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**The Republic of Zambia**

**“Mid-term Review Rural Electrification Infrastructure and Small  
Projects”**

**Contract N°  
Framework Contract Beneficiaries – Lot 4  
RFS 2013/316602**

**Final Report  
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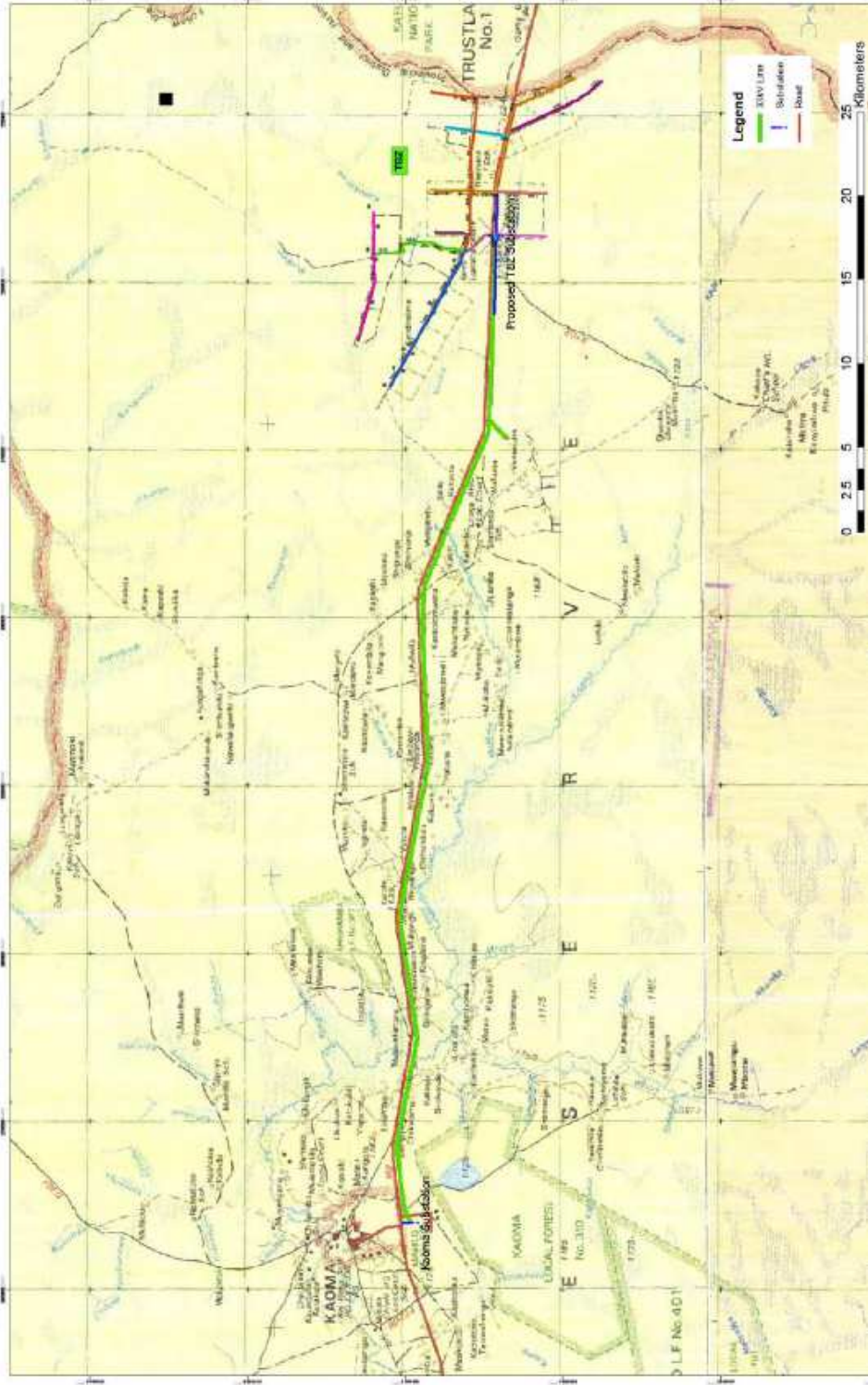
# KAOMA TBZ FARMBLOCK PROJECT

KAOMA 66kV S/S

60km 33 kV OHL

TBZ 33/11 kV S/S

33/11kV Distribution



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## **List of Abbreviations**

ACSR	Aluminium Conductor Steel Reinforced
BoQ	Bill of Quantities
BST	Bulk Supply Tariff
EIRR	Economic Internal Rate of Return
ERB	Energy Regulation Board
FIRR	Financial Internal Rate of Return
FYP	Five Year Plan
GWh	Gigawatt hours (energy); 1000 x MWh
GRZ	Government of Republic of Zambia
HH	Households
ICB	International Competitive Bidding
IEE	Initial Environmental Examination
kV	kilovolt (voltage)
kVA	kilovolt ampere (power)
kW	kilowatts (power; load)
kWh	kilowatt-hour (energy)
LV	Low voltage, 240V single phase (Zesco definition)
M&E	Monitoring & Evaluation
MEWD	Ministry of Energy and Water Development
MV	Medium voltage, 400V three phase and 11 kV (Zesco definition)
MW	Megawatts; 1000 x kW (power, load)
MWh	Megawatt-hour (energy)
NPV	Net Present Value
O&M	Operations and Maintenance
PREP	Priority Rural Electrification Project
RE	Rural Electrification
REA	Rural Electrification Authority
ROW	Right of Way
SWER	Single Wire Earth Return
TBZ	Tobacco Board of Zambia
TOR	Terms of Reference
WB	The World Bank
ZESCO	Zesco Limited; Zambia Electricity Supply Corporation
ZNS	Zambian National Service

## **Executive Summary**

### **INTRODUCTION**

Electricity is important for poverty alleviation, but access to electricity in rural areas of Zambia is only 2%. The Rural Electrification Authority (REA) is mandated to plan, manage the Rural Electrification Fund (REF), mobilise further funds and finance projects, offer concessions for electrification of selected areas, promote decentralised technologies, etc.

A Financing Agreement (FA) for “Rural Electrification Infrastructure and Small Scale Projects”, was fully signed between the European Commission and the Government of the Republic of Zambia on 10 May 2008. The total project cost was estimated at Euro 36,511,211.00, of which Euro 9,980,750.00 was from the ACP-EU Energy Facility and Euro 26,530,461.00 by the Rural Electrification Authority (REA).

For the specific European Development Fund (EDF) component under this Financing Agreement, the expected result is to provide sustainable electricity services to 6,800 rural households and 12 schools and rural health centres in target rural areas. The project is expected to contribute to improved productivity and income levels and improved social service delivery systems in order to facilitate the achievement of the MDGs.

A Mid Term Review Team was fielded to Zambia 3 June 2013 to 25 June 2013. The Team met with key stakeholders in Lusaka and in the field 11-18 June, 2013. An Inception Report was submitted 6 June 2013 and a de-briefing of the MTR was carried out at the EU Delegation in Lusaka on 24 June 2013.

### **DESIGN AND RELEVANCE**

The design of the electrical distribution system is based on ZESCO’s adopted design and construction standards, which will simplify future ZESCO’s stores inventory and maintenance processes. However, the design documents do not cover all the prevailing site conditions, thus prompting claims for additional costs and extension of time from the contractor.

The project is consistent with national policies and the European Union (EU) programme, however there is no specific project log frame for the EDF Project and thus assessment of performance is only possible in the broadest terms.

### **EFFICIENCY**

The project has under-performed due to lack of programme management support and foresight as well as underperformance by the Contractor. The contracting authority is the National Authorising Officer of the European Development Fund (NAO). The Supervisor is the Rural Electrification Authority (REA). Although the documents stipulate that REA would delegate “authority in full as Supervisor to ZESCO Ltd”, this did not eventuate, but a representative from ZESCO has been participating in the Site Meetings.

The European Union Delegation (EUD) to Zambia lacked the time, resources and expertise to handle energy projects and, additionally, the division of labour, competencies and responsibilities between the EUD and EC Headquarters were

unclear. In REA, there were gaps in the appointment of dedicated personnel with responsibility for the project, resulting from staff turnover and departures overseas for study. Recently and in attempt to address these issues, both the EUD and the REA have appointed dedicated project officers.

The Consultant's strict adherence to the specification and fairly brusque communication style have caused considerable frictions in his dealings with the Contractor. Delays in replacement of key consultancy staff for 3 and 4 months and short term social and environmental expert for over a year is attributed to his lack of knowledge of EDF rules.

The PSC has not managed to plan for necessary studies, designs and design reviews early enough to correct the project steering direction<sup>1</sup>. The documents comprising the works contract were contradictory with regard to capacity of main transformers, length of lines, and quantities. Although the order of precedence in the contract and Tender Dossier was that design documentation (drawings) takes precedence over the BoQ, the consultants' Design Review Report dated November 2011, says that at the very beginning of the project it was decided that the data and quantities stated in the BOQ should prevail. The Contractor later claimed for extra costs for items not mentioned in the BoQ.

Eltech Investments Ltd had signed the contract, supplied guarantees and received payments, but the MTR was informed that all legal JV requirements in the tender dossier had been complied with authorising Eltech Investments Limited to represent the JV Eltech Investments Ltd and ZISMO Engineering in contractual matters. Although for all practical purposes Eltech has acted as the Contractor, Eltech did not have sufficient experience for this type of projects.

The project has suffered problems with procurement of materials, e.g. incorrect material, incorrect quantity, delays and unnecessarily tying up the Contractors funds as the Supervisor/Consultant were by-passed because (i) the contractor obtained the 30% advance without providing a procurement plan and (ii) at the beginning of the project the contractor placed purchase orders for the entire scope of wood poles, transformers, and conductors, based on the Bill of Quantities without requesting the approval of the consultant and REA/ZESCO. An example of the procurement problems is the procurement of wood poles for the line. The Contractor paid up front US\$288,741 for having all 3,671 poles delivered early, but had them rejected because of insufficient creosote penetration and unidentified suppliers following a fire in the FAT inspected factory and had to go to other suppliers without being reimbursed (at the time of the MTR) for the upfront payment.

The contractor has submitted a number of variations requesting contract extensions. However, the project completion is likely to go beyond the extension the Supervisor/Consultant is likely to allow. To change the Contractor is not a feasible option due to the remaining EDF time and as the remaining uninstalled materials has either been procured, is in the process of being procured or is stored at the Contractor.

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<sup>1</sup> The design review report was submitted in August 2011 and discussed in November 2011, almost a year after the works contract was signed, which made direction changes difficult. In addition, the EUD informed the MTR that the design review report did not capture all the issues they had expected, but the consultant did not accommodate their concerns.

The MTR Team argues that because of a “collective responsibility” for the current state of affairs and the development context an “ex gratia” extension of the contractual completion date without cost should be accepted. This extended completion date should be set to secure completion.

### **EFFECTIVENESS**

The MTR team assesses that the Kaoma TBZ project is 70-80% complete<sup>2</sup>. The 66/33 kV Kaoma Substation still requires the transformer and switchgear which has to be transported from Lusaka together with a crane. The TBZ 33/11 kV substation is somewhat further advanced. The MTR team believes that the Contractor’s estimate of having this sub-project finalised within 2-3 months is overly optimistic and believes it could take up to the end of the year.

The Mumbwa Big Concession Project is further behind than Kaoma TBZ and the MTR Team assesses that it is 50-60% complete. The Mumbwa 88/33 kV substation is almost ready for connection. REA/ZESCO has yet to carry out a preliminary survey for the Northern Part of the Big Concession, which was not included in the original project. Again the MTR team thinks that the Contractor’s estimate of finishing the projects in 4 months time is unrealistic and believes it will be well into next year.

If variations now on the table are approved, the contractual completion date moves to August 2013. Discussions are on-going on how to deal with Contractors Claims and variations estimated to EUR 621 000.

According to the TAP, the EDF component was

....to provide sustainable electricity services to 7,000 rural households<sup>3</sup> and 16 schools and rural health centre in target rural areas. The project is expected to contribute to improved productivity and income levels and improved social service delivery systems in order to facilitate the achievement of the MDGs.

At the time of the MTR, neither of the expected results had been achieved; nor, in the opinion of the MTR team are the expected household connections likely within a year of the immediate conclusion of the project. The major focus of the project is the construction of a backbone with a 20 year time horizon, which will facilitate ongoing connections into the foreseeable future. Thus, no judgement is possible regarding the expectation that electrification will lead to increased economic activity, which will contribute to poverty reduction in the targeted areas. While the MTR team believes that the assumption is logical, should farmers take up the opportunity, there is at present no evidence to suggest that they will be in sufficient numbers to make a significant impact on poverty levels in the target areas.

Nor, does the MTR team believe that occupants of 500 ha farms or international investments qualify as poor. Connecting them may help them increase productivity, but unless it also results in substantial new jobs, this will not reduce poverty. Electrification may contribute to poverty reduction but this is a function of equitable

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<sup>2</sup> The MTR assessments of the extent of completion of the projects are based on the documents provided by the Contractor during the MTR

<sup>3</sup> Subsequently revised downward to 6 800 in Rider 1.

access; this project does not address this, instead depend on the World Bank-financed subsidy scheme for connections. Should this not be extended beyond the current completion date (December 2013), even fewer connections can be expected since fees will rise 1 133% over the subsidized rate.

On the other hand, the MTR team is confident that with the project's completion the 16 targeted GoZ institutions will have been connected. As noted, this will have a positive effect on the quality of pupils' learning and, possibly, on improved adult literacy along with an increase in the schools income streams from this source. Similarly, health services will improve; a reliable power supply will enable the Nkema Health Centre, for example, to operate its CD4 count equipment improving sexual health services to the TBZ population. Furthermore, lighting will improve maternity services, possibly contribution to the MDG goals in relation to infant and maternal mortality.

There are also questions surrounding the expected main environmental benefit, a reduction in deforestation arising from a reduction in charcoal use. However, if successful, any reduction will have a negative income effect on rural residents. Furthermore, there are questions whether the assumption is correct. As a result, the achievement of this benefit is questionable.

The MTR team recommend that the EU should commission an *ex post* evaluation of the EDF-funded project component at least five years after its completion to determine the achievement of the expected results and their contribution to the expected outcome, poverty reduction.

## **IMPACT**

Impact assesses the contribution of the results achieved to achieving the expected outcome (project purpose or immediate objective). Assessing impact at this point in time is difficult as clear evidence is not evident prior to the programme's completion.

However, it is expected that the projects will provide:

- High quality electricity supply, and thus potential for economic development & the advantages of a diversified production system.
- Contributions to a more efficient use of resources by improving the efficiency of energy usage by farms and rural households and reducing the consumption of fuel wood, charcoal and other air polluting sources
- Improved service delivery – education and health
- Improved educational performance – access to longer study periods
- Increased income stream for schools – adult literacy
- Improvements in maternal and infant mortality (MDGs) – night time deliveries in light

## **SUSTAINABILITY**

*Technology.* The MTR Team suggests that REA for future projects should consider reducing the high costs of electrification by using documented and proven, low cost methods and techniques in electricity networks that have become used in different countries in sub-Saharan Africa, although not yet in Zambia.

