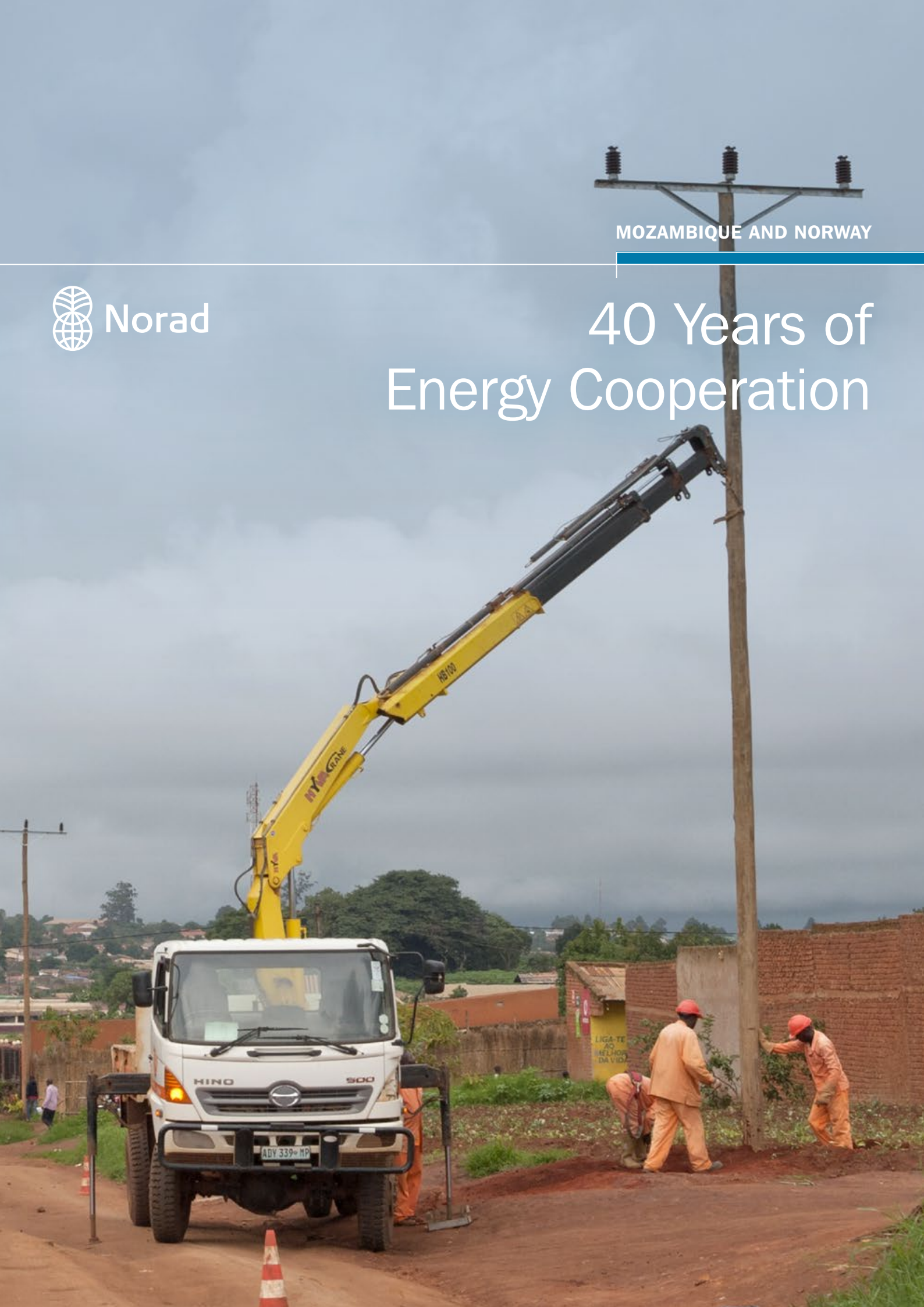


MOZAMBIQUE AND NORWAY



40 Years of Energy Cooperation



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'Mozambique was one of Norway's first, and has been one of our most important partner countries within energy related development cooperation. Norway has donated NOK 2.5 billion to the energy sector in Mozambique over the last 40 years. We have supported basic infrastructure development, helped give access to electricity for a large number of families, improved services within health and education and facilitated private investments in the power sector. This is important, because without energy there will be no development.'

BØRGE BRENDE,
MINISTER OF FOREIGN AFFAIRS,
NORWAY



'It has been a great honor and privilege to work with Norway in the energy sector for the last 40 years. Together we have achieved substantial results. We have built strong energy institutions, extended the electrical network and 97 percent of our districts now have electricity. Private companies are producing power in Mozambique and we will soon have our first solar power plant, which will be among the largest in East Africa. Norway is a governance model for Mozambique. We are thankful for 40 years of friendship and cooperation and hope that Norway will stay with us in our efforts to provide electricity for all and to develop Mozambique into a sustainable energy hub in our region. We look forward to further collaboration in the years ahead.'

LETICIA KLEMENS,
MINISTER OF MINERAL RESOURCES
AND ENERGY, MOZAMBIQUE



Introduction

Mozambique became independent from Portuguese colonial rule in 1975. At that time 15 of the country's 130 districts had access to electricity. Today, 40 years later, the national electricity grid covers 147 of the country's current 154 districts. It has been challenging to arrive to this point: Shortly after liberation, Mozambique entered into a 16-year civil war, which ended in a peace agreement in 1992. The brutal destruction of the civil war greatly affected the country's infrastructure and the energy sector was not exempted. Electricity lines and other critical installations were sabotaged nearly every day. The World Bank estimates that less than one per cent of the population had access to electricity after the war. Given the history, the current electricity access rate of 26 per cent is impressive, especially when taking into account that the population has more than doubled from around 14 million in 1992 to almost 30 million in 2017.

The energy cooperation between Mozambique and Norway started around the same time as the civil war broke out in 1977. Since then, Norway's cooperation with the energy authorities in Mozambique and the electric utility EDM has grown into a strong partnership. Norway has followed the development of the energy sector in Mozambique during three important phases from: i) 16 years of civil war through ii) a longer period of power sector reconstruction and an overall positive development, to the final phase of iii) increased focus on the facilitation of private sector participation and catalytic use of the energy support.

The objective of this report is to highlight the main achievements of the 40 years of energy cooperation between Mozambique and Norway. This partnership has contributed to the development of all aspects of Mozambique's energy sector, hereunder:

- > Institutional cooperation and capacity building within a number of institutions.
- > Mapping, development and construction of new power plants.
- > The development of Mozambique's national electricity grid and connections to neighbouring countries.
- > Rural electrification.
- > Off grid electricity and cooking.

The report has been prepared based on desktop studies of existing material, literature and reports from the Norwegian Agency for Development Cooperation (Norad), the Embassy and the Norwegian Ministry of Foreign Affairs, earlier evaluations covering Norwegian support to Mozambique, project documents and bilateral agreements. In addition, field work and interviews have been conducted with a number of individuals in Mozambique and Norway, who play or have played a key role in the energy cooperation.

The report is not an evaluation or formal review. It has been designed to mark 40 years of cooperation with focus on that which has been achieved during the years. It is not intended to be a critical assessment of the entire energy support or its impact. However, the report does address some of the challenges encountered along the way and sums up some of the most important experiences.

The report covers the cooperation within clean energy and the power sector (including gas power generation). Upstream petroleum-related cooperation between Mozambique and Norway, such as the Oil for Development Programme (OfD) is not included in the report. A full list of the identified projects funded by the assistance for clean energy and the energy sector in Mozambique is found in appendix form.

Over a period of 40 years Mozambique has...



- > Developed the national electricity grid to cover 147 of the country's 154 districts (only 15 districts were covered in 1977).
- > Increased access to electricity (grid-connected) from less than 1% of the population after the civil war (1992) to 26% of the population in 2017.



- > Multiplied the national generation of energy from approx. 500 GWh/p.a. to around 18,000 GWh/p.a.
- > Started developing mega projects for energy generation and transmission that could help Mozambique become a regional power hub.



- > Built up a strong national electric utility, which currently supplies around seven million people with electricity.
- > Opened up for the private ownership of power plants through the establishment of the Energy Act in 1997.



- > Built several privately owned power plants with a total capacity of almost 300 MW.
- > Became the majority owner of Cahora Bassa (HCB), Mozambique and Southern Africa's largest hydropower plant (2075 MW).
- > Signed a 20-year power purchase agreement with the country's first solar power plant (40 MW).

...and Norwegian energy support has amongst others contributed to:

- > More than 200,000 people in rural areas having access to electricity through the grid and 80,000 having access to off-grid electricity solutions.

- > More than 400,000 people having access to cooking stoves for cleaner and more efficient cooking.

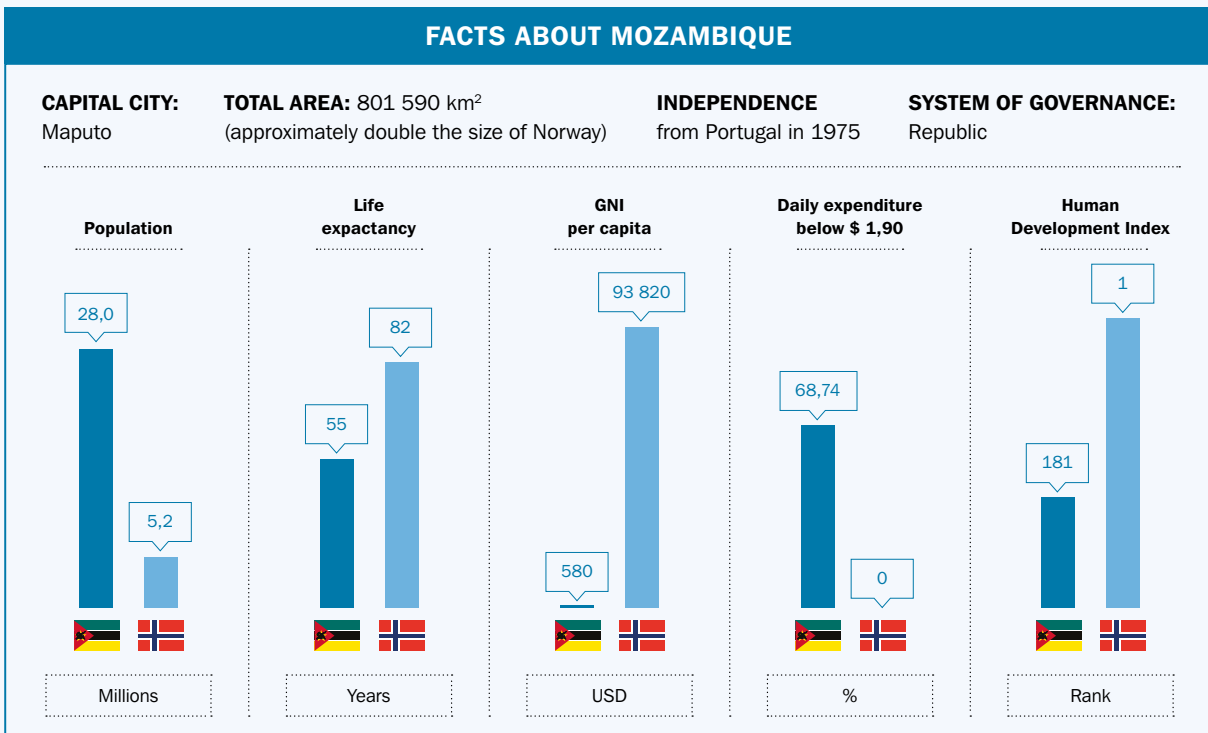
- > Construction of more than 1,750 km of power lines:
 - > For transmission: More than 750 km.
 - > For distribution: More than 1,000 km.

- > Educating and training more than 700 employees in the national electricity company EDM.

- > Educating and training more than 100 employees of the energy authorities.

- > Development of three small hydropower plants and transaction advisory for three large gas power plants.

- > Development of the country's first grid-connected solar power plant (40 MW), with a Norwegian developer and investment from Norfund.



SOURCE: UNDP, WORLD BANK





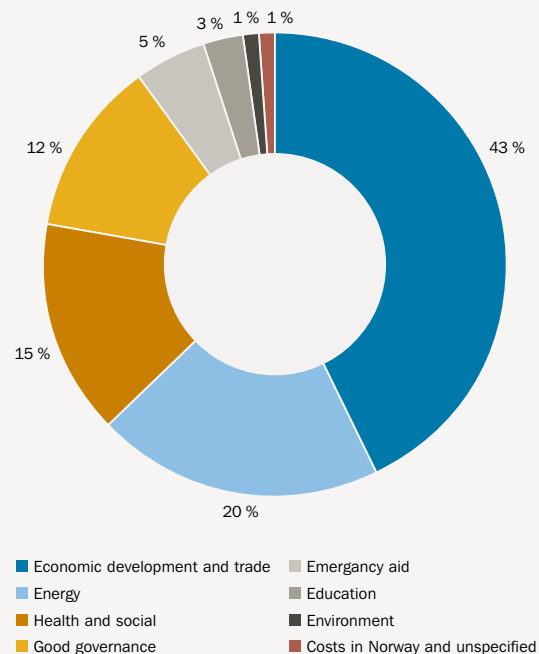


Overview and milestones

MOZAMBIQUE AND NORWAY: DEVELOPMENT COOPERATION SINCE THE 70S

Mozambique has been one of Norway's main partners for development assistance in Africa since the mid-70s and one of the countries that has received most bilateral support from Norway. In 1977, Mozambique was defined as a 'main partner country' for Norwegian support. About 20 years later, in 1996, the cooperation was further boosted through the establishment of a Norwegian Embassy in Maputo. The total amount of Norwegian aid to Mozambique from 1980–2016 was around NOK 12.3¹ billion. Of this, 20 per cent, or NOK 2.4 billion, was support to the energy sector. This includes support to the power sector and clean energy, but not support to Oil for Development (OfD). Support to OfD amounted to approximately NOK 190 million from 2006–2016.

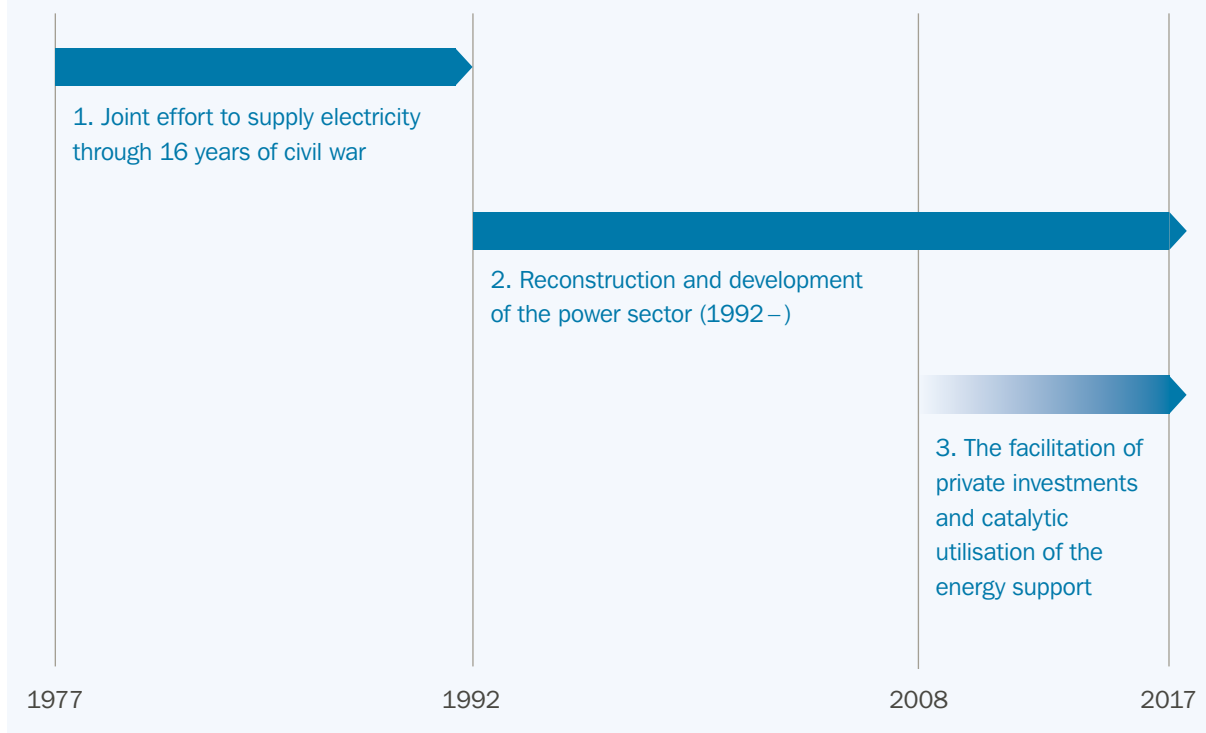
FIGURE 1: BILATERAL SUPPORT TO MOZAMBIQUE BY SECTOR GROUP, 1980–2016



*MNOK 5.1 of the BNOK 2.4 in energy aid to Mozambique from 1980-2016 constituted transfers through the Oil for Development Programme.
 **MNOK 190.5 of the total BNOK 12.3 in aid to Mozambique from 1980-2016 constituted transfers through the Oil for Development Programme. OfD is distributed over several sector groups: financial development and trade, good governance, energy, the environment and unspecified. SOURCE: NORAD

1. Based on the total of nominal values for the years 1980-2016. SOURCE: NORAD.

The energy cooperation between Mozambique and Norway can be divided into three main phases:



1. Joint effort to supply electricity through 16 years of civil war

Mozambique and Norway started their cooperation to develop the energy sector shortly after Mozambique gained independence from Portuguese colonial rule in 1975. The earlier energy cooperation included Norwegian funding and technical assistance for the development of small hydropower plants and the delivery of diesel generators (supplied, for example, by the Norwegian company Bergen Diesel) to establish a certain level of electricity supply in larger cities and towns. A comprehensive mapping of Mozambique's hydropower resources was initiated, and Norwegian and Swedish advisers assisted EDM with feasibility studies for at least ten promising projects.

