of Taiz, Hajjah, Abyan and Lahj. Low lands are characterized by a relatively flat topography, hot and humid weather, and low depth of groundwater with possible interchange with seawater on coastal areas. Some of the low lands are important areas for birds’ migration, especially wetlands and coastal areas where it is usually resting points for birds’ migration between Asia and Africa contents.

**Agriculture**

Cultivated areas in Yemen is about 1.5 million hectares, in which about 1.3 million hectares are located in REAP governorates. In the 12 on-grid governorates the cultivated areas is about 18% of the total governorates area in average, it reaches as high as 24.5% in Hodeidah and as low as 2.7% in Lahj. This ratio reaches lower values in large governorates like Al Mahra and Hadramout (0.04 % and 0.3%, respectively of the total governorate areas). The majority of the crops lands is cultivated by cereals then fodder crops. There are few areas cultivated by legumes, vegetables, and fruits. The most widely cultivated crop is sorghum, followed by Qat and wheat.

**Socioeconomic Characteristics**

Around 42 percent of Yemen 19.2-millions population is living below the poverty line with a higher concentration in rural areas. Rural residents represent over 75% of the Yemeni population living in
scattered 41,800 hamlets. Rural areas of Yemen embrace about 83% of the poor and 87% of those who suffer from food poverty. The 1.5 million households in rural Yemen are largely dependent on agricultural production as the prime source of income and livelihoods. Agriculture is considered one of the least rewarding economic activities in terms of the value-added and profitability, particularly with degradation of land and water resources. The decline in the traditional livelihoods system of rural people led to their marginalization from the economic benefits. Their survival strategies sometimes have negative impact on their socio-economic conditions and on the natural resources.

**Gender Issues**

The situation of Yemeni women is challenged by many cultures and traditions that prevent them from participation. Yemen Gender development Index (DGI) is ranked 121st out of 140 countries. This suggests the big issues of inequalities that women face in Yemen. Girls, particularly in rural areas have neither equal education nor employment opportunities. Although a significant contributor to the household income, women contributions are usually unseen, unrecognized and underestimated, mainly because they are engaged in informal activities which is not recorded in statistics and because men are the key bread winner for the family. Women are overwhelmed with plenty of domestic responsibilities posed on them by the traditional labor distribution arrangements. This, among other factors, is considered one of the big challenges that prevent women from participation.

**Energy Access**

On studying the energy related issues, it was found that rural households, currently, rely on multi energy sources for different purposes. The majority of the rural areas lack access to electricity but people adapts different strategies in order to get some service even for very limited time duration everyday. The current institutions concerned with electricity provision are the Public Electricity Corporation (PEC), informal providers (rural residents), cooperative/Community Development Association (CDA) and contractors/small investors. The in-common shortfalls among all the delivery models is
the unreliability of service which resulted in many socioeconomic impacts, namely, inconvenient indoor conditions including lack of light, lack of machines like refrigerators, washing machines and satellite. This increased the work load done by women. Lack of electricity also affected the efficiency of social services that operate in villages. It is also seen as a reason for the increased number of drop outs in villages. The current situation also poses a financial load on families who pay for unreliable service and are obliged to pay for more sources to compensate the absence of electricity.

People showed high level of willingness to pay in return for a reliable electricity service. Women were found to be active player on the household level where they are the main actor in rationalizing electricity consumption, finding alternative sources (like fuel wood) and collect them from outside homes. Men, on the other hand, are the one who pay the cost of different energy sources needed at home. They are more active in energy management on the village level by participating in cooperatives or NGOs/CDAs and spell out complaints and coordinate with service providers. Women and children are more vulnerable to the negative impact of the current energy sources and practices.

**Potential Environmental Impacts and Mitigation Measures**

**REAP Environmental and Social Benefits**

The project will achieve important socioeconomic benefits that will lead to achieving developmental goals in rural Yemen. Among these benefits:

- Improving life standards of rural population and provision of an enhanced sense of wellbeing
- Providing better opportunities for education attainment as illumination and computing facilities will be provided to many education institutions
- Increase openness of rural population to the world and provide opportunities for better level of awareness though introduction of TV, satellite and computers
- Improving functioning of social services such as healthcare services which could utilize necessary equipment such as incubators and refrigerators
- Achieving economic development through direct job opportunities in the REAP and its associated services, such as RESP, contractors, construction workers and general entrepreneurs. Also economic development would be achieved through better performing business in different fields especially the services sector
Achieving benefits to women through improved awareness and openness, reduced efforts and improve efficiency of different home tasks through introduction of home appliances and providing active participation in local electricity organizations.

The REAP is also expected to achieve some environmental benefits through utilization of renewable energy in off-grid areas, which achieves utilization of clean energy and reduces the consumption of fossil fuel and associated emissions of carbon dioxide and other greenhouse gases. The estimated amount of carbon dioxide emissions that could be saved through utilization of 20,000 SHSs is 1,300 tons/year, this CO2 emissions would have been released if the same amount of renewable energy were generated by isolated diesel generators.