Cost savings can be achieved by omitting 11 kV lines, especially where 33 kV and 11 kV lines run in parallel. Aerial Bundled Cables has less maintenance and non-technical losses by illicit consumption and extension of the low-voltage system is easier as no safety distances to obstacles have to be considered. Single-phase, instead of three-phase, networks are likely to be adequate in many situations with customers requiring high-powered three-phase motors served by using phase converters. Single-phase Single Wire Earth Return (SWER) technology is typically 20 – 60% cheaper than 3-phase, whereas 2-wire systems are somewhere in between 3- phase and SWER in both cost and transmission capacity. Many countries have omitted the earth wire on their 33 kV OHL.

*Institutional Sustainability.* Rural electrification projects must be institutionally viable. Projects are institutionally viable when they have adequate organization and funding for operation, maintenance and follow up. These projects will be owned and managed by the national utility, ZESCO, and the MTR team feels that ZESCO will have capabilities to manage the operation and maintenance of the project.

*Economics.* It is often a challenge for power utilities to balance financial sustainability with expanding grid coverage. Although ZESCO for a long time had tariff levels far below the cost of service levels, recent tariff adjustments have been relatively substantial. The 2007 Pre-feasibility studies indicated acceptable EIRR and FIRR assuming the tariffs increased at 5% p.a. for a zero NPV result with no Bulk Supply Tariff and 9.5% for a zero NPV result with a Bulk Supply Tariff, which the recent migration to cost-reflective tariffs seems to have achieved. This raises the question if customers can afford the new tariffs.

A cost recovery based connection fee usually constitutes a main barrier to customer connections as it is often high compared to income levels in the local population. Experience shows that poorer household often have both the ability and the willingness to pay for electricity consumption, but not for the connection fee.

ZESCO now allows customers to pay connection fees over a period of 36 months through electricity purchases on a prepayment metering system. ZESCO has also introduced a special program to connect households for K150, but this runs out in December, 2013.

*Productive use.* REA's rural electrification projects focus on connecting public institutions and existing businesses. The projects have to a lesser degree targeted the specific productive and social sectors and focused on strengthening these. Experiences from other countries' rural electrification interventions suggest that rural electrification should be integrated with plans and strategies for local business development to maximize positive income generating effects.

## **7. RECOMMENDATIONS**

1. Ensure that the EUD has the appropriate skills and expertise to deal with energy infrastructure.
2. Ensure, in all future similar projects, that the appointed Consultant is on site at least two months in advance of the Contractor

3. Ensure that a Design Review is completed and available before the Contractor is on site.
4. Ensure that the Contractor has prepared an approved Procurement Plan before any advance payment is made.
5. Ensure that (a) social and environment expert(s) are in post from the start of actual implementation. Ensure that there is an adequate allocation of time (minimum 200 days) available for such inputs.
6. Ensure that the Supervisor has nominated a contact point for the project's life.
7. Ensure that the Contractor appoints a responsible site-office based individual to respond to the requirements of the EMP and SMP.
8. Commission an ex post evaluation of the project at least five years after completion to assess achievement of the EDF-component's results and their contribution to expected outcomes.
9. Approve an 18 month no-cost extension to enable the Contractor to complete the works.

## **1. INTRODUCTION**

### **1.1 Background**

Energy and in particular electricity is an important requirement towards poverty alleviation and improvements in service delivery to various sectors of the economy. Electricity is used for various purposes, *inter alia* water pumping, agro-processing, commercial activities, social activities and house hold use. Access to electricity in Zambia, particularly in rural areas, is very low, nationally 20% but in rural areas only 2%.

The 2002 Country PRSP outlines the GoZ objective to increase access to electricity from the current 2% to 15% by the year 2015. This, together with other sectors' initiatives, expects to contribute to poverty reduction and the achievement of the MDGs. Estimates to achieve this level of access in rural areas are in excess of Euro 700 million. As this can only be achieved with the support of cooperating partners, the EU/ACP Energy facility allocated 171 million Euros under the 9<sup>th</sup> EDF to support various projects under the Energy facility.

### **1.2 Sector Context**

Zambia has an installed electricity generation capacity of 1 786MW, of which 1 676MW is hydropower. Electricity is also produced using thermal energy mainly biogasses and diesel. However, electricity generation from diesel is expensive as petroleum products are imported. Generation averages about 7,500 to 8,000 GWh per annum with Maximum Demand at 1 100MW. The country has an undeveloped hydropower generation potential of over 6 000MW and plans are underway to develop a number of both large and small hydropower stations. As well as from hydropower, the country has potential for electricity generation from solar energy and biomass. The main electricity companies are ZESCO Limited, Copperbelt Energy Corporation (CEC) Plc. and Lunsefwa Hydropower Company (LHPC) Limited. LHPC is primarily in generation while ZESCO and CEC are vertically integrated. Generation by CEC is for emergency supply to its large mining customers.

Power is generated mainly in the southern part of the country and transmitted to the main consumption area, the Copperbelt in the north and the line of rail. The main grid consists of the 330kV transmission system and sub-transmission at 220kV, 132kV, 88 kV and 66kV. A number of transmission projects are planned within the country *inter alia*, a 330kV Zambia/Tanzania Interconnector, 330kV to the North-Western province and an additional 220kV line to connect Zambia and Congo DR. The distribution system consists mostly of 66kV networks covering the urban areas and is managed by ZESCO.

Rural electrification in Zambia predominantly focuses on grid extensions to replace diesel generators in isolated towns and to electrify towns without electricity. The National Energy Policy (NEP) (1994) changed the concept to include the application of alternative energy sources such as solar PV and mini-hydropower. Rural electrification policy development and national planning was and is still the responsibility of the MEWD while execution of rural electrification projects was done

by ZESCO Limited until the Rural Electrification Authority (REA) was established in 2004. Currently, the REA is mandated to plan, manage the Rural Electrification Fund (REF), mobilise further funds and finance projects, offer concessions for electrification of selected areas, promote decentralised technologies etc.

### **1.3 The Rural Electrification and Small Projects Project**

#### **1.3.1 Global objective**

The main objectives of the joint REA/ACP-EC Energy Facility project is to contribute to the achievement of the MDGs and in particular poverty reduction. It is anticipated that access to sustainable energy and in particular electricity could contribute to increased economic activity and improved social services thereby helping to reduce poverty. This project aims at to increase access to electricity in rural areas through promotion of the financing of grid and renewable energy projects.

#### **1.3.2 Specific objective(s)**

More specifically the project is intended to achieve the following: -

- 1) To facilitate increased access to electricity to targeted rural households, social institutions, farmers and small scale commercial undertakings;
- 2) To facilitate private public partnership in rural electrification projects in order to leverage financing for the Zambian rural electrification programme; and
- 3) To promote application of different electrification technologies in order to maximise sustainable utilisation of locally available energy resources.

The EU funding under the ACP-EC Energy Facility directed to this project will support increased access through the extension of the national grid.

#### **1.3.3 Expected results**

The project is expected to provide sustainable electricity services to 26,800 rural households and 696 schools and rural health centre in target rural areas. This will result in the improved productivity and income levels, improved social service delivery systems and reduced reliance on kerosene, batteries and candles for lighting, radio, television and powering small machines and appliances. This would not only result in cost savings, but also in the reduction in carbon dioxide emission to the atmosphere.

Facilitate private public partnership in rural electrification projects in order to leverage financing for rural electrification programme. This component is important to attract private sector participation in rural electrification in order to maximize resource availability and socio-economic development impact.

Increased use of grid electricity, mini-hydro, solar, biomass and other locally available renewable energy resources and technologies in rural areas.

For the specific EDF component under this Financing Agreement, the expected result is to provide sustainable electricity services to 6,800 rural households and 12 schools and rural health centres in target rural areas. The project is expected to contribute to improved productivity and income levels and improved social service delivery systems in order to facilitate the achievement of the MDGs.

The Financing Agreement (FA) for “Rural Electrification Infrastructure and Small Scale Projects”, was fully signed between the European Commission and the Government of the Republic of Zambia on 10 May 2008. The total project cost is €36,511,211.00, of which €9,980,750.00 is from the ACP-EU Energy Facility and €26,530,461.00 by the Rural Electrification Authority (REA). Two contracts namely; Supervision of Two Grid Extension Projects in Kaoma (Western Province) and Mumbwa (Central Province) Districts in Zambia which was signed on 6 December, 2010 and Construction of Two Grid Extension Projects in Kaoma (Western Province) and Mumbwa (Central Province) which was also signed on 6 December, 2010. Execution started on 7 March, 2011.

## **1.4 Methodology**

The study activities have included

- Documentary review (A list of consulted documents is presented in Annex 3.)
- Interviews with key stakeholders – EU Delegation, Sida, A representative sample of Government stakeholders: NAO, REA, ZESCO, The Consultant and Contractor (A list of people met is presented in Annex 2.)
- Field visits to the Kaoma and Mumbwa areas.
- Stakeholder consultation and validation
- Final Report

In the course of the kick-off meeting, the team was informed that the MTR should focus on the EDF component.

The team has pursued the envisaged three-phase approach envisaged in the ToR, *viz*: (i) Inception phase, (ii) Desk-research phase, and (iii) Fieldwork phase.

An **inception report** was submitted on 6 June, 2013 outlining (i) methodology, (ii) activities, (iii) Responsibilities; and (iv) Work plan and milestones.

During the **desk research phase**, the evaluation team (i) reviewed and analysed relevant documents (Annex 3), (ii) summarised the information already gathered and limitations, and identified issues still to be covered, (iii) developed the (participatory) tools (semi-structured interviews, focus groups, etc.) applied in the field phase, and (iv) developed a detailed work plan for the field phase.

During the **fieldwork phase**, the evaluation team visited the two project sites, interviewed selected people, met with the Consultant and Contractor, participated in site inspections and site meetings with stakeholders and the contractor. About a week and half was spent on visiting the project sites, having focus group interviews with electricity consumers and regional staff of ZESCO, and having one-to-one meetings with

relevant staff of REA, other relevant key stakeholders, the consultant and the contractor. E-mail communication was established with both Sida and the World Bank.

## **1.5 Structure of the Report**

The report is structured in accordance with the OECD DAC requirements for evaluations. In Section 2, we discuss the programme's design and its relevance to national and provincial priorities and EU country programme priorities and strategies. Section 3 discusses the programme's efficiency, including the conversion of resources (financial and human) into results. Section 4 follows with a discussion of effectiveness, in particular the contribution of the results achieved to achieving the immediate objective (outcome). Section 5 and 6 discuss the programme's impact (the likelihood of achieving the objective) and sustainability over time. This is followed by a discussion of the conclusions and recommendations emerging from the programme experience.

## **2. DESIGN AND RELEVANCE**

### **2.1 Design**

The Kaoma TBZ Farmblock Project involves work at the Kaoma 66/33 kV substation, construction of a 60 km 33 kV overhead line to a new 33/11 kV substation in TBZ, and a 33 and 11 kV distribution in TBZ. Refer Annex 4 for an overview of the TBZ Farm Plots.

The Mumbwa Big Concession Farm Block Project, which has two larger commercial farms with more than 5,000Ha, namely the Kalenda National Service camp (ZNS) and Chitumba Prison Farm, involves work at the existing 88/33 kW ZAF substation and approximately 175 km 33 kV overhead distribution line. As the actual demand at ZNS did not justify the originally specified construction of 20 km of 11 kV line and installation of a number of transformers, the electrification of the ZNS area has been changed to come from 33/0.4 kV transformers and moving a specified 33/11 kV 500 kVA transformer to a location where the Northern Part of the concession area (still not surveyed) could be supplied. A number of 11/0.4 kV transformers became spares. Refer Annex 5 for an overview of the Mumbwa Big Concession Farm Block.

A few connections<sup>4</sup> for schools, clinics and other public institutions are included in both projects.

ZESCO has adopted design and construction standards for distribution systems, which have been incorporated in the project design approach. The project thus includes the conventional 33 kV and 11 kV 3-phase distribution system, where 33 kV represent the transmission feeders and the 11 kV the distribution network. Standardising plant and materials with similar projects and present ZESCO design standards, including specifying the same poles and conductors will simplify ZESCO's stores inventory as well as maintenance processes and should contain costs.

The documents and the design do not cover all the prevailing site conditions, thus requiring the contractor to make his own investigations and design. This includes unspecified soil conditions, water logged areas, existing foundations, stringing requirements, clearance distances over roads and undeveloped areas. The extra costs for some of these conditions are still being debated.

### **2.2 Consistency with national and local development policy and sector policies**

The policy measures and strategies specified in the National Energy Policy 2008 includes to improve accessibility and service delivery to agriculture, tourism, manufacturing, mining and other commercial activities and specifically by: (ii) *Providing electricity to farm blocks, new mines and other industrial consumers.*

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<sup>4</sup> The DC in Kaoma complained that several institutions had been left out from within a 15 km corridor along the 33 kV line. The DC argued that it was REA policy to include connections to all government institutions within such a corridor. The REA subsequently stated that there was no such policy.

The policy also seeks to increase access to affordable energy in rural areas to reduce poverty and promote economic growth and specifies (i) implementing measures outlined in the Rural Electrification Master Plan and (ii) providing relevant subsidies for energy in rural areas.

Zambia's Rural Electrification Master Plan (REMP) was developed with the assistance of the Japanese Government and officially launched in April 2010. The REMP sets out to increase the rural access rate from 3.1 % in 2006 to 51% in 2030, a target which supports Zambia's *Vision 2030* to be a 'prosperous middle-income country'. After a nationwide multi-faceted study, the REMP formulated and prioritized a list of core areas designated as Rural Growth Centres (RGCs), which, when electrified, had potential to catalyse social and economic development in the contiguous villages, thus expanding the opportunities for escaping the worst forms of poverty. The REMP designated 1,217 Rural Growth Centres. The average estimated cost of undertaking these projects is USD 50 million per year, every year up to 2030. The rate of implementation of the REMP and the resulting growth of rural electricity access rates was unrealistically optimistic. It was particularly unrealistic in terms of expected funding (USD 50 million a year) and capacity of REA. In 2010 the Sixth National Development Plan (SNDP) estimated that the rural electrification access rate in 2009 was 3.5% compared to the REMP forecast for then of 9.2%. The SNDP went on to say that 'this was due to the slow implementation of the Rural Electrification Programme.'

### **2.3 Coherence with EU Programme**

Neither the CSP 2001 – 07 nor that for 2008 – 13 addresses the country's energy infrastructure, instead both focus on the transport sector, and roads in particular. As a result both EDF IX and EDF X resources were fully committed and the Grid Extensions were financed through a call for proposals in the 1<sup>st</sup> semester of 2007 under the Energy Facility. Two projects were approved<sup>5</sup>, but only one, Project 284, the subject of this report, was implemented, supporting increased access through the extension of the national grid.

### **2.4 The project's identification and initial formulation.**

During the first phase of the World Bank preparations for the Increasing Access to Electricity and ICT Services (IAES) Project, i.e. up to mid-2005 various studies were carried out to identify "Priority Rural Electrification Projects (PREPs). These included electrification of the farm blocks, e.g. the electrification of the TBZ farm block. The IAES preparations stalled towards the end of 2005, making these studies "available" for other financiers.

Under the ACP-EU Energy Facility (EF), Zambia was successful with the Rural Electricity Infrastructure and Small Scale Projects (increased access to energy services in rural areas) which included (i) The grid extension to the Mumbwa big concession in Mumbwa District, Central Province (ii) The extension of the grid to

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<sup>5</sup> The other (€10 million), to be equally co-financed with the World Bank, did not materialize as World Bank funding was not forthcoming.