EDM and Norway – 40 years of cooperation

Around 1980, an institutional cooperation was established between the national electric utility, Electricidade de Moçambique (EDM), and the



Engineers from EDM and Norwegian experts carrying out an inspection in connection with the construction of the small power plant in Lichinga in Northern Mozambique early in the 80s. PHOTO: NORAD'S ARCHIVES

Norwegian Water Resources and Energy Directorate (NVE). This was probably the first institutional cooperation initiated by Norad within the energy sector. Even though the cooperation was challenging at several levels, it represents a significant milestone in Norwegian energy assistance. During the last 40 years, the cooperation with EDM has grown to be one of Norway's strongest partnerships within energy sector development.

Civil war in Mozambique (1977–1992)

At the same time as the energy cooperation with Norway started, Mozambique entered into a bloody 16-year civil war. The conflict started in 1977, just two years after liberation. The resistance movement, Renamo, rebelled violently against the governing party, Frelimo and the National Armed forces. Renamo was financially and politically supported by the then unrecognised state of Rhodesia (now Zimbabwe) and South Africa.

Attacks on civilians were common. Five million out of a population of around 14 million had to flee from their homes in 1980, and it is estimated that approximately one million people lost their lives through starvation or battle. Even more were maimed by landmines, which were widely used during the civil war and continue to be a serious problem for Mozambique today. The civil war ended with the signing of a peace agreement in 1992, after which a UN peace mission arrived in the country to support the transition to democracy. Mozambique held its first democratic election in 1994.

Energy sector severely affected by the war

Some of the challenges facing Mozambique's energy sector during the civil war were that i) the power system was frequently targeted for sabotage, ii) it was difficult to travel around the country, making development of new projects highly demanding, and iii) the political climate made it hard to develop the institutional cooperation.

Norway and Sweden chose to maintain their support to Mozambique's energy sector throughout the war. However, the situation made it necessary to shift focus from long-term development of the energy sector to short-term emergency measures, in order

Challenging times for EDM

'It was challenging to keep the wheels running during the civil war, due to continuous sabotage of our infrastructure. Among other things, I remember a phone call from the transformer station in Caia, I believe it was in 1985. The call was from the leader of the rebel forces, who had taken the transformer station and told me it would be blown up. I asked them persistently to leave it, because a new transformer station could take years to build. Unfortunately I was not heard, and this was EDM's reality at that time. Norway stood by our side throughout the war and supported us so that we could maintain a certain level of power supply, develop and build new projects and educate new employees. This was extremely important in keeping the morale up during the first 16 years of EDM's history, and in building it into a strong power company. Today we supply nearly 7 million people with power, and if you look at the challenges Mozambique has had over the last 40 years, EDM is a success story! Norway should have a great deal of credit for this.'



ERNESTO FERNANDES,
35 YEARS WITH EDM,
FROM 1977 TO 2012

PHOTO: ERNESTO FERNANDES

secure a minimum supply of electricity for vital functions in the largest towns and cities.

With this support, EDM and the Mozambican authorities tried to the best of their ability to maintain and boost the electricity supply in the country. The aim of the Norwegian support was to meet all the above-mentioned challenges through the funding of new hydropower plants, transmission lines and transformer substations, along with comprehensive assistance from Norwegian advisers. Between 1977 and 1992, Norway contributed more than NOK 400 million for

procurement and installation of equipment and spare parts to EDM. This facilitated quick repair or replacement of critical power system components when needed during the war. Other extraordinary measures were also implemented, such as the procurement of a dedicated project aeroplane for transportation of staff and equipment to hydropower projects in more remote districts.

2. Reconstruction and development of the energy sector

The civil war ended with a peace agreement in 1992 and Mozambique entered into a longer period with a relatively stable political climate and considerable economic growth. During this period, comprehensive reconstruction of the power sector was facilitated including the expansion of the electricity grid and establishment of a more robust institutional framework, as described below. Despite a somewhat increased political unrest and an economic downturn in later years, this overall positive development has largely lasted until today.

Development of the national electricity grid

In the middle of the 1990s, the Mozambican authorities adopted ambitious plans to electrify the whole country. After the civil war, only 15 of the country's 130 districts had an appreciable electricity supply and it became one of the main political objectives to develop the national electricity grid to reach all the districts². Through electrification of the country, the authorities wanted to strengthen national and regional public administration, contribute to political stability and facilitate economic growth. Norway has supported Mozambique with several large electrification projects, including development of transmission lines, local distribution networks and connection of new electricity customers. A number of other partners have also given considerable support to Mozambique during this development. As a result, Mozambique has largely succeeded in reaching its goal: 147 of 154 districts were electrified at the end of 2016.

² The number of districts has slightly changed since then due to restructuring. Mozambique is currently divided into 154 districts.

One of the main factors that has contributed to this development is access to the electricity supply from one of Africa's largest hydropower plants, Cahora Bassa on the Zambezi River. The plant was built by the Portuguese and commissioned just days before liberation in 1975. Even though a few power plants have been built since then and more are being investigated, Cahora Bassa, in 2016, supplied around 55 per cent of the national electricity in Mozambique. This national supply still only constituted half of the plant's total generation, with the rest of the energy being exported to South Africa and other neighbouring countries.

In 2016, Cahora Bassa was forced to reduce its electricity generation due to long lasting droughts and low water levels in the reservoir. Only with increased rainfall can the generation be turned up to normal levels again.

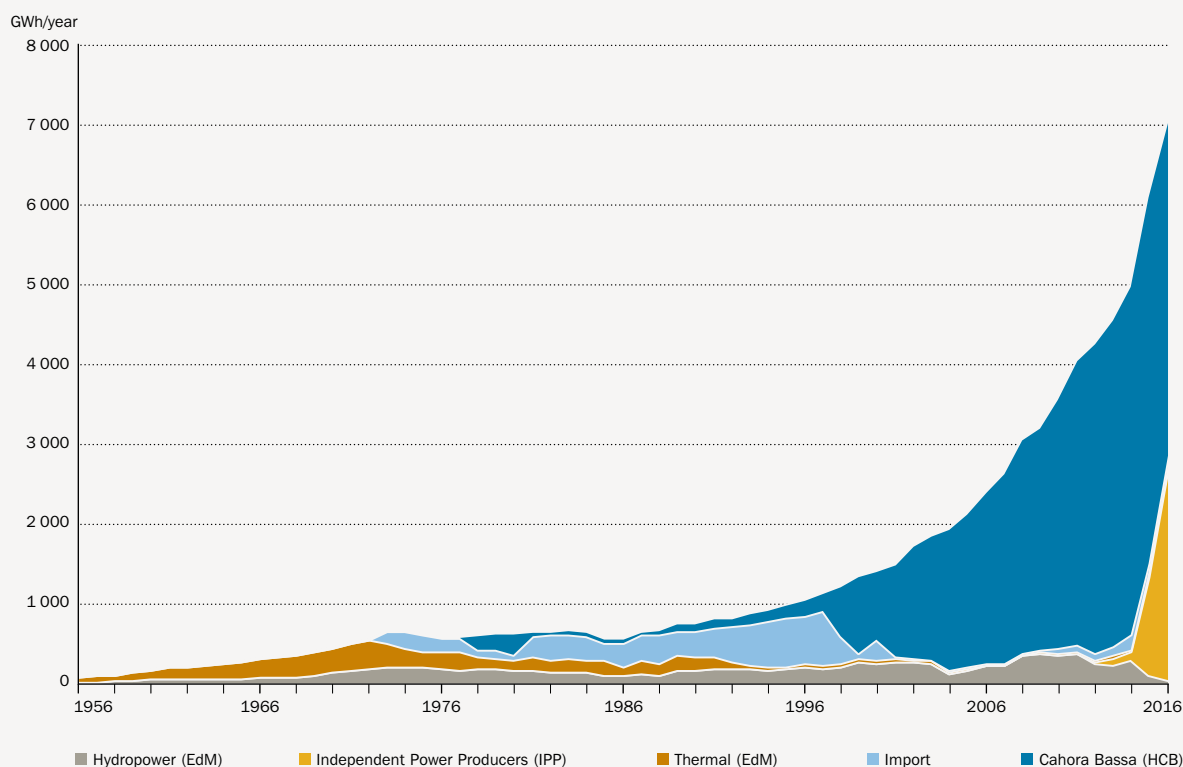
As figure 2 (next page) shows, the demand for electricity in Mozambique has grown massively since the end of the civil war in 1992, in line with the development of the national grid. In 2007 the control over the operating company Hidroeléctrica de Cahora Bassa (HCB) was transferred to Mozambique. The transfer to state ownership of the country's largest source of electricity was a major milestone for the sector.

3. Facilitation of private investments and catalytic utilisation of the energy support

Norwegian support to the energy sector in Mozambique has contributed towards new infrastructure, maintenance of existing plants and electrification of rural villages since the 1970s. These areas do not generally attract private investments and must therefore be financed by the Government and its development partners. However, state resources and development assistance is far from sufficient to trigger the full potential for electricity generation in Mozambique. Therefore, considerable resources have been allocated to facilitate private investments in both small and large-scale electricity generation.

Norway has contributed to this effort; for example, through the 'Technical Assistance – Large Scale Transmission and Generation Programme'. Supported

FIGURE 2: TOTAL NATIONAL ENERGY SUPPLY (GWH/YEAR) IN MOZAMBIQUE, 1956–2016



Total electricity supply in Mozambique. Electricity from Cahora Bassa constituted around 55 per cent of the total supply in Mozambique in 2016. The amount of electricity from independent power producers has increased considerably since 2014 following the construction of new gas plants. The figure does not include electricity exported from Cahora Bassa to South Africa and other neighbouring countries through long-term agreements. SOURCE: EDM

by Norwegian expertise, the Mozambican authorities and EDM have worked towards enabling private investments in electricity generation. The programme has focused on developing sustainable collective agreements and strengthening EDM's general capacity, along with implementation of specific projects. Amongst other things, this has contributed to the successful construction of new gas power plants financed by the private sector, which now deliver flexible electricity supply to the national grid at competitive prices.

Private investments in Mozambique's first grid-connected solar power plant

In October 2016, Mozambique reached an important milestone with the signing of a 25-year power purchase agreement between EDM and the Norwegian solar

power developer Scatec Solar. With funding from Norfund, Scatec will build the first grid-connected solar power plant in Mozambique with an installed capacity of 40 MW. Read more about this on page 31.

Catalytic use of the energy support

Public funds are limited, pointing to the need for facilitation of private investments. Some investments (e.g. infrastructure in the national electricity grid) must still be covered by public funding. Thus in recent years, Norway has put more emphasis on channelling support to the most critical areas of cooperation, so that it may have a catalytic effect on other contributions. This approach requires continuous mapping and investigation of the sector's investment needs and cooperation with other financial institutions with private sector and other donors.

Cahora Bassa Hydropower Plant

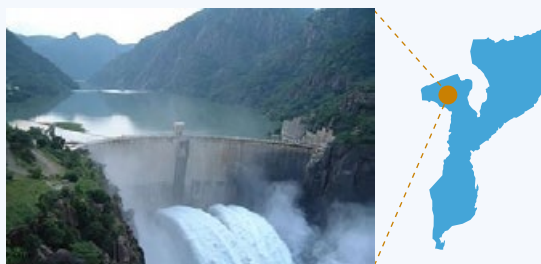
Cahora Bassa was opened in 1975 and is still Mozambique and Southern Africa's largest hydropower plant. The installed capacity of 2,075 MW corresponds to the approximate capacity of Norway's largest power plant, Ulla-Førre. Cahora Bassa lies on the Zambezi River in the North-Western corner of Mozambique and is the driving force of the national power system. The plant accounts for more than 80 per cent of Mozambique's annual electricity generation. Mozambique took over Portugal's majority ownership of the power plant and the operating company HCB in 2007, and today holds more than a 90 per cent of the shares.

Earlier history

- > In 1956, the first Portuguese colonists reached the stretches of Cahora Bassa on the Zambezi River and saw the potential to generate electricity.
- > At the end of 1966, Hidrotecnica Portuguesa was hired to plan and design the hydropower development.

Development

- > Building of the dam started in 1969, followed by installation of systems for generation and transmission of electricity.
- > A Power Purchase Agreement was signed with South Africa as the main procurer in 1969 (with transmission through Cahora Bassa's HVDC line, which was connected to the power grid in Johannesburg).
- > The construction was consistently attacked by guerillas during the fight for independence.
- > The hydropower plant was put into commercial operation just before Mozambique's independence agreement was signed in 1975.



KEY FACTS

Location	Zambezi River, Mozambique
Type	Reservoir
Operational start-up	1975
Installed capacity	2,075 MW
Annual generation (2015)	16,000 GWh
Dam height	171 m
Dam width	303 m

PHOTO AND SOURCE: HIDROELECTRICA DE CAHORA BASSA

Some Milestones of the Energy Cooperation

1977–80



The energy cooperation between Mozambique and Norway starts with the mapping of hydropower resources and the establishment of institutional cooperation between EDM, and the Norwegian Water Resources and Energy Directorate (NVE). Mozambique becomes the main partner country for Norwegian development assistance. At the same time in 1977, civil war breaks out in Mozambique two years after liberation from Portuguese colonial rule. [Read more on page 8](#)

1977–92



The three small power plants in Lichinga, Cuambe and Corumana are built with financial support from Norway and technical assistance from Norwegian hydropower experts. [Read more on page 27](#)



1983–94



Norway supports Mozambique's procurement of equipment, spare parts, repairs and the building of infrastructure to maintain the country's electricity supply during the civil war. [Read more on page 9](#)



1997



The Mozambican authorities adopt a new Energy Act. The process of preparing the Energy Act and appurtenant regulatory framework is supported by Norway through NVE. In the same period, a national strategy for the electrification of villages in Mozambique is drawn up. [Read more on page 17](#)

1997



Completion of the first transmission line between Mozambique and Zimbabwe (250 km, 400 kV), two years after construction work started in 1995. Norway supported feasibility studies, planning and construction of the power line. [Read more on page 35](#)

2001–15



Norway finances a number of large electrification projects in five different provinces in Central and Northern Mozambique. The projects involve approx. 1,500 km of new power lines and stable electricity supply to at least 40,000 new customers. [Read more on page 43](#)

2008



The establishment of 'technical assistance for the development of large generation and electricity transmission projects'. The programme later becomes instrumental in the development of Mozambique's first large-scale gas plant CTRG (operational from 2014). [Read more on page 10](#)



2011



Norway grants MNOK 500 to the development of regional electricity systems. This includes support for the development of the mega transmission project 'Backbone' and a new interconnector between Mozambique and Malawi. [Read more on page 38](#)

2016



Establishment of the 'Short-Term Investment Programme (STIP)'. The need for acute upgrading of the electricity grid's infrastructure was investigated in cooperation with Norwegian advisers. [Read more on page 40](#)



2016



EDM signs a 25-year power purchase agreement with Scatec Solar and Norfund to build the country's first grid-connected solar power plant at Mocuba (40 MW). [Read more on page 31](#)



PHOTO BOTTOM: SCATEC SOLAR. PHOTO OTHERS: KEN OPPRANN

WHAT HAS NORWAY SUPPORTED?

