Report No: ACS17091

Republic of Mozambique
Mozambique Energy Sector Policy Note
Energy Sector Policy Work

November 30, 2015

GEE01

AFRICA

Document of the World Bank

Acknowledgements

This Policy Note was prepared by a core World Bank team led by Mustafa Zakir Hussain (Senior Energy Specialist) and including Isabel Neto (Senior Operations Officer), Mariano Salto (Energy Economist), Ewa Klimowicz (Energy Consultant) and Marial Meer (Program Assistant Temporary). Analytical support was provided by Frontier Economics Limited, London. Important inputs were provided by World Bank staff including: Pedro Antmann (Lead Energy Specialist), Vladislav Vucetic (Lead Energy Specialist), Atsumasa Sakai (Energy Specialist), Alexander Huurdeman (Senior Gas Specialist), Enrique Blanco Armas (Senior Economist), Julio Revilla (Program Leader), Carlos Da Maia (Consultant), Chris Trimble (Energy Specialist), Sudeshna Banerjee (Senior Economist) and Thomas Buckley (Country Program Coordinator). The team wishes to acknowledge strong partnership with the IFC country team: Marcel Bruhwiler (Principal Investment Officer), Joseph Rodriguez (Principal Investment Officer), Carla Faustino Coelho (Senior Investment Officer) and Richard Warugongo (Senior Investment Officer). Peer reviewers were Vivien Foster (Practice Manager), Richard MacGeorge (Lead Infrastructure Finance Specialist), Sameer Shukla (Senior Energy Specialist) and, at concept review stage, Franz Gerner (Lead Energy Specialist). Overall guidance and management review was provided by Lucio Monari (Practice Manager), Mark Austin (Program Leader) and Mark Lundell (Country Director). This work was part-funded using ESMAP S-TAP funds allocated to Mozambique under the Sustainable Energy for All program.

During preparation of this Note, the team benefited from meetings with the Mozambique Ministry of Mineral Resources & Energy, EDM, FUNAE, CNELEC, and representatives in Maputo of the Royal Norwegian Embassy, SIDA and the European Union. Inputs were also received from AfD, KfW, JICA and the European Investment Bank. A draft of this document was discussed with the Mozambique Ministry of Mineral Resources & Energy, EDM, FUNAE and the Energy Sector Working Group during October and November 2015.

Abbreviations and Acronyms

AC	Alternating current
AFD	L'Agence Française de Dévelopment
CAGR	Compound annual growth rate
CAPEX	Capital expenditure
CDB	China Development Bank
CFO	Cash flow from operating activities
CMH	Companhia MoCambicana de Hidrocarbonetos, SA. (Mozambican company of Hydrocarbons, S.A)
CNELEC	Conselho Nacional de Electricidade
CTRG	Centrale Termica Ressano Garcia
DBSA	Development Bank of Southern Africa
DFI	Development Financing Institutions
EPC	Engineering, procurement and construction
EBITDA	Earnings before interest, taxes, depreciation, and amortization
EDM	Electricidade de Mocambique
ESKOM	Electricity Supply Commission
FOCF	Free operating cash flow
FUNAE	Fundo de Energia
GBV	Gross book value
GoSA	Government of South Africa
HCB	Hidroelectrica de Cahora Bassa
HVDC	High voltage direct current
IDA	International Development Association (of The World Bank)
IPP	Independent Power Producer
LNG	Liquefied Natural Gas
LV	Low voltage
MT	Mozambican Metical
MV/HV	Medium voltage/high voltage
NBV	Net book value
O&M	Operations and maintenance
PPA	Power Purchase Agreement
SAPP	Southern African Power Pool
SE4All	Sustainable Energy for All
SEB	Swaziland Electricity Board
SGCC	State Grid Corporation of China
SHS	Solar home system
SRF	Strategic Research and Forecasting
STE	Sociedade Nacional de Transporte de Energia
STIP	Short Term Investment programme
WtP	Willingness to pay

Executive Summary

The objective of this Policy Note

- This Note is intended to support the Government of Mozambique in determining priorities for policy decisions with the aim of delivering efficiently produced, technically and financially sustainable electricity supply to the Mozambican population.
- To support the development of recommendations, this Note includes simulation analysis based on the current finances of the sector. EDM's corporate financial model was adapted for this work. Targets for electrification are based on discussions with government officials. EDM's current generation pipeline and its timing was taken as a given in order to simulate investment needs and evolution of sector finances under various tariff and funding availability assumptions. The various simulations and the broader sector quantitative and qualitative discussion should support policy formulation and prioritization going forward.

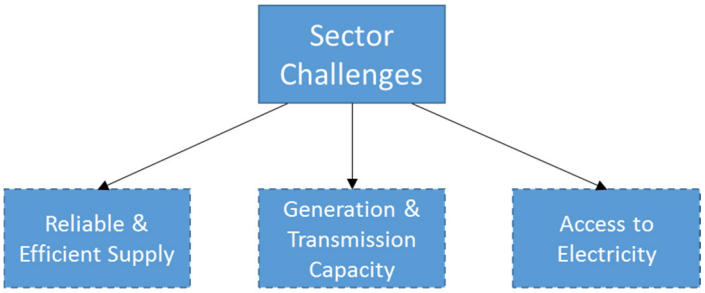
The energy sector in Mozambique

- Mozambique has a small electricity system (approximately 680 MW installed capacity normally supplying the system) that has developed on the margins of important regional projects such as the Cahora Bassa hydropower plant (1977), the Mozal aluminium smelter near Maputo (2000) and the Sasol-run Pande/Temane gas processing and pipeline project (2004). Despite EDM carrying out major electrification in recent years, mostly in urban centers, the system still needs significant refurbishment and expansion if it is to enable Mozambique to develop in an inclusive manner and meet the economic potential suggested by its mineral resource wealth.
- In particular, the power system has developed as three separate systems (although the northern and central systems have some interconnection). The transmission system does not cover all areas of the country. For instance power to the Maputo region from Hidroelectrica de Cahora Bassa (HCB) is delivered from South Africa. In large parts of the country that it does reach, it lacks resilience. In addition, while the distribution network has reached all administrative centers, the system has large gaps without a power grid - contributing to the difficulty in increasing access to electricity.

Challenges in the sector

- Currently, the power sector in Mozambique faces three key challenges: i) to provide **Reliable and Efficient Electricity Supply** to its customers; ii) to cope with the increase in the electricity demand from its current (and future) customer base by expanding its **Generation and Transmission Capacity**; and, iii) to provide **Access to Electricity** to the vast majority of the population.

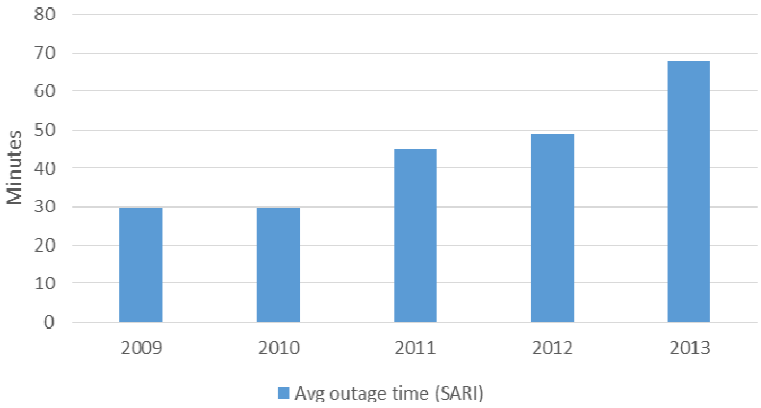
Figure 1: Power Sector Challenges in Mozambique



Reliable and Efficient Electricity Supply:

- The physical condition of the system is poor, with frequent breakdowns and high rates of electricity losses (approx. 23.2% in 2014). There were over 59 hours of transmission interruptions in 2013[1] with the average interruption time increasing from 30 minutes in 2009 to 68 minutes in 2013. This is also caused in part because EDM lacks the technical staff to cope with the regular operation and maintenance of the grid[2] at the same time as working on a new connections program.

Figure 2: Average interruption time in HV network (in minutes)



Source: EDM, Resenha Histórica 2009-2013

- The maintenance and overhauling of the grid is constrained by the financial situation of EDM. Its audited accounts show that the cash flow from operations is insufficient to maintain the system and fund the current capital expenditure program. The evidence suggests that EDM is foregoing important maintenance work that would normally form part of operating costs.

- EDM is very much dependent on external funding for investment, including government and donor support. EDM's ability to raise money in commercial settings remains limited and the cost of doing so is high (loans from local banks are supplied at approximately 14% per annum). It is very likely that this high cost of debt funding from local banks relates to credit concerns and underlying tariff and operational uncertainty.

[1] EDM, Resenha Histórica 2009-2013, p17.
[2] Nordic Consulting Group, January 2014. Evaluation of Sida financed interventions for increased access to electricity for poor people, with case studies in Tanzania and Mozambique

- EDM is also financially constrained due to a significant amount of debt relative to its earnings. In 2013, EDM's current ratio was very close to 1 and the debt service coverage ratio below 1, indicating that EDM's operating income is insufficient to meet its debt repayments and interest costs.

Generation and Transmission Capacity:

- Going forward, significant growth in electricity demand is expected due to growth in industrial and commercial activities and broader increases in access to electricity. In 2014, peak demand was 831MW[3] and growth has averaged over 11.6% per annum over the past 5 years.[4] Demand for electricity, as measured by billed energy including exports, has risen by over 9% per annum on average for the last 5 years and is expected to continue to increase rapidly in future.
- The country is well endowed with natural resources for power generation, including certain large renewable energy projects – namely the 1,500 MW Mphanda Nkuwa hydropower project and the North Bank extension to Cahora Bassa (additional 1,245 MW) that could provide least cost power for the country and the region. However, to improve its resilience, coverage and/or to be able to export more power, the transmission system also needs to be extensively refurbished and expanded.
- The cost of refurbishment and expansion, especially in relation to increasing electricity access, is high. The following table sets out a base case estimate of costs to meet a potential government target as set out in a draft Energy Strategy, for 50% access to the grid by 2023.

Table 1: Master Plan transmission and distribution investment program (meeting 50% access target by 2023)

US$(2012) million	2014-2017	2018-2022	2023-2027	Total
Transmission	838	921	763	2,521
Distribution	955	1,756	2,242	4,953
Large projects	514	60	2	576
Special projects	95	37	0	132
Total	**2,401**	**2,774**	**3,006**	**8,182**

Source: Norconsult, Master Plan Update Volume III April 2014 Table 14-1, adjusted by EDM for timing and adjusted by consultants to the World Bank to reflect additional new connection costs and based on the use of lower cost engineering solutions known to World Bank staff. In addition, some of the special projects are assumed to be private sector financed and therefore have been removed.

Note: Large projects include load dispatch centres, Tete-Malawi Interconnection project and Temane Transmission; Special projects include equity investments in JV projects.

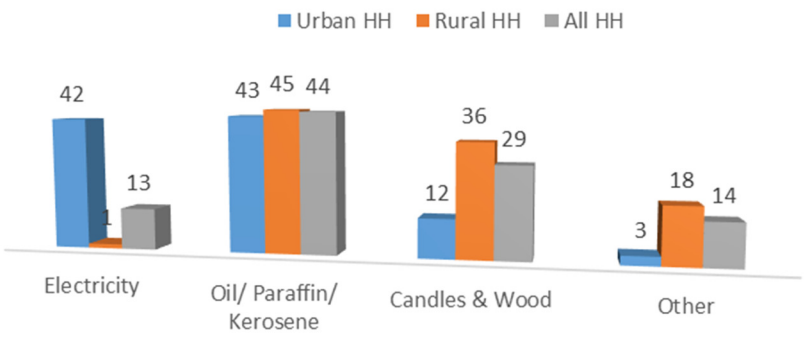
Access to Electricity

- Without an effective government policy for electrification, electricity access is currently low and mainly focused in urban areas. By the end of 2014, only 25.2% of the households had access to the grid. Only a fraction of the population chooses electricity as their energy choice for lighting. Most are in urban areas. However, the vast majority (70%) of Mozambique's population lives in rural areas and a very small proportion of these consumers use electricity for lighting (only 1.3% of rural households) (see Figure 3).

[3] Excluding the demand from BHP Billiton's Mozal Aluminium which is supplied by Eskom (import).

[4] EdM, Statistics Report, December 2014. The system peak of 831MW occurred on 15 December 2014.

Figure 3: Percentage of households using different fuels for lighting



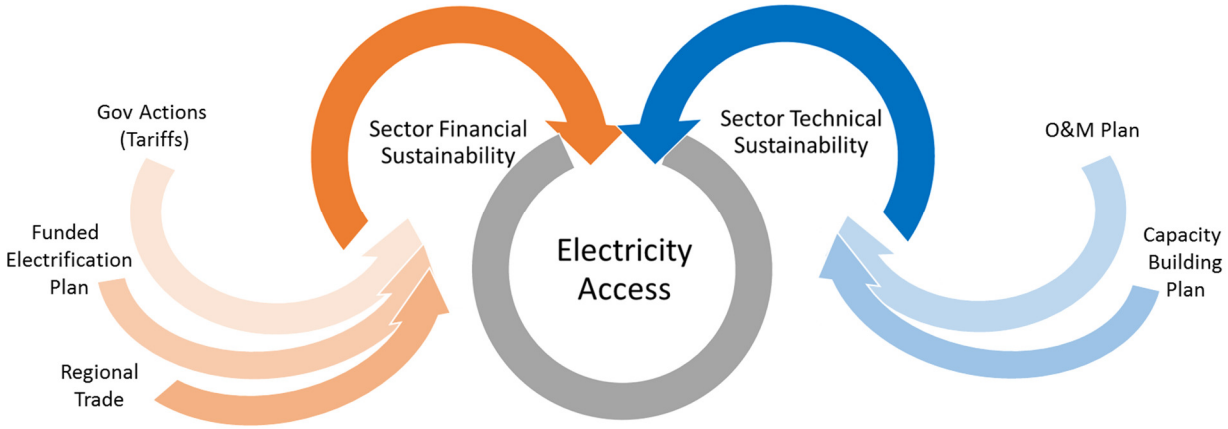
Source: World Bank

- The Government of Mozambique in its latest 5 year government plan (Plano Quinquenal 2015-2019) has clearly highlighted the need to promote – *inter alia* – agricultural and industrial development as the basis for the socio-economic development of the country. Chief in achieving this objective, as recognized in the plan, is the development of the necessary infrastructures in the power sector to promote the development of value adding activities in such sectors.

Options and Solutions

- Mozambique has inter-linked areas to focus on: levels of access to electricity among the population and the financial and technical sustainability of the sector, with the latter also contributing to the financial health of the power sector.
- The financial sustainability can be addressed by government actions, developing a fully funded national electrification plan and development of regional trade. The technical sustainability can be achieved by developing and funding an operations and maintenance plan and by implementing a capacity building program that allows EDM (or other stakeholders) to efficiently develop technical interventions in the grid.

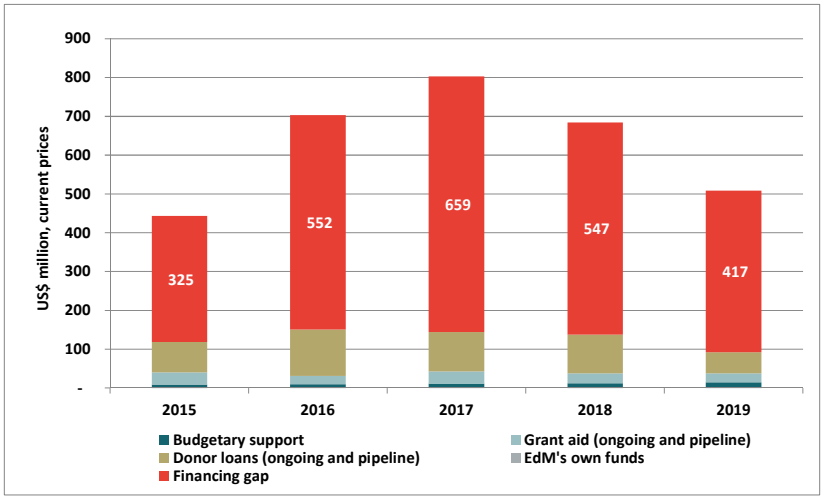
Figure 4: The key sector issues are inter-linked



Improving access to electricity

- To date, increasing access has been treated by government as part of EDM's regular operating activities. However, based on analysis in this Note and experience from other countries, there is a need for the government to take a more proactive approach to funding access related investments. The size of investments involved are simply too large. The red bars in the figure below show the annual funding gap if Mozambique is to reach 50% access to the grid by 2023. This takes full account of all other sources of funding available.

Figure 5: Financing gap to meet EdM's investment needs and 50% access target by 2023[5]



Note: This scenario considers a 25% tariff increase in 2015, budgetary support at the level of 0.05% of Mozambican GDP and 50% access target being met by 2023; it also assumes ongoing and pipeline donor loans and grants which effectively reduce the remaining financing gap (please refer to Annex 6 for a list of ongoing and pipeline loans and grants); 'financing gap' is the additional funds needed to meet the stipulated access target of 50% by 2023 beyond budgetary support of 0.05%, ongoing and pipeline donor grants and loans. It is worth noting that under this scenario, including the 2015 tariff increase, EDM's financial position does not improve to the extent that would allow EdM to at least partly finance its CAPEX.

- Government should consider developing a 'National Electrification Plan'. Such a plan would consider the technologies, appropriate costs, coordinating activities between EDM and FUNAE to ensure an off-grid strategy is in place to cover those areas in which the grid will not be extended in the short-term, financing mechanisms and implementation modalities for reaching access targets in both grid and off-grid alternatives. Critically, the Electrification Plan would need to be costed, funded and then implemented. Such a Plan and the various studies needed to develop and implement it could be funded with grants already available to Mozambique from the World Bank under the Sustainable Energy for All initiative.

- Government should explicitly consider how the investment program under the Electrification Plan would be paid for. The important point being that EDM (or any other off-grid operator) needs to be supported with such an ambitious access plan. Without such a plan, as is currently the case, the difference between customer revenues and the cost of connecting and servicing these new customers

[5] Annex 4 provides information on ongoing and pipeline loans and grants.

stands to create a financing gap that – if unchecked – would lead to an increasingly serious financial hole for EDM.

Technical Sustainability

- The development of an Operations and Maintenance Plan is key for ensuring the technical sustainability of the grid and to contribute to its financial health. EDM has taken a positive step in the reduction of technical and non-technical losses by starting the implementation of two activities under the Energy Development and Access Project (EDAP) financed by the World Bank: (i) incorporation of a state-of-art commercial management system (CMS) and (ii) roll-out of a revenue protection program (RPP), based on systematic recording and monitoring of consumption of EDM's largest 4,000 users with the support of Advanced Metering Infrastructure (AMI). These activities need to be fully implemented.
- The evidence from the level of system faults shows that EDM is not carrying out sufficient O&M expenditures. It is difficult to say what would be the appropriate level of O&M for EDM because this is highly dependent on the specific characteristics of the utility; nonetheless, determining the level of O&M and funding it is an exercise that EDM must perform on a regular basis in order to ensure that EDM is maintained under certain quality of service parameters. The Ministry of Mineral Resources and Energy would need to ensure that the sector has sufficient funding.
- There is an urgent need for capacity building at all levels in the power sector. The Ministry of Mineral Resources and Energy needs stronger capacity to drive system planning and competitive processes to improve the efficiency of the sector while also helping to drive it towards the government's access targets. CNELEC's mandate should be clarified and its regulatory role strengthened, particularly in the area of tariff setting as a means to institutionalize financial sustainability for EDM and the need for tariff adjustment. Training and recruitment is also needed at EDM. A human resources development plan is needed as few staff are sufficiently qualified to maintain an expanding EDM system.
- FUNAE tends to be excluded from energy planning, which has sometimes led to unnecessary projects or investments that are not in line with the national planning of grid extensions. FUNAE should consider building sufficient institutional capacity both in terms of financing rural electrification and in terms of executing stand-alone off-grid low-cost projects.

Financial Sustainability

- Tariffs have decreased by about 20% in real terms between 2010 and 2014 as shown in Table 2 below. The 26.4% nominal tariff increase in October 2015 means that, in real terms, 2015 tariffs are just about three percentage points higher in real terms than in 2010. For residential customers, tariffs would still be five percentage points lower than in 2010.

Table 2: Tariff analysis

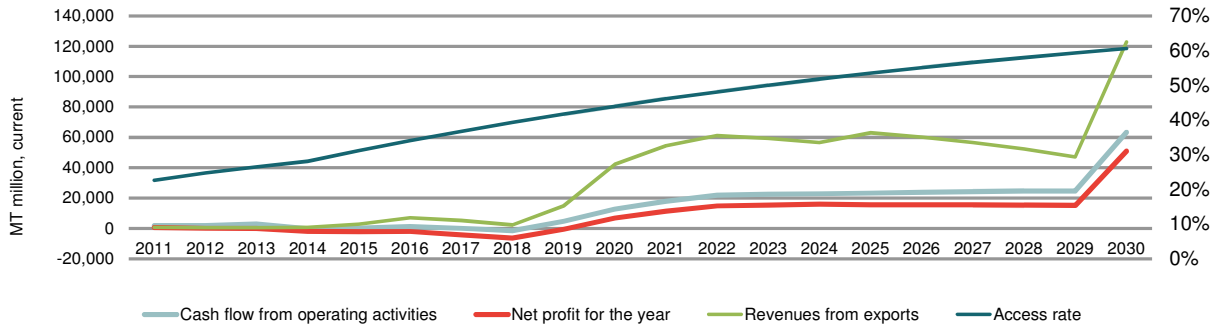
	2010	2011	2012	2013	2014	2015
Inflation, Mozambique	12.7%	10.4%	2.1%	4.2%	2.3%	4.0%
Real tariff levels (as compared to 2010 tariffs).	100%	89.6%	87.5%	83.3%	81.0%	103.0%

Source: World Bank

- Scenario modelling shows that, even with a 25% nominal tariff increase in 2015, followed by inflation level increases, EDM's financial condition does not actually improve to the point of financial viability until the end of the decade (EDM is forecast to make a net loss until 2018) when significant exports are expected from 2019 onwards. This is shown in Figure 6 below; other scenarios are considered in Annex 3.

Figure 6: Base case scenario

Assumptions: 50% access by 2023, 25% tariff increase in 2015 and rises with inflation thereafter



- The size and timing of tariff increases directly affects EDM's cash flows, profit and therefore its dependence on external funding, including budget support. A simulation analysis undertaken by the Bank (see Annex 2 and Annex 3) shows that with a 25% tariff increase, EDM will not be in a position to finance access related CAPEX in the short-medium term as all the surplus from the operational activities will be devoted to the repayment of its short term liabilities. The more ambitious the access target, the more difficult for EDM to finance access CAPEX with its own resources and the higher debt burden on EDM.

- From simulation analysis carried out by the Bank (see outputs for the base case scenario in Figure 6), EDM is forecasted to generate net profit from 2019. Before that, even though EDM's cash flow is positive, it is not sufficient to fund the rising debt costs, resulting in a net loss until 2018. The improvement from 2019 is the simulation can be linked to the commissioning of the 400 MW Temane MGTP gas-to-power project (to be developed by Sasol and EDM), with 100% off-take by EDM and sufficient transmission to Maputo constituting phase 1 of STE. In the simulation, the Ncondezi coal-fired IPP also contributes to the positive cash flows and profit during this period. Whilst EDM will get a smaller amount of energy from the Mphanda Nkuwa hydropower project (10% of the 1,500MW), this energy is expected to cost EDM significantly less – and therefore to also have a positive effect if it becomes available from 2021.

- Meanwhile, EDM needs to be able to operate and maintain the existing system. To do so, its current tariffs need to cover the cost of operations and maintenance (O&M). We estimate that a tariff increase of 35% would have been required in 2015, followed by inflation level increases to cover appropriate O&M only. Such an increase would ensure a positive net profit. An increase of 25% in 2015 and thereafter increases in line with inflation only - would only enable EDM to become financially viable following the start of substantial exports of power to the region following the commissioning

of new plant around the end of the decade. We recommend that any tariff increases be designed taking into account the impact on the poorest.

