Norad

TANZANIA – NORWAY

50 Years of Energy Cooperation

Photo: Norad, 2019

«It has been great honor and privilege for Tanzania to work with Norway in the Energy Sector for the marked 50 years cooperation. Together we have achieved substantial results in power generation, transmission, electrification of new areas and competence building of individuals. Access to modern energy has stimulated economic activities in both rural and urban areas as evidenced by the decreased rural - urban migration. We are thankful and hope Norway will continue to cooperate with us in our effort to provide electricity for all Tanzanians.»

DR. MERDARD M. C. KALEMANI,
MINISTER OF ENERGY, TANZANIA (2019)

Photo: Norad, 2019

“Norway has a special status in the energy sector on Zanzibar, because it has been such a long-standing, supportive and results-oriented partner that takes the needs and wishes of Zanzibar on-board. There has always been trust and transparency between the parties, and this has made the cooperation simple.”

MR. KHAMIS OMAR, PRINCIPAL SECRETARY,
MINISTRY OF FINANCE & PLANNING (2019)

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Key results after 50 years

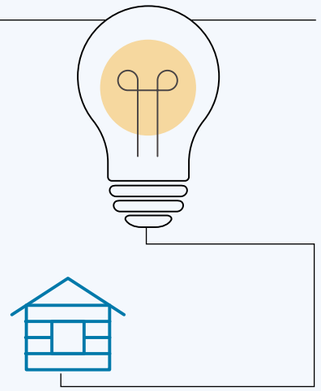
In the 50 years of energy cooperation between Tanzania and Norway, Tanzania has had remarkable achievements within hydropower production, building of energy infrastructure and electrification of the Mainland country as well as the islands of Zanzibar, with Norway contributing with energy experts, training and funds. The cooperation between the two countries has led to competence building within the renewable energy sector in Tanzania and Zanzibar, and the support of higher educational programs within renewable energy.

HIGHLIGHTS

Tanzania has:

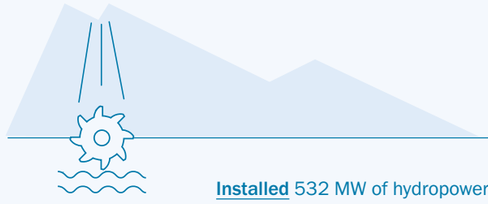
10 times

Increased power production by more than 10 times, from about 500 GWh to more than 6,000 GWh.



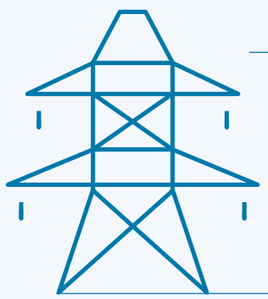
1/3
of all households

Connected businesses, hospitals, hotels, schools, 1/3 of all households on Mainland and 50% of the population on Zanzibar.



Installed 532 MW of hydropower and increased total hydropower capacity to 573 MW.

Built 670 km of 400 kV high voltage transmission lines.



Developed significant institutional and human expertise in power generation, operations and maintenance.

Norway has contributed to:

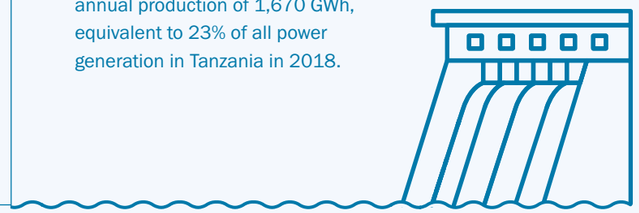
Enabling the construction of 510 km of 400 kV transmission line to connect to neighbouring countries and financing a 33 kV sub-sea cable of 77 km to Pemba Island in Zanzibar.

PEMBA ISLAND

77 km
sub-sea cable

60%

Installing almost 60% of hydropower capacity, with an annual production of 1,670 GWh, equivalent to 23% of all power generation in Tanzania in 2018.

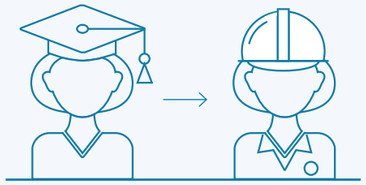


Connecting 30,000 rural households in Mainland and 232 villages in Zanzibar.

Constructing 1,750 km of electricity distribution lines on Mainland and 1,100 km on Zanzibar.

30,000
rural households

Educating more than 40 master students in hydropower from NTNU, close to 100 students in renewable energy at the University of Dar es Salaam, professional training of about 500 female engineers, and support to build additional capacity of key institutions both on Mainland and Zanzibar.



Introduction

In 1970, less than one per cent of Tanzanians had any access to electricity whatsoever. Almost 50 years later, Tanzania's National Bureau of Statistics (NBS) reports that 29 per cent of the households in Tanzania Mainland are connected to electricity (2018)[1], while 67.5 per cent of the population had community access to the grid (2016)[2]. This is a significant achievement, especially considering the population of Tanzania has quadrupled during the same period, from 13 million in 1970 to nearly 60 million today. Tanzania currently has a relatively high economic growth rate in the Eastern African region[3], and aims to become a middle-income country as soon as 2025, further fuelling the need for energy.

However, targeted efforts to achieve the United Nations Sustainable Development Goal 1 of eliminating poverty by 2030 (SDG1) is needed as half of Tanzania's population still lives on less than USD 2 a day[4]. Access to affordable and clean energy is a Sustainable Development Goal in its own right (SDG7) and can facilitate economic and social development.

The energy cooperation between Tanzania and Norway started in 1970 with the mapping out and investigating Tanzania's hydropower resources. Since then the cooperation has covered all aspects of electricity sector development, including design and construction of hydropower plants, 50 years of competence building of individuals and capacity building within key institutions, support to major transmission line projects, and electrification of new areas.

Since 1986, Norway has also supported rural electrification in Zanzibar, cooperating with the government and state-owned utility, ZECO[5]. The nearly 35 years of cooperation has included extension of the distribution network to more than 200 villages and supplying the whole island of Pemba with electricity from the Mainland through a sub-sea cable.

The objective of this report is to highlight the main achievements of the 50 years of energy cooperation between Tanzania and Norway. This partnership, typically conducted in an spirit of friendship, openness, and mutual respect, has contributed to the development of various aspects of Tanzania's and Zanzibar's energy sectors, hereunder[6]:

- Hydropower development
- Rural electrification, and support to connections to neighbouring countries
- Competence development and capacity building
- Electrification of Zanzibar

With support from Norway (and other donors), Tanzania has increased its power generation capacity tenfold and expanded the national power grid to almost all rural areas, and to the islands of Zanzibar. More than 140 Tanzanians have received part of their technical education with support from Norway, and many others have benefitted from conducting on-the-job project work with Norwegian power sector experts. In 2020, Tanzanians educated in Norway hold senior positions within many key energy sector institutions, including the state-owned utility TANESCO[7] and the Rural Energy Agency (REA).

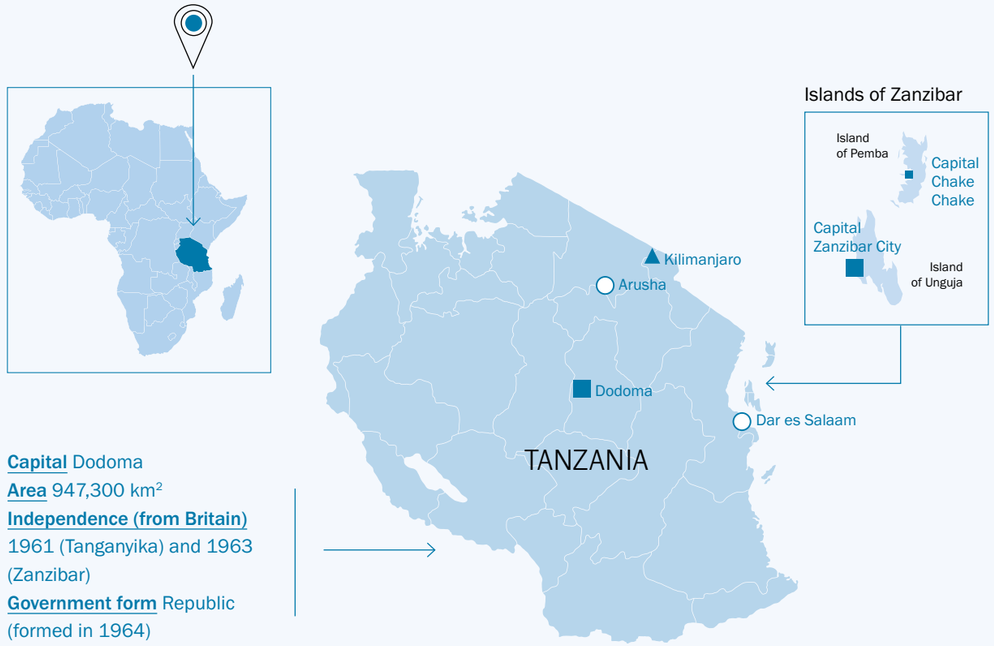
ELECTRICITY ACCESS VS. CONNECTION

Access rates refer to households that are within reach of the electricity grid but do not give any indication on how many of those are physically connected. There could be different reasons why households with access are not connected, but often this is due to affordability of both connection fee and tariffs.

Connection rates refer to the households that are physically connected to the grid and can receive and consume electricity in their homes.

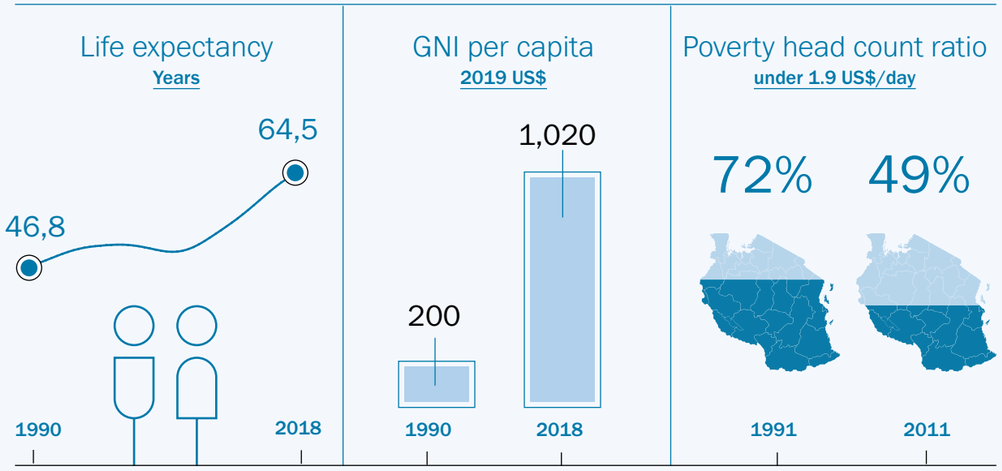
1 (National Bureau of Statistics Tanzania, 2019)
2 (National Bureau of Statistics Tanzania, 2017)
3 (African Development Bank, 2019)
4 In 2011. (World Bank, 2020)
5 Zanzibar Electricity Corporation
6 Norwegian support to Tanzania channelled through multilateral institutions is not covered in this report.
7 Tanzania Electric Supply Company Limited