The total amount of Norwegian assistance to Mozambique's energy sector from 1980–2016, with the exception of upstream petroleum-related activities, was approximately NOK 2.4 billion³. Annual payments to the sector reached their highest level in 1994 with around NOK 200 million. See figure 3, next page.

In all, around 80 per cent of these funds have gone to funding infrastructure, hereunder electricity generation (state and private actors) and the development of the national electricity grid. See figure 4, next page.

EXPERIENCE 1

Technical assistance is effective assistance

The STIP program was prepared by EDM in cooperation with Norwegian advisers. A method was developed to identify critical investment needs in the national electricity grid in Mozambique, as well as a number of criteria for prioritising those that were most important. The project manager for the program, Joao Catine refers to STIP as a good example of effective assistance.

'The approach of the STIP program meets the needs of EDM and the power sector because it focuses on the technical realities of high priority in the primary power grid. Support from technical experts has helped us identify and address critical investment needs. Once a concrete list of priorities was established, it was easier for donors to coordinate on the ongoing financing of different items. The Norwegian Embassy has played a very important role in gathering donors around these priorities.'

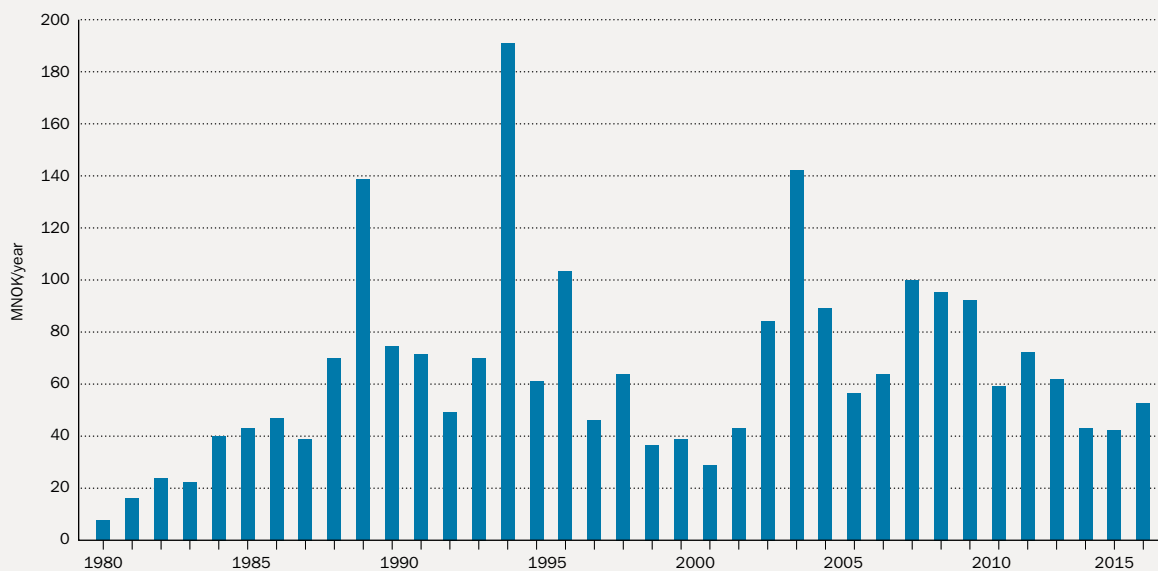


JOAO CATINE,
PROJECT MANAGER STIP,
EDM

PHOTO: KEN OPPRANN

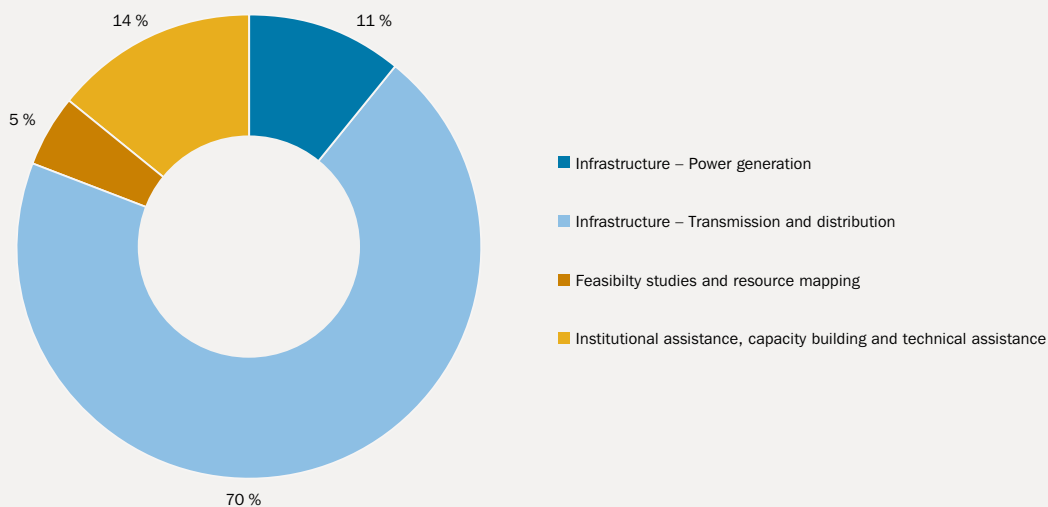
³ Nominal figure.

FIGURE 3: NORWEGIAN BILATERAL ENERGY SUPPORT TO MOZAMBIQUE, 1980–2016



*In the period 1980–2016, Norfund had two transfers to Mozambique over the energy sector: 0.8 million in 2010 and 0.6 million in 2016. However, from 2014 onwards, all transfers from the Ministry of Foreign Affairs (MFA) to Norfund are reported as economic development and trade, due to new statistics guidelines. Thus only the transfer in 2010 is included in the table. SOURCE: NORAD

FIGURE 4: NORWEGIAN BILATERAL ENERGY SUPPORT TO MOZAMBIQUE BY CATEGORY



SOURCE: PROJECT LIST IN APPENDIX (NORAD)





Institutional capacity

The foundation for a functioning energy sector



NORWAY HAS CONTRIBUTED TO:

- > Educating and training of more than 700 employees in the national electricity company EDM.
- > Educating and training of more than 100 employees of the energy authorities.
- > Developing the energy sector's regulatory framework.
- > Developing the regional energy market.
- > Extensive technical assistance and capacity development.

Organisation of the energy sector

With the exception of some institutional and market-related changes, Mozambique's energy sector has had the same general structure for the last 40 years. Since 2015, the energy sector has been under the Ministry of Mineral Resources and Energy (MIREME) with the National Directorate for Electrical Energy (DNE⁴) as the subordinate agency.

EDM (Electricidade de Mozambique) is a state-owned utility with a mandate for generation, transmission, distribution and sale of electricity. The generation side is open to private participation, and more privately owned power plants have been built in recent years. Up to now, Mozambique has not had an independent regulator for the energy sector (such as NVE – The Norwegian Water Resources and Energy Directorate in Norway) and the energy authorities have functioned as the regulator. The National Electricity Council (CNELEC) was established in 2004 as an internal adviser to the Ministry for the regulation of the sector. CNELEC also monitors EDM's activities.

⁴ Direcção Nacional de Energia.

Fundo de Energia (FUNAE) is a public institution that contributes to increased access to modern energy services in rural Mozambique. FUNAE was established in 1997 and is responsible for increased access to energy, especially in areas that are not reached by the national electricity grid. This means promoting off-grid solutions such as small scale solar PV and hydropower, and appliances and fuel for improved cooking.

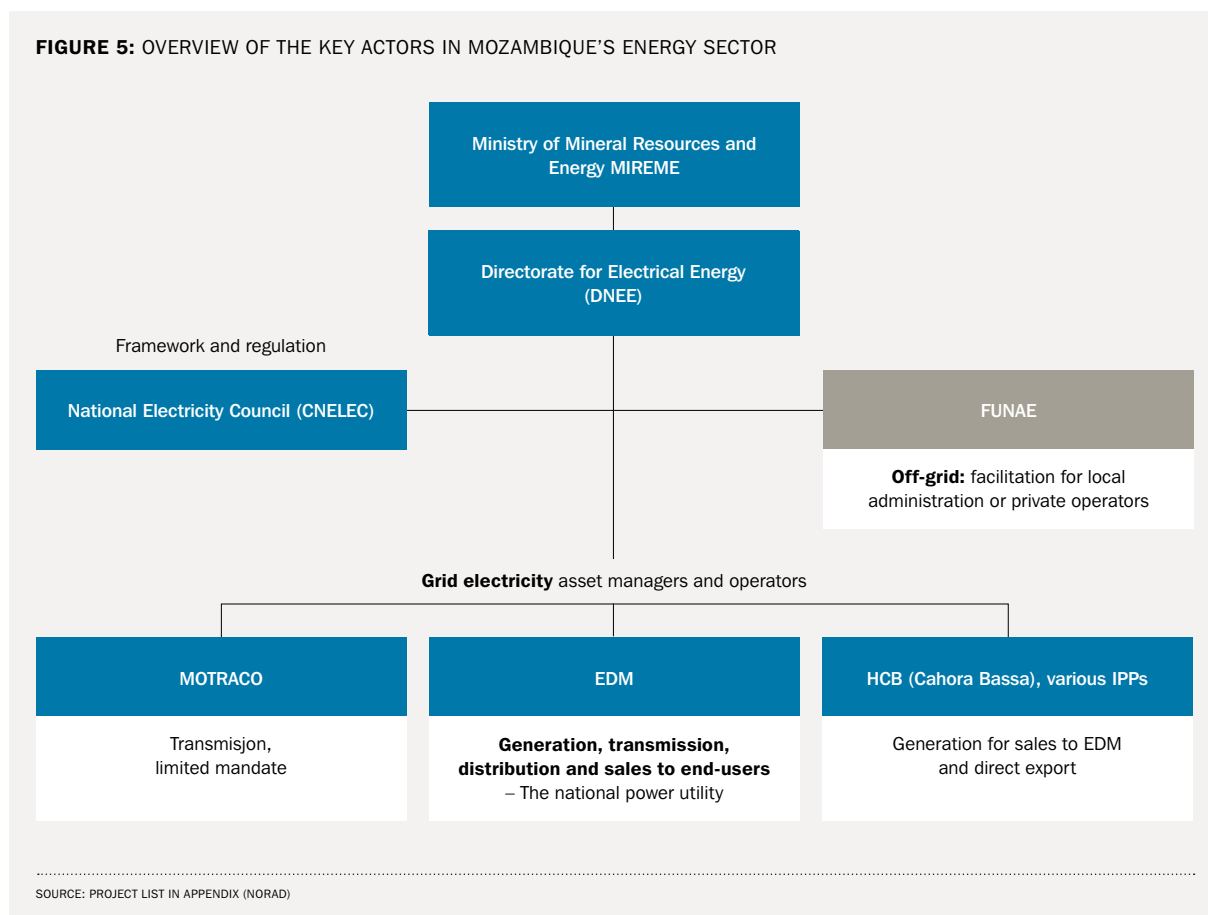
Discussions around the regulatory framework for the energy sector

In connection with Mozambique's expansion of the national electricity grid in the 1990s, a discussion regarding the organisation of the energy sector also emerged. This was part of a global debate concerning the structure of energy sectors in developing countries, and how they should be structured to best facilitate development and growth. It was widely agreed that in the long-term, private sector participation would be

necessary in order to finance development of the generation and distribution capacity. For example, Uganda initiated a full energy reform in 1999, which involved de-regulation and privatisation of the production and distribution of electricity, as well as the establishment of an independent regulator for the energy sector. The World Bank and Norway supported the reform in Uganda, which many considered to be very successful, making Uganda one of the most attractive countries for private investment in renewable energy on the continent.

While Norway supported the energy sector reform in Uganda, this was not the case for Mozambique. It was assessed to be too early, as both the electricity grid and the regulatory framework for the sector were still weak. During this process, Norway's role was mainly to assemble all stakeholders for constructive dialogue. For example, Norway initiated a study to analyse the impact

FIGURE 5: OVERVIEW OF THE KEY ACTORS IN MOZAMBIQUE'S ENERGY SECTOR



of a potential energy sector reform. The study indicated that this could slow down the electrification of the districts and access to electricity in villages, which were deciding factors when choosing to postpone the reform.

Even though de-regulation of the energy sector in Mozambique still seems quite a long way off, it is now widely agreed that an independent regulator for the sector needs to be established. For example, this could strengthen the regulation of EDM's activities and contribute to improved coordination and long-term planning. The growing interest and participation of private actors also increases the need for a strong

regulator. A framework has been established for a regulator (ARENE – Autoridade Reguladora de Energia), which according to plan should be put into operation during the next two years. Norway supports this process through the institutional cooperation between NVE and MIREME.

Norwegian support to the energy authorities

Norwegian support to the Mozambican authorities has gone directly to the Ministry of Energy and many state-owned institutions in the sector, including DNE, CNELEC and FUNAE. However, the most comprehensive cooperation has been with the national utility EDM.

EXPERIENCE 2

Energy sector reform or not? And when?

When discussions on deregulation and privatisation of the energy sector in Mozambique emerged started in the 2000s, the authorities were concerned that it would weaken the push to electrify all districts in the country. If the mandate for distribution was to be put into the hands of private actors with concessions, it was feared that this development would be slowed down due to the lack of commercial incentives in most of the districts. However, in terms of generation it was largely agreed that one should be open to private actors, as the political and commercial incentives are less likely to come into conflict when establishing a national electricity grid (generation can largely be centralised anyway). This has also been achieved, as the first independent power producers have already supplied power to the Mozambican grid.

'The discussions and choices made regarding a possible power sector reform about 15 years ago were crucial for the further development of Mozambique's power sector. Norway had an important role in this process, because Norwegian advisors accepted that the answer to this question would not necessarily be the same across different countries. Based on Norway's own power sector

development, it was understood that the organization of the power sector must be adapted to the resources, capacity, power system and political climate in each country.

At this time Mozambique had a dozen development partners on energy, all with different perspectives and opinions. Norway helped us gather all partners into fruitful discussions based on Mozambique's prerequisites and plans for power sector development. This type of support has been typical for the energy cooperation with Norway. The Norwegian Embassy also took the initiative to set up the energy sector's joint working group, where partners and stakeholders meet monthly to coordinate their power sector efforts in the best possible way.'



LAURA NHANCALE,
CONSELHO NACIONAL DE
ELECTRICIDADE (CNELEC)

PHOTO: ENDRE OTTOSEN / NORAD



'A great share of my competence on power systems and project development come from our close cooperation with Nordic advisors, who have worked as integrated EDM employees since the 70's. I particularly remember one travel to South Africa, where we tested steel towers to be delivered for the construction of a new power line in Mozambique. My Norwegian colleague destroyed two expensive steel towers because he tested them all the way to their maximum tolerance. I was surprised and uncertain as to whether this was necessary. But he made me realize that the cost of two broken towers was nothing against the cost and the problems we would face if a tower should break after the line was built and put into operation. This kind of experience and knowledge transfer has been vital for EDM as a company, up until today.'

ABEL CHAMBUCA,
PROCUREMENT DIRECTOR, EDM

The earlier cooperation between NVE and the energy authorities largely focused on mapping of local hydropower resources. During the years after the civil war, the institutional cooperation gradually resumed, and in 1998, NVE and the DNE signed a comprehensive cooperation agreement. The overall objective of the programme, which lasted until 2005, was to enable the Ministry of Energy (through DNE) to act as a credible authority using the relevant regulatory tools. A significant amount of training and procurement of computer equipment and software was carried out through the programme. A national strategy for rural electrification and a regulatory framework based on Mozambique's Energy Act of 1997, were also prepared. This framework largely formed the basis for further development of the sector.

Additional support for capacity building within the Ministry of Energy was provided through the consultancy company KPMG from 2007–2012. Following this, Norway also contributed with strategic advisory services for the energy minister through the previous Minister of Petroleum and Energy in Norway, Mr. Eivind Reiten, who was a key figure in the Norwegian energy sector reform early in the 1990s. Further, the cooperation between MIREME and NVE has gradually resumed in recent years. A new programme for capacity development will be starting in 2017. Amongst other things, this will address the further development of the regulatory framework and establishment of the new independent regulator for the energy sector (ARENE).