TBZ in Kaoma District, Western Province and (iii) The electrification of Lukulu in Northern Province. The Financing Agreement was signed 7 December, 2007.

As the three sub-projects had not been surveyed in detail, a local consultant, ASCO Limited was engaged by REA to carry out the surveys on site. The surveys involved the derivation of specific engineering design works for each of the projects and the elaboration of the environmental project briefs (EPBs). After having established cost estimates for the three projects the electrification of Lukulu was dropped through Addendum No. 1 to the Financing Agreement dated 3 December, 2009.

ASCO Limited subsequently elaborated the detailed engineering design<sup>6</sup>, cost estimates and assisted with the preparation of the tender dossiers for works and supervision and support during the tender process.

## 2.5 The Logical Framework

The logframe appended to the FA is in respect of Project 284: Rural Electrification Infrastructure and Small-Scale Projects (FA ACP RPR 174). As such it covers the whole project, inclusive of both EU and REA/GoZ financing. As such, it deals with components far beyond the Intra-ACP EDF-financed grid extension, *inter alia* ‘...mini-hydro, solar, biomass and other locally available renewable energy resources and technologies in rural areas’.

While the overall project logframe is a coherent and apparently logical progression from results through specific objective to overall objective, the same cannot be said for the EDF-financed component. There is little in the logframe that responds to the contention, for example, that increased grid coverage will lead to the targeted 6 800 household connections. Nor do the assumptions and risks address the cost (to householders) of connections<sup>7</sup> or their ability to bear consumption costs<sup>8</sup>. Nor, is there necessarily any logical link between the availability of electricity and poverty reduction. Rather the logframe imputes a connection, which requires another link, e.g. the creation of new or expansion of existing employment opportunities.

Given the specific statement in the TAP that

....the specific EDF component under this Financing Agreement, the expected results is to provide sustainable electricity services to 7,000 rural households<sup>9</sup> and 16 schools and rural health centre in target rural areas. The project is expected to contribute to improved productivity and income levels and improved social service delivery systems in order to facilitate the achievement of the MDGs.....

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<sup>6</sup> Best practice requires that the same consultant should not both carry out design and environmental impact assessment, refer the World Bank Operational Policy 4.01.

<sup>7</sup> Even under the World Bank-subsidised connection scheme (which expires in December 2013), rural household connections cost KR 150. While some households in the target area will be able to afford this cost (and possibly even the unsubsidized amount), by no means all will and it is questionable whether the targeted 6 800 can be met.

<sup>8</sup> ZESCO policy is to install pre-paid electricity meters. However, according to one report [Daily Mail, 3 June 2013], consumption of charcoal has risen following the installation of pre-paid meters as consumers sought to reduce electricity costs.

<sup>9</sup> Subsequently revised downward to 6 800 in the Rider with the dropping of one province.

it is to be regretted that this sub-component of Project 284 did not warrant its own specific logframe. In its absence, assessment of performance except in the broadest terms is not possible.

The MTR team considered adapting Project 284's logframe to one specific for the EDF-financed component. However, after careful review, this was found to be a largely futile exercise since they would have had to redo the entire logframe to develop a specific focus on the grid extension. Furthermore, this would have affected all the log frame's columns, in particular the MOVI and Assumptions and Risks. In the light of this, the MTR team is of the view that the exercise would have resulted in a logframe that was almost entirely divorced from that of Project 284 and, therefore, a false result.

## **2.6 Conclusions**

The design of the electrical distribution system is based on ZESCO's adopted design and construction standards, which will simplify future ZESCO's stores inventory and maintenance processes. However, the design documents do not cover all the prevailing site conditions, thus prompting claims for additional costs and extension of time from the contractor.

The project is consistent with national policies and the EU programme, however there is no specific project log frame for the EDF component and thus assessment of performance is only possible in the broadest terms.

### **3. EFFICIENCY**

This section discusses the resources made available to the Rural Electrification Infrastructure and Small Projects programme under the EDF component, their amendment, and their conversion into Results.

#### **3.1 Financial Resources: the Financing Agreement, as amended by the Rider**

The Financing Agreement, which came into effect with the signature of GRZ in March 2008, sets out the budgetary provisions for Project 284: Rural Electrification Infrastructure and Small-scale Projects. The total cost was estimated to be € 36 561 211, of which the EU contribution amounted to € 9 980 750. Table 1, below, sets out the budgetary allocation.

Table 1: Budget

Category	Programme/Activity	EC contribution(€)	REA Resources (€)	Total (€)
Human Resources		0	709 200	709 200
Travel		0	9 000	9 000
Office Equipment & Vehicles		0	227 800	227 800
Local Office/Action Cost		0	141 000	141 000
Other Costs/Services		0	51 000	51 000
Activity 1	TBZ Kaoma	3 658 684	0	3 568 684
Activity 2	Lukulu	211 282	0	211 282
Activity 3	Mumbwa Concession	4 663 443	0	4 663 443
Activity 4	Chininga (1.0 MW)	0	5 161 085	5 161 085
Activity 5	West Lunga	0	6 451 356	6 451 356
Activity 6	Zengamena II	0	2 155 265	2 155 265
Activity 7	Solar PV System	0	5 017 722	5 017 722
Activity 8	Biomass	0	3 225 678	3 255 678
Activity 9	Consultancy Services: Works supervision for grid extension	510 000	0	510 000
Activity 10	Consultancy Services: Works supervision PV, hydro, biomass feasibility	0	1 960 000	1 960 000
Activity 11	Service Contract: EIA for PV, hydro, biomass	0	100 000	100 000
Communications/Visibility		10 000	10 000	20 000
Contingencies <sup>10</sup>		907 341	1 263 355	2 167 696
External Evaluation		90 000	24 000	114 000
Audit		20 000	24 000	44 000
TOTAL		9 980 750	26 530 461	36 561 211

Source: TAP, Financing Agreement, FED/2008/20-660 (9 ACP RPR 174)

Consequent to a request submitted by the NAO on 10 August 2009, a Rider was approved on 3 December 2009. Table 2 sets out the revised budget following the Rider's approval and Table 3 the differences between the two budgets.

<sup>10</sup> The European Community's contribution to the "Contingencies" heading may be used only with prior agreement of the Commission.

Table 2: Budget, as Revised by Rider 1

Category	Programme/Activity	EC contribution(€)	REA Resources (€)	Total (€)
Human Resources		0	709 200	709 200
Travel		0	9 000	9 000
Office Equipment & Vehicles		0	227 800	227 800
Local Office/Action Cost		0	141 000	141 000
Other Costs/Services		0	51 000	51 000
Activity 1	TBZ Kaoma	3 548 491	0	3 548 491
Activity 2	Lukulu (cancelled)	0	0	0
Activity 3	Mumbwa Concession	5 016 851	0	5 016 851
Activity 4	Chininga (1.0 MW)	0	5 161 085	5 161 085
Activity 5	West Lunga	0	6 451 356	6 451 356
Activity 6	Zengamena II	0	2 155 265	2 155 265
Activity 7	Solar PV System	0	5 017 722	5 017 722
Activity 8	Biomass	0	3 225 678	3 225 678
Activity 9	Consultancy Services: Works supervision for grid extension	718 213	0	718 213
Activity 10	Consultancy Services: Works supervision PV, hydro, biomass feasibility	0	1 960 000	1 960 000
Activity 11	Service Contract: EIA for PV, hydro, biomass	0	100 000	100 000
Communications/Visibility		10 000	10 000	20 000
Contingencies <sup>11</sup>		577 195	1 263 355	1 840 550
External Evaluation		90 000	24 000	114 000
Audit		20 000	24 000	44 000
TOTAL		9 980 750	26 530 481	36 561 211

Source: Addendum 1 to Financing Agreement

Table 3: Budgetary Changes Effected by Rider 1

Category	Programme/Activity	EC contribution(€)	EC Resources Rider 1 (€)	Variation (€)(+/-)
Human Resources		0	0	0
Travel		0	0	0
Office Equipment & Vehicles		0	0	0
Local Office/Action Cost		0	0	0
Other Costs/Services		0	0	0
Activity 1	TBZ Kaoma	3 658 684	3 548 491	- 110 193
Activity 2	Lukulu (cancelled)	211 282	0	- 211 282
Activity 3	Mumbwa Concession	4 663 443	5 016 851	+ 353 408
Activity 4	Chininga (1.0 MW)	0	0	0
Activity 5	West Lunga	0	0	0
Activity 6	Zengamena II	0	0	0
Activity 7	Solar PV System	0	0	0
Activity 8	Biomass	0	0	0
Activity 9	Consultancy Services: Works supervision for grid extension	510 000	718 213	+ 208 213

<sup>11</sup> The European Community's contribution to the "Contingencies" heading may be used only with prior agreement of the Commission.

Activity 10	Consultancy Services: Works supervision PV, hydro, biomass feasibility	0	0	0
Activity 11	Service Contract: EIA for PV, hydro, biomass	0	0	0
Communications/Visibility		10 000	10 000	0
Contingencies <sup>12</sup>		907 341	577 195	- 330 146
External Evaluation		90 000	90 000	0
Audit		20 000	20 000	0
TOTAL		9 980 750	9 980 750	0

Rider 1 extended the final implementation date to 31 December 2013 and noted that any further extension required a justified request, including an evaluation and a comprehensive analysis of the programme, to be submitted to obtain the Commission's approval at least 90 days before 31 December 2013, effectively 1 October 2013.

### 3.2 Utilisation of Resources

#### Expenditure

Information related to expenditure was extracted from the monthly progress reports prepared and submitted by the project consultant. Progress reports between 7 March 2011 and 31 December 2012 are approved; those for the period 1 January 2013 to 30 April 2013 are drafts.

Table 4: Works Contract, December 2012

	Currency - €	Total
Contract Amount	€	8 275 666.15
Addendum 1	€	112 763.00
Addendum 2	€	89 240.72
Total	€	8 477 669.87
Disbursement (to 30 November 2011)	€	4 284 771.01
Disbursement (December 2012)	€	543 224.53
Total Disbursement	€	4 827 995.54
Contract Balance	€	3 649 674.33

Source: Progress Report 22, 1 – 31 December 2012

Table 5: Works Contract, April 2013 (Provisional)

	Currency - €	Total
Contract Amount	€	8 275 666.15
Addendum 1	€	112 763.00
Addendum 2	€	89 240.72
Total	€	8 477 669.87
Disbursement (to 31 March 2013)	€	5 275 507.73
Disbursement (April 2013)	€	0
Total Disbursement	€	5 275 507.73
Contract Balance	€	3 012 162.14

<sup>12</sup> The European Community's contribution to the "Contingencies" heading may be used only with prior agreement of the Commission.

Source: Progress Report 26, 1 – 30 April 2013 (Draft)

According to the April draft progress report, two IPCs could have been outstanding as no information had been received in respect of those submitted on 19 February (IPC 14) and IPC 15 was only submitted on 18 April.

Table 6: Service Contract

	Currency - €	Total
Contract Value	€	717 900.00
Disbursements (to 30 November 2012)	€	366 322.00
Disbursements (December 2012)	€	0
Contract Balance	€	351 578.00

Source: Progress Report 22, 1 – 31 December 2012

Table 7: Service Contract, April 2013 (Provisional)

	Currency - €	Total
Contract Value	€	717 900
Addendum 2	€	353 681.00
Total Value	€	1 071 581.00
Disbursements (to 31 March 2013)	€	394 163.16
Disbursements (April 2013)	€	0
Contract Balance	€	677 417.84

Source: Progress Report 26, 1 – 30 April 2013 (Draft)

As of the end of April, a total of two invoices in respect of the third and fourth interim payments were outstanding.

### 3.3 Programme Management

The documents spell out that the contracting authority for both works and supervision contracts would be the National Authorising Officer of the European Development Fund (NAO). The supervisor of those contracts would be the Rural Electrification Authority (REA), who would delegate authority in full as Supervisor to ZESCO Ltd. The Supervisor would delegate certain of his responsibilities to his representative, the Consultant selected for the supervision, but not the power to order additional works involving extra time and/or extra costs. The documents furthermore spell out that the Supervisor would appoint one of his staff in ZESCO as the Project Engineer, who would be the consultant's day-to-day contact person in ZESCO and in the in addition would be in charge of monitoring the supervision contract. Although the EUD informed the MTR Team that ZESCO has been fully involved from the start in the design and supervision of the two projects including planning for the commissioning of the projects, ZESCO admitted to a reduced supervision role basically involving attending client and site meetings on approximately a monthly basis. The MTR understands that this was a commercial decision by ZESCO and that REA has been providing per diem compensation to ZESCO's Staff to attend the site meetings.

#### EU Delegation (EUD)

The project has experienced a number of challenges, which were clearly identified in the ROM mission report [14 May 2010]:

“.....energy and electrification is not currently a focus area for the EU Delegation (EUD) in Zambia. The EC Energy Facility (ECEF) is managed from EC Headquarters in Brussels. The EUD lacks the time, resources and expertise to handle it. Additionally, the division of labour, competencies and responsibilities between the EUD and EC Headquarters are unclear. Consequently, the project has become an orphan and its implementation is seriously suffering from lack of support.”

While the ROM mission acknowledged the potential benefit from rural electrification, the foregoing critical gaps have continued and have expanded. The EUD has sought to address the lack of ownership through a dedicated Programme Officer.

The MTR team understands that ongoing EDF XI programming will result in Energy being a focal sector in the new programme. If this understanding is correct, it seems appropriate to ensure that the EUD possesses the requisite energy sector expertise in order to manage the proposed focal sector efficiently and effectively.

#### The Rural Electrification Authority (REA)

The appointed REA project manager, who was involved in the early stages of the project unfortunately passed away during a particularly difficult and turbulent period for REA, which resulted in ownership challenges experienced in REA. These have manifested in gaps in the appointment of dedicated personnel with responsibility for the project, resulting from staff turnover and departures overseas for study.

This was further aggravated by a considerable amount of project documentation not being entered into the REA archives, which made it difficult for the successor REA Staff to understand the project and what was required. During this period, REA lacked management of the supervision, lacked knowledge of EDF procedures and lacked understanding of how to interpret the contracts. REA even “lost” invoices for up to 2.5 months which caused delays in payments to the contractor and the consultant<sup>13</sup>.

At the time of the MTR, REA had appointed a dedicated contact point for the project, which has led to an improvement in supervisory responsibilities but the underlying human resource scarcity and ownership challenges remain<sup>14</sup>. In addition experience in managing EDF funded projects is still limited.

#### Programme Steering Committee (PSC)

The project implementation is experiencing serious delays. The financial agreement was signed on 10 March 2008 and the project officially started on 1 January 2009. The operational implementation period of the financing agreement was originally on 31 December 2013, but the NAO has requested an extension to DEL for two years.

Detailed designs and cost estimates for the three projects, Mumbwa Big Concession, TBZ farm Block and Lukulu Farm Block were only available by mid-2009. As the cost estimates indicated that the total project cost would be significantly higher than

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<sup>13</sup> The invoices that were misplaced (due to changes in management) have since been located and processed for payment.

<sup>14</sup> Comments received on the Draft Final Report highlighted that the REA has recruited more engineers to allow for adequate allocation of human resource to all projects being implemented by the Authority. The Authority appoints particular project managers to manage projects under the guidance of the Director of Technical Services who is the main project contract manager.

the approved budget, the Lukulu Farmblock grid extension project was dropped in order to maintain the cost within the budget. A consequent rider to the financial agreement was signed on December 2009.