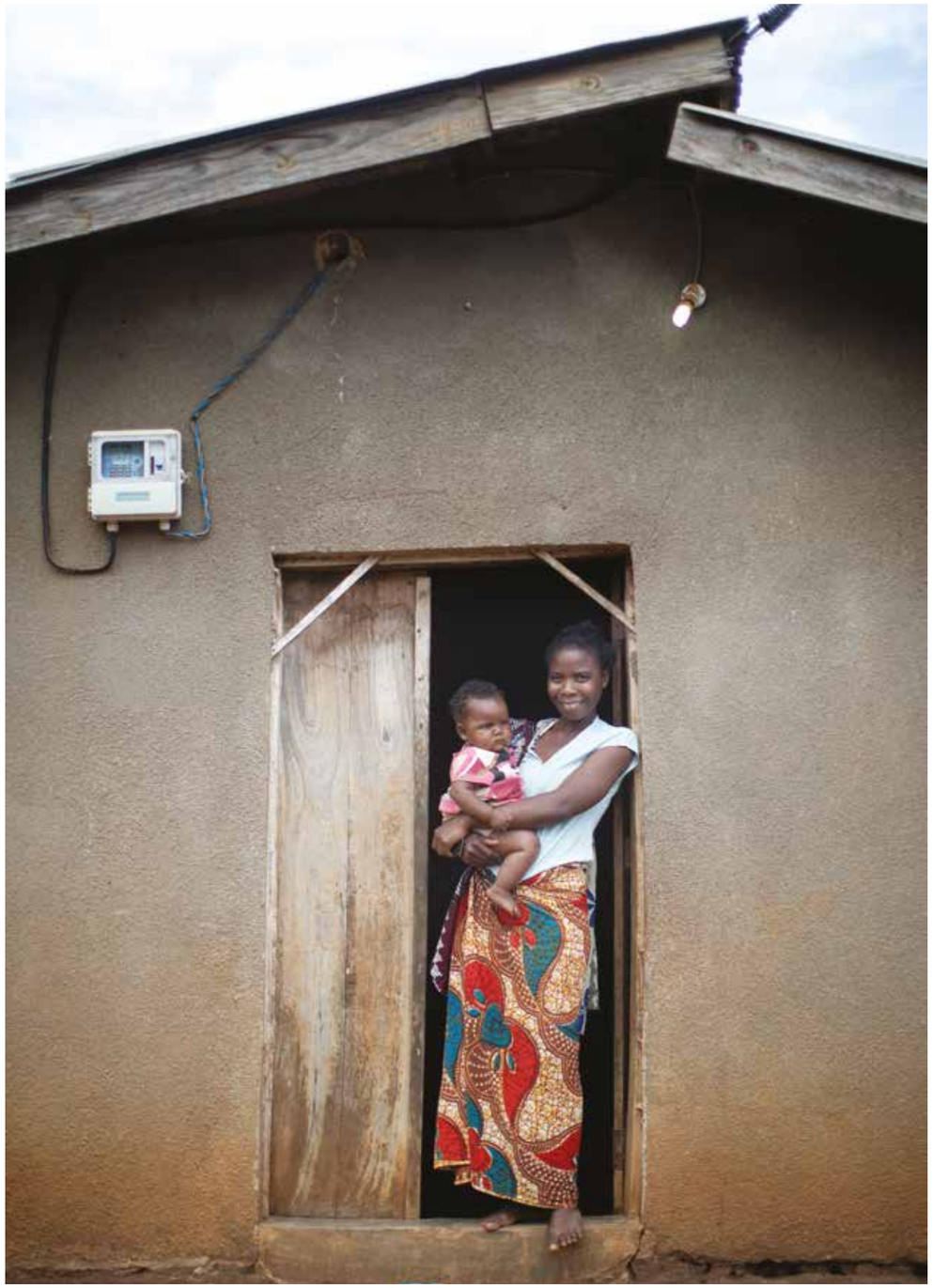
About Tanzania



Capital Dodoma
Area 947,300 km²
Independence (from Britain) 1961 (Tanganyika) and 1963 (Zanzibar)
Government form Republic (formed in 1964)

Key figures





Zaina Waziri and her daughter in Hondogo Village (Pwani region). She uses electricity for lighting and charging the phone, and would like to buy a TV and fridge. The family used to spend 30,000 TZS/month on kerosene, compared with today's expenditure of 9,000 TZS/month for electricity. Savings pay for education and better food. Photo: Espen Røst (2019).

2. Overview and milestones

TANZANIA AND NORWAY – DEVELOPMENT PARTNERS SINCE THE 1960s

Tanzania has been one of Norway's main partners for development assistance since the early 1960s when Tanzania's first post-independence President, Julius Nyerere, laid out his vision and bold accompanying policies. His ideas appealed to Norway at the time, given their adherence to many of the principles of social democracy, the dominant Scandinavian political ideology.

The total amount of Norwegian official development assistance (ODA) that has been disbursed to Tanzania and Zanzibar between 1960 and 2018, was around NOK 18.4 billion in nominal terms (higher in real terms). Of this about NOK 2.35 billion[8], or 13 per cent, was support to the energy sector. When including support of ongoing agreements not yet fully disbursed, the total support to the energy sector amounts to about NOK 2.7 billion.

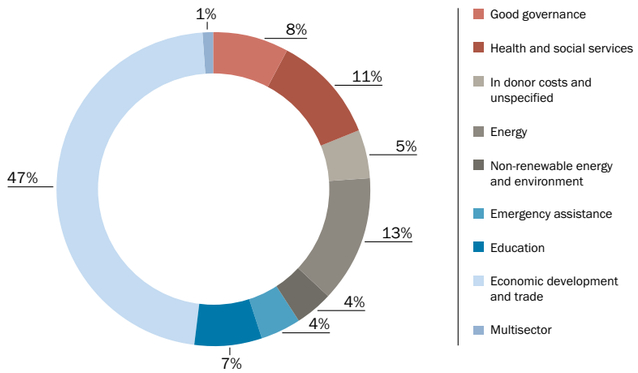


Figure 1: Total transfer of ODA to Tanzania (1960–2018), share by sector.
Source: (Norad, 2019)

8 Note that this figure only includes what has been disbursed to date of the ongoing 700 MNOK agreement with REA. Neither does it include the support for the Norad Fellowship Programme and Norad's Programme for Master Studies, as these have not been part of the energy support budgets.

Name Khalfan Mohammed and Kizase Saidi
Age 35 and 33 respectively
Business Motorcycle repair/ welding and retail store
Location Kidomole village, Bagamoyo district

Photo: Espen Røst (2019)

“My future hope is to save up more capital to be able to expand my business. Now we are only repairing iron beds and do not have enough funds to buy material and make new beds that people can buy, but I hope to be able to make beds for sale as this will give more profit.”

KHALFAN MOHAMMED (2019)

Khalfan Mohammed and Kizase Saidi, husband and wife, run a motorcycle repair shop and retail store together. The repair shop also offers welding services, such as reparation of iron bed frames. By replacing the diesel motor they used previously, the cost has gone down significantly after connecting to electricity. The couple has doubled their earnings. With business going well, they also employ four young persons at the repair shop.

Sippy, Coca Cola, Fanta and Pepsi – these are some of the chilled drinks that customers can choose between from the refrigerator in the store. When they have saved up enough, the couple plans to buy a more efficient refrigerator, expanding their product range to ice cream and homemade juices.

The business is located right next to their house, which has also been connected to the grid, allowing their six children to study in the evenings and watch television.

Employee at the repair shop.
Photo: Espen Røst (2019)

1970s → From post-independence optimism to economic crisis

1980s → Energy sector development on hold

1990s → Hydropower to the rescue!

2000s → Energy sector reform

2010s → Rural electrification and plant maintenance

Photo: Espen Røst (2019)

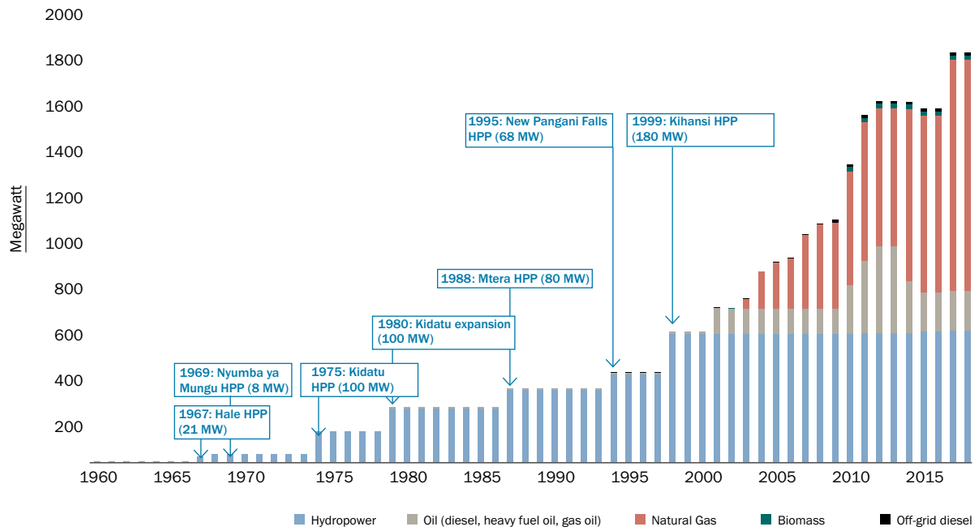
1970s – FROM POST-INDEPENDENCE OPTIMISM TO ECONOMIC CRISIS

After the challenges surrounding independence, the late 1960s and early 1970s were characterized by optimism and increased political consistency bringing with it a sustained period of economic growth, averaging 4–5% per annum[9]. This early growth prompted ambitious new government plans for industrial development, fuelling efforts to rapidly develop the country's hydropower resources, considered the cheapest, most secure form of electricity generation. Norway's own industrial and economic development was driven by increased utilization of abundant hydropower resources in the early-to-mid 1900s, meaning hydropower was a natural starting point for Norway's development assistance. Early support focused on technical assistance for mapping and assessing the country's hydropower potential, mainly in the form of hydropower pre-feasibility and feasibility studies.

Tanzania experienced a series of economic shocks in the second half of the 1970s, following a prolonged drought and the oil crises in 1973 and 1979 resulting in collapse in agricultural and industrial productivity. Development support thus became even more crucial as Tanzania struggled to fend off successive years of recession[10].

Although the ambitious Stiegler's Gorge multipurpose project was eventually abandoned (see page 29), one hydropower plant was successfully completed during this period: Kidatu (1975) with support from Sweden. The next major hydropower plant in Tanzania would not be built until the end of the 1980s.

Figure 2: Installed power generation capacity build-up, 1960–2019[11]



9 (Eriksen, 1987)
10 (Urdal, 2009)

11 Source: (TANESCO, 2020); (Ministry of Energy and Minerals, United Republic of Tanzania, 2013); (Eberhard, et al., 2018)

1980s – ENERGY SECTOR DEVELOPMENT ON HOLD

In combination with increased oil prices, global commodity prices (including those of important Tanzanian exports) continued to decrease drastically during the early 1980s, leading to severe balance of payment deficits, budget deficits and high levels of government borrowings. Towards 1985, jumps in the US dollar/Tanzanian shilling exchange rate and US dollar interest rates quickly resulted in a shortage of foreign currency for imports and a monetary crisis ensued in Tanzania. The International Monetary Fund required Tanzania to carry out economic reforms as a condition for receiving emergency loans. Known as "structural adjustment" these conditions included cuts to spending on public services, limiting imports, removing trade barriers and liberalising business and investment. Some development assistance partners also withheld support until Tanzania complied with these terms.

Other donor countries, including Norway, Sweden and the Netherlands, continued their support and, at least for a period, switched their development assistance to directly strengthening currency reserves and the national budget, as well as targeted grants and concessional loans to support import of vital goods.

Given the challenging state of public funds, no new generation facilities could be completed, placing a serious strain on the power system for much of the 1980s, holding back the country's economic recovery.

One exception that made a lasting improvement to the reliability of electricity supply was the establishment of the Tanelec transformer factory in Arusha in 1981, enabled partly by Norwegian currency loans for import of necessary materials and goods (see page 46).

Norwegian support during this decade was two-pronged; currency and import support combined with continued support for hydropower feasibility studies and rehabilitation of the Pangani River System hydropower plants. Norway also supported the Mtera hydropower plant (1988, 80 MW) with a dedicated financial grant, as it was an opportunity to optimize the use of the Mtera dam (1980), originally built to add additional storage capacity for the Kidatu hydropower plant.

Towards the end of the 1980s, Tanzania started undertaking reforms to tackle the economic crisis, towards privatization and less public spending. Development assistance from other partners started returning shortly thereafter and slowly GDP began to increase again.

Figure 3: Norwegian ODA transfers to the Tanzanian energy sector (excluding transfers to non-renewable energy related projects). *Source: (Norad, 2019)*

"During the economic crisis, there were less funds available for investments in infrastructure in the power sector, when at the same time demand was growing swiftly, which lead to frequent load shedding. Industrial and commercial customers were struggling, and the government stopped direct subsidies to rural electricity customers, instead introducing cross-subsidies. TANESCO was struggling financially during this period."