Regional Trade

- Mozambique has energy resources (including hydropower, coal, natural gas, solar and wind) well in excess of that needed to meet its internal electricity demand for decades to come (even considering potential unconstrained demand). It is also fortunate to be next to the second largest economy in Africa and a broader region with high demand for energy. This means that regional trade, whether through electricity or gas, could play an important role in assisting the development of Mozambique's economy and could provide the critical mass needed to develop large energy projects within the country.
- Furthermore, a comparison between average tariffs for Mozambique sales (9.1 USc/kWh in 2014), export tariffs (12.5 USc/kWh in 2014) and the avoided cost of generation in South Africa (10.5 USc/kWh in 2012[6]) shows that an integrated Mozambican and exports driven approach provides an important potential route to ensuring EDM's financial viability in the long-run and could also be used to partially subsidize tariffs for Mozambican customers. Assuming these export prices persist, they could substitute for high tariffs from consumers and/or substitute for budget support and donor funds being used to increase access.
- In the immediate near term, Mozambique is expected to derive benefit from gas from the existing Pande/Temane fields (operational since 2004, but mostly used for Sasol commercial activities in South Africa to date). A number of gas-fired generation projects are being developed along the pipeline, which could supply electricity within Mozambique or supply cross border to power markets in the region. The Centrale Termica Ressano Garcia (CTRG) 150 MW plant was recently commissioned, and EDM are in discussions with Sasol regarding a 400 MW plant at Temane.
- Regarding Mozambique's abundant hydropower resources, the primary projects being talked about are the Mphanda Nkuwa 1,500 MW project located approximately 60 kilometres downstream of Cahora Bassa and a 1,245 MW expansion to Cahora Bassa involving developing generating capacity on its north bank. Current expectations are for Mphanda Nkuwa to be operational by 2021, though there are high upfront costs and the need to attract commercial financing means that significant work still needs to be done to appropriately structure the project and raise the financing.
- For the longer-term, Mozambique has abundant gas resources from the offshore Rovuma Basin, allowing gas to play an increasingly important role in the energy sector in the region in the future. There is a series of complex trade-offs to be made between the different uses for this gas, between exporting gas and exporting power to the region and between the level of economic rent to be achieved in the power sector and in the gas sector. Preliminary analysis shows that the levelized cost of Mphanda Nkuwa hydropower plant would be considerably lower than that of a large gas plant of similar capacity[7]. Decisions also need to be made in the context of HCB's contract with Eskom expiring in 2029, and a potential additional 1,575 MW becoming available to EDM as well as potential changes to arrangements with Mozal that currently involve demand for 950MW of power. Given the

[6] Vatenfall Power Consultant and Norconsult, March 2012. Transmission backbone feasibility study.
[7] This assumes gas prices at US$5/MMBtu.

uncertainties and the timeframes involved, there may be greatest 'option value' in deferring decisions around allocation and forward regional sale of Rovuma gas for now. Options need to be carefully analyzed to ensure that Mozambique is optimising its resources.

Government Actions

- In this environment, government has an important role to play on a number of issues. Government should consider taking the following actions:
    - Taking the lead in ensuring that the National Electrification Plan is properly prepared, funded and implemented. This would include a work plan for publicly funded grid activities as well as modalities for off-grid private sector generation and supply models. Funding the Plan involves reaching out to donors in a coordinated manner to ensure maximum funding for the sector is channelled in a coordinated manner to address the funding gap for access investment.
    - Ensuring that for O&M, EDM is financially viable. This means increasing tariffs at least in line with O&M costs. As noted above, real tariffs had decreased by approximately 20% since 2010 before the tariff increase, while costs have risen. The tariff increase of 25% in 2015 followed by inflation level increases are the minimum to keep EDM afloat – even without giving it responsibility for investment in new connections. Regional trade would make EDM cash positive from operations from around 2019. For EDM to be able to operate and maintain its plant well now, an increase nearer 35% would have been needed in 2015, followed by inflation level increases.
    - Working effectively with potential investors. Given the size of projects Mozambique is looking to develop, it needs to be particularly careful in ensuring that it provides an attractive environment for large investors. In this regard, the Government's recent track record is poor. A number of large and highly credible global operators/investors worked together to reach agreement on development of STE and Mphanda Nkuwa. However, in 2013, the government bypassed existing parties to work with new parties. This severely dented investor confidence and has held back the process on these projects by at least 2 years.
    - Ensuring that the legal framework is clear, transparent and certain for investors. For example, there are currently discrepancies between the Electricity Act and the PPP Law that have led to significant delays in re-financing of the new gas fired EDM/Sasol CTRG plant.
    - Working with multi-lateral partners to offer specific comfort to investors and financiers, such as with guarantees, to ensure that investments take place. Certain third party guarantees, such as those of the World Bank, can reduce the amount of contingent liability the government needs to take in offering guarantees. Such guarantees can also be used by the government in a programmatic manner to increase the ongoing impact of public sector funds in the sector.

Table of Contents

Mozambique Energy Sector Policy Note

I. Introduction

1. **This Note is intended to support the Government of Mozambique in determining priorities for policy decisions with the aim of delivering efficiently produced, technically and financially sustainable electricity supply to the Mozambican population.** There are trade-offs created by the circumstances Mozambique finds itself in, and the government needs to be able to determine how it will prioritize actions as well as their relative timing. The emphasis, driven by government objectives, is on increasing access as well as diversifying the energy mix as a means to delivering the electricity to the population with security of supply. Given the current performance of the sector, being able to meet these objectives will require significant changes to how the sector is performing.

For simulations, the Government draft Energy Strategy which sets a target of 50% access by 2023 is used.

2. The Ministry of Mineral Resources and Energy has developed a draft Energy Strategy for the sector which covers the period 2014-23[8]. The strategy sets out the vision and the way the Government expects to respond to challenges and opportunities in the energy sector. The Government Strategy sets as an objective, reaching 50% grid connectivity for the population by 2023 (from a current figure of 25.2%[9]). The UN's Sustainable Energy for All program targets universal access[10], which the Government should aspire to in the long run. Nevertheless, the Government's objective for grid access will need to be complemented by off-grid connections, where more cost effective. Meeting these significantly higher levels of access will require significant investment not just in the grid and off-grid access, but also in the provision of power.

II. Country Context

Growth has been strong but not inclusive.

3. Mozambique is a low income country with a population of almost 26 million. It has enjoyed strong and sustained growth since the end of its civil war in 1992. Its economy grew at an average rate of 7.4% over the past two decades, due in large part to sound macroeconomic management, large-scale foreign investment in projects and support from development partners. However, robust and broad based growth and rapidly falling poverty rates in the aftermath of the civil war have gradually given way to less equitable growth, persistent poverty and rising inequality. Over 50% of the population was still living below the poverty line in 2009 and at the end of 2014, only 25% were connected to the electricity grid.

4. The vast majority (70%) of Mozambique's population lives in rural areas[11], mostly working on subsistence farming. They face several constraints to transforming

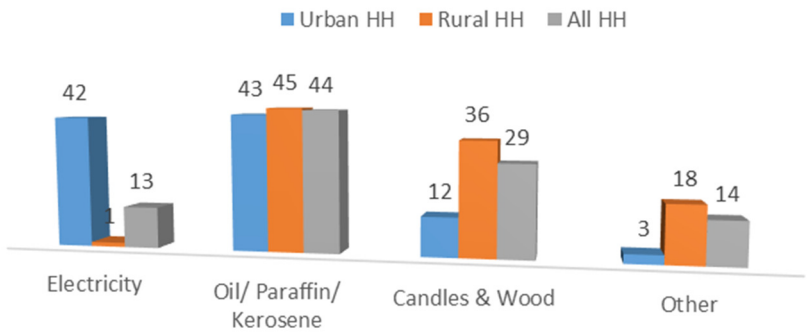
[8] There is also a Gas Sector Masterplan.
[9] EdM, Statistics Report, December 2014.
[10] "*Universal Access to Modern Energy by 2030*" has been proposed as one of the three key pillars of the global Sustainable Energy for All (SE4All) program – an initiative co-chaired by the United Nations Secretary General and the World Bank President.
[11] 2011 figures.

subsistence farming into market-oriented agriculture. Adoption rates for productivity-enhancing agricultural inputs and technologies are very low. In these circumstances, access to electricity is a key factor of production to enable both greater access to markets and services. Access to electricity is thus a key enabler of socio-economic development.

Access to electricity is a key enabler for growth and poverty alleviation.

5. Access to electricity remains low, with only a small fraction of households in Mozambique relying on electricity as the main source of energy for lighting. They tend to rely on less efficient and poorer quality alternatives such as kerosene, candles or wood for lighting.[12]

Figure 7: Percentage of Mozambican households using different fuels for lighting



Source: World Bank

6. The Government of Mozambique, in its latest 5 year Government Plan[13], highlights the need to promote – *inter alia* – the agricultural and industrial development as the basis for socio-economic development of the country. Chief in achieving this task, as recognised in the plan, is the development of the necessary infrastructures in the power sector to promote the development of value adding activities in the country.

7. Going forward, Mozambique has abundant energy resources, including an estimated 18,000 MW of hydropower potential, 277 trillion cubic feet of natural gas, 20 billion tonnes of coal and significant solar and wind potential.[14]

8. Mozambique is in the fortunate position of being able to engage in significant regional trade. It neighbours South Africa, whose peak annual demand was 36,000 MWs in 2013, has suffered significant load shedding recently due to issues with maintenance of existing plant and delays with new plants. Although Eskom is currently facing financial challenges, Government of South Africa (GoSA) backed Power Purchase Agreements (PPAs) have proven to be commercially bankable. Since 2011, South Africa has enabled over 4 GW of private sector financed renewable energy Independent Power Producers (IPPs) based on GoSA backed PPAs with Eskom. Mozambique is well interconnected with

[12] World Bank – Mozambican statistics.

[13] República de Moçambique. Proposta do programa quinquenal do governo 2015-2019. Aprovado na 4ª Sessão Ordinaria do Conselho de Ministros 17 de Fevereiro de 2015.

[14] República de Moçambique, Conselho de Ministros Plano Director do Gás Natural, Aprovado na 16.ª Sessão Ordinaria do Conselho de Ministros 24 de Jonho de 2014. Of the 277 tcf of reserves, 128 tcf are 3P reserves.

The government sees increasing access to electricity as a key element to ensuring inclusive benefits from Mozambique's resource wealth.

not only South Africa, but also Zimbabwe with opportunities for onward trade with the wider region forming the Southern African Power Pool (SAPP).

9. If developments in the coal and gas sectors proceed as planned, public revenues will increase dramatically; resource revenues could be as high as US$9 billion annually by 2032, representing 7% of GDP and 21% of total government revenues[15]. However, international experience has repeatedly demonstrated that extractable resources only realize their development potential if they can be efficiently managed and the resultant wealth effectively transformed into productive physical and human capital. Increasing electricity access is a key part of the government's strategy to reduce inequality and to enable the wider population to benefit from the economic growth due to the exploitation of these national resources.

III. Sector Description and Challenges

Sector Context

10. The sector is governed through the 1997 Electricity Law. The Ministry of Mineral Resources and Energy[16] is responsible for governance, planning and policy in the sector. Electricity tariffs are set by the Ministry. Electricidade de Moçambique (EdM) is the state-owned, vertically integrated, generation, transmission, distribution and grid supply company. The Energy Fund (Fundo de Energia /FUNAE) is a public body with the aim of promoting the development and use of different forms of low cost power and the sustainable management of power resources. Initially setup as a fund, FUNAE today operates mostly as an implementing agency notably for off-grid generation and access projects. The National Council for Electricity (CNELEC), although often considered as having a regulatory type function, was established (in 1997) as a purely consultative body, its role being to advise the Ministry of Energy and Council of Ministers on issues including new concessions and tariffs.

11. The Mozambican power system has been heavily influenced by the development of the Cahora Bassa hydropower facility which primarily sells power to South Africa, with Mozambique taking some of the power for its own consumption. It is owned and operated by Hidroelectrico de Cahora Bassa (HCB), which is 92.5% owned by EdM and has a reporting line to the Board of EdM. The plant is a 2,075 MW plant (5 x 415 MW units) with approximately 100 square kilometre reservoir located on the Zambezi River upstream of the city of Tete in the central region of Mozambique. Most of this power is exported to Eskom - though 300MW of firm power and 200MW of non-firm power is made available to EdM. It commenced operations in 1977. Two 533kV high voltage direct current (HVDC) lines were built from this region to South Africa – but no connection was built through Mozambique to its southern region. To this day, power to the Maputo region from Cahora Bassa is still delivered from South Africa.

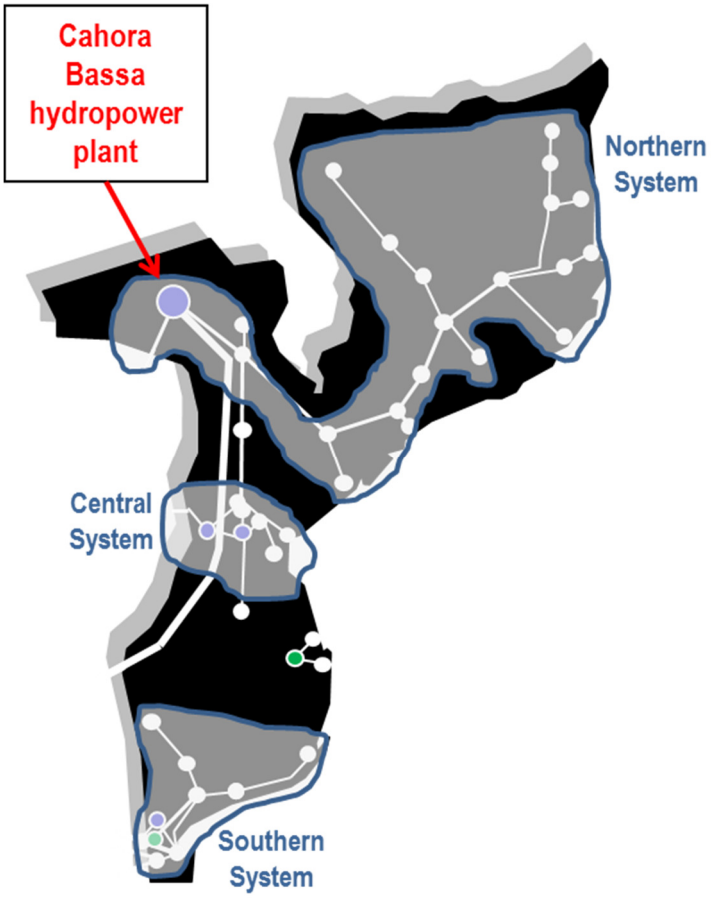
[15] World Bank, Generating Sustainable Wealth from Mozambique's Natural Resource Boom, World Bank Mozambique Policy Note, January 2014.

[16] The Ministry was restructured following the October 2014 elections and previously consisted of two separate ministries – one covering downstream energy and one covering upstream mineral resources (mining and extractives).

12. The Mozambique power system actually developed as three separate systems (although the northern and central systems have some interconnection). The transmission system does not cover all areas of the country and - in large parts of the country that it does reach - lacks resilience. In addition, while the distribution network has reached all administrative centers (all 128 district administrative centres had been connected by the end of 2014[17]), the system has large gaps with no grid access - contributing to the difficulty in increasing access.

The power system does not meet current requirements and requires significant development.

Figure 8: Mozambican Grid



13. Mozambique has a significant renewable generation endowment estimated at over 23,000 GW, the vast bulk of which is solar. Of this potential, 7.5 GW have been identified as priority projects including 5.6 GW of hydro, 1.1 GW of wind, 0.6 GW of solar and smaller quantities of biomass and geothermal.[18] The Government has a strategy to deploy renewable energy so as to increase access to power and to build human capital in the renewable sector. Indeed, the optimal way to increase access is likely to include significant off-grid, mini-grid and pico-grid developments using conventional and renewable resources. To support the development of renewable generation,

[17] EDM, Desempenho da EDM e Visão de Crescimento Empresarial - Apresentação ao novo Ministro de Recursos Minerais e Energia, sobre o Ponto de Situação da Electricidade de Moçambique E.P. em Janeiro 2015, e as perspectivas para o Futuro, February 2015.

[18] Renewable Energy Atlas of Mozambique, 1st edition 2014.

Mozambique has approved a regulation for renewable energy feed-in tariffs (REFIT). The REFIT scheme will target generation plants of 10MW or less, connected to the main grid and using any of four types of renewable technology: hydropower, solar, biomass and wind. The feed-in tariffs vary by plant size and technology, ranging between 4.06-5.74 MT/kWh (12.23-17.29 USc/kWh) for biomass, 4.12-8.00 MT/kWh (12.41-24.09 USc/kWh) for wind, 2.29-4.81 MT/kWh (6.90-14.49 USc/kWh) for hydropower and 7.91-13.02 MT/kWh (23.82-39.21 USc/kWh) for solar, although the tariffs could be changed after three years.[19]

14. FUNAE has been active in funding and implementing off-grid power production systems, namely in the areas of solar PV, mini-hydro and biomass. For example, in 2012, it put in place 81 mini-grid and off-grid systems with a total capacity of 274kW.[20] Over the 17 years of its existence, FUNAE has made an important contribution to improving access to energy in rural areas through the implementation of projects with the support of partners (World Bank, Belgium, European Union, Portugal, Spain, China, India, Denmark and Finland) which consisted of electrification of (i) 260 villages, of which 191 were with photovoltaic systems and 69 with generators and extension of the network; (ii) 580 schools, including the residences of teachers and distribution of computers in some schools; (iii) 561 health centers, including the residences of nurses and providing fridges for the conservation of vaccines; (iv) 74 administrative post buildings; (v) 3 fish markets and ice storage facilities; (vi) construction of 1 mini hydro; (vii) installation of 19 water pumping systems; and (viii) production of 1,500 stoves that will be distributed in rural communities for the dissemination of this technology. In addition, FUNAE has overseen the construction of three Photovoltaic solar plants funded by South Korea and that have enabled the electrification of the Mavago, Muembe and Mecula districts in Niassa province, as well as the construction of a solar panel factory in Maputo province, which is expected to help reduce costs of implementation of solar energy projects in Mozambique. FUNAE has also promoted the development of a Renewable Energy Atlas for Mozambique, as well as the construction of 51 fuel filling stations under a program of geographic incentives. With the implementation of these projects, about 5 million people have benefited in some form from the energy services in rural areas either directly or indirectly.

Mozambique currently has significant gas from Pande/Temane which is increasingly being used for domestic power generation.

15. Mozambique has significant experience with gas. Gulf Oil discovered natural gas in Mozambique in the Pande gas field in 1961, followed by Buzi (1962) and Temane (1967)[21]. Initially, the gas fields were thought not to be commercial. The internal strife of independence and the civil war combined with the lack of an internal market for the gas delayed development. Work was undertaken to map and appraise the Pande and Temane fields in the 1980s and 1990s[22]. In 2003, Sasol undertook extensive drilling of exploration and production wells in the Pande/Temane block and commercial gas production from the Pande/Temane fields began in February 2004. Gas reserves (3P) at

[19] Regulamento que Estabelece o Regime Tarifário Para as Energias Novas e Renováveis (Refit).

[20] FUNAE, Relatório Anual de Actividades 2012, January 2013. For the avoidance of doubt, 274kW is not the total installed capacity of mini-grid and off-grid systems. Rather it was the capacity FUNAE reported to have installed during 2012.

[21] Source: CMH. Some sources note that the Temane field was discovered in 1956.

[22] Source: National Petroleum Institute website.

Temana and Pande are estimated at 3.5 trillion cubic feet (tcf). As at June 2013, 1,026 MGJ (0.97 tcf) of gas had been produced, of which 989 MGJ (0.94 tcf) had been exported to South Africa. Current production is at a rate of 171 MGJ/annum (0.16 tcf/yr) and these will be at the rate of 198 MGJ/annum (0.19 tcf/yr) during 2017-24. The pipeline to South Africa was built with five exit points within Mozambique and licenses for further new Pande/Temane gas finds are being linked explicitly to use for economically important activities within Mozambique. Significant quantities are expected to supply gas-fired power generation within Mozambique.

Mozambique will have a globally significant quantity of gas from Rovuma.

16. In 2010, gas discoveries were made in the Rovuma Basin, offshore in Northern Mozambique. Gas reserves, at 128 tcf (3P), are sufficiently large to be used simultaneously for LNG exports, for major industry within Mozambique, for power generation and potentially for pipeline exports to South Africa. Announced investments to develop the first phase of two Liquefied Natural Gas (LNG) value chains from reservoirs to export markets amount to US$70 billion. Gas production is planned for 2019, but could be delayed.[23] Key risks to development include incomplete institutional capacity, slow development of the regulatory framework[24], a lack of infrastructure in the region near the gas resources which may affect the cost and timing of LNG production and price trends in the global LNG market. The estimated revenues are transformational and could be in excess of US$300 billion over the life time of the projects[25].

17. Mozambique as a primary resource rich country also has world class reserves of coal. Part of these reserves have sufficient quality to be exported, while a significant portion can be used for domestic power generation. Specifically, coal deposits are estimated at 20 billion tons and annual exports could amount to 100 million tons at peak, making Mozambique one of the most important coal exporters in the world.[26]

18. There are two sources of power demand growth in the region. The first is the South African economy. It is the second largest in sub-saharan Africa and its rate of access was 82% in 2014. Its growth would lead to a significant increase in power demand in the region. A significant portion of Eskom's old coal fired fleet will be decommissioning over the coming years requiring additional generating capacity in the region in addition to that needed to meet incremental demand. For Eskom, peak (suppressed) demand is currently 42,416 MWs and actual available capacity is 41,074 MWs[27]. In considering its options for purchase of power, Eskom would be expected to consider lifetime costs of various technologies across the region. The Integrated Resource Plan for South Africa quotes imported levelized cost of energy (LCOE) from Mozambican hydro as ZARc 33.2-39.3/kWh (2.7-3.2 USc/kWh). This, together with Zambian hydropower quoted at ZARc 14.9-17.5/kWh (1.2-1.4 USc/kWh) is highly competitive compared with other options

[23] For example IHS Energy assumes a commercial operations date of 2026 for the first four LNG trains at Rovuma. IHS Energy, LNG Strategic Research and Forecasting Service (SRF) Short-Term Tracker, April 2015. In the context of such delays, Pande/Temane gas becomes even more important.

[24] There is a US$60m IDA Mining and Gas Technical Assistance Program (MAGTAP) currently under implementation focused on addressing these issues.

[25] World Bank Extractives Staff estimates.

[26] World Bank, How Wealthy is Mozambique after the discovery of coal and gas? Measuring wealth in Mozambique using the wealth accounting framework, January 2014

[27] Figures from SAPP website http://www.sapp.co.zw/demand.html (accessed on May 14, 2015).

Due to the SAPP and the shortage of power in the region, over-supply in Mozambique can be exported to the region at a premium and there is little current risk of generation assets being stranded.

(see Table 3). Regarding coal, South African environmental regulation will make coal fired local generation relatively less competitive. The other source of increasing demand is improving access rates in the region. Electricity access in Southern Africa is around 28% – below the continental average of 31% – and would barely reach 17% – the lowest rate among all Africa sub-regions – if South Africa is excluded. In all these countries, expanding electricity access is critical to complement poverty reduction efforts and thus is at the core of their national development plans. If advanced, this should also lead to a significant increase in electricity demand in the region. Currently, even with existing access rates, there is a significant deficit in the available generating capacity, giving a high market value to all exportable power available in Mozambique. For the nine countries interconnected by the Southern African Power Pool (SAPP), peak (suppressed) demand is currently 50,636 MWs and actual available capacity is 48,792 MWs.

Table 3: Levelized cost of energy in South Africa as set out in IRP

Source of power in the region	ZARc/kWh	USc/kWh
RSA pulverized coal with FGD[28]	58.4	4.7
RSA Nuclear	69.2-70.3	5.6-5.7
RSA CCGT (with gas imports/LNG)	86.1	7.0
Mozambique sourced hydropower	33.2-39.3	2.7-3.2
Zambia sourced hydropower	14.9-17.5	1.2-1.4
Wind	69.4	5.6
Concentrating Solar Power	129-165	10.4-13.4

Source: Republic of South Africa Integrated Resource Plan 2010 – updated in 2013. Figures relate to 2012.

Note: Exchange rate used is US$ 1 = ZAR 12.35

19. A number of generation projects based in Mozambique could be important least cost options for the country and the region. The Integrated Resource Plan (IRP) prepared by the Government of South Africa[29] and feasibility study work carried out by EDM in Mozambique[30] indicate that certain large projects in Mozambique – namely the 1,500 MW Mphanda Nkuwa hydropower project (some 60 kilometers downstream of Cahora Bassa) and the North Bank extension to Cahora Bassa (additional 1,245 MW) would provide least cost power for the region. These projects require significant extra transmission capacity to be built – and the projects themselves are highly capital intensive. Mphanda Nkuwa is estimated to cost in the region of US$3 billion and the high voltage direct current (HVDC) transmission to evacuate power to the region a further US$1 billion (part of the regional DC and national Alternating Current (AC) system known as STE). The size of the required investment suggests the project will require significant international and private sector investment and skillful leadership on the part of the Government of Mozambique to advance.

[28] FGD is flue-gas desulphurization is used to remove Sulphur dioxide from emissions. Installation of FGD is a Government of South Africa requirement.

[29] Government of South Africa, Integrated Resource Plan 2010-2030 Update report, November 2013.

[30] EDM, Mozambique Regional Transmission Backbone Project. Feasibility Study Report, March 2012. Norconsult/Vattenfall.