Low interest necessitated re-launching of the request for expressions of interest for supervision works services and the supervision contract was eventually only signed 6 December, 2010. The works contract for the construction was signed the same day. Thus the contracts were signed just before the EC regulations deadline of 7 December 2010. Both contract had a starting date of 7 March 2011.

The documents comprising the works contract were contradictory with regard to capacity of main transformers, length of lines, and quantities. The PSC decided at the beginning of the project that the data and quantities stated in the BoQ would prevail. The Contractor later claimed for extra costs as “transformer platforms” and “transformer earthing” were not mentioned in the BoQ. These costs are still being debated.

It would seem that the PSC had prudently wanted a substantial initial Design Review by the Consultant, however the Consultant’s terms reference only stipulated that the consultant should as preliminary services acquainting his team with the formulation study (including all the technical annexes) and the detailed engineering design, the tender dossier with all the tender addenda and the tender submitted by the selected contractor. The consultant should and at the end of the review exercise prepare a brief design review report (Aide Memoire) on his findings and proposed recommendations. With a starting date of 7 March 2011 and many initial mobilisation issues, this report was only submitted in August 2011 and was discussed and decided upon in November 2011. If the Consultancy Contract had allowed time (approximately 3 months) for a substantial review, including site investigations to carried out prior to the contracting of the works contractor this would have allowed for many corrections of the Works Contract and the BoQ which would have avoided some of the subsequent problems with the works contract.

### The Consultant

#### Management

The Consultants tendered methodology spells out that he will ensure a strict conformity with the tender specification and the scope of work/supply of the contract. This he seems to have done so successfully that the Zambian authorities felt that the Consultant had been too obsessed and rigid in his interpretations of the wordings in the ToR and specifications. The Consultant’s fairly brusque communication style seems to have caused considerable frictions in his dealings with the Contractor.

The ToR calls for the Consultants staff to have working experience in EDF OR other international agencies procedures, but the Zambian authorities complained that some individuals had little experience of EDF’s specific procedures. Another complaint was that the Consultant had not followed the contractual requirements for replacing Staff, which had delayed such replacements.

#### Staffing

The Resident Engineer took up his assignment at the project start up of 7 March 2011, but the tendered Project Engineer (Electrical) and Project Engineer (Civil) were both replaced. As the consultant only submitted one *curriculum vitae* for each proposed replacement, not the required three, the process became entangled. REA issued a letter of acceptance on 24 May 2011 and the replacements were accepted, but on the understanding that this was an exception. The civil project engineer started on 17 June 2011 and the electrical project engineer on 12 July 2011.

The consultant's offer stipulated the need for social and environment expert[s] from the project's outset, a need underlined in the first progress report (31 March 2011) in which the consultant's organogram proposed two experts' names. Possibly because of not understanding EU programme requirements, the consultant only submitted one *curriculum vitae*, not the required three. As a result, the proposal had to be withdrawn and three CVs submitted for consideration by the Supervisor. In considering the three CVs, the Supervisor failed to follow the correct procedures (only one person evaluated the CVs) and this effort to recruit social and environmental expert(s) also failed.

In the event, a successful evaluation exercise was undertaken and one person was selected to fulfil both roles. He took up the STE post on 27 April 2012, over a year after the commencement of the project. Initially allocated 80 person days, these were subsequently cut back to 63. The MTR team is strongly of the view that the delay in appointment and the limited number of days available represent a major absence of appreciation of the critical role that social and environmental experts should play in all infrastructure projects. Arguably, had an STE been available to the Consultant from early in the project, the Contractor's failure to implement the EMP could have been avoided<sup>15</sup>. Furthermore, the number of days allocated to social and environmental activities is grossly inadequate. A social and environment STE is required throughout the construction activities of the project's life. This suggests a minimum 200 days, and preferably more, total input spread over the implementation period.

#### The Contractor

The contract for the works contract spells out that it is a contract between the NAO and Eltech Investments Limited & ZISMO Engineering Ltd Joint Venture (JV), ("the Contractor"), however Eltech Investments Ltd had signed the contract, supplied guarantees and received payments. The MTR Team was informed that all legal JV requirements in the tender dossier had been complied with authorising Eltech Investments Limited to represent the JV Eltech Investments Ltd and ZISMO Engineering in contractual matters<sup>16</sup>. Although for all practical purposes Eltech has acted as the Contractor, Eltech did not have sufficient experience for this type of projects.

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<sup>15</sup> For example, the Environment and Social Report notes that although the Contractor's practice adhered to some aspects of the EMP, site teams displayed no knowledge of its existence. As such, in the MTR team's view, this suggests that the Contractor is aware of the need to demonstrate sensitivity to the environment but that this only reflects some areas (e.g. avoiding servicing vehicles on site). Other aspects, e.g. negotiating access to and crossing of agricultural fields, warning road users of heavy traffic, etc., did not take place.

<sup>16</sup> In addition, the MTR Team was informed that the tender bid received from the Joint Venture was evaluated following requirements stipulated for joint venture evaluation in the tender documents

The contractor has failed to observe a number of contractual obligations ranging from using email instead of written communications, timely submit procurement schedule, cash flow prediction, programme of performance of the contract, advise about equipment ready for inspections, proper superintendence of the works, provide sufficiently skilled and experienced staff, to timely execute and complete the works itself. Although the contractual completion date is being considered, due to a number of Variations, to be extended to August 2013, the reality is that the project might take another year to be completed. The contractor seems to have been very naïve in some of his contractual undertakings, especially in procurements.

The situation is incredibly complex. By all accounts project completion (provided the Contractor “hangs on”) will be beyond any extension the Supervisor/Consultant is likely to allow based on strict interpretation of the contract and performance. What to do?

To change the Contractor would not seem a feasible option as most of the remaining uninstalled materials has been procured, is in the process of being procured or is stored at the Contractor. In addition to get another contractor would also take too long time for the current EDF time frame.

The MTR Team believes it has observed a general acknowledgement of a “collective responsibility” for the current state of affairs and an apparent willingness to forfeit the contractual penalties as long as the Contractor finishes the job. There is possibly a tacit understanding to that effect as the Contractor appears to be doing his “best” to complete the project.

The MTR Team agrees with the collective responsibility concept. It is obvious that the Contractor (Eltech) did not have sufficient experience of this type and size of project to be awarded the project on his own merits. His tender is likely to have shown this and that the “Joint Venture” was accepted only because of the additional information from the supposed J/V Partner ZISMO.

To get out of this fix, the MTR suggests that an “ex gratia”<sup>17</sup> extension of the contractual completion date without cost is accepted. This extended completion date should be set to secure completion.

## **3.4 Procurement**

### **3.4.1 Introduction**

Because of the failed tender exercise to recruit the Consultant, it was necessary to launch a second tender. The EU’s D +3 rule necessitated that this be launched concurrently with the tender for the Contractor. As a result, the Contractor was on the ground before the Consultant’s arrival, which impacted negatively of the necessity for a Design Review and the potential impact on procurement<sup>18</sup>. According to the

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<sup>17</sup> “Ex gratia” is given as a favour or gratuitously where no legal obligation exists.

<sup>18</sup> For example, the Design Review suggests that fewer transformers were necessary than was suggested by the project design and the tender documents to which the Contractor, and unsuccessful bidders, responded. While, in itself, this is not critical, it is for this reason that Design Reviews are required so as to inform the development of a Procurement Plan that responds to actual requirements

General Conditions of the Contractor's contract, the advance payment was due once a number of conditions had been met. *Inter alia*, these included an inferred requirement that the Contractor should provide a procurement plan. In fact the advance payment was made without any procurement plan.

Furthermore, despite the Contractor's contract making provision for price adjustment in the event of price movements after the expiry of the guarantee period, the contractor did not appear to appreciate what this meant.

The contractor procured most of the equipment at the start of the project, before the design review was completed and without securing the Supervisor/Consultant's concurrence, and this equipment had to be stored until required. In some cases the contractor was not allowed payment for certain stored equipment, which has impacted on his cash flow (essentially, the early procurement meant capital investment on which no return is possible until it is utilized on the project). Due to design changes it also appears that there are too many transformers.

### 3.4.2 Wood Poles

A classic example of this is the saga surrounding the procurement of wood poles for the line. The contractor contracted the Zimbabwean company, Allied Timbers, to supply the required 3 671 poles early in the project's life<sup>19</sup>. This contract proved problematic for other reasons as well. Allied Timbers required that payment of US \$288 741.00 be upfront, which the contractor paid. Subsequent rejection of deliveries (for insufficient creosote penetration and unidentified suppliers following the destruction of the Mutare factory, which had been subject to the FAT) resulted in alternative suppliers (CFC and Timberg) being sought. However, Allied Timbers had not refunded (at the time of the MTR) the contractor the payment<sup>20</sup>, which, although possibly not the major reason, has added to cash flow challenges experienced.

Throughout the project period up to the time of the MTR, the availability (or lack thereof) poles has negatively affected the project's implementation, so much so that by the end of May 2013, the erection of poles is 18 and 17 months behind schedule in Kaoma and Mumbwa respectively<sup>21</sup>. Based upon information provided in the Consultant's Progress Reports, Fig. 1 below, illustrates the delivery of poles and the numbers required throughout the project's life. It clearly demonstrates that supply and availability continues to negatively affect the achievement of the project's completion.

Fig. 1: Poles Delivered and Required

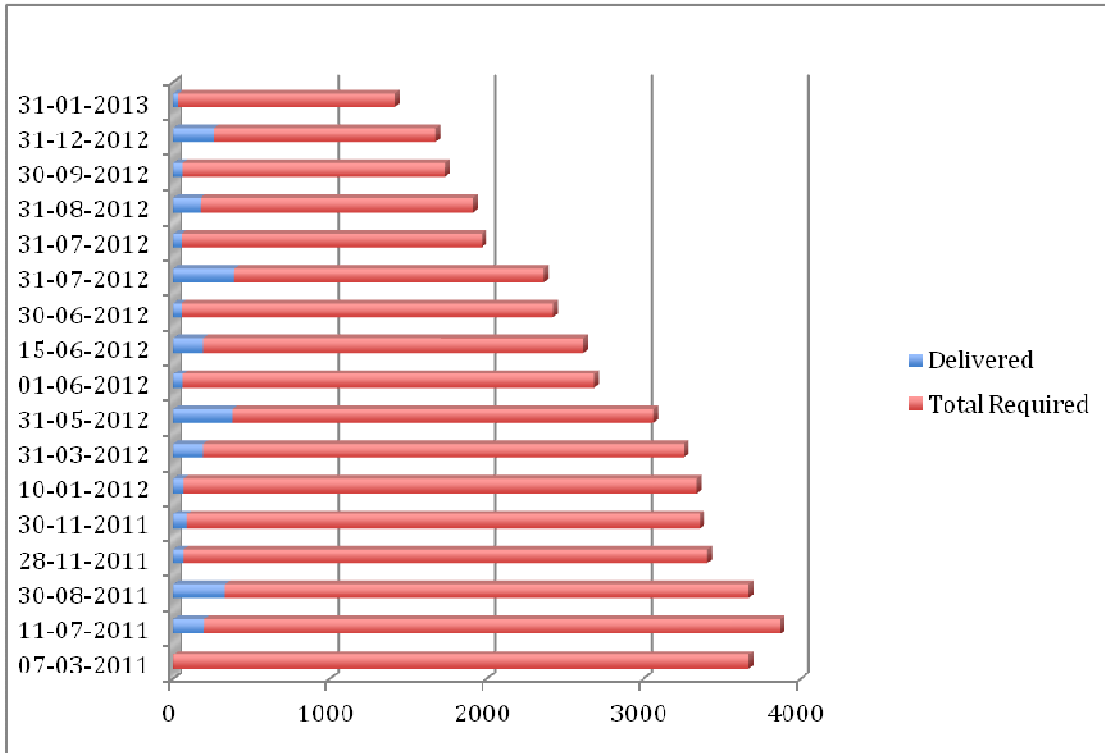
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and schedules the procurement of necessary inputs. The fact that the Contractor's and the Consultant's commencement date were so proximate to each other meant that the required Design Review was unable to inform the desirable, if undelivered, Procurement Plan.

<sup>19</sup> The precise date of this contract is unknown to the MTR team. However, the fact that the first delivery of 200 poles took place on 11 July 2011 clearly shows that negotiations were commenced and the contract price agreed and paid in full before this date. Furthermore, despite the need for a Factory Assessment Test (FAT) before any delivery, no such test was conducted before November 2011.

<sup>20</sup> The Contractor informed the MTR team that the repayment was being pursued through the courts, which will be a lengthy process.

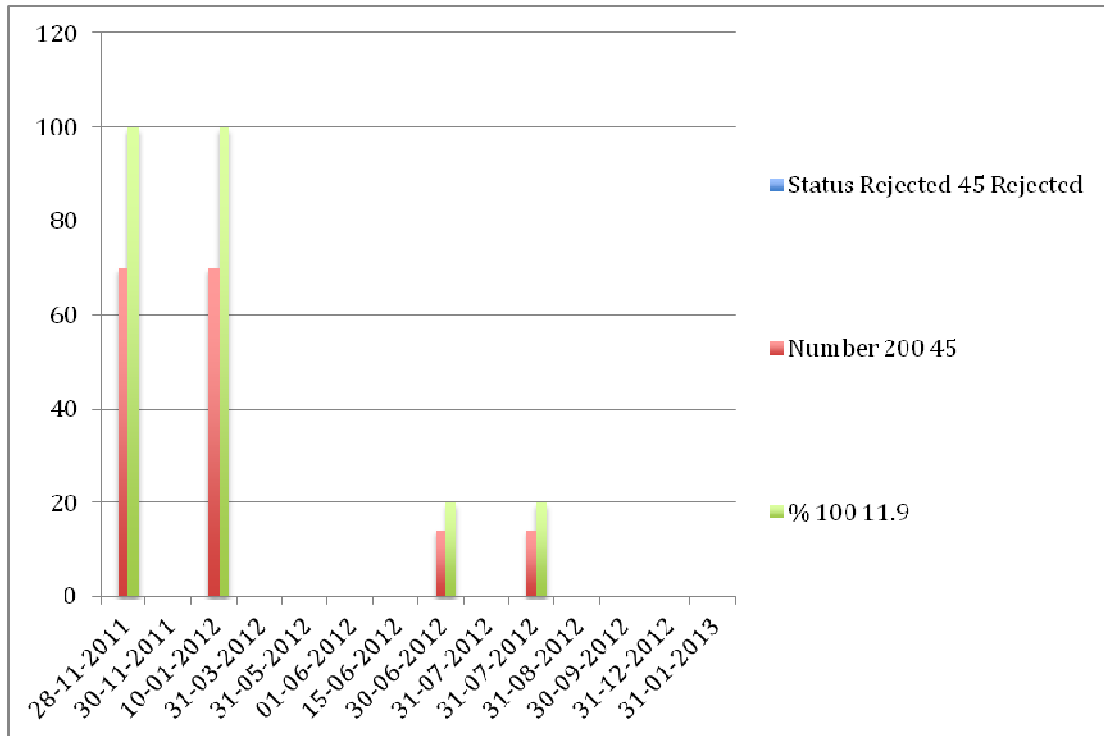
<sup>21</sup> Draft Progress Report, 1 – 31 May 2013.



