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

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Environmental and Social Impact Assessment

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LIST OF ACRONYMS AND ABBREVIATIONS

AFP	Agence Francaise de Developpment
ARP	Abbreviated Resettlement Plan
AST	Above-ground Storage Tank
CAC	Cooperative and Agriculture Credit Bank
CCA	Chromated Copper Arsenate
CDA	Community Development Association
CFL	Compact Florescent Lamp
CSO	Central Statistical Organization
ECS	EcoConServ Environmental Solutions
EHS	Environment, Health and Safety
EIA	Environmental Impact Assessment
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
FGD	Focus group discussion
GDI	Gender Development Index
GIS	Geographic Information System
GOY	Government of Yemen
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit (German Technical Cooperation)
HES	Household Energy Supply Report
IDA	International Development Association
IDB	Islamic Development Bank
KEMCO	Korean Energy Management Corporation
KV	Kilo Volt
LPG	Liquefied Petroleum Gas
M&E	Monitoring and evaluation
mG	milliGauss
MDGs	Millennium Development Goals

MEE	Ministry of Electricity and Energy
MoAI	Ministry of Agriculture and Irrigation
MoFW	Ministry of Fish Wealth
MoIT	Ministry of Industry and Trade
MoPD	Ministry of Planning and Development
MoSAL	Ministry of Social Affairs and Labor (MoSAL)
MoTE	Ministry of Tourism and Environment
MoVTTE	Ministry of Vocational Training and Technical Education
MVA	Mega Volt Ampere
NESC	National Electric Safety Code
NRES	National Rural Electrification Strategy
O&M	Operation and Maintenance
OGREDS	Off-Grid Renewable Energy Development Strategy and Action Plan
PAH	Polycyclic Aromatic Hydrocarbons
PAPs	Project-Affected persons
PEC	Public Electricity Corporation
PMU	Project Management Unit
POP	Persistent Organic Pollutants
PRA	Participatory Rapid Assessment
PRSP	Poverty Reduction Strategy Paper
PV	Photovoltaic
RAP	Resettlement Action Plan
RE	Rural Electrification
REA	Rural Electrification Authority
REAP	Rural Energy Access project
RESP	Rural Electric Service Providers
ROW	Right-Of-Way
RPF	Resettlement Policy Framework

SAO	Social and Awareness Officer
SFD	Social Fund for Development
SHS	Solar Home System
SL	Solar Lamp
SIA	Social Impact Assessment
SSI	Semi Structured Interview
ST	Service Territory
ToR	Terms of Reference
UNDP	United Nations Development Program
USAID	United States Agency for International Development
USEPA	United States Environmental Protection Agency
USREA	United States Rural Energy Administration
UST	Underground Storage Tank
WB	World Bank
WHS	Wind Hybrid System
Wp	Watt peak
WUA	Water Users Association
WTP	Willingness To Pay
YR	Yemeni Riyal
YWU	Yemeni Women's Union

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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 components triggered involuntary resettlement. Furthermore, the World Bank Operational Policy OP 17.50 on “Disclosure” was followed for timely dissemination of information to affected local groups, including nongovernmental organizations.

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 Developpement (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)

Financing Agency	Contribution in REAP Budget (Million US\$)
WB/IDA	25.0
AFD	47.1
IDB	25.0
GOY	10.2
USAID	5.0
Government of Germany	3.5
Total	115.8

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 use 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 contractors 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 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 prevents 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 adapt 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 through 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 RESPs, 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 losing 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

Item	Estimated Cost (\$)
Budget for independent report on ESMP progress during midterm	20,000
Budget for environmental consultancy for assisting the PMU in implementing the ESMP	50,000
Socioeconomic study for establishing targeting mechanisms for poor families	25,000
Institutional/socioeconomic study on the possible conflict of interests in different service territories	60,000
Training	100,000
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 overweigh limited environmental and social impacts which could be mitigated through the proposed Environmental Management Plan.

1. Introduction

1.1 Background

Electrification rate in Yemen is among lowest rates compared to other countries in the Middle East. According to the statistics of 2004 only 41.5% of the households in Yemen is connected to the national electricity grid. Connection to the national grid for households in rural Yemen is well behind the previous average figure, with most of the rural population deprived from access to electricity. Most of the rural population uses kerosene lamps for illumination, which generates harmful fumes to the households, while a portion of the rural areas are served with irregular electrification service, only for few hours during night, provided by small scale diesel generators owned by private contractors.

Historically, rural electrification has been made through the Public Electric Corporation (PEC) which is an entity affiliated to the Ministry of Electricity and Energy (MEE). PEC has connected few rural areas to the national grid. However, the service currently provided for these rural areas has historically been problematic, with disproportionately high outage rates and limited hours of service that have strained the commercial relationship between PEC and the rural communities.

In 1997 the Government of Yemen (GOY) has approved a Power Sector Development Strategy Note, in which the GOY has committed it self to supporting a nationwide rural electrification (RE) program. In 2007 the National Rural Electrification Strategy (NRES) has been finalized. The NRES has established a methodological and institutional framework that seeks to address many critical issues in RE development including appropriate policies and laws, political support, technical, engineering and financial issues. The NRES has recommended issuing an Electricity Law that regulates RE, 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 NRES has also recommended delegating the RE 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.

Because of the various types of population density and topographic features in rural Yemen, the NRES has recommended different modes for providing the electrification services. The first mode is connecting the rural areas with 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 electrification will be in lower populated areas, where connection to the grid will be unfeasible, through off-grid systems. These 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 plans have been recommended in the Off-Grid Renewable Energy Development Strategy and Action Plan (OGREDS) which has been finalized in 2008.

Besides the low access of the rural population to electricity a large percentage of the rural population in the country is deprived from access to Liquefied Petroleum Gas (LPG) for cooking purposes and uses other sources of cooking fuel such as wood fuel, organic fuel and sometimes paper/cardboard fuel. The low efficiency and irregular heating value of such fuels adds to the development problems that are encountered by the rural population in the country, especially among women.

1.2 Initiation of the REAP

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 proposed Project would consider new public, private and community-based delivery models as well as grid and off-grid technologies. The primary indicators for the achievement of the development objectives will be:

- i. number of additional electrified households in the participating areas;
- ii. cost recovery of the local distribution entities; and
- iii. number of additional off-grid households provided with electricity based on renewable energy technology options (Solar Home Systems).

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 and 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. Options of providing the services and operation of the decentralized systems, including rural electric cooperatives, will be explored. The REAP will benefit from the issue of the new Electricity Law and the establishment of Rural Electrification Agency (REA) which is expected to be an entity, separate from PEC, that is responsible for supervising the construction and operation of the RE system. These legal and institutional modifications are expected to overcome the shortcoming of the old system of rural electrification.

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 the LPG access strategy, which will be providing analysis of the current situation, of LPG access, and will include methods to improve this access. It is worth noting that the REAP will not include investments in implementing LPG distribution improvements projects but will provide the strategy for possible implementation of its recommendations by other projects.

The GOY has requested support from the World Bank (WB) for implementing the REAP, accordingly the WB has issued a Project Information Document in February 2007 and has conducted a pre-appraisal mission in October 2008 to prepare for the project appraisal expected in early 2009.

Because the Yemeni Environmental Law and the World Bank environmental assessment safeguard policy require the preparation of environmental and social assessment for developmental projects, MEE has prepared Terms of Reference for the preparation of an environmental and social assessment for the REAP. Accordingly this Environmental and Social Impact Assessment (ESIA) has been prepared by EcoConServ Environmental Solutions (ECS) and JET for Engineering and Trading.

1.3 The ESIA Objectives

According to the Terms of Reference, this consultancy task has two main outputs; the first is the Environmental and Social Impact Assessment (ESIA) which have the following objectives:

- Assess the potential environmental and social impacts of the project in areas of implementation
- Compare the impacts in relation to relevant national and international requirements and guidelines
- Develop screening criteria for acceptability of project intervention from environmental and social aspects
- Develop an environmental and social management framework for mitigation of the potentially negative impacts and for monitoring compliance with relevant environmental laws
- Assess the capacity of the implementing agencies to implement the developed environmental and social management framework
- Develop a capacity building program to cover any identified gaps in the capacity of implementing agencies regarding environmental and social measures
- Develop a Resettlement Policy Framework (RPF) to address cases where involuntary resettlement may occur.

The second output is the Resettlement Policy Framework (RPF) indicated above. The objectives of the RPF are to:

- Assess the potential occurrence of any adverse social impact on settlement, property or livelihoods from the implementation of the project
- Review for the Yemeni national legislation and policies related to land acquisition and ownership, resettlement and compensation as well as the safeguards policies of the WB related to involuntary resettlement and identify any gaps between Yemeni legislation and Bank policies
- Prepare RPF that shed the light on the Project-Affected Persons (PAPs), compensation, methods for valuing and delivery of entitlements, grievance mechanisms and monitoring process. RPF should also include measures to ensure that PAPs are informed about their options and rights, consulted and offered technically and economically feasible choices and alternatives.
- Prepare a resettlement action plan (RAP), based on the RFP, for any of the determined project sites for which land acquisition will occur.

1.4 The ESIA Methodology

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. Thus, the ESIA included collecting data from previous reports and studies for obtaining background data about environmental and socio-economic characteristics of the project area. Literature review included both reports provided by the client as well as web based resources, which helped in assessing:

- The environmental and socio-economic characteristics of the targeted rural areas
- Project background and proposed interventions
- The legal, institutional and organizational framework and background of the electricity sector and the historical background
- The Yemeni legislations and the WB safeguard policies related to resettlement issues
- Environmental and social standards and guidelines for related environmental and social issues
- People current expenditure in the different energy sources and their willing to pay (WTP) for the new intervention

In addition to literature review structured site visits were undertaken to collect primary data in order to get stakeholders perceptions about some issues, especially social issues, such as:

- People perceptions towards the project,

- The current energy sources and their impacts on the families' livelihoods particularly on the vulnerable groups (children, women, the poor),
- Gender issues related to energy management on the level of household and village,
- Existing service providers, their strengths and weaknesses,
- The viability of the Cooperatives, NGOs, private sector as models for service provision in their areas as well as key issues to consider in forming cooperatives,
- The short and long term impacts predicted from the project,
- Ideas for maximizing the positive benefits especially on people's livelihoods and the economic development,
- The social power dynamics and the different interests of different stakeholders,
- People's WTP for the service costs and their ability to afford the fees required for getting connected to the service and whether any community organization could offer credit for this aim, and
- Consult with project-affected groups and local non-governmental organizations about potential resettlement issues, and take their views into account,

Due to the large extent of project area and the limited timeframe of the EAS, selection criteria were developed in order to select site visits that could be representative for certain key factors, including:

- Geographic and topographic conditions,
- Tribal and historical backgrounds,
- Culture and tradition,
- The nature and providers of electricity service,
- Economic activities and
- The existence and level of activities for cooperatives and NGOs.

The main tools that have been adapted during the survey are focus groups discussion (FGD); semi structured interviews (SSI) as well as some individual in-depth interviews with some key informants.

2. Legislative and Regulatory Consideration

2.1 General Environmental Regulations In Yemen

2.1.1 Environmental Protection Law (Law No. 26 of 1995)

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 requires the preparation of an environmental impact assessment study as a licensing prerequisite for new projects as stipulated in Article 35: *"It is not permissible for any competent body to give permission or issue a license to establish or operate or amend projects or establishments that effects and damage the environment or contribute to its deterioration or causing its pollution or participate in occurring such effect or harm human health or other living organisms, only in accordance to the standards or criterias or specifications or conditions that are determined and specified by the council¹".*

For handling hazardous substances and wastes, the law stipulates, in Article 44, that handling hazardous materials is not allowed without permission from the competent body, the Law indicates that a list of hazardous materials would be prepared however, this list was not available during the preparation of this ESIA. Article 50 of the law stipulates that is it is prohibited to dispose or discharge hazardous materials unless all necessary measures and precautions, to prevent any risks of such disposal or discharge, are taken.

Handling of some hazardous substances (such as transformers mineral oils, wind turbines lube oils and diesel²) are expected among REAP activities. Also there may be some amounts of hazardous waste generated through the REAP activities (such as used containers of the previous hazardous materials and possibly contaminated soil). 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) in Chapter 7 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.

It is worth noting that there was no hazardous waste handling and disposal sites available in Yemen during the preparation of this ESIA, therefore the ESIA has dealt with

¹ The Environmental Protection Council has been changed to the Environmental Protection Authority

² Although there were no legal lists of hazardous materials issued before the preparation of this ESIA, these materials could be classified hazardous due to their toxic and flammability properties

hazardous waste issues using the Best Available Technology Not Entailing Excessive Costs (BATNEEC) concept. The proposed Environmental Health and Safety (EHS) Department in REA (which is further detailed in Chapter 7) should review the ESMP measures related to hazardous waste management in light of any new legal details or establishment of an approved hazardous waste handling sites or transportation facilities.

2.1.2 Electricity Law

The draft Electricity Law has been approved by the Cabinet and being reviewed, during the preparation of this ESIA, by the Parliament. The law is expected to be issued by December 2008. The law is governing electricity generation, transmission, distribution and supply.

Article 4 of the Law specifies the objectives of the law in the following points:

- Insuring electrical energy security of the Republic.
- Varying the sources of environmentally friendly power production including renewable energy and relying on it as a sustainable source of energy.
- Organized and effective developing in such a way that guarantees functional separation of electrical energy services and achieving efficient management on economic and commercial bases.
- Ensuring the preparation and application of tariffs in an economically fair, sound and transparent method according to the type of electrical service provided.
- Ensuring the safety, sustainability and quality of electrical service.
- Regulating the relationship in the sector between the consumers and the licensees and any other entities related to the provision of electrical service on fair and equitable basis.
- Encouraging local and foreign investment in the activities of the sector.

The law regulates issues related to tariff (Chapter eight). It states that setting tariff should consider the financial sustainability (costs of operation and maintenance) as well as economic, financial, social and environmental factors. Under the electricity law, any licensee (entity) that charge higher sums than the approved tariffs shall refund such sums to their owners.

Chapter ten of the law spells out that electricity projects should be dealt with as public benefit projects and that decisions on public benefit of land needed should consider the Law of Acquisition for Public Use. It also clarified that high voltage electrical lines shall be considered public right-of-ways (ROW) with width not less than 12 meters.

Chapter eleven of the law regulates the obligations and rights of the consumer. It focus on the means of measuring the supply power and that it should be done by the approved testing and measuring devices compliant with the specifications and standards stated in

the Regulations. Licensed consumers should be responsible for collecting consumers' fees according to the approved tariffs and recorded readings in the approved measuring devices. It also states that *"No consumer shall be exempted from paying the cost of consuming electrical power"*. It also states the cases where the distribution licensee may disconnect consumer service from the service. Under Article (36) of the same chapter, the law stated that MEE shall formulate procedures for allowing public comment on tariff issues and applications before the Board, including the issues presented by the consumers or any other issues that concern them and protecting their rights, in such a way that guarantees the application of this Law and the Regulations. Article (38) of the same chapter stated that dealing with consumers shall be on the basis of fairness and equally applied rules without discrimination.

Chapter twelve is regulating rural electricity in the country, where the Law indicates that REA shall be established and that 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. Article (40) of the Law stipulates that The Authority shall aim at implementing the national plan for rural electricity through the provision of electrical power to rural areas of the Republic in such a way that guarantees the following:

- Achieving parallel development in a comprehensive economic manner through provision of future power needs to rural areas in the framework of the general policy of the State.
- Effective planning and development of programs and all needed activities to obtain universal electrification in rural areas or provide other commercially or economically and environmentally sustainable types of electrical services within the Republic.
- Enhancing productive and efficient economic use of energy to stimulate rural development with a special focus on increased use of energy towards activities that increase the income of the population.
- Coordinating the activities of the Authority with the tasks and activities of other government apparatuses that participate in enhancing or regulating rural electricity in order to guarantee financial sustainability for the legal entities participating in the provision of rural services to subscribers

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. However, these standards were not available during the preparation of this ESIA.

2.1.3 Legislation Related to Resettlement and Compensation³

From the Yemeni legislations and in relation to resettlement issues, the following are the key relevant legislations:

Yemeni constitutions dealt with resettlement issues, most importantly Article 20 and 7 that regulate issues around private land property. Article 18 and 19 about issues related to public land/ Government owned land and Article 22 about the Waqf/ Endowed land. Article 7 of the constitution deals with Agriculture land.

The civil law also like article 1159, 1154 on private land property and Articles 527, 756, 761, 765, 770 and 1159 on Agriculture land. Articles 1161, 1163, 1164 governs neighborhood rights

Law no. 21 of 1995 and the Republican Decree no. (170) of 1996 related to the same law regulate issues around the Real Estate and the common use of land as well as rights of squatters.

There is also the Waqf law no. (23) 1992 and Estates Republic Decree No. (99) 1996

Law (1) of year 1995, regulates all the issues related to land acquisition with different types for different purposes.

2.1.4 Cooperatives Societies and Unions Law (Law No. 39 of 1998)

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 ESIA because one of the important models proposed for the service delivery in rural areas are the electricity cooperatives.

Law no. 39 of 1998 grants a relevant Ministry and its departments and branches in the governorates the right to supervise and assure compliance with relevant laws, and provide advice and technical assistance to the cooperatives to plan their activities as well as to attend their General Assembly meetings. It defines five specific types of cooperatives. Any other type of cooperative, such as a rural electric cooperative, can be created according to the provision of Article 142, which states that it is lawful to establish other cooperative societies, according to provision of this Law, in other services. More specifically, 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 MEE for the

³ The legislation related to resettlement are explored in more details in the Resettlement Policy Framework (RPF)

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.

The main objectives of the cooperatives are to produce and distribute power to all population in its geographic territories and other commercial products related to electric power. They shall provide electric power services with minimum cost and high quality in according to efficient management and sound economy.

The key duties of cooperatives are defined, among others, as distributing electric power services produced by the society or transferred from the main grid or made from other sources of energy. They are also responsible on conducting any other commercial business related to electrical power. The full draft decree for establishing the of Cooperative Societies for Electricity & Energy Services for Rural Areas is attached in Annex III of this report.

A need is still seen to introduce some modifications to Cooperative Law 39 to include Rural Electric Cooperative Societies.

2.2 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.

Table 2-1: List of ILO Conventions ratified by Yemen⁴

Convention	Ratification Date
<u>C14 Weekly Rest (Industry) Convention, 1921</u>	1976
<u>C15 Minimum Age (Trimmers and Stokers) Convention, 1921</u>	1969
<u>C16 Medical Examination of Young Persons (Sea) Convention, 1921</u>	1969
<u>C19 Equality of Treatment (Accident Compensation) Convention, 1925</u>	1969

⁴ Source: <http://www.ilo.org/ilolex/english/newratframeE.htm>

<u>C29 Forced Labour Convention, 1930</u>	1969
<u>C58 Minimum Age (Sea) Convention (Revised), 1936</u>	1969
<u>C59 Minimum Age (Industry) Convention (Revised), 1937</u>	1969
<u>C64 Contracts of Employment (Indigenous Workers) Convention, 1939</u>	1969
<u>C65 Penal Sanctions (Indigenous Workers) Convention, 1939</u>	1969
<u>C81 Labour Inspection Convention, 1947</u>	1976
<u>C86 Contracts of Employment (Indigenous Workers) Convention, 1947</u>	1969
<u>C87 Freedom of Association and Protection of the Right to Organise Convention, 1948</u>	1976
<u>C94 Labour Clauses (Public Contracts) Convention, 1949</u>	1969
<u>C95 Protection of Wages Convention, 1949</u>	1969
<u>C98 Right to Organise and Collective Bargaining Convention, 1949</u>	1969
<u>C100 Equal Remuneration Convention, 1951</u>	1976
<u>C104 Abolition of Penal Sanctions (Indigenous Workers) Convention, 1955</u>	1969
<u>C105 Abolition of Forced Labour Convention, 1957</u>	1969
<u>C111 Discrimination (Employment and Occupation) Convention, 1958</u>	1969
<u>C122 Employment Policy Convention, 1964</u>	1989
<u>C131 Minimum Wage Fixing Convention, 1970</u>	1976
<u>C132 Holidays with Pay Convention (Revised), 1970</u>	1976
<u>C135 Workers' Representatives Convention, 1971</u>	1976
<u>C138 Minimum Age Convention, 1973</u>	2000
<u>C144 Tripartite Consultation (International Labour Standards) Convention, 1976</u>	2000
<u>C156 Workers with Family Responsibilities Convention, 1981</u>	1989

<u>C158 Termination of Employment Convention, 1982</u>	1989
<u>C159 Vocational Rehabilitation and Employment (Disabled Persons) Convention, 1983</u>	1991
<u>C182 Worst Forms of Child Labour Convention, 1999</u>	15:06:2000
<u>C185 Seafarers' Identity Documents Convention (Revised), 2003</u>	06:10:2008

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.

2.3 World Bank Safeguard Policies and Guidelines

2.3.1 OP 4.01 – Environmental Assessment

The REAP has been classified as a Category B project, requiring an environmental assessment in accordance with the Bank's Operational Policy on Environmental Assessment (OP 4.01). Projects under Category B in general could have potential adverse environmental impacts on human populations or environmentally important areas - including wetlands, forests, grasslands, and other natural habitats. The impacts are site-specific, reversible and temporary in nature.

The environmental impacts that are likely to be caused by the project have been analyzed in this ESIA. Mitigation measures were identified for all expected negative impacts, along with an Environmental and Social Management Plan (ESMP) presenting mechanisms for implementation of these mitigation measures.

2.3.2 OP 4.12 – Involuntary Resettlement

Involuntary Resettlement safeguard policy addresses impacts related to the REAP project. The policy deals with involuntary resettlement in wider terms than the physical displacement of people due to development projects. It rather considers individuals who might be subjected to adverse economic, social, or cultural impacts. OP 4.12 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 components triggered involuntary resettlement.

2.3.3 OP 17.50 – Disclosure

WB policy OP 17.50 on “Disclosure” is also seen to have relevancy to the project. This Policy details the Banks requirements for making operational information available to the public. The Bank reaffirms its recognition and endorsement of the fundamental importance of transparency and accountability to the development process. In addition, timely dissemination of information to local groups affected by the projects and programs supported by the Bank, including nongovernmental organizations, is essential for the effective implementation and sustainability of projects. The ESIA and RPF have been disclosed and is publicly available. Announcement has been made in the local newspapers indicating that the reports (with executive summary in Arabic) are available at: (a) Office of the Project Management Unit, Rural Energy Access Project, Ministry of Electricity and Energy; (b) Public Information Center, Sana’a University; and (c) Offices of the Governors of the Governorates of Taiz, Amran, Hajjah, Dhamar, Al-Mahweet, Ibb, Al-Baida, Lahj, Sana’a, AQI-Hodeidah, Abyan and Al-Dhale. In addition, the report is t the World Bank in Washington D.C. and in Yemen at the local governorate offices and on the PEC website at www.pec.com.ye. The reports are also available at the World Bank Infoshop in Washington DC. and on the World Bank website.

3. Project Description

3.1 Project Components

3.1.1 Connecting Rural Areas to the Grid (Service Territories)

The NRES has categorized Rural Electrification in Yemen into two main categories: the first is expansion and connection of new rural areas to the national grid, and the second is providing isolated rural communities with off-grid systems provided with renewable energy generation sources. The distinction between the two modes of services has been based upon the feasibility for connecting a certain rural settlement to the national grid, where a threshold construction cost of \$ 1,000/customer was considered the maximum feasible for on-grid figures.

The REAP will include implementation of both categories according to the findings of the NRES and the Off-Grid Renewable Energy Development Strategy and Action Plan (OGREDS).

The NRES has identified 27 service territories, in 12 of the Yemeni governorates, for rural electric expansion and integration into the national grid. The remaining 9 governorates are either considered of an urbanized nature, such as Sanaa City and Aden, or characterized by a dramatically dispersed settlement patterns, such as Al Mahra and Shabwa.

The identification of these service territories has been done through application of certain criteria to a Geographic Information System (GIS). The following factors have been used to identify the borders of the service territories:

- The service territory should interconnect existing rural electric systems to achieve a minimum of 10,000 but no more than 40,000 consumers
- The service territory should allow for immediate expansion to connect rural communities within a buffer of approximately ten kilometers
- The goal of the newly established service territory should be to consolidate isolated distribution system through interconnection, and to either provide power through interconnection to the national transmission system, or to consolidate power generation in a single, larger power plant
- Where possible, no more than four service territories should be created per governorate, unless the above criteria cannot be satisfied

The borders of the 27 service territories, along with the requirements of the distribution system in each service territory, have been identified based upon the above criteria. Because the construction of the 27 service territories could not be finalized in one phase

due to the large investment requirements and efforts to be made, the NRES has prioritized these service territories according to a criteria based upon:

- Economic efficiency as projects with the lowest required subsidy and lowest cost per consumer were prioritized
- Geographic balance so that no more than one project per governorate has been included in the priority list

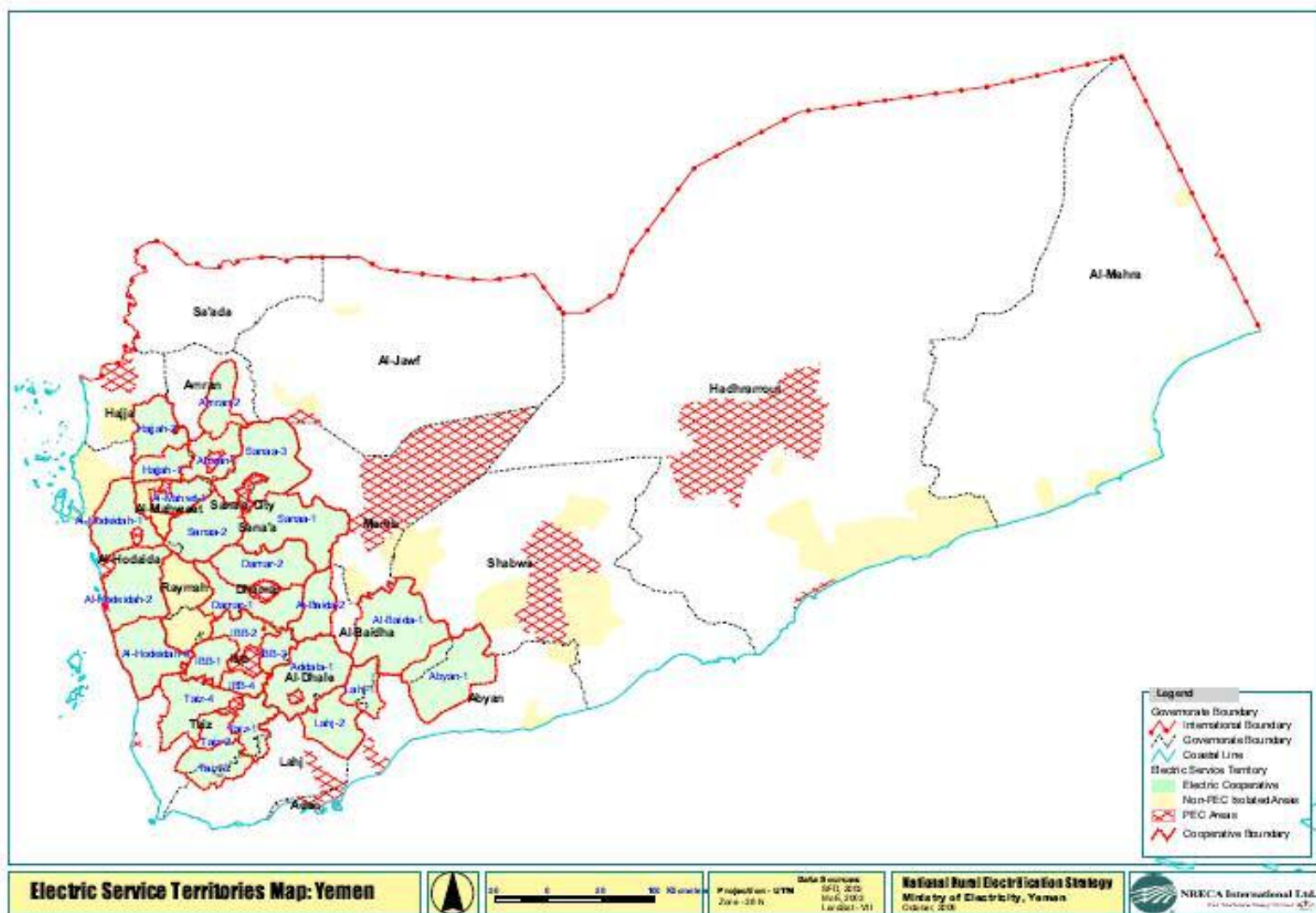
According to the above criteria the NRES has recommended implementing the identified projects in 3 phases, the first phase (including prioritized projects) includes 10 service territories, and the second phase includes 5 other service territories, while the third phase includes the remaining 12 service territories.

The REAP is aiming to implement the electrification infrastructure, and the associated institutional set-up, in 12 of the prioritized service territories of the NRES: 10 service territories of NRES phase one and 2 of the service territories of NRES phase two projects, so that 12 of the governorates covered by NRES will be also covered by the REAP. 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. The proposed REAP interventions are illustrated in Table 3-1. Figure 3-1 shows the locations of the 12 service territories that shall be covered by the REAP, while the maps of 12 service territories and their proposed interventions are presented in Annex 1.

Table 3-1: REAP interventions in the 12 service territories to be connected to the national grid

Service Territory	No. of New Consumers	Length of 11 KV line (km)	Length of 33 KV line (km)	No. of Substations (5 MVA)
Ibb -1	20,480	116.49	8.51	1
Taiz – 1	22,011	146.05	-	-
Hajjah – 1	20,525	215.45	9.59	-
Al Mahawet – 1	12,962	202.96	6.21	1
Al Hodiedah – 3	36,919	339.44	-	-
Sanaa – 1	19,184	224.52	-	-
Dhamar – 1	20,598	311.14	-	-
Amran – 1	13,460	196.17	19.13	1
Abyan – 1 (Phase II in NRES)	3,110	111.45	33.67	2
Lahj – 2	3,524	60.57	-	-
Ad Dhale – 1 (Phase II in NRES)	27,257	507.51	18.82	2
Al Baida - 2	6,746	136.73	-	-

Figure 3-1: Location of the 12 service territories to be connected through the REAP (10 of the service territories are marked for phase 1 of the NRES while Abyan-1 and Ad Dhale-1 phase 2 of the NRES)



The finalization of the distribution systems illustrated in the above table is expected to raise the power demand on the national grid to satisfy the needs of the new customers. The NRES has estimated the total power demand in the proposed service territories to increase by about 39 MW to reach a total of about 129 MW after 15 years from the project operation. The expected power demands in the 12 REAP service territories are illustrated in Table 3-2.

Table 3-2: Power demand for the 12 service territories

Service Territory	Power Demand (KW)				Energy Purchase (kwh)			
	Year 1	Year 5	Year 10	Year 15	Year 1	Year 5	Year 10	Year 15
Ibb -1	8,209	10,241	11,047	11,918	35,083,530	44,217,087	48,267,447	52,696,727
Taiz – 1	10,923	13,239	14,280	15,406	46,738,998	57,210,646	62,451,237	68,182,098
Hajjah – 1	8,939	11,020	11,887	12,824	38,217,096	47,592,660	51,952,228	56,719,644
Al Mahawet – 1	7,139	8,546	9,219	9,946	30,489,156	36,870,681	40,248,098	43,941,479
Al Hodiedah – 3	11,200	14,640	15,792	17,036	47,928,618	63,283,133	69,079,974	75,419,124
Sanaa – 1	6,140	7,948	8,573	9,249	26,203,338	34,275,931	37,415,664	40,849,126
Dhamar – 1	9,100	11,197	12,078	13,030	38,910,618	48,359,931	52,789,782	57,634,056
Amran – 1	7,753	9,236	9,963	10,748	33,126,570	39,859,492	43,510,688	47,503,463
Abyan – 1	4,968	5,509	5,943	6,411	21,169,458	23,705,113	25,876,541	28,251,111
Lahj – 2	2,000	2,386	2,574	2,778	8,424,810	10,169,461	11,101,001	12,119,688
Ad Dhale – 1	9,198	11,975	12,723	13,726	39,330,252	50,952,596	55,619,940	60,723,924
Al Baida - 2	4,333	5,104	5,506	5,940	18,441,810	21,949,564	23,960,182	26,158,896
Totals	89,902	111,041	119,585	129,012	384,064,254	478,446,295	522,272,782	570,199,336

3.1.2 Providing Areas with Off-Grid Systems

The areas which have been included in the OGREDS are the areas that do not meet NSER service territories criteria and are not in the PEC extension plan. The OGREDS has also set screening criteria for selecting rural settlements to be prioritized:

- Household densities in the rural settlement or villages, as settlements with larger number of households were given higher priority as they will be more economically viable. It is worth noting that villages with less than 50 households are generally screened out of the project due to the high costs of implementation⁵.
- Poverty index of the villages, as villages with higher ability to pay for energy services were given higher priority. Villages with Poverty Index Levels 1, 2 and 3 were considered in the OGREDS, while villages with Poverty Index 4 were screened out.

⁵ However, villages of less than 50 households could still be included in the project if there is demand for solar lamps as shall be discussed later

The off-grid areas identified by the OGREDS according to the above criteria cover more than 2,299 villages in 56 districts located in 11 Governorates, as illustrated in Table 3-3, in addition to 3,977 villages of less than 50 households. The number of households registered in these selected areas in year 2005 is more than about 180,000 households, in addition to about 60,000 households in villages of less than 50 households. Further to households the off-grid systems will also cover a number of isolated public facilities including rural health centers, schools, mosques and military checkpoints.

Table 3-3: Number of villages by household size distribution category identified by OGREDS

Governorate	Number of villages by household distribution						
	< 50 (screened out)	50-100	101-150	151-200	201-300	301-450	> 450
Al-Mahara	75	2	2	2	1	0	0
Hadramout	1,783	138	41	13	17	5	2
Raimah	51	110	28	12	4	4	0
Taiz	8	2	4	1	7	6	12
Hajjah	386	101	12	12	5	7	5
Al Mahawet	168	175	78	32	12	3	2
Al Hodiedah	29	17	6	8	1	4	4
Amran	286	139	339	166	376	180	8
Abyan	298	15	6	0	1	0	1
Lahj	670	51	15	6	10	4	2
Al Baida	223	63	13	2	3	2	0
Totals	3,977	813	544	254	437	215	36

It has been recommended to use renewable energy sources for power generation in these off-grid areas, which are considered sustainable sources. The OGREDS has recommended the use of solar energy as primary source, because solar radiation is sufficient all over the county, with possibility to use wind energy in areas that may have sufficient wind, such as coastal areas, pending more accurate wind measurements during the first stages of the project. Namely three power systems have been recommended:

- 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 as illustrated in Table 3-4. The SHS is considered suitable for low density rural settlements in the range of 100-450 households.

- 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 OGREDS estimated the number of villages that meets these criteria by 23 villages.

Table 3-4: Off-grid renewable solar energy sources and their power supply capabilities for households

System Type	System Capacity	Daily Power Supply (Watt-hrs) ⁶	Possible Usage	Suitable Village population	Market potential (No of units)	No. of potential villages to apply	Suitable areas to apply
SL	5 Wp	25	Lighting 4W bulb for 4-5 hours per day	< 50	66,771 ⁷	3,977	
				50-100	54,918	813	
SHS	20 Wp	100	Highlands: Lighting 3 CFLs (11 W) for 3 hrs	100-450	54,981	2,263 ⁸	High lands
	50 Wp	250	Highlands: Lighting 3 CFLs (11 W) for 4 hrs Lowlands: Lighting 3 CFLs for 4 hrs and a 20 W fan for 5 hrs	100-450	37,477		All districts

⁶ Estimated peak sunlight is for 5 hours per day

⁷ Although the OGRERS has mentioned that installing SLs in villages less than 50 households will have very low economics, there may be potential for such units, among these villages based on supply and demand patterns, during the project implementation

⁸ This number is representing the number of villages of populations between 50-450 households previously presented in Table 3-3. In addition to this number there is 3,977 village with population less than 50 households that could alternatively use SL systems although the installation costs may be very high

System Type	System Capacity	Daily Power Supply (Watt-hrs) ⁶	Possible Usage	Suitable Village population	Market potential (No of units)	No. of potential villages to apply	Suitable areas to apply
	100 Wp	500	Highlands: Lighting 4 CFLs (11 W) for 4 hrs and a TV (60 W) for 4 hrs Lowlands: Lighting 4 CFLs (11 W) for 4 hrs, a TV (60 W) for 4 hrs and a fan (20 W) for 4 hrs	100-450	16,093		
WHS	3x25 kw wind turbines, 1x30 kw diesel generator and 300 kwh battery	312,500	Normal electricity consumption for isolated rural areas identified by PEC (1.25 kwh / household / day)	> 150	23	23	Districts with coastal areas ⁹

For off-grid power supply for public facilities such as health centers, schools, mosques and military checkpoints the SHS will not be sufficient to meet their power demand, therefore different PV arrays will be used as illustrated in Table 3-5.