20. The system was clearly not designed for the current and future needs of Mozambique and currently requires significant adaptation and investment together with institutional development.

EDM demand and supply

Consumer demand in Mozambique has been increasing steadily over several years.

In 2014, peak demand on the EDM system was 831MW and growth has averaged over 11.6% per annum over the past 5 years.[31] Demand for electricity, as measured by billed energy including exports, has risen by over 9% per annum on average for the last 5 years and is expected to continue to increase rapidly in future. EDM had 1.38 million retail customers at the end of 2014. This number has grown by over 13% per annum over the last 5 years. Consumption in 2014 was broken down as follows by consumer group: transmission connected clients 9.8%, residential customers 40.6%, commercial 9.1%, agriculture 0.7%, large LV customers 4.8%, large MV/HV tariff based customers 30.7% and exports 4.2%. The consumption breakdown by customer category for the period 2011 – 2014 can be seen in Table 4 below.

Table 4: Demand by customer type (GWh)

Customer	2011	2012	2013	2014
Transmission connected customers	122	253	310	371
Residential customers	1,052	1,233	1,416	1,536
Commercial	245	258	322	345
Agriculture	1	0	25	27
Large Customers LV	150	169	170	182
Large Customers MV/HV Tariff based	890	1,007	1,080	1,159
Exports	670	328	260	160
Total	**3,130**	**3,248**	**3,583**	**3,780**

Source: EDM statistical reports 2011, 2012, 2013 and 2014
Note: For 2014, data for LV categories other than residential customers are estimated by applying the average growth rate of LV non-residential demand between 2013 and 2014 (7.26%) to the 2013 figures; Commercial customers are low voltage customers including selling market stalls, small shops with glacier or freezer and some lights, stores or small offices with 2 A/Cs and good lighting, Bars, restaurants and larger offices; Large LV customers include SMEs such as carpentries or metalwork industries; large customers MV include factories, manufacturing and other services as well as hotels and tour operators or banks (EDM, Fundamentação da Proposta de Ajustamento do Tarifáfio de Energía Eléctrica da EDM, June 2015).

21. All customers with the exception of those directly connected to the transmission system are tariff based customers. In 2015, average tariffs were as follows: residential customers 11.3 USc/kWh, commercial customers 17.95 USc/kWh, agriculture 5.7 USc/kWh, large LV customers 6.5 USc/kWh, and large MV/HV customers 5.23 USc/kWh.[32] EDM estimates that in 2014, customers connected directly to the transmission system (who are free to negotiate tariffs with EDM) paid on average 10.00 USc/kWh.[33] EDM charges for connections. However, these charges do not recover the full cost of connecting new customers. In 2012, customers on the social tariff paid about

[31] EDM, Statistics Report, December 2014. The system peak of 831MW occurred on 15 December 2014.
[32] For conversion between MT and US$ exchange rate of 33.2 MT/US$ for the year 2015 was used
[33] For details on tariffs refer to Table 14: Current level of tariffs.

875 MT (US$ 30.84 at the 2012 exchange rate) for connections and normal household customers paid about 3,630 MT (US$ 127.90).[34] The same study estimated that it cost EDM an additional US$ 1,000 for each ordinary connection.[35]

22. Looking forwards, demand from large loads is expected to increase rapidly. Developments in the southern region include large mixed commercial/residential developments and new office, residential and mixed use buildings in the center of Maputo. Industrial developments expected include cement works, aluminum foundries, cable manufacturers and a titanium smelter. Developments in the central region include an industrial park and developments of coal and rail facilities and the construction of hydro and thermal power stations. Developments in the northern region are larger and include mining activities, primarily heavy sands, and phosphate, rail and port developments for coal export, off-shore support services to the on-going natural gas exploration and future extraction, and large agricultural and forestry projects[36].

Historically, generation was dominated by Cahora Bassa – but is now increasingly complemented by gas-fired generation.

23. EDM has generation capacity available to it from HCB, own generation and IPPs. Historically, Mozambique's power was based on hydropower. As discussed earlier, HCB power makes up the majority of power available to EDM (see Table 5). EDM received power from HCB as well as some small hydropower plants. However, recently, gas from the Pande and Temane gas fields has been used to develop gas fired power generation. EDM signed a temporary PPA with Aggreko for power now being generated at Ressano Garcia[37]. It has recently partnered with Sasol to develop a 175MW gas engine plant at Ressano Garcia (Centrale Termica Ressano Garcia or CTRG) which, at a reported wholesale price of USc 8.5/kWh, will be the least cost power from gas. Some PPAs have also been signed with further IPPs that are being developed, though these are understood to be at higher prices (e.g. Gigawatt 100MW which is also sited at Ressano Garcia).

Table 5: Generating capacity available for EdM

Project	Technology	Installed capacity (MW)	Notes
HCB Firm	Hydro	300	HCB
HCB Non-firm	Hydro	200	HCB
Mavuzi	Hydro	52	EDM under rehabilitation
Chicamba	Hydro	44	EDM under rehabilitation
Corumana	Hydro	16	EDM
Pequenos Libombos	Hydro	2	EDM
Aggreko 1	Gas	15	Temporary IPP
Aggreko 2	Gas	32	Temporary IPP
Aggreko (Nacala)	Diesel	18	Temporary IPP
Total		**679**	

[34] Norconsult, Final Master Plan Update Report Volume III – Main Report. See Section 10.14.2.
[35] Ibid. section 14.1.
[36] Norconsult, Final Master Plan Update Report Volume II - Load Forecast Report.
[37] EDM also has a contract with Aggreko for peaking power supply from diesel fired generation plan in Nacala.

CTRG	Gas	175	Sasol/EdM commissioning

Source: EDM Desempenho da Edm e Visão de Crescimento Empresarial Feb 2015, and Aggreko website accessed 12 May 2015

Table 6: EdM supply and demand balance (GWh)

Customer	2011	2012	2013	2014
Own generation	389	263	251	318
Purchase HCB	3,549	3,874	4,084	4,351
Purchase IPP	-	30	95	102
Imports	87	84	109	190
Total supply	**4,025**	**4,251**	**4,539**	**4,962**
Exports	669	329	260	160
Gross available energy - national territory	3,356	3,922	4,278	4,802
Transmission and station losses	190	220	240	298
Transmission connected customers (non-tariff)	122	253	310	371
Distribution losses	649	725	657	815
Electricity for end use (distribution connected customers)	**2,395**	**2,724**	**3,071**	**3,318**
Public lighting	50	53	52	52
EdM's consumption	6	6	6	6
Sales (distribution connected customers)	**2,339**	**2,665**	**3,013**	**3,260**

Source: EdM statistical reports 2011, 2012, 2013 and 2014

EDM network connectivity

24. Of the three grid systems, the Southern system serves Maputo and areas up the coast and is connected to South Africa and Swaziland via the Mozambique Transmission Company (Motraco)[38] lines as well as 275kV and 110kV lines to Komatipoort in South Africa. The central system covering the Beira corridor is connected to local hydropower generation at Mavuzi and Chicamba as well as a link to Zimbabwe (mainly used for back-up imports) – and a northern system fed directly from Cahora Bassa and stretching up to Nampula in the north. This northern system also connects to the Southern African Power Pool (SAPP) via the 330kV AC line at Songo into Zimbabwe as well as the 533kV HVDC lines to Apollo in South Africa (the route for the majority of power evacuated from Cahora Bassa). Details can be seen in the map in Annex 7: Map of Mozambique Energy Sector and Proposed Transmission Lines.

25. Due to a lack of connectivity between the central and southern systems, Mozambique actually needs to transfer power via its neighbours to deliver power from the central to the Maputo regions. The power travels via the DC lines to South Africa,

[38] Owned by a joint venture between the three national power companies: Eskom of South Africa, Electricidade de Mocambique (EDM), and the Swaziland Electricity Board (SEB) from South Africa and Swaziland.

and Eskom sends power to the Maputo region via the Motraco lines. Whilst this has worked to date, any new generation in the central region – which includes significant hydropower and coal reserves – would require a national backbone to deliver power down to the Maputo region. The development of a backbone transmission line, known as STE or Sociedade Nacional de Transporte de Energia, has been held up by the slow pace of development of further large Zambezi hydropower generation plants[39] – which are seen as critical for the financial viability of such a major transmission project. STE would run from the central Tete region to the south of the country (approximately 1,300 kilometres) and is hence key to improving access to electricity for several parts of the country, national security of supply and providing a means to export power from new generation projects utilizing Mozambique's energy resources. The STE would connect to the existing Motraco lines to South Africa. The Motraco lines are currently used to feed power from Eskom to BHP Billiton's Mozal aluminium smelter[40] using two 400kV transmission lines. The capacity of the lines is about 1,200MW and the smelter consumes about 950MW – which would therefore allow up to about 2,150MW of exports from the Maputo region using the existing lines in reverse flow.

26. A single transmission line delivers power to the north-eastern region, making power supplies vulnerable to outages on the line. In January 2015, floods damaged the line to this region, cutting power to 350,000 EdM customers (and 2 million people altogether) for a period of four weeks.[41] Even under normal operation the line to the north east is overloaded, resulting in load shedding in the region of over four hours per day.[42] The development of a second line to the north east is key to improving security of supply for existing customers and for providing the transmission capacity required to meet demand from new customers as access to power in the region is increased. Options include the 400kV US$ 620 million Caia (Chimuara) via Alto Molocue to Namialo line combined with a 220kV line from Nampula to Nacala[43] as well as extension of the proposed Mozambique-Malawi line which would provide a more direct and likely higher capacity (400kV) connection between Matambo substation in central Mozambique where significant future new hydropower development is expected and Nacala in the North East.

EDM's network is well connected with South Africa but does not

EDM physical condition of the system

27. EDM's own generation plant availability is low. Of the 109MW of installed capacity of hydropower plant, 92MW is available and of the 98MW of installed capacity

[39] Overall potential hydropower capacity in Mozambique is estimated at 18,000 MWs. The next major plant developments on the Zambezi are expected to be the Mphanda Nkuwa 1,500 MW plant approximately 60 kilometers downstream of Cahora Bassa followed by a 1,245 MW expansion of Cahora Bassa on its north bank.

[40] We understand that Mozal makes up 75% of Mozambican manufacturing activity and 50% of Mozambican exports.

[41] EDM, Emergency energy Crisis in the Northern region due to Floods - Presentation to USTDA, 23 February 2015 and http://www.bloomberg.com/news/articles/2015-02-09/mozambique-restores-power-to-flood-ravaged-northern-provinces . Note that this refers to the number of customers affected and not to the number of people.

[42] EDM, Mozambique's Power Supply Overview, 8 August 2014, p21.

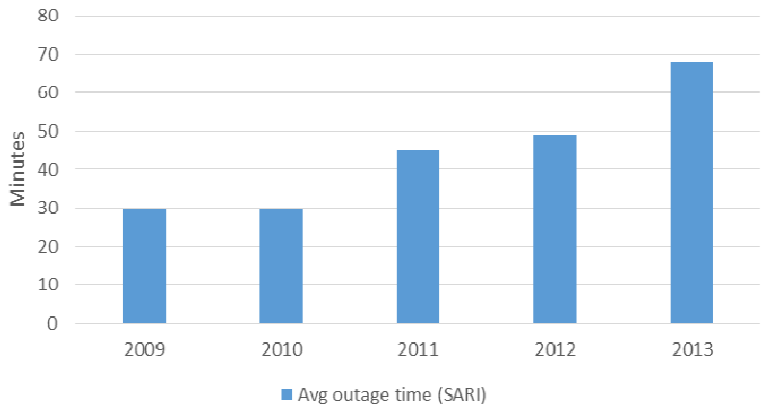
[43] EDM, Desempenho da EDM e Visão de Crescimento Empresarial - Apresentação ao novo Ministro de Recursos Minerais e Energia, sobre o Ponto de Situação da Electricidade de Moçambique E.P. em Janeiro 2015, e as perspectivas para o Futuro, February 2015, p89 and Norconsult, Master Plan Update Volume III, section 4.8.1.3.

provide sufficient connectivity within Mozambique to meet national or new export needs.

for thermal plant, 59MW is available.[44] This reflects the age of the system and the lack of routine maintenance. There are long delays in the rehabilitation of existing generation and the development of new generation such that demand growth has outstripped generation, reducing exports to the potentially lucrative South African market, and increasing needs for high cost short term power options.

28. Grid breakdowns have led to widespread electricity outages due to a lack of resilience on the system as evidenced by the above loss of supply following the floods of January 2015 and unreliable supply as evidenced by over 59 hours of transmission interruptions in 2013.[45] The average interruption time increased from 30 minutes in 2009 to 68 minutes in 2013 (see figure below). This situation is also caused in part because EDM lacks the technical staff to cope with a large connection program and perform the regular operation and maintenance of the grid; with political pressure on extending grid connections, there is not sufficient staff to carry out maintenance activities.[46]

Figure 9 – Average interruption time in HV network (in minutes)



Source: EDM, Resenha Histórica 2009-2013

29. A conservative estimate of the cost of unserved energy[47] in Mozambique was US$ 220/MWh. Assuming this level for the cost of unserved energy, in 2013 the Mozambican economy would have lost approximately 0.03% of its annual GDP (142 MT million) as the direct result of 59 hours of transmission interruptions and due to the unreliability of its transmission system. The 2015 "Doing Business" report rates Mozambique 164 out of 189 countries on "Getting Electricity".[48]

[44] EDM, Annual Report 2012. Note, these data are from prior to the two hydro plants Chicamba and Mavuzi being temporarily taken out of service for refurbishment that is due to have been completed by the end of 2016.
[45] EDM, Resenha Histórica 2009-2013, p17.
[46] Nordic Consulting Group, January 2014. Evaluation of Sida financed interventions for increased access to electricity for poor people, with case studies in Tanzania and Mozambique
[47] 'Cost of unserved energy' is the opportunity cost to electricity consumers (and the economy) resulting from unplanned electricity outages due to a lack of resilience on the system.
[48] http://www.doingbusiness.org/data/exploreeconomies/mozambique#getting-electricity accessed on June 11, 2015.

30. Total losses in electricity supply were 23% in 2014. From the experience of Bank staff, technical losses for the transmission and distribution system operated by EDM, with most of the demand concentrated in the Maputo-Matola region, should not exceed 12%. This implies that the level of non-technical losses (consumption that is not metered and billed) is at least around 10% of gross available energy, but probably more. In comparable utilities like Kenya Power, non-technical losses do not exceed 7%. The high level of non-technical losses reflects poor performance of EDM in consumption metering and billing activities.

31. As at 2013, pre-payment meters had been installed for 84% of household customers and in that year EDM's collection rate was 98%.[49] Total unbilled consumption in 2014 amounted to 2.6% of gross available energy (123 GWh). Unbilled consumption consists of public lighting for which EDM does not get any revenue, EDM's own consumption and bad debts (electricity billed but not paid for). Recently there has been an increase in the collection rate from 97% in 2013 to 98% in 2014.

32. Under the Energy Development and Access Project (EDAP) financed by the World Bank, EDM is currently implementing two key activities aimed to achieve and sustain on time an acceptable level of non-technical losses: (i) incorporation of a state-of-art commercial management system (CMS) to support efficient, transparent and accountable execution of all commercial processes and activities, in particular the revenue cycle (metering-billing-collection); (ii) implementation of a revenue protection program (RPP), based on systematic recording and monitoring of consumption of EDM's largest 4,000 users (3% of total number, representing more than 45% of total current sales) with the support of Advanced Metering Infrastructure (AMI).

Table 7: Reported losses and unbilled consumption (% of gross available energy)

Customer	2011	2012	2013	2014
Reported losses				
Transmission losses	4.7%	4.7%	4.6%	5.2%
Distribution losses	19.3%	18.5%	15.4%	17.0%
Station losses	0.9%	0.9%	1.0%	1.0%
Total losses (%)	**25%**	**24.1%**	**21.0%**	**23.2%**
Total losses (GWh)	**839**	**945**	**897**	**1,113**
Unbilled/unpaid consumption				
Public lighting	1.5%	1.4%	1.2%	1.1%
EdM's own consumption	0.2%	0.2%	0.1%	0.1%
Energy billed but not paid	2.1%	2.0%	2.1%	1.4%
Total unbilled / unpaid consumption (%)	**3.8%**	**3.5%**	**3.5%**	**2.6%**
Total unbilled / unpaid consumption (GWh)	**126**	**139**	**149**	**123**

Source: EDM's annual statistical accounts for 2011 - 2014
Note: Station losses are not reported in EDM's statistical reports from 2013 onwards. We assume these are 1 percentage point of transmission losses in line with historic data.

[49] EDM, Resenha Histórica, 2009 – 2013 Março 2014, p1 and p3. EDM's collection rate between 2011 and 2013 was 97% - EDM, Annual Statistical Report, 2013.

33. EDM is needing to resort to lumpy emergency expenditure in place of continuous maintenance and replacement. An example is the recent short term investment priority (STIP) program which has been packaged by EDM and is being discussed with donors for funding. The STIP consists of 13 network projects that can be completed in the next 2-3 years, estimated to cost $118 million. A further example is the plan to install 50MW of temporary high cost diesel fired power generation in the north of the country.[50]

EDM's financial situation

EdM is not spending adequate levels on regular maintenance and is therefore needing to plan larger rehabilitation programs. Donor funding is being taken from long-term economically important projects to fund emergency maintenance that should be covered by tariffs.

34. The current financial position of the sector is perilous. Whilst EDM delivers positive cash flows from operating activities, these can be considered to be symbolic as this is at the expense of significant operating expenses that are being foregone and that are important for maintaining the system and ensuring quality in electricity supply. Moreover, cash flows from operating activities will soon become negative without tariff increases and will continue to be negative if revenues from export do not materialize. A realistic picture of the utility (making assumptions for activities for which it should be spending) shows that the business is not being operated on a financially sustainable basis. Even with tariff increases of 25% in 2015 and assuming inflation level increases thereafter, cash flows from operating activities would be insufficient to cover debt service obligations and co-finance its capital expenditure. This suggests that in order to ensure financial sustainability of EDM, further tariff increases above the rate of inflation may be needed even after the considerable increase in 2015 before sufficient revenues can be generated from exports. Future tariff adjustments should be considered together with the revenues generated from exports as there is a potential to partly subsidize domestic tariffs from export revenues in the longer term.

35. Over the last three years, EDM's finances have deteriorated. From making a profit in 2011 and 2012 it reported a net loss of 68 MT million (US$ 2.4 million) in 2013. Bulk supply costs rose faster than revenues from the sale of electricity, while depreciation and net financing costs also rose more rapidly than revenues. Although EDM's revenues increased by 14.8%, its operating expenses increased by 18.4% per annum on average between 2011 and 2013. EDM's employee numbers fell from 3,735 in 2009 to 3,525 in 2013 (a reduction of 5.6%) while the number of customers increased by 71%.[51] Table 8 below provides an overview of EDM's current financial situation. For further information on the current and forecast financial situation of EDM refer to Annex 1: Financial appraisal of EDM.

Table 8: EdM Financial indicators (historic)

MT million, current prices, where relevant	2011	2012	2013
Total revenue	7,352	8,496	9,913
Total operation expenses	5,398	6,707	7,563
Cash flow from operating activities	1,901	1,772	3,023
Net profit for the year	638	105	-68
Capex	-3,380	-4,557	-5,046

[50] EdM, Desempenho da EdM e Visão de Crescimento Empresarial, February 2015, p80 and p81.
[51] Our understanding is that EdM is currently understaffed.

Free operating cash flow	-1,480	-2,785	-2,023
Debt / EBITDA	8.9	8.5	7.9
EBITDA / Interest	9.8	9.0	9.4
CFO / Debt	11%	12%	16%
FOCF / Debt	-9%	-18%	-11%
Net Debt / Net Debt + Equity	51%	42%	46%
DSCR	0.83	1.22	0.60
Current ratio	1.21	1.12	1.02

Source: EdM's audited financial statements 2012, 2013
Note: Debt figure excludes grants

36. The audited accounts show that EdM has a positive cash flow from operations but that these are insufficient to maintain the system and fund current and future capital expenditures. EdM currently does not have the financial resources to meet the government's access targets and enhance the system, resulting in its continual dependence on external funding. EdM has a significant amount of debt relative to its earnings, as indicated by the debt / EBITDA, CFO / debt and FOCF / debt ratios. A current ratio greater than 1 indicates that EdM would be able to meet its current liabilities at short notice. However, this ratio has deteriorated over time and in 2013 was very close to 1. In addition, the debt service coverage ratio is below 1, indicating that EdM's operating income is insufficient to meet its debt repayments and interest.

37. Investments in the power sector currently are dependent on a number of different forms of funding. Specifically, EdM's assets grew by about 24% (from 35,134 MT million to 43,631 MT million) between 2011 and 2013, mainly as a result of the expansion of the distribution network. These capital expenditures were covered mainly through budget support in the form of grants, on-lending loans from the government (sourced from institutions such as World Bank IDA, Belgium, Sweden, etc), direct grants from donors and other concessional loans.

38. As at 2013, on-lending loans from the government formed the most important source of debt funding for EdM (44% share in debt funding) and grants from donors 38%.[52] EdM's outstanding on-lending loans in 2013 were 6,875 MT million (US$ 222 million) and grants from donors amounted to 5,941 MT million (US$ 192 million). The different forms of debt funding are set out in Table 9 below.

EdM finances its activities through revenues, budget support,

Table 9: Forms of debt funding (outstanding balances)

US$ million, current prices	2011	2012	2013	2013 (share in debt funding)
On-lending loans	274	197	222	44%
Donor grants	92	161	192	38%
Commercial and quasi commercial loans	58	56	90	18%

Source: EdM's audited financial statements 2012, 2013

[52] Grants from donors are net income for EdM as there is no expectation on repayment. These grants are however recorded as liability on EdM's balance sheet and recognised in profit and loss account on a systematic basis over time in line with when the underlying expenditure for which the grants were received are incurred.

onlending from government originating from development partners and direct donor grants.

39. In addition to the on-lending, the Government of Mozambique provides budget support. The amount of budget support provided was MT 194 million (US$ 7 million) in 2011, and increased significantly by MT 3,646 million (US4 128 million) in 2012 with a view to increasing the electrification rates in Mozambique.[53] The amount allocated in 2013 was MT 216 million (US$ 7 million). These budget supports amounted to 0.84% and 0.05% of Mozambican GDP in 2012 and 2013, respectively.

Table 10: Budget support

MT million (US$ million), current prices	2011	2012	2013
Government budget support allocated	194 (7)	3,409 (120)	216 (7)
Government budget support as outstanding balances	*237 (8)*	*3,646 (128)*	*3,862 (125)*

Source: EdM's audited financial statements 2012, 2013

Note: Financial recourses received by EdM from the government are recorded under 'supplementary capital' in EdM's audited financial accounts. These grants are aimed to finance projects related to rural electrification in Mozambique. It is expected that this capital will be converted into share capital in future.

40. Direct donor grants have increased considerably in recent years, mostly destined for access projects in peri-urban and urban areas. Specifically, EdM received of the order of 1,974 MT million (US$ 70 million) and 1,389 MT million (US$ 45 million) of new grants from donors in 2012 and 2013, respectively.

Table 11: Grants from donors

MT million (US$ million), current prices	2011	2012	2013
Donor grants awarded	0 (0)	1,974 (70)	1,389 (45)
Donor grants as outstanding balances	*2,685 (92)*	*4,563 (161)*	*5,941 (192)*

Source: EdM's audited financial statements 2012, 2013

41. Only a small proportion of EdM´s current debt funding originates from commercial and quasi commercial loans (18%). EdM had in the order of 2,792 MT million (US$ 90 million) of outstanding loans as at 2013 from a combination of quasi-commercial lenders and private sector investors (local banks). Outstanding commercial and quasi commercial loans increased in absolute terms (from US$ 58 million in 2011 to US$ 90 million in 2013) and also increased relative to other sources of external funding (i.e. concessional loans and grants). Outstanding commercial and quasi-commercial loans as a proportion of EdM's total loans and grants outstanding increased from 14% in 2011 to 18% in 2013. The absolute increase in commercial funding suggests that EdM has been better able to raise money in commercial or quasi-commercial settings. The majority of this funding comes from AfD, DBSA and Sasol.[54] The most significant lender is Sasol with

[53] The budget support is recorded as ('supplementary capital') in EdM's financial report and will be converted into share capital.

[54] AFD (L'Agence Française de Développement), DBSA (Development Bank of Southern Africa)

an outstanding balance to EdM in 2013 of 1,277 MT million (US$ 41 million)[55]. The share of loans from local banks is small, with an outstanding balance totalling 467 MT million (US$ 15 million) in 2013.