Source: Progress Reports, 7 March 2011 – 31 May 2013 inclusive

The Fig. 2 below sets out the status of deliveries, identifying the rejection of deliveries on absence of source identification and quality grounds. These have added to the lack of poles required for the project’s completion. As of 31 May 2013, according to the Progress Reports, a total of 1 382 poles were still required; however, it was apparent from the Stakeholder’s Meeting (Mumbwa, 13 June 2013) that the Contractor was unsure how many poles he had available on site.

Fig 2: Status of Deliveries



The procurement of poles, and other supply challenges, has been an important cause of delays experienced by the project, which was projected to have been completed.

Fig. 3: General Delays against Plan: Kaoma and Mumbwa

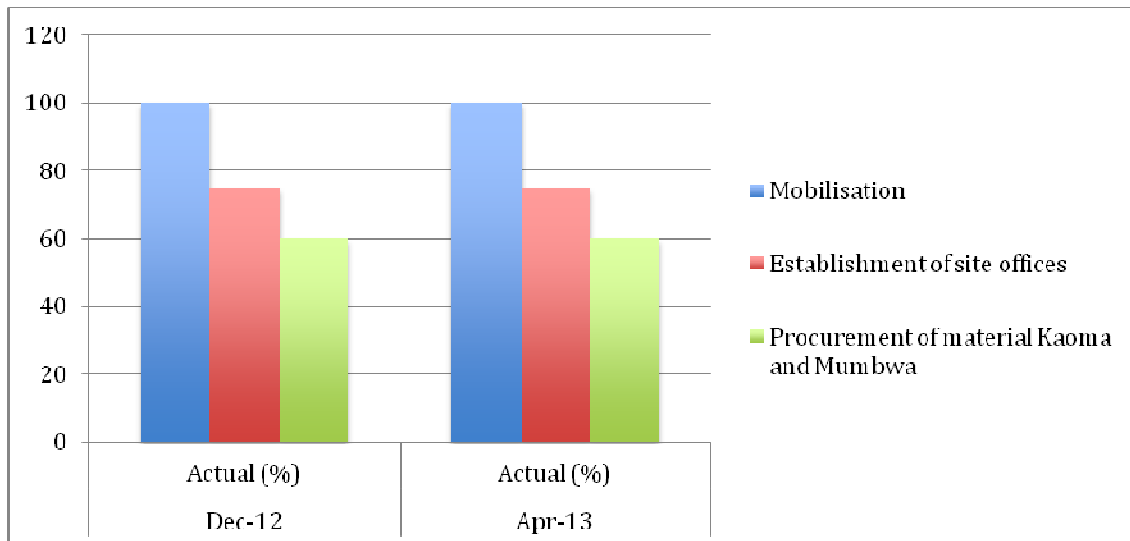


Fig. 4: Kaoma Delays against Plan

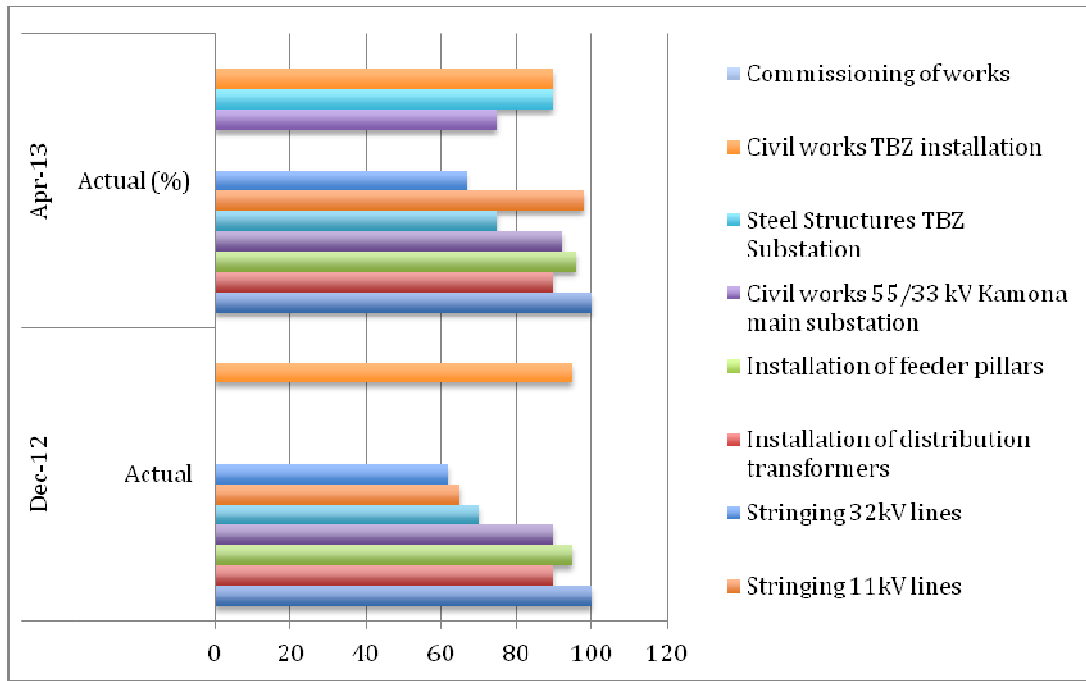
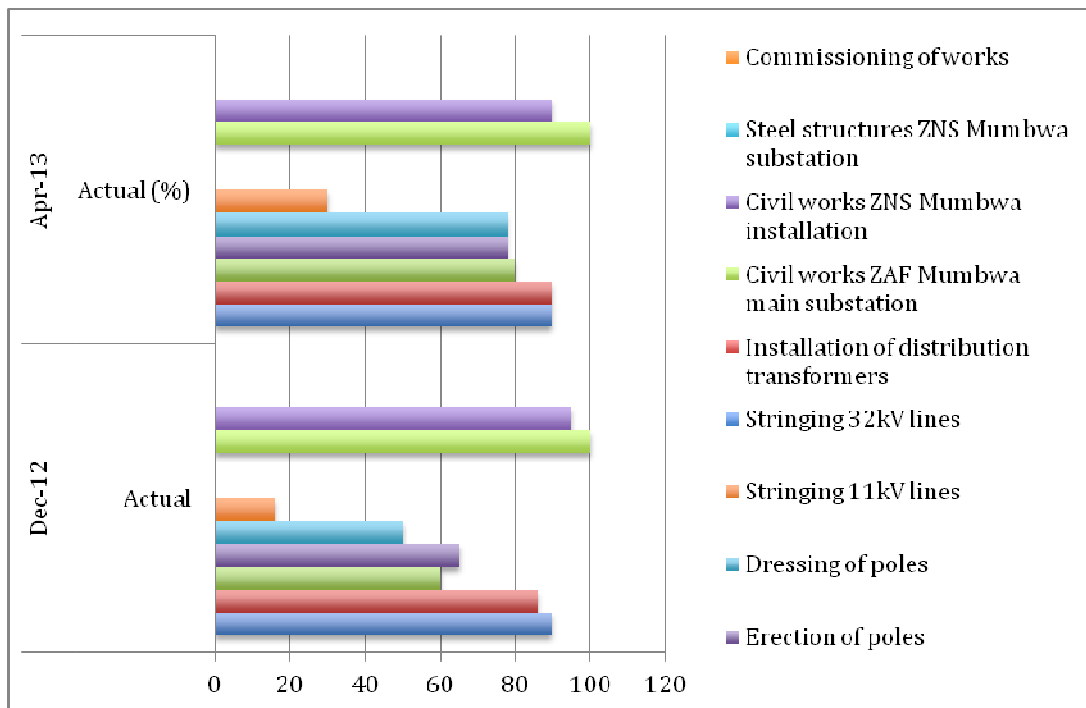


Fig. 5: Mumbwa Delays against Plan



### **3.5 Conclusions**

The project has under-performed due to lack of programme management support and foresight as well as underperformance by the Contractor. The contracting authority is the National Authorising Officer of the European Development Fund (NAO). The Supervisor is the Rural Electrification Authority (REA). Although the documents stipulate that REA would delegate authority in full as Supervisor to ZESCO Ltd, this did not eventuate, but a representative from ZESCO did participate in the Site Meetings.

The EUD lacked the time, resources and expertise to handle energy projects and, additionally, the division of labour, competencies and responsibilities between the EUD and EC Headquarters were unclear. In REA, there were gaps in the appointment of dedicated personnel with responsibility for the project, resulting from staff turnover and departures overseas for study. To address these issues, both the EUD and the REA have appointed dedicated project officers. In fact, the REA has recruited more engineers in an attempt to provide adequate allocation of human resources to all projects being implemented by the Authority.

The Consultant's strict adherence to the specification and fairly brusque communication style have caused considerable frictions in his dealings with the Contractor. Delays in replacement of key consultancy staff for 3 and 4 months and short term social and environmental expert for over a year is attributed to lack of knowledge of EDF rules.

The PSC has not managed to plan for necessary studies, designs and design reviews early enough to correct the project steering direction. The documents comprising the works contract were contradictory with regard to capacity of main transformers, length of lines, and quantities. Although the order of precedence in the contract and Tender Dossier was that design documentation (drawings) takes precedence over the BoQ, the consultants' Design Review Report dated November 2011, says that at the very beginning of the project it was decided that the data and quantities stated in the BOQ should prevail. The Contractor later claimed for extra costs for items not mentioned in the BoQ.

Although the works contract is a Joint Venture between Eltech Investments Limited & ZISMO Engineering Ltd., Eltech Investments Ltd has signed the contract, supplied guarantees and received payments. The MTR was informed that all legal JV requirements in the tender dossier had been complied with authorising Eltech Investments Limited to represent the JV Eltech Investments Ltd and ZISMO Engineering in contractual matters. Although for all practical purposes Eltech has acted as the Contractor, Eltech did not have sufficient experience for this type of projects.

The project has suffered problems with procurement of materials, e.g. incorrect material, incorrect quantity, delays and in some cases unnecessarily tying up the Contractors funds. The Supervisor/Consultant were by-passed because (i) the contractor obtained the 30% advance without providing a procurement plan and (ii) at the beginning of the project the contractor placed purchase orders for the entire scope of wood poles, transformers, and conductors, based on the Bill of Quantities without

requesting the approval of the consultant and REA/ZESCO. An example of the procurement problems is the procurement of wood poles for the line. The Contractor paid up front US\$288,741 for having all 3,671 poles delivered early, but had them rejected because of insufficient creosote penetration and unidentified suppliers following a fire in the FAT inspected factory and had to go to other suppliers without being reimbursed (at the time of the MTR) for the upfront payment.

Project completion is likely to go beyond any extension the Supervisor/Consultant is likely to allow based on strict interpretation of the contract and performance. To change the Contractor is not a feasible option due to the remaining EDF time and as the remaining uninstalled materials has either been procured, is in the process of being procured or is stored at the Contractor.

The MTR Team argues that because of a “collective responsibility” for the current state of affairs and the development context an “ex gratia” extension of the contractual completion date without cost should be accepted. This extended completion date should be set to secure completion.

## **4. EFFECTIVENESS**

In this section, we discuss the achievement of the programme's results.

### **4.1 Progress Achieved**

During a Site Meeting in Mumbwa on 13 June, 2013 the Contractor presented schedules of the project progress in Kaoma and Mumbwa. These spreadsheets have subsequently been slightly adjusted. Table 8 below shows the Contractor's estimated progress for the Kaoma TBZ Farmblock project. The Contractor assesses the percentage of total completion to 75%.

Table 8: Progress of Work for the Kaoma TBZ Farmblock Project, 21 June 2013

<b>ACTITVITIES</b>	<b>UNITS</b>	<b>BOQ ESTIMATE</b>	<b>TO DATE</b>	<b>% complete</b>
Primary Bush clearing	M	130000	130000.00	100.00
<b>33KV LINE CONSTRUCTION</b>				
Pole pits Excavations	Each	702	702.00	100.00
Pole Dressing (intermediate )	Each	498	450.00	90.36
Pole Planting (intermediate)	Each	498	450.00	90.36
H-Pole structures(dressing & planting)	Each	60	46.00	76.67
Stay Pits Excavations	Each	332	332.00	100.00
Stay Installation	Each	332	300.00	90.36
Line Stringing	M	60000	46000	76.67
Line Binding	M	60000	46000	76.67
Transformer Installation	Each	10	0	0.00
Feeder Pillar Installation	Each	61	0	0.00
D.O.F installation	Each	30	0	0.00
Auto Recloser Installation	Each	1	0	0.00
<b>11KV LINE CONSTRUCTION</b>				
Pole pits Excavations	Each	600	600	100.00
Pole Dressing	Each	514	514	100.00
Pole Planting	Each	600	600	100.00
Stay Pits Excavations	Each	52	52	100.00
Stay Installation	Each	52	52	100.00
Line Stringing	M	60000	60000	100.00
Line Binding	M	60000	60000	100.00
Transformer Installation	Each	50	0	0.00
D.O.F installation	Each	150	0	0.00
<b>MV LINE CONSTRUCTION</b>				
Pole pits Excavations	Each	110	110	100.00
Pole Dressing	Each	90	58.00	64.44
Pole Planting	Each	110	110	100.00
Stay Pits Excavations	Each	20	20.00	100.00
Stay Installation	Each	20	17.00	85.00
Line Stringing	M	10000	7000	70.00
Line Binding	M	10000	7000	70.00
Service Connections	Each		0	0.00
Metering	Each		0	0.00
<b>SUBSTATION CONSTRUCTION</b>				
<b>TBZ KAOMA</b>				100.00
<b>KAOMA MAIN S/S</b>				
Civil works				100.00
Transformer Installation				0.00

Source: Spreadsheets provided by Eltech Investments Limited 21 June, 2013

The MTR team assesses that the Kaoma TBZ project is 70-80% complete<sup>22</sup>. The 66/33 kV Kaoma Substation still requires the transformer and switchgear which has to be transported from Lusaka together with a crane. The TBZ 33/11 kV substation is somewhat further advanced. The MTR team believes that the Contractor's estimate of having this sub-project finalised within 2-3 months is overly optimistic and believes it could take up to the end of the year.

Table 9 below shows the Contractor's estimated progress for the Mumbwa Big Concession project. The Contractor assesses the percentage of total completion to 60%.