Table 3-5: Off-grid renewable energy sources and their power supply capabilities for public facilities

Type of facility	Location ¹⁰	Capacity of PV unit(s) (Wp)	Possible Usage	Market potential (No of units)
Health Centers	Highlands	490	4 lamps (18W) 6 hrs/day + 5 lamps (11W) 5 hrs/d + freezer (12 V)	285
	Lowlands	1,120	4 lamps (18W) 6 hrs/day + 5 lamps (11W) 5 hrs/d + 4 fans (50W) 6 hrs/d + mosquito lamp (50W) 12 hrs/d + freezer (12 V)	
Schools	Highlands	280	10 lamps (11W) 5.6 hrs/day	1,025

⁹ These districts are in the Governorates of Hadramout, Abyan, Lahj, Taiz, and Al Hodeidah. However, the OGREDS has put a condition about the suitability of these 23 villages which undertaking representative wind measurements

¹⁰ Highlands need less power supply for refrigeration and air conditioning

Type of facility	Location ¹⁰	Capacity of PV unit(s) (Wp)	Possible Usage	Market potential (No of units)
	Lowlands	910	10 lamps (11W) 5.6 hrs/day + 6 fans (50W) 6 hrs/d + 2 mosquito lamps (50W) 2 hrs/d	
Large mosques	Highlands	140	5 lamps (18W) 3 hrs/day + 2 lamps (7W) 3 hrs/d + amplifier (50W) 1.5 hrs/d	1,900
	Lowlands	280	5 lamps (18W) 3 hrs/day + 2 lamps (7W) 3 hrs/d + 2 fans (50W) 3 hrs/d + mosquito lamp (50W) 2 hrs/d + amplifier (50W) 1.5 hrs/d	
Small mosques	Highlands	60	2 lamps (18W) 3 hrs/day + amplifier (50W) 1.5 hrs/d	2,850
	Lowlands	140	2 lamps (18W) 3 hrs/day + 1 fans (50W) 3 hrs/d + mosquito lamp (50W) 2 hrs/d + amplifier (50W) 1.5 hrs/d	
Checkpoints	Mobile offices	1,200	Lighting, PC, printer, TV, fax, wireless phone, fan, refrigerator, charging cell phone, blender.	200
	Large checkpoints	680	Lighting, fax, wireless phone, fan, refrigerator, charging cell phone	
	Small checkpoints	480	Lighting, fan, refrigerator, charging cell phone	

3.2 Institutional Set-up for Rural Electrification

Historically rural electrification has been made through PEC but without recognized criteria for prioritization of rural electrification projects. In order to overcome such institutional draw-backs the NRES has recommended the establishment of a Rural Electrification Agency (REA) to undertake the following responsibilities:

- Supporting formation and development of the rural electric service providers that will design, develop, and operate conventional and renewable energy electrification systems within defined service territories
- Definition of rural electric service provider master plans. As each rural electric service provider is formed, a master plan that defines the implementation sequence of sub-transmission lines interconnecting the service territories to the transmission grid, installation of 33/11 substations, construction of 11 kV feeders and laterals, and electrification of communities. Master plans will be updated periodically to accommodate changes in population and load growth, a process that will also be overseen by the REA.

- Defining and ensuring application of design and construction standards
- Design and provision of training programs for rural utility managers, administrators, engineers, linemen, and other professionals and technicians
- Definition of annual program plans that will include establishing annual budgetary program expansion targets, as well as allocation of funds to achieve political and geographic balance.
- Definition and implementation of operating policies and procedures for REA borrowers as the basis for the process of performance monitoring, including key technical and financial ratios, reporting processes, and recovery programs for troubled borrowers
- Definition of regulations and guidelines for program grants and loans that will be administered by the REA financial management entity

The Decree forming REA was in the approval process during the preparation of this ESIA and it is expected to be finalized by December 2008. REA shall be totally independent and shall report directly to the MEE. Figure 3-2 illustrates the relation between REA and other stakeholders.

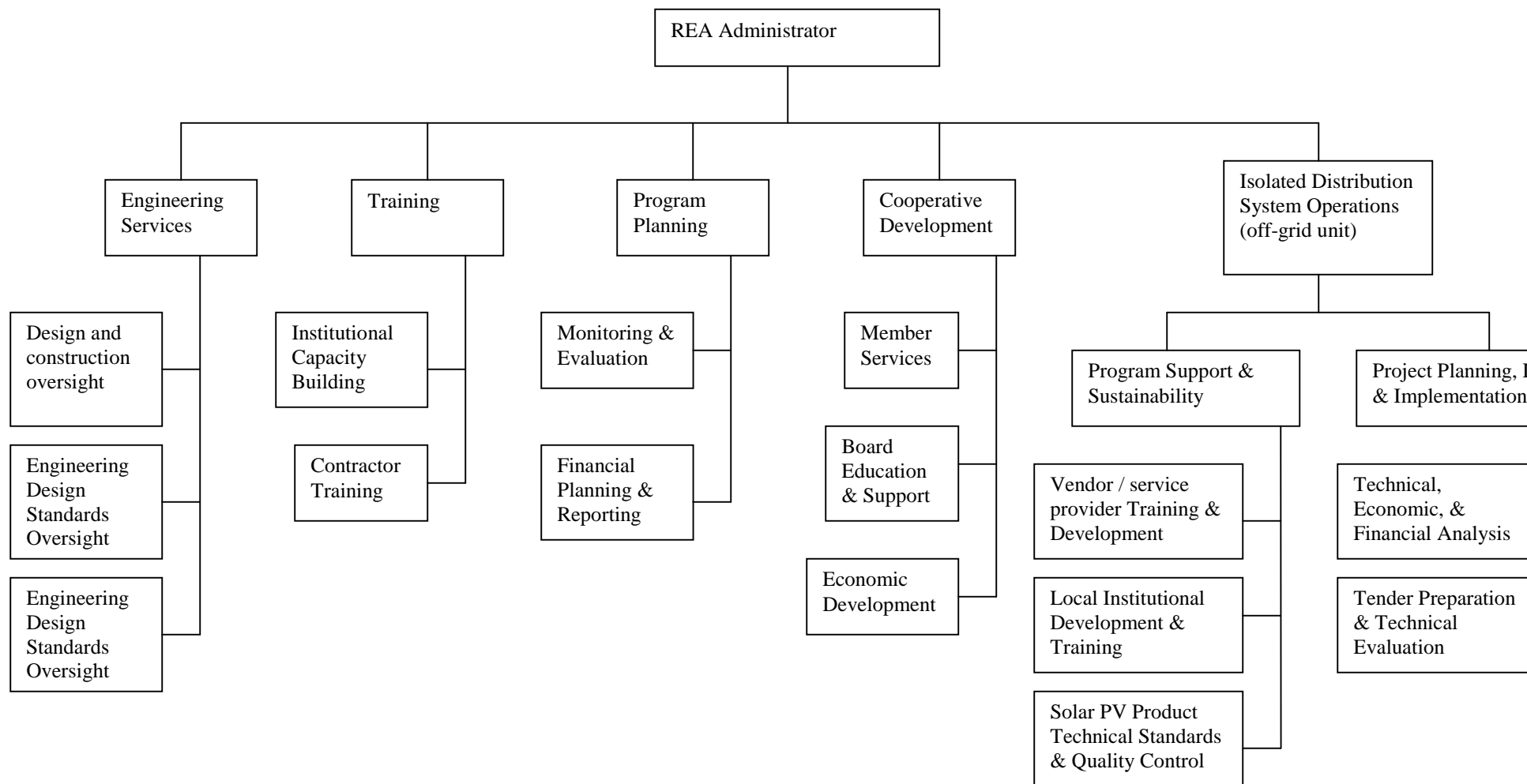
The NRES has studied different forms of service providers including rural electric cooperatives, municipal corporations, private contractors and user associations, the strategy concluded that rural electric cooperatives are generally the most suitable form of service providers in on-grid service territories. For off-grid areas the OGREDS recommended to have private service providers so that the services will be market driven. However, it has been proposed that off-grid areas in the 12 REAP service territories could be operated by the working electric cooperative if it chooses to provide the service for some off-grid areas if the economics were promising.

The proposed organizational chart of REA is presented in Figure 3-3. The organizational chart illustrated in Figure 3-3 has been proposed by NRES, except that the OGREDS has proposed establishment of an Off-Grid unit within REA that includes the departments illustrated in Figure 3-3¹¹.

It is expected that REA will be the implementing agency of the REAP, as REA establishment Decree is expected to be approved prior to REAP appraisal.

¹¹ It has been assumed that the Isolated Distribution System Operations Department in the organizational chart proposed by NRES is the same as the Off-Grid Unit proposed by OGRES

Figure 3-3: Proposed Organizational Chart of the REAP



3.3 Project Costs

3.3.1 Cost of Construction and Operation of Rural Electrification for REAP Areas

Using the NRES figures for construction costs of distribution network, the total cost for constructing the distribution network in the REAP 12 service territories is about \$101 millions as illustrated in Table 3-6. For off-grid systems the OGREDS has estimated the investment requirements for supply and installation of SLs, SHSs, PVs for public facilities and WHSs by about \$ 69 millions as illustrated in Table 3-7.

Table 3-6: Construction Costs for the Distribution Network in the 12 Service Territories

Service Territory	Construction Costs (\$)
Ibb -1	9,392,626
Taiz – 1	9,705,918
Hajjah – 1	9,404,083
Al Mahaweeet – 1	6,769,198
Al Hodiedah – 3	16,919,431
Sanaa – 1	9,001,222
Dhamar – 1	10,054,441
Amran – 1	6,938,169
Abyan – 1	3,002,992
Lahj – 2	1,702,601
Ad Dhale – 1	14,641,390
Al Baida - 2	3,481,442
Total	101,013,513

Table 3-7: Investment Requirements for Off-Grid Systems According to the OGR

System Type	Unit cost (\$)	Investment requirements (\$ millions)
SL	117	4.23
Small SHS	261	19.97
Medium SHS	652	
Large SHS	1,564	
PV for health centers	7,910 for highlands and 18,620 for lowlands	4.38
PV for schools	4,760 for highlands and 15,470 for lowlands	12.52
PV for large mosques	2,240 for highlands and 4,760 for lowlands	7.59
PV for small mosques	950 for highlands and 2,380 for lowlands	5.55

System Type	Unit cost (\$)	Investment requirements (\$ millions)
PV for checkpoints	25,802 for mobile offices, 14,621 for large checkpoints and 10,321 for small checkpoints	2.55
WHS	525,000	12.3 (including studies)
Total ¹²		69.09

Funding of on-grid projects will be through a development fund that will be managed by REA, which will fund construction of new projects and provision of subsidies. It is expected that the service providers in the 12 service territories (electric cooperatives) will borrow from REA development fund (as illustrated in Figure 3-2) to undertake constructions and will collect connection fees from end-users or from subsidizing agencies to repay REA fund. Operational costs for on-grid systems in the 12 service territories are expected to be totally covered by service tariffs collected by the service providers, with possible support from REA development fund during the first years of services to balance relatively low number of subscribers. The operation costs for the on-grid systems are illustrated in Table 3-8.

Table 3-8: Operational Costs for On-Grid Service Territories Systems

Service Territory	Operational Costs (\$)			
	Year 1	Year 5	Year 10	Year 15
Ibb -1	2,842,317	3,407,309	3,959,380	4,180,844
Taiz – 1	3,646,237	4,286,235	4,909,477	5,196,020
Hajjah – 1	3,054,812	3,632,147	4,200,105	4,438,476
Al Mahawet – 1	2,400,430	2,788,060	3,208,851	3,393,520
Al Hodiedah – 3	3,960,471	4,923,456	5,685,550	6,002,507
Sanaa – 1	2,168,176	2,673,265	3,098,241	3,269,914
Dhamar – 1	3,134,233	3,715,641	4,311,316	4,553,530
Amran – 1	2,587,246	2,995,078	3,435,847	3,635,485
Abyan – 1	1,581,832	1,725,061	1,945,391	2,064,119
Lahj – 2	654,897	760,765	870,705	921,640
Ad Dhale – 1	3,260,187	3,985,466	4,600,256	4,855,455
Al Baida - 2	1,421,285	1,632,349	1,862,444	1,972,380
Totals	1,421,285	1,632,349	1,862,444	1,972,380

The OGREDS recommended different options for funding off-grid household systems (SLs and SHSs) such as microfinance institutions, CAC Bank and Postal Saving

¹² This total has not been indicated namely in the OGREDS but this summation has been done by the ESIA consultants by adding the figures used in the OGREDS for estimating investment costs of different off-grid systems

Authorities. The funding of Public facilities PVs will be undertaken by their corresponding ministries, namely: Ministry of Health (for health units), Ministry of Education (for schools), Ministry of Religious Endowment and Islamic Affairs (for mosques), Ministry of Defense and Ministry of Interior (for checkpoints).

Operation costs for off-grid solar systems are limited to replacement costs of lamps, batteries and controllers. SWH systems will have operational costs related to O&M activities in addition to replacement costs. The unit operation costs of off-grid systems are illustrated in Table 3-9. It is expected that operational costs will be totally incurred by end users.

Table 3-9: Unit Operational Costs for Off-Grid Systems

System Type	Item	Cost (\$)	Replacement period
SL	Replacement of lamp and battery	13	Once every 3 years
Small SHS (20 Wp)	Replacement of lamp and battery	72	Once every 3 years
Small SHS (50 Wp)	Replacement of lamp and battery	181	Once every 3 years
Small SHS (100 Wp)	Replacement of lamp, battery and inverter	584	Once every 3 years
SWH	O & M	3,960	Once every year
	Replacement of diesel generator	16,875	Once every 5 years
	Replacement of wind turbine	75,000	Once every 10 years
	Replacement of battery	36,000	Once every 10 years
	Replacement of inverter	42,000	Once every 12 years

3.3.2 Estimated 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 Developpement (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 3-10.

Table 3-10: Breakdown of REAP Budget (Figures in million US Dollars)

Financing Agency	Contribution in REAP Budget (Million US\$)
WB/IDA	25.0
AFD	47.1
IDB	25.0
GOY	10.2
USAID	5.0
Government of Germany	3.5
Total	115.8

The REAP budget for on-grid systems is slightly lower than the estimated cost of construction illustrated in Table 3-6, this is because estimated construction costs in Al-Hodeidah and Ad-Dhale is higher than the fixed budget.

The REAP budget includes financing 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. The technical assistance budget indicated in Table 3-10 will include preparation of a strategy to improve LPG access in rural area.

3.4 Description the Construction Phase

3.4.1 Construction of On-Grid Systems

The NRES has recommended certain measures to minimize the construction costs of the distribution systems and to maintain its safety. The NRES has recommended adoption of the United States Rural Energy Administration (USREA) standards which is already recognized by MEE, and the safety measures of the National Electric Safety Code (NESC) developed by the Institute of Electrical and Electronics Engineers in the US.

Prior to the construction phase the electric and mechanical design of the system would be undertaken and accordingly the tender procedures will be followed. The construction of the on-grid distribution network involves the following general steps:

- Fixing line poles which are expected to be from treated wood. The poles shall be placed in a limited excavated area (to make use of support of the undisturbed soil).
- Fixing cross arms that supports the conductors and isolators
- Staking the conductors over the insulators after maintaining the correct tensioning, sagging and clearances
- Secondary lines are connected to the high voltage line through distribution transformers that are fixed on the line. Secondary lines feeds individual customers

- Accessories such as regulators, fittings, consumer meters ... etc. are installed.
- The construction of 33/11 substations involves conventional construction works of the transformer building, guard house and the fence. The transformers and accessories are then commissioned and installed.

Generally construction of the line will involve limited amount of construction waste as excavated soil, for fixing the poles, is generally a small amount and most of it will be filled around the pole for fixation. Therefore construction waste will be limited to scrap materials, such as damaged poles, cross arms, insulators ... etc. Also the construction of substations is not expected to generate large amount of construction waste because construction works are limited to one-story buildings and small foundations for the transformers. The expected shallow foundations will not, most probably, require any dewatering especially in highlands.

3.4.2 Installations of Off-Grid Systems

The installation of SHSs, SLs and PVs are rather a simple procedure which is limited to fixing PV frames, installing the PV panels, batteries and controllers. The wasted materials from this process could be of negligible amount.

The construction of WHS will involve fixing of wind turbines which requires relatively large foundations, fixing the diesel generator and the limited distribution network to the village consumers. The excavation and construction of the wind turbines foundations will generate relatively large amount of excavation waste, as soil is not backfilled, and inert construction waste. The process may involve dewatering, especially in lowlands where the WHS is most suitable.

3.5 Description of the Operation Phase

In addition to the extensive managerial and administrative activities that are expected to be undertaken by service providers, the operation of the on-grid system involves limited technical activities for operation and maintenance for the distribution grid. The waste resulting from such operations will be replaced items, such as poles, insulators, cross arms, meters ... etc. The normal operation of substations will not involve activities of environmental significance, except for some safety issues which are discussed later in Chapter 5. The most important waste-generating activities during the operation of substations is changing the transformers oil, which takes place once every 5 years as reported in one of the existing substations in Sanaa. It is worth noting that no PCB based oil will be used as coolant in the transformers that will be installed by the REAP. Generally speaking, even old transformers in Yemen are also non-PCBs transformers,

except in Hadramout Governorate¹³, which does not include any of the REAP on-grid Service Territories. Annex 7 presents a brief description of Stockholm Convention on Persistent Organic Pollutants (POPs), in which PCBs are included, and the situation of Yemen regarding the compliance with the Convention.

The operation and maintenance of substations could also generate scrap conductors and some accessories.

For SHSs, SLs and PVs the PV panels, batteries and invertors will need change every few years, as indicated in Table 3-9, therefore it is expected that there will be relatively large cumulative amounts of such waste.

For WHS the operation of the wind turbines requires regular lubricating of the blades and fueling of the diesel generators. Limited amounts of waste will be generated during the operation and maintenance of SHSs.

¹³ Source: National Chemical Profile prepared by National Coordination Team of the POPs National Implementation Plan

4. Description of Baseline Environmental and Socioeconomic Conditions

4.1 The Project Area

The REAP shall be implemented in 15 governorates out of a total 21 governorates in Yemen. As mentioned in the previous Chapter, the REAP shall connect 12 service territories in 12 governorates to the national grid, while the REAP interventions in the 3 remaining governorates (namely Al-Mahara, Hadramout and Raimah) will be through provision of off-grid systems. The districts that will be served by on-grid systems are illustrated in Table 4-1. A map showing borders of Yemeni governorates is presented in Figure 4-1, while maps of the service territories showing the locations of REAP interventions are presented in Annex 1.

Table 4-1: Districts that will be connected to the national grid through the REAP

Service Territory	Districts
Ibb -1	Hazm Al Udayn, Hubaysh, Al Udayn, Hubaysh, Far Al Udayn and Mudhaykhirah
Taiz – 1	Mawiyah, Khadir, As Silw and Haifan
Hajjah – 1	Kuhlan Affar, Mabyan, Sharas, At Tur (Bani Qa'is), Wadhrah, Hajjah City, Hajjah, Najrah. Ash Shaghadirah and Bani Al Awwam
Al Mahaweeet – 1	AtTawilah, Shibam and Kawkaban, Al Mahwait, Ar Rujum and Hufash
Al Hodiedah – 3	Zabid, Al Garrahi, At Tahita, Jabal Ra's, Hays and Al Khawkhah
Sanaa – 1	Attyal, Khwlan, Sanhan, Jahanh, Bani Dhabyan, Attyal, Bilad Ar Rus and Al Husn
Dhamar – 1	Jabal Ash sharq, Al manar, Mayfa'at Anss, Anss, Utmah and Maghirib Ans
Amran – 1	Dhi Bin, Kharef, Iyal Surayh, Raydah, As Sawd, Amran, Iyal Surayh, Maswar and Thula
Abyan – 1	Jayshan, Mukayras, Lawder, Mudiya, Al Wade'a
Lahj – 2	Halmeen, Habil Jabr, Radfan and Al Milah
Ad Dhale – 1	Juban, Damt, Qa'atabah, Ash Shu'ayb, Al Husha, Al Hussein, Ad Dhala and Al Azariq
Al Baida - 2	Al Quraishyah, Wald Rabia, Al Arrsh, Wald Rabia, Rada, Sabah and Ar ryashyyah

Figure 4-1: Governorates of Yemen



The project area covers most of Yemen; therefore it has various characteristics, topography and climate according to its location. 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.

The OGREDS has classified low lands for having high potential for Wind Hybrid Systems for the relative high wind speeds, as shown in Figure 4-2 while concerning solar radiation; most of Yemeni governorates have relatively high solar radiation patterns as illustrated in Figure 4-3.

Figure 4-2: Wind Energy Resources Potential in Yemen (Source: OGREDS)

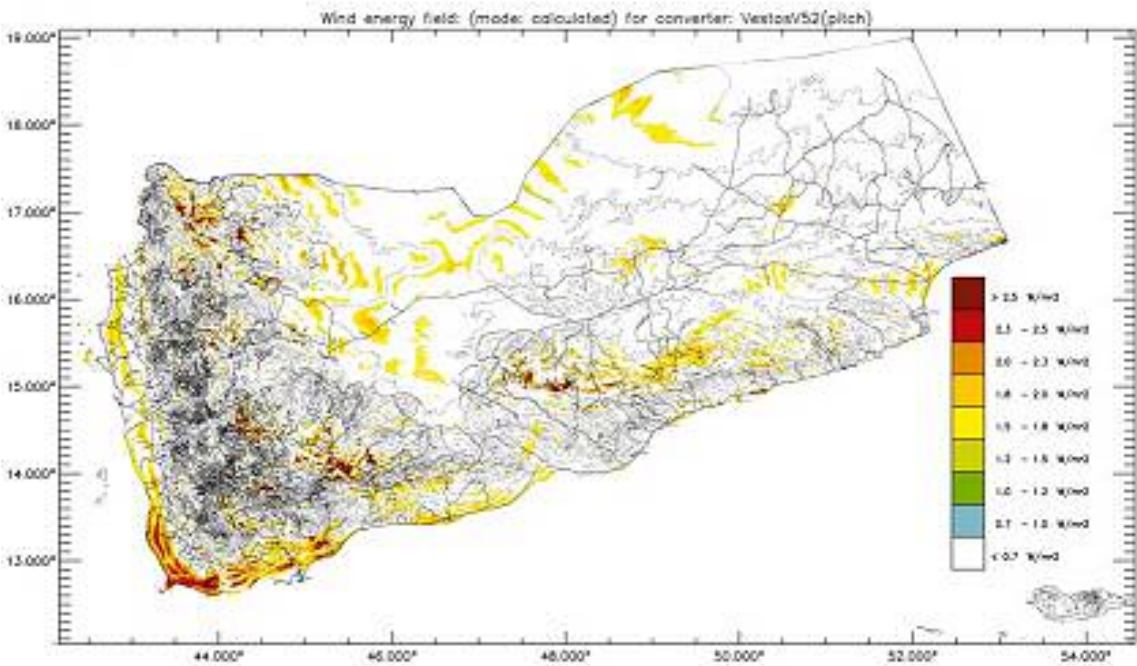
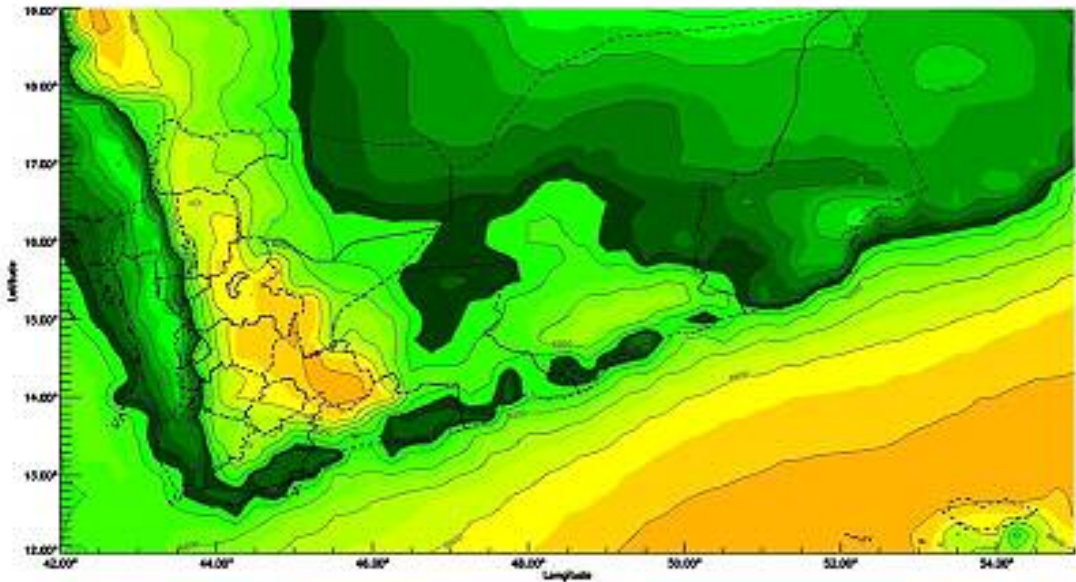


Figure 4-3: Average Solar Radiation in Yemen (Source: OGREDS)



4.2 Agriculture

Agriculture is the major developmental activity in rural Yemen with about two thirds of the rural population relies on agriculture as a source of income. According to the 2007 Yearly Statistics Book, the cultivated area 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 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). Table 4-2 illustrates the cultivated areas in REAP governorates.

Table 4-2: Crops Areas and Cultivable areas in REAP Governorates

Governorate	Total Area (km ²)	Cultivated Areas (ha) ¹⁴	% of Crops Area to the total area
Ibb	5,344	88,671	16.6
Taiz	10,009	87,922	8.8
Hajjah	8,306	148,117	17.8
Al-Mahweet	2,332	30,491	13.1
Al-Hodeidah	13,252	324,944	24.5
Sana'a	11,961	176,479	14.8
Dhamar	7,586	124,011	16.3
Amran	7,900	107,153	13.6
Abyan	16,445	58,925	3.6
Laheg	12,697	34,366	2.7
Al-Daleh	4,000	16,845	4.2
Al-Baida	9,271	40,936	4.4
Al-Maharah	67,300	2,979	0.04
Hadramout	167,749	46,810	0.3
Reymah	2,000	26,419	13.2

Source: 2007 Statistical Book of CSO for all data except total areas of governorates which has been taken from MoPIC Third Economic and Social Plan

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. Table 4-3 illustrates the different crops cultivated in Yemen and the correspondent area for each crop.

¹⁴ In the CSO Statistical Book the unit given for areas in the table was hectares in Arabic, while the English translation was Acre. It has been assumed that the areas are in hectares (10,000 m²) for calculation of % of cultivated land to the total area

Table 4-3: Type of Crops Cultivated in Yemen

Crop Type	Area (ha)¹⁵	% of total Cultivated Area
Total area of cereals cultivation	890612	60.0
Wheat	141498	9.5
Maize	51961	3.5
Sorghum	520963	35.1
Millet	133287	9.0
Barley	42903	2.9
Total area of Legumes	52992	3.6
Broad beans	4031	0.3
Dry beans	1341	0.1
Peanuts	2308	0.2
Other legumes	45312	3.1
Total area of vegetables cultivation	82103	5.5
Tomatoes	16934	1.1
Onions	13402	0.9
Potatoes	19343	1.3
Sweet-melons	2945	0.2
Water-melons	12628	0.9
Other vegetables	16851	1.1
Total area of fodder cultivation	147007	9.9
Alfalfa	25249	1.7
Other fodders	121758	8.2
Total area of cash crops cultivation	83373	5.6
Cotton	18504	1.2
Sesame	21776	1.5
Tobacco	9642	0.6
Coffee	33451	2.3
Total area of fruits cultivation	87781	5.9
Dates	14180	1.0
Bananas	9529	0.6
Grapes	12920	0.9
Orange (including mandarin)	9256	0.6
Papayas	1434	0.1
Mangoes	24130	1.6
Other fruits	16332	1.1
Total area of Qat cultivation	141163	9.5
Grand total	1485031	100

Source: 2007 Statistical Book of CSO

¹⁵ Please refer to the previous note

4.3 Socioeconomic Characteristics

Yemen is considered one of the world's poorest countries, with around 42 percent of its 19.2-million population living below the poverty line with a higher concentration in rural areas¹⁶. Official sources indicate that the government's poverty-eradication strategy has had considerable success in decreasing the percentage of people living below the poverty line. However, estimates by the United Nations Development Program (UNDP) indicate that the poverty gap is increasing in spite of national macroeconomic growth. Although the rate of urbanization has been steadily increasing over the last two decades, over 75 percent of the Yemeni population is still rural living in 41,800 scattered hamlets¹⁷. Poverty in Yemen takes on a rural attribute. Rural areas of Yemen embrace about 83% of the poor and 87% of those who suffer from food poverty¹⁸. 45% of the rural population is classified as poor. Income opportunities and wealth are seen to be concentrated in certain urban centers and also not equally distributed among the country.

Yemen is a predominantly agricultural society, with over two thirds of the population living in rural areas (approximately 1.5 million households in rural Yemen) with livelihoods dependent on agricultural production of various crops, fruits, vegetables and Qat as the prime source of income (Table 4-4). Agricultural activity is considered to be one of the least rewarding economic activities in terms of the value-added and profitability. 91% of all households involved in agriculture hold some kind of livestock, whether it is cattle, sheep, goats, camels or chickens. Livestock products are one of the most important sources of income and are regarded as a key for improving livelihoods in rural Yemen¹⁹.

Table 4-4: Population, population density and percentage of labor in agriculture by Governorate

Governorate	Population (in thousands)	Population Density (pop/km2)	Labor in agriculture (as % of all labor)
Al Baidha	563	61	35.6
Al Jawf	433	11	72.0
Al Hudeidah	1,942	151	50.3
Al Dale	403	101	66.9
Al Mahweet	452	194	66.2
Al Mahara	70	1	41.4
Abyan	420	26	45.9
Sana'a City	1,488	3,900	2.3

¹⁶ Country Assistance Strategy, World Bank, May 2006

¹⁷ Country Social Analysis, World Bank, January 2006

¹⁸ Poverty Reduction Strategy Paper (PRSP), World Bank, 20003-2005

¹⁹ Yemen Times [<http://www.yementimes.com/article.shtml?i=1015&p=business&a=1>]

Governorate	Population (in thousands)	Population Density (pop/km2)	Labor in agriculture (as % of all labor)
Ibb	2,019	318	67.7
Taiz	2,296	229	50.1
Hajjah	1,361	165	77.2
Hadhramaut	873	6	21.6
Dhamar	1,200	158	65.0
Shabwah	455	12	33.7
Sa'adah	596	48	73.1
Sana'a	1,352	98	70.5
Aden	504	679	2.4
Amran	956	245	68.0
Lahej	650	51	39.3
Mareb	226	13	56.4
Total	18,261	40	Not available

Source: Republic of Yemen, Ministry of Planning and Development, Second Five-Year Plan for Economic and Social Development Plan 2001-2005, Table 10-2 and 10.5.

Many challenges are currently associated with the agriculture sector, most importantly, degradation of resources especially the land, and water, resource over the past few decades. This in turn seriously poses a serious obstacle on the way of Yemen rural development. 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 (e.g. unorganized migration to urban area) and on natural resources²⁰.

The inequalities between urban and rural areas is a major issue in Yemen, particularly concerning access to services. There are also remarkable inequalities in educational attainment levels between urban and rural children, between boys and girls and among regions. Female youth illiteracy (15- 24 year olds) for instance, reaches 73 percent in rural areas compared to 15 percent of their male counterparts or 18 percent of their urban female peers²¹.

²⁰ Comprehensive Development Review: Environment, World Bank, January 2000

²¹ Country Social Analysis, World Bank, January 2006

Table 4-5: Variance in access to water and sanitation between urban and rural Yemen

Access to improved water sources	Urban	74%
	Rural	68%
Access to improved sanitation	Urban	76%
	Rural	14%

Source: USAID Country Health Statistical Report Yemen, May 2008

4.4 Gender Issues

Yemen is facing a significant challenge of gender inequalities which is considered to be amongst the highest in the world. Yemen is ranked 121st out of 140 countries in Gender development Index (GDI). Generally speaking, in addition to the traditions and culture that prevent women from contribution in many of the life domains²², they suffer from restricted access to resources like land as well as education and employment opportunities²³. Only 33% of rural girls compared to 73% of rural boys and 78% of urban girls are enrolled at schools²⁴. This on one hand suggests not only a low level of schools enrollment for both sexes in rural area but also inequity in rural girls access to schools compared to their fellows of urban girls and even rural boys. Girls in villages did not have access to the same educational resources as in the cities. Especially with regard to computer skills, which are so necessary for employment and for development today, lack of access to this information was damaging to the potential for village women to succeed.

“If we want to encourage women’s contributions. They need to be pulled out of the dark tunnel and the vicious cycle that they live in.

Girls illiteracy programmes and education are the keys ”

Ar Rajm, Mahweat – Women FGD

The unavailability of computer at schools is very linked to the absence of sufficient energy. Unemployment is also higher among educated women²⁵. Although the role played by women in the household economics is significant, their input is to a far extent invisible and underestimated. Women are more engaged in the informal sector which is seldom recorded in the official statistics. Women are also overwhelmed by additional domestic responsibilities associated to the absence of services. They are the primary responsible person on fetching water, firewood and animal fodder and this, among other factor, is seen to be a major challenge for women²⁶.

Certain categories of women are seen to be more vulnerable. This includes the poor and those do not have recorded genealogies or tribal origin.

²² Ar Rajm, Al Mahweat – Women FGD

²³ Country Social Analysis, World Bank, January 2006

²⁴ Poverty Reduction Strategy Paper (PRSP) , World Bank, 20003-2005

²⁵ Poverty Reduction Strategy Paper (PRSP) , World Bank, 20003-2005

²⁶ Ar Rajm, Al Mahweat – Women FGD

During the field work that was conducted as part of this SIA, gender related issues was assessed during the interviews. It was found that the situation of women in certain places is very restricted and their mobility is very limited like the case in Sana'a. On the other hand, women were found to be more active in the public life in places like Abyan and Ad Dale. Table 4-6 below shows the key findings related to women economic activities in the surveyed areas

Table 4-6: Key findings related to women economic activities in the surveyed areas

Service Territory	District Surveyed	Key Economic Activities Practiced by Women
Al Mahawet – 1	Hufash	Women role is limited in the domestic role ²⁷ as well as limited traditional activities related to farming.
	Ar Rajm	Women role is limited in the domestic role as well as limited traditional activities related to farming.
Sanaa – 1	Attyal	The majority of women are housewives who help their husbands in farming activities, pottery works and other traditional rural works in addition to their domestic role. Women contribution in the public life is unacceptable due to the social and tribal considerations
	Khwlal	The majority of women are housewives who help their husbands in farming activities, pottery works and other traditional rural works in addition to their domestic role. Women started to be more engaged in formal activities along the last decade but the number of those women is still very limited.
Abyan – 1	Mudiyah	Significant number of women is engaged in formal activities (around 500 on the level of Mudiya district) include involvement in different line-ministries like Education, Health, Social Affairs. Female leaders in civil and community work like Yemeni Women's Union (YWO) Informally, women are engaged in small commercial activities (clothes, incense, chewing gum....etc) Women are the main person in charge of all domestic activities

²⁷ Domestic role in rural Yemen include: cooking, washing clothes, cleaning house, fetching waster, firewood and animal fodder in addition to raising children.

Ad Dhale – 1	Demt	<p>Formal Activities include involvement in different line-ministries like Education, Health, Social Affairs.</p> <p>Female leaders in civil and community work like Yemeni Women's Union (YWO)</p> <p>Informally, women are engaged in small commercial activities (clothes, incense, chewing gum....etc)</p> <p>Women are the main person in charge of all domestic activities</p>

Key Poverty and Economic Characteristics related to the Service Territories

According to the Social Fund for Development (SFD) general poverty index, 2005, Table 4-7 shows the levels of poverty in the REAP 12 service territories by presenting the least and worst poor districts inside each district

Table 4-7: Poverty level in the targeted service territories

Name of territory	Number of Districts	Name of the poorest district (s)	% of poverty index	Name of the least poor district (s)	% of poverty index
Ibb -1	6	Hazm Al Udayn Hubaysh Far Al Udayn	72.9	Mudhaykhirah	63.8
Taiz – 1	4	Mawiyah	71.2	Haifan	50.9
Hajjah – 1	10	At Tur (Bani Qa'is)	93.3	Hajjah City Hajjah	45.1
Al Mahaweeet – 1	5	Hufash	68.5	Shibam and Kawkaban	53.8
Al Hodiedah – 3	6	Jabal Ra's	81.3	At Tahita Al Garrahi Zabid	63.6
Sanaa – 1	8	Attyal Khwlan Jahanh Bani Dhabyan Attyal Bilad Ar Rus Al Husn	65.3	Sanhan	44.9
Dhamar – 1	6	Utmah	82.4	Mayfa'at Anss Anss	47.7
Amran – 1	9	As Sawd	75.1	Raydah	51.6
Abyan – 1	5	Jayshan	74.5	Mudiyah	30.1

Name of territory	Number of Districts	Name of the poorest district (s)	% of poverty index	Name of the least poor district (s)	% of poverty index
Lahj – 2	4	Hazm Al Udayn Hubaysh Far Al Udayn	72.9	Mudhaykhirah	63.8
Ad Dhale – 1	8	Al Azariq	72.6	Juban	47
Al Baida - 2	7	Nata	77.2	Al baida	33.4

Source: National Rural Electrification Strategy for Yemen, Phase I Final Report, volume II, October 2006

As observed from Table 4-7, territory Hajjah – 1 had the lowest level of poverty general index that reached 93% in At Tur (Bani Qa'is). This was followed by Dhamar – 1 and Al Hodiedah – 3. on the other hand the areas with the least percentage of the poverty index are located in Abyan – 1 and Al Baida – 2. The widest gap between the poorest district with 93.3% on the poverty index and the better off districts with 45.1% could be observed in Hajjah – 1. The findings from the analysis of Table 4-7 accord to a far extent with the consultant's observation in the filed.