42. **EdM's precarious financial position is partly due to a lack of tariff increases in recent years.** Tariffs are currently uniform across the country with large customers (supplied at voltage level of 66kV or higher) required to negotiate their tariffs with EdM. Tariff-based customers form 90% of EdM's non-export energy sales. The average current level is 3.57 MT/kWh (10.74 USc/kWh) after a 26% increase approved in October 2015. However, the last tariff increase took place in 2010 and since then EdM's tariffs have decreased by about 20% in real terms while costs have risen by about 18% between 2011 and 2013. This is despite a tariff study undertaken for EdM in 2011 that recommended tariffs increase by an average of 15% in 2012, 15% in 2013 and 9% in 2014.[56] Table 12 below shows the evolution of tariff in real terms. The 26% nominal tariff increase in October 2015 means that that in real terms 2015 tariffs would be about three percent higher than in 2010.

Table 12: Tariff analysis

	2010	2011	2012	2013	2014	2015
Inflation, Mozambique	12.7%	10.4%	2.1%	4.2%	2.3%	4.0%
Real tariff levels (as compared to 2010 tariffs).	100%	89.6%	87.5%	83.3%	81.0%	103.0%

43. Although tariff revenues have increased with the increase in the number of connections, the revenue from each new customer is insufficient to cover EdM's costs of connection and supply.

44. In October 2015, the Council of Ministers granted EdM an average tariff increase of 26.4%.[57] EdM structured the tariff proposal so as to avoid an increase for those on the social tariff and for agricultural consumers connected at low voltage. Below average tariff increases were proposed and approved for residential customers and agricultural customers connected at medium voltage. Above average increases were proposed for other tariff customers (large customers and commercial customers).

[55] This is likely related to the recent CTRG project, where EdM's 51% equity share is currently being carried by Sasol until the project can be re-financed (expected imminently).
[56] Elexpert (Pty) Ltd, EdM: Review of the Electricity Tariff Arrangement and Tracking Mechanisms - Summary Report, 17 January 2012.
[57] See EDM, Fundamentação da Proposta de Ajustamento do Tarifáfio de Energía Eléctrica da EdM, June 2015.

Table 13 Proposed tariff increases and EdM's revenues

Customer type	Proposed tariff adjustment	Proportion of current revenues
Social tariff	0%	0.02%
Residential customers	18%	52.96%
Agriculture LV	0%	0.12%
Agriculture MV	15%	0.54%
Commercial	40%	16.59%
Large Customers LV	30%	5.02%
Large consumers MV	40%	22.65%
Large consumers HV	35%	2.13%
Average tariff increase	**26.4%**	**100%**

Source: EdM

45. A comparison between average tariffs for sales in Mozambique and export tariff shows that exports are important to ensure EdM's financial viability in the long-run. Exports revenues can also be used to partially subsidize Mozambican tariffs. The economic impact study for the Transmission Backbone Feasibility Study estimated an avoided generation cost of 10.5 USc/kWh and a willingness to pay of 17.5 USc/kWh in South Africa.[58] For 2014, the average export tariff was 12.5 USc/kWh and for 2015 EdM's assumed average export tariff is 14 USc/kWh. In comparison, the tariff for transmission connected customers in Mozambique was 10 USc/kWh in 2014 and is assumed to be 11.5 USc/kWh in 2015. Currently, average tariffs for sales in Mozambique are 10.83 USc/kWh[59] for tariff based customers. Table 14 below provides the weighted average tariffs (before and after the tariff adjustment of October 2015) for Mozambican tariff-based customers and export tariff.

Table 14: Current level of tariffs

Customer type	Before Tariff Adj	Actual		Before Tariff Adj	Actual
	USc/kWh	USc/kWh		MT/kWh	MT/kWh
Social tariff	3.22	3.22		1.07	1.07
Residential customers	9.58	11.30		3.18	3.75
Agriculture LV	11.17	11.17		3.71	3.71
Agriculture MV	3.73	4.31		1.24	1.43
Commercial	12.83	17.95		4.26	5.96
Large Customers LV	5.00	6.51		1.66	2.16
Large consumers MV	4.13	5.78		1.37	1.92
Large consumers HV	3.70	5.00		1.23	1.66
Average tariff (tariff based customers)	**8.52**	**10.83**		**2.82**	**3.57**
Large non-tariff customers (>=66kV)	10.00	11.50		3.25	3.82
Export price	12.50	14.00		4.07	4.65

Source: EdM
Note: For conversion between MT and US$ a conversion rate of 33.2 MT/US$ is used (World Bank)

[58] Vatenfall Power Consultant and Norconsult, March 2012.
[59] For conversion between MT and US$ exchange rate of 33.2 MT/US$ (2015 FX rate) was used (World Bank)

46. There are 3,596 customers on the social tariff compared to 1,259,638 on the residential tariff.[60] This and the low average consumption of customers on the social tariff suggest that the social tariff is not currently placing a large financial burden on EdM.

47. The 18% tariff increase for residential domestic customers is about 8 percentage points lower than the average proposed tariff increase of 26.4%. That is, in real terms, tariffs for residential customers would still be about five percentage points lower than in 2010.

48. EDM's analysis shows that bills for low income households (consuming 200 kWh per month) would increase by 114.48 MT per month, bills for medium income households (consuming 500 kWh per month) would increase by 286.20 MT and bills for high income households (consuming 1,000 kWh per month) would increase by 597.60 MT per month.[61]

49. EDM´s approved tariff increase in October 2015 shows an average tariff increase of 26.4%. At the time of preparing this Note, mostly prior to October 2015, the Bank's team considered a more conservative tariff increase of 25% as the base case scenario. This follows from discussions with the Ministry of Mineral Resources and Energy and EdM. Other scenarios for different tariff increases are considered in Annex 3 to show their effect on EDM´s financial situation going forward.

IV. Analysis of opportunities going forward

50. Delivering efficiently produced, technically and financially sustainable electricity to consumers in the current context of the Mozambican power sector is a challenging activity, requiring careful planning and coordination.

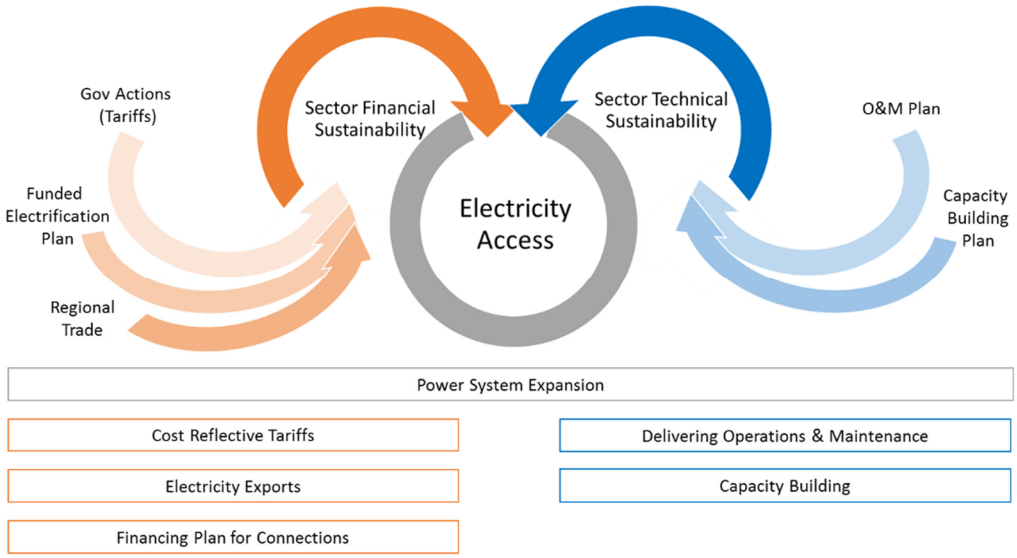
51. Expanding energy access in a sustainable manner requires a plan to prevent new customers further deteriorating EdM's finances. Promoting a financially sound EdM will require the government to target more budgetary support directly to energy access programs.

52. Furthermore, if Mozambique can take advantage of its natural resources and geographical location to promote regional trade in the power sector, then it could be possible to use trade as a complementary mechanism to help EdM in achieving financial sustainability while promoting electricity access.

53. With this structure in mind, there is a broad range of activities, projects or measures which could contribute, directly or indirectly, to the objective of ensuring sustainable electricity access (see Figure below).

[60] EdM, Proposta de Ajustamento Tarifário para 2015, June 2015
[61] EdM, Fundamentação da Proposta de Ajustamento do Tarifário de Energia Electrica da EdM, June 2015.

Figure 10: The key sector issues



Delivering Operations & Maintenance

54. Another important aspect that is crucial to drive improvement in the financial sustainability of EDM, is the reduction of technical and non-technical losses. Under the Energy Development and Access Project (EDAP) financed by the World Bank, EDM is currently implementing two key activities aimed at achieving and sustaining an acceptable level of non-technical losses: (i) incorporation of a state-of-art commercial management system (CMS) to support efficient, transparent and accountable execution of all commercial processes and activities, in particular the revenue cycle (metering-billing-collection); and (ii) implementation of a revenue protection program (RPP), based on systematic recording and monitoring of consumption of EDM's largest 4,000 users (3% of total number, representing more than 45% of total current sales) with the support of Advanced Metering Infrastructure (AMI). These activities need to be fully implemented.

55. Apart from improving operations, EDM needs to be able to fully fund its operations and maintenance (O&M). Doing so involves having sufficient income from operations which basically means sufficiently high tariffs. Having certainty over sufficient revenue income will enable EDM to plan more effectively.

56. EDM is not carrying out sufficient O&M expenditures. It is difficult to say what the appropriate level of O&M should be for EDM, and it is difficult to benchmark EDM against other utilities as utilities tend to be different in their characteristics. If we assume that the rate of 80,000 connections per year is a proxy for sufficient additional O&M, to cover these costs, at least a 35% increase in tariffs would be required in 2015. This would make EDM financially sustainable even in the short term.

Power System Expansion

57. Three forms of investment will be required to deliver on access targets. Firstly, project focused investment for major generation (which will likely be mostly from the private sector with possible limited EDM participation) and for major transmission projects (mostly public sector funded with development partner support). Secondly, a large program of less discrete investments across the grid – mostly focused on increasing access. Thirdly, for off-grid electrification projects.

58. The UN's Sustainable Energy for All program targets universal access[62], which the Government should aspire to in the long run. However, if this target was to be met by 2030, this would require a substantial increase in the rate of new connections. Specifically, this would require 419,000 new connections per year which is about 301,000 new connections per year more than EDM's current connection rate of 118,000 per annum. Given the large increase in the rate at which EDM is currently connecting new customers required, the prospects for achieving universal access by 2030 do not seem realistic.

59. EDM published its Business Plan for the period 2015 – 2019 in October 2014.[63] Thus EDM's Business Plan was published after the Ministry indicated a draft target for 50% access rate by 2023. Based on EDM's Business Plan, EDM should be connecting of the order of 100,000 to 135,000 new households per year in the next five years. According to our calculations, this translates into achieving a 35.8% access rate in 2019. This is about 6 percentage points lower than the one implied for 2019 by the Government's draft Energy Strategy target of 50% access by 2023.[64] [65]

60. The optimal way to increase access to electricity services is likely to include significant off-grid or mini-grid developments given the large gaps with no main grid access. Even though the Government's access target as currently set out specifically applies to grid connected customers only, there is a need for coordination between on-grid and off-grid roll out plans. This should form part of a National Electrification Plan.

It is important to establish the cost of meeting the access target -

61. The Bank has estimated the cost of connecting new customers to the grid based on the Master Plan Update report, revised to use lower cost engineering solutions similar to those used in a number of countries including in the US, in Latin America and recently in Africa. This includes much greater use of single phase instead of three phase distribution – which allows to supply low and medium voltage demands with acceptable service quality at significantly lower costs. Market-determined pricing from Peru is used

[62] "*Universal Access to Modern Energy by 2030*" has been proposed as one of the three key pillars of the global Sustainable Energy for All (SE4All) program – an initiative co-chaired by the United Nations Secretary General and the World Bank President.

[63] Corporate Business Plan of Electricidade de Moçambique 2015 – 2019, October 2014

[64] The government in its five year government program stipulates a target of 55% access rate by 2019 (Proposta do Programa Quinquenal do Governo 2015 – 2019, p. 34). Our understanding is that this access target refers to 'access to public lighting' rather than grid access as such. The explicit target for grid access of 50% by 2023 was stated by the government in its Energy Strategy for the period 2014 - 2023 (Estratégia de energia 2014-2023, p. 21).

[65] We assume linear growth in the number of connections from 2015 to 2023 to achieve the Government target.

to evaluate whether and how it can be funded.

for reference calculation purposes, and make possible to establish a lower bound for electrification costs in Mozambique. The actual costs will likely be higher. With the low cost solutions, connection costs vary by type of customer between around US$385 per connection for an 'ordinary' single-phase connection request to over US$1,400 per connection for rural customers where intensification of the distribution network is required. Given that this is a lower bound, a higher but still reasonable estimate of connection costs made by Bank staff again based on the experience in a number of countries ranges between about US$580 per connection for ordinary requests to over US$2,100 per connection for additional connections above the Master Plan assumptions.[66] This compares to revenues today from household customers of about US$120 per annum.[67]

62. Achieving the 50% grid access target by 2023 would require a considerable increase in the rate at which EDM is currently connecting new customers. EDM has recently been connecting about 120,000 households per annum (between 2011 and 2014) and would need to connect an additional 57,000 households per annum above its current rate of connections if it was to meet the 50% access target by 2023[68]. This suggests the following capital cost program (Table 15). These costs use the base assumptions discussed above for low cost engineering solutions estimated by the Bank.

Table 15: Master Plan transmission and distribution investment program (meeting access target by 2023)

US$(2012) million	2014-2017	2018-2022	2023-2027	Total
Transmission	838	921	763	2,521
Distribution	955	1,756	2,242	4,953
Large projects	514	60	2	576
Special projects	95	37	0	132
Total	**2,401**	**2,774**	**3,006**	**8,182**

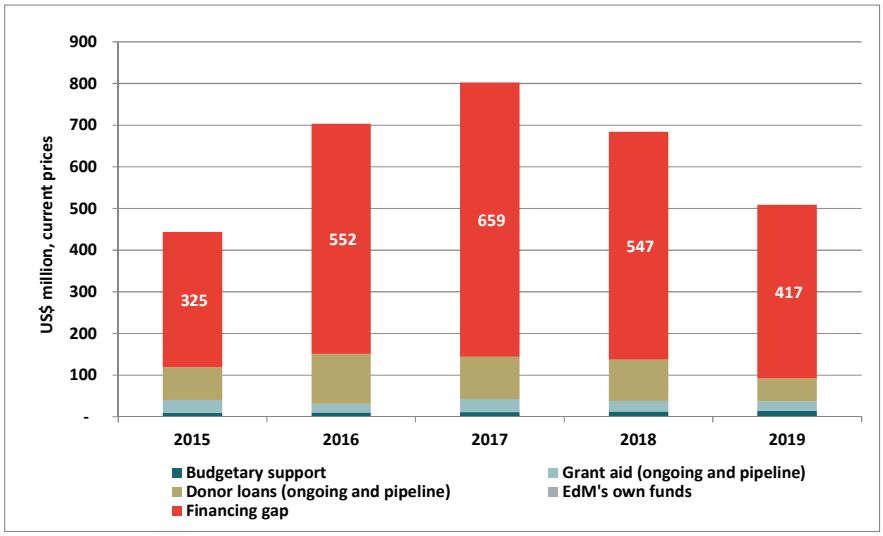
Source: Norconsult, Master Plan Update Volume III April 2014 Table 14-1, adjusted by EDM for timing and adjusted by World Bank consultants to reflect additional new connection costs and based on the use of lower cost engineering solutions by World Bank staff. In addition, some of the special projects are assumed to be private sector financed and therefore have been removed.
Note: Large projects include load dispatch centres, Tete- Malawi Interconnection project and Temane Transmission; Special projects include equity investments in JV projects (CTRG, Moatize and Temane CCGT)

63. It would take many years for EDM to recoup the capital expenditure for connecting customers even setting aside the cost of new generation which will largely take place via IPPs. Figure 11 estimates the amount of additional funds needed for the next five years to meet EDM's investment needs if it was to meet the 50% access target by 2023 and assuming a 25% tariff increase in 2015.

[66] This higher cost of connections estimated by the Bank staff is used in the estimation of CAPEX, unless stated otherwise.
[67] In 2013, the average sales per residential customer was 1,224 kWh (1,416 GWh of billed sales divided by 1.156 million residential customers). The average tariff for residential customers in 2012 was 2.95 MT/kWh (the amount invoiced 3,637 MT million divided by 1,233 GWh of total consumption for residential customers). This implies annual revenues of US$ 117 per customer in 2013. Sources: EDM Annual Statistical Report 2012 and 2013, and EDM corporate model.
[68] Ministério da Energia. Estratégia de Energia (2014 -2023) [draft document].

The base case costs for meeting the access target by 2023.

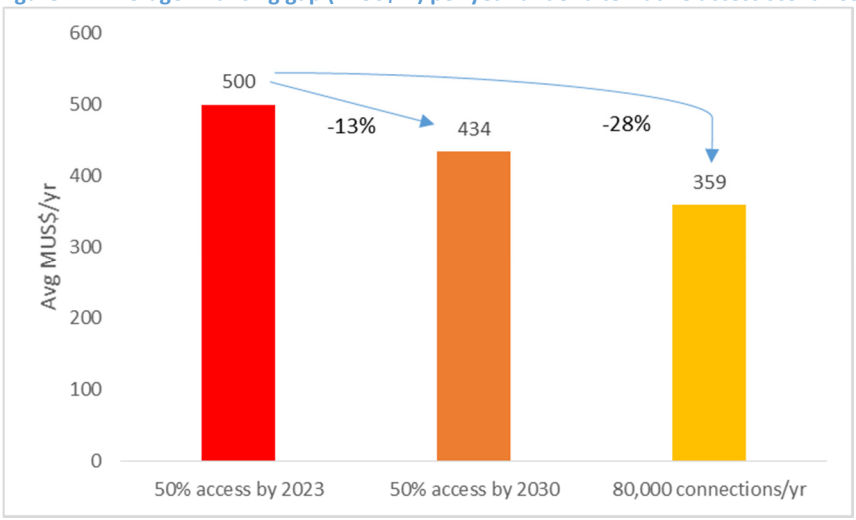
Figure 11: Financing gap to meet EDM's investment needs and 50% access target by 2023[69]



Note: This scenario considers a 25% tariff increase in 2015, budgetary support at the level of 0.05% of Mozambican GDP and 50% access target is met by 2023; assumes ongoing and pipeline donor loans and grants (please refer to Annex 6 for a list of ongoing and pipeline loans).

64. The above figure shows that EDM will need, on average, US$500 million per year on top of its currently expected budgetary support (0.05% of Mozambican GDP) in order to achieve the 50% access target by 2023. A comparison between a 50% access target by 2023 and less stringent access scenarios show that a 13% reduction in the yearly financing gap could be achieved if the 50% access target is achieved by 2030 (instead of 2023). Alternatively, EDM would need to raise 28% less funds if it was connecting on average 80,000 new customers per year (approximately 35% access would be achieved under this scenario in 2023 and 38% by 2030). This information is summarised in **Figure 12** below.

Figure 12: Average financing gap (in US$m) per year under alternative access scenarios



Note: This analysis assumes lower cost engineering solutions are used in line with the World Bank staff estimates (base case).

[69] Annex 6 provides information on ongoing and pipeline loans and grants.

65. The implication of the 25% tariff increase (followed by inflation adjustments) is to help EDM restore its financial health, especially in the longer term. It is important to note that even if cash flow from operating activities is positive for most of the years of the forecast, EDM's ability to fund its CAPEX remains limited. This is because these funds are firstly needed to cover any short term liabilities, including debt financing. Only then, and – if anything is left after the repayment of short term liabilities – could EDM finance part of the access CAPEX. However, as the amount of short term liabilities is linked to the access target, the more aggressive the access target is, the more likely EDM will need to rely on short term loans (unless additional Government or donor support is provided) and so less financial resources will be available to fund access CAPEX from EDM's own resources.

66. Table 16 below shows that, even under a less aggressive access target (50% access target met by 2030), it will take more than 7 years to restore EDM's financial position to the extent that it will be able to co-finance the access CAPEX. We note however that if the forecast export revenues materialise, there is a potential that in the longer term, EDM should have enough internal resources to finance a substantial share of the access CAPEX. Specifically, EDM could finance on average up to 76% of the overall capital expenditures for the period between 2023 and 2026, as indicated in Table 16 below.

Table 16: EdM's ability to fund CAPEX

(% of CAPEX)	2015-2018	2019-2022	2023-2026	2027-2030
50% access target met by 2023	0%	0%	0%	55%
50% access target met by 2030	0%	0%	76%	100%
80,000 connections per annum	0%	31%	99%	100%

Note: This analysis assumes lower cost engineering solutions are used in line with the World Bank staff estimates (base case) and there is a 25% tariff increase in 2015 followed by increases at inflation rate. The remaining CAPEX is funded by a combination of commercial and quasi-commercial loans at an average rate 7.4% per annum. Worth noting that if the remaining CAPEX is funded by a combination of grants, donor loans and commercial loans, EDM's ability to fund the CAPEX from its own resources would be higher. This is because commercial loans are relatively more expensive as compared to concessional loans and grants represent net income for EDM.

67. Finally, it is important to note that there is a need to enhance EDM's ability to raise funds at relatively low cost in commercial settings so that the debt burden on EDM is not unsustainable (currently the average cost of debt from local banks for EDM is approximately 14% per annum). Enhancing EDM's ability to raise funds in commercial settings at a lower cost could be achieved by improving the commercial and operational fundamental performance of EDM and also by considerably improving sector transparency on policy and tariff decisions. This should in turn lead to a decrease in cost of debt (lower interest rates), thus improving EDM's overall profitability and its ability to use its operating cash flow to partly fund its CAPEX rather than using its revenues to repay the high cost of debt. It is important to note that ultimately, before export revenues increase, EDM's ability to carry out such an ambitious access investment plan will depend on a combination of factors, including tariff increases, EDM's ability to raise money, the ability of donors to grant or provide loans to EDM, as well as Government budget support.

68. EDM in its estimates from November 2014 also assumes that it will heavily rely on external funding. Specifically, it assumes the following financing split between donor loans, commercial loans and grant funding for the next five years.

Table 17: Financing split (% of CAPEX)

% of CAPEX	2015	2016	2017	2018	2019
Financing split – MTm current prices					
Donor loans	4,494	9,462	11,885	8,853	5,090
Commercial loans	7,305	10,754	12,121	11,007	9,072
Grants, incl. budget support	2,932	3,599	3,757	4,304	4,172
Total	14,731	23,815	27,764	24,164	18,334
Financing split – % of CAPEX					
Soft loans	31%	40%	43%	37%	28%
Commercial loans	50%	45%	44%	46%	49%
Grants	20%	15%	14%	18%	23%

Source: Assumptions on financing (% of CAPEX) are based on EDM's Corporate Model from November 2014
Note: This analysis assumes the 50% access target is reached by 2023 and lower cost engineering solutions are used in line with the World Bank staff estimates (base case).

69. The above shows that EDM assumes a considerable increase in the amount of commercial loans going forward. Taking 2015 as an example, EDM assumes that it will be able to raise 7,305 MT million of commercial loans. Although there has been recently an increase in commercial funding (from 1,694 MT million in 2011 to 2,792 MT million in 2013), suggesting that EDM has been better able to raise money in commercial or quasi-commercial settings, the current level of commercial funding is considerably lower as compared to EDM's assumptions going forward. Whether EDM will be able to raise additional funds in commercial and quasi-commercial settings, is likely to depend on tariff and sector/regulatory transparency, among other aspects.

In addition to transmission and distribution costs, meeting the access targets will also require investment in generation.

70. From the generation perspective, meeting the needs of increased demand due to expanding access and increased economic activity requires a significant increase in generation capacity and electricity production. Mozambique has many generation development options, mostly focused on utilizing indigenous energy resources including hydropower, gas, coal and renewables. While some of the projects would be developed partly by EDM, most would be developed as independent power producers (IPPs) selling output to EDM through a long term power purchase agreement (PPA). Here, we expect that EDM will engage more and more in competitive processes to determine developers and shareholders – especially in the case of standard generation technologies such as gas and solar PV.

71. The choice of which projects to develop and when must be made taking into account security of supply, diversification of supply technology, geographic spread, the ability to develop the project and cost.

72. EDM has developed a generation expansion scenario from these options to meet future demand, as summarized in the table below with more detailed breakdown provided in Annex 5: Planned generation projects.