Norway has also taken the initiative to devise a programme for increased awareness to the fact that that access to electricity is indeed a tool for gender equality. Access to electricity can help increase the welfare of women and release their time for other income-generating activity or education. The programme is to ensure that new connections to the electricity grid meet the needs of women, especially in rural villages. As part of this work, EDM has dedicated resources for training for women.

Establishment of the national electric utility EDM

When Mozambique won the struggle for independence from colonial rule in 1975, much of Portugal's competence and know-how within a number of fields practically disappeared overnight. This also applied to the generation and distribution of electricity. When the newly established EDM was given responsibility for developing the country's electricity supply in 1977, access to qualified personnel, resources and competence was extremely limited. The solution was to bring in personnel without any noteworthy relevant education or experience, many of them very young, to give them the best possible internal training within planning, development and operation of the power system through learning by doing. A system was established, which involved newly employed personnel being sent to various districts to work with different parts of the power system over a period of several years. In this way, it was possible to build up a functioning utility relatively quickly.

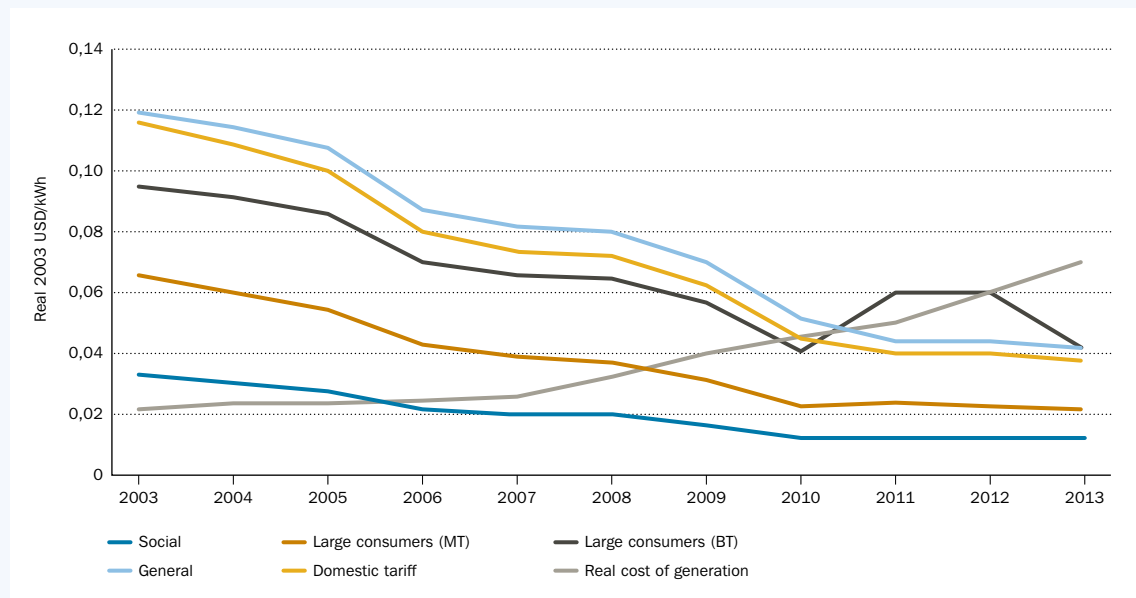
Affordability vs. sustainability – a key development dilemma

In 2013 Multiconsult, commissioned by Norad, conducted an Impact Assessment of three selected rural electrification projects in Mozambique. A cost-benefit analysis of the three projects revealed that the life-time benefits of electricity access far outweigh the costs. However, the Impact Assessment found that the 2012 power tariffs charged by the national utility (EDM) was below the real cost of generation (see figure).

This means that EDM lost money for every kWh sold, even before new investments in infrastructure were

counted in. So, while the project was highly beneficial to Mozambique overall, the connection of new customers left EDM losing even more money. This in turn meant that less money was available for maintenance and expansion of the grid.

EDM's financial situation has since improved, but the above situation demonstrates why it is crucial to the sustainability of the power system and ability to connect more consumers that electricity tariffs reflect the actual costs of maintaining and expanding the grid.



With the outbreak of the civil war within in the same year as EDM's establishment, the utility experienced an arduous first 16 years in business. Almost daily it was necessary to mobilise personnel on short notice to replace shot-down masts, destroyed transformers and other types of sabotage. The war with its extensive use of landmines made this a very risky affair for EDM's employees indeed. Following the peace agreement in 1992, EDM could to a larger extent prioritise development and strengthening of its organisation.

EDM's growing pains

From the 1990s until today, EDM has experienced technical and financial challenges related to a fast-growing national electricity system, increased consumption and a larger customer base. Mozambique's political goals for access to electricity in the districts has been supported by development partners, and reinforced by global focus on poverty reduction and access to clean energy for all.



'Through 40 years, cooperation with Norway has been crucial for building a national power system that facilitates further development and modernisation in Mozambique. The support has also helped us establish a national utility with the capacity to operate and develop the system, and has contributed towards a framework that facilitates private investment in the power sector. Given that we started from virtually nothing, this is a success story. Still, more than 70 percent of the population still lack access to electricity and we still have a way to go.'

AUGUSTO DE SOUSA FERNANDO
DEPUTY MINISTER, MINISTRY OF MINERAL RESOURCES & ENERGY

It is widely agreed that access to electricity in rural villages is hugely beneficial in terms of the socio-economic effect. At the same time, the effort has contributed to financial challenges for EDM. It has been politically difficult to establish electricity prices that reflect the company's actual costs and this has elevated the problems. However, this is about to change, as the authorities and EDM have agreed to implement a step-wise increase in electricity tariffs. In 2015 and 2016 prices rose by 24 and 40 per cent, respectively, depending on the level of consumption. Further increases are planned in 2017 and 2018. Hopefully, this will boost EDM's financial situation and its ability to adequately operate, maintain and develop the power system.

In recent years, the pressure on the energy sector and EDM's financial situation has slightly declined. The high generation at Cahora Bassa in recent years has played an instrumental role in this, following rehabilitation works in the 2000s.⁵ The profits from increased power sales have enabled the Mozambican government, with its majority share in the plant, to repay project debts. In the long-term, these profits could be utilized for re-investments in the national power system. The ongoing tariff increase is expected to reinforce this positive development in the sector's sustainability.

⁵ However, Cahora Bassa has been forced to significantly reduce its generation in 2017, as a result of permanent drought in the region. This will create significant problems for the sector should the situation last.

Norwegian support to EDM

The cooperation between EDM and Norway started around 1980, and was firmed up through an extensive cooperation agreement in 1987. In the beginning, NVE managed most of the support to EDM. Focus was placed on direct and close cooperation, with the aim of enabling EDM to develop all aspects of the country's power sector. In recent years, NVE's focus has been shifted towards Government cooperation, while support to EDM has been provided mainly through private advisers. Norconsult has played an important role in this, as a trusted adviser for EDM since the 1980s. The successful program on technical assistance for development of large energy projects (see the chapter on energy generation) is just one of many examples of the strong cooperation between EDM and Norconsult.

Statnett entered into institutional cooperation with EDM in 2013 to reinforce, among other things, EDM's energy system planning. However, this ended, as Statnett closed down its international activities shortly afterwards.

Norwegian technical assistance to EDM has been holistic, covering long-term planning, studies, design and construction of infrastructure projects. A number of Norwegian and Swedish advisers e.g., from NVE, Statnett, Norconsult and Swedpower have assisted EDM for years, and have been considered fully integrated employees. The trust established through close cooperation has been emphasised by several as a key to success, and may have contributed to positive effects beyond those that can be measured.



EDM technicians constructing poles during installation of a power line in Northern Mozambique. PHOTO: KEN OPPRANN



EDM's characteristic orange distribution transformer now symbolises access to electricity and development. PHOTO: KEN OPPRANN

Despite the presence of Norwegian and other advisers during EDM's first 40 years as a utility, EDM still lacks capacity in many areas. Throughout the cooperation it has been challenging to institutionalise the acquired experience, know-how and competence in a systematic and uniform manner. Hence, there is room for improvement when it comes to ensuring that knowledge and skills are passed on to newer generations of EDM employees. However, it should also be noted that EDM has experienced almost continuous growth since the civil war. At times, the combination of increasing responsibilities and limited resources may have forced the utility to prioritise day-to-day operations rather than long-term institutional development.

Mozambique as a future regional power hub

With record-high generation at Cahora Bassa combined with several new gas power plants installed in recent years, Mozambique now has a significant surplus of energy. Even with continued electrification and increasing national consumption, the country will continue to be a net exporter in the foreseeable future. This is bolstered by plans to develop more large hydropower and gas power plants.

On this basis, Mozambique has ambitions to strengthen its position as a regional power hub, that can offer reliable and flexible power supply to neighbouring countries. In order to accomplish this, new power plants and related infrastructure must be built, and the regional energy cooperation needs to be reinforced through new connections between neighbouring countries and a strengthened regulatory framework for the regional power market. All this will demand comprehensive political efforts, planning and coordination across the borders, along with massive public and private investments.

SAPP – The regional energy market

Norway has played a central role in the development of the regional energy market in Southern Africa, SAPP (Southern Africa Power Pool). SAPP was established by SADC (Southern African Development Community) in 1995 to coordinate the energy systems and markets of the 12 member states. It is now Africa's largest energy market. Norwegian advisers have contributed

to the development of electronic energy trading between the countries, building on the principles and technical solutions from our own regional power market, NordPool.

Market-based energy trading, as part of the total bilateral trading in the region, increased from six per cent in 2014/15 to fifteen per cent in 2015/16. The potential is even higher, because around half of potential trades are suppressed by insufficient transmission capacity in the region.

Along with the support to SAPP, Norway has also promoted regulatory functions in the region. RERA (Regional Electricity Regulators Association of Southern Africa) consists of electricity regulators from 10 SADC countries, whose objective is to have joint planning and a coordinated regulatory framework in the region. Norway entered into an agreement in 2004 to support RERA, which primarily involves technical assistance and advisory through NVE. In addition, through its cooperation with Cape Town University, Norway has established a network for exchanging experiences and know-how between the regulators of the various countries.

Infrastructure in the regional energy system

Norway has allocated NOK 500 million to the 'Mozambique Regional Transmission Development Programme' through a World Bank trust fund. The regional 'Backbone' project is supported through this fund (see the chapter on the national electricity grid). Such a comprehensive expansion of Mozambique's national power system, combined with new inter-connectors to neighbouring countries, will provide an important basis for new large-scale energy generation and export. Norway has also previously supported the planning and building of a 250 km long 400 kV transmission line to Zimbabwe (finished in 1997), as well as numerous studies for power lines to Mozambique's neighbouring countries, including Zimbabwe, Malawi and Swaziland.

FIGURE 6: MEMBER COUNTRIES AND KEY DATA FOR SAPP

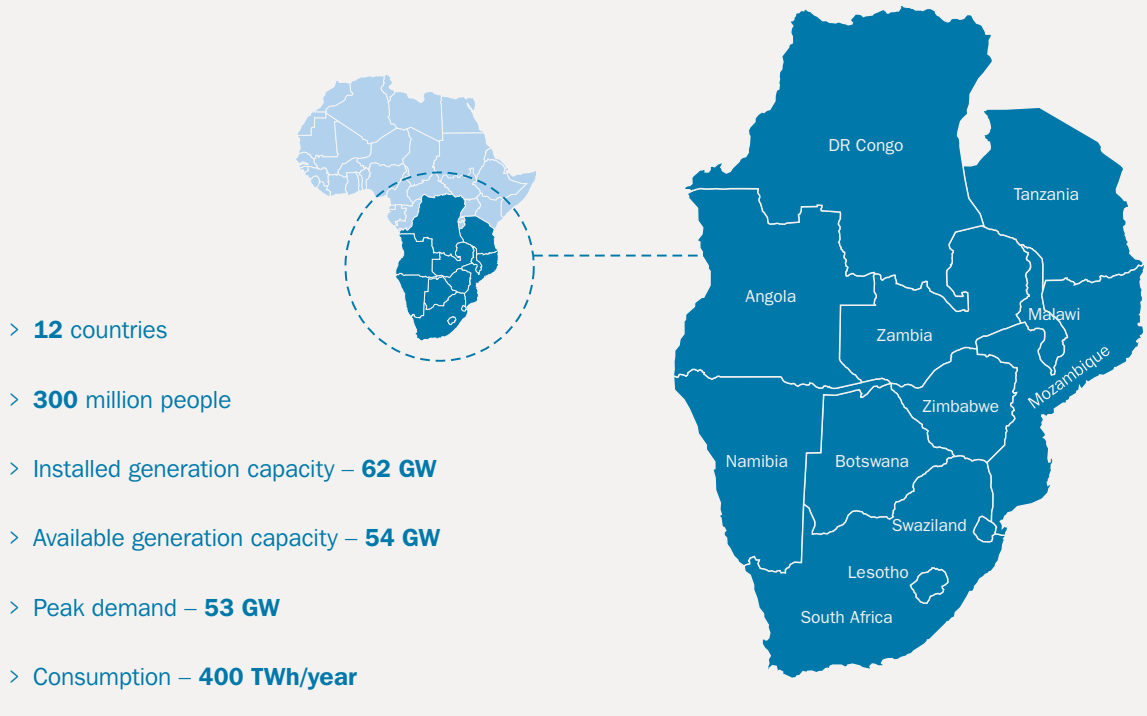


PHOTO: KEN OPPRANN





Energy generation

From small-scale hydropower to Mozambique's first solar power plant



NORWAY HAS CONTRIBUTED TO:

- > The development of three small power plants and transaction advisory for large power plants.
- > The country's first grid-connected solar power plant (40 MW), which is being developed by Scatec Solar, Norfund and EDM.
- > Development of the country's first large-scale natural gas power plant.
- > Mapping of the country's hydropower potential and numerous feasibility studies for small and large power plants.

Early development of hydropower under demanding conditions

Following the initiation of the bilateral energy cooperation, great emphasis was placed on mapping and developing the country's hydropower resources. Between 1982 and 1994 Norway allocated approximately NOK 45 million to support around 20 studies of potential hydropower projects. However, given the situation created by the civil war, it was extremely difficult to develop the projects. Partly because of problems with moving around the country and partly due to very limited access to funding and qualified personnel. Nonetheless, three projects were built during this period in different parts of the country: the Lichinga, Cuamba and Corumana hydropower plants, with a combined installed capacity of around 16 MW. Two of these are in operation today, whilst the third temporarily ceased operations in 2015 due to lack of water. The projects were developed and built in cooperation with Norwegian experts from NVE, Norconsult and others, and they played a significant role in EDM's capacity building.

In the 1990s, development of small hydropower in the country stagnated. This was largely due to electricity generation from Cahora Bassa being considered sufficient to meet the country's needs at the time. Hence, focus was shifted towards expanding the national electricity grid, enabling distribution of the power from Cahora Bassa throughout the country. Nonetheless, the hydropower studies from the 1980s and 1990s still largely apply and can be used when EDM and the authorities assess the further development of the national power system.

Increasing need for new electricity generation locally

After almost 20 years with a strong focus on the development of the national electricity grid and electrification, EDM is experiencing a continually increasing demand for electricity. The electricity generated at Cahora Bassa and other power plants is transported over increasingly long distances, which leads to higher losses and problems with voltage levels. Therefore, there is an increasing need for decentralised electricity generation. 'This means that the feasibility studies for the hydropower projects carried out in the 1980s and 1990s are again relevant. Access to funding for this type of project is the main challenge,' says Luis Salamao, Head of EDM in the District of Lichinga, northern Mozambique.