Table 4-8: Key economic activities as mentioned during the interviews

Service Territory	District Surveyed	Key Economic Activities
Al Mahawet – 1	Hufash	Rain fed farming Livestock products Honey production Commercial Activities
Sanaa – 1	Attyal	Rain fed farming Livestock products Commercial Activities (retail trade in Khawlan and stock trade in Sana'a) Governmental Works Pottery works Temporary laborer
	Khwlal	Rain fed farming Small commercial activities (retail trade in Khawlan and stock trade in Sana'a) Arms Trade Temporary laborer
Abyan – 1	Mudiyah	Rain fed farming Livestock products Commercial Activities Temporary laborer

Service Territory	District Surveyed	Key Economic Activities
Ad Dhale – 1	Demt	Rain fed farming Livestock products Commercial Activities Honey production Tourism activities (internal and external) Governmental Works Temporary laborer

4.5 Energy access

Rural households, currently, rely on multi energy sources for different purposes. The majority of the rural areas lack access to electricity but people adapt different strategies in order to get some service even for very limited time duration everyday. Main other energy sources include, fuel wood, other biomass fuels and LPG. The choices that people have depend on the economic level of the household as well as the availability of alternatives in the neighborhood. The current alternatives could be summarized in the following:

- Households with access to electricity from the PEC grid or isolated power systems in more remote areas. This is usually for limited hours per day that varies from 7hrs /day²⁸ to 15 hrs/ day²⁹. Cut offs frequently occur and varies in length according to the place³⁰. Those households are around half of those who have access to electricity in rural areas and their consumption is less than half that of the grid-connected households.
- NGOs/CDAs and cooperative operate service in some villages through large diesel generators (250 kilowatt capacity)³¹ in return for collecting service fees from consumers.
- Households which own their private power generators: These generators are normally very small (2, 3, kilowatt) in terms of capacity. They operate with Kerosene or diesel. It provides electricity for around 5-7 hours per day. Residents normally give priority to lighting and operating TV. These generators are also used by shops and health institutions where PEC service does not exist³².
- Households who are provided with informal service providers: They are normally village residents who purchase 5-10 kilowatt generators provide electricity to rural households in return for service fees that they collect

²⁸ e.g. Huffash, Al Mahweat

²⁹ e.g. Mudyia, Abyan

³⁰ In Attyal market, people mentions 4 cut offs a day with average 4:5 hrs/cut off.

³¹ Al Kanawes NGO, El Hodiedah

³² Attyal villages, Sana'a

monthly³³. The mechanism of charging varied from one place to the other. In certain villages, the providers charge per appliance (e.g. 500 YR for T.V./month and 200: 300 YR for lamp³⁴) and in other places it is a monthly or daily amount that the provider determines according to the generator expenditure of oils and fuels. Table 4-9 summaries the percentage of rural households' access to different lighting sources

- The uses of electricity vary from one place to the other according to the economic status and the hours of availability. Rural poor, as mentioned, give priority to lighting and television while better off use other privileges including refrigerating and ventilation. Table 4-11 from the energy Supply and Use, 2005 accords to a far extent with the field findings.

³³ According to the field investigation and according to the Household Energy Supply (HES) Report, World Bank, 2005, around 70% of the households who own generators operate and hire them for their neighbors.

³⁴ Attyal, Sana'a

Table 4-9: Percentage of dwellings access to different lighting source in rural areas across Yemen

Governorate	% of dwelling access to different lighting sources							
	Public Network	Private Network	Cooperative Network	Private Generator	Kerosene	LPG	Other	Unspecified
Ibb	35.54	2.59	1.97	2.40	42.88	8.92	1.67	4.03
Abyan	30.12	3.87	5.75	2.19	32.39	15.48	6.09	4.12
Capital City	75.18	3.80	0.28	4.83	2.43	5.39	2.98	5.11
Al Biada	38.28	4.51	1.78	5.04	16.96	26.17	3.33	3.92
Taiz	18.57	4.32	3.12	2.30	63.40	3.69	1.54	3.06
Al Jawf	5.26	1.47	0.67	1.97	67.96	6.00	9.55	7.12
Hajjah	7.49	0.95	0.80	3.15	75.41	6.23	1.88	4.08
Al Hodiedah	3.47	3.81	2.18	1.46	84.44	0.77	0.81	3.05
Hadramout	38.92	16.58	1.35	5.78	24.53	4.37	4.66	3.81
Dhanmar	26.22	2.63	1.07	2.17	38.64	23.87	1.34	4.08
Shabwah	30.01	9.09	6.07	10.67	26.02	9.39	3.87	4.90
Sa'adah	12.39	4.99	1.88	4.89	38.43	31.87	2.26	3.32
Sana'a	47.52	2.38	1.52	2.19	23.42	17.91	0.57	4.49
Aden	0	0	0	0	0	0	0	0
Lahj	28.92	4.79	5.72	1.15	44.15	8.26	2.26	4.76
Mareb	28.94	5.56	0.80	4.00	33.79	19.77	2.58	4.55
Al Mahweat	22.50	3.54	2.79	3.57	52.81	11.15	1.05	2.58
Al Mahrah	21.03	3.31	7.67	6.23	33.20	6.12	16.88	5.55
Amran	17.72	1.17	1.95	2.52	38.49	32.26	1.30	4.60
Al Daleh	32.70	5.83	2.77	7.27	40.07	5.85	2.46	3.06
Reymah	1.36	1.81	1.96	2.49	79.74	7.51	1.60	3.53
Total	22.40	3.87	2.32	2.90	51.74	10.84	2.08	3.58

Source: CSO (Central Statistical Organization) report of the census 2004

Table 4-10: Background information on the Territories that will be electrified during REAP first phase

Name of territory	Population	Number of villages	Number of Households	of electrified villages (% of total number of villages)	Health facilities with access to electricity (% of total facilities)	Education facilities with access to electricity (% of total facilities)
Ibb -1	573000	542	95599	21.58	26.79	28.95
Taiz – 1	486803	497	79355	38.83	44.23	40.15
Hajjah – 1	398070	1045	58870	39.61	58.06	47.79
Al Mahweet – 1	305954	669	44197	36.6	44.44	52.04
Al Hodiedah – 3	482493	673	81148	11.2	20.75	19.93
Sanaa – 1	389843	507	50168	14.20	10.64	23.87
Dhamar – 1	542798	1150	84589	29.47	43.21	35.16
Amran – 1	373450	630	46732	30.15	43.85	44.81
Abyan – 1	236912	1081	29973	43	80.70	61.29
Lahj – 2	135959	1086	18875	19.15	60	13.53
Ad Dhale – 1	439581	963	61608	23.7	40.98	28.10
Al Baida – 2	212240	202	28693	27.2	27.27	33.79

Source: National Rural Electrification Strategy for Yemen, Phase I Final Report, volume II, October 2006

Access to electricity for the 12 service territories of REAP are shown in Table 4-10 above. As shown in the table health and education facilities also have limited access to electricity. In some cases the percentage of facilities with access to electricity does not exceed 10.64% as the case in health facilities in Sana'a and 13.53% as the case in education facilities in Lahj 2.

Table 4-11: Electricity (where available): Use by Social Category and Purpose

Location	The main uses for electricity		
	Well-off	Poor	Very poor
Rural highland	lighting Television Refrigeration	lighting Television	Not connected
Rural lowland	lighting Television Refrigeration Fans	lighting Television	Not connected
Urban	lighting Television Refrigeration Fans/ air conditioning	lighting Television	Some households connected, used for lighting

Source: *Household Energy Supply and Use in Yemen* ESMAP, 2005.

It was also found that LPG is a key source of energy, for rural households, that is used by all the previously mentioned cases for cooking purposes and also for lighting in order to supplement during the absence of electricity. As could be observed from Table 4-12 LPG is not a major player in rural households cooking purposes. However, LPG and firewood represents together the option with highest use frequency among rural households for cooking purposes. This in itself suggests that in many cases rural households supplement the absence of LPG by using firewood. The field consultation referred to the problem of the excessive demand for LPG over the current supply and the need to expand LPG plants. The registered distributors mentioned that they have a specified number of bottles/cylinders (240) that they are not allowed to exceed per day. LPG is still a luxury that poor households can not afford. The high start up of the cost of the LPG bottles/cylinders (around 3000 YR) and LPG stove is a challenge that prevents the poor from using LPG. Yemen has 84 LPG filling plants. The sector is seen to involve positive social impacts in the form of creating many job opportunities in both filling and marketing. Moreover, it covers a significant need in the energy supply.

Table 4-12: Percentage of dwellings and households by main source of cooking fuel in Urban and Rural area

Main source of cooking fuel	Urban		Rural	
	% of dwellings	% of households	% of dwellings	% of households
LPG	77.37	79.79	10.84	10.92
Kerosene	4.44	4.67	3.36	3.62
Wood and Charcoal or both	1.20	1.26	34.80	35.33
Wood and LPG	7.05	7.85	44.72	46.63
LPG and electricity	0.19	0.20	0.24	0.24
Other	2.21	1.77	1.29	0.96
Unspecified	7.54	4.46	5.67	3.17

Source: CSO (Central Statistical Organization) report of the census 2004

Even in places with grid service, poor are less likely to get legally connected to the electricity systems because of the connection fees which is a big bulk (varies from 10,000 to 17,000 YR) that they can not afford. They are also less likely to enjoy the privilege of paying the connection fees in installments because the installment system is not formally operated by the PEC, although it is applied in some cases where the beneficiaries have power or connections with the PEC officers. Some poor households are also not able to pay for the capital cost of the LPG cylinder and the stove so they rely on firewood for cooking and other fuels like kerosene for cooking and lighting.

Gender Arrangements related to Rural Electricity Management

The field investigations and stakeholders consultations showed some key aspects related to the roles played by men and women in the electricity management both on the level of households and village.

On the household level, women were found to play the bigger role in electricity rationalization and the protection of electric appliances from break downs due to several power cut offs by unplugging them. These efforts aim, in the first place, to reduce the monthly payments in the electricity bill³⁵. In places where firewood is still used for cooking³⁶, women were found to be responsible on fetching it from outside the house. However, men are usually responsible on paying for the cost of different sources of energy. Women only contribute to these expenses if they are heading the household or if they work and contribute to household expenditure.

³⁵ Ar Rajm, Al Mahweat, Women FGD

³⁶ Attyal Villages, Sana'a

Women are also the key actor responsible on finding alternatives in places where electricity and LPG do not exist or to supplement their shortage. Women are the key persons in collecting firewood and a female child is also much more likely to do this job than a male child. A female child carries roughly 10kg on her head and a grown woman can carry 15- 20kg of sticks and trees branches. This amount can cook about four meals for an average household of seven³⁷.

On the other hand, men are dominating the electricity management issues on the village level. In case of the informal provision of electricity services through community members, men were found to be the key player in the issues related to managing the services and communicating with customers (neighbours). In cases of NGOs/Cooperatives management for energy service, men are the members with active roles in the job. Men are also more aware of the institutional arrangements related to electricity and they are the ones who send out complaints and remarks on the service to the service providers (PEC or cooperatives). In few cases like the case in El Khreshba CDA, a female member was represented in the Electricity Committee and was interviewed. She was also concerned with carrying out some administrative and financial issues related to the project. It is important here to mention, that this is considered a rare case and that women participation in energy management issues is very unlikely to happen on the village level due to local culture that still prevail in many rural parts and that limitate women mobility and prevent them from interacting with outsiders.

It was also found that the negative impact that result from the current situation are more likely to affect women and children than the other family members as will be explored below.

Key Socio-economic Impacts Related to the Current Situation

Despite the diversified service provision models to rural residents, certain weaknesses are in common to all these models. The following are the key shortfalls mentioned by the interviewed stakeholders:

The unreliability of the electricity service:

- People can not operate appliances like washing machines and refrigerators. This in turn is reflected on the nutrition pattern and work load inside the family, particularly borne by women and children

“We don’t have vegetables or fruits in our homes except on Friday. Whatever remain is spoiled and thrown away because of heat” Houfash, Al Mahweat

- Students can’t study except for limited hours. This, in addition to other factors

³⁷ Household Energy Supply and Use in Yemen ESMAP, 2005

like poverty, was seen to be linked to children dropping out from schools particularly girls with boys given the first priority in many places. This finding accords with the findings of the Household Energy Survey (HES) which suggests that fuel wood collection contributes to low school enrolment among girls.

- Poor functioning of social services institutions in rural area like health facilities, schools and other governmental services³⁸.

“We have a rural hospital with all the departments, equipments and facilities but it does not provide a service because of the absence of electricity. Medical equipment and medicines have expired inside dark rooms” Houfash, El Mahweat

- Lack of safety where there is no public lighting. This in particular affect women and girls and constrains their ability to move about freely in their communities³⁹

Financial Load

- The average monthly amount that a medium size household pay for operating a generator for only few hours a day in very limited purposes (2: lamps and TV) is around 4000 YR.
- People who choose to own a generator pay a start up cost that ranges from 15.000 to 20.000 YR to purchase such generator.
- Service irregularity and frequent cut offs result in breaking down for the household electric appliances and a need for spending money to fix them.

Unhealthy indoor environment:

- Exposure to smoke from cooking fires contributes to the burden of respiratory and eye disease.
- Insufficient lighting

Hindered investment and economic development potentials

- The availability of important unutilized raw materials for cement and marble manufacturing and for tourism industry⁴⁰
- The hindered potential of job opportunities creation in shops, commercials, workshops and factories that might be established if power is available.
- Proximity to commercial centers in large cities⁴¹
- The existence of unutilized capitals⁴²

³⁸ This was a key concern that was mentioned in all the interviews

³⁹ Household Energy Supply and Use in Yemen ESMAP, 2005

⁴⁰ Moudiya, Ebyan

⁴¹ Attyal, Sana'a

⁴² Attyal, Sana'a

Limited level of awareness and isolation from the world

- Lack of access to many means of media, most importantly TV and the satellite. In the closed and isolated areas and the places where tribal tensions and social instability prevail, the lack of access to media contribute to worsening the situation

“If Illiterate people access TVs and learn the importance of educating girls, family planning, the dangers of tourists kidnapping on our image and economy, the impact of revenge etc. Yes, this will make difference” Attyal, Sana’a

Gap between local communities and the concerned organizations

Local people perceive the service provided by PEC to be very poor and unreliable. This is reflected on form of a gap created between PEC and Consumers who consider this to be lack of responsiveness to their needs.

*“We are forgotten in this desert. No one to care about us.
Government only care about places on the paved road ”
Houfash, El Mahweat*

*“a bad unreliable service and once we are late on the payment, , PEC is ready to cut off electricity and never return it again unless after paying the late payments and fines”
Attyal, Sana’a*

Higher cost paid by the poor and other vulnerable groups (women and Children)

Poor were observed to be more vulnerable to the negative impacts of the current energy sources. They are normally unable to pay for a reasonable level of service, regardless the provider. They adapt many strategies in order to rationalize the use of energy and the expenditure in this sector. So they largely rely on the traditional cheaper types of fuel which has plenty of negatives impacts on health and labour input. They are also more exposed to health troubles due to deficiencies in their dietary system. They are also less likely to receive quality health care services in case of sickness. Women and children in particular are more vulnerable to negative impacts of traditional fuels because of their long hours spent indoors and their domestic responsibilities (e.g. cooking). Women is also the key actor in issues like collecting firewood. They also suffer from time and effort consumption required to accomplish domestic activities with the current energy shortage (e.g. washing, cooking)⁴³.

⁴³ Ar Rajm, Al Mahweat – Women FGD

Affordability and Willingness to Pay (WTP)

Community Consultation revealed that the average monthly payments for electricity service is 2000:4000 YR⁴⁴. In average the same household pay around 3000 YR for LPG.

“We are already paying a lot, service fees, fines, in addition to the costs of fixing our appliances. We are ready to pay more BUT for a reliable service” Attyal, Sana’a

People showed willingness to pay as long as a reliable service will be received. The availability of electricity is assumed to contribute to achieving surplus in the expenditure currently paid for LPG (which is sometimes used for lighting) and other supplementary sources (candles, dry batteries, keroseneetc). these findings agree with the findings from the pilot project in IBB and the WTP survey carried out there.

⁴⁴ The payment is based on the meter records if a contact is issued between PEC and the consumers. This estimate was mentioned in Modyia, Abyan for houses with 3 rooms, a TV, refrigerator and a receiver.

5. Potential Environmental and Social Impacts

The assessment of potential impacts has been done through analyzing different project activities and envisaging possible changes to the environment. Each potential impact was qualitatively analyzed to classify its significance to three degrees: *major impacts* which are impacts with a reasonable likelihood that are likely to cause violation of applicable standards, *medium impacts* which are impacts with a reasonable likelihood that are likely to cause violation of applicable standards only in combination with the impact of other sources, and *minor impacts* which are impacts which are not likely to cause violation of applicable standards whether on its own or in combination with other sources⁴⁵. The likelihood of each impact has been qualitatively evaluated to two degrees: highly probable and low probable.

An Environmental and Social Management Plan (ESMP), presented later in Chapter 7, includes mitigation measures that minimize the negative impacts using available technologies and managerial procedures.

5.1 Impacts during Construction Phase

5.1.1 Impacts of Construction Waste

Construction waste is expected to be limited in amount. The excavation of soil for fixing wood poles, for the distribution lines, will generate very little amount of soil that will be filled back in the hole to support the pole. The excavation for the construction of steel poles and substations buildings will also be limited amount of excavated waste for relatively small footings. On the other hand, the construction of wind turbines will require a relatively large amount of excavation for construction of the footing (which could be 10-15 meters diameter on average). In all cases the excavation waste is expected to be limited. The rural areas to be developed are, in general terms, newly developed areas that have not been used in previous polluting applications.

Other types of construction waste could include trimmings of steel, wood, tiling materials, concrete, etc, in addition to wasted or faulted materials of the poles, conductors, insulators, transformers, switches, etc. With exception of treated wooden poles, which includes wood treatment pesticides, the above types of waste are generally harmless and risk-free.

The impacts of such construction waste, resulting from possible mismanagement, are generally aesthetic impacts, in addition to possible changes of the topography of the disposal site. Because of the limited waste management facilities available in Yemen, construction waste could be dumped in empty lands, drainage lines (Wadis) or on sides of rural roads. Such practices could lead to a limited aesthetic effects to the nice landscape normally viewed in the rural areas in Yemen, and a possible obstruction of drainage lines.

⁴⁵ This criteria for classifying impacts significance is used in environmental legislation of Saudi Arabia

Such impacts could be mitigated if construction waste is adequately handled and disposed in designated sites.

Wood poles used to carry electricity conductors are usually treated with pesticides, fungicides and anti-bacteria agents such as creosote and Chromated Copper Arsenate (CCA) in order to prevent its decay. If wasted wood poles were disposed in open dumps, there will be possibilities for leaching of these treatment materials from the wood to environment. Depending on the location of the disposal site the impact on the receiving environment will vary from limited contaminated area of soil to possible open burning with municipal waste, where arsenic, chromium Polycyclic Aromatic Hydrocarbons (PAH) emissions could be generated. Also open dumping of treated wood could lead to recycling this wasted wood in applications, such as furniture. Generally CCA is more resistant to leaching than creosote, however both materials have tendency to leach from the poles.

Despite that the CCA includes arsenic the United States Environmental Protection Agency (USEPA) did not call for the removal or dismantling of existing CCA treated wood structures as no evidence has demonstrated that CCA treated timber posed unreasonable risks to humans in normal use. USEPA has therefore not restricted the use of CCA treated wood for industrial and commercial applications (highway construction, utility poles, etc.). However, it has recommended certain precautions for the disposal of CCA treated wood including refraining from burning these wastes and disposal in domestic solid waste landfills. The same disposal procedure also applies for creosote treated wood but with more precautions to handling workers as to prevent possibly leaching creosote from direct skin contact.

Impact Significance

The effects of improper disposal of conventional construction waste depend on the aesthetic value, and the drainage characteristics of the disposal site. Because of the uncertainties about these factors this impact has not been classified as of minor significance. This also applies to the treated wood issue, for the possible limited exposure to arsenic and creosote after disposal, therefore the impact has been classified as medium impact. By implementing the mitigation measures recommended in the ESMP, including adequate haulage and disposal of construction waste, the impact significance could be reduced to minor impact.

5.1.2 Limitations on Land Use and Risks of Involuntary Resettlement

The proposed Electricity Law implies that a Right Of Way (ROW) zone of 12 meters should be kept along high voltage power lines above 132 kV. This requirement is not applicable for distribution lines that shall be constructed under the REAP. However, the possible effects of electromagnetic fields of the line, discussed later as an impact of the operation phase, will pose certain limitations on some land uses under the line. Therefore

a certain area under the line will be kept as a buffer zone for maintaining the public safety from electric hazards and high exposure to EMFs. The limitations on land uses in this area include preventing buildings and plantation of trees. The width of this strip is not identified by the law, however, the NRES Phase III report recommended keeping ROW strip of 10 meters (30'), 5 meters from each side of the line, which will have limitations on trees plantation.

Location of power lines will be most convenient on sides of existing rural roads to facilitate access to these lines for construction and maintenance. Power lines located besides rural roads will cause little limitations on land use because the 10-meter strip will intersect with the road buffer zone and the remaining area of the strip, if any is left, will be very narrow strip that is usually not suitable for development, especially in the rocky zones of the highlands. Therefore the land use limitations for power lines along roads are not expected to be an issue of concern.

The ROW zone should be free from tall trees in order to maintain the safety of the line; therefore there will be a limitation on agriculture crops that are cultivated by tree plantation. This limitation will most probably include some of the most common crops of the country including Qat, coffee and fruits in general.

Other than the safety issue of trees there are no known effects of EMF on vegetation and plant growth, therefore, short crops (such as cereals, vegetables and fodders) may still be planted within the ROW if the EMF exposure safety measures to farmers, as shall be discussed in the impacts during operation phase, is respected.

There are no known effects related to power lines to animals passing under them nor to birds flying above them therefore construction of power lines is not likely to cause limitations on grazing activities or effect birds migration. However, there is an exceptions to this regarding beehives and honey production. some research activities recommends that EMF of power lines effect the flight performance of insects, which may cause "coloney collapse disorders" for bees in which bees could not return to the beehives, so it may effect honey production at that hive. As a precautionary measure the ESMP has recommended that no beehives should be located within the ROW of power lines (estimated by 10-meter width).

Other than power lines, the need for involuntary physical resettlement and land acquisition related to substations and transformers are much lower, considering that only 7 substations will be constructed in the 12 service territories. According to the MEE, efforts will be made to avoid setting any of the projects components (substations and transformers) on citizens owned land, in the first place. The stakeholders consultations showed that in certain districts Government land property are available⁴⁶ and resettlement will be unlikely. However, in other districts stakeholders mentioned that most of the

⁴⁶ Hufash, Al Mahweat

lands are privately owned⁴⁷. According to local rural residents' previous experiences in similar cases, land donation is a quite common community contribution in public projects. In other cases, people were compensated for their land, shelter, existing commercial, business enterprises or other public or private structures through a valuation committee that was formed and consulted the project affected persons (PAPs).

Impact Significance:

The areas that will have restrictions on cultivating certain crops and operating honey production projects could not be exactly calculated at this phase of the project. However, it is not expected that REAP restrictions on land use will cover large areas of agriculture lands nor beehives.

Assuming that the restricted crops, according to Tables 4-2 and 4-3 in Chapter 4, is about 18 % of the total cultivated lands on the average, that power lines established besides roads will not require restrictions on its ROW and that about 25%⁴⁸ of the power lines will need to penetrate areas not within existing roads the areas of land that may be located within fruits or Qat field could be estimated by 15 ha, as illustrated in Table 5-1. Because areas of ownership by individuals are, in most cases areas, small areas, designers could bypass these restricted crops and could choose slightly different power line these lands, which further reduce possibilities of resettlement.

Table 5-1: ROW areas and cultivated areas with restricted crops

Governorate	Length of distribution lines (km)	ROW area for distribution lines (ha)	ROW area not located parallel to roads (ha)	Total Cultivated area (ha)	Calculated area for restricted crops (ha)	% of cultivated area to total area	Restricted Areas that may possibly intersect with ROW (ha)
Ibb	125	125	31.25	88,671	15,960.78	16.6	0.9
Taiz	146.05	146.05	36.5125	87,922	15,825.96	8.8	0.6
Hajjah	225.04	225.04	56.26	148,117	2,6661.06	17.8	1.8
Al Mahawet	209.17	209.17	52.2925	30,491	5,488.38	13.1	1.2
Al Hodiedah	339.44	339.44	84.86	324,944	58,489.92	24.5	3.7
Sanaa	224.52	224.52	56.13	176,479	31,766.22	14.8	1.5
Dhamar	311.14	311.14	77.785	124,011	22,321.98	16.3	2.3
Amran	215.3	215.3	53.825	107,153	19,287.54	13.6	1.3
Abyan	145.12	145.12	36.28	58,925	10,606.5	3.6	0.2
Lahj	60.57	60.57	15.1425	34,366	6,185.88	2.7	0.1
Ad Dhale	526.33	526.33	131.5825	16,845	3,032.1	4.2	1.0

⁴⁷ Demt, Ad -Dhale - Attyal, Sana'a, Hagana Khawlan , Sana'a

⁴⁸ This ratio is a rough estimate using the drawings of Annex 1

Governorate	Length of distribution lines (km)	ROW area for distribution lines (ha)	ROW area not located parallel to roads (ha)	Total Cultivated area (ha)	Calculated area for restricted crops (ha)	% of cultivated area to total area	Restricted Areas that may possibly intersect with ROW (ha)
Al Baida	136.73	136.73	34.1825	40,936	7,368.48	4.4	0.3
Totals	2,664.41	2,664.41	666.1	1,238,860	222,994.8	-	15.0

This impact has a low likelihood, as illustrated above, but the consequences of resettlement could be significant if not well mitigated and compensated. Thus the impact is classified as of medium significance, and could be reduced to minor if adequate mitigation measures were followed. According to WB OP 4.12 the risk of any potential involuntary resettlement should be dealt with in early design stage, therefore a Resettlement Policy Framework (RPF) was prepared in order to address and guide any potential resettlement issue that might be triggered. In case the number of people who will be displaced as a result of the project reached 200 or exceeds that, a Resettlement Action Plan (RAP) should be prepared and implemented. If less than 200 are displaced an Abbreviated Resettlement Plan (ARP) should be prepared. The RPF presents a guideline for the preparation of RAP/ARP in case triggered. It sets the legal framework that should guide the process, defines PAPs and entitlements. RPF also defines the institutional responsibilities and propose activities to ensure PAPs consultation.

5.1.3 Loss of Environmental Benefits of Trees along Power Lines

As previously mentioned the Right Of Way (ROW) for power lines, which is estimated by about 10 meters wide along the line, will require removal of any trees that are located within this zone to maintain the line safety after it is energized.

The socioeconomic impacts of removing trees, including compensations to farmers, were discussed in the previous section of this ESIA and in the RPF, but the environmental benefits of trees and green cover include, as well known, purification of the atmosphere through synthesis of carbon dioxide, production of oxygen and stabilization of the soil, will be lost by removal of trees.

Impact Significance

The power lines are expected to pass on sides of roads with minimum passing through farms or forests, therefore, the number of trees expected to be removed is little. Accordingly, the regional impacts could be negligible. However it has been recommended in the ESMP that for each removed tree the project management should oversee the plantation of two trees within the same area (of native species) to substitute for the removed tree in the form of compensatory afforestation. The impact significance is classified as negligible.

5.1.4 Affecting Air Quality by Air Emissions During Construction Works

The excavation, filling, loading and unloading of soil cause suspension of airborne dust that raises the particulate matter concentration on ambient air. These emissions are temporary and its severity depends on the construction activity, meteorological conditions, silt content of the soil and moisture content of the soil.

Excavation works expected for fixing line distribution poles are very limited as the wood poles, which are expected to be the dominant type, will depend for its support on undisturbed soil, so the excavation will be for a very limited area around the pole. Also excavation for footings of steel poles and excavation works for constructing substations will be in a very limited area that is not likely to cause major dust emissions.

Another source of air emissions during construction is the exhaust emissions of construction machinery. The extent of these emissions depends on the number of machinery working at the site at one time, the type and efficiency of the engines and also the climate conditions.

Impact Significance:

The limited excavation works and the rocky type of soil in most of the project areas make the expected dust emissions from construction works insignificant. Also, the project construction is not expected to employ intensive machinery input, therefore there will be very limited air emissions/smoke from such machinery. Furthermore, the low population density that characterizes rural areas will make it unlikely to cause adverse effects to any sensitive groups, or to cause cumulative impacts with other sources. Therefore this impact has been classified as minor impact. It has been recommended, in the ESMP, to apply water spraying if there were significant dust emissions.

5.1.5 Raising Noise Levels

Normally construction works include noisy activities related to the operation of construction machines, possible hammering and drilling works in addition to the noise generated from construction related trucks. The noise impacts could be analyzed in two main aspects: noise inside construction area, and the noise in the neighboring sites.

Impact Significance:

Construction noise is not likely to effect neighboring areas because the expected low level of noisy machinery input from one hand, and the low population in rural areas of the REAP from the other hand.

For noise within the construction site, it is possible that construction workers could be exposed to relatively high levels of noise for short periods. This could be mitigated through application of the normal precautions normally taken by construction labor. Accordingly this impact has been classified as a minor impact which could be further minimized if construction workers used safety gear as recommended in the ESMP.

5.1.6 Impacts on Traffic

Construction of power lines could cause two main impacts to the traffic: the first is by narrowing of roads or occupation of one or more traffic lanes by stored construction materials or construction waste. The second is by increasing traffic volumes on rural access roads by construction vehicles and machinery that are expected to pass through.

Narrowing of roads and increasing traffic volume impact the efficiency and the average speed of these road, this impacts are proportional to degree roads are narrowed and to the amount of extra traffic volume.

Impact Significance

Most of power lines will be established on road sides in rural areas where there will be plenty of space for storage of construction materials and construction waste on road sides, therefore there will be very little possibilities that construction contractors will actually need to store materials on road lanes. Furthermore, the extra traffic caused by construction vehicles is not expected to effectively impact the flow of traffic on rural roads because the average traffic volume on such rural roads is usually less than the design flow.

It has been recommended in the ESMP that storage of construction materials, wastes, and equipment should be on road sides without any occupation or narrowing of traffic lanes. In case secondary roads in villages will be occupied by construction machinery (for loading-unloading or temporary parking) alternatives access routs for villagers should be facilitated. The impact significance has been classified as minor.

5.1.7 Affecting the Culture and Privacy of Local Communities

During the construction phase, local communities are expected to be exposed to openness and interaction with the project crew and workers who might be coming from different cultural and tribal affiliations. This might be regarded as a positive social opportunity particularly for the closed communities. On the other hand, and considering the tensions that exists among certain tribes and the fact that certain rural sites are very conservatives and closed, it is expected that receiving outsiders in certain villages might result in negative consequences due to alerting local people's privacy and affecting their culture.

Impact Significance

This is expected to be a minor and temporary impact. It has been recommended in the ESMP to maximize the use of local labor to reduce such impact and to maximize the benefits to local communities.

5.1.8 Creation of Job Opportunities and Flourishing Economies of Construction Sites

The construction works associated with the project are expected to result in the creation of number of temporary job opportunities. These opportunities are expected to be appropriate for low and semi skilled workers who represent wide portion of rural residents.

Also an increased demand on different consumable goods like food and drinks will emerge due to the increased population in construction areas. This is expected to increase business demand on private entrepreneurs providing services.

Impact Significance

The impact is a temporary positive impact. Maximizing employment of local workers, indicated when discussing the previous impact, will maximize the benefits of local communities from the project.

Table 5-2: Assessed Significance of Expected Impacts during Construction Phase

Impact	Likelihood and severity	Significance	Mitigation Measures Effects
Handling of construction waste	Uncertain likelihood for medium impact	Medium	Reduce impact significance to minor
Limitations on land use and risks of involuntary resettlement	Generally low likelihood for resettlement for substation and higher likelihood for power lines	Medium	Reduce impact significance to minor following recommendations of RPF
Losing environmental benefits of trees along power lines	Low likelihood of major or medium impacts	Minor (negligible)	Further minimizing impact significance
Construction air emissions	Low likelihood of major or medium impacts – high likelihood of minor impact	Minor	Minimizing impact significance – only needed in loose sandy soil

Impact	Likelihood and severity	Significance	Mitigation Measures Effects
Construction noise	Low likelihood of major or medium impacts – high likelihood of minor impact	Minor	Minimizing impact significance
Impacts on traffic	Low likelihood of major or medium impacts	Minor	Minimizing impact significance
Affecting culture and privacy of local communities	Low likelihood of major or medium impacts	Minor	Minimizing impact significance
Creation of job opportunities and flourishing business of private entrepreneurs	High likelihood	Minor Positive	No mitigation measures required

5.2 Impacts during Operation

5.2.1 Risks of Scrap and Hazardous Waste

There shall be different types of wastes generated during the operation phase resulting from maintenance, repair and replacement activities. Among these types:

- Used batteries that are expected to be disposed from off-grid systems and WHSs. The type of batteries that will be employed in the project is not defined at this stage, but normally waste batteries are considered as hazardous waste because they usually contain heavy metals and hazardous materials such as lead, mercury, cadmium etc. The disposal of such components poses different environmental risks, especially if the disposal was in open dumps that often have fires
- Used florescent lamps, which normally contains mercury that could be released to the surrounding environment during disposal either to soil or to air
- Scrap transformers, which raise two main environmental risks: the first is that used mineral oil is considered a hazardous waste, and the second is the relatively large volume and heavy weight of wasted transformers which require special arrangements for temporary storage. It is worth noting that the REAP will not include installation of transformers that are cooled with PCB containing oil; it has been emphasized in the ESMP that the procurement policy should include instructions to screen out such transformers from the project. It is worth noting that Yemen has signed Stockholm Convention on Persistent Organic Pollutants (POPs), in which PCBs are included. Annex 7 summarizes the requirements of the conventions and situation of Yemen in fulfilling these requirement.

- Wasted cables that will be replaced. Some of these cables may be covered with PVC insulators, which, if burned, cause harmful emissions including dioxins. Accordingly, waste cables could be of high risk if PVC cables were disposed in open dumps where it could be exposed to open fires.
- Wood poles which have been discussed earlier with the impacts of the construction phase. The risk of wood poles are mainly the CCA or creosote treatment that could leach to the environment or cause harmful air emissions in case it catch fires in open dumps
- Scrap inverters, panels, fittings, insulators, cross arms, conductors, wind turbine blades and other scrap which are expected to be from inert materials that does not cause high risk in disposal/recycling procedure.

Impact Significance:

Non-hazardous waste, which include types that are mentioned in the last point above are associated with relatively low environmental risks, however, the quantitative aspects could be an issue. Because there could be large quantities of such scrap, certain waste management procedures should be taken to avoid situations where scrap occupies large areas of land and causes aesthetic and land-use impacts. Therefore the ESMP includes measures for establishing temporary stores for scrap at each of the 12 service territories and keeping the tidiness and cleanliness of these stores until scrap is sold for recycling or disposed as shall be detailed in the ESMP.

For hazardous wastes, such as batteries, lead containing florescent lamps, and spent transformers oils, although the environmental significance resulting from release of such materials are high, the expected quantities for such waste is expected to be **low**. As indicated in Table 5-3 it is expected to receive an average of 46 batteries, 139 florescent lamps one transformer and 12 wood poles per month in each service territory per month. These quantities will not start to be generated except after few years from starting the project. In addition to these materials there will be few diesel generators and WHS batteries generated after several years of operation.

Table 5-3: Expected quantities of some types of wastes according to their average replacement periods

Material	Expected life span (years)	Average qty in REAP areas	Waste qty in REAP areas per month	Average waste qty per service territory per month
Batteries for SL and SHS ⁴⁹	3	20,000	556	46
Florescent lamps	3	60,000	1,667	139

⁴⁹ Assuming 20,000 medium SHS will be introduced by the REAP

Material	Expected life span (years)	Average qty in REAP areas	Waste qty in REAP areas per month	Average waste qty per service territory per month
Transformers ⁵⁰	10	1,200	10	1
Wood poles ⁵¹	30	53,288	148	12

It could be concluded from the above analysis that hazardous waste, and special waste such as batteries and wood poles, are not expected to be generated in large quantities, but they pose different environmental risks, while non-hazardous waste will be generated in relatively larger volumes but they are associated with minor environmental risks. The impact has been classified as medium impact. The ESMP includes measures for waste minimization and waste management that could reduce the impact to be of a minor significance.

5.2.2 Safety of Power Lines, Substations and Off-Grid Systems Batteries

There are two main safety risks associated with the operation: electric shock risks and fire risks. Electrocution could happen for maintenance operators during repairs or to the general public because of unforeseen accidents; however the normal safety precautions that are followed in the design and construction of distribution lines, transformers, substations ... etc are generally minimizing such risks both to the general public and to the maintenance workers.