Table 18: Supply summary

Name	2014	2015	2016	2017	2018	2019	2020	2021	2022
HCB	500	542	600	600	600	600	600	600	600
EDM	18	18	18	114	114	114	114	114	114
IPP	60	233	382	309	322	750	1,469	2,015	2,424
IMP	-	-	-	-	-	-	-	-	-
Total	578	793	1,000	1,024	1,037	1,464	2,184	2,729	3,138

Name	2023	2024	2025	2026	2027	2028	2029	2030
HCB	600	600	600	600	600	600	600	1,475
EDM	114	114	114	114	114	114	114	114
IPP	2,424	2,424	2,574	2,574	2,574	2,574	2,574	2,574
IMP	-	-	-	-	-	-	-	-
Total	3,138	3,138	3,288	3,288	3,288	3,288	3,288	4,163

Note: generation supply available to EDM, not including import capacity. The considerable increase in 2030 follows the potential to increase the power available to EDM following the expiry of PPA contract between Hidroelectrica Cohora Bassa (HCB) and Eskom. As this power could be sold at export market price from 2030 onwards.

Cost Reflective Tariffs, willingness to pay and affordability

73. The experience shows that tariffs have not been adjusted in line with EDM's costs. To ensure the ongoing financial viability of EDM it is important that in future tariffs are adjusted in line with reasonable costs. Our earlier estimate suggested that full O&M costs may be covered with a tariff increase in 2015 of the order of 35%. If we add to this, the government target of 50% access by 2023, we find that a 45% tariff increase is required in 2015 (see Table 36 in Annex 3). However, such tariff increases are unrealistic to expect in 2015, as it has been demonstrated with the 26.4% tariff adjustment recently approved. In this respect, we consider scenarios with a 25% tariff increase in 2015 as the base case scenario with further increases at inflation and/or further options for filling the 'gap'.

74. As EDM strives to meet the government's access targets by connecting more customers, its cash flow position is likely to get worse and its reliance on external sources of financing will likely increase. The following table (Table 19) shows 3 scenarios for EDM's financial performance, assuming the 50% access target is met by 2023. The comparison of these scenarios demonstrates the need for a tariff increase. Even with a tariff increase of 25% in 2015, EDM would continue to make a loss from 2015 until 2019 that amounts to 2,730 MT million (US$ 82 million) on average per annum.[70] Only from 2020, and provided that new generation projects create a surplus of power in Mozambique and all excess supply can be exported to South Africa/the SAPP, would EDM likely become profitable. This would reduce but not eliminate EDM's dependence on external sources of funding. [71]

[70] Measured at constant 2015 prices.

[71] The estimates (Table 19-Table 20) are based on an assumption that the financing gap is funded by commercial loans at an average rate of 7.4% per annum. We note that if the financing gap was funded by a combination of grants, donor loans and commercial loans, EDM's financial position would improve, reducing its dependence on external sources of funding in subsequent years.

Table 19: EDM's financial performance (MT million, current prices)

Tariff scenario	MT million, current prices	2015	2020	2025
No tariff increase whatsoever is considered under this scenario	Cash flow from operating activities	-1,844	3,898	-2,363
	Net profit for the year	-4,388	-2,146	-10,371
25% tariff increase is assumed for 2015 and increase at inflation thereafter	Cash flow from operating activities	196	12,729	23,212
	Net profit for the year	-2,156	6,842	15,502
25% tariff increase is assumed for 2015 and 2017. Tariffs are assumed to increase at inflation in 2016 and in 2018 and thereafter	Cash flow from operating activities	196	16,358	30,206
	Net profit for the year	-2,156	10,516	22,569

75. A less ambitious target of meeting 50% access by 2030 would still require a significant tariff increase to make EDM profitable in the medium term. However, it would place less financial pressure on EDM, importantly reducing the underlying cost of debt finance.

Table 20: EDM's financial performance – 50% access by 2030

MT million, current prices	2015	2020	2025
Cash flow from operating activities	628	14,602	27,267
Net profit for the year	-1,621	9,233	20,781

Note: a 25% tariff increase is assumed for 2015 and tariffs are assumed to increase at inflation thereafter

76. In terms of affordability, households would be, on average, better off if given access to the grid compared to the current situation in which they have to rely on other fuels to cover their power needs. This holds even with the 25% nominal tariff increase in 2015.

77. In general, kerosene and other alternatives for lighting are poor substitutes for electricity. This is because not only is the cost of kerosene lighting to consumers considerably higher than the cost of electricity in Mozambique, but also the quality of lighting that can be derived from kerosene is very poor.

78. In 2012, the estimated cost of kerosene lighting was 12.0 USc/kWh[72] (about 13% higher than the average residential electricity tariff at that time) which can be considered the opportunity cost of electricity.[73] Alternatively, the Feasibility Study for the Transmission Backbone[74] estimated that the willingness to pay for electricity lighting is

[72] Final Feasibility Study – Volume II economic Impact Study, March 2012

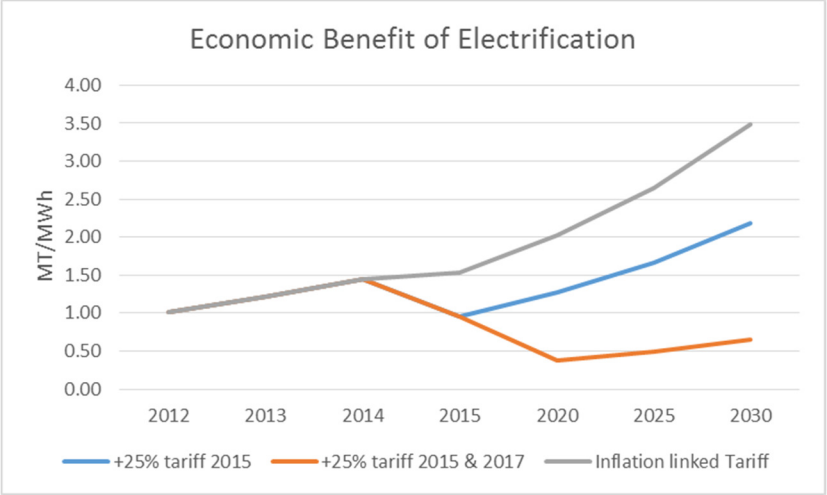
[73] Moreover, as the quality of electricity lighting is considerably higher to the kerosene one (6-18 lumen per watt as compared to 0.1 lumen obtained from kerosene).

[74] Final Feasibility Study – Volume II economic Impact Study, March 2012

14.0 USc/KWh (about 17% higher than what households were paying for kerosene at that time and about 32% higher than what they were paying for electricity).

79. The figure below uses a comparison between projected cost of kerosene lighting, and the electricity tariffs to demonstrate the relative benefits of electrification. The analysis shows that as at 2014, residential consumers would have paid on average about 1.5 MT/MWh more for electricity than what they were paying for kerosene. Even if there was a 25% tariff increase in 2015 and in 2017 and tariffs increased at inflation in 2016 and in all years post 2017, the opportunity cost would still have exceeded the electricity tariff.

Figure 13: Net Economic benefit of tariff scenarios based on opportunity cost



Source: Final Feasibility Study – Volume II Economic Impact Study, March 2012
Note: The cost of kerosene lighting is assumed to increase in line with Mozambican inflation (no real price change), tariffs for electricity are assumed to increase in line with inflation in years when there is no tariff increase

80. As expected, poorer households would be the most affected by a general tariff increase, as the proportion of the electricity bill over total household expenditure is higher for lower income households than for higher income ones. This is why the tariff adjustment proposed by EDM excludes customers under the social tariff. For the rest of the residential consumers, on average, a 25% tariff adjustment would increase the share of the electricity bill as a percentage over total household expenditure from current 2.2% to 2.5%, thus, marginally affecting the affordability of the electricity tariffs (see Table 21).

Table 21: Proportion of household expenditure on electricity

Quintile	Electricity expenditure as a % of household expenditure		
	Pre-tariff increase	After 25% tariff increase	% point change
1	5.3%	5.3%	0.0%
2	4.1%	4.8%	0.7%
3	2.7%	3.2%	0.5%
4	2.3%	2.7%	0.4%
5	2.1%	2.5%	0.4%
Average	**2.2%**	**2.5%**	**0.4%**

Note: only households that use electricity are included in this analysis. No price elasticity assumed in the estimation and first quintile of the population assumed under the social tariff.
Source: World Bank Household Survey for expenditure data

Electricity Exports and Regional trade

When considering the funding of these investments, regional trade offers an important opportunity to achieve profitable returns that can be used to cross-subsidize such costs.

81. As well as meeting growing demand, delivering access and meeting security of supply needs, the investment strategy for both the grid and generation also needs to consider an integrated approach with exports to help the financial sustainability of the sector. This is because with the region being in deficit, there is an opportunity to sell power to the region at profitable prices, and to cross-subsidize activities in Mozambique with these profits. This would enable additional investment or substitution for payments from consumers or the budget. The generation expansion scenario provides for generation in excess of that required to meet Mozambican demand. With the current and expected generation deficit in the region, we assume there will continue to be a market to absorb exports at a higher sales price than the long run marginal cost of new generation in Mozambique. As previously discussed, for 2014, the average export tariff was 12.5 USc/kWh and for 2015 EDM has advised us that it expects an export tariff of 14 USc/kWh. This is a 'spot' price based on current market fundamentals and therefore not guaranteed going forward. However, there is a reasonable likelihood that demand/supply fundamentals across the region will remain similar for the foreseeable future. The 14 US$c /kWh price is therefore seen as reasonable. For good measure, a 10 US$c /kWh scenario is also run as a sensitivity (refer to Annex 4 for further details). With the current generation expansion plan and all surplus power being exported, the following export revenues are possible.

Table 22: Export revenues and supply surplus (50% access in 2023)

MT million, current prices	2015	2020	2025
Export Revenue	2,846	42,281	62,968
Export (% total revenue)	17%	53%	46%
Amount exported (GWh)	612	6,927	7,856

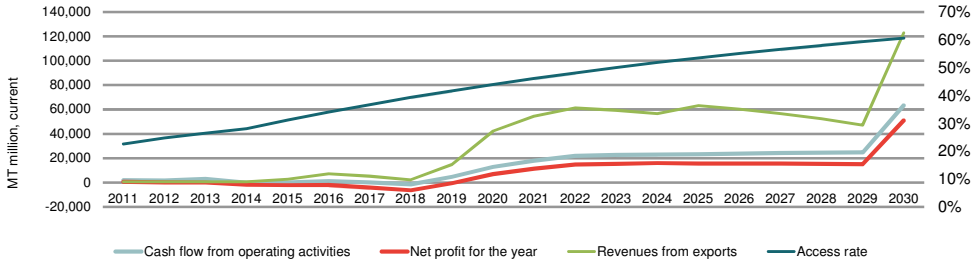
Note: a 25% tariff increase is assumed for 2015 and tariffs are assumed to increase at inflation thereafter

82. Analysis on export income using the above price for exports relative to income per new household customer finds that income from exports during the period 2015-30 has a financial value of roughly 5 times the financial value of a new household customer when considered in present value terms in 2015. The trade-off between meeting the needs of Mozambican consumption (and the large investment program this entails) and the benefits of export revenues indicates the need for appropriate inter-temporal policy choices leading to an investment strategy consistent with national objectives and financial sustainability for EDM. This may mean trading off the timing as to when the access target is met and the timing of distribution grid investments required to meet the target against the higher revenues from using a greater proportion of generation output for exports and the investments in generation, regional transmission, and the gas facilities required to deliver those exports.

83. 'What if' scenarios are used to simulate the impact of different decisions on EDM. These are presented in Figure 14 and in more detail in Annex 3. These show the importance of the timing and size of tariff increases and exports of power – and what this means for financial sustainability and achievability of access rates. Scenario 1 below shows that the 25% nominal tariff increase in 2015, followed by inflation level increases is the minimum – and in fact, that EDM's financial condition does not actually significantly improve until the end of the decade when significant exports are expected. In the longer term and if the export revenues materialize, there is a potential to partly subsidize domestic tariffs from exports/to use this revenue to fund the underlying CAPEX needs.

Figure 14: Scenario 1 (further scenarios in Annex 3)

Assumptions: 50% access by 2023, 25% tariff increase in 2015 and rises with inflation thereafter



Financial performance of EdM improves from around 2019.

84. When we consider the supply and export options that lead to EDM's improved financial performance from 2020 onwards (Figure 14), the biggest driver in the simulation is the development of the Temane MGTP gas-to-power project that is due to be developed by Sasol and EDM and for which EDM is due to off-take 100% of the 400MW capacity of the plant. The Ncondezi coal-fired IPP also contributes to the positive cash flows during this period. Whilst EDM will get a smaller amount of energy from Mphanda Nkuwa (10% of the 1,500MW), this energy is expected to cost EDM significantly less – and therefore to also have a positive effect if it becomes available from 2021.

Critical to improvement in financial performance of EDM is development of relatively low cost sources of power for EDM – including the 400 MW Temane MGTP (with associated STE phase 1 transmission to Maputo to enable export) from 2019 and

85. For the longer-term, Mozambique has abundant gas resources, allowing gas to play an increasingly important role in the energy sector in the region in the future. There are a series of complex trade-offs to be made between the different uses for gas, between exporting gas and exporting power to the region and between the level of economic rent to be achieved in the power sector and in the gas sector (see box below).

Mphanda Nkuwa (with STE high voltage connection to Maputo) from 2021. The Government will need to consider the trade-offs and inter-temporal decisions between meeting access and ensuring financial sustainability of the sector.

Box – Opportunities for Mozambique in regional trade in gas[75]

Mozambique has emerged as the second largest gas resource holder in Sub-Saharan Africa as a result of a series of major offshore gas discoveries recorded since 2009. However, developing LNG on such a scale could take 20 years or more to accomplish, particularly since Mozambique will face competition in global LNG markets. Nevertheless, even if all the gas needed for 10 trains were set aside today, Mozambique would still hold at least 30 TCF of uncommitted gas, equivalent to 20 GW of generation capacity and more than the existing and projected thermal energy demand in the domestic market. Thus, the gas resource base is not a constraint on almost any commercialization options Mozambique wishes to consider. LNG exports, domestic power sales, pipeline exports, and petrochemical applications can all move forward, constrained only by market access, financing capacity, and inter-fuel competition.

For Mozambique, LNG exports are clearly the overwhelming gas allocation priority. Indeed, royalties, profit shares, and taxes from future gas exports offer a transformational opportunity to increase national wealth and income. However, because of the sheer size of its resource base, Mozambique can afford to allocate gas to domestic supply without compromising its capacity to export. Thus, the LNG netback price is not a measure of the opportunity cost of gas. In fact, over the long term, any gas application with a netback price above the minimum wholesale price could potentially be good business. This opens the door not just for the domestic power sector, but also for petrochemical and industrial applications and potential gas exports to South Africa.

Mozambican gas can be competitive with coal in a number of circumstances. As argued earlier, Mozambique has leeway to sell its gas at less than the LNG netback given the enormity of its resource base. Furthermore, the viability of gas-fired power projects would not have to rely on power exports because the economic scale of such project is just 300 MW, an amount that could realistically be absorbed by the domestic market alone.

Mozambican gas is competitive against coal in baseload power generation [in South Africa] at a delivered gas cost of $7 per MMBTU. Netting out pipeline transportation costs, this translates into a wellhead price in Mozambique of $4 per MMBTU, lower than Mozambique's LNG netback but still above its minimum wholesale price. At lower load factors, the generation economics move increasingly in favor of gas, although higher per-unit transportation costs could offset that advantage.

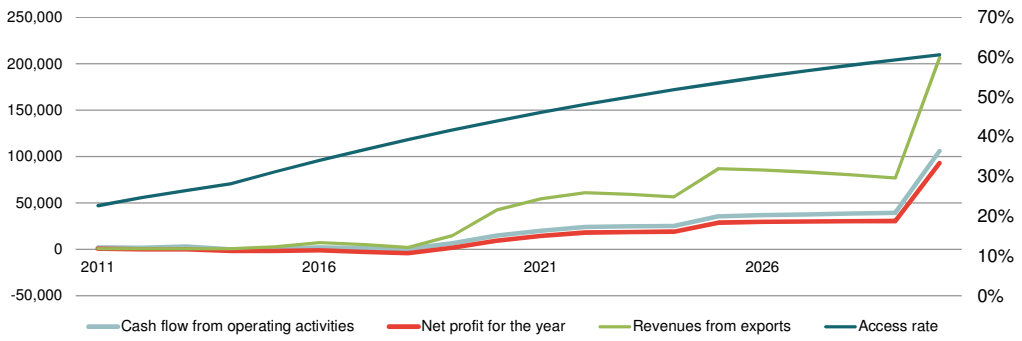
The Rovuma gas from 2025 onwards could support further improvement in EDM's financials.

86. Preliminary analysis shows that the levelized cost of Mphanda Nkuwa hydropower plant would be considerably lower than that of a large gas plant of similar capacity[76]. Decisions about allocation of gas also need to be made in the context of HCB's contract with Eskom expiring in 2029, and a potential 1,575 MW becoming available to EDM. Arrangements for supply to Mozal of 950MW could also undergo change, significantly effecting the sub-regional demand/supply balance. Given the uncertainties and the timeframes involved, there may be 'option value' in deferring decisions around Rovuma gas for now and to make decisions after careful analysis.

[75] Summary of "Harnessing African Natural Gas - A New Opportunity for Africa's Energy Agenda?" World Bank Report (2012).

[76] This assumes gas prices at US$5/MMBtu.

Figure 15: Gas versus hydro trade off



Note: This scenario assumes 50% access target met by 2023, 25% tariff increase in 2015 and rises with inflation thereafter, 400MW CCGT fired on Rovuma Basin gas at $5/MMBtu available from 2025

Building institutional capacity

87. The Ministry of Mineral Resources and Energy needs stronger capacity to drive system planning and competitive processes to improve the efficiency of the sector while also helping to drive it towards the government's access targets. Mozambique has moved from a situation in which there were just a few available generation options to a situation in which there are many options to choose from. This requires that the government develop a least cost plan for meeting demand and export needs, while meeting diversification and security of supply requirements.

88. The Ministry needs to be able to give direction on large projects – and international investors look for such direction, as has been the case with Mphanda Nkuwa and STE. For these projects, highly capable developers and investors including EdF of France, Electrobras of Brazil and Eskom of South Africa had been engaged with EDM to develop agreements for joint development of the projects during 2012-13. However, while initial agreements had been signed and there were high hopes of progress, in April 2013, the Government signed a memorandum of understanding with China Development Bank (CDB) and State Grid Corporation of China (SGCC) that reduced the expected shareholdings of the existing investors significantly in order to make room in both projects for significant shareholding for SGCC. Not only did this action badly dent the confidence of these pre-existing potential investors in Mozambique, but progress on agreements came to a halt and has not progressed any further in the last two years. It appears that SGCC and Eskom are looking to the government to address current bottlenecks. Lessons from this experience - as well as from the more successful completion of the Sasol driven Pande/Temane gas processing facility and transmission pipeline program (which had a cost of over US$1 billion and has met all gas production targets), need to be understood and acted upon[77].

[77] Some lessons learned can be found in the Implementation Completion and Results (ICR) Report on the Southern Africa Regional Gas Project (Report No: ICR86374-MZ) published by the World Bank on June 30, 2014. Accessible at: http://documents.worldbank.org/curated/en/2014/06/19759279/mozambique-southern-africa-regional-gas-project

89. Although EDM is signing Power Purchase Agreements (PPAs) with Independent Power Producers (IPPs), it is not currently required to follow a pre-agreed least cost generation expansion plan. Such a plan should, in fact, be based on a broader decision framework whereby the development of primary energy sources is analyzed against characteristics such as affordability (least cost approach), security of supply/reliability, environmental footprint and energy access. It would also take account of national and regional demand. This would contribute to improving sequencing of investments to best meet overall sector objectives. EDM should also adopt an approach of competitive tendering for relatively standard technologies such as thermal generation, leaving the option of negotiation for less standardized and higher risk projects (large hydropower being an obvious example). In such cases, underlying contracts such as for the engineering, procurement and construction (EPC) would be expected to be competitively procured.

90. To attract the required level of private sector financing, investors would need confidence that their investments have reasonable protection from non-market risks. This means having in place a clear legal and regulatory framework that provides for reasonable investor protection and guarantees or other mechanisms to protect against the framework being changed unreasonably[78], and providing credit support for EDM as borrower or contract counterpart. A particular current concern is the ambiguity created between the Electricity Law and PPA Law as to whether generation projects must be selected via a competitive tender process or whether the direct award of a PPA is allowed.

91. CNELEC[79] has a largely advisory role to the Government and the Ministry of Energy on tariff proposals and setting, as well as in the concession award process. CNELEC's mandate should be clarified and its regulatory role strengthened, particularly in the area of tariff setting as a means to make EDM's financial sustainability and the need for tariff adjustment more transparent.

92. EDM's human resources require[80] training and further recruitment is needed. As noted above, EDM's employee numbers have fallen while at the same time the system has expanded substantially. A study by Statnett concludes that EDM management needs training in leadership and motivational management, that a human resources development plan is needed and that few staff are sufficiently qualified to maintain EDM's grid assets.[81]

[78] In the short-term, while the confidence is built up, a program of guarantees/political risk insurance involving the government/third parties may be required to provide the requisite comfort to the private sector and commercial lenders.

[79] CNELEC is the national energy council which is the power sector regulator of Mozambique. Its role is largely to advise the Ministry of Energy and Council of Ministers including on new concessions and tariffs.

[80] EDM, Desempenho da EdM e Visão de Crescimento Empresarial, February 2015.

[81] Statnett, Capacity and capability in Electricidade de Moçambique (EDM) - Assessment of Needs for Organizational Development, 15 January 2015.

93. An area of need that has been identified is building sufficient institutional capacity both in terms of financing rural electrification and in terms of executing stand-alone off-grid low-cost projects. A recent European Union evaluation[82] finds that FUNAE, having been established primarily as a financial institution, is not adequately equipped to implement projects – the role it finds itself in for some off-grid projects. It also finds that coordination between EDM and FUNAE on projects and intended grid extension could be strengthened. It finds that FUNAE tends to be excluded from energy planning, which has sometimes led to unnecessary projects or investments that are not in line with the national planning of grid extension.

94. As mentioned above, FUNAE has been playing an operator role in the off-grid area and there is a need to better define FUNAE's role to ensure that it has the necessary capacity projects[83,84] it is expected to deliver and, especially, to ensure sustainability of the projects going forward. Maintenance of these projects is challenging, and there are currently no functioning cost recovery mechanisms. Further, exploring ways of attracting private sector for off-grid investments would be important. Driven partly by falling prices and new business models, other countries in the region have been successful in attracting private sector investors into the off-grid area, for example through pay-as-you-go Solar Home Systems (SHS) models. FUNAE has recently completed an exercise to look at how to further involve the private sector in its operations. Discussions with FUNAE have suggested, for example, that a constraint on development of private sector investment in off-grid is the insistence of consumers to pay no more than grid tariff levels. Further studying success stories and best practices elsewhere may help inform government policy especially in relation to attracting investors and replicating these positive experiences in Mozambique. A process of developing a National Electrification Plan is expected to include examination of models that have worked in other countries – and to address the various current issues.

95. There is a need for clear guidance for how the private sector can avail of feed-in tariffs for renewables – especially when this supports off-grid and mini-grid access to electricity as part of the National Electrification Plan.

Financing Plan for access and connections

96. The access target is an explicit target for access to the national grid. The government could broaden the target to allow it to be met by main grid and off-grid/mini-grid connections. Grid and off-grid strategy should be coordinated in order to increase the electricity access rates and to maximise access at minimum cost.

97. Access investments need to be costed and funded. Costing includes two activities. Costs of power system expansion and costs of connecting new customers.

[82] European Union, Final Evaluation of Projects Under the 9th Energy Facility in Mozambique, Final Report, February 2014

[83] EU, Final Evaluation of projects under the 9th EDF Energy Facility in Mozambique Annexes to Final Report, November 2013.

[84] Defining an EU joint position in the Energy sector in Mozambique, 25/11/2014 - Meeting Minutes.

98. As discussed above, EDM needs to carry out significant power system expansion in view of increasing the access rates.

99. Regarding connection costs, customers currently are required to make a significant up front contribution towards their connection costs (about US$ 128 in the case of ordinary household customers and US$ 31 in the case of customers on the social tariff[85]). These costs were about 20% of annual income per capita as at 2014. Therefore, connection costs represent a very significant burden for Mozambican households.[86] These high costs of new connections borne by the final consumers cause significant delays in the uptake in an area even once the system has been extended to that particular area. To increase the rate at which Mozambican households are connected to the grid, the up-front connection cost should be supported through a financing program or subsidy of some form.

100. In order to address funding of both power system expansion and connection costs, the Government should develop a National Electrification Plan that discusses the technology (lower cost engineering solutions, underlying cost and grid vs off-grid strategy), financing mechanisms and implementation modalities for reaching access targets. Clarification of role of Mozambican institutions' funding and the role for private sector would be critical.

101. The government needs to explicitly consider how increasing access will be funded ('Financing Plan for Connections'). If we assume that tariff adjustments and income from exports will be needed to maintain EDM's viability whilst paying for sufficient operations and maintenance, then access is likely to need to be funded through a combination of budget support and donor support, before additional revenues from exports picks up.