ENG. MANENO KATYEGA, EMPLOYED IN TANESCO FROM 1977 TO 2013, FORMER DEPUTY MANAGING DIRECTOR AND RESPONSIBLE FOR INVESTMENTS (2011–2013)

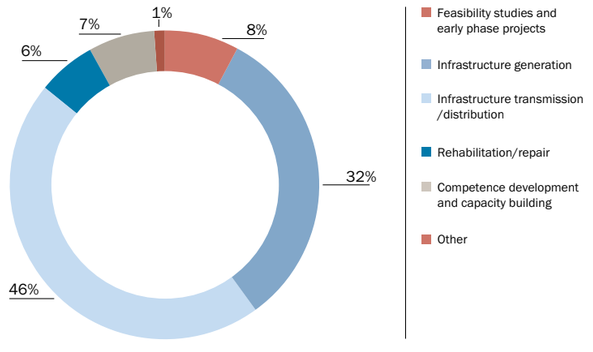


Figure 4: Distribution of Norwegian ODA to Tanzanian energy sector (including Zanzibar). Note that the "Infrastructure transmission/distribution" includes the full 700 MNOK awarded in the agreement with REA.

1990s – HYDROPOWER TO THE RESCUE!
Demand for power accelerated during the 1990s as the economy began to recover and the population almost doubled from 13 million in 1970 to 25 million in 1990.

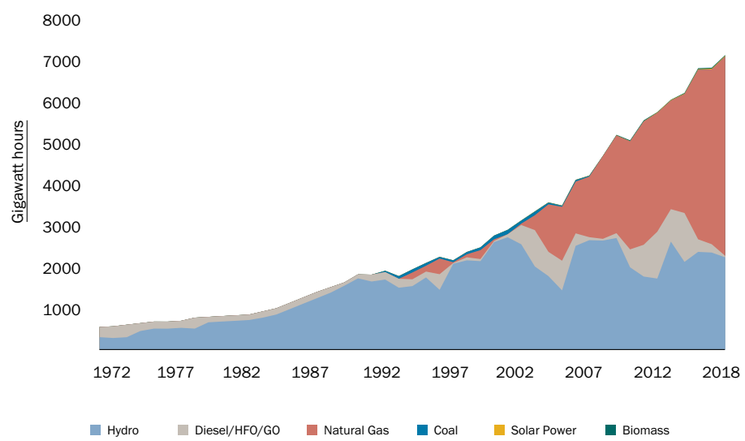
Tanzania faced a prolonged drought in the first years of the 1990s, slashing hydropower generation to record low levels. With only a handful of plants available, security of power supply was in serious jeopardy. A power crisis was emerging.

In response to the acute need for additional power, partners (including Norway) quickly raised funding for two new hydropower plants; New Pangani Falls (68 MW) and Kihansi (180 MW). Kihansi became the second largest operating plant in the country, and both plants provided sorely needed power to the grid when they were commissioned in 1995 and 1999 respectively. In its first full year of operations, the Kihansi hydropower plant supplied about one-fourth of the total power generated in Tanzania and has provided Tanzania with a significant share of stable power to the national grid for several decades.

Pangani Power Station. Photo: Norplan/Multiconsult (1996)

Kihansi dam building site, 1998. From the left: Jan Lindemark (Norplan/ Multiconsult), Buruany Luhanga (Managing Director of TANESCO), Patrick Rutabanzibwa (Commissioner for Energy). Photo: Even Sund (1998)

Figure 5: Electricity generation by source in Tanzania 1972–2018. *Source: (TANESCO, 2019); (International Energy Agency, 2020)*



2000s – ENERGY SECTOR REFORM
A wave of new government policies and Acts of Parliament during the 2000s served to fast-track reform of the energy sector (see text box below). The Rural Energy Act (2005) and the establishment of the Rural Energy Agency (REA) is a case in point, making rural energy access a key political priority in the 2000s.

In 2007, rural electricity access was only 2%[12]. Norwegian support for power infrastructure would shift in accordance with political priorities from support to building up the country's hydropower capacity towards expanding the electricity grid and connecting rural areas.

The turn of the millennium also marked the beginning of a shift in the energy supply mix in Mainland Tanzania, from mainly hydropower towards natural gas. As Tanzania was able to develop their own natural gas resources, this provided a reliable and competitive source of electricity supply. Simultaneously, lack of funding (public and private) was a challenge for hydropower construction which typically requires a large upfront capital investment (but very low running costs), and long droughts during the period affected hydropower generation and the reliability of the electricity supply. Combined with continual increases in electricity demand, severe power shortages and widespread use of load shedding across Mainland Tanzania ensued. Norwegian investment in the Tanzanian gas company Songas channelled through Norfund, as well as Norwegian engineering companies like Jacobsen Elektro, contributed to private sector involvement in the development of gas production like the Songo Songo gas field.

Knowledge transfer and competence development had always been a vital part of the cooperation between Norway and Tanzania. A notable achievement during the 2000s was the establishment of a master programme in Renewable Energy at the University of Dar es Salaam (UDSM) in 2007, in cooperation with the Norwegian University of Science and Technology (NTNU) and the Makerere University in Uganda (see page 55).

RELEVANT ENERGY POLICIES AND ACTS

Energy and Water Utilities Authority Acts of 2001 and 2006 To establish a regulatory authority which would have the mandate to promote competition and private sector involvement and protect consumer interests and availability of regulated services for all consumers.

National Energy Policy 2003 To ensure a reliable and affordable energy supply. In addition, the policy also concerns liberalization of the energy sector, financial viability of the sector, and developing a predictable investment framework.

Rural Energy Act of 2005 To promote access to modern energy services in rural areas, this act established the Rural Energy Board, Rural Energy Fund and Rural Energy Agency.

Electricity Act of 2008 To establish a general framework for the mandate of the Ministry of Energy and the regulator (EWURA).

Source: (African Development Bank; Climate Investment Funds, 2015)

12 (REA, 2019)

MAINLAND ENERGY SECTOR OVERVIEW

The Ministry of Energy (MoE) sets policies and aims to ensure "a vibrant Energy Sector that contributes significantly to economic growth and improved quality of life of Tanzanians" through providing reliable, affordable, safe, efficient and environmentally friendly modern energy services.

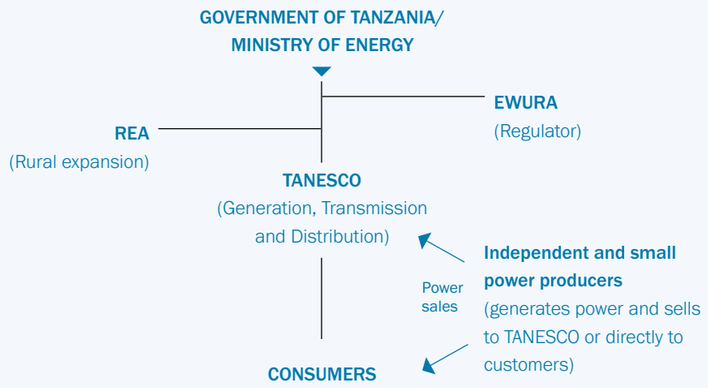
TANESCO (Tanzania Electric Supply Company Limited) is the state-owned vertically integrated utility, responsible for most power generation, transmission and distribution. TANESCO builds, owns and operates a large share of the country's power plants, all transmission, and most of the distribution network.

The Energy and Water Utilities Regulatory Authority (EWURA) is the regulator, established under the Energy and Water Utilities Authority Act 2001, responsible for the technical and economic regulation of the electricity sector (as well as petroleum, natural gas and water sectors).

The Rural Energy Agency (REA) is responsible for increasing access to electricity and grid connections in rural areas, as well as off-grid and clean cooking solutions. REA was established under the Rural Energy Act of 2005 and became operational in 2007.

Independent and small power producers (IPPs and SPPs) also own and operate some generation assets and distribution networks, selling the power produced to the national grid (TANESCO) or mini-grid consumers, as well as emergency power producers (EPPs) that sell to the grid during times of severe power shortages.

STRUCTURE OF THE ENERGY SECTOR IN TANZANIA[13]



13 Note: Energy sector overview for Zanzibar is included in Chapter 6.

2010s – RURAL ELECTRIFICATION AND PLANT MAINTENANCE

Despite increased development of gas generation projects, in the 2010s power shortages and the resultant load shedding continued to plague the sector. Demand growth was constantly outstripping growth in supply. TANESCO was eventually compelled to acquire costly oil or diesel-fired emergency power as a short-term solution to meet electricity demand. The financial impact on TANESCO was severe and yet there remained an urgent need to fund more permanent solutions. Despite the existence of untapped hydropower potential, government policy favoured natural gas power plants which would take shorter time to build, cost less upfront and provide reliable, stable baseload power[14].

Several major natural gas reserves have been discovered in Tanzania, the first as far back as the 1970s, meaning security of fuel supply for a new fleet of gas fired power stations. Norway, drawing on its expertise in management of oil and gas exploration during the 1960s and 70s, funded the early seismological studies and provided experts that contributed to the discovery of the Songo Songo gas field.

The 2010s also saw a concerted effort by REA, supported by several development partners, including Norway, resulting in a significant increase in rural energy access. From only 2% in 2005, Tanzania increased rural energy access to around 50% by 2016.

Norway first entered an agreement with REA in 2013 to support rural electrification, ear-marking a sum of NOK 700 million. This was and remains, the largest bilateral energy agreement Norway has entered (see chapter 4), with focus on institutional support to REA,

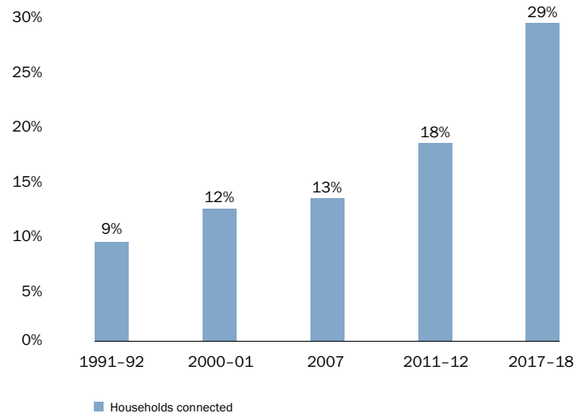


Figure 6: Percentage of households with main building connected to electricity. *Source: (National Bureau of Statistics Tanzania, 2019)*

14 Technological risks for hydropower are generally greater, for instance linked to geology of the site and hydrology affecting the water flow and production.

as well as least-cost energy access expansion. One of the components of this support has been to connect households that were already near the grid, but not yet connected. Another important component of the support to REA is the Productive Use of Energy (PUE) programme, which aims to stimulate the local economy through entrepreneurial activity.

In this period, it became clear that Tanzania's hydropower plants were inadequately maintained, leading to reduced efficiency and power output. In line with an increasing Norwegian focus on competence development within energy cooperation, Tanzania and Norway commenced the rehabilitation of several hydropower plants and capacity building projects during the 2010s. This included emergency repairs of five hydropower plants, on-the-job plant maintenance training, and the establishment of a training centre for hydropower technicians at Arusha Technical College. Notably, the efficiency gains from the emergency repair project, had an estimated combined savings of USD 10–20 million.

ELECTRICITY ACCESS VS. CONNECTION

Access rates refer to households that are within reach of the electricity grid but do not give any indication on how many of those are physically connected. There could be different reasons why households with access are not connected, but often this is due to affordability of both connection fee and tariffs.

Connection rates refer to the households that are physically connected to the grid and can receive and consume electricity in their homes.