Fire risks could be due to connection of power lines to vegetation, an issue which have been previously discussed in the impacts of construction phase and it was mentioned that power line routing will avoid, as much as possible, fields having high trees, and that trees will be removed from the ROW zone of power lines. Another factor which could cause fires is overloading of power lines and cables, a risk that is also minimized by adequate safety precautions in the design and operation of the system.

During the field visits of the scoping phase, a transformation station in El Roda, Sana'a was visited and found to be located with proximity to residential sites. The proximity occurred due to the extended urbanization of the area. People in the neighborhood seemed to be more concerned about the unreliability of electricity service rather than the safety issues. However, in places where electric shocks in the rainy high altitude sites were mentioned to result in death cases⁵², people showed concern about safety issues.

In addition to the above-mentioned two main safety risks, there is another safety risk related to the operation of lead acid batteries that could be used in some off-grid systems. When overcharging such batteries hydrogen gas may be released which may reach a

⁵⁰ Average 100 transformer per service territory

⁵¹ Assuming all poles will be wood and the span between poles is 50 meters

⁵² Hufash, Al Mahweat

flammable concentration, however, it is believed that overcharging batteries so that dangerous quantities of hydrogen gas could be released is not likely especially that the SHSs that may use such batteries are of a relatively low capacity.

Impact Significance:

Although electrocution accidents and fires could lead to losses in lives and properties, it is believed that the normal design, construction and operation procedures expected to be followed by the REAP will provide sufficient safety precautions so that accidents will be due to unforeseen factors that could not be considered in risk estimation.

The impact has been classified as medium impact that could be reduced, following mitigation measures, to minor impact.

5.2.3 Effects of electromagnetic fields

Energized power lines generate electromagnetic fields around the conductors, the intensity of such fields are proportional with the line voltage and electric current. EMFs attenuate rapidly at a relatively close distance from the conductor. Electric fields directly beneath overhead distribution lines may vary from a few volts per meter to 100 or 200 volts per meter. Magnetic fields directly beneath overhead distribution lines typically range from 10 to 20 mG for main feeders and less than 10 mG for laterals. Peak EMF levels, however, can vary considerably depending on the amount of current carried by the line. Peak magnetic field levels as high as 70 mG have been measured directly below overhead distribution lines and as high as 40 mG above underground lines. Magnetic intensity attenuates rapidly with distance, for a typical 115 KV lines if magnetic fields under the lines reads 29 mG, it attenuates to 6.5 mG at 15 meters, 1.7 mG at 100 meters, 0.4 mG at 61 meters and 0.2 mG at 91 meters⁵³.

There are some concerns that EMFs could cause health impacts to the general public by prolonged exposure. EMFs have been considered by the International Agency for Research on Cancer (IARC) as possible carcinogenic, this classification was based on some evidences; however, there is no agreement among the scientific community about certain effects of EMFs.

In order to maintain safety of the general public and minimize exposure to EMFs some laws and guidelines require maintaining a suitable ROW distance so that the EMFs would effectively attenuate at the edge of this ROW. Some environmental legislations and guidelines have also recommended certain values for electric fields and magnetic fields related to the ROW zone. In some states standards in USA magnetic fields should not

⁵³ Source: Report on EMFs of power lines of the National Institute of Environmental Health Science

exceed 150-200 mG at the edge of ROW and electric fields should not exceed 1-3 kV/m at the edge of ROW and 7-11.6 kV on ROW⁵⁴.

EMFs of transmission lines interfere with electronic appliances, such as TVs, radios, screens, and some medical equipment. EMFs as low as 5 mG could be detected in some sensitive electronic devices.

Impact Significance:

The International Commission on Non-Ionizing Radiation Protection⁵⁵ (ICNIRP) has set a guideline figure that public exposure to EMF should not exceed 833 mG and occupation exposure should not exceed 4,200 mG, these figures for electric fields are 4.2 and 8.3 kV/m for public and occupational exposure respectively. Because the power lines that will be constructed under the REAP are relatively low voltage the resulting EMFs are not likely to exceed these figures. By fixing a ROW distance of 10 meters⁵⁶ (5 meters from each side) the impact of EMFs on the rural areas inhabitants is expected to be ineffective (EMF below the line is expected to be 20-25 mG and at the edge of ROW 15-20 mG).

Effects related to interference with electronic devices are considered minor effects outside the ROW because the magnetic fields are attenuating rapidly with distance and it is unlikely that it will cause effective interference with electronic equipment. Also electronic equipment, except TVs and radios, are not common in rural areas in Yemen. The impact significance has been classified as a **minor** impact.

It is worth noting that EMF effects on beehives were previously discussed with the impacts of the construction phase.

5.2.4 Risks of soil contamination

Risks of soil contamination with oil could arise in substation locations, transformers and isolated diesel generators associated with WHSs. There may be two causes for soil contamination: the first is associated with oil changing for transformers⁵⁷, or fueling the diesel tanks of the generators. Such oil release incidents could be because of uncontrolled discharge of the oil or diesel, such as overflowing, or improper discharge/disposal of used oil which lead to contaminating surrounding soil.

The second cause could be due to leakage from oil/diesel storage tanks, which could not be noticed in case of USTs until large areas of soil has been already contaminated.

⁵⁴ Previous source

⁵⁵ A scientific organization recognized by the WHO

⁵⁶ This ROW has been guided in NRES Phase III Pilot Project Final Report

⁵⁷ It is worth noting that no PCB containing oil will be used in the project as previously indicated

Impact Significance:

The possibility of contaminating the soil during changing transformers oil in distribution lines and in substations is proportional to the number of oil changing times for transformers and substations. Given that changing transformers oils could be needed once every few years (once every five years for substation transformers) the possibilities of contaminating the soil during oil change or caused by land disposal of used oil are not high. The severity of such impact will depend on the local conditions where the oil is released and whether contaminants migration would be likely to reach sensitive receptors, but in general, the amounts of transformers oils is a relatively little amounts and would effect a small area of land if accidentally released.

The impact would be more significant in case of leakages from an UST where the leaked fluid will not be observed until larges areas of soil are affected. However, the implementation of WHSs will be in very limited locations, if implemented at the first place by the REAP, and the using of USTs is not likely as it will be a more expensive option. The impact significance has been classified as minor and could be further minimized if recommended measures in the ESMP were followed.

5.2.5 Special impacts of WHS

Although Wind Hybrid Systems will most probably be installed by the REAP in a very limited number, its possible impacts have been discussed in the Section for proper environmental management of such systems if installed.

As mentioned in Chapter 3, WHS comprise three main components, the wind turbine, the emergency diesel generator, and the battery. The main environmental issues associated with WHS will be the air emissions and noise of the isolated diesel generators, noise and shade variations of wind turbines, and bird colliding in wind turbines.

Air emissions of isolated generators depend on the efficiency of the generator and the power rating. According to the USEPA average figure a diesel engine produces 19 g of nitrogen oxides, 4.1 g of carbon monoxide, 709 g of carbon dioxide and 1.3 g of sulphur oxides for each kwh of energy output. Also diesel generators are characterized with high levels of continuous noise.

Although wind turbines are one of the renewable energy or clean energy sources, it is also associated with limited environmental impacts, such as:

- Risks to birds, as it are common that birds get killed by the wind turbines.
- Causing uncomfortable environmental to people near the wind turbines because of the intermittent noise it causes. Although such noise is not high level, but its intermittent nature cause certain discomfort to nearby residents

- Also the rotating blades cause shades variations which may lead to discomfort to people located within the shades of the turbines, after long exposure.

The impacts of batteries have been discussed earlier with the impacts of hazardous wastes.

Impact Significance:

Impacts of air emissions could be classified as minor in general terms, because the rural areas where the WHSs would be installed will be generally characterized by very low air emissions from other sources, so it would be expected that these air emissions will be dissipated and diluted in the atmosphere. For generators noise it could only effect a narrow area around its location and is not expected to cause cumulative increase to the background noise in relatively far locations.

The effects of wind turbines on birds could be considerable if the turbine is installed in an important location for birds' migration, as it could kill considerable number of birds which may be from endangered species, in other locations the numbers and type of effected birds would not be significant.

The noise and shades discomfort impacts of wind turbines only affect small area around the turbine.

Generally because the WHSs are not expected to be implemented in many areas, and because of the localized nature of its expected impacts, such impacts have been classified as **minor** impacts.

5.2.6 Impacts on Landscape

Effects on landscape will be limited to the view obstruction caused by power lines and by substation buildings and fences.

Impact Significance:

Impacts of power lines on the landscape are very limited because its obstruction to the general view from an open area could be negligible. For substations, the impact on landscape could only be materialized if the location was selected right besides a building so it would obstruct the view from the lower floors, which is not likely to happen for safety reasons. Therefore the impact is classified as **minor**.

5.2.7 Indirect Impacts of REAP on Power Generation

It was previously indicated in Table 3-2, Chapter 3, that the proposed REAP on-grid systems will require power demand of 89,902 KW (384,064,254 kwh of energy purchase) in the first year, 111,041 KW (478,446,295 kwh of energy purchase) in the fifth year, 119,585 KW (522,272,782 kwh of energy purchase) in the tenth year and 129,012 KW (570,199,336 kwh of energy purchase) after 15 years. This power demand is expected to be met by the existing power plants that are connected to the grid. Because most of the power demand in Yemen is met by thermal power plants that either uses fuel oil (such as diesel) or natural gas, the extra power demand of the REAP is expected to lead to extra fuel combustion in existing power plants which will cause additional air emissions which will effect the airshed around existing power plants. If carbon dioxide emissions from thermal power plants operating gas turbines (natural gas fuel) could be assumed 400 g/kwh⁵⁸, cumulative CO₂ emissions caused by the additional power demand caused by the REAP will be about 37,750 tons by the fifth year, about 55,280 tons by the tenth year and about 74,450 tons by the fifteenth year.

On the other hand this power supply (or part of it) used to be provided by small diesel generators that generates more carbon dioxide emissions for the same amount of power generation. Therefore, the implementation of the project will lead to achieving the environmental benefit by connecting the isolated systems run by diesel generators to the main grid system. The diesel generators could be used in case of backup, as necessary.

According to the USEPA Emission Factors Guidelines (Document AP 42) the CO₂ emission factors of diesel generators (less than 600 HP) is about 700 g/kwh, therefore, if these diesel generators are currently supplying the customers with electric power for the same service hours (as planned to be supplied through the national grid) the cumulative effect of connection to the national grid will be positive, however, this is not the case in most of the rural areas that will be served. According to energy access survey, presented in Chapter 3, the operating hours for small diesel generators are 5-7 hours per day, which is about half the service hours of the national grid, according to the data of Table 3-2. Assuming that diesel generators was working half the service time planned to be provided by the national grid, the estimated emissions of diesel generators that could be avoided is about 33,030 tons CO₂ by the fifth year, 48,370 tons CO₂ by the tenth year and 65,150 tons CO₂ by the fifteenth year.

Accordingly the net additional CO₂ emissions (after subtracting the avoided CO₂ emissions of diesel generators) will be about 4,700 tons by the fifth year, 6900 tons by the tenth year and 9,300 tons by the fifteenth year.

⁵⁸ Using the assumptions of used in USEPA Emission Factors Guidelines (Document AP 42) for estimating the emissions from stationary gas turbines. Because the document only gives emission factors related to fuel consumption the consultant used available data about the efficiency of gas turbines from experience to relate the emission factor to output power.

Impact Significance:

This impact is an indirect impact that is expected to be managed through the existing procedures followed in thermal power plants. Therefore the impact has been classified as a **minor** impact, while no mitigation measures are required by the REAP.

5.2.8 Indirect Impacts on Groundwater Resources

Although groundwater is the main source of water in Yemen, there are limited groundwater resources and the deep aquifers are suffering from relatively rapid depletion rates. The introduction of rural electricity may lead to expansion of the use of electrical pumps which may lead to increasing the depletion rates of groundwater resources.

Impact Significance:

Abstraction of deep groundwater usually requires high power pumps that are usually operating using diesel oil, therefore rural electrification is not expected to significantly increase operation rate of deep water pumps. This impact is not directly related to REAP activities, therefore it has been classified as a **minor** impacts. No mitigation measures required by the REAP.

5.2.9 Economic Burden on Poor Households

The previous surveys carried to assess WTP as well as the field investigation for this SIA showed that the service fees that will be required from the consumers is expected to be affordable for a wide portion of community members and that they are already paying relatively big amounts for an unreliable service. Still, the discussions with the NGOs engaged in electrification projects revealed that the delayed payment for the service fees by poor households is one of the challenges that they encounter⁵⁹. The cost of electrification connections (installation fees) to the households is considered a high start up cost (which range from 10,000 to 15,000 YR). The start up costs required for purchasing LPG cylinders and stoves is still high as well. The field investigation also showed some fear from the increased level of consumption with the availability of electricity.

“We will be increasing our consumption without increasing our incomes. Maybe we will buy a fridge but how to fill it with meat and other food stuff? ” Bani Maser village, Nahm tribes, Sana’a

Appropriate tariffs that allow recovery of operating costs, even when some of the capital cost is subsidized, is required to make rural electrification possible. Cost recovery is critical for the long-term sustainability of rural electrification programs, and tariffs must

⁵⁹ Al Kanawes Cooperative Association, El Hodeidah

allow the utility to meet its revenue requirements. Although, consumers in rural areas have often shown that they are both willing, and accustomed, to paying for energy services, the question is about affordability, particularly for poor households who have limited, seasonal and unsecured sources of income.

Impact Significance

In assessing the significance of this impact, it is important to consider the fact that the percentage of the rural population who are poor amounts to 45%⁶⁰. Thus the likelihood of facing this impact by poor household is considered high. Baring in mind also the linkage between electrification provision and poverty reduction that was made explicit in the REAP objectives; it is essential to deal with this impact as an impact of high significance.

5.2.10 Exposure of rural communities to urbanized pattern of life

Rural communities' exposure to the urbanized style of life, particularly due to the increased access to media is seen as a mixed blessing. While increased level of awareness and better opportunities are the key positive sides, there is the risk of changing the rural life style in the way that negatively affects their livelihoods. Few of the interviewed stakeholders expressed fears from potential negative impact of the rural random exodus to the urban population centers which result in increased urban poverty and contribute to worsening the situation in villages. Other expressed that exposure to media might also pose a negative impact on the conservative and religious culture of the local communities.

“After electricity, rural men will spend the whole evenings till late at night chewing qat and watching TV. They will not be waking up early as usual to farm their lands ” Hufash, El Mahaweet

Openness to the urbanized life style is also perceived to cause a dissatisfaction attitude towards the village life among rural residents, especially if new economic opportunities do not emerge. The consequences of this is the unorganized exodus to cities which result in leaving the villages behind underdeveloped and cause the creation of new slums and socially unsecured categories as well as plenty of social and environmental problems in cities. This in turn might result in deterioration for the agriculture sector in villages and increase the vulnerability of rural women who are largely engaged in this sector

“Electricity caused confusion for rural people. Lots of the time has been saved after the home electrical facilities. This surplus time is spent in front of satellite. Cities attractions then pull village residents. They leave the village assets unutilized and go to cities causing chaos and pollution

⁶⁰ Poverty Reeducation Strategy Paper, WB, May 2002

and live as poor there” Meeting MEE

Impact Significance:

The likelihood of this impact is medium and the severity of its consequences is seen as high because it will directly challenge achieving one of the important REAP goals which is economic development and poverty reduction in rural areas. The impact significance is estimated as medium

5.2.11 Consequences of Conflict of Interests

In the context of Yemen, conflict is an issue that could not be disregarded. Although conflict is an existent problem and could not be ranked as a direct impact of the project, careful mechanisms need to be drawn in order to ensure that the existing conflicts or other conflicts that might emerge will not affect the project. Existing conflicts involves tensions between Sheikhs, tribes and the Government in certain places, particularly Sana’a and Al Bayda. There is also a fear from new conflicts that might emerge between the project and the current service providers in the rural areas, if other service providers are introduced without paying attention to the concerns of the current ones. . Conflict of interest might result also in more complicated social unrest which may negatively affect the targeted communities.

Impact Significance:

The potential of conflicts to occur is high only in certain places (namely the eastern parts in Sana’a and certain parts in Al Bayda where conflicts among tribes and between them and the Government exist) so the likelihood of the impact is considered low. The severity of consequences could be assessed as high in the places where it might happen because it will have a direct impact on the projects as well as the communities. So the impact significance is ranked as medium.

5.2.12 Increase the vulnerability of certain groups

There is a fear from inequitable access to the project benefits. The poor and landless people and those with very limited assets (including level of education and skills) or those who are socially marginalized (akhdam) are very unlikely to benefit from the economic opportunities without being targeted with assistance. Houses that are built in unstable structures⁶¹ (e.g. huts, mud houses, shanties ... etc) are also unlikely to get connect to the project due to the fragility of their houses as well as their inability to pay the costs (both the connection and the service cost). It is worth also to mention that connecting these unstable structures to electricity might pose a serious risk on them, in

⁶¹ Attyal, Sana’a , Mudya, Abyan

cases of heavy winds and rains⁶². Handicapped and female headed households are also special categories that need special considerations. The fact that those groups might not be able to harvest the fruit of the project like the remaining community members will have the negative consequence of their social exclusion and increasing the gap between them and the rest of community members.

Impact Significance:

This impact has a high potential to occur unless special programs are designed to consider those groups and as mentioned its consequences might be severe. It might have a medium level consequences severity. Thus it is classified as medium significance.

5.2.13 Reduction of Income Sources

Certain categories were found to be vulnerable to adverse impact on their livelihoods due to the project implementation. This includes:

- Villagers who sell electricity service informally through operating diesel generators
- Owners of gas stations/fuel traders
- Workers in gas and oil stations

Providing fuels, oils or power to the local community members who are the potential beneficiaries from REAP was one of the sources of income for those groups. They are expected to encounter some reduction in their income level after the operation of the project. There were no accurate statistics available on the number of the previously mentioned categories or the share of their income that will be affected but according to the consulted stakeholders, fuel traders and workers in gas stations are normally engaged in other sources of activities which actually represents the larger portion of their income (e.g. providing fuel and oils for agriculture trucks, selling spare parts and car tires)⁶³. As general the benefits of access to improved service is in itself a great return that will compensate for small losses.

Impact Significance:

The likelihood of this impact is medium and its severity is relatively low, particularly on people who have other sources of income as mentioned above. Thus the impact significance is ranked as minor.

⁶² Reference here is made to the disaster in Hadramout, October 2008

⁶³ Hagana Khawlan , Sana'a

5.2.14 Environmental Benefits of Utilizing Renewable Energy

There will be at least 20,000 SHS installed in off-grid areas that generate clean renewable energy as indicated in Chapter 3. Assuming that these SHS are from the medium capacity type, a total of 5,000 kilowatt-hours of renewable energy could be generated. The environmental benefits of such power generation could be seen as reduction of emissions of greenhouse gases if other non-renewable energy sources were used. Assuming that these amounts of power are generated by small diesel generators causing CO₂ emissions of about 700 g/kwh, as previously indicated in Section 5.2.7, the above figure of 5,000 kilowatt-hours generated from solar energy could save about 1,300 tons of CO₂ emissions annually if this energy will continue to be generated by diesel generators.

Impact Significance:

This is a positive impact that will be proportional in its significance with amount of renewable energy units installed; however, the impact is an indirect impact that could be balanced with the amount of power generated by non-renewable energy for meeting the expected demand of on-grid systems. Therefore the impact has been classified as minor positive impact.

5.2.15 Improved Living Standards and Enhanced Sense of Wellbeing for Rural Residents

Households conditions will be much healthier. Around 4579803 rural residents will be able to enjoy the privilege of sufficient lighting, ventilation (electric fans) and refrigerating. This means less labor input as well as less time consumed in the several domestic activities. Women will be able to replace the traditional manual washing with the electric washing machines. The introduction of electricity will contribute to the elimination of harmful indoor fumes from kerosene, to which vulnerable groups of women and children are exposed.

Impact Significance:

The likelihood of attaining this impact is high and it will make a major improvement in the quality of life of rural people, thus it is ranked as major positive impact.

5.2.16 Better Opportunities for Educational Attainment

There will be higher potential for children regular attending for schools. On one hand, children will be able to spend longer time reading and studying at night. This suggests better students' performance that encourages them and their families to continue going to schools. On the other hand, schools will be a better encouraging environment with the availability of electricity. Computer labs and other facilities might be used and benefit students. With high level of illiteracy particularly among rural residents, especially women with no more than

59% primary schools enrolment rate⁶⁴, this impact is expected to play a significant role in moving with the country towards achieving development goals and is a real investment in the future

“Schools will be equipped with educational facilities as well as the educational TV. Students will be able to follow up educational programs on TV” Attyal, Sana’a

Impact Significance:

The likelihood of attaining this impact is high and it will result in major positive consequences on the level of household, village and on the national level, thus it is ranked as major positive impact.

5.2.17 Increased Openness to the World and Better Level of Awareness

The Consulted stakeholders, during the preparation of the ESIA, perceived this to be one of the most important impacts on rural residents. They expect that the opened channels that they will have with the external world through access to satellite and television will play important role in educating people and raising their awareness in many issues related to their lives, including gender related issues like girls education, family planning and women rights. This perceived level of awareness is expected to result in more tolerant and socially open communities.

Impact Significance:

The likelihood of attaining this impact is high and local people perceive it as one of the most important and significant impacts so its significance is seen as major positive impact.

5.2.18 Better Functioning Social Services on the Village Level

The current insufficient quality of the health and education services was a major concern for the interviewed stakeholders and the improvement of these services is one of the key objectives that the project seek to achieve. When health centers and schools are electrified, they can operate longer hours and use special equipment. Graduated physicians who are normally reluctant to serve in villages will be more willing to work there⁶⁵. This will mean better quality of service provided to the rural population who currently suffer a lot in terms of cost and time consumed to obtain these services.

Impact Significance:

⁶⁴ The universal primary education is one of the Millennium Development Goals (MDGs) indicators that the country is working to achieve.

⁶⁵ Meeting with MEE and also from Household Energy Supply and Use in Yemen ESMAP, 2005

The likelihood of attaining this impact is high and local people perceive it as one of the most important and significant impacts so its significance is seen as major positive impact.

5.2.19 Economic Development, Better Resources Utilization and Job Opportunities Creation

In addition to the immediate benefits that will be attained on the household level, economic development is a key positive impact that is predicted after the implementation of the project. Although a longer term impact that might need some years to be sensed, it is the most important justification for government support to rural electrification. Modern energy can contribute to increased income in rural areas by making it possible to increase production and productivity and create jobs, particularly in agriculture and related commercial or agro-processing activities small industries and household-based economic activities. Electricity will help in better functioning for the existing economic activities in villages including machineries in workshops which will work for more hours and allow for better goods and services because of refrigeration in shops. On the other hand the provision of electricity will help in making the best of many unutilized resources in the communities like the potential of tourism⁶⁶ or the raw materials manufacturing⁶⁷. This will play a great role in creating job opportunities for rural youth and make villages an attractive environment for the residents. This will in turn contribute to solving the problem of unemployment and the random internal migration to urban centers which has negative impact both on the rural areas resources as well as on the cities.

Impact Significance:

The likelihood of attaining this impact is high and local people perceive it as one of the most important and significant impacts so its significance is seen as major positive impact.

5.2.20 Benefits to women

As explained earlier, women were seen to be more vulnerable to the negative impacts of the absence of clean power sources. It is expected that the project will offer special benefits to women which will contribute to their empowerment. Rural women access to knowledge and awareness will significantly help in improving her situation and raise her awareness about her rights. Access to knowledge is predicted to improve women performance on the households and neighborhood levels in issues related to children raising skills, dealing with husbands as well as communicating with neighbors. On the household level, benefits are also expected to occur from saving time and efforts through introducing home electric appliances.

⁶⁶ Demt, Ad Dalea

⁶⁷ Mudiya, Abyan

Moreover, communities' access to the satellite and increased knowledge will have an indirect impact on improving women situation through raising the awareness of different community sectors towards many women related issues like girls early marriage, girls education and the inferiority attached to the female child⁶⁸.

With the obvious inequalities that Yemeni women suffer from, they become the focus of attention of many national and international organizations who target rural women with many interventions, especially credit schemes for economic development. With the availability of an important development component like electricity, it is expected that women will attain plenty of opportunities. Women are seen to be key players in many off-farm potentials like livestock breeding. This is regarded as a promising area of growth that could be carried out by women, who normally have limited economic opportunities. Many organizations are expected to play a role in this regard particularly Agriculture Cooperatives, SFD, NGOs could be involved in implementing income generation projects which will empower women economically.

On the level of energy management, women role is expected to be wider than her current household oriented role⁶⁹. They are potential members in the various service provision institutes (cooperatives, NGOs, CDAs). The interviewed women showed enthusiasm about being engaged in electricity cooperative which could, as they suggested, form Women Committee, perceiving their role as especially important in:

- Studying women related problems in their ST
- Set plans and recommendations to solve women problem in coordination with electricity cooperatives and other programmes that support women.
- Work towards finding solutions for the poor and those groups (including women) who face problems in affording service fees.

The interviewed men from the local communities seemed, in certain districts, to be welcoming for the idea of women participation in electricity cooperatives/NGOs⁷⁰. In other places, men seemed to be reluctant to accept the idea of women participation due to the culture of the district⁷¹.

Impact Significance:

The occurrence of this impact has medium likelihood as it is expected that other factors and considerations (culture, traditions ... etc) might prevent women from harvesting the mentioned fruits. Although the positive consequences of this impact are high in terms of improving women situation, it is given a medium level of significance.

⁶⁸ Ar Rajm, Al Mahweat

⁶⁹ Ar Rajm, Al Mahweat

⁷⁰ Demt, Ad -Dhale - Mudya, Abyan,

⁷¹ Hagana Khawlan , Sana'a- Attyal, Sana'a

Table 5-4: Assessed Significance of Expected Impacts During Operation Phase

Impact	Likelihood and severity	Significance	Mitigation Measures Effects
Risks of scrap and hazardous waste	Low likelihood of major impacts	Medium	Reduces impact significance to minor
Risks of electrocution and fires	Low likelihood of major impacts	Medium	Reduces impact significance to minor
Exposure to EMFs	Low likelihood of major or medium impacts	Minor	Minimizing impact significance
Risk of soil contamination	Low likelihood of major or medium impacts	Minor	Minimizing impact significance
Special impacts of WHS	Low likelihood of major or medium impacts	Minor	Minimizing impact significance
Impacts on landscape	Low likelihood of major or medium impacts	Minor	No mitigation measures required
Indirect impacts on power generation	Indirect impact	Minor	No mitigation measures required
Indirect impacts on groundwater resources	Indirect impact	Minor	No mitigation measures required
Economic Burden on poor households	High likelihood of unaffordable households	Major	Minimizing impact significance
Exposure of rural communities to urbanized pattern of life	Medium likelihood of impacting rural areas	Medium	Minimizing impact significance
Conflict of Interests	Low likelihood of high severity impacts	Medium	Minimizing impact significance
Increase the vulnerability of certain groups	High likelihood of medium severity impacts	Medium	Reduces impact significance to minor
Reduction of income sources	Low likelihood if medium severity impacts	Minor	Minimizing impact significance
Environmental benefits of utilizing renewable energy	Indirect positive impact	Minor positive	No mitigation measures required
Improved living standards and enhanced sense of wellbeing	High likelihood for achieving major benefits	Major positive	No mitigation measures required
Better opportunities for education attainment	High likelihood for achieving major benefits	Major positive	No mitigation measures required
Increased openness to the world and better level of awareness	High likelihood for achieving major benefits	Major positive	No mitigation measures required

Impact	Likelihood and severity	Significance	Mitigation Measures Effects
Better functioning social services	High likelihood for achieving major benefits	Major positive	No mitigation measures required
Economic development, better resources utilization and job opportunities creation	High likelihood for achieving major benefits	Major positive	No mitigation measures required
Benefits to women	High likelihood for achieving important benefits	Medium positive	No mitigation measures required

6. Project Alternatives

6.1 No Project Alternative

In addition to many developmental advantages that will be achieved by the REAP, such as upgrading facilities and infrastructure in rural areas, poverty reduction, improve education, healthcare, nutrition and other services, the REAP will generally achieve many environmental benefits. Among these benefits are:

- Eliminating the use of kerosene lamps which are currently used widely in rural areas. Kerosene lamps has many environmental and safety impacts such as harmful gaseous emissions (including sulphur compounds and aromatic hydrocarbons) and high flammability of the lamps fuels that usually cause many fire accidents
- Eliminating the use of many private isolated diesel generators which cause many environmental impacts due to emissions of oxides of carbon, sulphur and nitrogen and contamination of soil which usually takes place around fuel tanks
- Generating appreciable quantities of energy from renewable sources, solar and wind energy, which indirectly saves resources from fossil fuels and reduce gaseous emissions from their combustion

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

6.2 Location Alternatives

The selection of the REAP 12 service territories was undertaken according to criteria that fulfilled technical and socioeconomic objectives. The selection of rural areas to be connected to the grid has been undertaken by GIS application to achieve most feasible application of rural electrification. For the off-grid systems the OGREDS has selected districts and governorates that were considered based also on certain technical and economic criteria, however, the exact locations for the villages that will be covered by the REAP has not been finalized yet.

Generally there are few environmental constraints for locating substations and wind turbines, these constraints are described in the ESMP screening criteria in Chapter 7. If these constraints were followed during the implementation of the project there will be no environmental/social objection on selecting sites for locating different utilities.

6.3 Renewable Energy Alternatives

It was mentioned in the project description (Chapter 3) that wind energy will only be suitable in locations where wind speed and blowing durations could be reliable, this will most probably be applicable in low lands, while solar energy systems could be applied all over the country. It was also mentioned that there are 23 villages that could be potentially provided with WHS, therefore the preference between solar energy and wind energy in the REAP will be limited to these villages.

Generally the WHS could potentially achieve more economic benefits if the village has relatively high population because some of the construction/installation costs will be distributed among the consumers in these villages. However, the discussion about the two alternatives in this Section will be limited to environmental advantages and disadvantages rather than economic factors that will be considered during the project design.

From the environmental perspective the advantages of the solar PV systems over the WHS are:

- The solar of the system does not cause the environmental impacts associated with the operation of the diesel generator including gaseous emissions, fire and leakage risks associated with diesel storage
- The environmental impacts of wind turbines discussed in the previous Chapter (killing birds, shades variations, noise, and large construction waste) are avoided by the solar systems
- No requirements for using or storage of lubricant oils, so no risk of leakage of such oils
- The operation of the solar system is quite simple and does not need mechanical or human input

On the other hand the environmental advantage of WHS is that it provides more reliable power that could be utilized in more applications than the solar systems, which may eliminate the need of off-grid areas inhabitants to search for other sources of energy that could be more polluting (such as private diesel generators).

In conclusion, if economics and technical aspects, in a particular village, does not favor solar or wind systems, it is recommended to use solar energy systems. However, if mitigation measures recommended in the ESMP were implemented there would be no major environmental concerns.

6.4 Service Provider alternatives

One of the key and crucial aspects related to the REAP sustainability is the selection of the appropriate service provider. There is a need on one hand for a commercially viable model that ensures the economic sustainability of the services and on the other hand a

high responsiveness and accountability to the local communities. The previous experiences in Yemen and elsewhere showed that decentralization and consumers' participation in the service provision is a guarantee for the long term sustainability. A community approach is not new to Yemen, where much of rural Yemen required complex coordination to implement traditional agricultural and water management systems, such as spate irrigation. The historical background of the electricity sector also revealed that the cooperative and private sector involvement in electricity provision was previously introduced into the country and that they are currently viable in many rural areas. Community participation in the service delivery and operation and challenging the traditional top-down model of management make it likely that the project will be well-received with increased sense of community ownership.

Although the low capacities of existing and potential cooperative might be a major issue of concern, the establishment for REA, which is underway, will contribute to facilitating the provision of technical assistance as well as the capacity building support needed to the service providers.

The field consultations carried out as part of the SIA investigated the perception of rural people for the capable institution and the suitable service provision model to their communities. People's views varied widely from one village to the other depending on their experiences and backgrounds and social context of the village. The key finding is that a uniform "One size fits all" model for service provision is not the best practical option to the Yemeni context. The social context needs to be reviewed to determine the most viable option.

The following section analyze the different service provision alternatives, discuss the strengths and shortfalls of each alternative and then recommend an alternative for the service provision that is driven from the analysis and the discussion with the stakeholders.

Alternative 1: Rural Electric Cooperatives

Cooperatives are defined as an autonomous association of persons united voluntarily to meet their common economic, social, and cultural needs and aspirations through a jointly-owned and democratically-controlled enterprise. Cooperative values involve self-help, responsibility, democracy, equality, equity, and solidarity⁷². Experience in other countries (Bangladesh, Costa Rica, and the Philippines) shows that rural electric cooperatives can achieve very impressive collection rates, low levels of technical losses, and a high degree of consumer satisfaction. In Yemen, local ownership and management is a model that is already being employed in rural Yemen for electricity provision but in

⁷² Consumers count: How water and sanitation utilities can become more accountable to their users? Practitioner Notes, World Bank , Issue 15, June 2005

an informal fashion. The current local operators have been able to operate without significant losses, but are forced to charge higher rates to compensate for high fuel costs.

Many strengths are seen to be attached to the rural electric cooperative as a service provider. The beneficiaries/consumers will be the shareholders so they will be keen to put effort to make the project successful and sustainable and ensure maintenance is done in an efficient manner. Cooperative members understand that a joint commitment is required from the utility and the consumer to achieve high quality, sustainable electric service. The joint commitment requires paying the utility for services received, and providing consumers with efficient and high-quality service. More importantly, under the rural electric cooperatives, shareholders are, basically, the grassroots who are quite aware of the local circumstances and are assumed to be accountable to the residents. One of the key strengths is that in case targeted actions for the poor segment of population are needed, the potential cooperatives will be good key informants and can develop schemes that are acceptable to local people.

Despite the limited number of cooperatives currently working in electricity services in rural areas, several cooperative have been previously formed as part of some SFD schemes related to agriculture, animal husbandry or fisheries. These existing entities, especially the successful ones, could be a good start for the electricity service provision cooperatives. The fisheries cooperatives in the south are successful models that worth benefiting from. The existing cooperatives members benefited from various capacity building and training programs but not from specialized programs in power management related issues. Training and technical assistance are monitoring to assure reasonable quality of service and effective management of critical commercial, administrative, and technical functions are important consideration for the both reorganized or newly established cooperatives.

On the other hand, key shortfalls include that the history of cooperatives in Yemen revealed that many of them are oriented towards profit-making rather than serving communities⁷³. They are also expected to face the problem of the limited capacities of the human and financial resources and the absence of assets including location and office facilities which pose serious challenges when they come to start working. Cooperatives as a model is not applicable to all territories. Certain surveyed areas did not seem to be welcoming the Cooperative ideas and mentioned that it is normally dominated by elites and result in many familial and tribal problems, especially because it will represent all the village in the ST⁷⁴. However the cooperatives model was favored by other places⁷⁵, provided that good representation for the different families and tribes in the area

⁷³ Meeting with SFD – Their experience with the cooperative in the north was not very positive. The cooperatives were especially formed/tailored in order to get donor fund and this made their accountability to community very low

⁷⁴ Attyal, Sana'a – Hagana Khawlan, Sana'a

⁷⁵ Demt, Ad Dalea – Moudya, Abyan

considered. Consulted community members also highlighted the importance of representing the historically vulnerable and marginalized groups (Akhdam)⁷⁶. Success stories for the work of Cooperatives were recorded in some places.

Box 1: A Success Story – El Kanawes Cooperative Association for Electricity Users

In an ordinary social gathering in the house of one of the businessmen of El Kanawes District, the issues of lack of services, including energy services, was discussed. The idea emerged in this gathering as an investment idea. However, and after further consultations with other stakeholders including head of the Local Councils, Heads of Executive Offices, members from MoSAL Office in El Hodiedah, Sheikhs and natural leaders, the ideas was reshaped to take the form of establishing a cooperative. The Cooperative Association was established in 1999 with 85 members in the public assembly who are also the shareholders. The largest portion of the project fund was provided by an investor (the businessman from the area previously referred to). The project started up in 2000 and now was extended to cover 4 of the neighboring villages and the beneficiaries amounted to 409 beneficiaries. Service fees are collected from households through fees collectors who are appointed by the project. The fees collector is the representative of the district where he serves in front of the project. The project staff include 3 engineers graduates from El Hodiedah Technical Institute and has previous experience from working with private companies.

No systematic monitoring system exist in the Cooperative Association but they perceive the increase in beneficiaries (from 85 households to 409 households) and the increase in revenues (from 300.000 YR in 2000 to 2.000.000 YR in 2008) as the key success indicators. They believe that community members also participate in the monitoring through their complains and remarks which they highly consider.

The key challenges for them is the delayed payments from some executive offices and from certain poor households. The Cooperative Association assisted those poor families by linking them to the MoSAL office in El Hodiedah in order to provide them with social guarantee payments from the Social Protection Fund in order to allow them to pay for their electricity bills.

Kanawes Cooperative Association perceive the key lesson learnt from their experience is involving community and allow them to participate and have a say in their projects.

Alternative (2) The private sector/ Small Investors/ Contractors

It must be noted that there are virtually no private sector parties with experience in the management of electric distribution in Yemen. However, the interviews showed that private sector/small investors/ contactors involvement exist but on small scale.