V. Recommendations

EDM needs to use its revenues to ensure good operations and maintenance.

102. Up to now, EDM has been required to develop new connections to the grid as part of its regular business. This is a significant drain on EDM resources and is degrading EDM's quality of regular operations and maintenance on the existing grid, thus effecting quality of supply and financial performance. It is recommended that EDM use its regular revenues from power sales to, in the first instance, ensure sufficient levels of operations and maintenance.

A tariff increase of 35% is required to make EDM viable for operations and maintenance (though this

103. Tariffs have not been adjusted in line with EDM's costs. To ensure the ongoing financial and operational viability of EDM, it is important that in future, tariffs be adjusted in line with reasonable costs for operations and maintenance. Assuming budget support provided by the Government in line with historic trends, our estimate is that to enable good levels of operations and maintenance and a financially viable utility, a tariff increase of 35% would have actually been needed in 2015, followed by inflation level rises. Taking account of regional trade, a tariff increase of the order of at least 25% in

[85] There are however only about 1,555 customers that benefit from this lower charge.
[86] The GDP per capita in Mozambique in 2014 was about US$ 638 (World Bank estimates).

does not include additional connections). A 25% increase followed by inflation level increases requires regional trade to lift EDM into viability.

2015 and thereafter increases with inflation would enable EdM to only become financially viable following the start of substantial exports of power to South Africa after the commissioning of new plant around the end of the decade. Any tariff increases should be designed taking into account the impact on the poorest.

104. The reduction of network losses needs to be an important part of improving the financial sustainability of EDM as it increases revenues without the need to increase tariffs.

105. EDM is currently implementing a state-of-the-art commercial management system and a revenue protection program, based on systematic recording and monitoring of consumption of EDM's largest 4,000 users with the support of Advanced Metering Infrastructure. The effective implementation of these activities will help EDM to increase control of non-technical losses.

106. Regional trade that takes an integrated approach to both supply within Mozambique and exports is an important route to improving the sector's financial sustainability. Simulations suggest that the need to fund the sector from external sources will diminish from around 2019 once significant exports are able to develop. To benefit from exports, EDM must purchase power from the project at a sufficiently competitive price to be able to make a reasonable margin through the sale. As EDM has limited funds – purchasing significant equity in projects is not a realistic option. Regional trade requires that the government prioritize the development of key national infrastructure that will enable regional trade.

<u>Priorities:</u>
i) Short-term rehabilitation of the grid to enable adequate system operation.
ii) Strategic assessment of gas-to-power in Mozambique and the region;
iii) Fiscal options on energy exports projects.

- In the short-run, the analysis shows that developing the 400MW Temane MGTP gas-to-power project, with sufficient transmission to Maputo constituting phase 1 of STE, 100% off-take by EDM at wholesale prices in line with the CTRG project, and an export PPA, would prove important for improving EDM's finances. This would happen by 2019 and would result in a significant increase in cash from the beginning of that period onwards. In the short-term, the existing grid needs to be in sufficient working order to enable such power trade activity. Short-term rehabilitation work is likely to be important.
- In the medium-term (2020-25), the analysis shows that Mphanda Nkuwa and Cahora Bassa North Bank, due to the economics of the power likely to be made available to EDM, would be important for safeguarding EDM's finances. **The importance of the timing of new generation to export power to South Africa also points to the importance of the backbone transmission project to evacuate the power from the center of the country – thereby enabling exports.**
- In the longer-term, although important decisions need to be made as to the way gas will be used in the economy, if Rovuma gas is delayed until 2025 (as IHS suggests), then it won't come on in time to save EDM's finances. Then, a combination of other measures will be needed to protect EDM's finances, e.g. higher tariffs, hydropower plant, government budget support and/or a delayed access target. In this regard, a 'wait and see' approach regarding sale of gas in the region creates option value for

the Government. Analysis shows that a 400MW CCGT with US$5 (2012)/MMBtu gas from January 2025 significantly boosts EdM's finances, assuming the power can get to market (see Figure 15). On this latter point, the power plant would likely be located in the north east, displacing imports to the region from the center of the country, i.e. freeing power in the center to flow to Maputo and out to South Africa and the SAPP.

Priorities:
i) EdM debt re-structuring options study;
ii) Guidelines for IPP use of EdM system;
iii) Financing models for engaging with private sector.

107. A strong utility and power off-taker is critical to the health of Mozambique's energy sector. In particular, generation projects are due to be developed as IPPs. EdM's creditworthiness will therefore be an important determinant of the extent to which efficiently priced power plants are developed in Mozambique, and the extent to which EdM is able to purchase and control power generated using Mozambican resources.

108. Given EdM's current poor financial condition, it may be necessary for the Government of Mozambique to work with its key development partners to enable the structuring of third party risk mitigation and credit enhancement instruments (generally available from multi-laterals with the backing of the host country). Such instruments normally reduce risk for commercial lenders, thereby reducing the cost of debt and increasing the chances of reaching financial closure and they also enable the host government to minimize the size of contingent liabilities it needs to take on in providing guarantees for the project (due to the involvement of the multi-lateral).

109. HCB has a relatively strong balance sheet due to the regular income from operation of Cahora Bassa and low levels of debt. It can be leveraged more to support financing in the sector. This could take various structures but basically involves using the HCB balance sheet to guarantee repayments on loans.

110. **Increasing access in line with Government targets will require major investments**. The Government needs to consider the trade-offs between the ambition of the access targets imposed upon EdM and the sector's broader financial viability for carrying out operations, maintenance and investment. EdM is not currently able to even fund these core activities despite significant budget support. Relaxation of the access target so that the 50% target is achieved by 2030 instead of 2023 gives EdM more liquidity in the first years.

111. There are opportunities to reduce current estimates for costs of increasing grid access by applying lower cost engineering solutions relating to distribution that have been applied successfully in other countries[87]. With such approaches, there are a number of countries that have rapidly increased access, and this is something that Mozambique can strive towards.

112. The access target is an explicit target for access to the main EdM grid. However, the government could broaden the target to allow it to be met by main grid and off-grid/mini-grid connections. Grid and off-grid strategy in order to increase the electricity access rates should be coordinated to maximize access at minimum cost.

[87] Cost reductions are of the order of US$700 million in the first 3 years alone.

113. Currently, customers must make a significant up front contribution towards their connection costs (about US$128 in the case of ordinary household customers and US$ 31 in the case of customers on the social tariff). This delays the uptake of connections in an area even once the system has been extended to that area. To increase the rate of connections, the up-front connection cost should be reduced or financially supported in some form.

114. The above revenue increases and cost reductions will help to ensure appropriate quality of operations and maintenance for the existing grid. Increasing the level of electricity access in line with national objectives will need explicit extra financial support and the government needs to explicitly consider how increasing access will be funded. It is likely that a combination of higher budget support and donor support will be required in the years to come. Such approaches for funding the electrification plan would free up EdM finances for regular operations, maintenance and – potentially financially viable investments.

115. As well as using budget and donor support, experience from other countries (Ghana or Vietnam) shows that explicit levies on consumers for funding a transparent and auditable electrification program are socially more acceptable than general tariff increases. This is something that the government could consider testing out.

Priority: National Electrification Plan (including a financing plan for connections – including Socio-economic analysis of electrification programs in Mozambique).

116. **The Government should develop a National Electrification Plan** which would discuss the technology (lower cost engineering solutions, cost and grid vs off-grid strategy), financing mechanisms and implementation modalities for reaching access targets. Clarification of role of Mozambican institutions' funding and role for private sector would be critical.

117. FUNAE tends to be excluded from energy planning, which has sometimes led to unnecessary projects or investments that are not in line with the national planning of grid extensions. **FUNAE needs to build sufficient institutional capacity both in terms of financing rural electrification and in terms of executing stand-alone off-grid low-cost projects**. It has been established primarily as a financial institution and is not adequately equipped to execute projects – the role it finds itself in for some off-grid projects. Also the coordination with EDM on projects and intended grid extension could be strengthened.

118. There is a need for **clear guidance for how the private sector can obtain feed-in tariffs for renewables** – especially when this supports off-grid and mini-grid access to electricity as part of the National Electrification Plan.

119. The Ministry of Mineral Resources and Energy needs stronger capacity to drive system planning and competitive processes to improve the efficiency of the sector while also helping to drive it towards the government's access targets. This requires that **the government develop a Least Cost Plan for meeting demand and export needs, while meeting diversification and security of supply requirements**.

120. EDM is not currently required to follow a pre-agreed least cost generation expansion plan. This should happen, and **EDM should also adopt an approach of competitive tendering for relatively standard technologies**.

121. **CNELEC's mandate should be clarified and its regulatory role strengthened**, particularly in the area of tariff setting as a means to institutionalize financial sustainability for EDM and the need for tariff adjustment. To help with this process, fuel and PPA elements of EDM's costs could be passed through to consumers as an automatic tariff adjustment.

122. **Training and recruitment is needed at EDM**. A human resources development plan is needed. Few staff are sufficiently qualified to maintain EDM's grid assets.

VI. Annexes

Annex 1: Financial appraisal of EDM

The following financial analysis was undertaken on the basis of EdM´s audited financial accounts for the period 2011 to 2013, and on the basis of EdM´s projected performance for the period 2014 to 2030. Here we describe the base case scenario which is used for the forecast of EdM's performance[88]:

- EdM´s forecast for domestic demand;
- The 50% access target is reached by 2023;
- A nominal tariff increase of 25% in 2015 (in terms of current MT), with a tariff increase in line with Mozambique inflation thereafter;
- Connection costs between $580 per connection for ordinary requests to over $2,100 per connection (based on estimates from World Bank staff experts);
- We assume that EdM will be funding its CAPEX (or part of its CAPEX) whenever they generate sufficient cashflow (i.e. positive bank balances after repaying any previous bank overdrafts);
- An annual budgetary support in the order of 0.05% of Mozambican GDP;
- All ongoing and pipeline loans and grants listed in Annex 6 to this note are considered;
- The remaining financing gap is funded through a combination of grants, donor loans and commercial loans;
- All surplus power is exported (at 14 USc/kWh in 2015).

All forecast figures are in 2015 constant MT prices and thus allow for direct comparison between years, unless stated otherwise.

EdM is forecast to generate positive cash flows from operating activities in most of the years of the forecast. However, this is not sufficient to fund EdM's capital expenditures or even the cost of financing, resulting in net loss for the period between 2015 and 2019. Only after that EdM is forecast to generate sufficient cash flows that would first need to be used to repay its short-term liabilities (including bank overdraft) and only from 2027 cash flow surplus could be used to co-finance the underlying CAPEX. Funding capital expenditure at least partly from cash flow from operations will decrease EdM's dependence on external sources of funding, reducing the underlying cost of debt.

Income statement

EdM's revenues increased on average by 10% per annum between 2011 and 2013. Nevertheless, these increases were insufficient to offset the increased power purchase cost and other operating expenses as these increased at a higher rate (14% and 11% per annum, respectively). Consistent with increasing access rates, the asset base has increased, meaning a higher depreciation and finance costs. This resulted in a loss of 76 MT (2015) million in 2013 as shown in Table 23 below.

[88] Refer to Annex 3 for further scenarios considered.

Table 23: Historical financial performance of EdM

MT million, constant 2015 prices	2011	2012	2013	CAGR (2011 – 2013)
Revenues from electricity sales	9,074	9,701	10,990	10.1%
Exports	857	648	646	-13.1%
Other revenue	690	676	928	16.0%
Total revenue	**10,620**	**11,025**	**12,564**	**8.8%**
Power purchase cost	3,037	3,188	3,927	13.7%
Other operating expense	3,626	4,471	4,458	10.9%
Total operating expenses	**6,662**	**7,659**	**8,385**	**12.2%**
Operating income	**3,958**	**3,367**	**4,179**	**2.8%**
Depreciation	1,710	1,623	2,196	13.3%
Finance cost (interest cost)	247	227	277	5.9%
Net profit	**787**	**119**	**-76**	

The forecast of EdM's financial performance suggests that its position deteriorates in the period from 2014 to 2019. Even if there were a 25% nominal tariff increase in 2015 and tariffs increased at inflation thereafter, EdM would make a loss in the order of 2,730 MT (2015) million on average per year from 2015 to 2019. Only from 2020, and provided that sufficient generation capacity is developed to create a surplus and all excess supply is exported, EdM would start making profits. These would be in the order of 10,695 MT (2015) million on average per annum from 2020 to 2030.

Table 24: Forecast financial performance of EdM

MT million, constant 2015 prices	2015	2020	2025	2030	CAGR (2014 – 2030)
Tariff bound electricity sales	16,574	61,183	78,691	130,831	15%
Unregulated customer sales	1,527	8,591	15,273	19,283	18%
Exports	2,846	32,198	36,518	77,424	25%
Other revenue	699	1,819	1,577	1,365	5%
Total revenue	**21,646**	**103,791**	**132,060**	**228,902**	**17%**
Power purchase cost	9,733	36,913	50,827	68,304	14%
Other operating expense	4,525	4,778	5,173	5,788	2%
Total operating expenses	**14,257**	**41,691**	**56,000**	**74,092**	**12%**
Operating income	**7,389**	**62,100**	**76,060**	**154,810**	**22%**
Depreciation	2,871	5,000	4,949	4,987	4%
Finance cost (interest cost)	1,315	4,099	2,061	701	-4.1%
Net profit	**-1,708**	**7,204**	**10,864**	**34,917**	

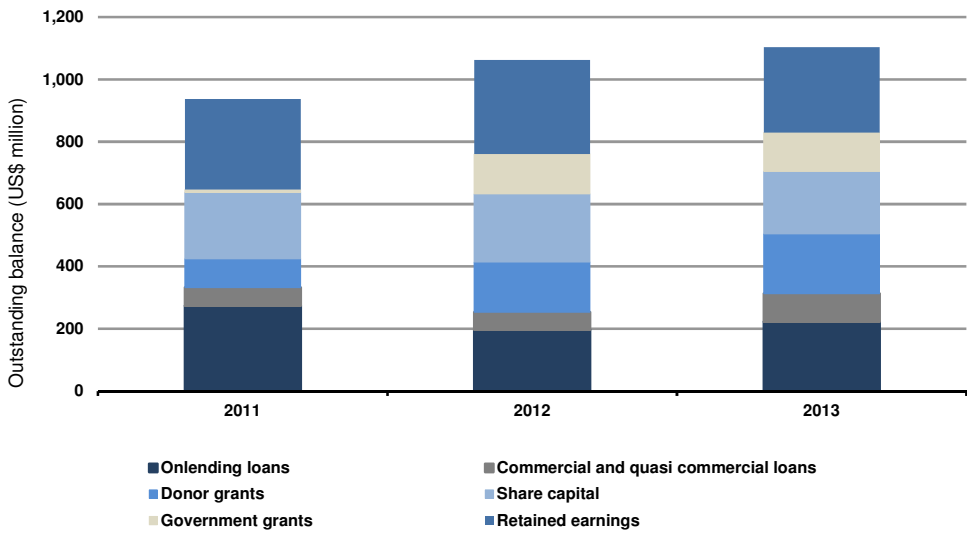
Finance costs are projected to increase considerably, subject to assumptions about the source of external funding (these costs would considerably decrease if the remaining financing gap was funded by a combination of grants, donor loans and commercial loans rather than commercial loans alone). About 8% of EdM's operating income will be used to cover the costs of debt finance between 2015 and 2020.

Statement of financial position

EdM's assets grew by 24% between 2011 and 2013 as measured by net book value in current MT. This increase in asset base reflects increased capital expenditures, mostly as a result of new connections and other projects. These capital expenditures were funded predominantly by grants from donors and the government.

Representation of EdM's sources of funding in its balance sheet is shown in the graph below. Budget support (government grants) has increased considerably as a source of funding over the years as has donor grants. Retained earnings also increased due to EdM profits in 2011 and 2012.

Figure 16: Representation of sources of funding for each balance sheet year



Source: EDM audited accounts

Table 25: EDM´s balance sheet – historical data

MT million, constant 2015 prices	2011	2012	2013	CAGR (2011 – 2013)
Assets				
Current assets	5,699	5,555	6,250	4.7%
Fixed financial assets	253	235	1,642	154.6%
Fixed assets (GBV)	68,298	70,019	75,747	5.3%
Depreciation	1,710	1,623	2,196	13.3%
Total assets (NBV)	**43,360**	**43,981**	**48,370**	**5.6%**
Current liabilities				
Trade payables	3,615	3,563	4,178	7.5%
Donations & grants	107	52	89	-8.6%
Concessional funding	323	452	696	46.8%
Commercial loans	525	518	500	-2.4%
Other current liabilities	153	372	641	104.8%
Total current liabilities	4,723	4,958	6,105	13.7%
Long-term liabilities and equity				

Trade payables	370	242	141	-38.3%
Donations and grants	3,206	5,158	6,497	42.3%
Concessional funding	9,497	5,925	6,926	-14.6%
Commercial loans	1,565	1,301	2,595	28.8%
Other (deferred tax)	3,990	3,786	3,699	-3.7%
Provisions	1,427	1,359	1,601	5.9%
Other non-current liabilities	215	249	260	9.9%
Total liabilities	**24,995**	**22,977**	**27,825**	**5.5%**
Equity	**18,365**	**21,004**	**20,545**	**5.8%**

Looking ahead over the period from 2014 to 2030, EDM's balance sheet is projected to continue to expand as it invests in the network to meet access targets. Investments in large generation projects and large transmission projects are assumed to be project financed and therefore are not on EDM's balance sheet.

Table 26: EDM´s balance sheet – forecast data

MT million, constant 2015 prices	2015	2020	2025	2030	CAGR (2014 – 2030)
Assets					
Current assets	4,541	5,307	14,564	48,527	17%
Fixed financial assets	2,860	4,155	3,164	2,409	-1%
Fixed assets (GBV)	99,065	175,415	211,107	212,785	5%
Depreciation	2,871	5,000	4,949	4,987	4%
Total assets (NBV)	64,912	115,719	136,058	153,160	6%
Current liabilities					
Donations & grants	198	151	115	87	-5%
Concessional funding	657	2,386	2,376	1,632	6%
Commercial and quasi commercial loans	2,050	4,770	3,090	574	-8%
Other current liabilities	4,280	3,435	3,090	4,661	1%
Long-term liabilities					
Donations and grants	10,360	21,713	21,181	12,567	1%
Concessional funding	19,240	41,633	25,395	10,219	-4%
Commercial and quasi commercial loans	8,304	20,738	8,944	777	-15%
Bank overdraft	0	0	0	0	
Other non-current liabilities	5,558	6,631	7,909	9,480	4%
Total liabilities	**50,647**	**101,458**	**72,100**	**39,997**	**-2%**
Equity	**15,650**	**16,313**	**67,328**	**118,486**	**14%**

Note: Trade payables (current) are included in other current liabilities; provisions, deferred tax and trade payables (non-current) are included in other non-current liabilities; due to accumulation of losses up to 2019, EDM's retained earnings are negative in 2020, showing a need for capital injection or increase in revenues.

Cash and liquidity position

In recent years, EDM's cash flow from operating activities has been positive. However, this cash is insufficient to fund EDM's investment activities, resulting in a negative free operating cash flow. EDM therefore has relied on external funding to fund capital expenditures to meet the government's access targets and enhance the system.

Table 27: Cash flow statement – historic data

MT million, current prices	2011	2012	2013	CAGR (2011 – 2013)
Cash from operating and investing activities				
Cash from operating activities	2,346	2,023	3,351	19.5%
Cash from investing activities	-4,023	-5,071	-6,888	30.9%
Debt finance (cash inflow – financing activities)				
Donations	0	2,254	1,540	
Concessional loans	613	1,249	3,245	130.2%
Commercial funding	0	0	0	
Debt repayment (cash outflow – financing activities)				
Concessional loans	-599	-115	-405	-13.3%
Commercial funding				
Periods cash flow	-1,664	340	843	

The projection of EDM's financial position shows that even though EDM's cash flow from operating activities is positive under most of the years of the forecast, in the next five years EDM will be unlikely to have sufficient revenues to cover all of its short term obligations (including debt repayment obligations), resulting in the need to take bank overdrafts in 2017 and 2018. This short term and expensive way to cover its short term obligations further increases the cost of financing. Only from 2019 is EDM forecast to generate positive cash flow (i.e. operating cash flow minus cash flow from financing activities), suggesting that there is a potential to decrease the dependence on external funding in the future. This is largely due to the commissioning of new generation projects and the revenue from the export of surplus power.

Assuming a considerable part of EDM's capital expenditures is debt financed results in a considerable increase to EDM's annual debt service costs. In 2013, EDM's annual debt service costs (comprising interest and debt repayments) were 682 MT (2015) million, and this is projected to more than quadruple by 2015 to 2,935 MT (2015) million. This is projected to further increase, to 10,206 MT (2015) million in 2020. As EDM's financial position is forecast to considerably improve in the long term, there is a potential to finance a considerable proportion of the CAPEX from EDM's own resources, decreasing the debt financing needs. That is, under this scenario EDM could start financing (approximately 70% of CAPEX) in the period 2022 to 2025 and almost all of the CAPEX required to meet the access target in the period after that, provided export revenues materialise. This results in a decrease in debt repayment from 2023 onwards.

Table 28: Cash flow statement – forecast data

MT million, constant 2015 prices	2015	2020	2025	2030	CAGR (2014 – 2030)
Cash from operating and investing activities					
Cash from operating activities	523	11,177	14,766	40,601	34%
Cash from investing activities	-14,731	-12,938	-13,686	-7,017	-5%
Debt finance (cash inflow – financing activities)					
Donations	3,492	3,849	1,767	-	
Concessional loans	5,885	3,276	625	-	
Commercial and quasi commercial loans	5,353	5,812	1,859	-	
Debt repayment (cash outflow – financing activities)					
Concessional loans	-375	-1,980	-2,285	-1,787	11%
Commercial loans	-1,245	-4,128	-3,580	-847	-3%
Period cash flow	-763	5,613	324	30,964	

Financial ratios

Currently, EDM has a significant amount of debt relative to its earnings. This is evidenced by the debt / EBITDA, CFO / debt and FOCF / debt ratios. A current ratio greater than 1 indicates that EDM would be able to meet its current liabilities at short notice. However, this ratio has deteriorated over time and in 2013 was very close to 1. In addition, the debt service coverage ratio is below 1, indicating that EDM's operating income is insufficient to meet its debt repayments and interest.

Table 29: Financial ratios – historic data

MT million, constant 2015 prices	2011	2012	2013
CAPEX (MT million)	4,171	5,204	5,594
Free operating cashflow	-1,826	-3,180	-2,243
Debt / EBITDA	8.9	8.5	7.9
EBITDA / Interest	9.8	9.0	9.4
CFO / Debt	11%	12%	16%
FOCF / Debt	-9%	-18%	-11%
Net debt / Net debt + equity	51%	42%	46%
DSCR	0.83	1.22	0.60
Current ratio	1.5	1.3	1.1

The projection shows that EDM's current ratio turns below 1 in 2014 and increases above 1 only in 2026. This suggests that EDM would have difficulties in meeting its short term liabilities if these became due at short notice.

Table 30: Financial ratios - forecast data

MT million, constant 2015 prices	2015	2020	2025	2030
CAPEX (MT million)	14,582	12,938	13,686	7,017
Free operating cashflow	-14,059	-1,760	1,081	33,583
Debt / EBITDA	17.3	4.0	2.1	0.4
EBITDA / Interest	1.8	4.8	11.0	81.0
CFO / Debt	1%	14%	31%	184%
FOCF / Debt	-35%	-2%	2%	152%
Net debt / Net debt + equity	71%	82%	36%	-22%
DSCR	-0.19	1.42	2.24	15.52
Current ratio	0.6	0.6	2.9	15.8

Annex 2: Cost of investment in power systems to deliver access

EDM has a power sector master plan that puts a significant emphasis on transmission and distribution investment to meet the grid access targets for EDM and to allow output from new generation projects to be delivered to Mozambican and export customers. The plan suggests the following capital cost program. This program allows for the connection of 100,000 new customers per year on average, about 60% of the number of new connections per year required to meet the Government's draft access target of 50% by 2023. At 100,000 per year, by 2023, 38% of the population would be connected and 43% by 2030.

Table 31: Master Plan transmission and distribution investment program

US$(2012) million	2014-2017	2018-2022	2023-2027	Total
Transmission	838	921	763	2,521
Distribution	560	921	894	2,375
Large projects	514	60	2	576
Special projects	95	37	0	132
Total	**2,006**	**1,939**	**1,659**	**5,604**

Source: Norconsult, Master Plan Update Volume III April 2014 Table 14-1, adjusted by EdM for timing and adjusted by Frontier Economics to reflect additional new connection costs and based on the use of lower cost engineering solutions by World Bank staff. In addition, some of the special projects are assumed to be private sector financed and therefore have been removed.
Note: Master Plan assumes 100,000 new connections per year; large projects include load dispatch centres, Tete- Malawi Interconnection project and Temane Transmission; Special projects include equity investments in JV projects

As compared to the sector Master Plan that targets connecting 100,000 households per annum or even EDM's current performance, the government access target of 50% by 2023 is quite ambitious. Achieving the 50% access target by 2023 would require connecting an additional 75,300 connections per year as compared to Master Plan assumptions, or alternatively an additional 57,200 new connections as compared to EDM's current performance. The information on the average number of connections per annum needed under different access scenarios are summarized below.