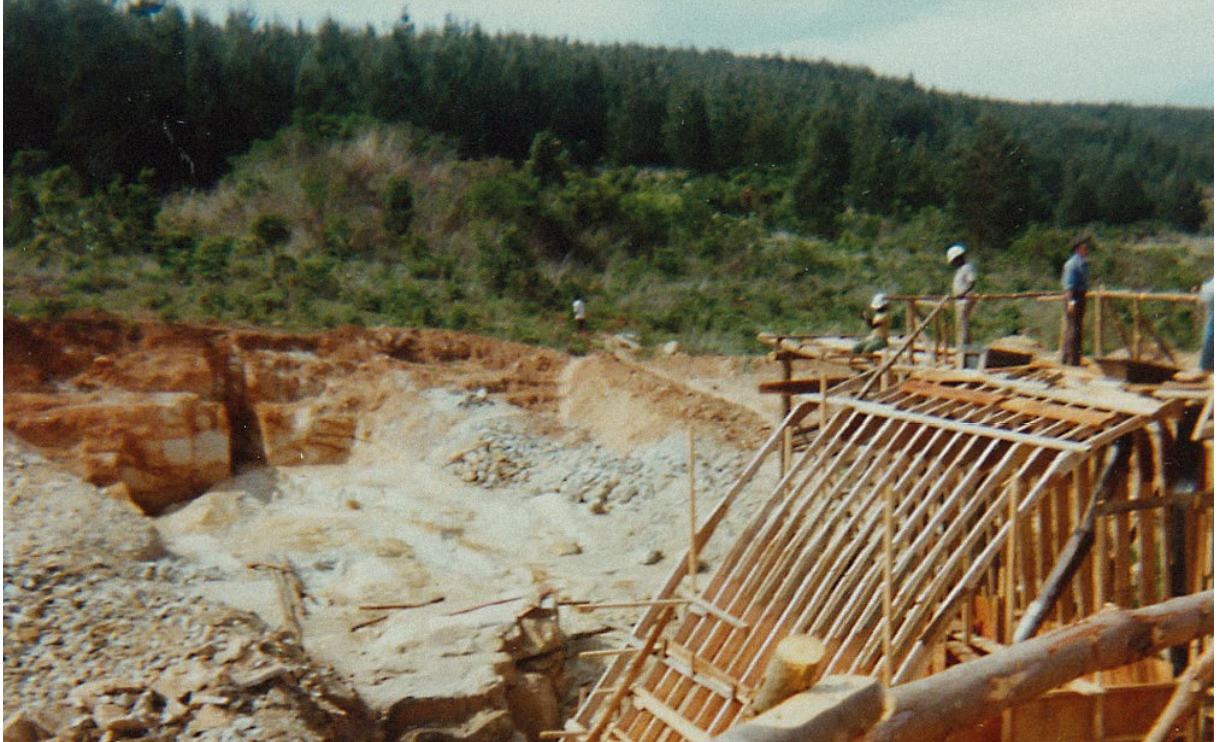
The head of EDM's district office in Lichinga, Luis Salamao, showing the principle outline of one of the hydropower projects in Lichinga that was studied by EDM and Norconsult in the 1980s. This was one of the projects that Norway chose not to prioritise and the power plant was never built. PHOTO: KEN OPPRAN

LICHINGA – AN IMPORTANT SMALL HYDROPOWER PLANT

Construction of the small power plant in Lichinga started in 1980 and finished as planned in 1983. The purpose of the project was to improve local electricity supply and to reduce the district's operational costs associated with diesel generators. Lichinga is the capital of the Niassa Province in northern Mozambique, therefore it was politically important to secure its electricity supply during the civil war. This would help maintain the administrative and operational capabilities of the authorities, and boost the morale of the local population.



The power plant was built on the upper part of the Lucheringo River with a 12-metre high and 130-metre wide dam, which forms a water reservoir measuring approximately 66,000 cubic metres. The 2.5 km long pipeline leads the water down to a power plant with a net head of around 50 metres. The plant is equipped with one Francis turbine and has a capacity of around 0.73 MW, which is delivered to Lichinga Town via a 15 km long power line. The power plant is still in operation. Since its commissioning in 1983, the average annual electricity generation of the power plant has been significantly lower than expected. Although the power plant was constructed according to plan, the water supply has been significantly lower than initially estimated due to droughts and other hydrological circumstances.



1982: Lichinga small power plant, construction of the dam. PHOTO: NORAD'S ARCHIVES



2017: Lichinga small power plant. The finished dam, still in operation. PHOTO: KEN OPPRANN

As with the other two power plants, Cuamba (1 MW) and Corumana (14.5 MW), that were finished in 1990 and 1994 respectively, Lichinga was a relatively expensive project. Evaluations have later indicated that these projects in isolation have not been financially viable investments due to higher costs and lower generation than what was originally estimated. At the same time, it has been highlighted that the projects have had other important ripple effects, both politically and in terms of developing hydropower competence. All these projects included training of local operations personnel and capacity building at EDM through the cooperation with Norwegian advisers. It is also important to remember that the difficult situation in Mozambique at the time made the projects significantly more expensive than they would have been under normal circumstances. However, this did not make the need for electricity any less acute. Lichinga town was finally connected to the national electricity grid in 2007 by the Norwegian-financed power line from Gurué (some 300 km south of Lichinga). This has resulted in great improvements to the security of electricity supply in the district.

Technical assistance for the development of large hydropower projects

Since the development of small-scale hydropower stagnated in the 1990s, Norwegian assistance was gradually moved to the development of the large hydropower plants on the Zambezi River (and its largest tributaries), for which the country had concrete plans. As part of this effort, Mozambique's Government established UTIP (Technical Unit for Implementation of Hydropower Projects) as a public project unit in 1996, to implement the mega projects Mphanda Nkuwa and Cahora Bassa North Bank. Norway contributed to the establishment of UTIP with funding for equipment, IT systems and vehicles, as well as assistance with the technical, legal and financial aspects of developing these large projects.

Although the projects have not yet been built, they are still of interest to international investors. The establishment of UTIP has greatly contributed to the further development of these projects through a number of studies and plans. UTIP was also established as a natural point of contact for investors seeking information about these projects.

Natural gas – a valuable addition to Mozambique's power supply

Mozambique has considerable petroleum resources both onshore and offshore. Two onshore gas fields, Temane and Pande, have been developed for commercial production. Most of the gas is exported to South Africa through an 850 kilometre long gas pipeline. However, some of the gas is also used to meet the national demand. Significant gas fields have also been found in Rovuma off the coast of Cabo Delgado. These findings are several tenfold the size of Pande and Temane and when developed they will make Mozambique one of the largest gas producers in the world.

The petroleum sector cooperation between Mozambique and Norway started in the early 1980s. During the first few years Norwegian support focused on the mapping of resources and surveys. Following the establishment of the Oil for development (OfD) programme in 2005–2006, Norwegian support has been directed towards establishing good governance of the petroleum sector. The OfD cooperation has mainly focused on the extraction of oil and gas (upstream), but Norway has also played a key role in developing Mozambique's natural gas power business.

During the last few decades, the energy authorities have initiated a major effort to develop natural gas power plants. As a result, Mozambique's first plant, Central Termica de Ressano Garcia (CTRG – 175 MW), was commissioned in 2014. Approximately one year later another natural gas power plant, Gigawatt, was opened by Mozambique's president. The plant has an installed capacity of 120 MW and has been placed adjacent to CTRG. With a third plant being planned (Kuvananga, 40 MW), it is expected that Mozambique will have an installed gas power capacity equivalent to more than 10 per cent of the country's total capacity within a couple of years.

The three above mentioned project have received technical assistance from Norwegian advisors through the program 'Technical Assistance – Large Scale Transmission and Generation', described on page 10.

Ressano Garcia Gas Power Plant (CTRG)

Power plant

Planning started in 2010 and the power plant was put into operation in 2014 with a capacity of 175 MW. The plant was developed by 'Electricidade de Mozambique' (EDM – 51%) and the South African company Sasol New Energy (SNL – 49%).

Importance to Mozambique

The installed capacity of CTRG constitutes around 20% of Mozambique's peak load and is therefore important to the country's energy system. As the country's first permanent, large-scale natural gas power plant, its development has been an important learning process for EDM and the entire energy sector.

Results

Ressano Garcia was the first large plant built after Mozambique's liberation. The successful completion of a \$250 million project with private investment and ownership is an important result for EDM in itself. The 18-month long development was completed in accordance with the timetable and a power purchase agreement securing good terms and conditions for Mozambique was negotiated by EDM.



Norwegian assistance

EDM's handling of CTRG was supported by Norway through technical assistance from Norwegian advisers, hereunder project planning, the drawing up of agreements and negotiations with private actors. During the development phase, the support also included assistance for the evaluation of investment costs, financial structuring and the calculation of tariffs. Norwegian assistance was given through the 'Technical Assistance – Large Generation Projects Programme'.

PHOTO: KEN OPPRANN

Is Mozambique's energy sector entering into a new era?

During the last 25 years Mozambique's energy sector has gone from wrack and ruin after the civil war to a sector that is now attracting significant interest from private investors and renewable energy developers. Private investments are critical to ensure that more electricity is generated in the districts, as EDM has problems with meeting the increasing local demand in many areas. In addition, increased private investments can free up public investment capital for other areas, for example, the development and reinforcement of transmission and distribution grids. An important milestone was reached when Scatec Solar and

Norfund signed a 25-year power purchase agreement with EDM in 2016, making Mozambique's first grid-connected solar power plant (40 MW) near Mocuba in Zambézia Province a reality. The solar power plant will generate around 77 GWh annually, equivalent to the electricity consumption of more than 170,000 households. The solar power plant will be built with equity from Scatec Solar (52.5%), Norfund (22.5%) and EDM (25%). Financial loans will be given by the International Finance Corporation (IFC), which is part of the World Bank, and the Emerging Africa Infrastructure Fund (EAIF). The plant is expected to be commissioned in 2018.



Managing Director Mateus Magala (EDM), Mozambique's Minister of Mineral Resources and Energy Leticia Klemens, Managing Director Raymond Carlson (Scatec Solar), Managing Director Kjell Roland (Norfund), Norway's Minister of Foreign Affairs Børge Brende, and other representatives of the parties during the signing of the power purchase agreement for the solar power plant near Mocuba. PHOTO: THE NORWEGIAN EMBASSY

The development of the solar power plant near Mocuba, with private investments and ownership, is a direct result of the long and close energy cooperation between Mozambique and Norway. The Norwegian Embassy has supported the planning and facilitated the partnership and negotiations for the power purchase agreement. It has also allocated NOK 32 million towards the development of a new power line and the upgrading of a transformer substation to connect the plant to the grid. Norad supported a feasibility study for the project.







The national electricity grid

A pillar for development



NORWAY HAS CONTRIBUTED TO:

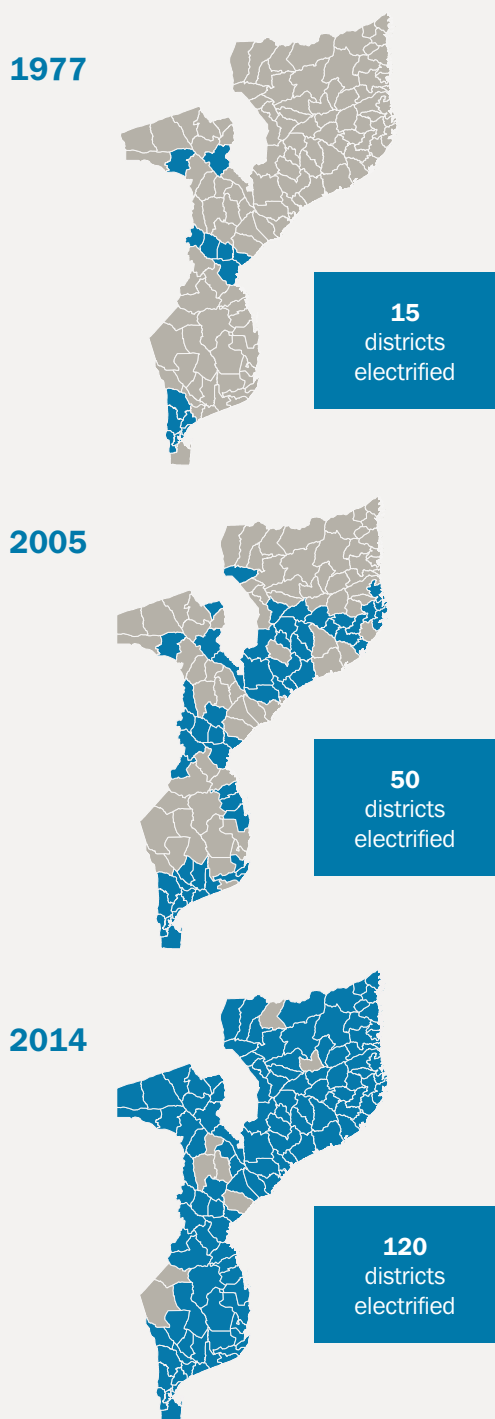
- > The development of more than 500 km of transmission lines in Mozambique and a 250 km long interconnector to Zimbabwe.
- > Feasibility studies for Mozambique's largest transmission project 'Backbone', that will strengthen the country's position as a regional electricity supplier.
- > Planning of a new interconnector to Malawi.
- > Broad support to boost and upgrade critical infrastructure in the electricity grid.

Broad efforts to electrify the country

After the civil war in Mozambique ended in 1992, the newly elected government prioritised electrification of the country. Only a few districts were at this time connected to the electricity grid and a definite goal was set to electrify all districts. This goal was highly prioritised as it could help bring together Mozambique's population after 16 years of war, and contribute towards social development and economic growth in the districts.

With support from Norway, Sweden and other donors, Mozambique has worked intensely towards its goal to provide grid access to all the districts. Considerable progress has been made particularly during the last decade or so. In 2016, 147 of a total 154 districts were connected to the national grid. It is important to note that electrification of a district in this context does not mean that the entire population has access to electricity. It means that the district is connected to the national electricity grid, which forms the basis for short or medium-term electrification of the most important centres of economic activity and public administration. In the long-term, access can be expanded to the entire district.

FIGURE 7: DEVELOPMENT OF THE ELECTRICITY GRID HAS LED TO THE ELECTRIFICATION OF ALMOST ALL THE DISTRICTS IN MOZAMBIQUE. AT THE END OF 2016, 147 OF 154 DISTRICTS HAD BEEN ELECTRIFIED



National electricity grid in Mozambique

In practice, Mozambique did not have a national electricity grid in 1977. The infrastructure consisted of a direct current cable from Cahora Bassa in the north to South Africa where most of the electricity was consumed. Maputo was connected to the South African grid through a single connection. In addition to these connections, the Portuguese had established a grid in central Mozambique from Manica in the west (with a foot in Zimbabwe) to Beira on the east coast⁶. This grid was mainly powered by the two smaller hydropower plants in Chicamba and Mavuzi⁷. During the civil war, focus was largely put on maintaining these systems to secure an electricity supply in Maputo and the towns in central Mozambique, in addition to the establishment of small hydropower plants⁸ and diesel generators in other important towns.

Since 1992 until today, a national electricity grid has been developed that covers the capital cities of the country's provinces. The overall strategy has been to bring the electricity generated at Cahora Bassa out to the provinces and districts. The electricity supply has been significantly reinforced in recent years through the development of gas power plants (see the chapter on electricity generation) and it is expected that reliance on Cahora Bassa will be further reduced in the coming years. Development of the national transmission grid forms the basis for the development of regional and local distribution grids. However, it will still take a long time and massive investments before Mozambique has a national electricity grid that can meet the goals

⁶ In addition to these systems, the Portuguese had small isolated diesel grids in other settlements, but they mainly deteriorated when the Portuguese left after the independence.

⁷ Chicamba and Mavuzi were built in the 1950s and 60s and have a combined capacity of 53 MW. Both power plants are currently undergoing rehabilitation, as the equipment had reached the end of its technical lifetime. After rehabilitation, the combined installed capacity for the two power plants will be 86 MW.

⁸ Lichinga, Cuamba and Corumana, as mentioned earlier in this report.

→
The image shows one of the last steel masts on the transmission line from Gurue – Cuamba – Lichinga, which secured the connection of the Niassa Province to Mozambique's national electricity grid. The line is 323 km long and it was financed by Sweden and Norway.

PHOTO: KEN OPPRANN





'The transmission line Gurue – Cuamba – Lichinga was an historic breakthrough. It connected Niassa Province, the last of our provinces to get connected, to the national electricity grid. This has meant a great deal in terms of our faith in growth and development of the region, and it has already contributed to a large increase in the number of enquiries from industrial developers. This is one of many examples of how the 40 years of energy cooperation with Norway has contributed to making development here in Mozambique possible.'

PASCOAL ALBERTO BACELA, NATIONAL DIRECTOR OF ENERGY
 MINISTRY OF MINERAL RESOURCES AND ENERGY (MIREME)

for further elevation of the national electricity supply and development of new energy resources.