⁷⁶ This was raised in Moudya, Abyan

Box 2: A Case Study on Private Sector Role in Hufash, El Mahweat

In Bani Mamoun and Gabal Noaman Sub-districts (Bet El Kaesh, El Gader and El Kherba Villages), Hufash, El Mahweat, a 350 k watt generator was provided by the PEC. A contract was issued between a private investor and the Local Council and the private investor now is the service operator for 850 households in the mentioned villages. The contractors pay 15% from the project revenues to the Local Council. He covers fuel, oil, project crew and depreciation costs. The service is operational since 2004 and consumers pay according a defined tariff. Apart from the common complaints of the insufficiency of operation hours, the services through this investors was assessed as very successful by community member

What is positive about private sector involvement is its financial viability. In theory, private sector should also be more accountable to the quality of the service provided. However, in the poverty context of rural Yemen, there is not the attraction for the private sector to invest in electricity provision. For community as well, although quality and reliability are major current concerns for them, there is a fear that when it comes to paying more for the private sector operation, people might be reluctant to do.

Nonetheless, the use of service contractors/ small investors (especially if they are trustworthy ones from the same area) will likely be an attractive and important option, especially for those service territories where cooperative and NGOs/CDAs alternative is not viable. Another option that might be explored would be to form cooperative-owned service contractors. That is, the communities that are served could be organized to form a cooperative utility that assumes limited functions as assigned by the Ministry of Electricity or the designated program management agency. Over time, if the ST grows in size to the point of commercial viability, the cooperative could assume full operating responsibility

Those contractors/ investors should be supervised by the potential concerned electrification institutions (REA) through the use performance standards and incentive-based performance agreements as a basis for compensating contractors. This approach has not been implemented before in Yemen as no private sector is present in the scene. However, appropriate standards and supervision mechanism should be established in order to ensure the service provider commercial and technical proficiency and competence to the served communities

Alternative (3) User Associations/NGOs/CDAs

NGOs/ Community Development Associations (CDAs)/ user associations like the Agriculture Associations, Fisheries Associations and Water Users Association (WUA) are the third alternative model for the provision of service in the REAP. None of the interviewed NGOs/CDAs is particularly registered for energy provision services, however many of the existing NGOs/CDAs have some energy related activities and

energy committees, among other committees. The success of these associations varied from one place to the other, but generally speaking Water Users Associations (WUA) proved big success on the level of water management in rural Yemen. They are designed to ensure the WUA safeguard and promote the common interests of the users of land in the command area of the WUA with regard to irrigation and agriculture. The composition of the WUGs (sub groups under the association) considers the social cohesion among the group members and their demonstrated abilities to work together in a group to manage water⁷⁷. Even in the successful models of NGOs/CDAs that work in electricity provision that was documented during the field investigation it was found that social cohesion and the absence of any tensions among families and tribes is a key for the project success. Box 3 below show a success story from El Khrebsha CDA. It also shows a failure story from the same NGO but in a different district. The differences in the social context between the stories are considered a key factor that should be considered in determining the appropriate service provider.

⁷⁷ Irrigation Improvement Project: Developing Water Users Organizations, A presentation prepared by Ministry of Agriculture and Irrigation

Box 3: A Success Story and a Lesson Learnt from El Khreshba CDA

A Success Story

El Khreshba CDA started studying the possibility of implementing electricity project in 4 villages in Kefl with 100 households. The project started by condensed consultations with villages residents who were the potential beneficiaries of the project to plan for the project implementation. A project management group was formed from representatives from the four villages and the CDA built the capacity of the formed group on management, financial issues, bookkeeping and monitoring issues. The management group was responsible for collecting monthly installments from beneficiaries and deposit it in the CDA established fund. After the completion of paying back the credit to the CDA, an asset transfer document was produced by the CDA to spell out village residents ownership for the project. Project management continue the same as the case before the asset transfer and the revenues are deposited into a project safe fund. The last installment paid back was in June 2006 and now the project account includes 700.000 YR net income after cutting down labour as well as O&M expenses. The project is one of the successful models and sources of proud for the CDA.

A Lesson Learnt

El Diaa project was initiated in the same time of Kefl villages project through the same CDA (El Khreshba CDA). Several meetings were conducted with residents prior to project implementation and the project was seen to be an insisting priority for local people. However, when it comes to the formation of the project management group (committee), big disagreement occurred among community members and led to failure in forming this committee. The CDA put an effort to find an alternative management technique and finally agreed on funding the project to a shareholder group of five investors from the village on the basis that they will be responsible on the service provision to the community. The success of this management technique did not last for more than three months until clashes and struggles started among the 5 shareholders. This ended up by disconnecting the service from beneficiaries. The CDA returned this unsuccessful results to the social tensions and tribal historical conflicts as well as some political concerns for some community members that led to conflict of interests. The CDA stated that their limited experience was the reason for their underestimation for these important considerations.

Generally speaking, some key challenges are seen to be attached to the NGOs/CDAs approach, this include⁷⁸,

- The domination of the charity approach
- More urban centered
- In many cases the NGOs/CDAs involves a “one man show” or is dominated by few number of elites
- No actual community participation exist
- Some of the NGOs/CDAs are formed for certain social categories/groups and his forms a sort of discrimination that prevents wider level of participation
- Not oriented towards profit making or projects financial sustainability

These challenges led to key shortfalls for the NGOs/ CDAs performance, including but not limited to:

- Lack of transparency and accountability

⁷⁸ SFD Presentations on Supporting NGOs, 2006

- Lack of creativity in vision and practices
- Increase the level of community dependence and work without empowering the marginalized groups
- Open channels for the emergence of opportunists who employ the NGOs/CDAs to

Alternative (4) The Rural Electrification Authority (REA)

Under the proposed Electricity Law, REA is the Governmental agency that will be established to be in charge of all the issues related to the provision of electricity services to rural areas as explained in previous chapters of this report. REA shall enjoy independent financial and administrative authority and shall have the authority in all legal acts. Article (40) of the Law stipulates that The Authority shall aim at implementing the national plan for rural electricity through the provision of electrical power to rural areas of the Republic. REA will also be responsible on 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. REA will also be responsible on building the capacity and train the different service providers including the Rural Electrification Cooperatives.

REA (or the Governmental entity) seemed to be welcomed as a service provider or a regulator for the service provider in certain types of communities where cooperative and NGOs do not exist or where the community-based models are perceived to face challenges in practical application. However, the involvement of REA as a service provider means maintaining the traditional top-down management model which the project originally seeks to challenge by enhancing the level of community participation. Without full local people participation, the project will unlikely achieve financial sustainability and cost recovery. Thus REA will be considered in the next section that will recommend the service provision models as a regulatory agency in certain places.

Recommended Service Provision Model

As explained above, each of the different discussed service provision alternatives has its strengths as well as its weaknesses. The recommended service provision model is not going to exclude any of the discussed alternatives. It rather will consider using all of them but in the proper place. As discussed earlier, some rural areas in Yemen are characterized by conflict and social unrest which might pose risk to the project sustainability, unless considered in early designing stages. As will be discussed under the ESMP, a conflict assessment is likely to be needed to ensure that the ST boundaries are properly drawn and to minimize the potential future conflicts. Although this proposed case by case assessment for conflict situation might come up with different recommendations on service provision models, Table 6-1 below present the recommendations related to the service providers in the respective ST. It is, however, crucial here to stress the importance

of the involvement of rural women in the different service provision models as much as possible. This recommendation might face difficulty in practical application due to the culture of certain communities but efforts should be made to ensure women participation through, for instance, forming women committees (like the case currently under establishment in Ibb) or involving women representative in the different activities associated to the project like awareness raising and social surveys. According to the SFD previous experience in women engagement, the role played by women in relatively significant in certain Governorates like Aden, Taiz, Hadramout, Abyan, Ad Dalea, Al Houdiedah. In these places, women mobilization will likely be easier than in other places like Sana'a, Hajjah, Omran⁷⁹.

Table 6-1: Service Provision Recommended Model

Service Territory	Recommended Service Provision model	Justification
Hajjah – 1	Electricity Cooperatives as a first option and private contractors with direct supervision from the Government as second option	Successful NGOs/CDAs models exist in these territories (e.g. El Khreshba – Al Mahweat). However NGOs/CDAs models were not seen to be applicable to all places due to tribal conflicts ⁸⁰ . Informal service provision models also worked successfully for years in certain parts of this ST (e.g. Gabal Noaman, Bani Mamoun Sub Districts- Al Mahweat). In the same service territory, private models also existed and operates successfully in partnership with the Government
Dhamar – 1		
Al Mahawet – 1		
Amran – 1		
Al Hodiedah – 3	Electricity Cooperatives	El Kanawes Cooperative Association for electricity services is a very good and capacitated model, registered since 1999 and is seen as a good starting point for the formation of Cooperative in the service territory
Lahj – 2	Electricity Cooperatives	These territories have plenty of fisheries cooperative that are working effectively. The consulted stakeholders recommended similar models for electricity provision. Building on the experience of existing cooperative and building their capacities on electricity related issues could be a good start.
Abyan – 1		
Ad Dhale – 1	Electricity cooperatives. Also private contractors could be considered	These territories have plenty of fisheries cooperative that are working effectively. The consulted stakeholders recommended similar models for electricity provision. Building on the experience of existing cooperative and building their capacities on electricity related issues could be a good start.
Taiz – 1		
Ibb – 1		

⁷⁹ This is driven from a discussion with the Head of the water and Environment Department in the SFD.

⁸⁰ Please refer to the success story and the lesson learnt from El Khreshba CDA

Service Territory	Recommended Service Provision model	Justification
Sanaa – 1	<ul style="list-style-type: none"> • Government (REA)⁸¹ • Private contractors in coordination with the Government⁸² 	<p>Although the model of the Government as a service provider was recommended by the local community, the consultant see many attached fears to this recommendation. The existing clashes among tribes and between tribes and the Government and the attitude adapted to enforce the Government to fulfill the tribes claims (by destroying infrastructure and kidnapping foreigners) means that there is a potential for similar reaction to occur if the Government (REA) is the responsible actor. Although, a more optimistic view might assume that the Government (REA) provision for the service might improve her relations and accountability with the communities, the likelihood of this is seen as low.</p> <p>Partnerships models are recommended in these areas where the service could be provided by a private local contractor/ investor (businessmen from the area) with REA fully involved in the supervision.</p> <p>Some of the key important figures in the community occupy important Governmental position. The involvement of those figures is highly recommended.</p>
Al Baida – 2		

⁸¹ This is the model that was recommended by community members in At Tyal, Sana'a. they recommended PEC (out of lack of awareness with REA). The area is well know of the tribal clashes being a very restricted ares. They see the cooperative model as inapplicable to their communities and mentioned that in the future after more openness to the Capital City, this model might be applicable.

⁸² This model is proposed by the consultant

7. Environmental and Social Management Plan

The Environmental and Social Management Plan (ESMP) aims at defining a mechanism for implementing mitigation measures for expected negative impacts and to monitor the efficiency of these mitigation measures based on relevant environmental indicators. The ESMP identifies certain roles and responsibilities for different stakeholders for implementing, supervising and monitoring the environmental and social performance of the project.

The ESMP has distinguished between mitigation measures that should be implemented during the construction and operation of the project taking into consideration the institutional set-up of the project demonstrated in Chapter 3.

Roles and responsibilities for implementing the ESMP during the construction phase have been proposed based on the following set-up:

- REA, represented by the Project Management Unit (PMU)⁸³, will contract specialized consultants to prepare detailed designs and tender documents, for construction of the distribution system, which will include the environmental measures that should be undertaken by the construction contractor
- During tenders evaluation REA/PMU will make sure that the winning offer includes the required environmental mitigation measures to be implemented during construction
- REA/PMU will assign supervision consulting engineering firms that will undertake supervision over the contractor to make sure that the mitigation measures specified in the design/tender document are implemented on field
- The site supervisor consultant will report to REA on monthly basis about the performance of the contractor in implementing the ESMP measures
- The installation of off-grid systems will be undertaken by the Rural Electric Service Providers (RESP). Because the installation of such systems will not be associated with considerable environmental issues, during the construction phase, there will be no specific ESMP requirements to be undertaken by the service providers

For the operation phase the service providers of the on-grid systems, RESPs, will be responsible for implementing the mitigation measures during the operation phase. REA will supervise the implementation of such measures through periodic reports prepared by the RESPs, and through auditing and inspections that will be undertaken on random basis. For the off-grid systems, the ESMP measures will be undertaken also by the RESPs, while supervising the implementation of these measures will be done by REA.

⁸³ The PMU has been already established and will be part of REA after its establishment

It is proposed, as further detailed in Section 7.3, that the environmental and social management team of the project will be based in REA and will include an Environmental Manager and a Social and Awareness Officer (SAO), but because such staff members may not be recruited from the beginning of the project the implementation of the ESMP will be done by the PMU Project Director, Technical Specialist and 6 site engineers, whom will be trained on the environmental and social aspects of the REAP, until an Environmental Health and Safety (EHS) Department is established within REA (please refer to Section 7.3 for more details).

It is worth noting that the lack of specialized hazardous waste management contractors, hazardous waste disposal sites, and sanitary landfill sites in Yemen have been considered during the preparation of the ESMP. The concepts of BATNEEC have been adopted for following best available environmentally sound procedures; however, these procedures should be reviewed if such facilities have been made available in Yemen during the course of project implementation.

The following sections will also present the main socioeconomic mitigation measures and the social management and monitoring plan. Improving energy access to rural areas is not seen as an ends, it is rather regarded as a means for longer term economic development and poverty reduction in the rural areas. Thus, the management and monitoring plan involves a wide range of stakeholders from the governmental, non governmental and donors communities on different levels. REA in many cases will be playing the role of lobbying and facilitating for the other stakeholders inputs. It is also important to mention that more than one of the mitigation measures will address in fact more than one impact. Reference will be made to these measures in their place

7.1 Environmental and Social Management Plan During Construction Phase

7.1.1 Management of Construction Waste

Mitigation measures:

- For each of the project districts, PMU/REA should communicate with the local authorities at these districts for officially assigning location for the disposal of construction waste. Agreement on these disposal sites should be reached prior to commencing construction works
- A certain location in the construction site should be assigned for temporary storage of construction waste, this location will be within the construction locations of substations or WHS, and will be in a convenient location close to the stretch that is being constructed for distribution lines. This location should be agreed between the contractor and the supervisor consultant prior to starting construction works.
- Construction waste should be hauled at the end of each business day to the officially approved disposal sites. Waste transportation should be undertaken by adequately equipped trucks. The supervisor consultant

- should make-sure that the trucks are not overloaded and that the waste is adequately contained inside the rear box to prevent dust or particles movements from the truck. The supervisor consultant should also occasionally inspect that the truck drivers are disposing the waste in the approved location, and not through practicing open dumping in the midway, through irregular visits and inquiries in the disposal site.
- Construction contractors should allocate stores to receive faulted/damaged equipment (such as conductors, insulators, cross arms ... etc.). The contractors should keep the tidiness and cleanliness of his stores and should keep records of the admitted waste in the store. The establishment of these stores will be part of the contractors bid price. The PMU/REA Environmental Manager⁸⁴ should make sure that the contractor has allocated adequate storage areas for the scrap.
 - Although the disposal of wasted treated wood poles should be in controlled areas to prevent access of scavengers and exposure to open fires, the generation of such waste is unlikely during construction because designs of lines, poles fixation and conductors' staking are expected to take all necessary precautions to prevent loss of poles due to improper fixation, which will be enhanced through providing close field supervision on the construction contractor. In the unlikely event of damaging a wood pole during construction, the damaged pole should be returned to the supplier by the construction contractor for replacement for another pole.

Monitoring Activities:

- No monitoring activities are required for construction waste as long as the above mitigation measures are implemented
- Contractors should keep records of quantities, types of scrap received in the store and the location where it has been received from.

Reporting

- o The monthly report of the construction supervisor consultant should include how well does the contractor abide to the above measures and any comments noticed by the site supervisor about mismanagement of construction waste, in addition to number of wasted treated wood poles during the month.
- o Contractors should keep records of received scrap items, sold items and disposed items and should report to PMU/REA Environmental Manager these records as necessary.

7.1.2 Management of Land Use Restrictions and Possible Resettlement

⁸⁴ PMU will supervise the implementation of the ESMP at the beginning until the EHS Department of REA is established and active

Mitigation measures:

- Avoid, to the maximum possible, locating routes of power lines in Qat, coffee, or fruits farms. Also avoid locating such routes so beehives and honey production areas would be within the line ROW.
- Locate new substations and transformers within government owned lands
- In case of resettlement the recommendations of the RPF should be implemented⁸⁵

Monitoring activities:

- Areas of restricted uses should be monitored along with the type and reason for the restriction. These areas should be reported by the designer in his design report.
- Monitoring possible resettlement arrangements are detailed in the RPF

Reporting

- The designer should identify the locations of intersection between power lines ROW with areas of restricted uses. In case where this intersection could not be avoided the designer should justify reasons for selecting this route in his design report.
- Reporting possible resettlement procedures are detailed in the RPF

7.1.3 Management of Removed Trees for Lines Right-of-way

Mitigation measures:

- Plant trees, by the contractor, in nearest suitable location to the location where the trees were cut during lines construction (two trees to be planted in substitution of each removed tree). The contractor should coordinate with the local authority the suitable location for planting such trees. planted trees should be of native species only.

Monitoring Activities:

- Number of removed trees should be monitoring by construction supervisor consultants

Reporting

- Monitored number of removed trees should be included in the monthly report prepared by the construction supervisor consultant
- The number of planted trees should be reported to PMU Director / REA Environmental Manager on quarterly bases.

⁸⁵ RPF purpose is to clarify resettlement principles, organizational arrangements, and design criteria to be applied to subprojects to be prepared during project implementation. The main elements covered by the RPF are the legal framework that regulate resettlement, estimated population to be displaced, PAPs eligibility criteria, methods for assets valuating, organizational procedures, consultation mechanism and monitoring mechanisms

7.1.4 Management of Construction Air Emissions

Mitigation measures:

- In areas of loose sandy soils the contractor should provide source of water for spraying soil before excavation, filling, loading and unloading. If the site supervisor consultant noticed visual/sensible increase of dust emissions, he should ask for additional spraying of water in the spot generating high emissions

Monitoring activities:

- Because of the insignificance of this impact monitoring ambient air quality in construction sites will not be required.

Reporting

- The Site Supervisor Consultant will prepare a monthly progress report, which would be submitted to REA/PMU, on implemented mitigation measures. The consultant should report on any incident of high dust emissions or smoke during construction works.

7.1.5 Management of Construction Noise

Mitigation measures:

- Workers that operate noisy machines and workers near them should be supplied with earmuffs and should be instructed to put them on when they get into noisy zones. Contractors should be responsible to instruct their workers to abide to this role, and the site supervisor should make sure the contractor is compliant with this role
- Working hours for workers exposed to noise equipment should be designed so that noise exposure periods do not exceed the safe limits

Monitoring activities:

- Because of the insignificance of this impact monitoring noise in construction sites will not be required.

Reporting

- o The monthly report should include how well does the contractor abide to the above measures and any comments noticed by the site supervisor about high noise levels.

7.1.6 Management of Traffic

Mitigation measures:

- An agreement between contractors and supervisor consultants should be reached about the suitable location for temporary storage of construction materials, equipment, tools and machinery prior to starting construction of each reach of the power lines. No storage of construction materials or electric tools should be allowed in traffic lanes
- In case a narrow access road needs to be occupied for limited period (for example by loading/unloading trucks or loaders) the occupation time should be minimized and alternative routs should be facilitated for villagers.
- The contractors should make sure that the employed drivers of construction machinery (such as trucks and loaders) have received sensitization/training on safety utilization of their machines in order to minimize accidents risks.

Monitoring Activities:

- No monitoring of physical indicators is required

Reporting

- Unusual traffic delays caused by REAP construction or any complaints received by villagers should be reported in the monthly report prepared by the construction supervisor consultant

7.1.7 Management of Possible Impacts on Culture and Privacy of Local Communities

Mitigation measures:

- The contractor should be advised to use construction labor from the areas where construction works will take place. The incentives to contractors for such measure include reducing accommodation and transportation for his workers. The contractor could be advised to seek the help of local NGOs or tribe leaders for recruiting labor from the local communities

Monitoring Activities:

- The contractor should provide list of construction workers and their governorates of origin on quarterly basis.

Reporting

- Reporting on percentage of labor recruited from local governorates should be presented by the contractor to the supervisor consultant and to the PMU Director / REA Environmental Manager on quarterly basis

Table 7-1: Environmental Management Plan Matrix during Construction Phase

Potential Impact	Proposed Mitigation Measures	Project Phase	Institutional Responsibility for Implementation	Responsibility of direct supervision	Means of supervision	Estimated Cost (\$)
Effects of construction waste	Identify disposal sites for construction waste approved by the local authority	Pre-construction	REA	PMU Director / REA Environmental Manager ⁸⁶	Review local authority approvals	Management costs
	Identify location within construction site for temporary storage of construction waste	Construction	Construction contractor	Construction supervisor consultant	Site supervision	Negligible additional costs to construction bids
	Adequate transportation and disposal of construction waste	Construction	Construction contractor	Construction supervisor consultant	Site supervision and occasional inspection of disposal site	Negligible additional costs to construction bids
	Allocate and prepare areas for temporary storage of scrap	Pre-construction	Construction contractor	PMU Director / REA Environmental Manager ⁸⁷	Auditing of storage areas	Included in contractors bid cost
	Returning possibly damaged wood poles to the supplier for replacement	Construction	Construction contractor	Construction supervisor consultant	Site supervision	Negligible additional costs to construction bids

⁸⁶ PMU staff will oversee the implementation of the ESMP until REA EHS Department is established with an Environmental Manager and Social Staff

⁸⁷ As above

Potential Impact	Proposed Mitigation Measures	Project Phase	Institutional Responsibility for Implementation	Responsibility of direct supervision	Means of supervision	Estimated Cost (\$)
Land use restrictions and possible resettlement ⁸⁸	Choose routes of power lines not passing through Qat, coffee and fruits fields and beehives	Design and planning	Design consultant	PMU	Design review	No additional costs of design consultant ⁸⁹
	Locate substations and transformers within government owned land	Design and planning	MEE officials and local authorities	PMU	Coordination and follow up	n/a
Trees removal for power lines right-of-way	Plantation of trees near removed trees	Construction	Construction contractor	Construction supervisor consultant	Site supervision	Included in contractors bid cost
Construction air emissions	Spraying soil before excavation in loose sandy soil	Construction	Construction contractor	Construction supervisor consultant	Site supervision	Negligible additional costs to construction bids
Construction noise	Provide ear muffs to construction workers usually located near noisy machines	Construction	Construction contractor	Construction supervisor consultant	Site supervision	Negligible additional costs to construction bids
	Organize working hours so that noise exposure to workers will be minimized	Construction	Construction contractor	Construction supervisor consultant	Site supervision	Negligible additional costs to construction bids
Impacts on traffic of rural roads	Prevent storage of construction materials, equipment or machinery on traffic lanes	Pre-construction and construction	Construction contractor	Construction supervisor consultant	Site supervision	Negligible additional costs to construction bids

⁸⁸ Details of possible resettlements measures and associated budget are in the RPF

⁸⁹ Possible additional construction costs caused by increasing the lengths of some lines to avoid areas of restricted use are assumed to be borne by the REAP construction budget

Potential Impact	Proposed Mitigation Measures	Project Phase	Institutional Responsibility for Implementation	Responsibility of direct supervision	Means of supervision	Estimated Cost (\$)
	Facilitate alternative access roads to villages during temporary occupation of narrow roads	Construction	Construction contractor	Construction supervisor consultant	Site supervision	Negligible additional costs to construction bids
	Drivers of construction machinery should receive sensitization/training on safety issues	Construction	Construction contractor	Construction supervisor consultant	Site supervision	Negligible additional costs to construction bids
Impacts of culture and privacy of local communities	Maximize the use of local workers as much as possible	Construction	Construction contractor	Construction supervisor consultant	Review of contractor's reports	Negligible additional costs to construction bids

Table 7-2: Environmental Monitoring Plan Matrix during Construction Phase

Potential Impact	Monitoring Indicator	Monitoring Location	Monitoring Methods	Monitoring Frequency	Monitoring Responsibility
Disposal of construction scrap	Quantities of scrap item by type	Contractor's stores	Inspection and recording of admitted items	Upon receiving scrap item, reporting to be as required	Construction contractor
Disposal of CCA treated wood	Number and dimensions of damaged poles	Construction site	Visual counting of wasted poles	Upon disposal of poles, reporting will be once monthly	Site supervisor consultant
Land use restrictions and possible resettlement ⁹⁰	Areas of restricted use by ROWs	Construction site	Area measurements on maps and on ground using surveying tools	Once during design phase	Design consultant
Trees removal/plantation during construction of power lines	Number of removed/planted trees	Construction site	Visual counting of removed/planted trees	Upon removal/plantation of trees, reporting will be once monthly	Site supervisor consultant
Impacts of culture and privacy of local communities	% of local labor to total labor	Construction site	Reporting labor origin governorates and calculating the natives ratio	Quarterly	Construction contractor

⁹⁰ Details of possible resettlements monitoring procedures and associated budget are in the RPF

7.2 Environmental and Social Management Plan During Operation Phase

7.2.1 *Management of Scrap and Hazardous Waste*

Mitigation measures:

- Each service territory will have utility store affiliated to each of the RESPs. Each of these stores should be of a sufficient area to receive the expected waste quantities and to ensure adequate maneuvering inside the store. The store should be covered and provided with flooring that could bear loads of forklifts and small trucks. The storekeeper of each RESP will be assigned to manage the utility store; he should keep separate areas for each type of waste, keep internal passages inside the store for facilitating access and should order for regular cleansing of the store. RESP storekeeper should keep records of the admitted waste in the store, and before the store is full he should advise RESP manager to organize a tender for selling the waste as scrap or for disposal of items that could not be sold.
- Selling of batteries, non-broken florescent lamps, wood poles and PVC cables should be limited to vendors that would sell these items to the suppliers or recycling plants. Also selling of transforms should only be undertaking after evacuating the oil in contained barrels, the oil could be then sold to oil refineries. Other type of waste could be sold for recycling vendors not necessarily working in the same business.
- Disposal of special waste which couldn't be recycled should be in controlled areas within the disposal sites where no scavenging or open burning takes place. This could be achieved by requesting a specific area within the disposal area that would be excavated, as required, to bury the waste and prevent access of scavengers and exposure to open fires. This activity will be implemented, if required.
- Transportation of wasted items from the on-grid systems to the utility store should be done by RESP operators according to the maintenance procedures
- For off-grid systems, RESPs should replace batteries for end users after receiving the used/damaged battery. Adequate program should be developed to ensure transfer of such batteries to officially approved recycling centers; this program should have adequate financial incentives for end-users so that the used batteries would end up only in approved recycling centers. REA Environmental manager should make sure that the RESPs comply with these measures through inspection of their records/manifests and utility stores. It is worth noting that this program will not be needed during the first years of REAP operation because the generation of such waste is not envisaged during this stage, so the implementation of this measure would be by REAP mid-term.

- The general public should be aware of the disposal procedure of batteries and lamps and the possible environmental risks associated with them.
- Avoid, as much as possible, the use of PVC insulated cables. This could be done through including such measure in the tender documents for materials. It may be unfeasible to use other type of insulators; however, PVC free insulators should have more technical score than PVC insulators⁹¹.
- Waste minimization procedures should be adopted during the construction and operation of the on-grid systems. The construction supervisor consultants should make sure that the contractors are implementing the design measures. These measures have been recommended in the NRES as follows:
 - Maximize the use of vertical single phase lines, so no cross arms will be needed, so the neutral shall be placed directly on the pole. This is a USREA recommendation that, in addition to saving construction costs, will reduce the amount of scrap cross arms, isolators, and conductors.
 - Raise the neutral level to be 107 cm below the pole top (according to the specs of USREA) which will allow the design engineer to extend the span between each two poles. Again, in addition to savings in construction costs this will work on minimizing wasted and scrap poles
 - Apply NESC overload capacity factors to ensure that the lines are being designed to withstand the designated loads for the planned lifespan, and hence minimize scrap volume
 - Prepare staking packets during the design phase and ensure application of its requirements during construction. The staking packets will summarize all critical design parameters, including a summary of the structures that will be employed, sag tables, and other design procedures to be observed in the staking process. Adhering to such parameters will prevent early failures of the lines and hence will minimize size of scrap
 - Ensure that different material quality and standards, especially for wood poles, are well described in the design and tender documents, and that the procurement procedures follow sound material testing and approval during construction phase. This will minimize material wasting during the operation phase

⁹¹ The feasibility of using PVC free insulators will be left for the REAP engineering consultants to decide, also the extra scores that will be given to non-PVC wires should be negotiated between REAP Environmental Manager and the Engineering Consultant

- Ensure that excavation done for fixing wood poles are not more the diameter of the diameter of the butt of the pole and that the excavation is exactly as deep as the construction standards required. This will help support of un-disturbed soil to the pole and prevent the pole from leaning and failure.
- Make-sure during construction supervision that the anchors are fixed at the designed depth and at the same angle of guy so that it provides the required support to the pole and prevent its early failure. It will be required that construction supervisor makes sure that contractors do not fix the anchor vertically and then bend it during the site survey
- Maintain the correct tensioning of the conductor so that it will not have high tension loads, line vibrations and premature failure. This could be ensured during the construction phase that the supervisor engineer makes sure that after the conductor has been properly stung, it is brought up to the initial tension within 4 hours, and that it sits in the rollers for at least two hours, after being tensioned, to give it chance to equalize it self prior to tying the conductors to the insulators.

Reporting

- RESP storekeepers should keep records of quantities, types of waste received in the store and the location where it has been received from, and destination where it has been directed to.

Reporting

- The monthly report of the construction supervisor consultant should include how well the contractor abides to waste minimization measures and any comments noticed by the site supervisor.
- RESP storekeepers should prepare a quarterly report including received waste items, sold items and disposed items

7.2.2 Enhancing the Safety of Power Lines, Substations and Utilization of Off-Grid Systems Batteries

Mitigation measures:

- Maintaining standard safety procedures for conventional distribution systems. Some of these procedures were already identified in the NRES, such as:
 - Maintain minimum clearance between line conductors and the ground according to the standards of the NESC

- Provide climbing space to allow linemen to work more safely on the structures while they are energized
- Carry out an awareness raising campaign that should target the different rural communities where the project will be implemented in order to educate them about the precautions that they should be considering in order to ensure their safety on both village and household level. These programs might also involve modules on consumption rationalization, waste management, safety precautions for avoiding overcharging off-grid systems batteries, caring about the cultivated trees and other related issues. There should be special attention for accessing women, who are so close to issues of energy rationalization on the households level and also to some associated risks outside house (e.g. herding activities near substation and the risk of electric shocks), and children because they are one of the most vulnerable groups to the risks of electric shocks both outside homes (e.g. by playing near substations or transformers) or inside homes. The awareness raising will be undertaken through local NGOs who will be trained by a specialized training consultant. The recommended procedure could be summarized in the following:
 - The REA Director, assisted by REA Environmental Manager and SAO, will contract a training consultant to provide training for local promoters of NGOs on general skills like communication skills, community participation and awareness raising techniques in addition to aspects related to the issues that will be disseminated through the awareness campaigns.
 - The awareness raising appropriate techniques should be determined in case by case basis according to the local conditions. Tools like community seminars are appropriate for men. Door to door visits are good tools for women. Children drawing sessions, football matches and camps might also be organized. The awareness materials should be sensitive to the targeted communities. The high level of illiteracy should be considered. Visual aids (photos, drawings ...etc) are recommended to ensure the delivery of messages

It is worth noting that there is a budget for awareness raising allocated in the REAP budget under the technical assistance component, therefore it has not been considered as part of the ESMP budget.

Monitoring activities:

- Number, location and causes of accidents related to the electricity distribution system

Reporting:

- Design consultant should present the safety precautions, which have been considered, as a separate section of his design report. For the training, the training consultant should report to the REA Director/SAO on the training of training courses that have been conducted, while the NGOs should report to the REA Director / SAO on the implemented awareness activities on quarterly basis.

7.2.3 Controlling Impacts of Electromagnetic Fields

Mitigation measures:

- Routes of power lines should be designed so that maximum possible distances could be maintained between the lines and developed areas
- A suitable ROW should be kept on both sides of power lines where no development buildings should be constructed. The NRES Phase III report indicated that the guidance ROW distance is 10 meters (5 meters from each side). Once the power lines are designed and the exact routes are identified PMU/REA should advise the Local Authorities with maps of ROW areas where no permanent structures should be established.
- In case the ICNIRP recommended EMF threshold was exceeded in one of the populated areas REA should prepare a plan to handle this issue, either through increasing the ROW in this particular location or through possible modification of the line characteristics. It would be required, in such cases, to seek advice from a specialized consultant to recommend the most advantageous solution.

Monitoring Activities:

- EMF should be measured frequently in different locations near power lines that penetrate residential areas. This monitoring should be undertaken by a specialized expert on quarterly basis for locations where power lines are close to relatively populated areas. The exact plan for such monitoring could not be identified at this stage as well as the suitable locations of monitoring points (where the lines are close to populated areas). Therefore the detailed EMF monitoring plan will be left to the PMU/REA to identify.

Reporting

- Results of the EMFs monitoring plan should be reported to the PMU Director / REA Environmental Manager, with the ESMP quarterly progress report or as required.

7.2.4 Management of Soil Contamination Risks

Mitigation measures:

- Oil changing procedures in substations should be over flooring lined with impermeable layer. Used oil should be collected in barrels and sent for possible recycling in refineries
- In case a leakage occurred the soil should be removed and disposed in the disposal site allocated for REAP special waste, as discussed earlier.

Monitoring activities:

- Amount and management methods of contaminated soil

Reporting

- Reporting of accidental release should be undertaken by the RESP operators, including location and reasons for such incidents, to the PMU Director / REA Environmental Manager.

7.2.5 Management of WHS Impacts

Mitigation measures:

- WHS should be installed far enough from residential areas where the noise of the generators would be dissipated before affecting these residential areas.
- No WHS should be allowed in or near locations identified by the Environmental Protection Authority (EPA) as important locations for birds migration

Monitoring Activities:

- Number and type of collided birds in the wind turbines

Reporting

- Design consultant should include in his design report how would the generator noise be dissipated among neighboring areas
- WHS operator should report on the number of birds collided in the wind turbines in addition to any possible noise complaints from neighboring residents. This reporting should be done on quarterly basis to the REA Environmental Manager

7.2.6 Alleviate economic burden on households

Mitigation measures:

The two key issues related to economic burden on the poor, are the start up/ connection cost and the running service monthly bill. During community consultation, people recommended certain mitigation measures. These suggested measures were perceived by the consultant to encompass shortfalls. This might result in creating different types of

problems. The proposed measures and the key shortfalls are explained below in the same table

Table 7-3: The suggested mitigation measures and the key shortfalls

Suggested measures	Key shortfalls
Provide Grants for the poorest households for the connection cost	<ul style="list-style-type: none"> - Seen as unsustainable solution as it creates sense of dependence among beneficiaries by treating them as passive recipients of charity - Might result in social problems and stigmatization for the poorest segment of society - Forms additional financial load on the project budget and might threaten financial sustainability
Set targeting mechanism to subsidize the cost of service for the poor	<ul style="list-style-type: none"> - This will contradict with the economic sustainability of the project, particularly because a big portion of the rural communities are poor. - Might result in social problems and stigmatization for the poorest segment of society - Untargeted members might regard this as unfair

It was found that there is a need for mitigation measures that assist the poor in getting the utmost benefit not only from the electricity connection but by creating opportunities for them in order to help them gain benefits in a sustainable manner. The recommended mitigation measures for this impact consider two key main objectives, namely, providing a convenient method for poor households to pay for the connection cost and empower them economically to allow them to pay the cost of electricity service. The following actions are needed:

- A preliminary step should be done in order to *establish a careful targeting mechanism* for the poor households who will benefit from these mitigation actions or benefit from the existing mechanisms and databases prepared in this regard. The tool to be applied varies from one place to the other depending on the availability of information and the community type. However, key informants interviews with natural leaders, SFD and the MoSAL branch offices in the respective service territories might be a good starting point. Consultancy services might be needed in order to ensure developing acceptance selection criteria and provide lists for the families that should be targeted. This step should follow the process of community mobilization in the different territories to establish the service providers. Initially, priority should be given to the families that lack access to

different kind of assets⁹²: Priority should be given to female headed households, landless, those with low seasonal income, people living in poor housing condition and unstable structures, socially marginalized groups (e.g akhdam). The beneficiaries from the MoSAL social guarantee payments are also an important category that may encompass the previously mentioned categories.