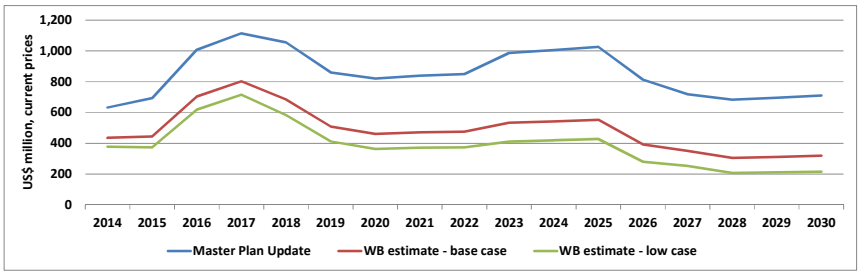
Table 32: Number of connections and access targets

Scenario description	50% access by 2023	50% access by 2030	EdM's corporate model	Master Plan
Number of new connections per year	175,300	130,780	80,000	100,000
Access rate in 2023	50.0%	42.9%	34.9%	38.1%
Access rate in 2030	60.6%	50.0%	37.9%	42.7%
Number of new connections per year beyond EDM's actual performance	57,193	12,656	(38,094)	(18,094)
Number of new connections per year beyond Master plan assumptions	75,287	30,750	(20,000)	n/a

Note: Comparison between EDM's actual performance and the number of connections under each scenario is based on the average of new residential connections EDM achieved between 2011 –and 2014. That is, 118,100 new connections.

The chart below compares the associated capital expenditures using the Master Plan Update report ('Master Plan Update'), market pricing from Peru ('WB estimate – low case'), a higher but still reasonable estimate made by Bank staff based on international experience ('WB estimate – base case). The following analysis uses these base case assumptions.

Figure 17: Capital expenditures under different engineering solutions (50% access target by 2023)



As 2023 is an aspirational target, we run a scenario for achieving the access target in 2030, which would require about 130,000 new connections per year. This suggests the following capital cost program (Table 33).

Table 33: Master Plan transmission and distribution investment program (meeting access target by 2030)

US$(2012) million	2014-2017	2018-2022	2023-2027	Total
Transmission	838	921	763	2,521
Distribution	721	1,262	1,444	3,428
Large projects	514	60	2	576
Special projects	95	37	0	132
Total	**2,168**	**2,280**	**2,209**	**6,657**

Source: Norconsult, Master Plan Update Volume III April 2014 Table 14-1, adjusted by EDM for timing and adjusted by Frontier Economics to reflect additional new connection costs and based on the use of lower cost engineering solutions by World Bank staff.

Note: Large projects include load dispatch centres, Tete- Malawi Interconnection project and Temane Transmission; Special projects include equity investments in JV projects

We also run a scenario whereby EDM connects 80,000 households per year, as is assumed by its financial model developed in 2014. This suggests the following capital cost program (Table 34).

Table 34: Master Plan transmission and distribution investment program (80,000 connections per year)

US$(2012) million	2014-2017	2018-2022	2023-2027	Total
Transmission	838	921	763	2,521
Distribution	455	699	536	1,690
Large projects	514	60	2	576
Special projects	95	37	0	132
Total	**1,901**	**1,717**	**1,300**	**4,919**

Source: Norconsult, Master Plan Update Volume III April 2014 Table 14-1, adjusted by EDM for timing and adjusted by Frontier Economics to reflect additional new connection costs and based on the use of lower cost engineering solutions by World Bank staff.

Note: Large projects include load dispatch centres, Tete- Malawi Interconnection project and Temane Transmission; Special projects include equity investments in JV projects

Base Case: Achieving the 50% grid access target by 2023 would require a considerable increase in the rate at which EDM is currently connecting new customers. EDM has recently been connecting about 120,000 households per annum (between 2011 and 2014) and would need to connect an additional 57,000 households per annum above its current rate of connections if it was to meet the 50% access target by 2023[89]. This suggests the following capital cost program (Table 35). These costs use the base assumptions discussed above for low cost engineering solutions forecast by the Bank.

Table 35: Master Plan transmission and distribution investment program (meeting access target by 2023)

US$(2012) million	2014-2017	2018-2022	2023-2027	Total
Transmission	838	921	763	2,521
Distribution	955	1,756	2,242	4,953
Large projects	514	60	2	576
Special projects	95	37	0	132
Total	**2,401**	**2,774**	**3,006**	**8,182**

Source: Norconsult, Master Plan Update Volume III April 2014 Table 14-1, adjusted by EDM for timing and adjusted by Frontier Economics to reflect additional new connection costs and based on the use of lower cost engineering solutions by World Bank staff. In addition, some of the special projects are assumed to be private sector financed and therefore have been removed.
Note: Large projects include load dispatch centres, Tete- Malawi Interconnection project and Temane Transmission; Special projects include equity investments in JV projects (CTRG, Moatize and Temane CCGT)

[89] Ministério da Energia. Estratégia de Energia (2014 -2023) [draft document].

Annex 3: Projections of inter-temporal dynamic for CAPEX, tariff revenue, access rates and exports

The present scenario analysis contained in this section enables us to assess the impact of various tariff increases on EDM's operating cash flows, as well as its profitability and therefore its dependence on external funding. Considering various scenarios for the level of access targets enables us to see the implications on EDM if they were to meet the stipulated access target.

Finally, EDM's profitability and therefore its own ability to invest in enhancing the transmission and distribution network is dependent not only on the domestic tariff increases but also on the level of budgetary and donor support it will get in the years to come. The level of budgetary and donor support not only affects EDM's ability to meet the stipulated access targets but also decreases the amount of capital EDM will need to raise on commercial and quasi commercial terms. This in turn decreases the associated cost of debt and the debt burden in general.

While we take the view that EDM's ability to raise additional capital in commercial and quasi commercial settings should be improved, there is likely to be the need for government support and donor support in the years to come before EDM can generate additional revenues from exports and before it becomes financially sustainable.

Finally, it is important to note that in recent years EdM was better able to raise funds in commercial settings, the cost of debt on the local market is relatively high for EdM (approximately 14% per annum).

Table 36 discusses five different scenarios that are further considered in more detail in the rest of this Annex.

Table 36: Scenarios description

Scenario description	Access target	Tariff increase (2015)	Funding of gap
Business as usual scenario	50% access target by 2023	No tariff increase	Funding at 7.4% per annum
Scenario at which EDM is profitable	50% access target by 2023	**45% tariff increase**	Funding at 7.4% per annum
More realistic tariff increase	50% access target by 2023	**25% tariff increase**	Funding at 7.4% per annum
Including donor funding (base case)	50% access target by 2023	25% tariff increase	Gap funded by grants, donor loans and commercial loans
Lower access rate, EDM profitable	80,000 connections p.a.	**35-40% tariff increase**	Funding at 7.4% per annum

Note: the level of budget support is considered to be of 0.05% per annum

Business as usual scenario

The 'Business as usual scenario' considers what would be the impact on EDM if there was no tariff increase whatsoever and EDM was to meet the 50% access target by 2023. The scenario simulation shows that under this scenario, EDM's financial situation is not sustainable both in the short and long term.

Specifically, EDM's revenues would not be sufficient even to cover the more limited operating expenditures it is currently undertaking (resulting in negative cash flows from operating activities). Hence, EDM would be completely dependent on external sources of funding not only to finance its capital expenditures but also there would be a need for external support to meet EDM's short term liabilities. It is worth noting that even in the years when EDM is forecast to make a profit (2021 – 2022 and 2030), these funds would need to be fully used to cover the associated cost of financing and debt repayment. This can be seen from the tables and chart below.

Table 37: Business as usual scenario (short term forecast)

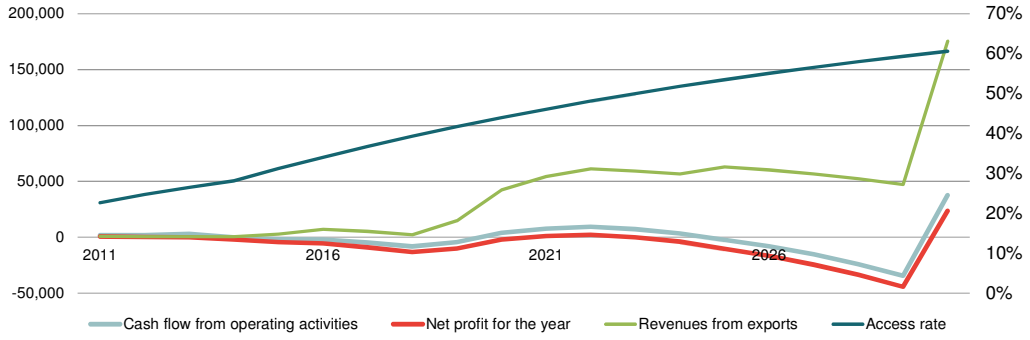
MT million, current prices	2015	2016	2017	2018	2019
Revenues	14,274	21,018	21,649	21,997	39,198
Debt repayment	7,365	14,106	23,567	33,548	35,086
Cash flow from operating activities	-1,844	-2,084	-4,828	-8,251	-4,425
Net profit for the year	-4,388	-5,449	-9,082	-13,266	-9,977
Total CAPEX	14,731	23,815	27,764	24,164	18,334
Financing gap	**10,795**	**18,700**	**22,781**	**19,324**	**15,014**

Note: Debt repayment includes both the repayment of principal as well as any associated cost of financing (interest rate) and bank overdraft

Table 38: Business as usual scenario (medium and long term)

MT million, current prices	2020	2025	2029
Revenues	70,810	112,283	114,838
Debt repayment	31,583	59,212	99,146
Cash flow from operating activities	3,898	-2,363	-34,371
Net profit for the year	-2,146	-10,371	-44,384
Total CAPEX	16,989	23,599	15,092
Financing gap	**14,258**	**22,155**	**12,841**

Figure 18: Business as usual scenario (medium and long term)



Finally, it is important to note that if the financing gap was funded by a combination of grants, donor loans, budget support and commercial loans, EDM's financial situation would improve. Notwithstanding the improved financial position, EDM' revenues would be sufficient to cover its operating activities only in the period between 2020 and 2026. Nevertheless, these revenues would not be sufficient to cover the

cost of financing and the cost of debt. EDM would not have any revenue that could be used to fund its CAPEX.

Scenario at which EDM is profitable

The 'Scenario at which EDM is profitable' considers what would need to be the tariff increase to make EDM profitable in the short term, holding other characteristics constant.

The simulation analysis shows that tariffs would need to increase by at least 45% in 2015 to make EDM profitable in the short term if EDM was to meet the 50% access target by 2023. Even though in the short term the financing gap would remain the same as in the previous scenario, from 2023 EDM would be in a good position to finance a considerable part of its capital expenditures. Specifically, EDM could finance approximately 80% of its capital expenditures from its own funds, considerably decreasing its dependence on external sources of funding.

Table 39: Scenario at which EDM is profitable (short term forecast)

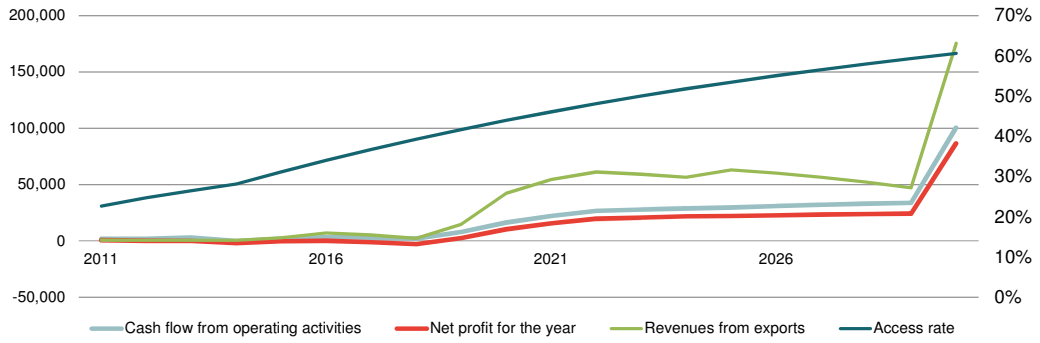
MT million, current prices	2015	2016	2017	2018	2019
Revenues	18,415	26,509	28,697	30,892	50,273
Debt repayment	4,376	7,599	14,794	21,262	19,601
Cash flow from operating activities	1,828	3,404	2,912	2,129	7,984
Net profit for the year	-371	151	-1,213	-2,732	2,613
Total CAPEX	14,731	23,815	27,764	24,164	18,334
Financing gap	**10,795**	**18,700**	**22,781**	**19,324**	**15,014**

Note: Debt repayment includes both the repayment of principal as well as any associated cost of financing (interest rate) and bank overdraft

Table 40: Scenario at which EDM is profitable (medium and long term)

MT million, current prices	2020	2025	2029
Revenues	84,244	142,676	167,391
Debt repayment	14,712	21,117	10,828
Cash flow from operating activities	16,293	29,659	33,808
Net profit for the year	10,445	22,012	24,139
Total CAPEX	16,989	23,599	15,092
Financing gap	**14,258**	**8,868**	**-**

Figure 19: Scenario at which EDM is profitable (medium and long term)



More realistic tariff increase

Even though a 45% tariff increase in 2015 would mean that EDM would be in a position to generate sufficient cash flows to make a profit in the short term, we consider that a 25% tariff increase in 2015 combined with budgetary and donor support in the early years of our forecast is sufficient to make EDM profitable in the medium and long term as shown in Table 42 below.

Specifically, in the first years of the forecast cash flow generated from operations would be sufficient to cover EDM's operations. EDM would be also in a position to partly fund its capital expenditures (on average EDM could finance approximately 27% of its CAPEX between 2023 and 2030). It is important to note that there is a delay between EDM's ability to fund part of its CAPEX and EDM's profitability. This is because EDM's financial position under a 25% tariff increase does not actually improve to the point of financial viability until the end of the decade, resulting in sourcing short term debt (taking bank overdrafts) and bearing the associated costs.

Table 41: More realistic tariff increase (short term forecast)

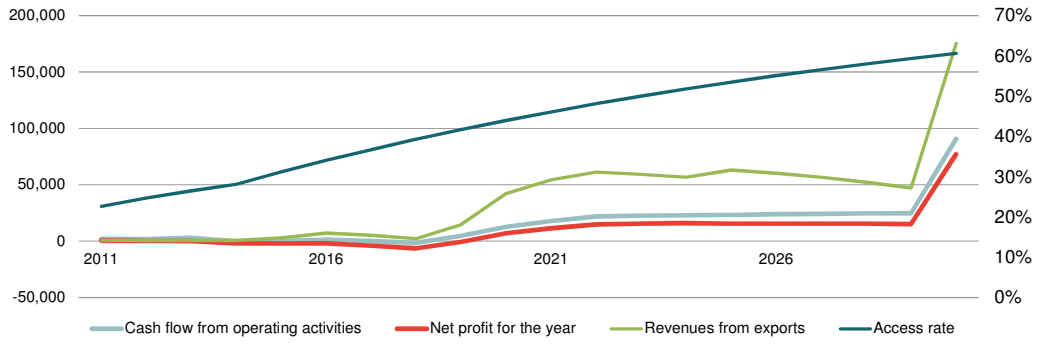
MT million, current prices	2015	2016	2017	2018	2019
Revenues	16,574	24,326	26,149	27,931	46,843
Debt repayment	5,325	10,521	18,085	25,595	23,964
Cash flow from operating activities	196	1,271	46	-1,456	4,773
Net profit for the year	-2,156	-2,010	-4,109	-6,352	-637
Total CAPEX	14,731	23,815	27,764	24,164	18,334
Financing gap	**10,795**	**18,700**	**22,781**	**19,324**	**15,014**

Note: Debt repayment includes both the repayment of principal as well as any associated cost of financing (interest rate) and bank overdraft

Table 42: More realistic tariff increase (medium and long term)

MT million, current prices	2020	2025	2029
Revenues	80,341	135,690	156,706
Debt repayment	19,791	24,501	20,458
Cash flow from operating activities	12,729	23,212	24,709
Net profit for the year	6,842	15,502	15,152
Total CAPEX	16,989	23,599	15,092
Financing gap	**14,258**	**22,155**	**3,702**

Figure 20: More realistic tariff increase (medium and long term)



More realistic tariff increase, including donor funding (base case)

This scenario considers a 25% tariff increase in 2015, followed by tariff increases at inflation in the years after, as in the previous scenario. The difference between this scenario and the previous one is in the way the resulting financing gap is funded. While the previous scenario considered that the financing gap is funded by a combination of commercial and quasi commercial loans at an average rate of 7.4% per annum, here we consider what would be the impact on EDM's financial position if the resulting gap was funded by a combination of grants, donor loans and commercial loans. Specifically we assume the following split between grants, donor loans and commercial loans:

Table 43: Funding of the financing gap

	Grant aid	Donor loans	Commercial loans
Cash flow from operating activities	22%	28%	50%

Under this scenario, grant aid and donor loans have a positive impact not only on EDM's net profit but also substantially decreases the associated cost of debt. In this respect EDM's revenues can be used to finance part of its capital expenditures and not only to cover the associated cost of financing.

Under this scenario EDM's dependence on external funding would decrease from 2022 onwards when EDM would be able to finance approximately 70% of its CAPEX itself. More specifically, between 2022 and 2030, EDM could finance almost 90% of its CAPEX from revenues generated by operations. This suggests that in the long term a combination of tariff increases and donor and government support enhances EDM's finances not only to the extent of EDM being financially sustainable but also to the point to be able to fund a considerable proportion of the underlying capital expenditures to meet the stipulated access target.

Table 44: More realistic tariff increase, including donor funding (short term forecast)

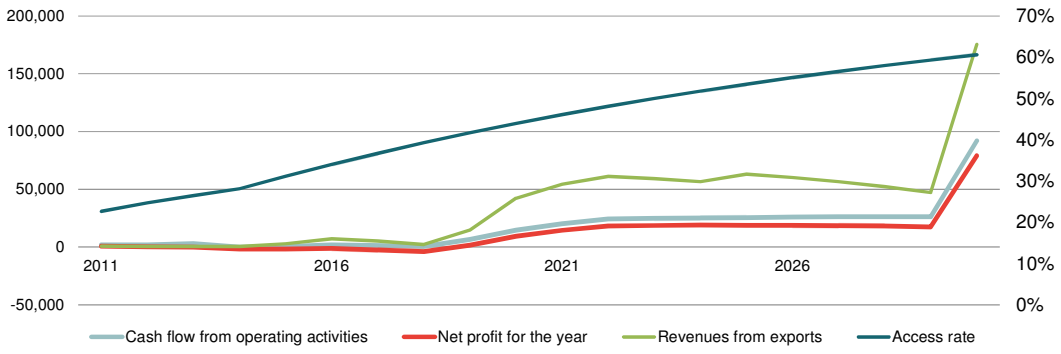
MT million, current prices	2015	2016	2017	2018	2019
Revenues	16,574	24,326	26,149	27,931	46,843
Debt repayment	2,935	4,940	8,713	14,337	11,640
Cash flow from operating activities	523	1,937	1,254	437	6,535
Net profit for the year	-1,708	-1,128	-2,582	-4,025	1,673
Total CAPEX	14,731	23,815	27,764	24,164	18,334
Grant aid	2,149	2,826	3,083	3,442	3,417
Donor loans	3,293	7,429	9,752	7,080	4,168
Commercial loans	5,353	8,444	9,946	8,802	7,429

Note: Debt repayment includes both the repayment of principal as well as any associated cost of financing (interest rate) and bank overdraft

Table 45: More realistic tariff increase, including donor funding (medium and long term)

MT million, current prices	2020	2025	2029
Revenues	80,341	135,690	156,706
Debt repayment	7,698	13,667	8,754
Cash flow from operating activities	14,677	25,462	26,258
Net profit for the year	9,459	18,733	17,442
Total CAPEX	16,989	23,599	15,092
Financing gap	7,633	3,206	-

Figure 21: More realistic tariff increase, including donor funding (medium and long term



Lower access rate, EDM being profitable

This scenario considers the impact on EDM's profitability and finances if EDM was connecting 80,000 new customers per annum, which is about half of the connections required to meet the 50% access target by 2023.

The simulation analysis shows that under this scenario it would be enough to increase the tariff of the order of 35 to 40% in 2015 to make EDM profitable even in the short term. The exact range of tariff increase to make EDM profitable depends on how the remaining financing gap is funded. That is:

- If the financing gap is funded by a combination of grant aid, donor loans and commercial loans, it is enough to increase the tariff by 35% to make EDM profitable from 2015;
- If the financing gap is funded by a mix of commercial and quasi-commercial loans at an average rate of 7.4% per annum, the tariff would need to increase slightly more (by 40%) to make EDM financially viable in the short term.

Table 46 and Table 47 below show the situation when the financing gap is funded by a combination of commercial and quasi-commercial loans.

Table 46: Lower access rate, EDM being profitable (short term forecast)

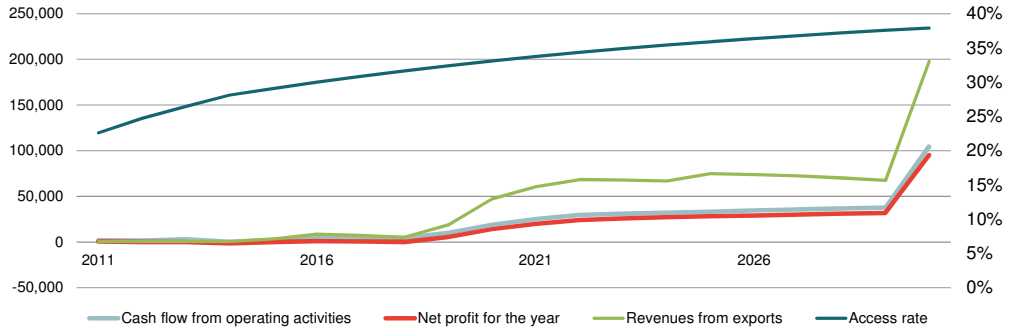
MT million, current prices	2015	2016	2017	2018	2019
Revenues	18,162	26,379	28,682	30,978	50,443
Debt repayment	3,143	5,188	8,246	11,910	10,319
Cash flow from operating activities	2,210	4,008	4,136	4,387	10,001
Net profit for the year	191	1,094	485	197	5,507
Total CAPEX	10,892	19,817	23,589	18,052	11,971
Financing gap	6,956	12,405	18,606	13,211	8,651

Note: Debt repayment includes both the repayment of principal as well as any associated cost of financing (interest rate) and bank overdraft

Table 47: Lower access rate, EDM being profitable (medium and long term)

MT million, current prices	2020	2025	2029
Revenues	84,491	143,873	169,712
Debt repayment	12,465	8,932	2,991
Cash flow from operating activities	18,817	33,384	37,647
Net profit for the year	14,061	28,142	31,982
Total CAPEX	10,364	12,372	1,362
Financing gap	7,633	-	-

Figure 22: Lower access rate, EDM being profitable (medium and long term)



Under this scenario the total CAPEX amount to US $4,759 million (2012 constant prices) which is about 43% lower than the capital expenditures required to meet the 50% access target by 2023, resulting in considerably lower financing gap.

Annex 4: Projections of inter-temporal dynamic for the access target, tariff increases and sensitivity analysis of export tariffs

EdM estimates that their export tariff amounted to 12.5 USc/kWh in 2014 and should equal 14 USc/KWh in 2015. We are of the view that as it stands due to a shortage of power in South Africa this is the tariff EdM could achieve. However, in the long term South Africa may be in the position to develop lower cost generation options, decreasing its reliance on exports from Mozambique. In this respect we consider what would be the impact on EdM and its profitability if the export tariff was 10 USc/kWh in 2015. Thereafter we assume that the export tariff will increase in line with inflation in Mozambique. Other parameters are held the same as in the base case scenario:

- 50% access target by 2023
- budget support 0.05% of annual GDP, and
- financing gap funded through a combination of grants, loans from donors and commercial loans.