Figure 8 indicates the major components of the national electricity grid to which Norway has contributed with investment support up until today. This corresponds to approximately 750 km of power lines from 110 kV and upwards. In addition to these large projects, Norway has supported numerous small and large extensions, reinforcements and upgrades of the electricity grid over the entire country since the 1970s.

Furthermore, Norway has contributed with investment support for development of the distribution grid in several areas (see the chapter on the electrification of villages). It should be noted that although they are presented separately here, investments in the national electricity grid (transmission lines and transformer substations) and rural electrification (development of local distribution networks and customer connections) go hand in hand.

Joint effort for acute reinforcement of the national electricity grid

Support from contributors to Mozambique's energy sector in recent years, has largely been aimed at the electrification of villages and the establishment of new connections there. This has gradually increased the load on the national electricity grid in which many components (lines, transformers and connection systems, etc.) are ageing and/or become overloaded. Therefore, in the past two years, EDM along with the authorities and development partners have initiated

a reinforcement programme for the national grid. The programme has been named the Short Term Investment Program (STIP). With the support of Norwegian advisers, EDM has identified numerous investments that are required to renew and reinforce the national grid. Investments are prioritised based on i) their importance to grid functionality and ii) urgency. It is evident that the authorities and EDM need the support from development partners to finance the heaviest investments, due to the generally poor economic climate that the country is facing. STIP identifies and investigates the most urgent investment needs, in order to enable shorter processing time for partners to finance these items.

'Backbone' – the future fortitude of Mozambique's energy sector

Mozambique has high ambitions for the further development of national power generation. This primarily applies to the further development of natural gas power and large-scale hydropower, but also small-scale hydro and solar. Besides contributing to the development of national finances, the goal is to supply neighbouring countries with energy at competitive prices. If this is to be successful, one has to rely on a strong and well-functioning transmission grid. As of today, Mozambique's transmission system does not have sufficient capacity to realise the massive potential in new power generation. The challenge is intensified by the fact that most of the large hydro and natural gas resources in Mozambique are localised in the northern parts of the country, whilst the demand for energy is highest in the far south.

Renovation of critical infrastructure through STIP

During the last 30 years, the substation CTM (Central Transmission Maputo) has distributed electricity imported from South Africa to Mozambique's largest cities Maputo and Matola. The equipment at the station is now aged and overloaded, and reinforcement investments are critical. STIP was created by EDM in cooperation with Norwegian advisers through the program for technical assistance (described earlier in this report). Based on the criteria established by STIP, upgrading of CTM was given high priority. Norconsult carried out a needs assessment with funding from the Embassy and upgrading work has now started.

Whilst upgrades are being performed, the functionality of the CTM station has been significantly reduced. For example, this means that if a fault occurs somewhere in the connected distribution grid, EDM must close down a large portion of the grid whilst they search for the fault manually within a large area. It can take many hours to find and remedy the fault. During the two-year renovation phase, electricity customers in the area will have to endure many and long-lasting power cuts. At the same time, it is important to point out that if renovation works were not carried out now, the consequences would have been much worse in the long-term. When upgrading has been completed, EDM will be able to deliver electricity to the area with a better quality than ever before.



The connection station CTM supplies electricity to Mozambique's two largest cities. The images show parts of the old station that is undergoing an upgrade. PHOTO: KEN OPPRANN



'Because the stations are continually deteriorating it has been a nightmare for EDM to operate the electricity grid in the area for many years. I live in the area, and I have experienced it personally. We are constantly waiting for the next power cut and it's difficult to plan day-to-day living at home and at work. As soon as the new station is ready, people's lives will drastically improve and that's why it's particularly motivating to work on this project.'

ALTENOR MAGUMANE,
AN ADVISER CONNECTED TO THE RENOVATION OF CTM, NORCONSULT

PHOTO: KEN OPPRANN



PHOTO: KEN OPPRANN

To facilitate the development of new large power plants, EDM has developed a mega project called 'Backbone', which is a new transmission connection between Tete in the north and Maputo in the south. Cahora Bassa lies in Tete, as do many other large hydropower projects that have not yet been built. These include Mphanda Nkuwa (1,500 MW) and Cahora Bassa North Bank (1,250 MW). Another important project in this context is the Temane gas plant (400 MW) near Vilanculos in south-eastern Mozambique. The development of this power plant will depend on the planned transmission connection from Vilanculos to Maputo, which in reality is the first part of the Backbone project.

Norway has allocated NOK 500 million to finance the transmission project⁹ through World Bank trust fund. The construction of the project is expected to take 5-6 years, and Norconsult has played a key role in the developing feasibility studies for the project. It is crucial that the implementation of this new connection is well-coordinated with the development of new power plants. The mutual dependency between the transmission line and potential generation projects creates uncertainty around planning, timing, dimensioning and funding. The fact that Mozambique is still a developing country and that long-term demand for energy in the region is highly uncertain, makes the process even more complicated.

⁹ This allocation also includes a new transmission connection between Mozambique and Malawi.





Rural electrification

Enabling modern communities



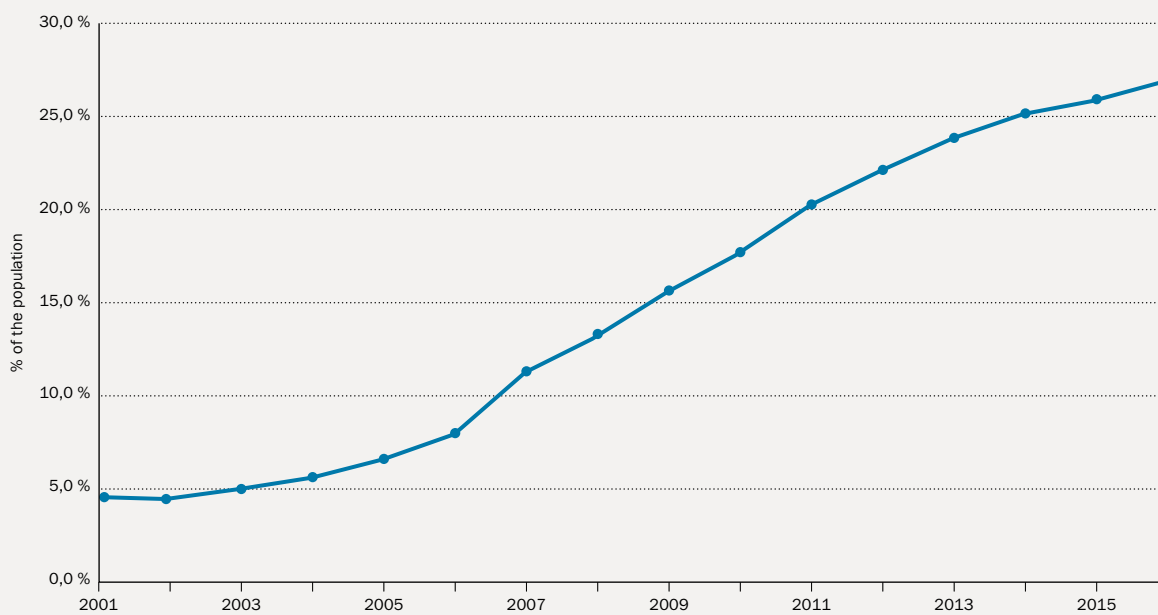
NORWAY HAS CONTRIBUTED TO:

- > More than 1,000 km of electricity distribution lines.
- > More than 40,000 new connections to the electricity grid, which has given electricity access to approximately 200,000 people.
- > The preparation of a national strategy for rural electrification.
- > Improved health and education services, as well as improved security and welfare in villages.
- > Increased revenue for local businesses.

Long-term investment in access to electricity

During the last 25 years Mozambique has gradually committed more to rural electrification, with support from a number of development partners. These efforts have been carried out under the assumption that access to electricity will not only increase the standard of living of households, but also contribute to increased economic activity and growth in the long term. According to the World Bank, less than 1 percent of the population had access to grid electricity after the civil war ended in 1992, and only around 5 percent as late as in 2005. Focus on village electrification was boosted through a national strategy for rural electrification, which was prepared in cooperation with Norwegian advisers from NVE around the turn of the millennium. An updated version of the strategy is currently being prepared and will form the basis for new electrification projects in the coming years. During the 2000s, the development gradually started to accelerate (Figure 9) and at the end of 2016 the national access rate was more than 26 per cent. The population of Mozambique increased by more than 50 % in the same period,

FIGURE 9: ACCESS TO ELECTRICITY IN MOZAMBIQUE (2001–2016)



Development of national access to electricity (per cent of the total population with access to the national electricity grid) from 2001–2016. SOURCE: EDM

from approximately 18 million people in 2001 to more than 28 million in 2016. Based on this, it is fair to say that the overall development over the past 10–12 years has been encouraging.

Norwegian support for rural electrification

Norway has supported rural electrification in Mozambique through the development of the national electricity grid (see the previous chapter on the transmission grid) and the regional/local distribution grids, as well as the funding of new connections. An impact assessment of i) the transmission line from Gurue – Cuamba – Lichinga and associated electrification projects in Niassa Province and ii) electrification projects in the districts of Namacurra and Pebane (see the map)¹⁰ in Zambézia Province was carried out by Multiconsult approximately five years after project completion in 2008. The study showed that the number of connections far exceeded the expectations. Up to 10,000 new connections were expected during the first five years, but by 2013 approximately 37,000

households, institutions and enterprises had been connected to EDM's grid in the project areas. A significant percentage of these were low-income households. Local village chiefs reported that access to electricity had a significant effect on the community in the form of improved security, better health, education and social services. The assessment also showed that the projects had led to increased productivity and income for existing business undertakings. At the same time, the growth of *new* financial activity had been slower than originally anticipated.

In addition to the projects above, Norway has more recently supported the electrification of Cabo Delgado, which so far has reached 4,000 new connections, as well as the Sofala – Manica – Tete electrification project, financed together with Sweden. The latter project has resulted in more than 2,600 new connections. Norway also supported some smaller electrification projects in the 1980s and 1990s.

The most important electrification projects supported by Norway are illustrated in Figure 10.

¹⁰ Carried out for Norad by Multiconsult in 2013.

EXPERIENCE 4

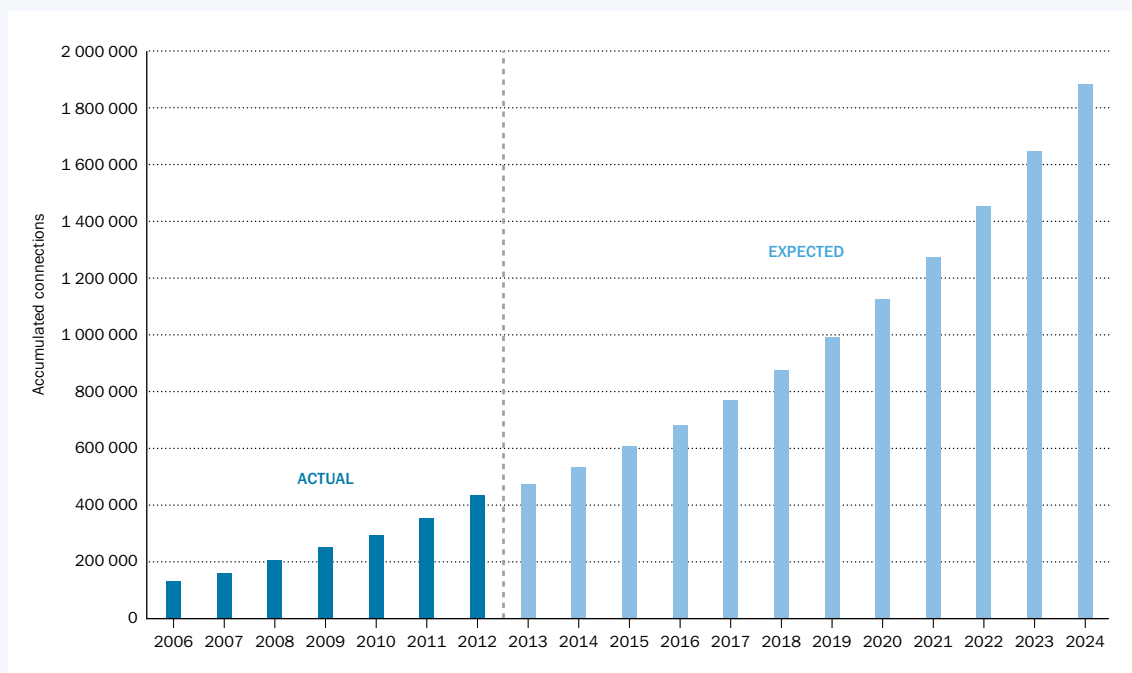
Realisation of the full benefits takes time when investing in access to electricity

In 2013, Norad commissioned Multiconsult to perform an impact assessment of three Norwegian-supported transmission and distribution projects that were carried out between 2005 and 2008.

By 2013 the number of new connections to the electricity grid was much higher than anticipated. 37,000 new connections were made even though only 10,000 were planned. Some of the main driving forces behind this were:

- > Relatively low new connection costs
- > Free connection for the poorest households
- > Low energy prices

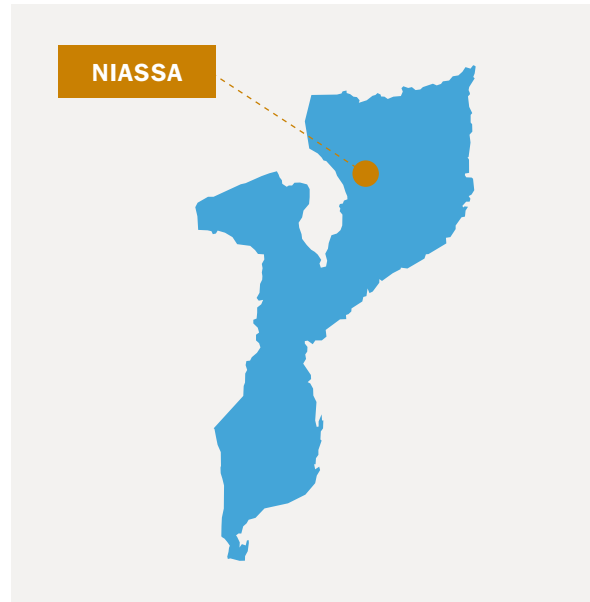
Based on these findings, the consultants forecasted a strong growth in the number of connections in the following decade, as indicated in the graph. This shows that it takes time before the full benefits of investment in increased access to electricity is realised.



Niassa – A community in transition

In 2007, Niassa Province was connected to the national electricity grid. This was made possible through the transmission line from Gurue to Lichinga, which is the capital of Niassa Province. This facilitated the expansion of EDM's local distribution grid in Lichinga and other districts. Even though it will probably take some time before access to electricity leads to significant economic growth, the electrification of a number of communities in Niassa has already led to observable changes. These changes are represented by the electrification of schools with new computer rooms, health clinics, and hospitals with incubators and other life-saving equipment, as well as the establishment of many new businesses.

The following pages show a few examples of how electrification has impacted local communities in the province.



A new life: A visit to the home of Margarida Agida (43) in Chimbonila. Following the electrification of her village in 2013, her kitchen is now filled with electrical appliances. 'My day-to-day living has become easier and more enjoyable since we got electricity. For example, I have acquired an electric oven, so I can now bake lovely cakes. I sell some of them at the local market and this provides my family with adequate extra income,' says Margarida. PHOTO: KEN OPPRANN

Electricity for entrepreneurs

In Niassa, access to the electricity grid has led to a boom in local business activities. Young entrepreneurs can now realise business concepts that would otherwise have been unviable due to expensive diesel-generated electricity. In addition, interest from large industrial actors is increasing – for example within forestry and agriculture.



Nine-year-old Tupele Antonio getting a haircut from barber Sandus Antonio Gewado. PHOTO: KEN OPPRANN

Charge your phone while you have your hair cut

'Even though the city has got electricity, not everyone can yet afford to connect their homes. Nonetheless, most people have a mobile phone that needs charging. It was expensive to charge phones before, as only those with a diesel generator could do it. Now that we've been connected to the grid, electricity is much more affordable. Since it takes quite a while to charge a phone, I thought it would be a good idea to have a charging station in the hairdressing salon. It's now a popular service with around 20-30 customers coming in every day.'