Table 9: Progress of Work for the Mumbwa Big Concession Project, 21 June 2013

ACTIVITIES	UNITS	BOQ ESTIMATE	TO DATE	% complete
Primary Bush clearing	M	205000	186485.00	90.97
<b>33KV LINE CONSTRUCTION</b>				
Pole pits Excavations	Each	2140	1642.00	76.73
Pole Dressing(intermediate)	Each	2140	1310.00	61.21
Pole Planting(intermediate)	Each	2140	1179.00	55.09
H-Pole structures(dressing)	Each	200	128.00	64.00
H-Pole structures (planting)	Each	200	170.00	85.00
Stay Pits Excavations	Each	1326	614.00	46.30
Stay Installation	Each	1326	579.00	43.67
Line Stringing	M	175000	87000	49.71
Line Binding	M	175000	87000	49.71
Transformer Installation	Each	94	0	0.00
Feeder Pillar Installation	Each	94	0	0.00
D.O.F installation	Each	12	0	0.00
Auto Recloser Installation	Each	8	0	0.00
<b>11KV LINE CONSTRUCTION</b>				
Pole pits Excavations	Each	60	5	8.33
Pole Dressing	Each	60	3	5.00
Pole Planting	Each	60	4	6.67
Stay Pits Excavations	Each	21	0	0.00
Stay Installation	Each	21	0	0.00
Line Stringing	M	20000	0	0.00
Line Binding	M	20000	0	0.00
Transformer Installation	Each	16	0	0.00
Feeder Pillar Installation	Each	16	0	0.00
D.O.F installation	Each	2	0	0.00
Auto Recloser Installation	Each	1	0	0.00
<b>MV LINE CONSTRUCTION</b>				
Pole pits Excavations	Each	259	88	33.98
Pole Dressing	Each	259	32.00	12.36
Pole Planting	Each	259	66	25.48
Stay Pits Excavations	Each	164	28.00	17.07
Stay Installation	Each	164	19.00	11.59
Line Stringing	M	10000	1850	18.50
Line Binding	M	10000	0	0.00
Service Connections	Each		0	0.00
Metering	Each		0	0.00
<b>SUBSTATION CONSTRUCTION</b>				
<b>ZAF Substation</b>				100.00
<b>ZNS Substation</b>				
Civil works				100.00
Transformer Installation	Each	1		0.00

Source: Spreadsheets provided by Eltech Investments Limited 21 June, 2013

<sup>22</sup> This assessment is based on the documents provided by the contractor, but does not allow for unknown complications in any contract variations not yet approved

The Mumbwa Big Concession Project is further behind than Kaoma TBZ and the MTR Team assesses that it is 50-60% complete<sup>23</sup>. The Mumbwa 88/33 kV substation is almost ready for connection. REA/ZESCO has yet to carry out a preliminary survey for the Northern Part of the Big Concession, which was not included in the original project. Again the MTR team thinks that the Contractor's estimate of finishing the projects in 4 months time is unrealistic and believes it will be well into next year.

## 4.2 Socioeconomic and Environmental Profile

As part of project preparation, a Zambian company (ASCO) was commissioned to prepare two project briefs. They submitted the reports in May 2008.

According to the 2010 Census, 61% of Zambia's population is rural.

Table 10: Central and Western Province Population

Province	Male	Female	Total	% of Total Population
Central	626 823	640 980	1 267 803	9.7
Western	416 885	464 639	881 524	6.8
Total	1 043 708	1 105 609	2 149 327	16.5

Source: Preliminary 2010 Census Report

Table 11: Population Growth Rate (%) 2000 – 2010

Province	Male	Female	Total
Central	2.1	2.5	2.3
Western	1.1	1.7	1.4
National	2.6	3.0	2.8

Source: *ibid.*

### 4.2.1 Kaoma and TBZ

#### 4.2.1.a Geography and Population

The project area, the TBZ, is located 70 km east of Kaoma, 15 km west of Kafue National Park and covers an area of 7 771 square kilometers. According to the 2000 Census, the total population of Nkema and the surrounding areas was 21 478; 80% of the population lived in the farming scheme. The population of Nkema ward was 21 478, of whom 50.9% were female.

#### 4.2.1.b Economic Life

Agriculture is the area's main economic activity. Because of the presence of tsetse fly, there is very limited cattle ranching. Crop agriculture is pursued by 58% of farmers, with mixed farming comprising 34.6% and livestock farming, 3%. Most agriculture is subsistence (68.8%) and only 2.6% is commercial. A larger group is categorized as emergent (19.3%), a mix of subsistence and commercial sales. The main crops are grains (maize, sorghum, millet and [some] rice), root crops (cassava

<sup>23</sup> This assessment is based on the documents provided by the contractor, but does not allow for unknown complications in any contract variations not yet approved

and sweet potatoes), and vegetables and beans. Commercial crops are tobacco (the main commercial crop), paprika, cotton and ground nut. Total output in 2004 was 11 600 tonnes, of which tobacco (2007) contributed 1 642 tonnes. Income from forestry-related activities (including charcoal production) was estimated at KR 97 000. Average income KW 301/month (for farms >30 ha) [SMEC 2007].

#### 4.2.1.c Social

##### 4.2.1.c.i Health

One health centre, the Nkema Rural Health Centre, serves *c.* 14 000 People. The centre has 10 female beds and four male beds. There is also a maternity wing; in the absence of electricity, night-time deliveries are carried out by torchlight. A second clinic, ZOTI Clinic, also serves the population. The morbidity profile is Malaria, Diarrhea (not bloody), Respiratory (not pneumonia), and STIs. The health center provides voluntary counselling and testing (VCT) and free anti-retroviral (ARV) distribution.; however they cannot use CD count machine so diagnosis has to be carried out at the district hospital.

##### 4.2.1.c.ii Education

Total enrolment was 39 752 enrolled, of whom 48.5% were girls. The literacy level (2000) was 56.5%.

##### 4.2.1.d Energy

The primary energy source is charcoal – 600 kg/household<sup>24</sup>. The underlying assumption is that an electricity connection will contribute to a reduction in charcoal/fuel wood use, which would have a substantial environmental benefit, although one with a direct cost to rural charcoal producers. However, media reports (Daily Mail, 3 June 2013) quoting a District Commissioner suggest that, in at least one district in Zambia, the introduction of pre-paid meters has resulted in increased charcoal consumption as users seek to minimize electricity costs<sup>25</sup>.

## **4.2.2 Big Farm Concession, Mumbwa**

### 4.2.2.a Geography and Population

Mumbwa is located 150 km west of Lusaka; the total area is 23 800 square kilometers, of which 47.1% are protected<sup>26</sup>. The Big Farm Concession established by the colonial government after World War 2 has a 40 km radius. It comprises 200 farms (*c.* 500 ha each) and two (ZNS Camp Kalenda and Chitumba Prison Farm) of 5 000 ha each. In 2000, the district's total population was 158 861, of which 50.2% was female.

### 4.2.2.b Economic Life

The main economic activities are fishing and subsistence farming. For the most part, agriculture is rain-fed agriculture except for those with fields in flood plains who are

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<sup>24</sup> SMEC (Australia): Priority Rural Electrification Projects (PREPs) Pre-Feasibility Report, TBZ Farmblock PREP Grid Extension Development, June 2007

<sup>25</sup> This may be an irrational response on the part of consumers but equally may reflect the reality that pre-paid meters require payment whereas consumers with illegal and other (post-consumption billed) connections may avoid payments.

<sup>26</sup> The ASCO Reports refer to “protected” areas, which the MTR has interpreted to mean “National Reserves”.

able to take advantage of flooding and recession of water. The principal crops are maize, beans (subsistence and small scale). Livestock ranching - cattle, goats, poultry, and pigs – is also undertaken. Fishing takes place along the Kafue River. Charcoal burning and some unskilled opportunities in small-scale mining also take place.

#### 4.2.2.c Social

##### 4.2.2.c.i Health

According to the socio-economic profile (2008), the area has one health centre, the district hospital in Mumbwa<sup>27</sup>, which is already connected to the grid. Like the TBZ project area, the principal causes of morbidity are malaria, diarrhea (not bloody), respiratory (not pneumonia) , and STIs. VCT and ARVs are available at the district hospital. There is also home-based care clinics provided by neighbourhood health care groups.

##### 4.2.2.c.ii Education

The project brief provided no information of the district’s educational profile.

##### 4.2.2.d Energy

As in the TBZ, the primary energy source is charcoal.

According to the SMEC PREP pre-feasibility study, the claimed socioeconomic and poverty reduction benefits of electrification are:

- Overall improvement in quality of life and well-being of households through providing opportunities to expand home-based businesses and provision of various health and education benefits
- Contribution to poverty reduction in the area
- Facility for village and household socioeconomic development, enhanced through construction/improvement of access roads to local markets
- Support to other projects (education, health, infrastructure, particularly roads and communication) that can improve the well-being of the target population and assist in poverty reduction
- Assist in the reduction of household vulnerability and provide opportunities to diversify income
- Support the enhancement of human resources – improve education and literacy levels

As noted, environmental benefits include an assumed reduction in firewood and charcoal consumption leading to less deforestation. However, if correct this would lead to loss of an income source for rural dwellers and there are some questions (e.g. the prevalence of charcoal use for cooking in Zambia’s urban centres) whether the assumption is correct.

### 4.2.3 The 2010 Position

Table 12: Mumbwa and Kaoma Districts Population Growth Rates

District	Male	Female	Total
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<sup>27</sup> According to subsequent information provided, there is also Nangoma Mission Hospital about 15km east of Mumbwa.

Mumbwa	3.1	3.4	3.2
Kaoma	0.8	1.2	1

Source: Preliminary 2010 Census Report

Table 13: Population Density 2010

Province	Persons/Sq Km
Central	13.4
Western	9.0
National	17.3

Source: Preliminary 2010 Census Report

In Mumbwa district, the population aged 18 or older totalled 85 378 people (44.8%); in Kaoma district, the total number of people aged 18 or over was 38 706 (47.5%). Average household size in the two districts has been estimated at 5.5 persons/household implying a total of 34 650 and 14 816 households in Mumbwa and Kaoma districts respectively. In Mumbwa and Kaoma districts, population density was 10.3 and 7.7 persons per square kilometer respectively clearly showing a widely dispersed, low density population, which poses clear challenges to the achievement of the connection targets in the EDF component.

#### 4.2.4 Project Benefits

At the time of the MTR socioeconomic benefits accruing from the project were limited. The clearest benefits related to employment created by the Contractor. Table 14 sets out the employment created and the additional monthly income resulting.

Table 14: Direct Project Employment (May 2012)

District	Category	Number	Rate/month ZMK <sup>28</sup>	Total – ZMK (Year)	Gender – % (Male)
Kaoma	Skilled	9	1 500 <sup>29</sup>	162 000	100
	Unskilled	58	700 (2012) <sup>30</sup>	487 200	99
Mumbwa	Skilled	4	1 500	6 000	75
	Unskilled	56	700 (2012)	470 400	100
Total	Skilled	13	1 500	234 000	100
	Unskilled	109	700 (2012)	915 600	99.5

Source: Contractor's timesheets and statutory minimum wages

In effect, the employment created appears likely to have improved the quality of life for approximately 600 people, assuming that the unskilled workers employed from local communities, are heads (or members) of households. In addition, local purchases of goods (diesel, food stuffs, other supplies) would have impacted positively on the local economy. However, the contractor experiences cash flow challenges and these benefits are likely to have been less than they might otherwise have been.

<sup>28</sup> Minimum wages (and allowances) for general workers (as well as some other categories) are stipulated by GoZ and do not appear to be regionally adjusted:

(<http://www.mywage.org/zambia/main/salary/minimum-wage/minimum-wages-general>)

<sup>29</sup> Steel Fixer (February pay sheet)

<sup>30</sup> <http://www.mywage.org/zambia/main/salary/minimum-wage/minimum-wages-2012>

It is evident that on completion and energizing of the line, there will be other social benefits accruing from the electrification of GRZ institutions, the schools and clinics, the ZNS camp and the Open Prison. Table 15, below, outlines the number of schools and clinics to be connected to the grid.

Table 15: Schools and Clinics Scheduled for Connection

District	Schools	Health Centres/Clinics
Kaoma/TBZ	<b>11</b> Mangongi, Nkeyema Basic School, Nkeyema High School, Kalale, Mundia, Nalumino, Kakwanda, Mwilo, Longe, Kamakokwe, Chazema (private school)	<b>3</b> Longe, Nkeyema, Namilange
Mumbwa	<b>9</b> Basic Schools Kanshinka, Kabwanga, Big Concession, Kitumba, ZNS, Kimilambo, Kaindu, Mpusu, Kulumaziba, Kimilambo???	<b>5</b> Kabwanga, Kimilambo, Kaindu, Mpusu, ZNS
<b>Total</b>	<b>20</b>	<b>8</b>

Source: Consultant

As we explain below (Section 4.6.i), the benefits accruing from this will affect the entire communities served by these institutions.

#### 4.2.5 Contribution by Social and Environment STE

The STE's task comprised reviewing the contractor's adherence to the Environmental Management Plan (EMP) and recommended social mitigation exercises. As part of this, the STE prepared three reports, *viz.* the Environment and Social Report [June 2012], the Reconnaissance Mission Report [June 2012] and the HIV/AIDS Activities Report [June 2012]. In essence, the reports determined that the Contractor had paid limited attention to the EMP (essentially following good practice) and had done nothing to address social mitigation, including HIV/AIDS sensitization, issues. The STE informed the MTR team that he had facilitated HIV/AIDS sensitization for the Contractor's workforce and surrounding communities<sup>31</sup>. Subsequent to the reports finalization and the sensitization workshops, his focus is on monitoring the contractor's compliance with the EMP. To this end, he has prepared checklists of actions undertaken.

The MTR team reviewed the original Environmental Project Briefs for Kaoma – TBZ and Mumbwa [ASKO, May 2008] as well as the Consultant's STE's three reports. A considerable part of all the reports consists of a 'cut and paste' exercise between each. The Environmental Project Briefs do not comprise an environmental and social impact assessment; they more resemble a selection of information from other sources, much of it duplicated in respect of both project areas, and a [very] limited socioeconomic profile of the two project areas. The STE's updating of the environmental and socioeconomic information is inadequate; for example, despite the preliminary 2010 census results being available from 2011, the updated reports continue to use 2000 census data used in the ASKO briefs.

<sup>31</sup> According to information from the Provincial AIDS Coordination Advisor, the Consultant's STE approached the Mumbwa District AIDS Task Force with a request for assistance. The Task Force prepared a proposal and budget, after which there was no further contact with either the STE or the Contractor.

Furthermore, the STE selectively interprets primary data (HIV/AIDS Activities Report]. For example, he acknowledges that there is overwhelming knowledge that HIV/AIDS in Zambia is caused primarily by sexual activity. He, then, reports the results of two questions relating to how else one can contract the disease, which points up two misconceptions shared by a substantial minority in the project areas, *viz.* through sharing food with an infected person and through mosquito bites, and concludes from this that further sensitization as to the causes of HIV/AIDS infection is necessary. While the MTR team shares the view that ongoing sensitization of communities is desirable and necessary, it is of the view that the underlying reason for these misconceptions rests in the widespread fear of the disease, and the accompanying ostracizing of sufferers. Breaking down the social barriers confronting HIV/AIDS sufferers is a far more critical reason for ongoing sensitization and, arguably, requires a different approach to achieve the required end.

If this analysis is correct, then the sensitization exercise carried out with support from the District AIDS Teams and NGOs, targeting the contractor's respective workforces, largely missed the boat<sup>32</sup>. Focused on ensuring understanding of the causes of HIV/AIDS, at best they reinforced existing knowledge<sup>33</sup>. Neither has the contractor followed this training up with practical actions; at neither site, was evidence observed of the availability of free condoms, which are readily available from Government hospitals.

The MTR team also checked the Contractor's procedures in respect of Health and Safety and adherence to the EMP on site. Individual forms in respect of both areas exist and are available in the site offices. According to information provided to the MTR team, the respective forms are completed as necessary (daily i.e. the EMP) and submitted to the Contractor's head offices in Lusaka, copied to the Consultant. The Consultant confirmed the latter in respect of Health and Safety issues, in particular accidents, but noted that the information frequently arrived late.

#### **4.2.6 Government and Civil Society Views**

The team sought the views on the likely impact of electrification in the project areas from key informants. Both sets of interlocutors emphasised that increased to electricity was necessary and a highly positive development. The delay – communities were first promised electricity was coming in 2006<sup>34</sup> – has caused considerable frustration, accompanied by rising levels of disbelief. Nonetheless, demand for electricity access has continued to rise in areas where it is already accessible and, in those areas still without, there is evidence of increasing impatience.