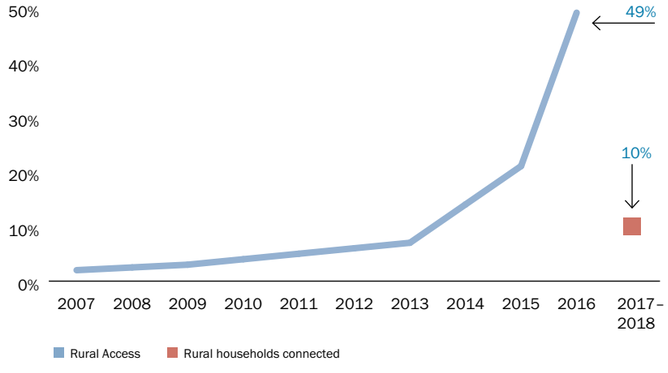
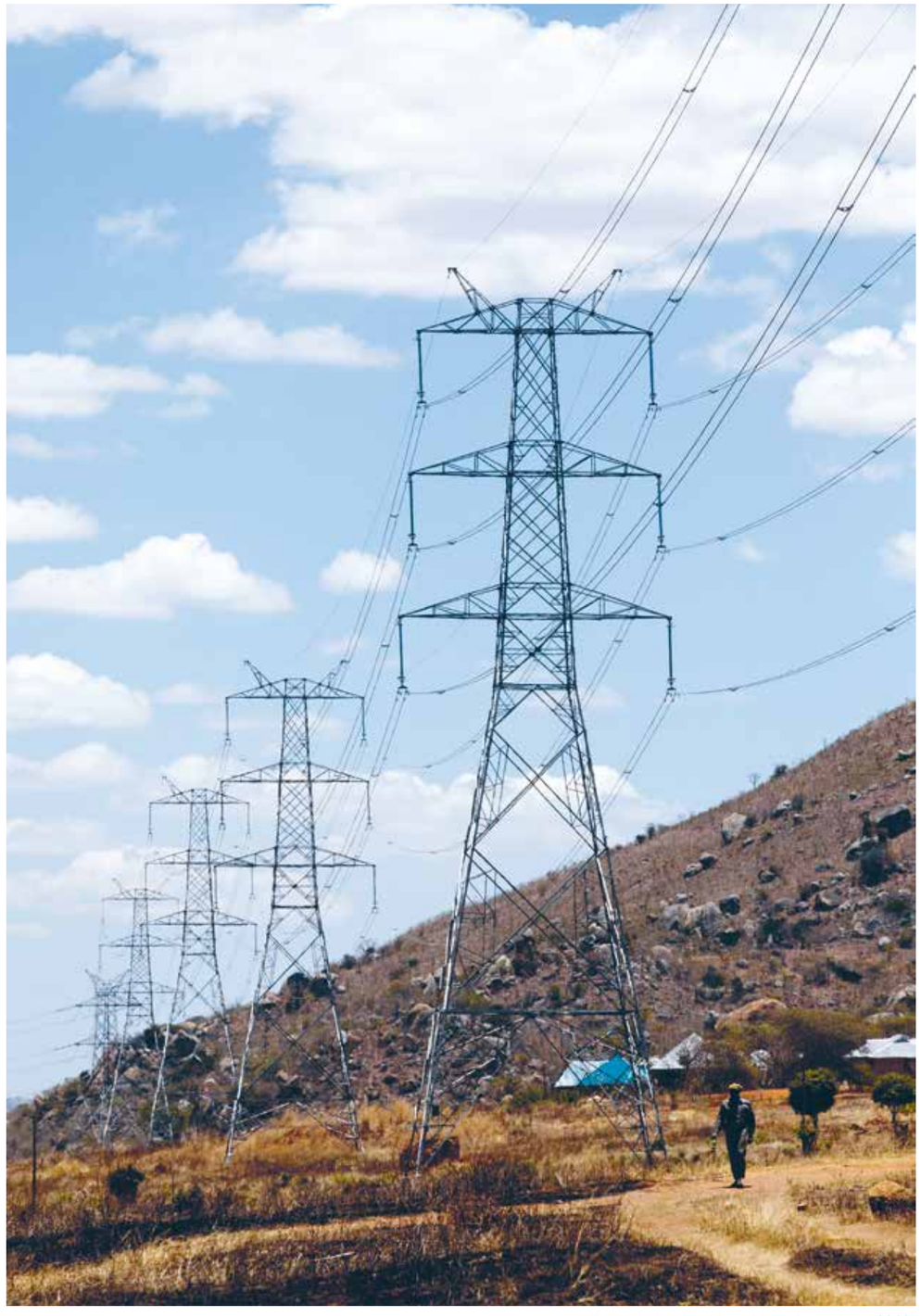


Figure 7: Rural electricity access and connection rates in Mainland Tanzania. *Source: (REA, 2019)*



Transmission line, Iringa. Photo: Espen Røst (2019)

MILESTONES

Year(s)	Project	Description
1970–1981	Stiegler's Gorge dam and hydropower plant	Norway supported a suit of technical studies for determining the potential for developing a large multipurpose project at Stiegler's Gorge in the Rufiji basin. The project was eventually found to be economically and environmentally unfeasible at the time. Support: NOK 150 million
1971–1980	Hydrological Survey Western Tanzania	Norway assisted the Tanzanian government in implementing a hydrometerological survey of Western Tanzania. The objective was to investigate the parts of the country that up until then had no coverage of hydrological surveys. Support: NOK 11.9 million, in addition to six Norwegian experts hired in the project.
1982–1984	Rufiji Basin Hydropower Masterplan	Norway supported the development of a hydropower masterplan for the Kilombero river in the Rufiji basin, which identified the Kihansi hydropower plant. Support: NOK 4.9 million
1984–1992	Mtera hydropower plant	Norway co-financed the construction of Mtera hydropower plant (80 MW), commissioned in 1988, with World Bank and other development partners. Norwegian support was provided for turbines and transformers. Support: NOK 110 million
1985–1990	Pangani River hydropower rehabilitation project	Rehabilitation of the three Pangani river system hydro-power plants and studies for New Pangani Falls. Support: NOK 42.4 million
1990–1995	New Pangani Falls hydropower plant	Support to the construction of New Pangani Falls hydropower plant (68 MW), co-financed with Sweden and Finland. Support: NOK 345 million
1992–1994	Emergency gas powered turbines	Norway and Sweden co-financed two gas turbines to provide emergency power during power scarcity in the early 1990s. Support: NOK 20 million
1994–2002	Kihansi hydropower plant	Support to the construction of Kihansi hydropower plant (180 MW), commissioned in 1999, and transmission lines to Iringa (97 km) and Kidatu (128 km). Co-financed with World Bank and other development partners. Support: NOK 380 million
1997–1999	Rehabilitation of Kidatu hydropower plant	Support to the second phase of rehabilitation of Kidatu hydropower plant, co-financed with Sweden (Sida). Support: NOK 40 million
2006–2020	NOMA and EnPE educational and research programs	Institutional cooperation between educational institutions in Norway and partner countries aimed at building institutional capacity and the exchange of knowledge and persons between North and South. In Tanzania, this has included establishing a master programme in Renewable Energy at UDSM (2007), and research cooperation including PhD students at UDSM in renewable energy topics such as hydropower and solar.
2010–2021	Professional Development of Female Engineers in Tanzania	Funding of the participation of female graduates in the Structured Engineers Apprenticeship Programme (SEAP), a programme established by the Engineers Registration Board (ERB) to assist graduate engineers to attain the required professional competence and qualify as professional engineers. Support: NOK 30.3 million
2011–2018	Emergency Repair Project of five HPPs	An emergency repair project for five of TANESCO's hydropower plants (Mtera, Kidatu, New Pangani Falls, Nyumba ya Mungu and Kihansi), including capacity building in operations and maintenance. Support: NOK 69.3 million
2012	Feasibility study for transmission line between Tanzania and Kenya	Feasibility study of 400 kV Kenya-Tanzania Interconnector. Support: NOK 19 million
2013–2021	Support to the Rural Energy Agency	Programme funding for electricity access and renewable energy investments in rural areas through the Rural Energy Fund (REF) administered by REA. Three approved projects so far: Backbone Transmission, Biogas and Densification Project. Support: NOK 700 million
2014–2019	Support to training centre for hydropower at Arusha Technical College	Technical cooperation for development of Kikuletwa hydropower station as a hydropower training centre for maintenance and operations, as well as training lecturers and building a micro turbine testing lab. Support: NOK 29 million

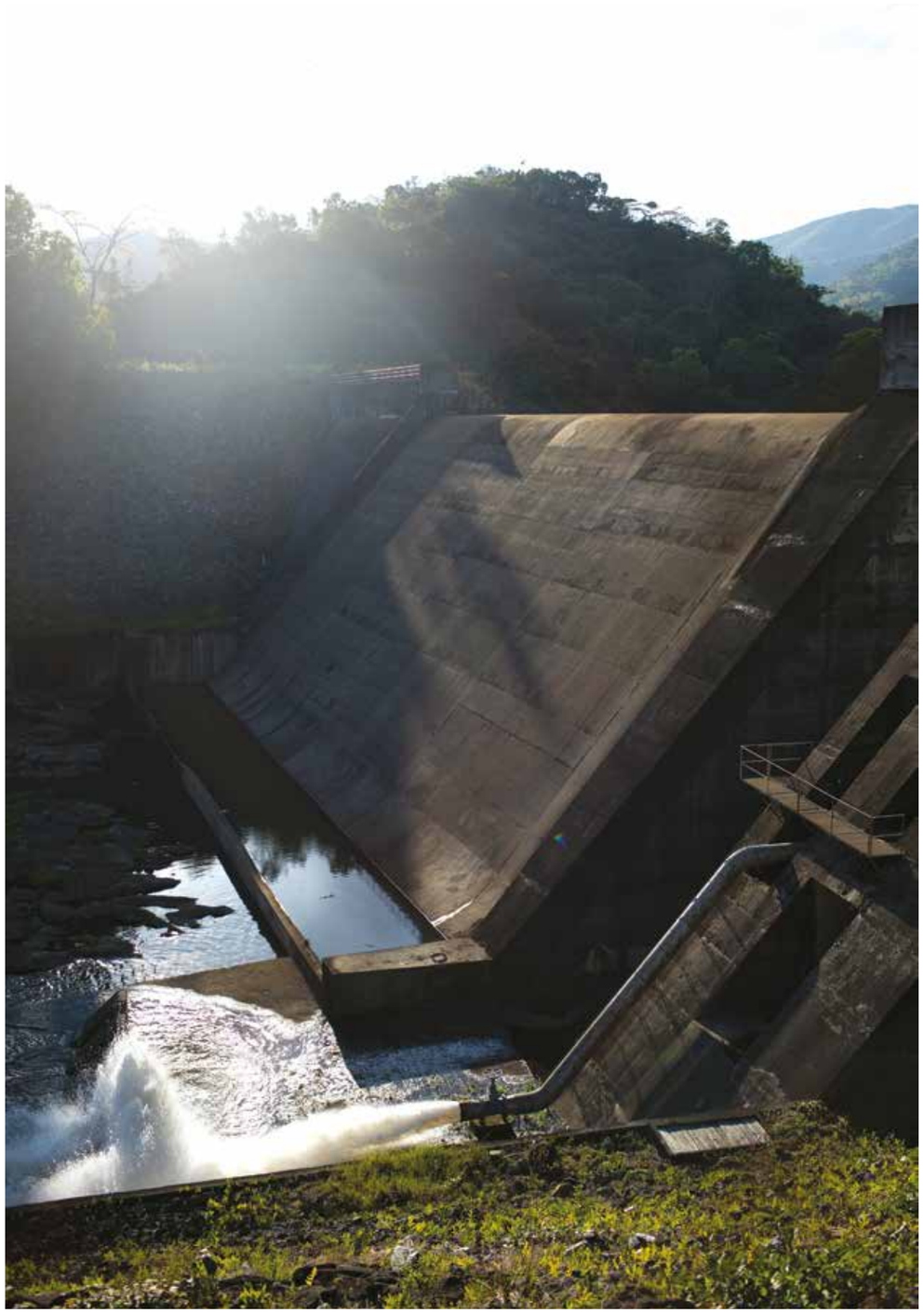
Name Amina Kadudu
Age 40
Business: Milling machine
Location: Bagamoyo village, Korogwe District

“I consider it an advantage to be a woman in business. I believe the bank considers women to be reliable clients as they are generally more diligent in repaying their loans.”

AMINA KADUDU

Amina Kadudu, the sole provider of three children, was already running a retail shop when she joined the Productive Use of Energy (PUE) program and decided to expand her business to include a flour mill. Today, one year after joining the PUE program, she has hired an employee and is constructing another building to expand her business.