Impacts and Mitigation Measures during Construction Phase

- Risks associated with handling construction waste. For mitigating this impact the ESMP includes measures for adequate waste management procedures including preparation adequate waste storage areas and enforcing the construction contractor to manage site construction waste in an environmentally sound manner
- Certain limitations to land use in the ROW zone of power lines, such as trees planting corps and beehives. For mitigating this impact the ESMP included measures to minimize intersection between ROW zones and the above applications. An RPF has been prepared in case resettlement of some businesses were needed, however, according to ESIA analysis it is believed that there is a very little possibility for such cases
- Trees removal from the ROW zone which will lead to loosing their environmental benefits. For mitigating this impact the ESMP recommended plantation of trees in other locations in substitution of the removed trees.
- Air emissions during construction. For mitigating this impact the ESMP recommended wetting of soil, in loose sand areas, before excavation.
- Construction noise. For mitigating this impact the ESMP recommended protection of construction workers through provision of ear muffs and adequate management of working hours
- Impacts on traffic. For mitigating this impact the ESMP recommended providing storage areas for construction materials, wastes and equipment away from traffic lanes
- Impacts on culture and privacy of local communities through possible friction with construction workers. For mitigating this impact the ESMP recommended using local workers as much as possible.

Impacts and Mitigation Measures during Operation Phase

- Risks related to management of hazardous waste (such as waste batteries) and scrap. For mitigating this impact the ESMP has recommended
adequate waste management procedures, introducing program for collection and transportation waste batteries to recycling centers, establishment of an adequate area for scrap storage at the utility stores of the service territories, controlled selling of scrap and special waste, preparation of a controlled cell in the disposal site for disposal of special waste (such as unsold waste items) if required, introduce some measures to the procurement procedures of materials towards preferring PVC-free materials and apply waste minimization plan during design and construction

- Risks of electrocution and fire accidents. To mitigate this impact the ESMP recommended include safety measures in system design and construction, and carryout and awareness campaign for raising safety awareness.

- Risks of EMF. For mitigating this impact the ESMP recommended designing routes of power line as far as possible from developed areas, maintain a suitable ROW zone and regular monitoring of EMF.

- Risks of soil contamination in substations, transformers and diesel generators locations. For mitigating this measure the ESMP recommended control of oil changing and fueling activities.

- Special impacts of WHS such as noise, air emissions, birds colliding and discomforts to close residents. For mitigating this impact the ESMP has recommended placing WHS away from households and birds important areas

- Increase the economic burden on poor households though installation costs and service tariffs, reduction of income sources of some groups and increase vulnerability of certain groups. For mitigating these impacts the ESMP recommended supporting poor families, affected and vulnerable groups though adequate mechanism, facilitating suitable credit schemes and establishing transparent tariff structure.

- Exposure of rural communities to urbanized pattern of life. For mitigating this impact the ESMP recommended increasing awareness of rural communities about these subjects through targeted campaigns.

Environmental Management Plan

For implementing the ESMP it was recommended to establish an Environment, Health and Safety Department (EHS) within REA structure that will include an Environmental Manager and a Social and Awareness Officer (SAO). During the course of the project a Safety Officer, Environmental Officers and more SAOs may be recruited. However, because the establishment of the EHS Department is expected to be later to the project start date the REAP Project Management Unit (PMU) will be trained to oversee the implementation of the ESMP and the RPF until REA EHS department comes to activity. A waste storekeeper will be assigned in each of the service territories, who will be affiliated administratively to the service providers and will be supervised by REA EHS Department (and by the PMU until the EHS Department is established). The ESMP estimated budget is $ 255,000. Table E2 below presents a breakdown for this budget:
Table E2: Proposed ESMP Budget

<table>
<thead>
<tr>
<th>Item</th>
<th>Estimated Cost ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Budget for independent report on ESMP progress during midterm</td>
<td>20,000</td>
</tr>
<tr>
<td>Budget for environmental consultancy for assisting the PMU in</td>
<td>50,000</td>
</tr>
<tr>
<td>implementing the ESMP</td>
<td></td>
</tr>
<tr>
<td>Socioeconomic study for establishing targeting mechanisms for poor</td>
<td>25,000</td>
</tr>
<tr>
<td>families</td>
<td></td>
</tr>
<tr>
<td>Institutional/socioeconomic study on the possible conflict of</td>
<td>60,000</td>
</tr>
<tr>
<td>interests in different service territories</td>
<td></td>
</tr>
<tr>
<td>Training</td>
<td>100,000</td>
</tr>
</tbody>
</table>

Grand total 255,000

Consultation with Stakeholders

Consultation during the scoping phase

Consultation with stakeholders has been carried out during the scoping period through meetings with key stakeholders and community consultation activities. The main tools that have been adapted are focus groups discussion (FGD), semi structured interviews (SSI) as well as some individual in-depth interviews with some key informants. The main stakeholders categories that participated in the assessment included rural residents in targeted communities (men and women), natural leaders, relevant Governmental agencies, NGOs and service provision Cooperatives.

The carried out stakeholders consultations were very informative and enriched the ESIA. The qualitative findings that were integrated into this report are the interpretation of people’s local experiences and expectations. Both the study of the current situation as well as the predicted impacts from the project were developed in full participation with local people. The findings from the stakeholders' consultation were utilized and presented in details under the different ESIA sections.

Public Consultation Workshop

A public consultation workshop was hosted by MEE for discussing the findings of the Draft ESIA. The participants of the workshop included different stakeholders from Governmental organizations (Water and Environment, Agriculture, Health ad Population, Irrigation ... etc) NGOs, donors, University Professors and consultancy firms. Generally speaking, the presented ESIA key findings were very well received by different stakeholders. The identified impacts and the discussion on mitigation measures, the
ESMP and the service providers’ alternatives were seen to be strongly relevant to the project and cultural context of the country. The different issues raised during this workshop were highly considered during the production of this final version of the ESIA.

**Conclusion**

The REAP is expected to attain many important benefits that outweigh limited environmental and social impacts which could be mitigated through the proposed Environmental Management Plan.