##### **4.2.6.i. Civil Society Organisations**

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<sup>32</sup> The Mumbwa District AIDS Task Force Manager confirmed that the team's focus in sensitization and education programmes is to ensure understanding of the causes of and appropriate preventative measures to deal with the virus. There is no focus on addressing issues of sufferers' experience of ostracisation until responding to home-based care for AIDS sufferers.

<sup>33</sup> There is evidence from a number of countries that knowledge does not necessarily change behaviour, particularly given the well known resistance to using condoms demonstrated by African men.

<sup>34</sup> Followed by REA community mobilization teams working in the districts to establish community-based project committees, comprising representatives of all stakeholders, *inter alia*, traditional leaders, churches, education professionals, NGOs, and local administration.

The MTR team interviewed two Kaoma-based NGOs, Concern and World Vision, on their perceptions of the potential benefits accruing to the districts' communities. Connecting schools and clinics was regarded as highly positive. For example, connected clinics, which have maternity facilities, will be able to provide better maternity services once they have light. At present, deliveries after dark are done by torchlight. Similarly, clinics will be able to store vaccines on site, rather than having to travel to clinics, which have electricity, before embarking on vaccination drives.

Zambia's adult literacy drive is conducted through schools, adult learners paying for the service. At present, this limits both the time available for adult literacy classes and the numbers that can be reached. With electricity, both time and numbers will increase providing a useful and appreciated service to adult community members while providing a useful additional income stream to benefitting schools.

Furthermore, since many school children's family background is poor (some cannot afford candles or paraffin for lighting, the number of hours available for academic study is determined by daylight hours. If schools have electricity, after-school study periods (e.g. 16.00 – 19.00 or 20.00 hours) are possible and will contribute to improved student performance in exams, increasing their chances of gainful employment.

Possibly the greatest advantage of the planned electrification is in Nkeyema and the TBZ generally, which currently have no banking facilities and limited retail outlets. As such, residents have to travel to Kaoma to meet their banking requirements and to stock up on supplies, both agricultural and consumer. With the advent of electricity, it is expected that the town's economic activity will expand and that banking services will be introduced. Having said this, there is a potential negative impact on Kaoma's economic life: as services multiply in Nkeyema, this is expected to negatively affect existing suppliers in Kaoma as business falls off.

#### 4.2.6.ii. District Commissioner

The old Kaoma district has been split into two, TBZ area having become a new district called Nkeyema, since the project was designed. As such, the project has very limited benefit to the newly defined Kaoma district since eight schools and five clinics within the 15 kilometre corridor<sup>35</sup> along the line have been excluded from the benefit of free connection and electrification<sup>36</sup>. The district's population has expressed strong criticism of the lack of benefit accruing to Kaoma's communities, accusing the district

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<sup>35</sup> According to the DC, REA policy is that all government institutions within a 15 kilometer corridor along the line should be electrified. REA has informed the MTR team that the District Commissioner is mistaken and that no such policy exists. However, REA acknowledges that some Government institutions have been excluded from the project's benefits and has plans to budget for their inclusion with effect from the next (2014 – 5) Financial Year.

<sup>36</sup> All Government institutions excluded as project beneficiaries will have to meet the connection costs themselves. What this means for schools and clinics is that they will have to put in a budget request for the following year in respect of these costs to their respective responsible Ministries, Ministry of Education and Health. In ZESCO's experience, most schools and clinics meet connection costs through a combination of parents' and the MP's Constituency Development Fund contributions. Such resources are necessarily limited; for example, the 13 Government institutions excluded from the project are all in Kaoma constituency so it is unlikely that the constituency development fund would be adequate to support the connection of all 13 in the first year of the project.

commissioner of having failed in his responsibility to maximize benefits to the district. The DC reports that he has made numerous unsuccessful enquiries with REA, including the CEO, for the reason the schools and clinics have been excluded from the project's benefits. He is concerned with the fact that TBZ communities will evidently benefit, while very few Kaoma communities will (e.g. only those schools within 200 metres of the line).

#### **4.2.7 Transept Drives**

##### **4.2.7.i Transept Drive, 12 June: TBZ**

In the course of the scheduled site inspection, the MTR team joined the Consultant and contractor's representatives on a transept drive from Nkeyema following the line to rejoin the main road outside the town for approximately 35 minutes.

In Nkeyema township, the team observed that a new construction of shops/retail outlets with rooms behind was under construction. The new building had already had electric conduits installed (on the right of illustration), suggesting that the presence of the line encouraged the builder to have the basic requirements for easy wiring installed.

Fig. 6: New Business Premises under Construction

Business premises (small retail outlets and bars) line both sides of the main road. There are no financial institutions (the nearest being in Kaoma, one bank and an ATM) or agri-service organisations (again, the nearest are in Kaoma). As a result, Nkeyema's and TBZ residents have to travel to Kaoma for banking services, agricultural inputs and most consumer products. The average taxi fare is KW 40 return.

In the course of four visits to the township, business was observed to be slow, except in the bars, where, judging by the number of patrons, it appeared brisk. It seems likely that once the line is electrified that businesses will connect and there could be new investment (particularly agri-outlets and financial institutions). This is expected to impact negatively on Kaoma's business community, particularly on the shops located along the town's access road.

The team's observations, in the course of the transept drive, led to their conclusion that few TBZ households appear likely to connect to the installed power supply when it is available<sup>37</sup>. In the course of the entire drive, four houses were observed to have satellite disks and three had solar panels installed. There were three schools, one of which was a boarding school, which will be connected. While it seems obvious that

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<sup>37</sup> Putting to one side observation-based conclusions in this regard, ZESCO's tariff structure is itself a disincentive in this regard. The cheapest household consumption tariff (R1 – up to 100 kW: post-paid) is KR 152/kWh. (ZESCO, Revision of Electricity Tariff). The pre-paid meter (ZESCO's preferred means of connection) tariff rate is KR 278.33/kWh, but proposed to be KR 381.31/kWh.

there are health facilities<sup>38</sup> in the area, which also will be connected, none were observed.

Most of the households observed in the course of the transept drive were wattle and daub, thatched structures; others were mud structures with flat corrugated iron roofs.

Fig. 7: Housing along Transept Drive

A few were four (or more) room structures. One tractor, with both front tyres flat, was observed, suggesting that the property's resident possibly was experiencing cash flow challenges, or believed it made sense to leave repairs until the start of the rain-fed agricultural season later in the year (October/November).

Based upon the team's observations, they are of the opinion that there is a real question over the potential number of connections in this primary project area; this observation is compounded by the requirement that household connections share equally the cost of the requisite transformer with ZESCO; obviously, the more connections, the lower the individual cost of this. The consultant's best estimate is that there will be a maximum 500 connections in the Kaoma – TBZ district areas, not least because there are very few actual structures in the TBZ farm bloc.

ZESCO Kaoma is quietly confident and has requested additional human resources to cope with the expected additional workload arising from the projected new connections in the TBZ area. The utility is of the view that in the first year following electrification, there will be 100 connections at best, most of these being of commercial premises<sup>39</sup>. Nor does the utility expect to achieve break-even point in the first three years, although, based on recent experience in Kaoma<sup>40</sup>, it believes that the rate of connection will increase rapidly once the first connections are made. However, a key constraint remains the dispersed rural TBZ population, which will ensure that the rate of connection will be slower than that experienced in Kaoma town.

#### 4.2.7.ii Transept Drive, 13 June, Mumbwa Big Farm Concession

The team joined the stakeholders and contractors site visit to the Mumbwa Big Farm Concession, following the line from the sub-station to the ZNS camp and on to Amatheon Agri farm and beyond to Mpusu Basic School, for an approximate total 70 kilometres distance. A number of observations both indicate the potential for connections but also cast doubt on their actually occurring in the short-term.

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<sup>38</sup> Government institutions (schools and health centres) will be connected. The tariff under which they will be charged for consumption is KR 284.89/kWh or a fixed monthly charge of KR 49 402.79. There is no clarity over where responsibility for consumption resides.

<sup>39</sup> Commercial connections cost KW 2 400.

<sup>40</sup> Currently, approximately 60% of residential properties in Kaoma have connected to the grid since 2004 with the pace of connections picking up as time passed and potential customers witnessed the greater reliability of supply since the replacement of the old diesel generators. In 2013, residential connections have increased by between 20% and 60% over the previous year. ZESCO predicts that the rapid expansion will continue for the foreseeable future, although as 100% coverage approaches the rate of connection will necessarily fall off.

Approximately 10 minutes from the sub-station on the main road, a site has been designated for the construction of a new township, Nsenge. Although no actual development, including no plots having been marked out, is underway, the potential exists for the construction of houses already wired for electricity connections. Given the proximity of the line (approximately 200 metres from the outskirts of the proposed township), connections can be assumed at some future point.

The route then follows through the outskirts of Mumbwa itself where existing connections were observed, which suggests that existing demand from the area has already been largely met. In any event, given that the area is already electrified, the newly constructed line is an irrelevance in this area.

Subsequently, observation indicates that housing is principally wattle and daub, thatched structures to which ZESCO will not connect and, in any event, the householders appear unlikely to have the necessary resources, even at the subsidized individual rate of KR 150, to meet connection fees or, alternatively, are likely to have other expenditure priorities.

Fig. 8: Housing observed in Course of Transept Drive

Along the line to the spur leading to the ZNS camp, turn-offs to two mixed farms (cattle and maize) were observed, strongly suggesting that this is a relatively low-density area.

The ZNS camp, located on a spur access road to the right of the main route, has a population of 114 households (single and married quarters), a school; the camp commander estimates that the average household size is 4.5 persons (reflecting the mix of married and single quarters), a total camp population of 513 people. (He was unable to estimate the number of children or the total school population; however, given it is a four classroom block and average teacher – student ratios are 1:58, this suggests a school age population of *c.* 232 – 45.2% of the camp's total population.) The camp also farms a considerable area (5 000 ha), producing maize and soya principally. At present agriculture is rain-fed and produces a single crop a year; electrification will allow irrigation, possibly increasing the number of crops a year to three. This will increase income to the camp and, ultimately, the national Department of Defence. The commander informed the MTR team that the whole camp will be electrified, building on the existing wiring for the administration block and officers' quarters. The camp's clinic, built with support from World Vision, serves the area's total population of *c.* 9 000.

Including the ZNS camp's school, a total of four schools were observed in the course of the drive, bring the total of government institutions to be connected through the programme to five.

Amatheon Agri has already connected to the main line, having done this at its own expense. There is obviously considerable investment that has already been made in the farm's productive potential – substantial water pumping and storage for irrigation purposes supported by substantial diesel generators. As such, the farm's productive potential appears to have been maximized already and connection to the grid will achieve lower production costs but not any decrease in capital investment (the generators will have to remain as back up in the event of load-shedding by ZESCO) or increase in employment is a capital-intensive operation. It is difficult to identify any significant poverty reduction impact for expediting the farm's connection, the main achievement of which will be to increase the rate of return on an international investment.

The consultant's best estimate of the total number of household connections in Mumbwa that will be achieved is 200. ZESCO Mumbwa informants suggested a far higher number, up to 500 in the first year after handover. In the MTR team's view this is grossly over-optimistic: there are only 202 farms in the Concession in total [200 of 500 ha each and two (the ZNS Camp's farm and the Open Prison farm) of 5 000 ha each. Furthermore, it seems unlikely that individual farmers will wire and connect their workers' housing at their own expense and farm workers are notoriously under paid so will have very limited disposable income to meet costs of wiring, even if accommodation is suitable.

### **4.3 Conclusion**

The MTR team assesses that the Kaoma TBZ project is 70-80% complete. The 66/33 kV Kaoma Substation still requires the transformer and switchgear which has to be transported from Lusaka together with a crane. The TBZ 33/11 kV substation is somewhat further advanced. The MTR team believes that the Contractor's estimate of having this sub-project finalised within 2-3 months is overly optimistic and believes it could take up to the end of the year.

The Mumbwa Big Concession Project is further behind than Kaoma TBZ and the MTR Team assesses that it is 50-60% complete. The Mumbwa 88/33 kV substation is almost ready for connection. REA/ZESCO has yet to carry out a preliminary survey for the Northern Part of the Big Concession, which was not included in the original project. Again the MTR team thinks that the Contractor's estimate of finishing the projects in 4 months time is unrealistic and believes it will be well into next year.

If variations now on the table are approved, the contractual completion date moves to August 2013. Discussions are on-going on how to deal with Contractors Claims and variations estimated to EUR 621 000.

According to the TAP, the EDF component was

....to provide sustainable electricity services to 7,000 rural households<sup>41</sup> and 16 schools and rural health centre in target rural areas. The project is expected to contribute to improved productivity and income levels and improved social service delivery systems in order to facilitate the achievement of the MDGs.

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<sup>41</sup> Subsequently revised downward to 6 800 in Rider 1.

At the time of the MTR, neither of the expected results had been achieved; nor, in the opinion of the MTR team are the expected household connections likely within a year of the immediate conclusion of the project. Nor should this be surprising, since the major focus of the project is the construction of a backbone with a 20 year time horizon, which will facilitate ongoing connections into the foreseeable future. Given this, no judgement is possible regarding the expectation that electrification will lead to increased economic activity, which will contribute to poverty reduction in the targeted areas. While the MTR team believes that the assumption is logical, should farmers take up the opportunity, there is at present no evidence to suggest that they will in sufficient numbers to make a significant impact on poverty levels in the target areas.

Nor, does the MTR team believe that occupants of 500 ha farms or international investments qualify as poor. Connecting them may help them increase productivity, but unless it also results in substantial new jobs, this will not reduce poverty. Electrification may contribute to poverty reduction but this is a function of equitable access; this project does not address this, instead depending of the World Bank-financed subsidy scheme for connections. Should this not be extended beyond the current completion date (December 2013), even fewer connections can be expected since fees will rise 1 133% over the subsidized rate.

On the other hand, the MTR team is confident that with the project's completion the 16 targeted GoZ institutions will have been connected. As noted, this will have a positive effect on the quality of pupils' learning and, possibly, on improved adult literacy along with an increase in the schools income streams from this source. Similarly, health services will improve; a reliable power supply will enable the Nkeyema Health Centre, for example, to operate its CD count equipment improving sexual health services to the TBZ population. Furthermore, lighting will improve maternity services, possibly contribution to the MDG goals in relation to infant and maternal mortality.

There are also questions surrounding the expected main environmental benefit, a reduction in deforestation arising from a reduction in charcoal use. However, as pointed out, if successful, any reduction will have a negative income effect on rural residents. Furthermore, there are questions whether the assumption is correct. As a result, the achievement of this benefit is questionable.

As such, the MTR team is of the view that the EU should commission an *ex post* evaluation of the EDF-funded project component at least five years after its completion to determine the achievement of the expected results and their contribution to the expected outcome, poverty reduction.

## **5. IMPACT**

Impact assesses the contribution of the results achieved to achieving the expected outcome (project purpose or immediate objective). Assessing impact at this point in time is difficult as clear evidence is not evident prior to the programme's completion.