Photo: Espen Røst (2019)



Kihansi Hydropower Plant. Photo: Espen Røst (2019)

3. Hydropower development

Norway has contributed to:

- Constructing three hydropower plants with 328 MW installed capacity (57% of total installed hydropower capacity and 32% of total installed energy capacity in Tanzania) and 1670 GWh firm annual generation (equivalent of 23% of total generation in 2018)
- Mapping of the country's hydropower potential and numerous feasibility studies for small and large power plants
- Rehabilitating and upgrading existing hydropower plants, with estimated combined savings of USD 10–20 million annually as a result of the Capacity building and Emergency Repair Project (2011–2018)
- Building institutional capacity in hydropower construction, operations and maintenance

Since 1970, Tanzania has built and brought into operation more than 500 MW of hydropower, making up about 95% of the power supplied to the grid until the turn of the millennium. The country continues to depend on hydropower, which still makes up one-third of the installed capacity.

Norway has a long history and experience when it comes to developing hydropower and water resource management. Hydropower development sparked the industrial revolution in Norway in the beginning of the twentieth century, with a peak in activity between 1960 and 1985[15].

As the development of hydropower and water resource management evolved during the century, social and environmental impact management became increasingly important. During the 1960s and 1970s there were growing concerns about the environmental and social impacts of several hydropower projects in Norway. In the 1970s, these concerns culminated in the implementation of the first Water Course Protection Plan and changes to the licensing process to include more comprehensive environmental and social studies as well as public consultations in affected areas.

In the 1980s, there were still some controversial projects in the pipeline and under construction in Norway which triggered public protests and debate. This led to the amended Water Course Protection Plans and a Master Plan for Hydropower Development[16].

15 (Faugli, 2015)

16 The Master Plan identified three categories of potential hydropower projects based on criteria like energy demand, environmental concerns, public conflict level and economic viability: Category I – hydropower projects where the licensing process could start at present; Category II – projects with high levels of conflicts which required a Parliament decision to be opened up for licensing in the future; Category III – projects with such a high level of conflict and/or economic costs that they were not to be opened up for licensing. However, the Master Plan was repealed in 2016 as the water and hydropower management had developed in terms of needs and knowledge and it was no longer considered necessary with the three management categories.

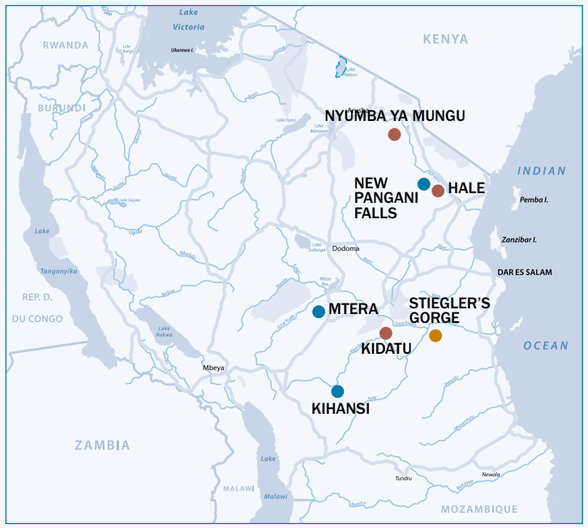
OVERVIEW OF LARGEST HYDROPOWER PROJECTS WHICH RECEIVED NORWEGIAN SUPPORT

HYDROPOWER PLANTS

MTERA HPP
MW: 80
Commissioned: 1988
Norwegian support:
1984–1992, 110 MNOK:
Grant support to construction

NEW PANGANI FALLS HPP
MW: 68
Commissioned: 1994
Norwegian support:
1990–1995, 345 MNOK:
Grant support to construction

KIHANSI HPP
MW: 180
Commissioned: 1999
Norwegian support:
1994–2002, 380 MNOK:
Grant support to construction



REHABILITATION

PANGANI RIVER REHABILITATION PROJECT
Power plants: Nyumba ya Mungu (8 MW), Hale (21 MW), (Old) Pangani Falls (17 MW)
Norwegian support:
1985–1990, 42 MNOK:
Rehabilitation and upgrade of the three HPPs in the Pangani River system

KIDATU HPP
MW: 100 (Phase I) + 100 (Phase II)
Commissioned: 1975 (Phase I) and 1980 (Phase II)
Norwegian support:
1997–1999, 40 MNOK:
Support to rehabilitation

EMERGENCY REPAIR PROJECT
Power Plants: Nyumba ya Mungu, Kihansi, Kidatu, Mtera, New Pangani Falls
Norwegian support:
2011–2018, 69 MNOK:
Emergency repair, upgrades and capacity building

UNDER PLANNING

STIEGLER'S GORGE HPP (now Julius Nyerere Hydropower Project)
MW: 2100
Commissioned: Expected 2020s
Norwegian support: 1970–1981, 150 MNOK:
Feasibility studies

Hydro-meteorological mapping: On-the-job training.
Photo: Torbjørn Tønnessen, Norad (1977)

This experience as well as policy and planning perspective influenced international projects where Norway or Norwegian consultants were involved.

In Tanzania, Norwegian hydropower support targeted all phases of hydropower generation from the development of various feasibility studies, the construction of New Pangani Falls and Kihansi hydropower plants, the emergency maintenance of five hydropower plants (including the four largest), to on-the-job and formal academic training of TANESCO staff in various project development phases.

"When the heavens cry over the Rufiji, they spill so much water that no-one can withstand its force. Man must obey the Rufiji."

TANZANIAN SAYING[17]

MAPPING THE POTENTIAL

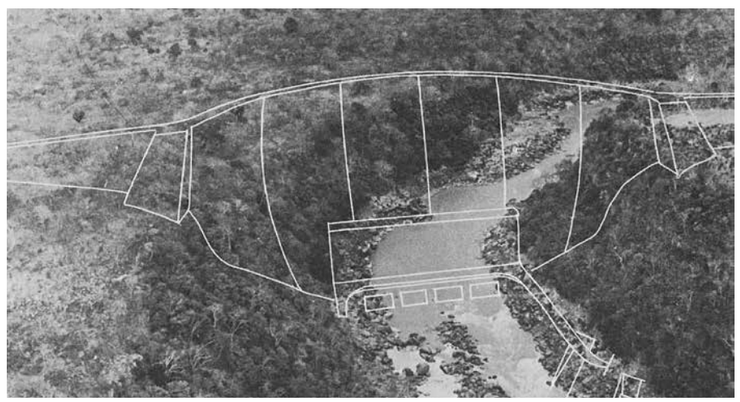
In the beginning of the 1970s, Norway received a request from the Tanzanian government to assist with a hydro-meteorological survey of Western Tanzania. Norway subsequently sent a small reconnaissance team from the Norwegian Water Resources and Energy Directorate (NVE) to undertake a hydrological survey to estimate the potential for hydropower production in the area. Norway supported with a grant of NOK 12 million, in addition to hiring six Norwegian experts in the project. This work led to a larger and more comprehensive hydrological mapping of several regions in Tanzania, co-financed by Norad, Danida (Denmark) and Finnida (Finland) and lasting through the 1970s. The data from this work laid the groundwork for much of the hydropower development in the region that was to follow.

50 YEARS IN THE WORKS – STIEGLER'S GORGE HYDRO-POWER PROJECT

The Rufiji Basin in South-Eastern Tanzania has a catchment area equivalent to one-fifth of the country's land area and holds the largest hydropower plants in Tanzania, Kidatu, Mtera and Kihansi (with a total of 460 MW of the 573 MW installed hydropower capacity in the country).

Between 1970 and 1981, Norway supported the feasibility studies and planning of the Stiegler's Gorge Dam and Hydropower Project in the Rufiji Basin with close to NOK 150 million (in nominal terms). The project was highly prioritized by the Tanzanian government given its potential role in power industrialization, electrification and the country's overall development. Norway was well positioned to make use of its hydropower development expertise at the time.

Norwegian consultants (Norconsult, Christian Michelsen Institute, Norplan (Multiconsult) and Hafslund/IVO) were involved in different phases of the project, tasked to assess both the feasibility of the hydropower plant, as well as the feasibility of building up an industry around mineral resources to create the necessary demand for the power. The reports concluded that the power potential was attractive, but the project was eventually put on hold in 1981 due to insufficient industrial



The planned dam in Stiegler's Gorge is drawn in white. The whole area above the dam would be under water. Photo: Taugbøl & Øverland (1977)

17 (Søyland, 2011)

development and hence lack of power demand, environmental concerns and lack of financing.

The project was one of the largest development projects supported by Norway during the 1970s. Looking back, it is less obvious why Norway continued to support the feasibility studies and planning to such maturity considering the relatively early indications related to the viability of the industrial development plans. Furthermore, considering that the national demand at the time was around the magnitude of 100–200 MW and an almost insignificant share of the population had access to electricity, while the plant would have had a capacity ten times that, it seems that the project was over-ambitious.

50 years later, Tanzania has revived the project, laying the foundation stone for a planned 2,100 MW hydropower plant at Stiegler's Gorge (now officially called the Rufiji or Julius Nyerere Hydropower plant) in July 2019. Today, electricity demand is expected to increase and make the hydropower plant economically viable, however, the project has raised environmental concerns.

NEW PANGANI FALLS HYDROPOWER PLANT

Around the mid-1980s, Tanzania was suffering from severe power shortages and load shedding, hence Norway supported the rehabilitation of the three power plants in the Pangani river system: Hale, Nyumba ya Mungu and Pangani (now known as the Old Pangani hydropower plant). Old Pangani was the first hydropower plant to be built in the former Tanganyika, in the early 1930s, while the other two were constructed in the 1960s. Through this work, an opportunity to build a new power plant at Pangani Falls to further increase the hydropower capacity was also identified.

Norway was asked to take the lead to construct the new plant, using Norwegian consultants with expertise in underground installations to oversee the construction as owner's engineer. Norway financed the largest share of construction cost[18] (42%), while the other donors were Finland and Sweden. The new plant, which started operating in 1994, had an installed capacity of 68 MW, about four times greater than the Old Pangani hydropower plant.

A RIVER FOR ALL – THE PANGANI BASIN WATER BOARD

As the Pangani river is part of a water system stretching from the Kilimanjaro area to the Tanga region, the water flow is highly dependent on good water resource management. Irrigation for agriculture and other uses of the river must be well managed to ensure a sustainable water flow. An important development during the construction of the plant was the establishment of the Pangani Basin Water Board, with the mandate to manage and develop the water resources. Setting up and building the capacity of the Water Board was done as part of the project, in particular supported by Norwegian experts. The Water Board is still operational today.

18 The total cost was NOK 820 million (nominal terms).

Pangani Dam under construction. Photo: Norplan/Multiconsult (1994)

Pangani Dam. Photo: Espen Røst (2019)

Name Steven Mahenda
Proffesion Plant Manager at New Pangani Falls

"The Pangani Plant is very important in our national grid and can simply be defined as a hub for electricity supply to the Northern part of Tanzania, which includes Moshi and Arusha, and to Pemba Island as well."

STEVEN MAHENDA (2019)

Eng. Steven Mahenda is the Plant Manager at New Pangani Falls at the time of writing. He is a mechanical engineer and has worked at TANESCO for 25 years. His long career within the hydropower sector, includes working at the Kihansi Hydropower Plant during its construction in the 1990s. He also attended a course on project and financial management in 1999 at the International Centre for Hydropower in Norway.

Photo: Espen Røst (2019)

KIHANSI HYDROPOWER PLANT

Once the construction of New Pangani Falls was completed, the team of engineers, other workers and TANESCO employees transferred more or less directly to Kihansi, with construction starting in 1994/1995 and commissioning in 1999. Kihansi was one of the projects identified in the Rufiji Basin Hydropower Masterplan developed in the 1980s with support from Norway.

With an installed capacity of 180 MW and firm annual generation of 1000 GWh, Kihansi would contribute to about a quarter of the total energy generation in Tanzania at the time of commissioning. Norway contributed with around NOK 380 million in grant-financing to the project (roughly one-fifth of the total cost), which also included financing from the Government of Tanzania, the World Bank, Sida, KfW (Germany), and the European Investment Bank.