SANDUS ANTONIO GEWADO (18),
BARBER, CHIMBONILA



Inocencio Sotomane (left) discusses opportunities for the development of energy-intensive industries with representatives from EDM headed by Luis Salomao (second from the left) and Heber Janeiro (right). PHOTO: KEN OPPRANN

Forestry can create 600 local jobs

The electricity supply in Niassa has also stimulated the interest of large industrial actors. For example, a large plantation and factory for processing and export of timber is planned in the region. This can create 600 new local jobs. However, the investors are concerned that EDM does not have enough funds to build the infrastructure that is required to supply large industrial enterprises with electricity. In addition, other types of infrastructure such as roads and railways must also be significantly improved to facilitate the export of products.



A corn mill in Lichinga operated with electricity from the grid. Electric corn mills can grind corn much quicker and with less effort than a manual grinder. PHOTO: KEN OPPRANN

More efficient cornflour manufacturing

Corn is vital for the livelihood of people in rural communities in Mozambique. It is used in the manufacturing of cornflour for cooking on a daily basis. Residue from flour manufacturing is used for animal feed. Traditionally villagers (especially women) have spent a great deal of time grinding cornflour manually. The alternative was to pay high corn grinding prices at the local diesel-operated corn mill. Access to electricity has made the operation of electric corn mills affordable for many more people, freeing up several hours each day. Consequently, the freed up hours can now be used for other jobs to increase people's base income.

The electricity supply still needs improving

Christo Botha is the general manager of an industrial corn mill in Lichinga, which can manufacture up to eight tonnes of corn flour in a 24-hour period. He buys corn from local farmers in the region:

'Since corn harvesting is seasonal, it is better for local farmers to sell some of their harvested corn here, where it is ground relatively cheaply. It can then be stored over a longer period of time. Farmers do not have the facilities to preserve it. When it is not harvesting season, they buy the cornflour here.'



Christo Botha shows off a 10 kg sack of cornflour. PHOTO: KEN OPPRANN

Botha emphasises that industrial manufacturing of cornflour would not have been possible without access to the electricity grid, because of high diesel costs. Nonetheless, he points out that he could have manufactured much more than what he does today:

'Because of power cuts or issues with frequencies that the machines cannot cope with, we often find it necessary to stop manufacturing. This means that we manufacture less cornflour that we would otherwise have done. Even though we know that EDM works around the clock, we hope to see improvements in the future.'

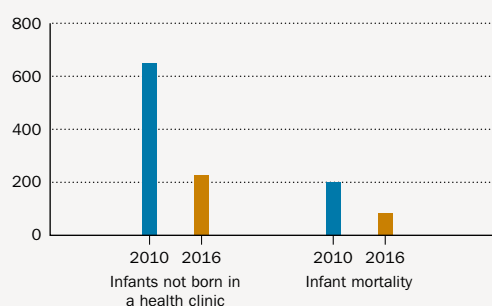
Improved rural health services

There are four hospitals and 168 health clinics in Niassa. Eighty of these institutions have been connected to the local electricity grid since 2006–2007 and around 60 receive electricity from solar panels. José Alberto Manuel, Director of Health in Niassa Province, says that they would like to connect all the clinics to the electricity grid in the future. The province is already seeing the positive effects of electrification.

‘After the hospitals and health clinics were connected to the electricity grid, the institutions have enjoyed a more affordable and stable electricity supply, and can offer better treatment. For example, the infant mortality rate has more than halved in the province since 2010. Lighting and more modern equipment at the clinics has resulted in more women travelling there instead of giving birth at home. In addition, the vaccination of school children has greatly increased. This means that fewer vaccines are destroyed due to high temperatures, as we now have cooling systems.’

JOSÉ ALBERTO MANUEL,
DIRECTOR OF HEALTH IN NIASSA PROVINCE

FIGURE 11: DEVELOPMENTS IN THE INFANT MORTALITY RATE IN NIASSA PROVINCE (2010 VS. 2016)



SOURCE: NIASSA DISTRICT ADMINISTRATION



Jose Manuel Alberto, Director of Health in Niassa, pointing at the UN's Sustainable Development Goal no. 3 (Good Health) and 7 (Clean Energy for All) stressing that these two go hand in hand. PHOTO: KEN OPPRANN

Saving lives with modern instruments

Access to electricity is crucial for a good health service. It was extremely time-consuming for the local health clinic in Chimbonila to give correct diagnoses earlier, as all tests had to be sent to the nearest hospital for analysis. This took a long time and there was a high risk of damaging the tests due to insufficient cooling.

‘Just a few years ago, it was very difficult to offer good health services. Solar panels only functioned for lighting and the operation of diesel generators is too expensive for a normal health clinic. Now that we have electricity we can, for example, detect HIV/AIDS with the help of simple and accurate tests here in our own laboratory. As a result, we can help many more people and follow-up quickly with correct treatment.’

DR. RAPSON DIAS CAGIPA, CHIEF PHYSICIAN
AT A HEALTH CLINIC IN CHIMBONILA



A nurse at Lichinga Hospital with an infant in an incubator. An incubator is a good example of an electronically operated instrument that is crucial for saving lives and one that fully relies on a stable electricity supply from the grid. PHOTO: KEN OPPRANN



Laboratory Analyst, Felizado Arabo, taking blood samples from a young boy at a public health clinic in Chimbonila. He says that the use of electronic analysis devices now enables the detection of many more diseases and better treatment. PHOTO: KEN OPPRANN



Energy for education

Schools in Lichinga can now guarantee evening classes and offer better living conditions for pupils and teachers who live in schools. Access to electricity has also enabled the installation of computer labs for IT classes and strengthened the administrative capabilities of the schools.

‘Not only can we offer better education within subjects such as IT, the school is now more efficient, which is also important. We now have an electronic data system to manage pupils and exam results, to create lesson plans and follow them up, which significantly simplifies the administration of the school. The fact that we can print out our own documents and make copies, also contributes to the simplification of our daily lives at all levels.’

MUSSA LUÍZ SAÍDE, DORMITORY MANAGER AT PAULO SAMUEL KANKHOMBA LOWER SECONDARY SCHOOL IN LICHINGA



Pupils in a well-lit classroom at Amizade Lower Secondary School in Lichinga. Access to electricity has meant that evening classes can now be offered to young people, for example, who have to work during the day. PHOTO: KEN OPPRANN



The principal of the upper secondary school for technical and economic subjects in Lichinga, Mário André Sarayabo, showing off the school's new computer lab. Pupils here shall develop their IT skills in a modern and adapted school environment. These pupils will be the first cohorts from their district to possess this type of competence. The challenge is now to maintain and further develop the new facilities, which is difficult for public schools, as Mozambique is undergoing a financial crisis. PHOTO: KEN OPPRANN





Off-grid electricity and cooking

Positive impact on the environment, health and families' finances



NORWAY HAS CONTRIBUTED TO¹¹:

- > Access to off-grid solutions for electricity for 80,000 people.
- > Cleaner and more efficient cooking for more than 400,000 people.
- > Access to energy for income-generating activities for at least 50 small companies.
- > The establishment of charcoal manufacturing methods that use less than half the amount of the tree that is usually used.
- > The manufacturing and distribution of cooking stoves that use less than half the amount of charcoal usually used.

Off-grid electricity

Mozambique is a large country with a widespread population. Despite the extensive development of the national electricity grid in Mozambique since the civil war, it will still take a long time before it covers the entire population. It is technically and financially demanding to secure full access to electricity through the grid. Off-grid electricity is therefore gaining increasingly more political attention in Mozambique as an important step towards full electrification and an essential measure to fight poverty.

The national energy fund FUNAE particularly works with small-scale off-grid solutions. Norway entered into an agreement with FUNAE in 2010 with the aim of establishing a programme for off-grid electrification.

¹¹ Most of the support mentioned in this chapter is not donated bilaterally, but through other channels, such as civil society support and contributions to international partnerships. Such support is not included in the statistics at the beginning of this report or in the overview of projects in Appendix I.

However, this programme was never realised or implemented. The programme was later converted to funding of two strategies to involve the private sector in the electrification of villages and maintenance of solar panel systems.

Norway has also contributed to rolling out small-scale off-grid energy solutions in Mozambique through EnDev (Energising Development). EnDev is a multilateral partnership working to improve access to energy in more than 20 developing countries. In Mozambique, EnDev has contributed to giving access to electricity for around 100,000 people through small-scale solar PV, small-scale hydropower and connection to the electricity grid (in cooperation with EDM). Moreover, more than 50 small companies have been helped to gain access to electricity or other types of energy.

Cleaner cooking

Each day 96 per cent of Mozambique's population uses charcoal, wood or other types of solid biomass to cook, boil water and to do daily chores (World Bank). The daily need to use large, ineffective volumes of charcoal and wood to survive particularly limits those most impoverished to use their time and resources on other things. This hinders development. Another consequence is damaged health caused by smoke, rapid and destructive stripping of the forests and greenhouse gas emissions.

Norway supports several actors who commit to the development, manufacture, promotion and distribution of improved cooking stoves in Mozambique. Through its cooperation with FEDESMO (Sustainable Energy and Development Forum of Mozambique) and many local organisations and entrepreneurs, Friends of the Earth Norway has contributed to the establishment of local production and distribution of more efficient cook stoves in Mozambique. These stoves use half the amount of charcoal compared to traditional stoves, which means that the consumer will get a return on the investment after one to two months. EnDev also works with the entire value chain for cleaner cooking in close cooperation with a number of local actors. Norwegian support through EnDev and Friends of the Earth Norway has so far contributed towards access to more efficient and environmentally friendly cook stoves to around 400,000 to 500,000 people in Mozambique.

More efficient fuel production (e.g., charcoal), justifiable forestry and general spreading of information about the topic of clean cooking are also targeted. In cooperation with local actors, Friends of the Earth Norway has worked with the entire charcoal manufacturing value chain. This has contributed to establishment of production methods that give double the amount of charcoal per harvested tree.

SAVES 40 PER CENT OF FUEL COSTS WITH THE NEW COOK STOVE

EnDev helps its cooperation partners to acquire and distribute more efficient cook stoves in the slums of Maputo. Sales to the local community happen through local merchants and entrepreneurs.



Casilda Fernando (right) has a kiosk in Maxaquene in the outskirts of Maputo where she sells cooking stoves and solar lamps. She says that sales are going well and that she sells around 10 cooking stoves per week. Here Cipriana Boane is about to purchase a new cooking stove.
PHOTO: KEN OPPRANN.

In the picture above, Cipriana Boane (23) is purchasing a new cook stove that will help her save 40 per cent of her monthly expenditures for charcoal. This means that the investment will be repaid after only two weeks. The stove has an expected lifetime of around three years with daily usage.

'A friend of mine has one of these cook stoves and she told me that it uses less fuel when cooking and boiling water, so she saved money. So, now I've bought one too.'

CIPRIANA BOANE,
OWNER OF NEW COOK STOVE

ENVIRONMENTAL CLUB: SCHOOL PUPILS SPREAD INFORMATION ABOUT COOKING STOVES IN THE LOCAL COMMUNITY

The local organisation 'Kulima' is supported through Friends of the Earth Norway and, amongst other things, works with the promotion of cleaner and more efficient cooking stoves in and around Maputo. As part of this

work, they have started the 'Environmental Club', which is a club for pupils from local schools who are particularly interested in energy and the environment. These pupils have regular gatherings where, for example, they learn how to use improved cook stoves, learn about the benefits to health and the climate, and the financial implications.



'As a member of the Environmental Club, I have learned a lot about how using improved cooking stoves benefit the environment and our health. One day we made 25 cooking stoves out of clay, which is more energy efficient than the traditional stoves that many people use. Even though my family has electricity and gas at home, I have influenced my family and friends in villages to buy a better cook stove. I want to continue going to the club to learn more about energy consumption and how I might be able to help even more people.'

NILZA ANATÓLIA (19), PRESIDENT OF THE ENVIRONMENTAL CLUB AND UPPER SECONDARY SCHOOL STUDENT





Lessons learned and the way forward

EXPERIENCE AND LESSONS LEARNED

40 years of energy sector cooperation between Mozambique and Norway has provided many interesting and useful experiences. Numerous reviews and evaluations have been conducted on various aspects of this partnership, covering both individual projects and programmes, and the overall efforts. Among the most important ones in this regard are; Review of the Auditor General of Norway on Norwegian development assistance to Mozambique (2004), Scanteam's evaluation of energy-related assistance from Norway (2007); Multiconsult's evaluation of the long-term development effect of a small selection of more recent electrification projects in Mozambique (2013); Review of the Office of the Auditor General of Norway on Norwegian energy assistance (2014) and; Itad's evaluation of capacity development projects supported by Norway (2015). The most significant findings of selected evaluations and reviews are described in Appendix II.

Based on earlier evaluations and reviews, and interviews conducted for this report, some key lessons can be summed up in the following. Many of these lessons are also relevant to similar partnerships in other countries.

- › The experience from Mozambique demonstrates that in order to gain results from strategic advisory, capacity building and institutional cooperation, it is important to maintain long-term presence and continuous support.
- › Capacity building is a long term process. Support from decision makers as well as institutionalization of the processes is necessary in order for the knowledge and systems to be maintained and brought on to next generations.
- › Any structural reforms in the energy sector must be based on in-depth analyses and country-specific assessments. What could be considered the best way to organize the sector at a given time in one developing country, is not necessarily transferrable to another.
- › Rural electrification may have negative impacts on the financial sustainability of the electric utility. The utility's ability to maintain sustainable operations further develop the power system must be ensured in such programs.

- > Studies show that the number of new service connections in an electrified area can exceed expectations for the short and medium-term, but the major positive effects of electrification, such as the emergence of new economic activities, are likely to take longer.
- > The facilitation of private investments in Mozambique's energy sector, especially off grid, has been supported for quite some time, and positive developments have been observed in recent years. It is important to establish a framework that will allow for this to accelerate further. An independent electricity regulator could play an important role in this process.

WAY FORWARD

Electrification of Mozambique has barely begun

Despite strong access growth in recent years, more than 70 per cent of the country's population still does not have access to electricity. In order to contribute towards poverty reduction and economic development, commitment in this area will remain important. Low electricity prices have been a key challenge, preventing EDM from extending their customer base in a profitable manner. Hopefully, the ongoing tariff increase will enable EDM to better cover its costs, and in the long term enable re-investments in maintenance and further development of the electricity grid. If EDM's daily operations become less dependent on support from Government and development partners, these funds can be released for other purposes, such as large regional transmission projects.

Capacity building is still required

In recent years the energy cooperation has focused more on strengthening the authorities' and EDM's roles in facilitating investments from the private sector. This involves building institutional capacity across several areas, including preparation of power purchase agreements, transactions, regional grid planning and coordination of mega projects. At the end of the day, this largely comes down to establishing a framework and practices that make it predictable, painless and attractive for investors to develop power projects in the country. Experiences documented in this report show

that there is a continued need to further develop and institutionalise competence in these areas.

Infrastructure is still important

Facilitation of private sector investments does not only refer to the institutional framework facing investors. For an investor within new energy generation it is equally important to meet a well-functioning electricity grid with satisfactory operations and maintenance. This must also be backed by well-founded plans for future upgrades and extensions. In other words, private sector facilitation concerns state-owned infrastructure and heavy capital investments, which will continue to be important for many years to come.

Mozambique as a regional power hub

The same unified approach described above must be considered if Mozambique is to develop as a regional power hub. Such an effort will demand massive investments in the electricity grid both nationally and in neighbouring countries. In addition, it will demand new competence and capacity as a result of increased complexity of the power systems and associated regional market.

Off-grid energy supplies

Although a lot has been achieved already, there is still a long way to go before Mozambique reaches UN Sustainable Development Goal no. 7 – access to clean energy for all. For the many people who do not have access to grid electricity in the foreseeable future, off-grid solutions must be considered on a continuous basis. A sustained commitment to modern methods of cooking are also important and necessary.

Mozambique and Norway - natural cooperation partners

Mozambique and Norway have built a unique relationship within the energy sector over the last 40 years. The many commonalities between Mozambique and Norway in terms of natural resources, long distances, and a widespread population, make the two countries natural partners for cooperation within the energy sector. The overall development in recent years, including increased private sector participation and commitment to plans for regional power system expansions, give reason to be optimistic.