- In order to assist the identified poor households to get connected to the electricity service, appropriate credit schemes should be encouraged in terms of the grace period (of at least 3-6 months), the required collateral, the value of installments.... etc. Currently many credit agencies are operational with strong networks in rural areas and could be involved, this include Microfinance Institutes (MFI) of the SFD (12 branches), postal services (240 in rural area), Cooperative and Agriculture Credit Bank (CAC Bank) (48 branches). The National Microfinance Foundation (NMF) is also one of the key organizations, particularly in the area of group lending for poor women. MoSSL also has some credit funds under Tribal Affairs, Handicapped Welfare and Martyrs Families which might be applicable to some cases. The service providers (Cooperatives /NGOs/CDAs/ private contractors) might also consider a subsidized capital cost for the poor families
- It is important here to mention that considering a transparent tariff that is realistic for the poor as well as sufficient for ensuring sustainability is a crucial point. For financial sustainability reasons, need might rise to reduce the petroleum subsidies. This might form a burden on the poor but it is essential for the sustainability of services. Gradual programs for reducing subsidies in both electricity and LPG sectors should be considered in order to avoid shocks on the poor

Monitoring Activities:

- Number and location of poor households received assistance, credit, or training
- Number of complaints received about the service tariffs

Reporting

REA Director will be responsible for implementing the social management plan, along with the RPF, assisted by the SAO who will be the key person responsible on reporting the progress of the social aspects of the ESMP and the RPF. The SAO will report to REA Manager. He/She should also be responsible on the preparation of workshops reports and evaluation

⁹² Assets here is referred to not merely as the tangible assets like land, livestock, income or sellable properties but also the intangible assets like skills, education, awareness, social networks....etc

7.2.7 Consequences of Conflict of interests

Mitigation measures:

As previously explained, different types of conflicts exist and might pose a threat for the project sustainability, unless carefully mitigated. *The selection for the appropriate model for the service provision* is one of the key mitigations for the potential negative impacts of conflict of interest. This has been explored in details under the project alternatives and the recommended service providers and their justifications were explained. Efforts should be also directed to *utilize the existing experience of current service providers* (formal and informal) and involve them in the project in order to avoid the potential of any future clashes between them and the projects. However, and as a preceding step, it would be of big benefit if REA consider *further activities for assessing conflict severity* before establishing the service provision entities. According to the PMU, amendments to the ST could be made in case it is recognized that conflict exist inside ST in a way that threaten project sustainability. In addition to the information presented in this ESIA which highlights the nature and key characteristics of the ST, The following simple guidelines in Box 4 were developed and could be used as an initial diagnostic case by case tool to:

- Identify the key persons in the service territory (initial list in provided in Annex V for the key persons in the surveyed areas)
- Identify power relations
- Understand the history of conflict (if exist) and its key actors
- Make decisions/ double check on the appropriate service provider

Box 4: Guideline for assessing the existing Conflicts in the Service Territory

- Who are the main actors in the ST (Governmental agencies , tribe leaders, Parliamentarians, NGO/ Cooperatives.....etc?)
- What is the nature of relations and power dynamic among those actors?
- What is the history of conflict in the area?
- Who are the main conflict parties?
- Which influence/ power do each party possess?
- Which groups are made vulnerable due to the conflict?
- What is the consequences of the existing conflict on the social level?
- Have there been any previous effort in conflict resolution?
- What was the main outcome of conflict resolution efforts?
- How the existing conflict situation may affect the project implementation? (Draw different scenarios/ alternatives and assess the consequences of each)

Due to the importance of mitigating this impact in a satisfactory manner, it is recommended to hire a consultant with significant background on the Yemeni conflict issues in order to:

- Consult the different conflict parties in the different ST
- Prepare territory specific studies focusing on the situation of conflict and predict its impact on the project
- Check the applicability of the proposed service provision models on case by case ST.

Reporting

The external consultant will prepare an assessment study on the conflict of interests as part of his/her assignment

7.2.8 Improve the chance of vulnerable groups to benefit from the project

As could be observed under Section 7.2.6 the meant categories under this impact are already covered by targeting program and capacity building activities under the mitigation measures for alleviating the economic burden on poor households. The previously recommended activities will help those categories to be integrated into the project benefits through facilitating their access to electricity and build their capacities. It is recommended also to represent those groups in the potential electricity cooperative.

7.2.9 Additional Key Issues for the Social Management Plan: Ensuing Community Participation

Incorporate the target communities in rural electrification efforts. Direct community participation greatly facilitates successful rural electrification planning and implementation. At a minimum, good communication with consumers at the beginning of a project increases penetration rates (hence the return on initial investment), avoids problems with right-of-way clearing, and helps identify priority end-uses. A cooperative or similar, formal format for consumer participation can make it easier to set adequate tariffs, keep collection rates up, raise capital, and tie electrification to other community needs⁹³. Community participation should not only be regarded as a means for ensuring that projects are demand driven, enhancing interaction and assessing community capacities to pay, it rather should be regarded as an ends. It is a pure right for local communities to have a voice and a say in the interventions that affect their lives. It is also seen as a precaution strategy to minimize future conflicts and tensions.

Community participation in the REAP started during the SIA process and is recommended to continue along the project implementation, monitoring and evaluation.

⁹³ NRES, Phase I, September 2007

The studied cases during the SIA suggest that successful models for electricity provision depended largely on the level of participation and engagement of the targeted communities⁹⁴.

The recommended activities to be conducted for ensuring community participation in different project phases are as follows:

- Consult community on the current situation, perceived REAP impact, service providers, WTP...etc. This is being undertaken through the activities of the ESIA
- Community participation in the selection of project components to minimize the need for involuntary resettlement, which could be done by the PMU/REA through Focus Group Discussions (FGD) and community meetings.
- Community consultation before the project appraisal to assess the proposed ESMP and get the different perceptions of local stakeholders.
- Community consultation to assess the pre project situation, set monitoring indicators, and assess awareness level and needs. This will be specific survey in the project service territories undertaken by local surveyors⁹⁵, which shall be trained and guided by a social consultant.
- Community Consultation to monitor the service and assess impacts, which will be a similar survey as mentioned in the above point, but will be targeted to monitor the project results and achievements.

It is worth noting that there is a budget for awareness raising allocated in the REAP budget, therefore it has not been considered as part of the ESMP budget.

Reporting:

Report on the different previous activities will be the responsibility of the SAO. Contracted consultants should also prepare reports on the conducted training evaluation.

⁹⁴ El Kanawes NGO, El Hodiedah

⁹⁵ It is recommended for those surveyors to be the same individuals who will work as awareness promoters

Table 7-4: Environmental Management Plan Matrix during Operation Phase

Potential Impact	Proposed Mitigation Measures	Project Phase	Institutional Responsibility for Implementation	Responsibility of direct supervision	Means of supervision	Estimated Cost (\$)
Generation of scrap and hazardous waste	Allocate adequate areas in RESP utility stores for storage of scrap and wasted items, and keeping tidiness and cleanliness of these stores	Operation	RESP storekeepers	REA Director / Environmental Manager	Auditing of stores	Cost of stores is part of RESP budget
	Controlling the selling of hazardous and special waste only to credible recycling vendors in the same application	Operation	RESP Managers	REA Director / Environmental Manager	Review documents defining vendors	Management costs
	Controlled disposal of non sold hazardous and special waste	Operation	RESEP operational managers	REA Director / Environmental Manager	Documents review and occasional inspection of disposal site	Part of REAP operation costs
	Adequate transportation of on-grid systems waste to waste store	Operation	RESP operational managers	REA Director / Environmental Manager	Documents review and occasional inspection of the store	Part of REAP operation costs
	Program developed, by project mid-term, for adequate transportation of used batteries to battery recycling center	Operation	RESP operational managers	REA Director / Environmental Manager	Review records and audit stores	n/a

Potential Impact	Proposed Mitigation Measures	Project Phase	Institutional Responsibility for Implementation	Responsibility of direct supervision	Means of supervision	Estimated Cost (\$)
	Raise public awareness about disposal of batteries and lamps	Operation	RESP	REA Director / Environmental Manager	Review documents	Part of awareness campaign
	Preference to PVC-free wires should be reflected in the technical scoring criteria in the tender document	Design and tendering	Engineering consultant	PMU/REA ⁹⁶	Review designs and tender documents	Management costs - No additional costs of design consultants
	Implement waste minimization measures in design and construction	Design and Construction	Design consultants for design, and contractors during construction	Construction supervising consultant	Site supervision	Negligible additional costs to construction bids
Safety of power lines, substations and off-grid systems batteries	Include safety standard precautions in the system design	Design	Engineering consultant	PMU/REA ⁹⁷	Review designs and tender documents	Management costs

⁹⁶ PMU staff will oversee the implementation of the ESMP until REA EHS Department is established with an Environmental Manager and Social Staff

⁹⁷ As above

Potential Impact	Proposed Mitigation Measures	Project Phase	Institutional Responsibility for Implementation	Responsibility of direct supervision	Means of supervision	Estimated Cost (\$)
	Carry out awareness campaign about safety precautions, including consumption rationalization, waste management and safe operation of off-grid systems batteries, with specific emphasis on women and children	Operation	Training consultant / NGOs local promoters	REA Director / Environmental Manager and Social Affairs Officer	Review NGOs training of trainers and visits of local promoters	Included in REAP awareness budget (including training of local promoters, posters, and field work)
Exposure to EMFs	Select routes of power lines as far as possible from developed areas	Design	Design consultant	PMU/REA ⁹⁸	Review design reports	Management costs - No additional costs of design consultants
	Fix a ROW distance on both sides of power lines where no permanent structures should be established	Pre-Construction	Design consultant	PMU/REA ⁹⁹	Review design reports	Management costs - No additional costs of design consultants
	In case EMF monitoring results gave high EMF readings in populated areas, EMF reduction measures should be taken according to recommendations of an engineering consultant	Operation	Specialized Engineering Consultant	REA Director / Environmental Manager	Review consultant reports and implementation of measures	Cost could not be approximately estimated

⁹⁸ As previous footnote

⁹⁹ As previous footnote

Potential Impact	Proposed Mitigation Measures	Project Phase	Institutional Responsibility for Implementation	Responsibility of direct supervision	Means of supervision	Estimated Cost (\$)
Risk of soil contamination	Care should be taken during transformer oil changing, which should be over an impermeable layer of soil	Operation	RESP operators	REA Director / Environmental Manager	Occasional visits to substations and transformers locations	Management costs
	Adequate collection and appropriate disposal of contaminated soil if necessary	Operation	RESP operators	REA Director / Environmental Manager	Occasional visits to substations and transformers locations	Cost could not be approximately estimated
Special impacts of WHS (if implemented by the project)	WHS should be located away from residential area so they will not be affected by generator noise	Design	Design consultant	PMU/REA ¹⁰⁰	Review of designs	Management costs
	No WHS should be allowed in areas identified as important for birds migration	Design	Design consultant	PMU/REA ¹⁰¹	Review of designs	Management costs

¹⁰⁰ As previous footnote

¹⁰¹ As previous footnote

Potential Impact	Proposed Mitigation Measures	Project Phase	Institutional Responsibility for Implementation	Responsibility of direct supervision	Means of supervision	Estimated Cost (\$)
Economic burden on poor households	Establish a careful targeting mechanism for the poor families	Design and operation	Socioeconomic consultant	REA Director / Social Affairs Officer	Review consultant reports and coordination with concerned bodies	25,000
	Facilitate the provision of appropriate credit schemes for the household connection (start up) cost	Design and operation	Mirco-Finance Institutions, National Microfinance Foundation, Ministry of Social Affairs and Labor, Social Fund for Development, Cooperative and Agriculture Credit Bank	PMU Director / REA SAO	Review proposed schemes and coordination with concerned bodies	Could not be identified at this stage ¹⁰²
	Establish a transparent tariff and ensure a Gradual programs for reducing subsidies	Design	MEE	-	-	n/a

¹⁰² Difficult to determine the amount required for the micro finance schemes yet. Allocating budget for this purpose will be the responsibility of the Microfinance agencies after coordination with PMU/REA

Potential Impact	Proposed Mitigation Measures	Project Phase	Institutional Responsibility for Implementation	Responsibility of direct supervision	Means of supervision	Estimated Cost (\$)
Conflict of interests	preparation of an assessment study on the conflict of interest	Design	Socioeconomic consultant	PMU/REA ¹⁰³	Review consultant reports	60,000
Increase the vulnerability of certain groups	Mitigation measures for reducing economic burden on poor households (above) also applies for this impact					Included in a previous item
Ensuring community participation	Consult community on the current situation, perceived REAP impact, service providers, WTP...etc	Planning	ESIA consultant	MEE and PMU	Review ESIA	Included in ESIA costs
	Community participation in the selection of project components to minimize the need for involuntary resettlement	Planning	PMU/REA ¹⁰⁴		Review conclusions of FGD and community meetings	Management costs
	Community consultation to assess the pre project situation, set monitoring indicators, and assess awareness level and needs	Planning	Social consultant and local surveyors	REA Director / Social Affairs Officer	Review consultant reports	Included in REAP awareness budget (including training of local surveyors, surveys and reporting)

¹⁰³ PMU staff will oversee the implementation of the ESMP until REA EHS Department is established with an Environmental Manager and Social Staff

¹⁰⁴ As above

Potential Impact	Proposed Mitigation Measures	Project Phase	Institutional Responsibility for Implementation	Responsibility of direct supervision	Means of supervision	Estimated Cost (\$)
	Community Consultation to monitor the service and assess impacts	Operation	Social consultant and local surveyors	REA Director / Social Affairs Officer	Review consultant reports	Included in REAP awareness budget (including training of local surveyors, surveys and reporting)

Table 7-5: Environmental Monitoring Plan Matrix during Operation Phase

Potential Impact	Monitoring Indicator	Monitoring Location	Monitoring Methods	Monitoring Frequency	Monitoring Responsibility
Disposal of hazardous waste and scrap	Quantities of waste items by type	RESP utility store	Inspection and recording of admitted items	Quarterly reporting	RESP storekeepers
Safety of power lines, substations and off-grid systems batteries	Number of electrocution or fire accidents by type	RESP	Counting accidents and reporting its causes	Once an accident happens	RESP Managers
Exposure to EMF	EMF (mG)	Selected locations where developed areas are closest to power lines	Measurements through EMF meter	Quarterly, or as required	EMF Expert
Risk of soil contamination	Volume of contaminated soil	Locations of release	Approximate estimation of the volume by measuring surface area and approximate depth	Once an accident happens	RESP Operators
Special impacts of WHS	Number and type of collided birds	WHS	Documentation and photography	Once an accident happens	RESP Operators
Economic burden on poor households	Number of households received assistance, credit or training	REA	Review reports of financing institutes and activities of relevant bodies	Monthly	REA Director / Social Affairs Officer

7.3 Institutional Setup for the Environmental and Social Management Team

7.3.1 Staffing and Affiliations

The environmental and social management tasks will be undertaken by different stakeholders as illustrated earlier in this Chapter. Because REA will be the main body responsible for the management and administration of the project, it has proposed that the main staff members of the environmental and social team should be located within REA. During the early stages of the project the PMU (comprising PMU Director, Technical Specialist and 6 site engineers) will be responsible for overseeing the implementation of the ESMP and the RPF as indicated earlier. The PMU staff shall receive tailored training on the environmental and social aspects of the REAP so that they could undertake the tasks assigned to them.

During the project progress, and after the establishment of REA, it is proposed to establish a separate Environment, Health and Safety (EHS) Department within the agency in which the responsibility of implementing the ESMP and RPF will be transferred from the PMU to this department. The core staff of the EHS Department will comprise an Environmental Manager, a Social and Awareness Officer (SAO) in addition to support staff. It may also be necessary to recruit a safety officer, in a later stage of the project, to support safety issues related to electricity technical staff and the general public. Also it may be required to introduce environmental officer(s) and other social officers, in case the work load has been increased, to help in effective implementation of the ESMP. The proposed location of the EHS Department within REA organizational chart is illustrated in Figure 7-1.

The responsibilities of different staff members of EHS Department will include:

- Environmental Manager: overall supervision on the ESMP implementation, follow up and review outputs of different consultants, report to the REA Administrator about the environmental and social performance of the REAP, undertake auditing and monitoring of certain locations as described in the ESMP and carry out specific focused EIAs for some project utilities¹⁰⁵.
- SAO: follow up the implementation of the social mobilization of the community, carry out limited FGD and stakeholders meetings, follow up and review outputs of social consultants, report to the Environmental Manager. SAO should also be in charge of all the

¹⁰⁵ The Environmental Manager will be trained to undertake specific site EIAs according to guidelines of this framework ESIA

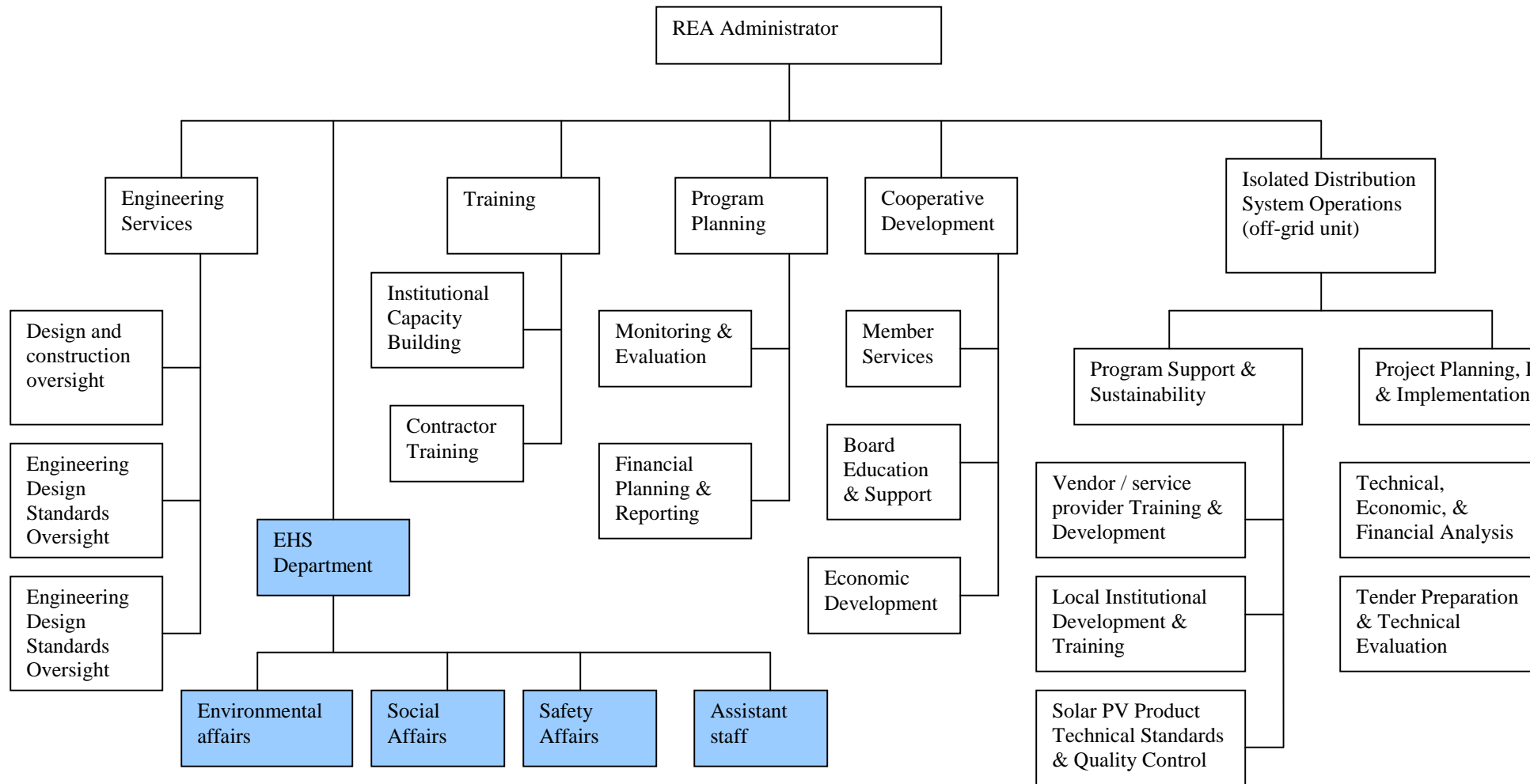
activities related to involuntary land acquisition and resettlement, including identifying PAPs, follow up the work of the valuation committees and ensuring that PAPs are fairly compensated through efficient implementation of RAP and ARP.

- Safety Officer (may be added at a later stage): Follow up the implementation of safety aspects in the ESMP and report to the Environmental Manager

Following staff may be added as required:

- Environmental Officer: Assist in the implementation of environmental aspects of the ESMP
- Secretary: Undertake secretarial and administrative works related to the EHS Department and coordinate reservations and arrangements of workshops
- Office Assistant: Perform cleaning and assistance jobs

Figure 7-1: Institutional set-up for the proposed EHS Department



It was understood that MEE does not have a specialized environmental department and does not include currently experienced environmental personnel; therefore the recruitment of the technical personnel (Environmental Manager, SAO, Safety Officers and Environmental officer) will most probably be according to open recruitment procedures for most qualified applicants.

Waste storekeepers will be attached to the regional RESPs and will report to RESP Managers on daily basis. They will be under technical supervision from the REA Environmental Manager. The proposed setup of the waste storekeepers is illustrated in Figure 7-2.

7.3.2 Training Needs

Two types of training shall take place, the first should target the REAP Environmental and Social Management Team (the PMU staff and the EHS staff when it is established) and the other should focus on other stakeholders.

During the early stages of the project the PMU staff should received a tailored training on the environmental and social issues presented in this ESA and the tasks illustrated in the ESMP as well as the training modules recommended in the RPF including the legal issues related to resettlement as well as the community (PAPs) consultation techniques. This tailored training would be also attended by key staff MEE in order to be aware of the ESMP procedures that would be taken. Another course should be prepared for the 12 waste storekeepers aiming at illustrating types and hazards of wastes expected to be received in the RESP stores. Finally a mid-term environmental and social training, proposed after 2 years from the project starting, is recommended to be undertaken to present an evaluation of the environmental and social performance of the REAP. The EHS Department of REA would have been established by that time, so EHS staff (including the Environmental Manager, SAO and safety officer) will attend this mid-term training.

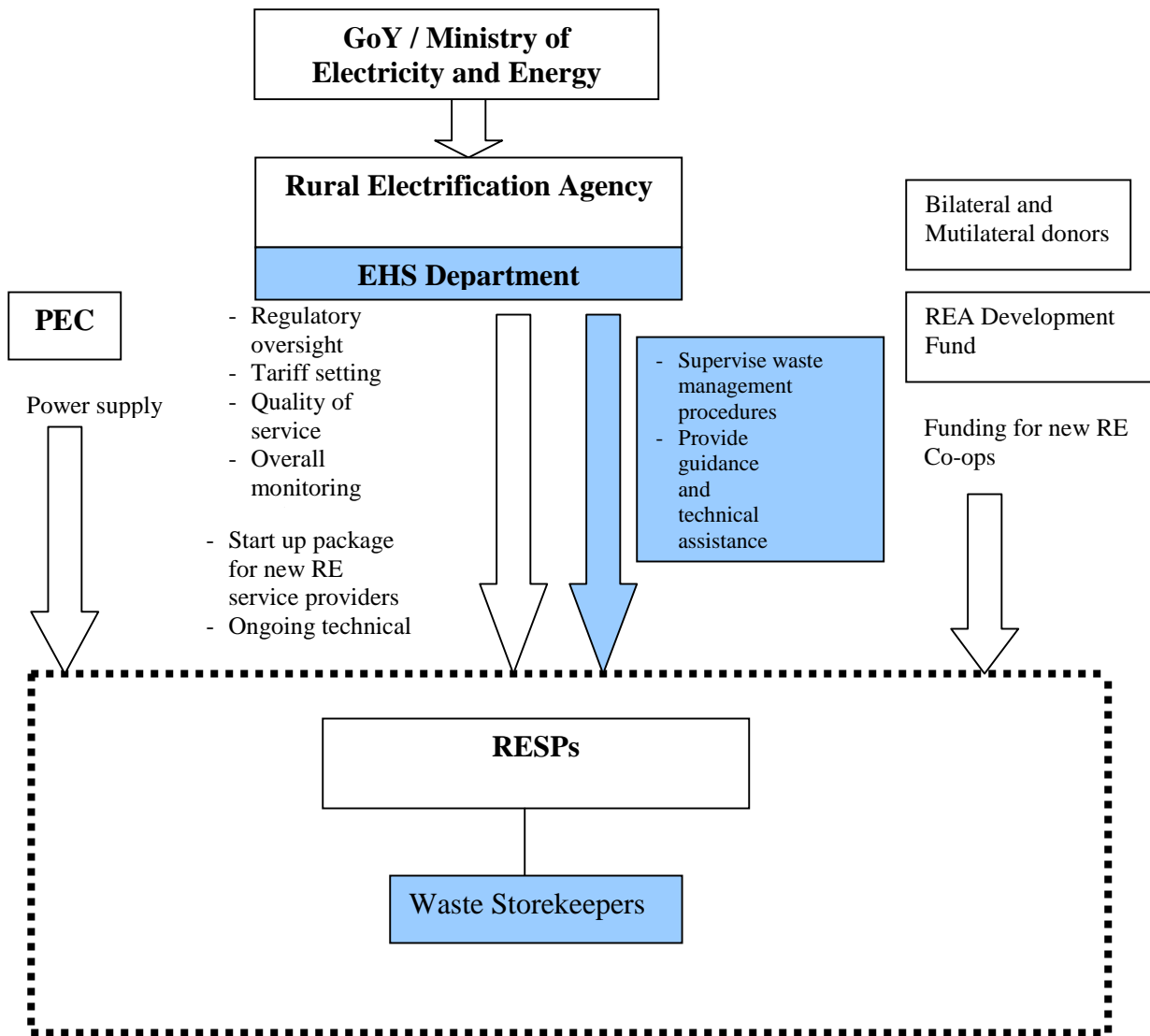
The other type of training will be aiming at enhancing the institutional capacities of the concerned stakeholders, which is seen as a crucial guarantee for the success and sustainability of the REAP. PMU/REA is expected to play a major role in building the institutional ~~FSDFWV~~ of the potential service providers. The main areas for training identified by the stakeholders for the cooperatives are:

- Management and planning
- Bookkeeping
- Accounting, Administration and financial management
- Governance and transparency
- Building voluntary spirit
- Community consultation and participation tools

- Participatory monitoring and evaluation
- Gender role in development

It is important here to refer to that the previous experience of the Water Users Associations (WUA), particularly the ones formed with assistance from SFD. Many of these models are very successful and worth benefiting from. SFD previous experience with WUA will be in particular useful in forming the Associations/Cooperatives, preparing project contract and the items that should be included, forming different committees (fees collection, maintenance, women, monitoring and evaluation ..etc) stakeholders representation and selection criteria, community mobilization and public disclosure.

Figure 7-2: Set-up of waste storekeepers and relation to REA EHS Department



It is also perceived that benefiting from the existing experiences and capacities and utilizing them to the highest level possible is a very important scope for the training and capacity building. Plenty of the existing local institutions like SFD and YWU can play a role in delivering capacity building program. Moreover, cross visits to successful NGOs or cooperative who have been engaged in the provision of electricity services should also be arranged in order to help the newly formed cooperative to benefit from the previous

successful experiences. MoSAL might also have a role in training cooperative members in poverty targeting mechanisms.

Table 7-6: Proposed Training Courses for Different REAP Stakeholders

Training Module	Targeted participants	Estimated cost (\$)
Tailored training on the environmental ,social and RPF issues of the REAP	PMU Manager, PMU technical specialist, PMU 6 site engineers and managers of technical departments of MEE	20,000
Training on waste management for expected types of waste	RESP store keepers, and other relevant RESP staff	5,000
Mid-Term training on the environmental and social issues of the REAP	PMU Manager, PMU technical specialist, PMU 6 site engineers and REA Environmental Manager, SAO other REA EHS staff members ¹⁰⁶ , managers of technical departments of REA and MEE	20,000
Management and planning	RESP Board member and project manger	5,000
Bookkeeping	RESP admin staff	5,000
Accounting, Administration and financial management	RESP accountants and financial manger	5,000
Governance and transparency	RESP Board members	5,000
Building voluntary spirit	RESP survey and awareness team	5,000
Community consultation and participation tools	RESP survey and awareness team	10,000
Participatory monitoring and evaluation	RESP survey and awareness team	10,000
Gender role in development	RESP survey and awareness team	10,000
Total		100,000

¹⁰⁶ It is expected that the EHS Department of REA would be established by then and the Environmental Manager and SAO would be recruited

7.4 ESMP Budget

The total estimated budget for implementing the ESMP according to the analysis presented in this Chapter is \$ 255,000. The details of this budget are presented in Table 7-7.

Table 7-7: Proposed ESMP budget

Item	Estimated Cost (\$)
Budget for independent report on ESMP progress during midterm	20,000
Budget for environmental consultancy for assisting the PMU in implementing the ESMP	50,000
Socioeconomic study for establishing targeting mechanisms for poor families	25,000
Institutional/socioeconomic study on the possible conflict of interests in different service territories	60,000
Training	100,000
Grand total	255,000

It is worth noting that the salaries of PMU staff who shall oversee the implementation of the ESMP is part of the project budget. Salaries of REA EHS staff, when recruited, will be part of REA budget. Also the budget of many of ESMP activities are expected to be part of the REAP budget as illustrated earlier in Tables 7-1 and 7-4.

8. Consultations with Stakeholders

8.1 Consultations during the Scoping Phase

Consultation with stakeholders has been carried out during the scoping period through meetings with key stakeholders and community consultation activities. A public consultation workshop has been conducted for discussing the findings of this ESIA after preparing the draft report as further illustrated in the following section.

The main tools that have been adapted, during the scoping phase, were focus groups discussion (FGD), semi structured interviews (SSI) as well as some individual in-depth interviews with some key informants. List of the checklists/guidelines that were used during community meetings are attached in Annex 2. The main stakeholders categories that participated in the assessment included rural residents in targeted communities (men and women), natural leaders, relevant Governmental agencies, NGOs, service provision Cooperatives. List of the names of stakeholders who were interviewed is attached in Annex 3.

Strengths and weaknesses of the Adapted Methodology

Certain strengths were seen to be attached to the assessment process:

- Local people participation in the assessment was positive in terms of raising people's sense of ownership for the project. Local communities participation in the planning ensured the developed recommendations/mitigation measures are appropriate and socially-sensitive.
- The selected areas for the survey, as explained above, could be dealt with as representatives for the key characteristics that exist in the rural Yemeni area. Thus the developed mitigation measure will be applicable to other places with similar circumstances.
- The employed participatory tools like community meeting, focus group discussions (FGDs) and semi-structured interviews (SSIs),...etc significantly helped in understanding the local conditions of the surveyed communities and the integration of the views of the poor and marginalized groups who were very informative.
- The incorporation of both secondary and primary information as well as qualitative and quantitative information in the preparation of the SIA helped in enriching the outputs and add value to the SIA.
- Gender sensitive approach was adapted by conducted separate meetings for women to allow them to speak freely and obtain gender specific perceptions. Women were more informative and precise about their current role in managing electricity on the household level, their expectations from the benefits that the project will bring to their life and their on and their inspirations in having better opportunities in

participation in NGOs or cooperatives after the project implementation. While men were more vocal about issues on the villages level related to cost of service, conflict of interests and institutional issues.

- The adapted approach is built upon the previous experiences and lesson learned of NGOs/CDAs and cooperatives in managing similar projects both in the same sector as well as in other sectors. It explored the factors that led to success as well as the constraints and shortfalls that faced the previous experiences in order to try to tackle in earlier stage.

One the other hand, certain key obstacles were noticed during the assessment, most importantly:

- The large traveling distances, lack of means of transportation as well as problems related to rural sites accessibility due to the tough topographic conditions. Moreover, time limitation was also a key obstacle. These factors led to spending limited times in the surveyed site, consequently some issues related to the composition of interviewed groups and the power dynamics came to surface. However, the findings of the different FGDs revealed that community members were able to speak up and spell out their concerns and fears freely despite the attendance of natural leaders and Government representatives. This might return to the fact that energy issues are insisting concerns that occupy people's mind and is very linked to the daily life.
- Local Communities lack of trust in PEC and their deeply rooted belief in its unaccountability formed a challenge to the SIA. The consultant get the impression that there might be a negative attitude towards the project, at least in the beginning, due to the historical and old mistrust in the relations between PEC and the consumers. However, and despite the fact that this in a way challenged the consultation works, it is an important impression for the SIA as it highlights the importance of having accountable intuitions with local people full participating in the management of the new project.

Table 8-1 below presents the surveyed districts, the characteristics that each represent and the other parts/ST with similarities.

Table 8-1: List of Surveyed Villages During the Preparation of SIA and their key features (justification for selection)

Service Territory	District Name Surveyed	Key Characteristics	Other targeted areas with in common characteristics
Al Mahawet - 1	<ul style="list-style-type: none"> Hufash (El Gader and El Kharba, Bani Mamoun sub district, El Kaesh, Gabal Noama n sub district) Ar Rujum 	<ul style="list-style-type: none"> Represents the western highlands and mountains of Yemen. Characterized by diversified weather conditions due to its diversified topographies (high mountains and wadis) Electricity service in the area is comprised of privately owned and public diesel generators The rural and tribal characteristics of its inhabitants, in which the area encompasses different tribes called the peace-loving tribes. They are supportive of the Government on different issues. El Safken Markaz is located in the area with a mixture of rural and urban features The area is characterized by out-migration to urban areas due to the limitation of services including energy <p><u>N.B.</u> El Khreshba CDA was taken as a representative for the NGOs/CDAs working in those areas and a large number of them have energy related projects</p>	<ul style="list-style-type: none"> All the remaining districts in El Mahweat All the districts in Omran, Hajjah and Dhamar Governorates
		<ul style="list-style-type: none"> Represents the southern coastal areas by the Arabian Sea. Characterized by different social and familial composition from the other sites in Yemen represented by Mudiya sub-district and which is composed of several families with deep historical roots, where very strong relations link all these families. High level of education attainment and high portion of senior Governmental officials Low level of services due to scattered residential gatherings Many unutilized investment potentials due to the absence of services including energy. These potentials include the existence of raw materials for tiles, marble and cement manufacturing as well as fish processing. There is also the potential of establishing a tourist resort along the coastal area. Diversified topographies (high mountains, hills and wadis) High level of women participation 	

Service Territory	District Name Surveyed	Key Characteristics	Other targeted areas with in common characteristics
Ad Dhale – 1	Demt	<ul style="list-style-type: none"> Represents the highlands in the middle of the country and the gate for the Southern Governorates. It has attraction features including a dormant volcanic area, in addition to water with a high sulfur content, and natural mineral baths, which are considered as major population attraction in the area. Economically, it is one of the most important tourism sites in Yemen Electricity services is limited to diesel generators Unutilized investment and economic development (particularly in tourism) potential due to shortage in infrastructure and electricity services. High education attainment level A mixture of rural and urban characteristics High number of its residents migrated to the Gulf region and the USA. The area is regarded as an important asset that can create future investment in the area after the provision of energy services. ~ 	<ul style="list-style-type: none"> All the remaining districts in Ad Dhale All the districts in Taiz All the districts in Ibb
	Attyal	<ul style="list-style-type: none"> The features of this area are very similar to that of Khawlan but this area is characterized by the absence of electricity services Tribal tension and revenge is widely practiced Includes government opposition, and opposers use many ways to force the Government to accept their claims (e.g. kidnapping of tourists) A very isolated and closed area, where the absence of media and awareness raising efforts contributed to worsening of the social situation. ~ 	<ul style="list-style-type: none"> The rest of the districts in Sana'a are not connected to electricity services Al Baida districts which are not connected to Electricity
Sana'a	Khawlan	<ul style="list-style-type: none"> Represents the eastern gate for the eastern part of Yemen. It is affiliated with the capital city of Sana'a. It is a purely rural Bedouin conservative area with the tribal structure dominating the social composition. No civil society organizations serve the area The role of women is very weak due to the social restricted backgrounds The area is a representative model for social instability and tribal conflicts. Revenge is one of the biggest social problems. Electricity covers all sub-districts and villages. Very high rate of illiteracy that reaches 95% among women ~ 	<ul style="list-style-type: none"> The rest of the districts in Sana'a are connected to electricity services

Key Findings from the Stakeholders Consultation:

The carried out stakeholders consultation were very informative and enriched the EIA. The qualitative findings that were integrated into the 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 EIA sections above. Reference were made to the different sources of information along the report. The following section sum up and present the key findings.

Current energy access situation:

- Rural households, currently, rely on multi energy sources for different purposes. The majority of the rural areas lack access to electricity but people adapt different strategies in order to get some service.
- The choices that people have depend on the economic level of the household as well as the availability of alternatives in the neighborhood.
- The main electricity alternatives include: access to electricity from the PEC grid or isolated power systems, NGOs/CDAs and cooperative operate service in some villages through large diesel generators, private power generators.
- People give priority to lighting above other privileges including refrigerating and ventilation.
- LPG is a key source of energy, for rural households, that is used mainly for cooking and for lighting in order to supplement during the absence of electricity. The excessive demand for LPG over the current supply and the need to expand LPG plants is a current challenge

Impacts of the Current Situation

- 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, inability to ~~RSHDM~~ 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 are willing to pay for a reliable electricity service

Gender Issues related to Energy management

- Women are active player on the household in rationalizing electricity consumption, finding alternative sources (like fuel wood) and collect them from outside homes. They and children are more vulnerable to the negative impact of the current energy sources and practices. Men are the ones 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

Perceptions towards REAP Impacts

- Local rural communities perceive getting better access to electricity and other sources as a high priority issue that will lots of opportunities for rural population in Yemen.
- People predict some key impacts during the project operation including:
 - o Increased sense of wellbeing and improved quality of life.
 - o More openness to the world through satellite
 - o Enhanced level of awareness.
 - o Better level of social services (schools and hospitals)
 - o Rural economic development to be achieved a longer term
 - o Women are expected to harvest many fruits from the project, namely facilities inside houses which mean less work load, higher level of awareness and improved perception for women from the community due to the increased level of awareness and a more significant role in energy management on the level of village with the formation of the new service providers (cooperatives).
 - o Potential negative impacts that people show concern about included the high financial burden on the poor families, the negative impact of losing employment or reduction in income. People also were very informative about the potential conflict of interest and the previous operation and

Project Operation

- Interviewed stakeholders also participated in setting the alternatives for the project operation and select the appropriate operation model for their neighborhood.
- From the carried out consultation, initial recommendations were made to the service providers on the basis of encouraging Cooperatives model in the areas with 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 to two models, namely cooperatives and private contractors working under the supervision of REA. In these places, previous private contractors 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 sensitive to the issues of conflict.