Pelton turbines from Kværner being mounted at Kihansi. Photo: Even Sund (1998)

Kihansi Power House. Photo: Espen Røst (2019)

ENVIRONMENTAL AND SOCIAL IMPACTS

According to Norwegian experts who were involved in various projects in the Tanzania-Norway energy cooperation, environmental and social impacts and mitigating measures were more systematically addressed in the construction of the New Pangani Falls and Kihansi compared to previous projects. As explained previously, this was likely due to a shift in public sentiment on hydropower development and its potentially harmful impacts on the environment both in Norway and internationally, leading to a change in how to manage the development of new hydropower plants, both in terms of project development and licensing.

Norway financed a pre-feasibility study in 1987, while the World Bank financed the actual feasibility study in 1990–1991. However, Norway and other potential donors were not satisfied with the initial environmental impact assessment, thus Norway financed further studies in this area. It was during this study that the now famous endangered Kihansi Spray Toad was discovered (see box below). In total, Norway supported studies and design of remedial measures for environmental and social impacts to a value of NOK 23.5 million.

KIHANSI SPRAY TOAD

The Kihansi Spray Toad was discovered in a mini ecosystem in the spray zone of the Kihansi Waterfall, found in the Lower Kihansi River Gorge. As the planned hydropower plant would lead to reduced/diverted water flow in the river, the spray zone habitat of the toad was threatened. To ensure that the toad would not become extinct, 500 toads were taken to a captive breeding facility at the Bronx Zoo in the USA, to breed in captivity and repopulate if needed.

As it turned out, the toad did go extinct in its natural habitat. However, specimens bred in captivity were re-introduced to the habitat, which was fitted with a sprinkler system to replicate the spray from the waterfall. Currently there are four captive breeding facilities in the world, one being at the Kihansi station of Tanzania Wildlife Research Institute (TAWIRI). Later research concludes that the habitat is recovering and the ecosystem is stabilized, potentially creating the right conditions for the toad to survive.

The Kihansi Spray Toad exemplifies the tension between the need for power generation on the one hand and environmental protection on the other. In a country where power shortage and load-shedding are real and daily challenges, and the natural environment a rich and diverse ecological system to be secured for generations to come, the dilemma is challenging. The discovery of the toad led to reduced generation from the power plant, as well as increased costs for Tanzania in conservation efforts, to the dismay of some.

The Kihansi Spray Toad. Photo: Espen Røst (2019)

THE MUAJAKI HEALTH PROJECT

In the initial feasibility studies for New Pangani Falls power plant during the 1980s and 1990s, impact assessments on health and social aspects, and associated remedial measures, received insufficient attention. However, additional health and social impact assessments were conducted and remedials implemented. With Kihansi, just a few years later, awareness had matured, and these issues were given full focus in the initial impact assessment.

The MUAJAKI Health Project was an integrated component of the Kihansi project, initiated to deal with various challenges that arose. It was a cooperation between the project and local authorities, building upon existing health and social activities and measures in the area.

The project had awareness campaigns related to the illnesses and health issues that arose, using movies, printed media, and local meetings. Although the impact of the initiative was never systematically measured, it was generally considered by those responsible to have a positive impact. Dr. Kåre Moen was hired as a medical expert during the construction of both New Pangani Falls and Kihansi as part of the team responsible for implementing social and health measures. According to him, the World Bank found the approach to be unique, highly innovative and world class. Many of the experiences from Kihansi have been used in other countries, for instance in the Melamchi Water Supply Project in Nepal.

Malaria. The Kihansi dam was built in the mountains in the Kihansi River Gorge. Villages in the highland areas had been naturally separated from the lowland areas by the mountains, but the hydropower project meant that roads had to be constructed, which opened a corridor between the two areas. Malaria was endemic in the lowland but travelled swiftly up towards the highlands when construction commenced. In these areas, which had not experienced malaria, people were affected severely almost overnight. Awareness campaigns and preventive measures were therefore introduced to prevent further spreading.

Sexual health and HIV/Aids. The Kihansi workcamp was located near the town of Mlimba. The small town therefore experienced a sudden influx of about 5000 workers, followed by others, such as vendors and restaurants, due to the resulting increased economic activity. Mlimba was subject to certain pressures that follow from such a rapid increase in (mostly male) population. The main concern was prostitution and the spread of sexual diseases and HIV/Aids. Awareness campaigns and distribution of contraceptives were introduced to avoid spreading of illnesses.

Hygiene. Several thousand latrines were built to accommodate the large population of workers, as well as the local population. The outdoor latrines, called Ventilated Improved Pits, or “VIPs” as a running joke in the project, were designed to be more hygienic. Looking back, the decision to focus on good hygiene was critical to limiting the spread of diseases whilst facing a sudden growth in population.

THE BIG FIVE EMERGENCY REPAIR PROJECT

Between 2011 and 2018, Norway supported TANESCO with capacity building and emergency repair and upgrades of five of Tanzania’s hydropower plants. This included the four largest (Nyumba ya Mungu, Kidatu, Mtera, New Pangani Falls and Kihansi) to ensure continued and stable operation of the plants. The programme involved institutional cooperation between TANESCO and NVE. The programme also included procurement of critical infrastructure parts for emergency repairs. On the job training of key personnel in all areas of operation and maintenance, was critical in enabling improved and efficient power production and security of supply. The project contributed to strengthened efficiency as well as on-the-job training of key personnel in all areas of operation and maintenance, to enable improved and efficient power production and security of supply. The project contributed to improved efficiency and energy security, staff safety and increased staff knowledge.

The project, according to TANESCO, has resulted in reduced monthly outages of about 95% at the New Pangani Falls plant. Additionally, the safety for plant personnel at New Pangani Falls has also been improved after fixing severe water leakages through the main intake valves. Internal power consumption at Kihansi was reduced by 25% and turbine output was restored from 67% to 100% at Kidatu. Combined savings as a result of this project was estimated to USD 10–20 million annually[19].

Following the repair and capacity building programme supported by Norway, outages were reduced from 170 hours to only 8 hours during a month. Photo: Espen Røst (2019)

19 (KPMG, 2018)

“I saw a potential in the market, as there was no salon here previously. I started with a single chair and hair clipper, now I have two. My plan is to start another hair salon in a nearby area and employ someone to run it. I am very happy now, as I can be proud of doing honest work, even though I must work 7 days a week.”

RATICKI HELLY (2019)

Ratticki Helly offers haircuts, shaving and beard trimming in his hair salon in Bagamoyo village. His customers would previously have to go to the nearest town which is about 2–3 km away. Now, they save time and the cost of transport back and forth.

One of the key learnings from the Productive Use of Energy programme is how to keep records of his business.

Name Raticki Helly
Age 23
Business Hair salon
Location Bagamoyo village, Korogwe district

Photo: Espen Røst (2019)

Photo: Espen Røst (2019)

4. Grid expansion and electrification

Norway has contributed to:

- Developing feasibility studies for interconnectors to Kenya and Zambia, making Tanzania one of the links between the Eastern and Southern African Power Pools
- Constructing more than 1,750 km of low voltage network
- Connecting more than 35,000 rural households (or 143,000 people) with electricity
- Increasing income for entrepreneurs through productive use of energy
- Establishing a national factory producing distribution transformers

Photo: Multiconsult (2019)

"Previously when the politicians came to the villages and asked people: "What do you want?", they would maybe say water, dispensaries, schools or other things, but never electricity. Now, everyone wants electricity. They are calling us and asking: "When is the electricity coming here?"

JUSTINA UISSO, DIRECTOR OF PLANNING IN THE RURAL ENERGY AGENCY (2019)

In Tanzania, the distances are large, sometimes with challenging topography, and the power plants where the electricity is generated, are often located far from where the electricity is used. Power transmission and distribution networks are required to distribute electricity to customers and ensure a stable and reliable supply. Following the contribution to hydropower development and power generation, the next phase of Norwegian support was increasingly focused on Tanzania's priority of transporting power to households, public services and businesses. Norway has supported national and regional transmission projects (including connections to neighbouring countries) as well as rural power distribution.

EMPOWERING RURAL COMMUNITIES

In 2013, Norway signed an agreement to support the activities of the Rural Energy Agency (REA) and the Rural Energy Fund (REF) with a grant of NOK 700 million with the goal of increasing access to modern energy services in rural Tanzania Mainland, for socio-economic development and poverty alleviation. This is the largest bilateral energy support agreement between Norway and Tanzania. In 2007, when REA was established, only 2% of the population had access to electricity[20]. Less than 10 years later (2016), the number was close to 50%.

To date, Norway's support has targeted connection of villages both along existing 400 kV transmission lines (backbone transmission investment) and medium voltage lines (densification), as well as the development of a market for household biogas plants.

The household biogas project was unsuccessful in terms of encouraging biogas adoption in the market. The marked had partially collapsed due to a subsidy phase-out beginning some time prior to this project component resulted in a partial market collapse [21]. The grid extension projects have succeeded in connecting several hundred villages and thousands of new connections.

REA's densification programme (the Rural Electrification Densification Program, REDP) is a nationwide scheme, being implemented in three phases (rounds), that connects villages and households in rural areas which are within a radius of about 1.2 km to the existing medium voltage (MV) lines. The programme aims to reach all regions of Mainland Tanzania by the end of the final round. The villages are connected by distribution transformers and low voltage line extension. Some of these transformers have been supplied by the Tanelec factory in Arusha (see text box on page 46). At the end of the first round of the programme, close to 143,000 people were connected[22].

ELECTRICITY AND GENDER

Joseph Sambali is Gender & Energy Specialist in REA, in charge of ensuring that REA is gender mainstreaming at all levels, both in their projects and internally in the organization.

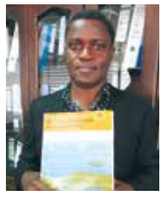
We have conducted orientation workshops for all employees and management. Most of the people here are very supportive of this initiative, also in high level management. All staff was interviewed and completed a self-assessment questionnaire to map the staff's gender values, opinions and needs. Based on the work, we have developed a gender action plan. We are now working on what kind of interventions to introduce. We want to go further and analyse how men and women benefit differently from interventions. We must explore what gender balance in an energy perspective means. Energy for cooking is a big challenge that we still need to address and where little progress has been made, and this affects women especially. (2019)

Photo: Multiconsult (2019)

20 (REA, 2019)

21 (REA; SNV, 2017)

22 36,000 connections were made. Assuming 4.8 persons in a household gives number of people connected. (Energy4Impact; Multiconsult, 2019)



"Before the 1960s, the majority of the country was not electrified, and a very small share of the population had access to electricity. Then we started building more hydropower plants, but still in the 1970s people weren't really aware of electricity and nobody was demanding electricity or complaining. In the 1980s, the situation started changing as more people became aware of the benefits of electricity, and in the 1990s people were demanding electricity and complaining that it wasn't expanding quickly enough or that there were shortages".

ENG. COSTA L. RUBAGUMYA, SENIOR MANAGER
STRATEGIC PLANNING TANESCO (2019)

Figure 8 Maps showing which regions are covered in which rounds of the REDP. Some regions are included in several phases. *Source: Multiconsult, 2019.*

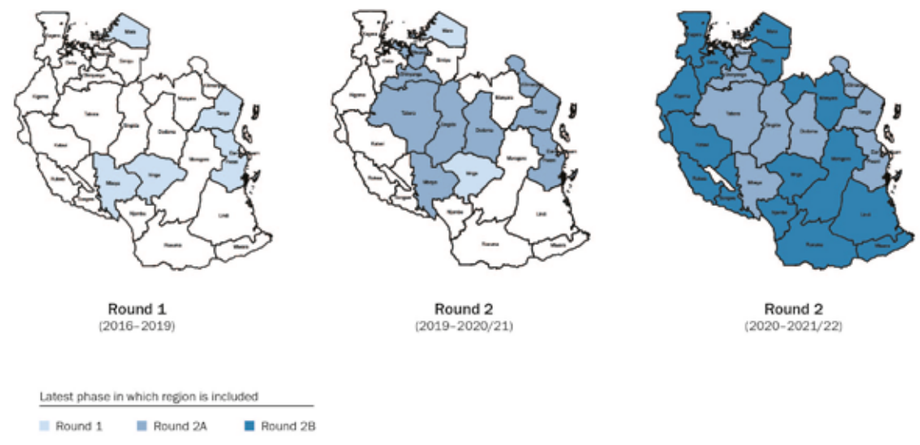


Photo: Espen Røst (2019)

Name
Hamza Zubeir Mkudulu
Age 42
Business Butcher
Location Bagamoyo village, Korogwe district

“I have learned how to keep records, so I can have a clearer picture of my profits. My mentor has also taught me how to improve on customer service, and health and safety in the handling of the meat. I would like to invest in a larger freezer and an electric carving knife to be more efficient, as I am now slaughtering three cows a week.”