SEGURANÇA SAFETY
 EQUIPAMENTO DE PROTEÇÃO OBRIGATORIO
 PROTECTIVE EQUIPMENT REQUIRED ON SITE

DANGER LIVE EQUIPMENT

UNAUTHORISED ENTRY PROHIBITED

HV SUBSTATION

NO SMOKING

UNAUTHORISED ENTRANCE PROHIBITED

WARNING
 ELECTRICAL SUBSTATIONS
 ARE HIGHLY DANGEROUS
 UNLESS YOU ARE A
 QUALIFIED ELECTRICIAN
 DO NOT ENTER
 UNLESS YOU ARE
 A QUALIFIED ELECTRICIAN
 AND YOU HAVE
 BEEN ADVISED BY
 THE OPERATOR
 OF THE SUBSTATION
 TO DO SO

Appendix I – Overview of the Most Important Bilateral Cooperation Projects

This overview includes the most important cooperation projects funded through the Embassy and/or Norad. Civil society support is included. The list does not include regional projects.

NAME OF PROJECT	FROM	TO	TYPE	DISBURSED (MNOK)
Maintenance and reinforcement of infrastructure (incl. emergency supply of various energy system equipment)	1981	1996	Diesel generators for important towns and cities, spare parts, various equipment for new infrastructure or maintenance/repairs, including transformers, transmission and distribution lines.	428.8
General institutional assistance for EDM	1981	1996	The objective of the institutional assistance was to boost EDM's ability to provide reliable and affordable electricity supply for its customers. During this period, around 700 of EDM's employees received training within administration, management, supplying electricity, transmission and operations, and electronics and mechanics.	68.7
Small power plant studies	1982	1994	Funding and technical assistance for more than 20 feasibility studies for small-scale hydropower in different parts of Mozambique.	45.0
Various technical assistance	1982	2006	Consultancy services to support EDM projects.	7.1
Small power plants in Lichinga, Cuamba and Corumana	1983	1990	The development and building of three small hydropower plants (1–14 MW) in Northern, Central and Southern Mozambique to reduce diesel costs and to secure an electricity supply to local areas. Included training of unskilled local personnel to operate the plants.	177.6
Electricity supply in Beira	1987	1987	Extension of the local electricity grid in Beira and the installation of diesel generators.	6.4
Cahora Bassa – Zimbabwe Transmission Line – CBZ	1987	1998	Feasibility studies were financed by Norway as early as in 1987 and recommended construction of the transmission line to export electricity from Cahora Bassa. Construction started in 1995 and the power line was finished in 1997. The project included a 250 km, 330/400 kV line and the necessary transformer stations.	171.0
Mozambique – Malawi interconnection: feasibility study	1988	1991	Feasibility study for an interconnection from Northern Mozambique near Cahora Bassa to Malawi.	18.0
Training and personnel fund (EDM)	1988	1997	A separate fund was established with Norwegian assistance for EDM to use for training and courses for its employees at all levels at home and abroad.	39.6
IDA & IBRD Energy – technical assistance	1988	1989	Technical assistance and investment support to EDM for various rehabilitation of infrastructure in the electricity grid.	38.8
Electricity supply in Maputo	1989	1992	Funding for the acquisition and installation of diesel generators to boost the electricity supply in Maputo.	57.4
Mozambique – Swaziland interconnection: feasibility study	1995	1995	Feasibility study for a new interconnection from Mozambique to neighbouring Swaziland.	4.0
Electricity supply in Maputo	1995	1998	Various measures to improve the electricity supply in Maputo.	19.8
Electrification of Zambezia	1998	1998	Extension of the distribution grid in Zambezia Province to increase local access to electricity.	21.6
Reinforcement of the electricity grid in various areas	1998	1998	Upgrading of infrastructure in several areas due to wear and tear and/or insufficient capacity.	25.0

NAME OF PROJECT	FROM	TO	TYPE	DISBURSED (MNOK)
Institutional capacity DNE (later ME)	1998	2006	The project consisted of two phases from 1998–2002 and 2002–2006. At least 80 employees of the Ministry of Energy were educated, including personnel in the provinces. The regulatory framework for the energy sector was further developed and modernised, and a national strategy for the electrification of villages was prepared.	37.5
Institutional assistance UTIP	1999	2006	The acquisition of a key adviser to build up UTIP's technical and administrative capacity. Establishment of an expert panel to investigate and to advise on potential hydropower development on the Zambezi River downstream Cahora Bassa. 10 UTIP employees received comprehensive training through courses, seminars and workshops.	35.0
Niassa electrification project	1999	2012	The project included the construction of the Gurué-Cuamba-Lichinga (323 km) power line, which connected Niassa Province to the national electricity grid, as well as the development of the distribution grid and connection to new electricity customers in several districts. The project was co-funded together with Sweden.	251.7
The Alto-Molocue – Gurué transmission line (AMG)	2001	2004	The construction of a 75 km, 110 kV, regional transmission line from Alto Molocue to Gurué, and a new transformer station and local distribution in Gurué. The project also included capacity development for skilled and unskilled personnel.	64.8
Namacurra electrification project: <i>Including Extension to Pebane</i>	2002	2008	Construction of a distribution grid (33 kV) and connection of new customers in the Zambezi districts of Namacurra, Maganja, Inhassunge and Pebane.	112.0
Sofala-Manica-Tete electrification project	2006	2007	The construction of the distribution grid (33 kV) and the establishment of new transformer stations, which enabled the connection of four district head offices, three administrative posts and numerous villages in the provinces of Tete, Sofala and Manica.	50.0
Capacity building – the Ministry of Energy	2007	2012	Extensive capacity building and organisational development for the energy authorities, including the development of an operations handbooks and training of personnel. The assignment was carried out by KPMG.	29.0
Cabo Delgado electrification project	2007	2015	The construction of a 120 km transmission line, transformer stations and numerous distribution lines for the electrification of many areas in Cabo Delgado Province. The project also included the construction of a SVC unit in Nampula, which helps increase the capacity and stability of the electricity supply to Cabo Delgado.	349.0
Technical assistance to EDM for the development of large energy generation and transmission projects	2008	–	The objective of the technical assistance is to strengthen EDM's commercial ability to develop, structure, finance and carry out large energy generation and transmission projects. Support is given for legal affairs, contract negotiations, loan agreements, project documents and regional energy market assessments.	59.7
Support for strategy development for FUNAE	2010	2011	The objective of the technical assistance is to strengthen EDM's commercial ability to develop, structure, finance and carry out large energy generation and transmission projects. Support is given for legal affairs, contract negotiations, loan agreements, project documents and regional energy market assessments.	2.4

NAME OF PROJECT	FROM	TO	TYPE	DISBURSED (MNOK)
Mozambique's regional transmission project 'Backbone' ('CESUL') /STE: Technical and financial feasibility study, and funding for development and EPC. New transmission connection Mozambique – Malawi	2011	–	Technical and financial report on a new large transmission connection (3100 MW) from the north to the south of Mozambique. The objective of the project is to contribute to financial and social development by facilitating the further energy and increased access to electricity nationwide. The investigation includes a new transmission connection to Malawi. Norway has allocated MNOK 500 to a fund at the World Bank to fund projects with many contributors.	64.2
Equality in development cooperation in the energy sector	2012	2014	A three-year programme headed by the Ministry of Energy in Mozambique, which involved numerous institutions and actors in the energy sector. The objective of the project was to secure the development of the energy sector, and increased access to energy contributes to equal opportunities for both men and women. Followed up by Norad and supported by consultancy company ENERGIA.	9.4
Caia-Nampula-Nacala transmission line feasibility study	2012	2014	Feasibility study for a new transmission line from Central Mozambique to Northern Mozambique.	9.4
Strategic advisement for Mozambique's energy minister.	2012	–	Personal adviser for Mozambique's energy minister: Eivind Reiten. 5-6 visits per annum with advisement according to the minister's needs.	5.9
SAPP (Southern Africa Power Pool) – Capacity development and institutional cooperation.	2012		Technical assistance and capacity development for the development of the regional energy market, hereunder the establishment of an IT system for electronic energy trading between the countries, etc.	75.3
Institutional cooperation between NVE/Ministry of Energy – Starting Phase	2013	2016	Preparatory phase for new institutional cooperation between NVE and MIREME.	4.9
Institutional cooperation between EDM and Statnett	2013	2016	Institutional cooperation between Statnett and EDM. Capacity development within long-term planning for the development of the electricity grid, operations and maintenance.	9.1
Institutional cooperation between NVE/Ministry of Energy – Programme Document	2014	–	Finalisation of the programme document for long-term cooperation and capacity development programme between NVE and MIREME. This will start in 2017.	5.0
Feasibility study for grid reinforcement	2014	–	Three feasibility studies for various grid reinforcement in Cabo Delgado and Quelimane.	6.4
Short Term Investment Program (STIP)	2016	–	A programme for the identification, investigation and coordination of funding (between the development partners) for acute reinforcement in the national electricity grid. For example, Norway supports the upgrading of a central connection station (CTM) in Maputo. Norway has allocated MNOK 88 to the programme.	20.0
Mocuba transformer station and power line	2016	–	The building of a new transformer station and power line in Mocuba to accommodate the connection of the solar power plant (40 MW), which Scatec Solar and Norfund will develop there.	25.8

Appendix II – Evaluations and Reviews

There are numerous reviews and evaluations covering various aspects of the energy assistance to Mozambique in the form of individual projects, programmes and more comprehensive efforts. This chapter provides a short overview of the main elements of selected evaluations and reviews. For additional information, the referenced documents are listed in the reference list.

Scanteam's evaluation of Norwegian energy-related assistance in 2007 particularly addresses Mozambique (Appendix 4 – Case Study: Mozambique). This study is still one of the most comprehensive evaluations of Norwegian assistance to Mozambique. Amongst other things, it concludes that Norwegian support for the development of a national electricity grid and access to electricity in villages has been highly beneficial in terms of general living standards, and the development of industry and commerce. It is believed that the support for the maintenance of physical infrastructure during the civil war, and the assistance for developing EDM laid an important foundation for overall positive development of the energy sector after the war. The cooperation with the authorities within, for example, long-term planning for the development of the energy sector may also have been important, even if it is said that the concrete effect can only be measured to a limited degree. The evaluation shows that the small hydropower plants that were supported in the early stages of the cooperation were not financially sustainable, but the political effect of the support at that time was probably great. To conclude, a general weakness partly resulting from insufficient reporting, especially within the institutional cooperation, has made it difficult to measure the results of many activities.

An impact assessment of the long-term development effect of a selection of rural electrification projects (finalised between 2005 and 2008) in Mozambique was carried out by Multiconsult (formerly Norplan) in 2013. This showed that the number of new electricity customers that were connected as a result of the projects was much higher than expected and that the socioeconomic benefits of these projects were substantial. However, it was also found that the effect on productive usage of electricity and new industry was limited within the time frame of the study. It was also illustrated that the revenue from electricity sales were not cost effective and thus the projects were not financially sustainable for EDM.

The Office of the Auditor General of Norway's review of the Norwegian energy assistance in 2014 covered projects for the electrification of villages in Mozambique. The attainment of planned results was assessed as good in terms of constructed infrastructure. On the other hand it was pointed out that the transmission lines that were supported for approximately four years after entry into operation were far from utilised by the expected number of electricity customers (households and industry). As a result, the Office of the Auditor General of Norway found that the benefits of the investment were small and that it had been inadequately planned.

This was more or less in line with the Auditor General's assessment of the effectiveness of Norwegian aid to Mozambique (2003-2004). This assessment also pointed out that even though the infrastructure in transmission and distribution projects were constructed according to plan, the number of connections were lower than anticipated. This assessment also pointed to weak implementation of Norwegian support to EDM and UTIP, and lack of goal achievement when implementing new IT systems with EDM. The assessment also points to positive results. One example being the establishment of UTIP, which, despite being dependent on donor assistance, was successfully established as a public project unit for development of large hydro power projects.

An evaluation from 2015 (Norad), which compared Norwegian support for capacity development projects for both EDM and the Ministry of Energy, concluded that the long-term effect greatly varied between the different programmes. The evaluation points out how important it is that the content of programmes are adapted to the applicable context and perceived as relevant by the receiver. It is stressed that in order to establish the level of trust required to enable the aforesaid, a long-term cooperative climate and good communicative skills are essential.

One criticism that is consistently seen in the evaluations concerns the lack of attention paid to information about results and reports on planned goals. Reports have been structured and consistent in the most successful projects.

Appendix III – Sources and contacts

DOCUMENTS

- > Evaluation of Norwegian Power Related Assistance (Norad, 2007)
- > Evaluation of Norway's support to women's rights and gender equality in development cooperation (Norad, 2015)
- > End-review Cabo Delgado Rural Electrification Project (Multiconsult, 2016)
- > Impact Assessment of Rural Electrification (Multiconsult, 2013)
- > End-review of the project Technical Assistance related to large scale generation and transmission projects in Mozambique (Norad, 2012)
- > The Office of the Auditor General of Norway's review of Norwegian development assistance to Mozambique (Auditor General 2004)
- > The Office of the Auditor General of Norway's review of the Norwegian energy assistance (Auditor General, 2014)
- > Norwegian Support to the Strengthening of Capacity to the Energy Sector of Mozambique (Steven Peterson, 2015)
- > Evaluation of Norwegian support to capacity development (Itad, 2015)
- > EDM Annual Statistical Reports (EDM, 2001–2016)
- > Mozambique Energy Sector Policy Note (Verdensbanken, 2015)
- > Review of Mozambique Electricity Law (Ministry of Energy, 2011)
- > Various internal documents and project databases at Norad, the Embassy and EDM

WEB

- > www.norad.no
- > www.hcb.co.mz
- > www.edm.co.mz
- > www.motraco.co.mz/index.php/en
- > www.sasol.com/mozambique

PEOPLE

- > A de Sousa Fernando, Deputy Minister – MIREME
- > Pascoal Alberto Bacela, Energy Director, MIREME
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- > Arlindo da Costa Chilundo, Governor Niassa Province
- > Danta Marizane Rosse, Director of Health, Niassa Province
- > Alberto Mussa, District Administrator, Lichinga
- > Marcelino Gildo Alberto, Board member, EDM
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- > Anathalie Musabyemariya, Kulima
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- > Alessandro Galimberto, AVSI
- > Even Sund, former Norad
- > Jonas Sandgren, NVE
- > Dag Arne Høystad, Friends of the Earth, Norway
- > John Lineikro, Friends of the Earth, Norway
- > Employees at the Embassy, see next page

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Name	Position	Responsibilities	Period
Thore Hem	Dep. Resident Representative	Power sector	1983–1986
Kristian Løkke	Programme officer	Power-Energy sector	1986–1989
Ellinor Melbye	Programme officer	Energy sector/Petroleum	1989–1992
Tor Øyvind Tanum	First Secretary	Energy sector/Petroleum	1991–1995
Einar Ellefsen	First Secretary	Energy sector/Petroleum	1995–1997
Johan Olav Bjerke	First Secretary	Energy sector/Petroleum	1997–2000
Anne Kronen Helgestad	First Secretary	Energy sector	2000–2002
Einar Ellefsen	First Secretary	Energy sector	2000–2003
Ingrid Dana	First Secretary	Energy sector/Petroleum	2003–2006
Fred Rasmussen	First Secretary	Energy sector	2006–2008
Thor Oftedal	Counsellor	Energy sector	2008–2011
Kristian Løkke	Counsellor	Energy sector/Regional	2008–2011
Hans Terje Ylvisåker	External advisor (NVE)	SADC/Regional	2008–2011
Mari Sofie Furu	Counsellor	Energy sector	2011–2014
Camilla H. Fossberg	Counsellor	Energy sector	2014–2017

ABBREVIATIONS AND ACRONYMS

ARENE	Autoridade Reguladora de Energia
CNELEC	Concelho Nacional de Electricidade
CTRG	Central Termica de Ressano Garcia
DNEE	The National Directorate for Electrical Energy
EDM	Electricidade de Moçambique
EnDev	Energy for Development
FEDESMO	Fórum de Energias e Desenvolvimento Sustentável de Moçambique
FUNAE	Fundo de Energia
GWh	Gigawatt hour
HCB	Hidroeléctrica de Cahora Bassa
kWh	Kilowatt hour
IPP	Independent Power Producer
ME	Ministry of Energy
MIREME	Ministry of Mineral Resources and Energy
MOTRACO	Mozambique Transmission Company
MW	Megawatt
NNV	Norges Naturvernforbund
NVE	Norwegian Water Resources and Energy Directorate
OfD	Oil for Development
RERA	Regional Electricity Regulators Association of Southern Africa
SADC	Southern African Development Community
SAPP	Southern Africa Power Pool
STIP	Short Term Investment Program
TCF	Trillion cubic feet
UTIP	Technical Unit for Implementation of Hydropower Projects



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