However, it is expected that the projects will provide:

- High quality electricity supply, and thus potential for economic development & the advantages of a diversified production system.
- Contributions to a more efficient use of resources by improving the efficiency of energy usage by farms and rural households and reducing the consumption of fuel wood, charcoal and other air polluting sources
- Improved service delivery – education and health
- Improved educational performance – access to longer study periods
- Increased income stream for schools – adult literacy
- Improvements in maternal and infant mortality (MDGs) – night time deliveries in light

## **6. SUSTAINABILITY**

### **6.1 Technology**

The level of electrification in rural Zambia is low, with less than 2% of the rural households having access to electricity. One of the key barriers to accelerating access is the high cost of connections, arising, *inter alia*, from the use of outdated, unsuitable, high-cost methods in electricity networks. A second key barrier is the small and dispersed nature of electricity demand, arising from low density of population and low income levels, which lead to high average costs of providing electricity service.

The MTR Team suggests that REA for future projects should consider reducing the high costs of electrification by using documented and proven, low cost methods and techniques in electricity networks that have become used in different countries in sub-Saharan Africa, although not yet in Zambia. We are highlighting some of the possible techniques below.

#### 33kV vs. 11 kV

REA/ZESCO use the conventional 33 kV and 11 kV distribution system where 33 kV represent the transmission feeders and the 11 kV the distribution network. This system is today considered outdated and expensive and many countries have already moved away from using 11 kV. Cost savings could have been achieved by omitting the 11 kV lines especially where 33 kV and 11 kV lines are running in parallel.

#### ABC Technology

The low-voltage lines are 50sqmm bare conductors. Today an increasing number of countries have migrated their low-voltage networks in rural areas to overhead lines with insulated twisted cables (Aerial Bundled Cables, “ABC”) mounted on the poles. Maintenance is cheaper, non-technical losses by illicit consumption are non-existent, and extension of the low-voltage system is easier as no safety distances to obstacles have to be considered. However, the ABC technique itself is slightly more expensive.

#### Single-phase vs. three-phase grid extension

Single phase grid extension is commonly used in many developing and some developed countries as well. The main reason for selecting a three-phase line rather than single-phase is increased efficiency for transmitting power as well as the ability to serve three-phase loads. However, single-phase, instead of three-phase, networks are likely to be adequate in many situations, with the design permitting upgrading to three-phase in the future. Customers who want to run high-powered three-phase motors could be served by using phase converters.

Three-phase equipment is generally more efficient, less expensive, and more readily available than the single-phase equivalent. Single-phase power supply is adequate for most domestic appliances, whereas three-phase would be beneficial for farms, hospitals, workshops and home industries. Single-phase Single Wire Earth Return (SWER) technology is typically 20 – 60% cheaper than 3-phase, whereas 2-wire systems are somewhere in between 3- phase and SWER in both cost and transmission capacity.

A comment received on the Draft Final Report highlighted that although low cost electrification methods might be considered by the REA, it would be subject to agreement with ZESCO, the national power supply utility, as the REA hands over all grid extension electrification projects to ZESCO for operation and maintenance.

#### Three-phase supply required because of balancing problems

The ZESCO Manager in Kaoma declared that ZESCO does not encourage single phase supply because of the problems with balancing the phases. He then went on to say that even when customers only need single phase supply they will run out three phase.

This is not an unusual argument, but balancing the 3 phases only requires staff to go into the field and do some simple corrective measures. The solution is to get portable meters and measure loads on each phase and realign consumers evenly between phases. Experience shows that very often the linesman connects consumers on the bottom line as this is the most convenient. This means that this phase becomes overloaded and the top line is quite under loaded. Sometimes 'special customers' are connected to the under loaded top phase to get better voltage. Frequently supervisors and managers do not make the simple effort of correcting the situation, which could result in the transformer burning out simply because one phase is overloaded and others are under loaded.

#### Earth wire on 33 kV line

Many countries have omitted the earth wire on their 33 kV OHL.

## **6.2 Institutional Sustainability**

Rural electrification projects must be institutionally viable. Projects are institutionally viable when they have adequate organization and funding for operation, maintenance and follow up.

These projects will be owned and managed by the national utility, ZESCO. This is the most common institutional model for operation of grid extensions and is considered an efficient and relevant model for ownership, operation and maintenance. However, this model is more challenging for distant rural areas that may not receive the necessary attention in a large organisation. Part of the reason might also be that national tariffs do not cover the cost of supply.

The ZESCO manager in Kaoma had requested extra staff and resources<sup>42</sup> to deal with maintenance and operation of the new project and was confident he would receive them as well. We also understand that ZESCO Mumbwa had requested extra resources from ZESCO HQ in Lusaka. In view of this, the team feels that ZESCO will have capabilities to manage the operation and maintenance of the project.

## **6.3 Economics**

### **Tariffs**

It is often a challenge for power utilities to balance financial sustainability with

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<sup>42</sup> 1 electrician, 1 linesman, 5 casuals and 1 vehicle

expanding grid coverage. Experience shows that grid extension to rural areas can easily over-stretch the resources of the responsible national utility and become an economic burden. Although ZESCO for a long time had tariff levels far below the cost of service levels, recent tariff adjustments have been relatively substantial. There is currently public consultations on the tariff application ZESCO submitted in August 2012, refer Annex 6. The cumulative inflation in Zambia over the last nine years was 121% while the cumulative average retail adjustments amount to 93.3%

Table 16: Inflation vs. Tariff Adjustments 2003-2011

	2003	2004	2005	2006	2007	2008	2009	2010	2011	Cum
Inflation	20%	17.5 %	15.9 %	12.7 %	8.9%	16.6 %	10.1 %	10.2 %	7.2%	119%
Approved tariff adjustment	5.3%	0%	11%	0%	0%	16%	35%	26%	0%	93.3%

Source: ZESCO Limited Revision of Electricity Tariffs, 10 August 2012

The 2007 Pre-feasibility study for the TBZ project indicated an EIRR between 17%-24% under the various scenarios. The financial return was dependent on subsidies, tariff increases, load growth and demand growth, but the financial analysis<sup>43</sup> mentioned that the tariffs (2007) would have to increase at 5% p.a. for a zero NPV result with no Bulk Supply Tariff and 9.5% for a zero NPV result with a Bulk Supply Tariff, which the recent migration to cost-reflective tariffs seems to have achieved.

### Affordability

This raises the question whether customers afford the new tariffs? The residential R1 “Life Line” tariff for less than 100kWh/month is K152/kWh. The next residential step R2, for consumption between 101-300kWh/month is K250.70, but proposed to rise to K343.46. Residential pre-paid tariff is currently K278.33, but proposed to rise to K381.31. The social services tariff is currently K239.40, proposed to rise to K284.89 and the current fixed monthly charge is K41,515.95, proposed to become K59,213.88.

### Connection Fee

A cost recovery based connection fee usually constitutes a main barrier to customer connections as it is often high compared to income levels in the local population. Experience shows that poorer household often have both the ability and the willingness to pay for electricity consumption, but not for the connection fee. Affordability of electricity is clearly a key issue in the rural areas of Zambia. A high connection fee, in particular, is a main barrier for the many low income households.

ZESCO’s current connection fee for a basic one-phase Standard Connection is K769,000 (or about US\$175). This includes the drop-wire and meter. The cost to build the necessary sub-transmission and distribution infrastructure is estimated at about US\$500-600 per customer, and is entirely financed by ZESCO. Although the connection fee is only a fraction of the overall costs, it nevertheless is a barrier to low income households to get connected.

<sup>43</sup> The numbers of consumers; tariffs; interest charges; capital expenditures, formulated financial projections, incorporating predicted consumer growth and electricity consumption rates in the analysis have not been analysed.

The current connection fees for residential customers are in three categories and prospective residential customers were expected to pay the connection fee within three months of the quotation from ZESCO:

<u>Customer Category</u>	<u>Capital Contribution (ZMK)</u>
Demarcated Areas (peri-urban)	769,000.00
Un-demarcated Areas (site & service)	1,709,000.00
Low density Areas (high cost townships)	2,800,000.00

Generally, the ERB's Distribution Licence template (Chapter 2, Section 2.4) states that charges levied for all connections should reflect the costs of making the connection and shall be based on the methodology for calculating costs approved by the ERB.

There is a need to look for new ways to make connections more affordable. This could include targeted subsidies or a variety of deferred payment options when a connection fee is paid over time, pre-financed directly by the utility/service provider or through cooperation with a microfinance institution. ZESCO has already started innovative schemes:

#### ZESCO's deferred connection payment scheme

ZESCO has now increased the time within which these customers can pay the fee whilst allowing them to be given the service. The customer is allowed to pay his/her connection fee over a period of 36 months through electricity purchases on a prepayment metering system.

In order to be eligible for the scheme a prospective customer should fall within the above three categories and all premises connected on the scheme will be on the prepayment metering system. A ready board is to be made available for customers who cannot afford the house wiring cost.

#### ZESCO's Malaiti oye! program

ZESCO has also introduced a program to connect households for K150. Under this connection subsidy program, priority is given to customers in demarcated areas who are within reach of a service line drop as follows: (a) Grid Extension Areas done under the Rural Electrification Authority (REA), (b) Grid intensification areas selected under the Increased Access to Electricity Services (IAES) project, and (c) Other ZESCO selected target areas. The connection comes with a meter and/or ready board (if the house is not wired) plus 6 free CFL lamps. Connection will be done within 30 days after making the payment.

#### **Effect of Projects on Zambia's Total Annual Electrical Energy Consumption**

One question received on the Draft Final Report was, considering the current load shedding, what effect the connections of the projects would have on the energy consumption.

To illustrate the magnitude of the effect, the MTR Team has chosen to re-capitulate the 2007 pre-feasibility study of the TBZ Farmblock. SMEC assessed the average domestic household electricity consumption to 190 kWh/month. This was derived

from an estimation of the proportions of domestic consumers in three consumption categories.

- 60% of consumers less than 200 kWh/month, assume 150 kWh/ month
- 40% of consumers 201 – 300 kWh/month, assume 250 kWh/month
- 0% of consumers at 400 kWh/month

This gave an average consumption rate of 190 kWh/household/month. SMEC then assessed the energy consumption for the TBZ project, taking account of the various consumer categories, refer the Table below.

Table 17: Energy Consumption Assessment TBZ Farmblock

Category	Number of new customers	Tariff type	Total Peak load kW Before diversity 50%	Average Consumption kWh/month Load factor 40%	Total Energy Consumption kWh/month
Households	3,000	Domestic	3,750	190	570,000
Hammer Mills	19	Commercial	285	2,160	41,040
Businesses, commercial	50	Commercial	75	216	10,800
TBZ offices	14	Commercial	70	720	10,080
Boreholes	20	Commercial	150	1,080	21,600
Schools, clinics, churches, training centre	25	Social	250	144	36,000
Hospitals	0	Social	0	0	0
Farms, 30 acres	500	Commercial	2,500	720	360,000
Farms, 90 acres	100	Commercial	1,500	2,160	216,000
Totals	3,728		8,580		1,265,520

Source: Pre-feasibility Report, TBZ Farmblock PREP, June 2007, SMEC

SMEC arrived at a total energy sales per year of 15.2 GWh. With a total Zambian consumption of 8,420 GWh, the TBZ project represented an increase of 0.18% in the total annual electrical energy consumption for Zambia. The MTR Team believes that the above number of new customers is too optimistic, so the increase is likely to be lower than that.

## 6.4 Productive Use

The rural population in many cases lack knowledge of modern energy services, and this is a major barrier to realise more of the potential from provision of electricity. Two of the most important barriers to productive use of electricity are the lack of technical knowledge/ skills of potential users, and the lack of financial means to acquire relevant electrical equipment. REA's rural electrification projects focus on connecting public institutions and existing businesses. The projects have to a lesser

degree targeted the specific productive and social sectors and focused on strengthening these.

Experiences from other countries' rural electrification interventions suggest that rural electrification should be integrated with plans and strategies for local business development to maximize positive income generating effects. Although experience also shows that positive effects from electrification will materialise after some time without complementary initiatives, it is a passive and uncertain approach to wait for effects to trickle-down. Lack of cross-sector focus results in suboptimal effects on economic development and poverty reduction.

## **6.5 Conclusions**

### **Technology**

The MTR Team suggests that REA for future projects should consider reducing the high costs of electrification by using documented and proven, low cost methods and techniques in electricity networks that have become used in different countries in sub-Saharan Africa, although not yet in Zambia.

Cost savings can be achieved by omitting 11 kV lines, especially where 33 kV and 11 kV lines run in parallel. Aerial Bundled Cables has less maintenance and non-technical losses by illicit consumption and extension of the low-voltage system is easier as no safety distances to obstacles have to be considered. Single-phase, instead of three-phase, networks are likely to be adequate in many situations with customers requiring high-powered three-phase motors served by using phase converters. Single-phase Single Wire Earth Return (SWER) technology is typically 20 – 60% cheaper than 3-phase, whereas 2-wire systems are somewhere in between 3-phase and SWER in both cost and transmission capacity. Many countries have omitted the earth wire on their 33 kV OHL.

### **Institutional Sustainability**

Rural electrification projects must be institutionally viable. Projects are institutionally viable when they have adequate organization and funding for operation, maintenance and follow up. These projects will be owned and managed by the national utility, ZESCO, and the MTR team feels that ZESCO will have capabilities to manage the operation and maintenance of the project.

### **Economics**

It is often a challenge for power utilities to balance financial sustainability with expanding grid coverage. Although ZESCO for a long time had tariff levels far below the cost of service levels, recent tariff adjustments have been relatively substantial. The 2007 Pre-feasibility studies indicated acceptable EIRR and FIRR assuming the tariffs increased at 5% p.a. for a zero NPV result with no Bulk Supply Tariff and 9.5% for a zero NPV result with a Bulk Supply Tariff, which the recent migration to cost-reflective tariffs seems to have achieved. This raises the question if customers can afford the new tariffs.

A cost recovery based connection fee usually constitutes a main barrier to customer connections as it is often high compared to income levels in the local population.

Experience shows that poorer household often have both the ability and the willingness to pay for electricity consumption, but not for the connection fee.

ZESCO now allows customers to pay connection fees over a period of 36 months through electricity purchases on a prepayment metering system. ZESCO has also introduced a special program to connect households for K150, but this runs out in December, 2013.

**Productive use**

REA's rural electrification projects focus on connecting public institutions and existing businesses. The projects have to a lesser degree targeted the specific productive and social sectors and focused on strengthening these. Experiences from other countries' rural electrification interventions suggest that rural electrification should be integrated with plans and strategies for local business development to maximize positive income generating effects.

## **7. RECOMMENDATIONS**

1. Ensure that the EUD has the appropriate skills and expertise to deal with energy infrastructure.
2. Ensure, in all future similar projects, that the appointed Consultant is on site at least two months in advance of the Contractor
3. Ensure that a Design Review is completed and available before the Contractor is on site.
4. Ensure that the Contractor has prepared an approved Procurement Plan before any advance payment is made.
5. Ensure that (a) social and environment expert(s) are in post from the start of actual implementation. Ensure that there is an adequate allocation of time (minimum 200 days) available for such inputs.
6. Noting that the REA has recruited more engineers for the projects it implements, ensure that the Supervisor has nominated a contact point for the project's life.
7. Ensure that the Contractor appoints a responsible site-office based individual to respond to the requirements of the EMP and SMP.
8. Commission an ex post evaluation of the project at least five years after completion to assess achievement of the EDF-component's results and their contribution to expected outcomes.
9. Approve an 18 month no-cost extension to enable the Contractor to complete the works.