HAMZA ZUBEIR MKUDULU (2019)

Photo: Espen Røst (2019)

Hamza Zubeir Mkudulu sells meat, mostly to local customers who use the meat for home consumption. Electricity allows longer opening hours and the freezer comes in handy for storing meat that is left over.

Participating in the Productive Use of Energy programme has not only taught him how to maintain accounting books, but also about health and safety measures and customer service. Hamza has invested in an apron, rubber boots and a bucket where he keeps clean water so he can wash his hands after serving customers.

Now, customers can call and place an order for home delivery and pay by mobile payment.

TANELEC – A TRANSFORMER FACTORY IN ARUSHA

Norway received a request at the end of the 1970s to support Tanzania to produce transformers nationally instead of importing from abroad. This led to the establishment of a production facility in Arusha in 1981. The company, called Tanelec, was owned 80% by the government of Tanzania and 20% by National Industri, a company based in Drammen, Norway. National Industri was later acquired by ABB, who became a majority owner in Tanelec from 1995 and until 2007.

Norway's support was in the form of favourable currency loans, smaller infrastructure investments, interest rate subsidies, as well as knowledge transfer and competence development, involving 15 Norwegian experts during the start-up phase to provide on-the-job training.

The first years were challenging, and the factory had to diversify its products and services to survive. An idea of selling cook stoves, based on a suggestion from an internal competition on how to earn money, became good business; Tanelec produced and sold up to 40,000 cook stoves per year.

After a few years, the competence development, along with welfare and social benefits, led to productivity and quality on par with the factory in Drammen. TANESCO was Tanelec's main customer, but it also exported to neighbouring countries such as Uganda and Kenya. Today, Tanelec produces mainly distribution transformers, low and medium voltage switchgear as well as offering repair and service of distribution and service transformers. It currently has the capacity to produce 7,000 transformers annually and has a 90% market share in Tanzania. At the most, 200 workers were employed at the factory.

The General Manager at the time of establishment, Petter Fergestad, notes that a major success factor relates to time spent gaining acceptance for the factory from the surrounding community.

"We had to communicate clearly that the factory would not only generate profits, but also help the community and society to develop over the long-term by providing jobs at the factory but also at other local businesses providing services needed by the factory and its employees. This led to improved loyalty and local ownership."

Petter Fergestad, former General Manager of Tanelec (2019)

Prominent guests: The then Crown Prince Harald and Crown Princess Sonja of Norway came to Tanzania to inaugurate the Tanelec transformer factory. Photo: Petter Fergestad (1981)

Source: (Bistandsaktuelt, 2003); interviews with Dag Larsson (2019), Petter Fergestad (2019).

"Distributing electricity for productive use is essential. Rural electrification is expensive and using it simply for lighting is not enough. Electrification can have a big impact but has to be utilized to its full potential. It should be used for irrigation, entrepreneurship and social services such as dispensaries and hospitals."

DR. LUTENGANO MWAKAESYA, FORMER DIRECTOR GENERAL OF REA (2019)

ELECTRICITY FOR JOB CREATION

A number of studies have quantified the effects on job creation by having access to modern energy services; for instance, a World Bank survey found that 40% of African businesses reported that the lack of access to reliable electricity supply is a major or severe constraint for their operations, and even higher for the least developed countries[23].

While contributing to physically connecting households to the grid has an impact, reaping the full benefits of access to electricity requires that it is used productively in homes and businesses. This means using electricity for more than just lighting and television. Part of the support to REA was therefore used to fund the Productive Use of Energy (PUE) program in Tanga and Pwani regions. The objective was to raise awareness about how to take full awareness of the benefits of electricity. The program offered opportunities for teaching skills required to be an entrepreneur and grow a business, thereby stimulating local economic activity. It has also linked entrepreneurs to financial institutions to enable access to loans.

To recruit entrepreneurs, programme staff travelled to hundreds of villages on so-called "road shows" setting up information clinics and demonstrating various electrical appliances (see picture below).

The Productive Use of Energy Clinics are an important venue for engaging potential entrepreneurs. The gatherings attract many villagers with music and entertainment, demonstrations of electrical appliances and general information sharing. Photo: Multiconsult (2018)

23 (KPMG, 2018)

Many entrepreneurs who had received training were successful in establishing and/or growing their own businesses. Some were later recruited as “champions” to act as role models and mentors for others in their local communities.

The programme has been highly successful, with more than 1,000 business owners trained and 349 entrepreneurs supported through a collaboration between the programme implementer (Energy4Impact and Multiconsult on behalf of REA) and Vision Fund Trust Microfinance Bank, a Tanzanian microfinance organisation. The program allowed entrepreneurs to access special business loans by a shortened/simplified loan application process. Combined with high focus on financial management, these loans have almost always led to increased business revenues with no cases of loan defaults reported.

The average profit of all the supported enterprises increased by an estimated 135% from baseline (USD 123) in June 2018 to June 2019 (USD 289)[24].

REGIONAL POWER TRANSMISSION

Norwegian support to regional energy cooperation has contributed to the development of power trade in the Southern and Eastern African regional power pools (SAPP and EAPP), where Tanzania is strategically located between the two and is a member of both. Cross-boundary energy cooperation helps promote regional integration and peace, more efficient utilization of infrastructure, and improved management of natural resources.

Through the integrated Nordic power market and its joint facility for power exchange, Nord Pool, Norway and the other Nordic countries are pioneers in cross-border power trade. Norwegian competence in this field has been used to support establishment of frameworks for cross-border trade in both Southern and Eastern Africa. Norway also supported feasibility studies for a number of regional infrastructure projects aimed at improving security of supply and resource efficiency.

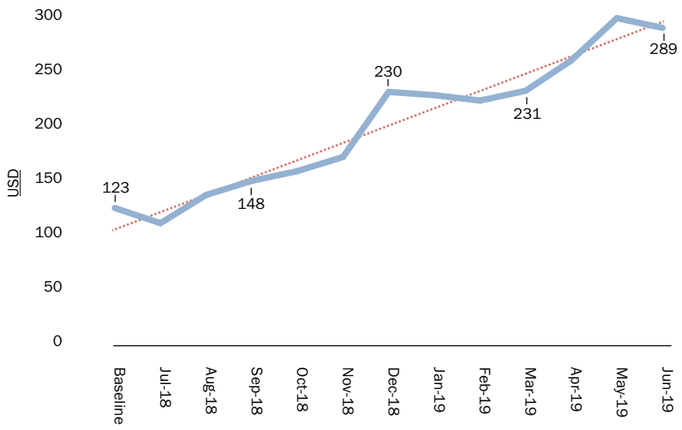


Figure 9: Average monthly profit in USD. *Source: (Energy4Impact; Multiconsult, 2019)*

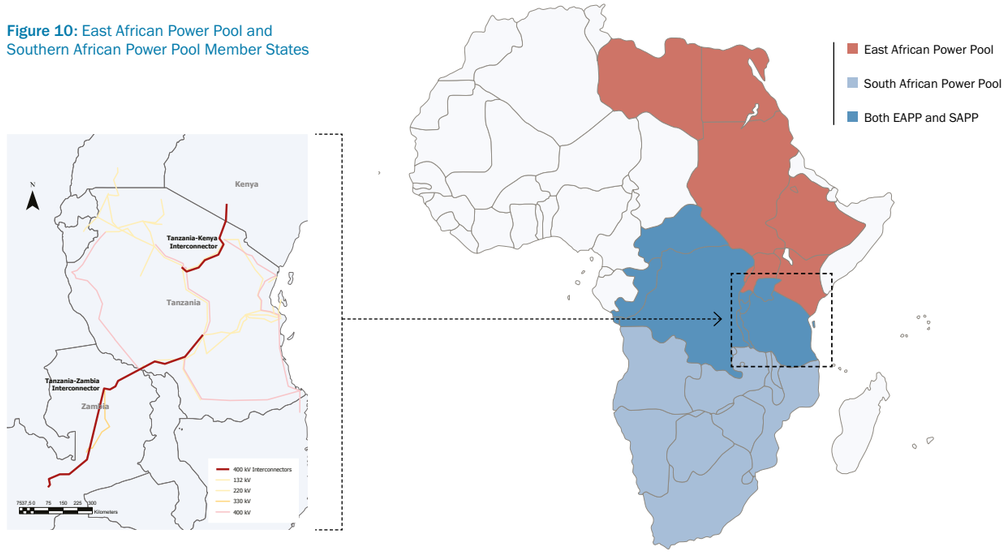
24 (Energy4Impact; Multiconsult, 2019)

In 2012 the feasibility study for a 510 km long transmission line between Kenya and Tanzania, a so-called 400 kV double circuit interconnector, was fully updated with support from Norway (NOK 19 million), in cooperation with NELSAP[25]. Running from Singida through Arusha in Tanzania, to Isinya in Nairobi, Kenya, the transmission line is expected to connect with the southern Tanzanian transmission line between Tanzania and Zambia, thus connecting the Eastern Africa Power Pool (EAPP) with the Southern Africa Power Pool (SAPP). The transmission line, found to be viable in the feasibility study, is currently under construction, financed by the African Development Bank (AfDB) and Japan International Cooperation Agency (JICA). It is scheduled to be completed in 2020 and expected to contribute to solving some of the power shortages in Tanzania, with power from amongst others Ethiopia.

Between 2013 and 2017 Norway further co-financed the feasibility study for the Tanzania–Zambia transmission line (NOK 18 million) together with KfW and the European Union. The World Bank later approved a USD 455 million credit for the construction of the line, with construction yet to commence at the time of writing.

These two lines will provide a strategically important connection between the EAPP and SAPP, creating what might become the largest geographic energy market in the world expanding from Cairo in the north to Cape Town in the south.

Figure 10: East African Power Pool and Southern African Power Pool Member States



25 The Nile Equatorial Lakes Subsidiary Action Program

“I am thankful to my mentor who has taught me how to run a business, how to keep records and helped me register my business and get a license. This, along with introducing me to financial institutions, allowed me to take up a loan for my business and increase my income.”

PETER JOSEPH MGWENO (2019)

Peter Joseph Mgweno is a retired religion teacher who has returned to his village to run a retail shop. He has purchased two refrigerators, where he stores cool drinks, juices and beer for sale. He also offers phone charging services where customers can come and charge their phone for 200 TZS.

Next to the shop is the foundation for a new house that he is constructing. It will be built with bricks and be bigger and more solid than his current house.

Peter also uses his income to support his children’s education.

Photo: Espen Røst (2019)

Sudi Kondo Mbegu (52) uses electricity to run a milling machine after his village Hondogo was connected. He employs two workers, as well as casual labour during high season. Previously, his customers had to walk 7 km to buy flour. Today they save time and the cost of transport. Photo: Espen Røst (2019)

5. Competence development and capacity building

Norway has contributed to:

- Participation of about 40 Tanzanian students in the master programme in hydropower development at NTNU
- Establishing a master programme in renewable energy in Tanzania (UDSM), with close to 100 registered students (about one-third female) and 50 graduated from this programme
- Supporting the professional training of close to 500 female engineers
- Setting up a vocational training programme for training hydropower technicians

"If you ask employees at TANESCO to tell you what first comes to mind when they hear "Norway", it will be firstly hydro, and second capacity building."