8.2 Public Consultation Workshop

After submitting the Draft ESIA, a public consultation workshop was hosted by MEE on the 21st January, 2009 with the aim of reviewing the findings of the ESIA and incorporating the stakeholders' comments into the assessment. This action came in accordance with the WB policy requirements for making operational information available to the public as stated in OP 17.50 on "Disclosure" out of recognition for the fundamental importance of transparency and accountability to the development process. MEE was responsible on announcing for the event through signboards in public places and advertisements in the national papers.

The participants of the workshop included different stakeholders from Governmental organizations (Water and Environment, Agriculture, Health and Population, Irrigation ... etc) NGOs, donors, University Professors and consultancy firms (List of workshop participants is presented in Annex 6). The workshop was a useful opportunity for the different stakeholders to come together, review and comment on the assessment. It involved sufficient time for comments, questions and open discussion. The draft ESIA was made available to the public review in the PMU and Sana'a University before the workshop, and an Arabic executive summary was distributed to all workshop participants. 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. The main comments that were raised included:

On the Environmental Issues

- Many participants emphasized on the hazards of batteries, which will be used in off-grid systems, in terms of heavy metals content and the possibilities of generating hydrogen gas during possible overcharging. The ESMP includes measures for collection and adequate management of used batteries, which are believed to minimize the impacts on the environment to the extent possible with the available resources in the country. For the overcharging issue, the risks of releasing dangerous quantities of hydrogen gas due to overcharging is believed to be a very

low probability because of the relatively small capacity SHSs that will be employed in the project, however, the awareness campaign proposed in the ESMP will include educating off-grid systems users the safety precautions that should be followed as recommended by the manufacturers.

- There was a recommendation to consider impacts on grazing lands. The consultant clarified that there are no expected impacts on grazing areas as grazing activities could be carried out in ROW zone. Furthermore the areas that will be occupied by project facilities could be negligible compared to grazing areas
- There was a recommendation for using construction waste in roads construction. This may be feasible if the waste quality and quantities meet the requirements of roads base and sub-base layers. Although the amounts of construction waste are not expected to be large amount, it will be left to the project management to decide how to utilize this waste in a feasible manner, putting into consideration that the measures recommended in the ESMP are minimum requirements for managing construction waste.
- One of the participants emphasized that the project should not affect culture heritage sites. Putting into consideration that construction works would not be associated with significant or deep excavations the possibilities for chance find of antiquities are negligible.
- Many participants emphasized that the distribution lines should be as far as possible from residential areas and that a suitable ROW should be designated. It was clarified that this issue is considered in the ESMP.
- One of the participants stressed that safety aspects related to the distribution network should be according to international standards. It was clarified that the design and implementation of the network will be according to NESC safety standards.

On the Social Issues

- Stress the importance of women role and the importance of their participation in the potential cooperatives by forming women committees.
- The positive impact of the openness of rural communities to the external world through TV and satellite could also be a threat to the culture and religious beliefs of the community and the involvement of the Ministry of Culture is very important in the awareness raising campaigns.
- Safety issues related to rural women working in herding activities near different project components.
- REA should be included as an alternative for service providers

- The historical involvement of the civil sector in electricity service provision in Yemen.
- The positive economic impact should be highlighted in the form of creating opportunities and improve the economic situation of rural areas.
- Benefiting from existing successful models like WUA.
- The importance of setting mechanisms to ensure eliminating the economic burden of the connection and service fees from the poor rural families.
- Importance of challenging the existing shortfalls of the NGOs as identified by the ESIA in order to ensure improving their role.

9. Conclusions

Environmental and social framework analysis were performed on the REAP activities during construction and operation phase. The conclusions of the analysis are:

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 through 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 RESPs, 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.

There will be limited negative environmental and social impacts during the construction phase and operation phase of the project. However, an Environmental and Social Management Plan has been designed for implementing mitigation measures to alleviate the significance of these impacts.

The expected negative impacts and correspondent mitigation measures during construction phase are:

- 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 losing 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.

The expected negative impacts and correspondent mitigation measures during operation phase are:

- 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.

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, a SAO, a secretary and an office assistant. During the course of the project a Safety Officer, Environmental Officers and more Social and Awareness Officers may be recruited. Because the establishment of the EHS Department in REA is expected to be later to the project start, the PMU staff will oversee the implementation of the ESMP and RPF measures until REA EHS is active. A waste storekeeper will be assigned in each of the service territories, who will be affiliated administratively to the RESPs and will be supervised by REA EHS Department.

ESMP estimated budget is \$ 255,000 in which \$ 155,000 is for technical assistance and \$ 100,000 is for training.

In conclusion:

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

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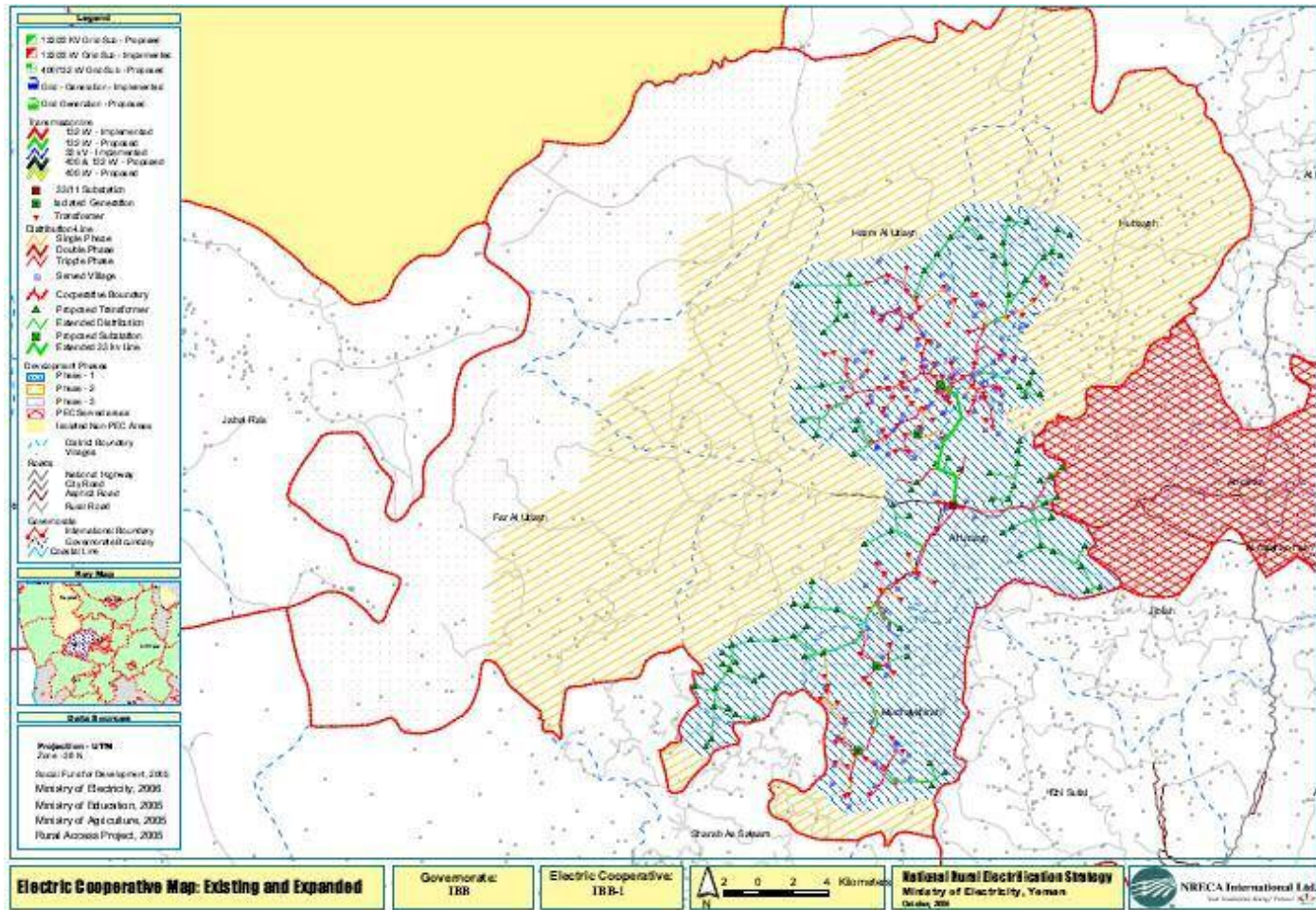
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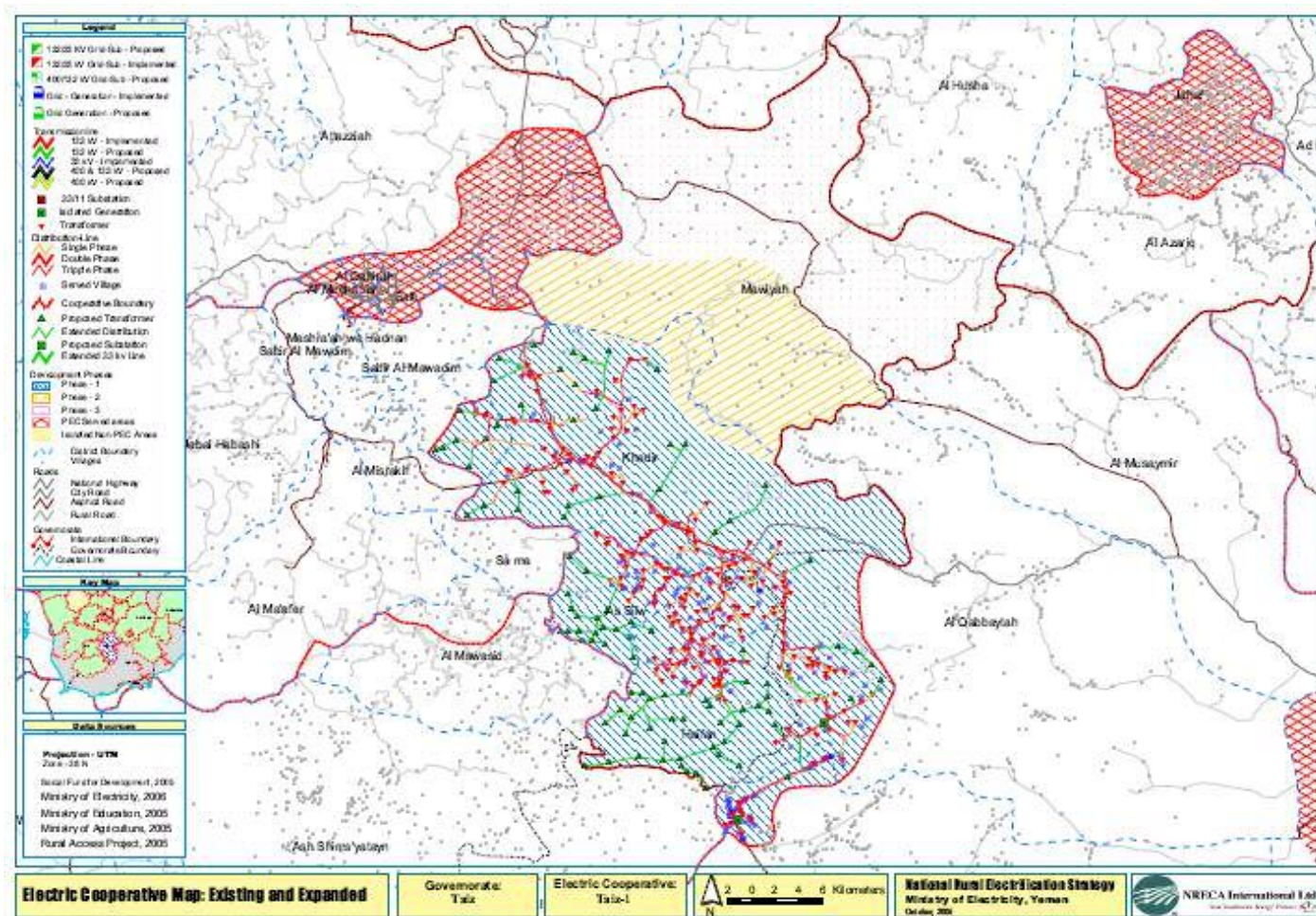
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Annex 1: Maps of the 12 Service Territories and REAP Interventions for On-Grid Systems

Rural Energy Access Project

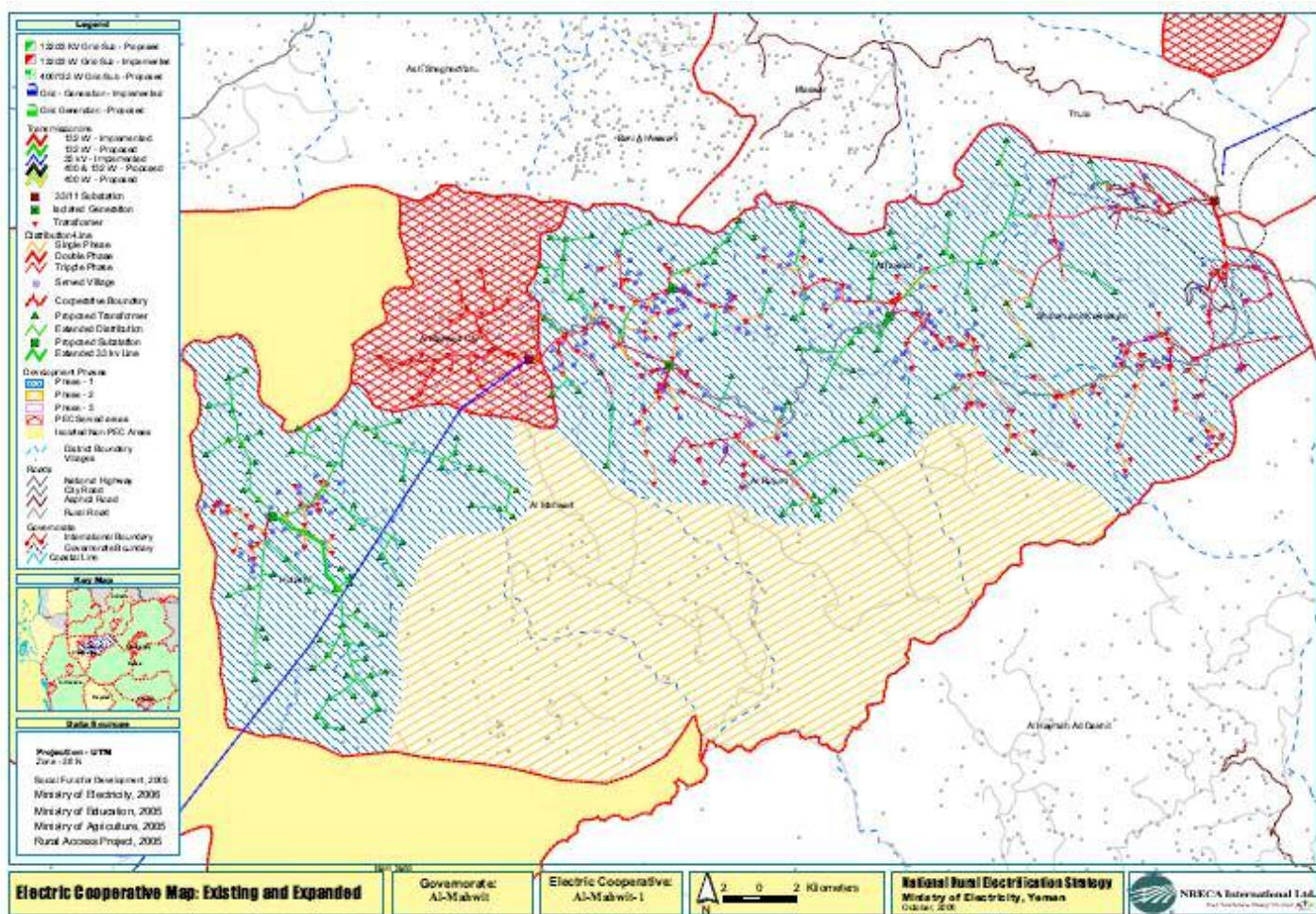


Rural Energy Access Project

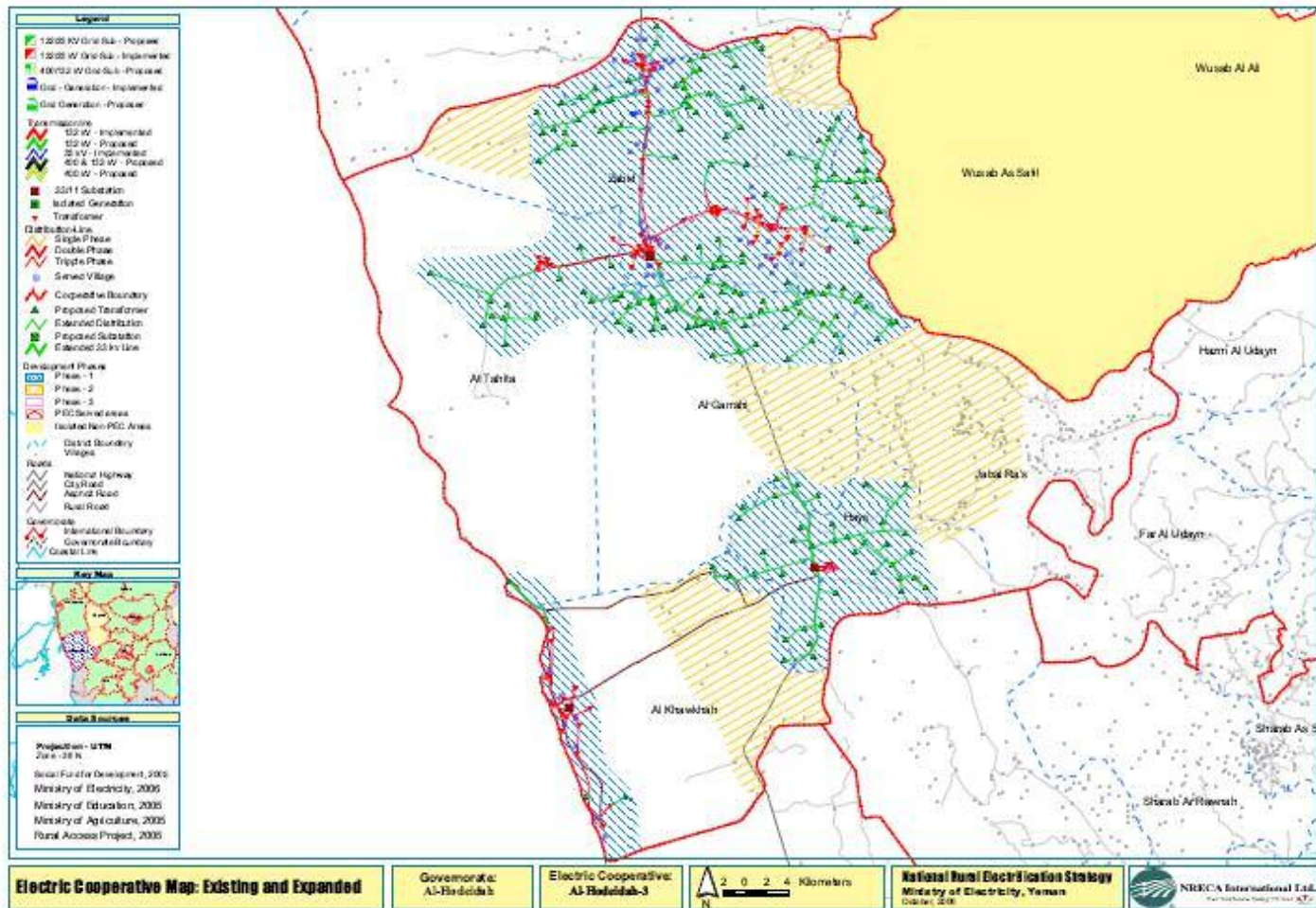




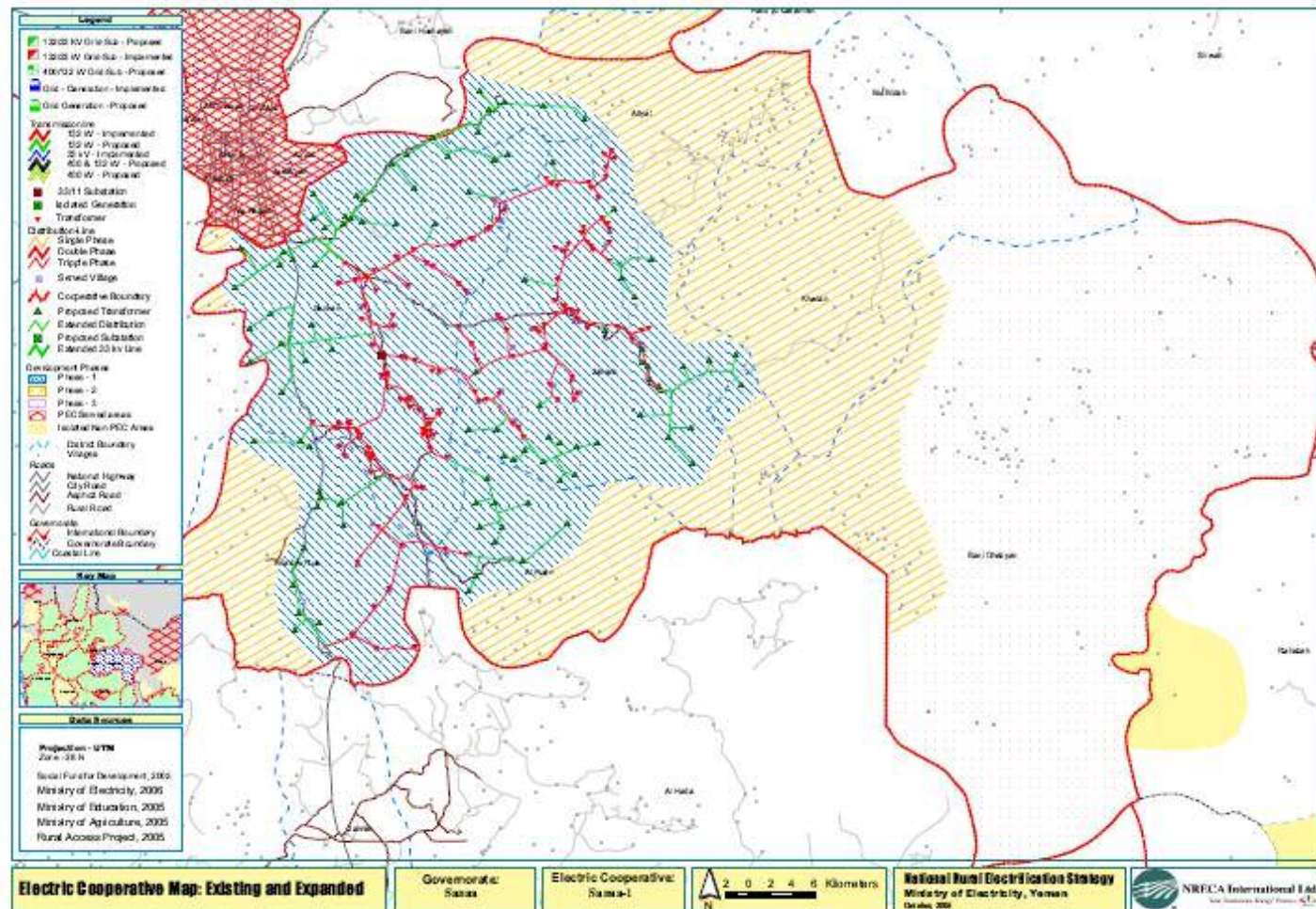
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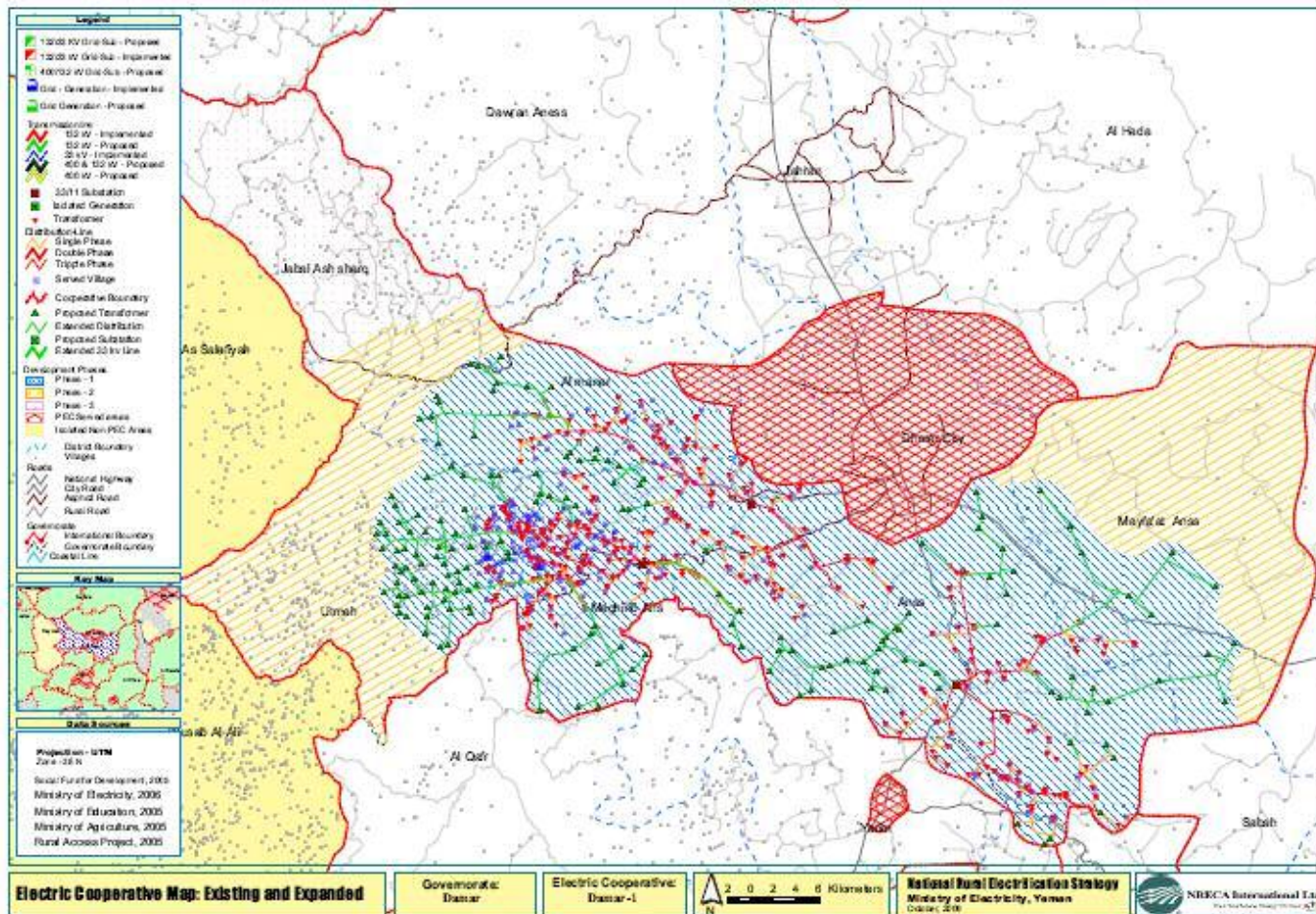
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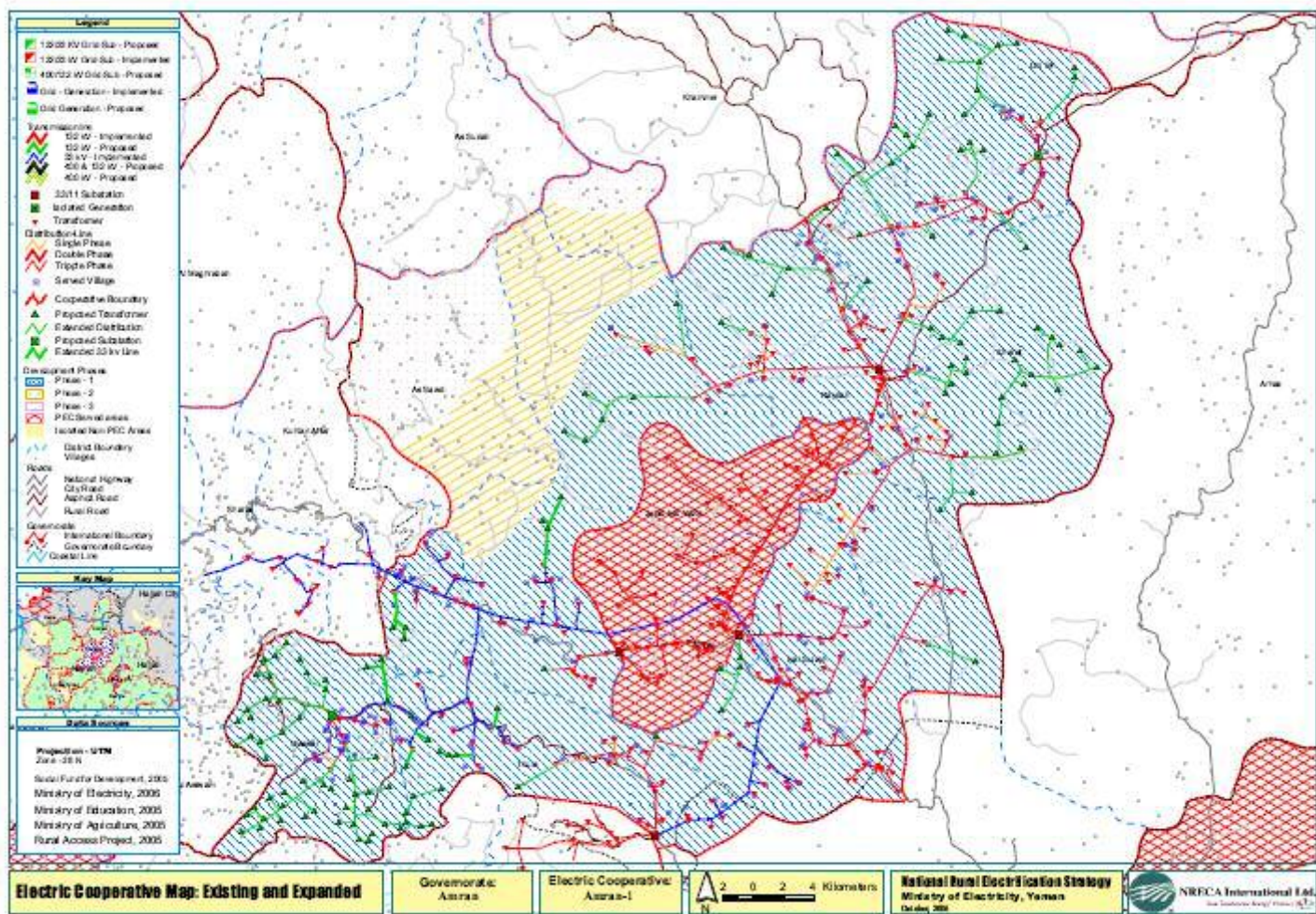
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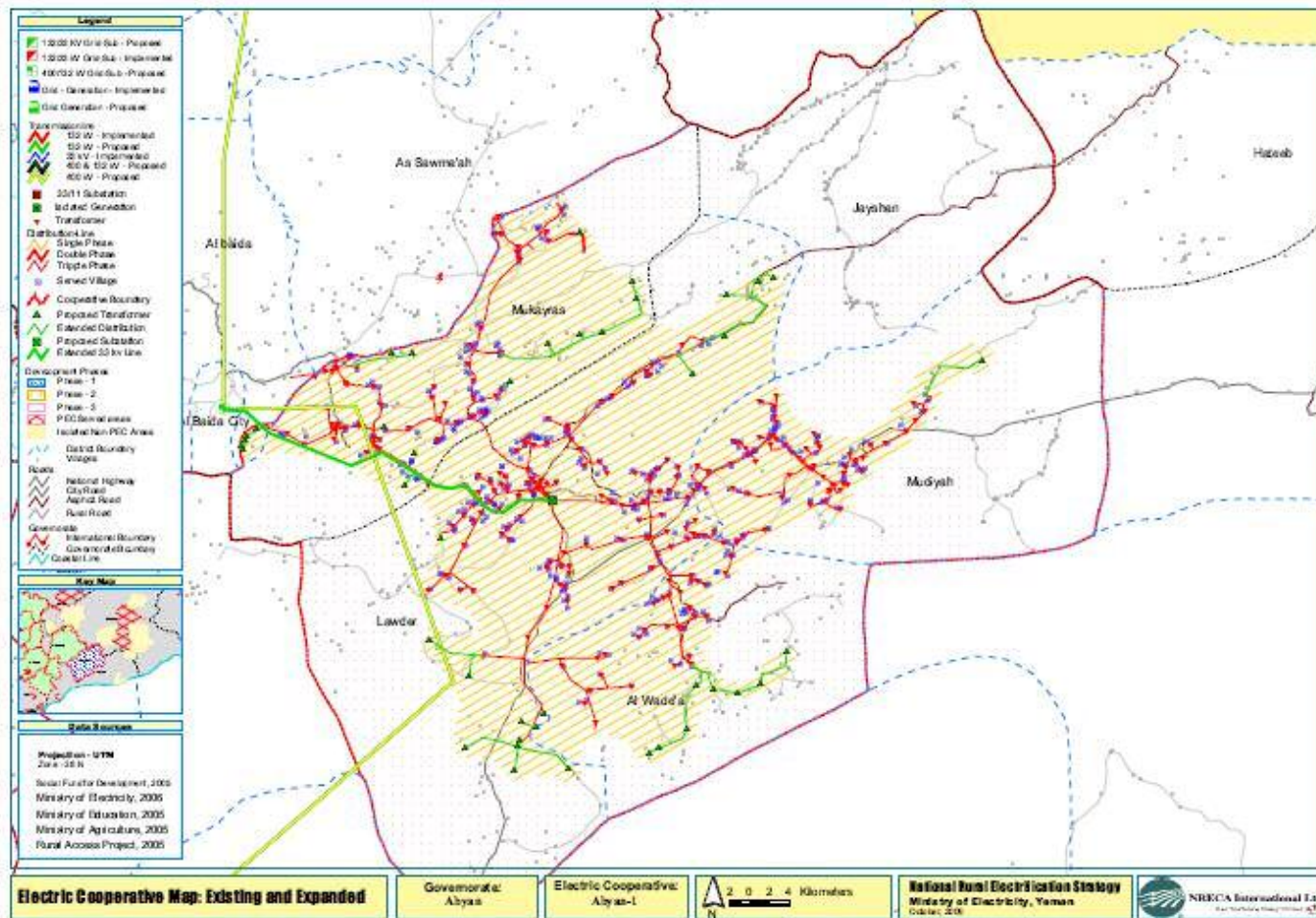
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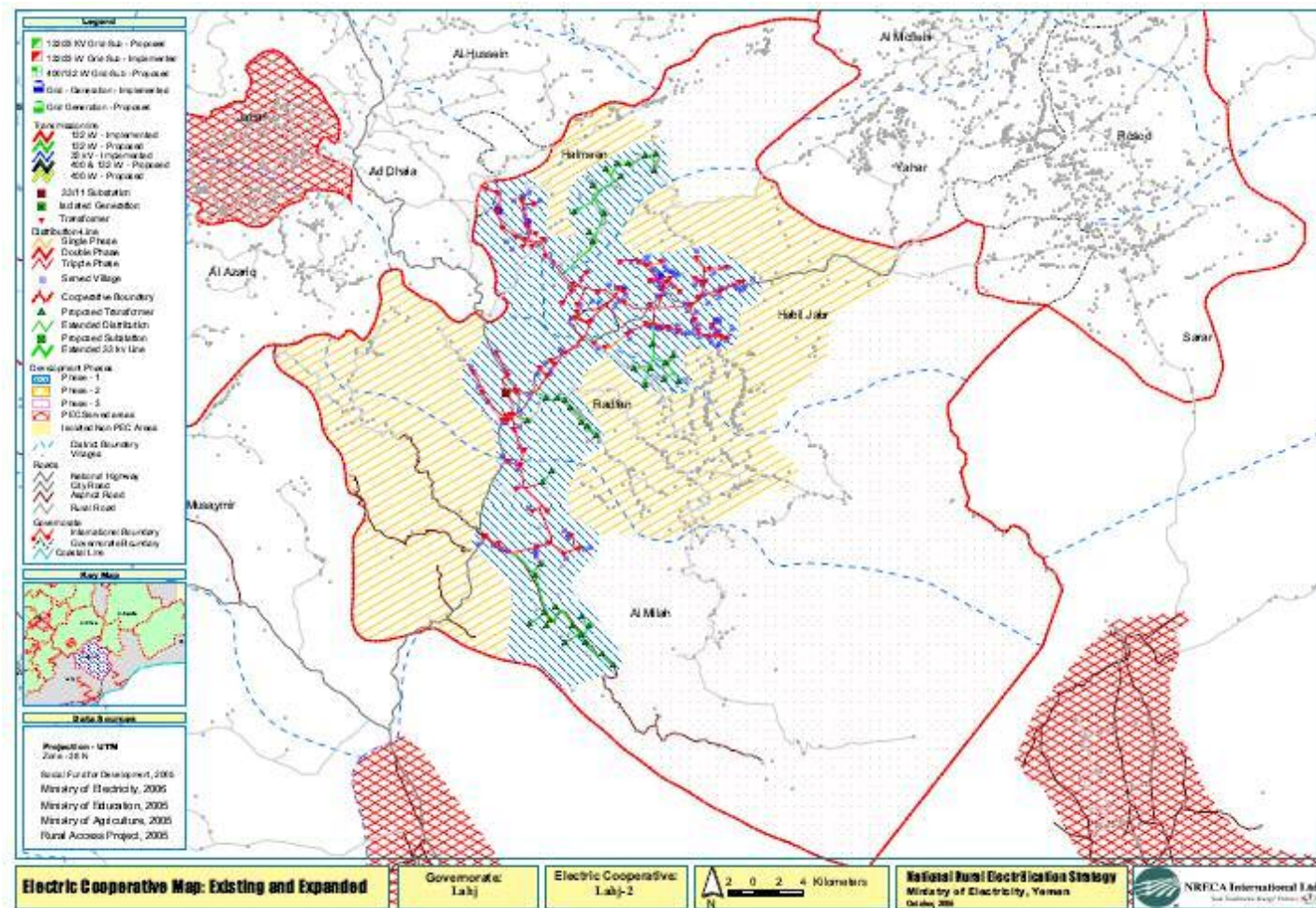
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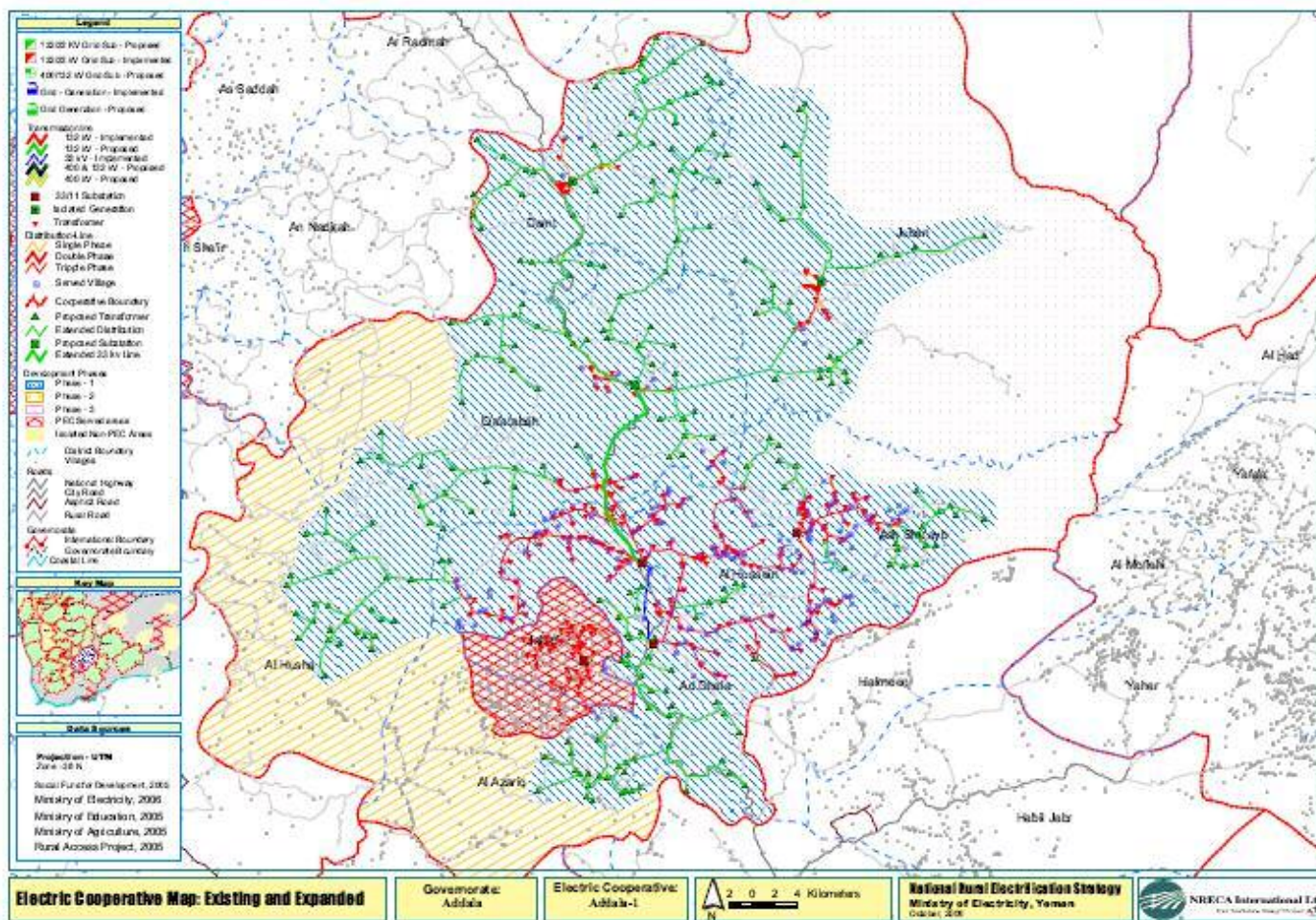
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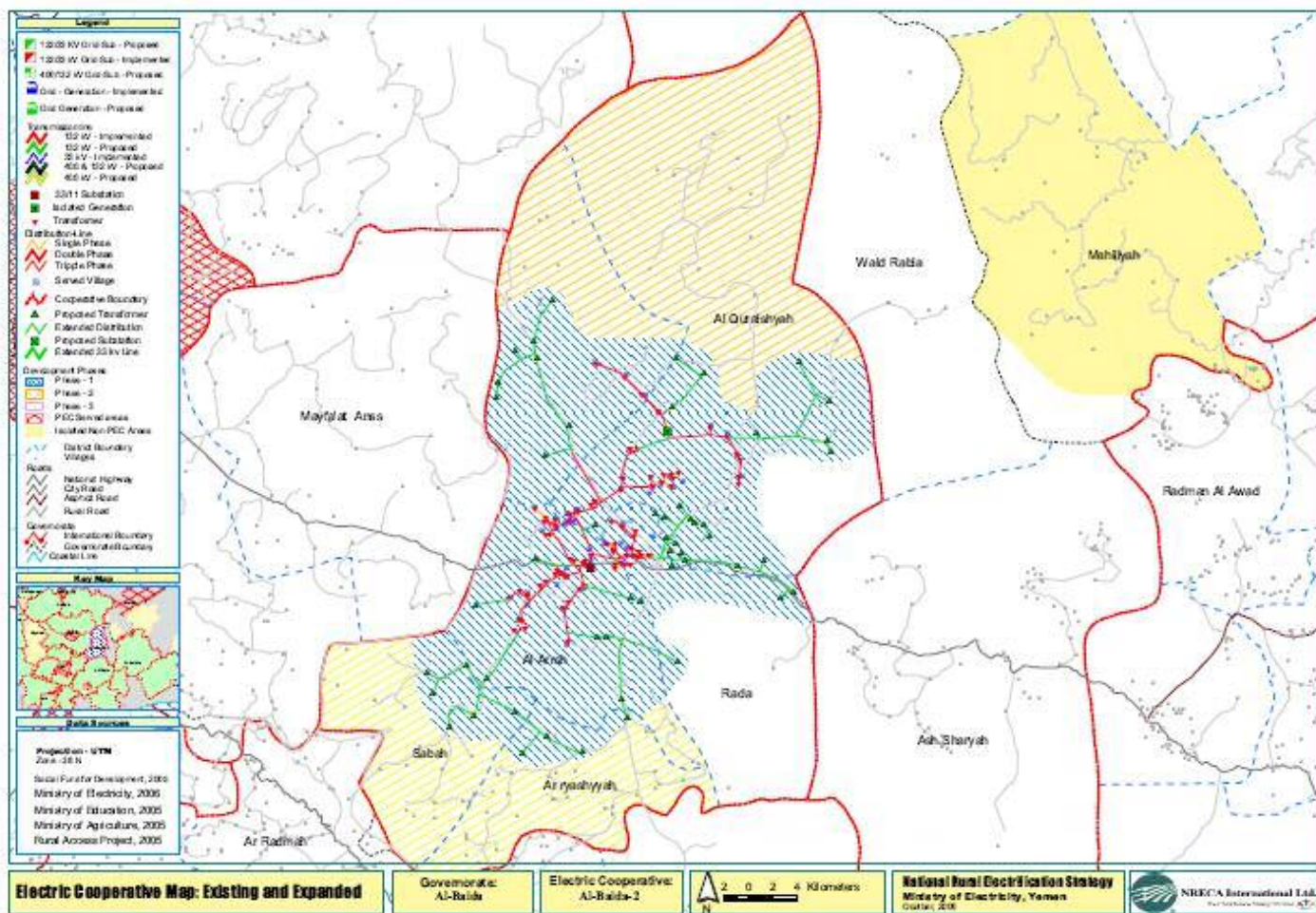
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Rural Energy Access Project