Table 48: Access target of 50% met by 2023, export tariff 14 USc/kWh

	Average net profit/loss		
Tariff increase in 2015	**2015 - 2019**	**2020 - 2024**	**2025 - 2030**
0.0%	-5,125	10,485	19,777
5.0%	-4,368	11,662	21,591
10.0%	-3,612	12,800	23,386
15.0%	-2,882	13,891	25,085
20.0%	-2,207	14,940	26,745
25.0%	-1,554	15,960	28,414
30.0%	-904	16,960	30,087
35.0%	-285	17,943	31,774
40.0%	325	18,888	33,458
45.0%	891	19,820	35,047
50.0%	1,412	20,722	36,597
55.0%	1,858	21,611	38,181

Note: Tariffs are assumed to increase at inflation following from 2016

Table 49: Access target of 50% met by 2023, export tariff 10 USc/kWh

	Average net profit/loss		
Tariff increase in 2015	**2015 - 2019**	**2020 - 2024**	**2025 - 2030**
0.0%	-7,291	-4,401	-4,503
5.0%	-6,534	-2,397	54
10.0%	-5,777	-568	4,488
15.0%	-5,021	917	7,768
20.0%	-4,265	2,309	10,560
25.0%	-3,520	3,634	13,316
30.0%	-2,774	4,905	15,850
35.0%	-2,028	6,169	17,819
40.0%	-1,363	7,301	19,606
45.0%	-719	8,350	21,338
50.0%	-67	9,321	23,023
55.0%	524	10,274	24,731

Note: This is a tariff increase in 2015, thereafter we assume tariff increases at inflation

Table 50: Access target of 50% met by 2030, export tariff 14 USc/kWh

	Average net profit/loss		
Tariff increase in 2015	2015 - 2019	2020 - 2024	2025 - 2030
0.0%	-3,838	13,395	24,839
5.0%	-3,127	14,405	26,418
10.0%	-2,469	15,376	27,951
15.0%	-1,811	16,293	29,369
20.0%	-1,153	17,226	30,836
25.0%	-517	18,122	32,321
30.0%	68	18,987	33,817
35.0%	646	19,849	35,318
40.0%	1,159	20,703	36,811
45.0%	1,605	21,523	38,274
50.0%	2,047	22,341	39,748
55.0%	2,481	23,176	41,236

Table 51: Access target of 50% met by 2030, export tariff 10 USc/kWh

	Average net profit/loss		
Tariff increase in 2015	2015 - 2019	2020 - 2024	2025 - 2030
0.0%	-6,353	-925	4,870
5.0%	-5,626	501	7,843
10.0%	-4,900	1,815	10,420
15.0%	-4,174	3,118	12,993
20.0%	-3,447	4,317	15,202
25.0%	-2,721	5,509	16,944
30.0%	-1,997	6,623	18,573
35.0%	-1,339	7,644	20,126
40.0%	-702	8,607	21,708
45.0%	-100	9,518	23,207
50.0%	500	10,418	24,757
55.0%	946	11,290	26,292

Note: This is a tariff increase in 2015, thereafter we assume tariff increases at inflation

Annex 5: Planned generation projects

Table 52: Generation capacity available to EDM

Available plant (MW)

Name	2014	2015	2016	2017	2018	2019	2020	2021	2022
Existing EDM supply									
HCB Firm	300	300	300	300	300	300	300	300	300
HCB - non firm	200	200	200	200	200	200	200	200	200
Mavuzi I	-	-	-	52	52	52	52	52	52
Cuamba	1	1	1	1	1	1	1	1	1
Lichinga	1	1	1	1	1	1	1	1	1
Chicamba	-	-	-	44	44	44	44	44	44
Corumana	17	17	-	-	-	-	-	-	-
Corumana	-	-	17	17	17	17	17	17	17
HCB ESKOM	-	-	-	-	-	-	-	-	-
Existing IPPs									
Aggreko	47	47	-	-	-	-	-	-	-
Imports									
Imports	-	-	-	-	-	-	-	-	-
New EDM supply									
HCB Firm	-	42	100	100	100	100	100	100	100
Emergency power for the North and other short term options									
Aggreko (Nacala)	-	18	18	-	-	-	-	-	-
EDP I (Nacala)	-	5	16	-	-	-	-	-	-
EDP II (Nacala)	-	5	16	-	-	-	-	-	-
Beira	11	14	14	-	-	-	-	-	-
New IPPs									
Ressano Garcia I (CTRG)	-	127	-	-	-	-	-	-	-
Ressano Garcia II (CTRG)	-	-	152	75	-	-	-	-	-
Ressano Garcia III (CTRG)	-	13	23	11	-	-	-	-	-
Gigawatt	-	-	109	109	109	109	109	109	109
Kuvaninga	-	-	32	38	38	38	38	38	38
Mocuba Solar Plant	-	-	-	-	-	-	-	-	-
Meteoro Solar Plant	-	-	-	-	-	-	-	-	-
Electrotec	-	-	-	18	30	30	30	30	30
Temane (MGTP)	-	-	-	-	-	101	400	400	400
Moatize I	-	-	-	-	-	76	150	150	150
Other IPP projects									
Cahora Bassa Norte	-	-	-	-	-	-	-	209	415
Mpanda Nkua	-	-	-	-	-	-	-	76	150
Mavuzi 2&3	-	-	-	-	-	-	-	-	-
Tsate	-	-	-	-	-	-	-	-	-
Massingir	-	-	-	-	-	-	-	-	-
Lurio	-	-	-	-	-	-	-	-	-
Alto Malema	-	-	-	-	-	-	30	60	60
Chemba	-	-	-	-	-	-	-	-	-
Boroma	-	-	-	-	-	-	-	-	-
Mugeba	-	-	-	-	-	-	-	-	-
Lupata	-	-	-	-	-	-	-	131	260
Central Terminca Maputo, CTM (JICA)	-	-	-	-	50	100	100	100	100
Central de Nacala a Gás	-	-	-	-	-	-	100	200	200
Palma ENI	-	-	-	38	75	75	75	75	75
Moatize	-	-	-	-	-	-	-	-	-
Rio Tinto Benga	-	-	-	-	-	68	135	135	135
Ncondezi	-	-	-	-	-	151	300	300	300
Small Libombos	2	2	2	2	2	2	2	2	2
Mpanda Nkua additional	-	-	-	-	-	-	-	-	-
ENI diesel	-	-	-	18	18	-	-	-	-
Total	578	793	1,000	1,024	1,037	1,464	2,184	2,729	3,138

Available plant (MW)

Name	2023	2024	2025	2026	2027	2028	2029	2030
Existing EDM supply								
HCB Firm	300	300	300	300	300	300	300	-
HCB - non firm	200	200	200	200	200	200	200	-
Mavuzi I	52	52	52	52	52	52	52	52
Cuamba	1	1	1	1	1	1	1	1
Lichinga	1	1	1	1	1	1	1	1
Chicamba	44	44	44	44	44	44	44	44
Corumana	-	-	-	-	-	-	-	-
Corumana	17	17	17	17	17	17	17	17
HCB ESKOM	-	-	-	-	-	-	-	1,475
Existing IPPs								
Aggreko	-	-	-	-	-	-	-	-
Imports								
Imports	-	-	-	-	-	-	-	-
New EDM supply								
HCB Firm	100	100	100	100	100	100	100	-
Emergency power for the North and other short term options								
Aggreko (Nacala)	-	-	-	-	-	-	-	-
EDP I (Nacala)	-	-	-	-	-	-	-	-
EDP II (Nacala)	-	-	-	-	-	-	-	-
Beira	-	-	-	-	-	-	-	-
New IPPs								
Ressano Garcia I (CTRG)	-	-	-	-	-	-	-	-
Ressano Garcia II (CTRG)	-	-	-	-	-	-	-	-
Ressano Garcia III (CTRG)	-	-	-	-	-	-	-	-
Gigawatt	109	109	109	109	109	109	109	109
Kuvaninga	38	38	38	38	38	38	38	38
Mocuba Solar Plant	-	-	-	-	-	-	-	-
Meteoro Solar Plant	-	-	-	-	-	-	-	-
Electrotec	30	30	30	30	30	30	30	30
Temane (MGTP)	400	400	400	400	400	400	400	400
Moatize I	150	150	150	150	150	150	150	150
Other IPP projects								
Cahora Bassa Norte	415	415	415	415	415	415	415	415
Mpanda Nkua	150	150	150	150	150	150	150	150
Mavuzi 2&3	-	-	-	-	-	-	-	-
Tsate	-	-	-	-	-	-	-	-
Massingir	-	-	-	-	-	-	-	-
Lurio	-	-	-	-	-	-	-	-
Alto Malema	60	60	60	60	60	60	60	60
Chemba	-	-	-	-	-	-	-	-
Boroma	-	-	-	-	-	-	-	-
Mugeba	-	-	-	-	-	-	-	-
Lupata	260	260	260	260	260	260	260	260
Central Terminca Maputo, CTM (JICA)	100	100	100	100	100	100	100	100
Central de Nacala a Gás	200	200	200	200	200	200	200	200
Palma ENI	75	75	75	75	75	75	75	75
Moatize	-	-	-	-	-	-	-	-
Rio Tinto Benga	135	135	135	135	135	135	135	135
Ncondezi	300	300	300	300	300	300	300	300
Small Libombos	2	2	2	2	2	2	2	2
Mpanda Nkua additional	-	-	150	150	150	150	150	150
ENI diesel	-	-	-	-	-	-	-	-
Total	3,138	3,138	3,288	3,288	3,288	3,288	3,288	4,163

Table 53: Summary of generation capacity available to EdM

Name	2014	2015	2016	2017	2018	2019	2020	2021	2022
HCB	500	542	600	600	600	600	600	600	600
EDM	18	18	18	114	114	114	114	114	114
IPP	60	233	382	309	322	750	1,469	2,015	2,424
IMP	-	-	-	-	-	-	-	-	-
Total	578	793	1,000	1,024	1,037	1,464	2,184	2,729	3,138

Name	2023	2024	2025	2026	2027	2028	2029	2030
HCB	600	600	600	600	600	600	600	1,475
EDM	114	114	114	114	114	114	114	114
IPP	2,424	2,424	2,574	2,574	2,574	2,574	2,574	2,574
IMP	-	-	-	-	-	-	-	-
Total	3,138	3,138	3,288	3,288	3,288	3,288	3,288	4,163

Annex 6: Ongoing and pipeline loans and grants

Table 54 provides an overview of the ongoing and pipeline of soft loans. These loans include both concessional loans directly provided to EDM or loans provided to the Republic of Mozambique first which then on lends to EDM – i.e. on lending loans.

Table 54: Ongoing and pipeline soft loans

Project description	Donor institution	Value (US$ million)	Start day	Date end (estimate)
Energy Development and Access Project (EDAP)	AFD	25.87	2010	2015
Rehabilitation of Mavuzi and Chicamba hydro power stations	AFD	64.68	2012	2016
Ressano Garcia gas-fired power plant - CTRG project	AFD	39.89	2014	2014
Rehabilitation of Mavuzi and Chicamba hydro power stations	KfW	23.28	2013	2016
EDM Network Modernisation Program (Beluluane Industrial Park & Split Meters in Maputo and Matola)	KfW	60.80	2015	2018
New Tsate HPP	KfW	64.68	2016	2020
EDM STIP	KfW	25.87	2016	2019
Rehabilitation of Corumana HPP	KfW	25.87	2017	2020
New Mavuzi II HPP	KfW	38.81	2018	2022
Maputo Gas Fired Combined Cycle Power Plant Development Project	Japan	146.02	2014	2018
Energy Development and Access Project (EDAP)	EIB	43.83	2011	2016
Energy Development and Access Project (EDAP)	World Bank	49.20	2009	2015
STE project	World Bank (IDA)	150.00	2017	2016
Mozambique -Malawi interconnection project	World Bank (IDA)	60.00	2016	2016
Total	-	**818.8**	-	-

Source: ESWG Mozambique, AFD, KfW, JICA, World Bank

Table 55: provides an overview of the ongoing and pipeline grants.

Table 55: Ongoing and pipeline grants

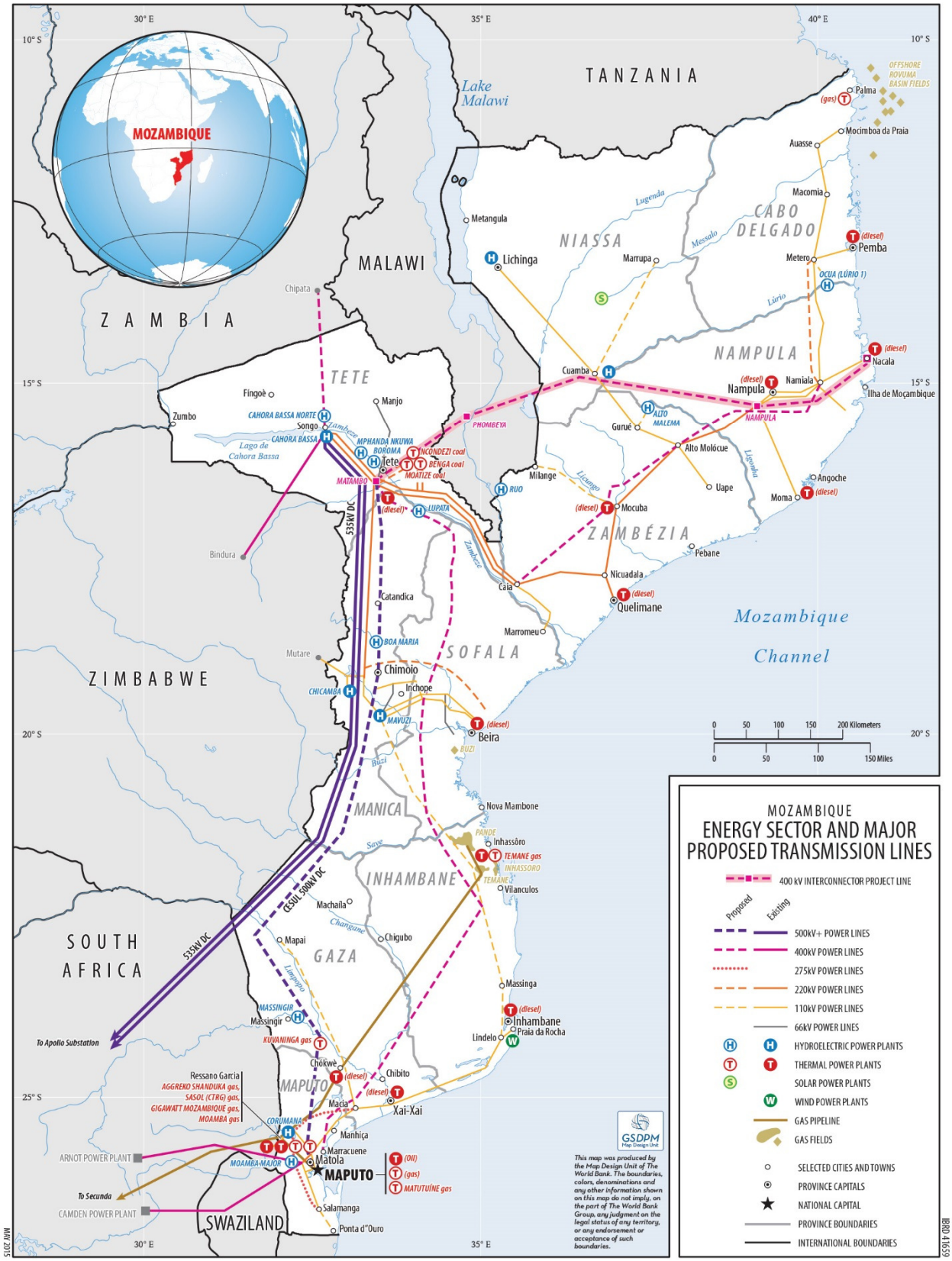
Project description	Donor institution	Value (US$ million)	Start day	Date end (estimate)
EDM Network Modernisation Program	KfW	7.49	2015	2018

Mozambique Malawi Interconnector	KfW	12.94	2016	2019
GET FiT	KfW	12.94	2017	2020
Reinforcement of Transmission Network in Nacala Corridor	Japan	17.01	2015	2017
Energising Development Mozambique. Formerly: Access to Modern Energy Services in Mozambique (AMES-M) Phase 2. Started with Dutch-Germanpartnership	ENDEV Program	13.97	2009	
Rural Electrification in Sofala	EU	17.45	2008	
Identification Mission to Mozambique in the Energy Sector	EU Africa Trust Fund	1.94	2012	
Strategic Regional Environmental and Social Assessment for CESUL (EU Africa Trust Fund_EIB as agent)	EU Africa Trust Fund	0.91	2010	
Support to WB trust Fund for Interconnection with Malawi and Backbone	Norway	78.81	2009	
Feasibility studies rehabilitation/reinforcement transmission/distribution system	Norway	1.42	2014	
TA to EDM on Mega Project Development	Norway	4.67	2008	
Rural electrification Chimbonila, Niassa	Norway	1.73	2011	
Rural electrification in Cabo Delgado	Norway	55.01	2007	2015
Rehabilitation of Mavuzi and Chicamba hydto power stations	Sweden	37.0	2013	2018
Tsate HPP	Sweden	87.0	2016	2023
Massinga electrification	Sweden	25.0	2016	2021
Fond for Strategic Studies in the Energy sector	Sweden	6.25	2016	2018
EDM Capacity Building	Sweden	5.0	2017	2020
Capacity building EDM + strategic studies	Sweden	6.58	2010	?
Capacity building UGDE unit at EDM	Sweden	2.11	2014	2017
Expansion of Temane gas fired power plant	Sweden	7.77	2012	2016
Niassa rural electrification (incl Cuamba extension)	Sweden	13.0	?	2016
SMT rural electrification (incl Tete extension)	Sweden	33.0	?	2016

Rural electrification in Vilankulos	Sweden	44.48	2015	2016
Support to WB trust Fund for Interconnection with Malawi and Backbone	Norway (managed by the WB)	64.50	2017	2015
Project preparation grant - Co-financing of the Regional Transmission Development Project ("STE Project") (P108934)	Norway (managed by the WB)	0.40	2015	2020
Mozambique-Malawi Transmission Interconnection Project (P144551)	Norway (managed by the WB)	3.60	2015	
Total	-	**561.98**	-	-

Source: ESWG Mozambique, KfW, JICA

Annex 7: Map of Mozambique Energy Sector and Proposed Transmission Lines



VII. References

1. Bloomberg (http://www.bloomberg.com/news/articles/2015-02-09/mozambique-restores-power-to-flood-ravaged- northern-provinces).

2. Defining an EU joint position in the Energy sector in Mozambique, 25/11/2014 - Meeting Minutes.

3. CMH (Companhia Moçambicana de Hidrocarbonetos) website.

4. EdM, Desempenho da EDM e Visão de Crescimento Empresarial - Apresentação ao novo Ministro de Recursos Minerais e Energia, sobre o Ponto de Situação da Electricidade de Moçambique E.P. em Janeiro 2015, e as perspectivas para o Futuro, February 2015, p89 and Norconsult, Master Plan Update Volume III, section 4.8.1.3.

5. EdM, Relatório de Desempenho 2009 – 2011.

6. EdM, Resenha Histórica, 2009 – 2013 Março 2014, p1 and p3.

7. EdM, Resenha Histórica 2009-2013, p17.

8. EdM´s audited financial accounts (2011 – 2013).

9. EdM´s Annual statistical reports (2011 – 2014).

10. EdM, Annual Report 2012.

11. EdM, Mozambique Regional Transmission Backbone Project. Feasibility Study Report, March 2012. Norconsult/Vattenfall.

12. EdM, Annual Statistical Report, 2013.

13. EdM, Mozambique's Power Supply Overview, 8 August 2014, p21.

14. EdM, Corporate Business Plan of Electricidade de Moçambique 2015 – 2019, October 2014

15. EdM´s Corporate model from November 2014.

16. EdM, Emergency energy Crisis in the Northern region due to Floods - Presentation to USTDA, 23 February 2015

17. EdM, Fundamentação da Proposta de Ajustamento do Tarifáfio de Energía Eléctrica da EdM, June 2015

18. EdM, Statistics Report, December 2014.

19. EdM. Short Term Investment Programme (STIP) to Reinforcement of EDM Transmission & Distribution Networks. Dec 2014.

20. EdM, Desempenho da EDM e Visão de Crescimento Empresarial - Apresentação ao novo Ministro de Recursos Minerais e Energia, sobre o Ponto de Situação da Electricidade de Moçambique E.P. em Janeiro 2015, e as perspectivas para o Futuro, February 2015.

21. EdM, Emergency energy Crisis in the Northern region due to Floods - Presentation to USTDA, 23 February 2015 and http://www.bloomberg.com/news/articles/2015-02-09/mozambique-restores-power-to-flood-ravaged-northern-provinces

22. EdM webpage (installed capacity, connection costs).

23. EdM. Proposta de Ajustamento Tarifário. June 2015.

24. EdM. FUNDAMENTAÇÃO DA PROPOSTA DE AJUSTAMENTO DO TARIFÁRIO DE ENERGIA ELECTRICA DA EDM, June 2015

25. Elexpert (Pty) Ltd, EdM: Review of the Electricity Tariff Arrangement and Tracking Mechanisms - Summary Report, 17 January 2012

26. ESWG in Mozambique (stands for Energy Sector Working Group), data on donor grants and loans. Please note that with respect to soft loans and grants we have been also in touch with various donor institutions including AFD, KfW, JICA and EIB.

27. European Investment Bank. Power Generation Scenarios for Mozambique. Prioritization of investments, undated.

28. European Union, Final Evaluation of Projects under the 9th Energy Facility in Mozambique, Final Report, February 2014.

29. European Union, Final Evaluation of projects under the 9th EDF Energy Facility in Mozambique Annexes to Final Report, November 2013.

30. FUNAE, Relatório Anual de Actividades 2012, January 2013.

31. Government of Mozambique, Proposta do Programa Quinquenal do Governo 2015 – 2019

32. Government of South Africa, Integrated Resource Plan 2010-2030 Update report, November 2013.

33. ICF. The Future of Natural Gas in Mozambique: Towards a Gas Master Plan Executive Summary. 20 Dec 2012.

34. IFC, Mozambique's Power Sector Review and Cash Flow Analysis - 28 Nov 2014.

35. Kenya Power and Lighting Company Limited Annual Report and Financial Statements 2012/2013 p114.

36. Ministry of Energy. Estratégia de Energia 2014-2023 Moçambique 2014.

37. Ministry – gas, República de Moçambique Conselho de Ministros. Plano Director do Gás Natural. Aprovado na 16.ª Sessão Ordinaria do Conselho de Ministros. 24 de Jonho de 2014.

38. National Petroleum Institute website.

39. Norconsult and Vattenfall. Mozambique Regional Transmission Backbone Project Feasibility Study Final Feasibility Study Report Volume II Economic Impact Study. March 2012.

40. Norconsult and Vattenfall. Master Plan Update Project, 2012 – 2027 Final Master Plan Update Report Volume I – System Review Report. 30 April 2014.

41. Norconsult and Vattenfall. Master Plan Update Project, 2012 – 2027 Final Master Plan Update Report Volume II – Load Forecast Report. 30 April 2014.

42. Norconsult and Vattenfall. Master Plan Update Project, 2012 – 2027 Final Master Plan Update Report Volume III – Main Report. 30 April 2014.

43. Norconsult and Vattenfall. Master Plan Update Project, 2012 – 2027 Final Master Plan Update Report Volume IV – Summary Report. 30 April 2014.

44. Norconsult and Vattenfall. Mozambique Regional Transmission Backbone Project Feasibility Study Volume V Line Route Report - 400 kV AC Line. Mar 2012.

45. Regulamento que Estabelece o Regime Tarifário para as Energias Novas e Renováveis (Refit)

46. Renewable Energy Atlas of Mozambique, 1st edition 2014.

47. República de Moçambique, Conselho de Ministros Plano Director do Gás Natural, Aprovado na 16.ª Sessão Ordinaria do Conselho de Ministros 24 de Jonho de 2014. Of the 277 tcf of reserves, 128 tcf are 3P reserves.

48. SA Department of Energy. Integrated Resource Plan for Electricity (IRP) 2010-2030 Update Report 2013. 21 November 2013.

49. SAPP website http://www.sapp.co.zw/demand.html (accessed on May 14, 2015).

50. Statnett, Capacity and capability in Electricidade de Moçambique (EdM) - Assessment of Needs for Organizational Development, 15 January 2015.

51. World Bank, Generating Sustainable Wealth from Mozambique's Natural Resource Boom, World Bank Mozambique Policy Note, January 2014.

52. World Bank, Harnessing African Natural Gas - A New Opportunity for Africa's Energy Agenda?, 2012.

53. World Bank, Implementation Completion and Results (ICR) Report on the Southern Africa Regional Gas Project (Report No: ICR86374-MZ) published by the World Bank on June 30, 2014.

54. World Bank – macro data (FX rate, inflation rates, population estimates – though the primary source for population estimates is INE – National Statistics Institute in Mozambique, connection costs).

55. World Bank (forthcoming). Guidance on linking project documents to Poverty and Prosperity Goals.

56. World Bank Household Survey in Mozambique.