Annex 2: Interviews Checklists / Guidelines

Key Issues for Investigation During the scoping phase

1. Background Information

- 1 .1 Relevancy of the project to the country context /the magnitude of the problem that the project seek to address.
- 1 .2 Current alternatives rural people use to cope with energy shortage
- 1 .3 Current impact of the energy problem on population, particularly the poor (what are the associated social and environmental costs)
- 1 .4 Issues around geographic significance concerning energy shortage, poverty, and coping mechanisms.
- 1 .5 What are the national, International ..etc guideline and reports of relevance to the proposed project.
- 1 .6 Projects with similarities to the proposed project in Yemen or other countries and the key lesson learnt.
- 1 .7 Alternatives that have been examined during proposal development in order to achieve the same objective (design, technology, construction techniques and phasing, O&M) – What were the social negative and positive impacts anticipated from the implementation of these alternatives.

2. Description of the proposed project:

- 2 .1 Project Goal, objectives and strategic approach
- 2 . 2 Proposed activities/ components
- 2 .3 Prioritization methods and sites identification
- 2 . 4 Technical designs
- 2 .5 Cost that community members will pay to access the proposed service
- 2 . 6 Community mobilization process
- 2 . 7Key stakeholders, interests, influence, conflicts
- 2 . 8 What are the key social impacts expected from the project (use the developed matrix for each of the components)
- 2 . 9 What mitigation measures could be considered in order to minimize the negative social impacts.

3. Institutional arrangements

- 3 .1 Which agencies (International, National, regional and local) will be involved in the proposed project? (unpack according to the

different components and refer to governmental agencies as well as NGOs).

3 .2 Current capacities of these institutions? What are the key institutional capacity challenges?

3 ,3 Coordination mechanisms among the respective agencies

3 .4 Which agencies should be involved in the implementation of the discussed mitigation measures

3 . 5 Key issues for training and capacity building for those agencies

4. Description of the targeted communities

4 .1 Targeted communities characteristics (size, age groups, gender desegregation, unemployment rates, economic activities, education, health, land tenure, women role and participation ..etc)

4 . 2 The targeted communities access to different services and infrastructure (energy, schools, health, roads, water, sanitation, SWM ..etc)

4 .3 Any relevant poverty classification data

4 .4 Details about the services that is provided to be delivered to communities (cost, WTP and affordability issues...etc). Will there be any subsidy mechanism to benefit poor families? -----↗
Discuss WTP survey, sites, sample, timing...etc

4 .5 How people perceive this type of energy? How they also perceive the O&M cost?

4 .6 Potential of NGOs support the poor to access the projects (micro finance, grants or other indirect interventions)

5. Resettlement Policy Framework

5 .1 Any involuntary resettlement is expected due to the project implementation? Are there viable alternatives in the project design to minimize this impact?

5 .2 Who are the persons who will be disadvantaged? (numbers, categories, their current assets, what will be affected de to the project implementation)

5 .3 What are the Yemeni relevant legislations in this regard? Obtain copies

5 .4 From local people's point of view, what are the RPF should include?

5. 5 The estimate costs associated to the resettlement process and the agencies who will be responsible on funding RAP.

Focus Group Discussion with Community Members in the Targeted Territories – Checklist/ Guidelines

Date/time:

Interviewer:

Place of Interview:

District/village:

Governorate:

Participants Background

1. Category:
2. Average age:
3. Number of participants:
4. Average size of family:
5. Educational background of participants
6. Educational background of participants' sons and daughters
7. Reasons for dropping out from schools (if any)
8. Key economic activities (in details)
9. Main sources of family income:
10. Main activities done by women both formally and informally:
11. Contact person in the area
12. Telephone:

Area Background

13. Location (distance from the nearest known center). Access methods to the village and roads situation
14. Average population
15. Average number of households
16. The familiar family composition (extended or nuclear families) – average number of families in the household
17. Description of houses construction pattern and average area of the house (estimates based on the consultant's observation)
18. Description for the land tenure situation in the area (legal status of land in the area in terms of rights in claiming property of houses and land)
19. The availability of commercial activities like shops, small industries, workshops ...etc. and the number of workers in these institutions

20. The situation of social services in the area (health – education – roads – drinking water – sanitation – recreation)
21. The main characteristics that distinguish the area (geographically – historically – economically – socially – environmentally)
22. What are the unutilized resources in the area?

The current use of energy and the socio-economic impact

23. What are the key energy sources used for different purposes (lighting – cooking – electric appliances – heating ..etc)
24. Are these sources available for all the households? In case the answer is “No”, what are the reasons for their unavailability for these houses?
25. Who is the provider for these energy sources? And what is the institution responsible on electricity services in the area?
26. What are the current communication mechanisms between the consumers and the service providers in the issues related to maintenance, fees collection...etc.?
27. Regularity and quality of current service (average hours per day)?
28. Average monthly expenditure on the each of the energy sources listed above (information should also be obtained on the family size and the number of rooms per house from persons who will answer this questions)
29. What are the key strengths and weaknesses in the current service providers?
30. What is the role of women in the process of energy management on household or village level?
31. What are the sources and cost of energy for the commercial and service institutions?
32. Level of satisfaction with the current level of energy service?
33. What are the key socio-economic impacts generated from the current situation
34. Are there certain groups who are more vulnerable to these impacts?
35. Are there any unutilized resources in the area because of the absence of energy sources?

<i>The consultant should present the idea of the project</i>

Service delivery and people willingness to pay for the service

36. What are the institutions/ entities that participants prefer to take the responsibility of service provision (cooperatives / CDAs/ NGOs/ individuals/ private sector/ public sector)? Why?
37. What is participants' willingness to pay for the service delivery, operation and maintenance to the service providers? What is the average monthly payment that they can afford per month?
38. What is the participants willingness to increase the paid amount later in order to keep up the level of service and regular maintenance?
39. Are there certain families in the area who will not be able to pay for the service fees? Do participants have any community suggestions to give those families the chance to benefit from the service in return for reduced fees? Are there any associations who can assist in that regard?
40. What is the level of willingness to pay for the connection fees which is around 10000 YR and what is the preferred method of payment (cash/credit)? Are there any institutions that can help community with this payment (credit banks, loans, postal service)?

Expected socio-economic impact from the implementation of the REAP

41. What are the key socio-economic impacts that participants expect from the implementation of the project (on individuals, household and village)
42. Will different community groups have equitable access to the impacts of the project?
43. Are there negative impacts expected from the construction and operation of the project?
44. Will certain groups be negatively influenced by losing livelihoods or being disadvantaged in their settlement?
45. Issues around land tenure, land acquisition and donation if small land plots will be needed for the establishment of the substations.
46. Average of individuals and houses that might be negatively affected
47. Community perception on methods to compensate those people and mitigate the negative impacts.
48. What are the suggestions for attaining equitable positive impacts and mitigate the negative impacts?

Institutions

49. What are the key civil institutions that serve the village (NGOs, Cooperatives...etc)
50. What are their key field of services and which groups benefit from these services
51. What are the key weaknesses / challenges that face these institutions?
52. What is the role of women in those institutions?

Present the idea of community involvement in the service provision

53. What is participants' perception for the applicability of this idea to their communities? Are there any considerations related to the social pattern of the area that may challenge the application of this proposal like conflict of interests or disputes? What are the other appropriate models that participants suggest?
54. Are there specific accountable and trustworthy association in the area and participants recommend their participation in the service provision
55. What is the level of acceptance for the engagement of women representative in the service provision entity? Mention names of women who you think are qualified for participation.
56. What are the topics that those service provision entities should be trained on in order to ensure providing good services for the community.
57. Are there any institutions concerned with credit provision for groups or individuals? What are these institutions? Who are the beneficiaries? What are the collaterals?

Project Alternatives

58. Discuss the project alternatives and the negative and positive issues related to those alternatives? Do participants see that the projects is the best alternative from the social perspective?

Consultant observations

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Focus Group Discussion with Community Members in the Targeted Territories - Women Group

Date/time:

Place of Interview:

Governorate:

Interviewer:

District/village:

Participants Background

1. Category:
2. Average age:
3. Number of participants:
4. Average size of family:
5. Educational background of participants
6. Educational background of participants' sons and daughters
Reasons for dropping out from schools (if any)
7. Key economic activities (in details)
8. Main sources of family income:
9. Contact person in the area
10. Telephone:

General Background about Women Situation

11. What are the women key responsibilities on the village level?
12. What are the women key responsibilities on the household level?
13. How do you perceive the current level of women participation in your neighborhood?
14. What are the key challenges for the rural women participation?

The current use of energy and the socio-economic impact

15. What are the key energy sources used for different purposes (lighting – cooking – electric appliances – heating ..etc)
16. Regularity and quality of current service (average hours per day)?

17. What is the role of women in the process of energy management on household or village level?
18. Level of satisfaction with the current level of energy service?
19. What are the key socio-economic impacts generated from the current situation
20. Are there certain impacts on women from the current situation?

The consultant should present the idea of the project

Expected socio-economic impact from the implementation of the REAP

21. What are the key socio-economic impacts that are expected from the implementation of the project on women situation?

Present the idea of community involvement in the service provision

22. How do you perceive women participation in the service provision cooperatives/ NGOs?
23. What role could women play in this regard?

Consultant observations

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Checklist for the NGOs/ CDAs/ Cooperatives working in the Electricity Sector

1. Name of NGOs/ CDAs/ Cooperatives:
2. Place/ Boundaries of activity
3. Type of NGOs/ CDAs/ Cooperatives
4. Date of registration , Registration number, Registration Expiry Date
5. Number of Board Members: Male () Female ()
6. Number of General Assembly Members: Male() Female()
7. Telephone number
8. Key activities/projects
9. What are the key finding agencies

Electricity Project

10. What are the NGOs/ CDAs/ Cooperatives efforts in electricity provision
11. (describe details about the starting date of the project- number of beneficiaries- type of service provided – delivery mechanisms – cost – the project staff, qualification, previous training, by whom – key implementation challenges and efforts to overcome)
12. what are the key M& E activities? Who is responsible on monitoring? What are the key indicators? Do consumers participate in this process?
13. Who are the stakeholders that the NGOs/ CDAs/ Cooperatives coordinate with in the implementation of the electricity project? What are the coordination obstacles? And what are the shortfalls in the different stakeholders capacities?
14. What are the main lessons learnt from your practical experience in the areas of formation, operation and capacity building of NGOs/ CDAs/ Cooperatives in the electricity sector?

N.B. Copies from case studies, monitoring reports, pamphlets (soft or hard copies) should be obtained

Annex 3: List of Individuals / Organizations Contacted

List of Organizations/ individuals contacted during the SIA preparation

Stakeholder Group	Organisation/ Site	Name of Interviewed Person	Position
Donors and NGOs	El Kanawes NGO for Electricity Users	Mr. Mohamed Ibrahim El Wahdi	Chairman
		Mr. Abdallah Mahmoud Taam	Financial Officer
		Mr. Houssein Ali Ahmed Korwa	Technical Engineer of the Projects Committee
		Mr. Ibrahim Mohamed Ayesh Megali	Treasurer
	El Khreshba NGO, Bani Saad- El Mahwet	Hassan Mohamed Sagher	Head of the Electricity Committee in the CDA
		Ali Mohamed Ali Abdo	Electricity Technician – studies officer in the Electricity Committee
		Nouria Ali Kasem El Nakhoza	Health promoter and Electricity Committee Treasurer
		Mohamed Ali Omar Ali	Public relations officer
		Yehya Saleh Saleh El Nakhoza	Electricity Committee Reporter
	SFD	Ms. Amat H. Al Sharki	Training and Institutional Development Unit Head
		Abdel Baki Ghayaden	Head of Water and Environment Department
		Dr. Abdallah Mousalam	Hygiene and environmental awareness
Government	Ministry of Electricity	Eng. Asa'ad S.Al- Ashwal	Project Director
		Dr. Andreas Zollener	Project Consultant
		Eng. Mohammad Hameed	Rural Electrification
		Eng. Hany Rashed	Engineer in the Rural Electrification
		Mogahed Ahmed El Hoshaby	Head of PEC, Demt, Ad Dalea
	Local Council, Mudiya- Abyan	Mr. Abdallah Ahemed Abdallah El Magaali	General Secretary for Mudiya Local Council

		Eng. Mohamed Ali Magour	Agriculture Engineer
	Local Council, Attyal, Sana'a	Eng. Ahmed El Akr	General Secretary for Attyal Local Council
	Local Council, Hagana Khwlan	Abdel Ghani Gamil Amin	General Secretary for Hagana Khawlan Local Council
	Ministry of Social Affairs	Eng. Mohamed Abdallah Hagar	Head of El Hodaaidah Office
		Yehia Headr	Head of Cooperative Fedration and Cooperative Associations – MSA El Hodiedah
Community Members and Natural Leaders	Bani Maser Village	Mr. Mohamed Abdallah Soheil & 5 men from the village residents	Farmers
	Mudiyah-Abyan	Ahmed Ali Mohamed El Abdelli	Farmer
		Khames Saleh Awzar	Driver
		Salah Awad	
	Hafash – El Mahwet	Mohamed Ahmed El Zohairy	Qat trader –Bani Mamoun Sub-district
		Abdo Saleh El Gader	Farmer –Bani Mamoun Sub-district
		Hassan Mokbel El Keaeshy	Qat trader –Gabal Naman Sub-district
		Naser Ali Esmael El Keaeshy	Education Instructor- Gabal Naman Sub-district
		Mohamed Sagher Hamed El kherba	Farmer – Bani Mamoun Sub-district
	Ar Rajm – Al Mahweat	Afrah Mohamed Yehia El Awami	Housewife – El Haifa Bani Habash , Ar Rajm
		Anisa Saleh Ali El Abdelli	University student, Mekhlaf , Bani Habash , Ar Rajm
		Fatma Ali Mohmed El Sharfy	Housewife, Mekhlaf , Bani Habash , Ar Rajm
		Gamila Ahmed Houssien El Moushki	Teacher, Mekhlaf , Bani Habash , Ar Rajm
	Demt, Ad Dalea	Shawki Ali Mohamed El Gafary	Daily labourer , Demt, Ad Dalea

		Fawaz Amin El Hefani	Hotel Owner, Demt , Ad Dalea
		Tarek Omar Ali Bashen	Accountant , Demt, Ad Dalea
	Attyal, Sana'a	Sheikh/ Mohamed Mahdi El Saher	Attyal Sheikh
		Ahmed Ahmed El Nagar	Pharmacist, Attyal, Sana'a
		Mohamed Ahmed El Shalaly	Trader, Attyal , Sana'a
	Hagana Khawlan , Sana'a	Sheikh/ Abdallah Ahmed El Shazby	Asnaf Sub-district Sheikh, Hagana Khawlan , Sana'a
		Ali Ahmed Ayna	Daily labourer , , Hagana Khawlan, Sana'a
		Mourad Mohamed Mohsen El Shazby	University Student, Hagana Khawlan, Sana'a
	Private sector	Yemeni Company for LPG filling and marketing	Mr. Soltan El Hamdany Company Representative

Annex 4: Draft Decree Establishing Electric Cooperative

Ministerial Decree No ()
On the Establishment of Cooperative Societies for
Electricity & Energy Services for Rural Areas

After reviewing Law No (39) of 1998 on the Establishment of Cooperative Societies & Unions and based on the request of the Minister of Electricity & Energy,

It is decided:

Article (1) Cooperative societies shall be established to provide electric power services for rural areas in the Republic of Yemen in accordance with Law No. 39 of 1998.

Article (2) Objectives of the cooperative societies for rural electricity:
The cooperative societies basically aim at producing and distributing power to all population in its geographic territories and other commercial products related to electric power. They shall particularly aim at:

1. Meeting energy needs of all population in their geographic territories particularly in rural areas in line with their available financial resources.
2. Providing electric power services in with minimum cost and high quality in according to efficient management and sound economy.
3. Establishing relationships and communicating with government and non-government bodies which participate in empowering and regulating the use of electricity in order to support social and economic development of the population.

Article (3) In order to achieve its objectives, the society may exercise the following tasks and duties:

1. Distributing electric power services produced by the society or transferred from the main grid or made from other sources of energy.
2. Conducting any other commercial business related to electrical power.
3. Acquiring private properties, buildings and facilities in such a way that serves its activity and they shall be considered as a capital of the society.
4. Supplying energy and purchasing goods in bulk and financing different projects in such a way that achieves its purpose and in line with laws and regulation applying to the electric sector and decision of the related authorities.
5. Determining fees and prices of all services and other energy products in such a way that guarantees enough revenues to cover

operational, administrative and constructive expenses of the society.

6. Any other tasks or duties stated in its articles of association or in the regulations and decisions of the Public Authority for Rural Electricity or other related authorities.

Article (4) The electric cooperative societies for rural areas are shall be based on a number of fundamentals the most important of which are the following:

1. They are non-profit societies and do not aim at profit making. Even if there are margins at the end of the fiscal year, they shall be distributed on members based on their share of consumption of power and payment of electricity bills in the year. Distribution of margins shall be done by a decision form the Board or general assembly of the society when the society's financial status allows so doing.
2. Each member shall have one membership only and one vote when voting.
3. The cooperative society shall be established according to Law No 39 of 1998, and laws, regulations and decisions of electricity.
4. The Board of the society shall be responsible to the general assembly according to the articles of association of the society and as specified also by laws, regulations and decisions of electricity.
5. Any other fundamentals or principles stated by regulations and decisions of electricity.

Article (5) The funds, properties and imports of the cooperative societies for rural electricity shall be exempted from all fees including taxes, customs and others whether the imports are made directly through the society or indirectly through others.

Article (6) The Rural Electrification Authority shall provide managerial and operational supervision over the affairs and activities of the rural electric cooperative societies. The laws, regulations and decisions applying to the electric sector shall apply to all acts and works of such societies.

Annex 5: Influential / Key Persons in the Surveyed Territories

Territory	District	Contact	Position	Telephone
Abyan – 1	Mudiyah	Mr. Naser Ahmed El Fadaly	General Secretary of the Local council	733610269
		Sheikh/ Ahmed Abdallah El Mageali	District Sheikh	
		Al Mostakbal Fisheries Association		
		Mudiyah Fisheries Association		
Sana'a	Hagana, Khwlan	Sheikh/ Abdollah Mohamed El Ghader	Khawlan Parliament member	
		Mr. Abdel Ghani Gamil	General Secretary of the Local council	
		Sheikh/ Abdallah Ahmed El Shazby	District Sheikh	771406048
	Attyal	Sheikh/ Mohamed Mahdi El Sahaer	District Sheikh	
		Eng. Ahmed El Okr	General Secretary of the Local council	
		Ahmed Ahmed El Nagar	Pharmacist and owner of medicine company	777733180
		Mohamed Ahmed El Shalaly	Trader	777134102
Al Hodiedah – 3	Al Kanawes	Mohmed Ebrahim El Wahdi	Head of El Kanawes Association and project funder	711239394
		Abdallah Mahmoud Taam	Association Accountant	711841821
		Khadega Borgy	YWU – El Hodaheidah	
Ad Dale	Demt	Ahmed Ebn Ahmed El Basha	General Secretary of the Local council and district Sheikh	711521241
		Women Social Charity Association		
Al Mahweat		Afraha El Nzely	YWU, Al Mahweat	

Annex 6: List of Participants in the Public Consultation Workshop

SN	Name	Position	Tel
Ministry of Electricity and Energy			
1	Eng Ahmed hassan Elainy	MEE Deputy	77421581
2	Eng Adel Abdel Rahman	MEE Assisstant Deputy	77000009
3	Eng Asaad Saad El Ashwel	PMU General Manager	711119661
4	Eng Mohamed Hamid El shaabi	Renewable Energy General Manager (MEE)	77214506
5	Eng Adel Andel Ghany	Planning General Manager (MEE)	
6	Ameen Ali	Assistant Director of the Rural Electricity Project	73389146
7	Hussain Mohamed	Manager of Services Department	
8	Abdel Rahman	Ministry of Electricity and Energy	733775532
Public Electricty Corporation			
1	Eng Abdel Moamen Mouter	PEC General Manager	328164
2	Shawki El Habob	PEC Deputy Manager for Adiministrative and Financial Affairs	
3	Eng Foad El Kousy	PEC Deputy Manager for Distribution and Technical Inspection Sector	328141
4	Eng Ahmed Qaed El Sabry	PEC General Manager for Rural Electrification Sector	711180194
5	Eng Abdelkarim Abbas	General Manager for Planning, Statisics and Follow-up	77741670
6	Eng Ali Mahmoud Abdelhamid	General Manager for Distribution	77744802
7	Eng Abdellah El Eryani	General Manager for Commercial Affairs	777701054
8	Eng Abdel Rahman El Masny	Projects General Manager (PEC Rural Electrification Sector)	
9	Eng Abdel Salam Mansour El Gond	General Manager for Renewable Energy	77200449
10	Eng Ismail Abu Donia	General Manager of Exectuvice Unit of Projects	77747076
11	Eng Fadl El Eryani	General Manager of Secondry Towns Electricity	733760314
12	Eng Adnan Ahmed El Aakoury	Manager of Renewable Energy of Rural Electrification Sector	77674648
Governmental Organizations			
1	Dr. Hussain Elwi El Gounid	Ministry of Water and Environment Deputy	777334260
2	Abdel Aalem Abdel Gabar	Manager of Energy Department - Projects Sector - Ministry of Planning and International Cooperation	777841636
3	Saleh Ahmed El Zief	General Manager of NGOs - Ministry of Social Affairs and Labor	
4	Nouria El Bahah	Director of the Rural Women's Development - Ministry of Agriculture and Irrigation	277348
5	Afraha saad El Mouhamady	Director of the Rural Women's Development - Ministry of Agriculture and Irrigation	73544236
6	Dr. Mahmoud Shedyoh	Chairman of the General Authority for Environmental Protection	
7	Abdella Sonbel	Deputy of Capital Governorate for Environmental Affairs	777206625

SN	Name	Position	Tel
8	Mohamed Shamsan	Director of Environmental Affairs	777718878
9	Salem Baqhizel	Solid Waste Disposal Site Project - Environmental Protection Agency	711747412
10	Dr. Lia	Adviser in the Ministry of Water and Environment	711789994
11	Helal El Raiashi	Deputy General Director of Environmental Monitoring and Survey - Environmental Protection Agency	733835643
12	Abdo Mohamed Noaman	Head of Programs Unit - Social Fund for Development	733541176
13	Mohamed Zemam	Deputy of Ministry of Local Development for Local Development Sector	
14	Mohamed Hamoud El Hamadi	Assisstant Deputy of Ministry of Local Development for Local Development Sector	
15	Mahmoud Hieder Salam	Social Fund For Development	733907294
16	Dr. Abdel Megid El Khalidi	Deputy of Ministry of Health for Planning and Development Sector	
17	Dr. Mohamed Mohamed Hagar	Ministry Of Health	733260319
18	Fahd Mohamed Sharaf Eldeen	Public Relation-Hassan Abdo Gaid Group	73265341
19	Taib Mohamed Ghaleb	General Manager of Allasi Co.for International Trade	777402222
20	Eng Abdel Wahab Megahed	Water and the Environment Unit -The Social Fund for Development	777232455
21	Eng Abdel Baky Ghilan	Water and the Environment Unit -The Social Fund for Development	777121626
22	Mosleh Ali Abdo	Social Fund	777466729
23	Said Abdo Ahmed	Public Works Project Manager	711252548
Research Centers and Consultants			
1	Dr. Tawfiq Sofian	Deputy Presedinet for Post Graduate Studies (Sanaa University)	733201309
2	Dr. Ali Mohamed El Ashwel	President of the Lebanese University-Sanaa	777902301
3	Dr. Nasser Saleh Fadl	Social Researcher-Sanaa University	
4	Alan Bashkifitsh	NRECA	733785474
International Organizations and NGOs			
1	Yehia Saleh Saleh	Khoraisheya Association for Development (NGO)	711432230
2	Dr. Arwa Yehia El Darem	Consultant of Soul Association	223999
3	Mohamed El Tawily	CARE	
4	Diana Hidrich	CARE	
5	Sobhia Rageh	Yemeni Women's Union	
6	Ali Khamis	World Bank - Sana'a	413401
7	Dr. Omr El Saghier	SGP Local Coordinator - GEF- UNDP	77710174
8	Christian Flamant	AFD's Country Director for Yemen	448308
9	Dr. Abdel Karim El Shargeby	Social Consultant - UNDP	73747017
10	Simon Goutner	Project Officer AFD	712657793
11	Arafat El Salhi	Manager of Beneficiary Unit - Social Care Fund	

SN	Name	Position	Tel
12	Samy Said Abdo El Aariqy	Head of Small Projects Finance Department - Islamic International Bank	777251453
13	Nabil Ahmed Said	Cooperative Agricultural Credit Bank	220100
General Public			
1	Mohamed Nagib	Member of the Parliment	
2	Abdel Rahman El Oshby	Member of the Parliment	777273239
3	Ali Mohamed Abdella	Citizen - Sanaa	

Annex 7: Summary of Stockholm Convention on POPs Requirements

The Stockholm Convention on [Persistent Organic Pollutants](#) 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. Exposure to [Persistent Organic Pollutants \(POPs\)](#) can lead serious health effects including certain cancers, birth defects, dysfunctional immune and reproductive systems, greater susceptibility to disease and even diminished intelligence. Given their long range transport, no one governing acting alone can protect its citizens or its environment from POPs. In response, the Stockholm Convention, which was adopted in 2001 and entered into force 2004, requires Parties to take measures to eliminate or reduce the release of POPs into the environment. The Convention is administered by the United Nations Environment Programme and based in Geneva, Switzerland.

According to Annex A part II of the Stockholm Convention, Parties to the Convention are obliged to eliminate equipment and oils containing PCBs from use by 2025 and bring these under environmentally sound waste management by 2028. Main obstacles encountered concerning the environmentally sound management (ESM) of equipments and oils containing PCBs are lack of capacities, resources and technologies.

Yemen is signatory to the Stockholm Convention. It signed the Convention on 12/05/2001 and ratified it on 01/09/2004. The Environmental Protection Authority (EPA) of Yemen has formed a National Coordination Team for preparing the National Implementation Plan (NIP) for complying with Stockholm Convention requirements in the country. For this, an inventory of PCBs, Dioxins and Furans has been prepared during January 2004. The National Coordination Team for Persistent Organic Pollutants (POPs) in Yemen has also prepared a National Chemical Profile during August 2006, which indicated that most of 10740 transformers around the country are free from PCBs, except for some transformers in Hadramout Governorate where Askarel (a PCB product) exists in limited number of transformers. It is understood that the NIP is being prepared by the EPA in collaboration with the United Nations Environmental Program (UNEP).

NIPs usually include the following elements:

- Elaboration of national legislation regarding the management, handling, monitoring, phasing out and disposal of oil and equipment contaminated with PCBs.
- Development and implementation of guidelines for management and handling of PCBs transformers by electricity agencies.
- Training employees responsible of management and handling of PCBs transformers on adequate practices

- Establishment of laboratory capacity for the analysis of PCBs in oil
- Gradual rehabilitation of the PCBs contaminated sites (including preparing an inventory of such sites)
- Disposal of mineral oil contaminated by PCBs (including preparing an inventory of PCBs containing equipment)
- Design and put in place a national PCBs monitoring program

According to the information provided in the PCB inventory, PCB containing transformers only exists in Hadramout Governorate as mentioned earlier. Because Hadramout does not include any of the REAP on-grid service territories, it is not expected that the REAP interventions will cause removal of any PCB containing transformers and, hence, will not be associated with any PCB waste management activities. Existing PEC customers in the project service territories, both the current on-grid customers as well as customers served by isolated diesel systems, will become RESP customers once RESP is established. The project is undertaking a study, the results of which will indicate which entity the diesel generators will belong to once the customers are transferred to the grid

Useful Links and Sources of Information:

- <http://chm.pops.int/Default.aspx>
- <http://www.chem.unep.ch/Pops/pdf/PCBtranscap.pdf>
- <http://www.chem.unep.ch/Pops/pdf/PCBident/pcbid1.pdf>
- <http://www.chem.unep.ch/pops/pdf/surveypcb/PCBdesteng.pdf>
- http://www.basel.int/pub/techguid/pop_guid_final.pdf