ENGINEER FELCHESMI J. MRAMBA (2019), TANESCO

INTRODUCTION

Funding of infrastructure alone cannot create a strong and sustainable power sector. Tanzania and Norway have always recognised the importance of building up human resource development and organizational strength through education and training. Professionally managed institutions with the will and ability to develop and follow policies, regulation, and long-term sector plans are a pre-requisite to manage the energy sector in a responsible and sustainable manner. This is the case at all levels of sector management; construction and plant operations also need to be supervised professionally. Education and professional capacity building have thus been priority areas of energy cooperation with Tanzania, comprising a suite of education, research and training initiatives.

"If you look at TANESCO between 1998 and 2002, almost every engineer and person in senior and mid-management levels had received some form of training at some point through Norwegian support. We cannot imagine TANESCO without the Norwegian cooperation."

ENG. COSTA RUBAGUMYA, SENIOR MANAGER STRATEGIC PLANNING TANESCO AND FORMER STUDENT AT NTNU (2019)

Over the past five decades Norway has supported multiple education and research programmes within energy-related fields. Since as far back as 1962 about 40 Tanzanian students, have participated in the internationally recognised master course in hydropower at the Norwegian University of Science and Technology (NTNU)[26] in Trondheim with scholarships from Norway[27]. A master programme in renewable energy was also created and funded in 2008 at the University of Dar es Salaam under Norad's Programme for Master Studies (NOMA), from which more than fifty students have now graduated[28]. The International Centre for Hydropower (ICH), based in Trondheim, has provided training for numerous Tanzanians through courses and capacity building related to hydropower in both Norway and Tanzania. In fact, TANESCO has had the most participants at ICH courses amongst all the participating institutions in Africa.

Norwegian scholarship funds have further contributed to a five-fold increase in registered female engineers in Tanzania between 2009 and 2019, illustrating a successful example of gender intervention related to clean energy. Support to Arusha Technical College has resulted in a training programme for hydropower technicians and artisans, who go on to operate and maintain Tanzanian hydropower plants.

Finally, on-the-job training of TANESCO technicians on projects supported by Norway such as the New Pangani Falls and Kihansi hydropower plants, has been a vital component of Norwegian competence development support.

These combined efforts over the years have had a lasting impact on past and future development of the Tanzanian power sector and institutions such as TANESCO. Just as important, students and programme participants report having greatly enjoyed and benefited from their experiences, the people they encounter and the knowledge they acquire, in many cases boosting career prospects.

TANZANIAN FELLOWS IN NORWAY[29]

Norway has offered fellowships for international students to take courses at Norwegian educational institutions since 1962 in fields where Norway has specialized competence. An estimated 6,000 students in all fields and from various countries have at the time of writing benefitted from the Norad Fellowship Program (NFP) between 1962 and 2004[30] where about 1,000 of these students were from Tanzania.

Of the fellows from Tanzania, 40 have taken a course in hydropower development at NTNU, and it is estimated that over 20 of the fellows were or are employed by TANESCO. Some TANESCO fellows have noted that they feel that they have been instrumental in developing the country's hydropower resources over the past 30 years. Other Tanzanian NFP fellows have had important roles in developing the petroleum sector in Tanzania, for instance through the development of the Songo Songo gas field. The gas from this field is used in the two Ubungo power plants (with total installed capacity just above 200 MW), supplying about 20% of Tanzania's electricity and is the main source of electricity supply for Unguja Island in Zanzibar.

It seems that the long-term and focused training scheme orientated around one sector and institution (TANESCO) has had a lasting impact in building up the institution's capacity[31].

The NFP was discontinued from around 2005 and substituted by other programmes.

BUILDING INSTITUTIONAL CAPACITY

In 2006, Norad's Programme for Master Studies (NOMA) commenced. The aim of NOMA was to achieve long-term sustainable capacity of institutions in partner countries, amongst others Tanzania. The programme also aimed to stimulate collaboration between partner countries through development of regional master programmes, while contributing to the institutional development of partner institutions, included administrative and managerial capacity[32]. This focus on establishing master programmes with the universities marked a shift in the sense that the programme training activities to a large extent moved to the institutions in the respective partner countries as opposed to in Norway.

A Renewable Energy Network Project was set up between Uganda (Makerere University), Ethiopia (Mekelle University), Mozambique (Eduardo Mondlane University), Norway (NTNU) and Tanzania (University of Dar es Salaam, UDSM). Under this project, a master programme in renewable energy was established at

"The cooperation with Norway has a big impact on our institution and society. We are working to make the master programmes sustainable and aim to develop the expertise of our students so they can graduate and contribute to the development of our energy sector, either by joining key institutions or private sector, and a few even starting their own businesses."

PROFESSOR CUTHBERT KIMAMBO, PRO-RECTOR RESEARCH UDSM (2019)

26 Formerly the Norwegian Institute of Technology (NTH)
27 (Nordic Consulting Group and Partners, 2005)
28 (SIU, 2015)
29 (Nordic Consulting Group and Partners, 2005)
30 Ibid
31 (Nordic Consulting Group and Partners, 2005)
32 (COWI, 2009).

UDSM in 2008, with specializations within hydropower, solar power, bio energy, as well as energy efficiency in buildings. The collaboration runs both between Norway and the African partner countries, and between the African partner countries, including exchange of students, teachers and knowledge. About 14–15 students from Tanzania as well as the other participating countries, are enrolled in the master programme every year. In total, nearly 100 students have been registered in the program (one-third of those female), and 50 students have graduated so far[33].

MORE FEMALE ENGINEERS IN TANZANIA[34]

Traditionally a male-dominated field, only 9% of all engineers in Tanzania are women (increased from 4% in 2009)[35]. According to female engineers that have been interviewed for this report, engineering is seen in Tanzania, as in many other countries, as a man's job, reinforcing that fewer women choose to pursue an education in this field. Among those who have chosen engineering, most are employed in lower level positions. By comparison, only about 20% of the employees (including non-engineers) in the energy sector in Norway are women[36]. Engineering and the power sector as such, have traditionally been male dominated with difficulties to recruit women also in Norway.

Since 2010, support from Norway has funded the participation of female graduates enrolled in the Structured Engineers Apprenticeship Programme (SEAP), a programme established by the Engineers Registration Board[37] (ERB) to assist graduate engineers to attain the required professional competence and qualify as professional engineers as quickly as possible (usually 3 years). Many of those who join SEAP, both male and female, drop out for financial reasons due to the unpaid or low wage apprenticeships offered. This is even more prevalent for women than men, who often have childcare and other family obligations duelling with their professional development.

During the first phase, about 290 female engineers benefitted from the support, of which a majority were registered as professional engineers. Another 200 women were enrolled in the second phase which is still ongoing at the time of writing this report. In total, the number of registered female professional engineers increased from 96 in 2009 to 548 in 2019, a five-fold increase, where almost 60% were supported from Norwegian funds[38].

Many of the female engineers have found relevant jobs, including establishing their own firms and several are working in managerial positions. By holding positions in male-dominated sectors, they are contributing to improved gender equality and balance, while also acting as positive role models for other women.

33 Dr. Joseph Kihedu, Coordinator of MSc in Renewable Energy Programme, UDSM, 2020
34 (Norad, 2015); (Engineers Registration Board, 2019)
35 (Engineers Registration Board, 2019)
36 (Statistisk Sentralbyrå, 2016)
37 The ERB is responsible for licensing and regulating the conduct of engineersand engineering companies in Tanzania, as well as building national engineering capacity through training and aligning curriculum with industry needs.
38 (Engineers Registration Board, 2019)

THE FIRST FEMALE ENGINEER

Engineer Margareth Munygai, age 69, has served on the board of the Engineers Registration Board and is leading a project on how to make the SEAP sustainable at the time of writing.

After graduating as an electrical engineer in 1976 from the University of Science and Technology in Ghana, Eng. Munyagi moved back to her home country Tanzania to work. Her first job was as an electrical engineer at the Kilimanjaro International Airport. In 1988 she was registered as an engineer, somewhat delayed after graduation, due to work and family obligations.

"When I started, I worked mostly with men. They would sit back and discuss among themselves: "will she do it, can she manage?". But once I proved that I was up to the job and could solve challenges same as them, they respected and supported me. But I had to put in the effort that was required to prove myself."

Eng. Munyagi's became the first female Director of the Julius Nyerere International Airport, then Director of all the airports in Tanzania, and finally the Director General of the Tanzania Civil Aviation Authority until her retirement in 2010. She serves as an important role model.

"... Girls seem to think that science and mathematics is more difficult. Women also have a bigger challenge because of the family situation. Thus, it is very important to get those who have graduated from engineering studies registered and into work as quickly as possible."

Eng. Margaret Munyagi. Photo: Espen Røst (2019)

At National Service Training Camp in 1972. All students who completed form VI had to attend six months compulsory military training prior to joining universities. Margaret Munyagi on the right.

Name Dorcas Mcheri
Profession: Electrical engineer

“My training with ERB has helped me to become a professional engineer, with confidence in myself.”

DORCAS MCHERI

Dorcas Mcheri has studied electrical engineering at the Dar es Salaam Institute of Technology and is now gaining her practical work experience as an assistant system operator in TANESCO at the Mbagala sub-station in Dar es Salaam. This entails monitoring, operating and controlling the operations systems. Mcheri receives support through the Structured Engineers Apprenticeship Programme (SEAP), and will soon complete her required practice. One day, she hopes to advance to become a principal engineer that oversees other engineers.

Photo: Espen Røst (2019)

ARUSHA TECHNICAL COLLEGE

The Arusha Technical College (ATC) requested Norwegian support to enable the college to take ownership of the Kikuletwa hydropower plant from TANESCO in 2014. The 1.5 MW plant, originally built in the 1930s, had provided power supply to Arusha and Moshi municipalities for many years until the 1980s, when the turbines collapsed[39]. ATC, a vocational college, saw an opportunity for using the idle plant as a training facility for hydropower operations and maintenance, as well as for power generation, as part of establishing a hydropower training centre at the college.

Norwegian support to ATC has contributed to the rehabilitation of the old buildings around the plant which used to be TANESCO staff houses and turned them into classrooms for students, establishing a training centre for hydropower technicians and building a micro turbine testing lab. The training centre trains craft workers at lower levels to become technicians and so-called artisans[40] who can do basic operations and regular maintenance. The long-term goal of the training centre is to become a regional centre of excellence for hydropower, and to eventually expand to other renewable energy such as solar, wind and biomass. The success of the centre so far has raised interest from other development partners such as the World Bank to support the ATC to achieve this goal. At the time of writing this report, rehabilitation of Kikuletwa is incomplete, hampered by unsuccessful attempts to find a private investor with a commercial interest in partnering with the training centre.

The programme has also reportedly had a broader development impact from improved hostels at the college and other facilities such as a road, bridge, dispensary and access to clean water. Local community members have also benefited from selling products and services to students and teachers at the training facility.

Joffrey Kisonga has worked as an operator for the last seven years at the privately owned Mwenga hydropower plant (4 MW) in the Iringa region. He operates and maintains the plant, ensuring smooth daily operations. Photo: Espen Røst (2019)

39 (Daily News, 2017)
40 Skilled craft workers

ABOUT MAINTENANCE AND THE CHALLENGES

"To put in place power plants and infrastructure is an achievement, but it is not success. It is only successful if we also manage to educate the people behind it to operate and maintain it properly and provide a stable and secure power supply to the country.

Our country is facing severe power shortages, and this is partly due to lack of maintenance. There is, on the one hand, lack of a culture for maintenance, and on the other, inadequate skills. The lack of culture for maintenance starts all the way at the management level and trickles down to those in charge of executing operations and maintenance. Managers also have heavy pressure on them for not disrupting operations. Thus, irregularities and lack of maintenance is not identified until something breaks down, then funds are taken from regular maintenance to solve the emergency.

On the other hand, those on the ground also need to "have an eye" for maintenance, to understand what is needed and when it is needed so they can do both regular and preventive maintenance. There also needs to be an understanding of the consequences if something breaks down, in terms of cost and supply disruption, and that this is much more serious if it breaks down compared to performing maintenance.

The training in hydropower maintenance is filling a gap in Tanzania at this level. It enables training of craftsmen, technicians and engineers in the skills and culture of maintenance. By offering this training, the college is not only contributing to solving the challenge of maintenance in the power plants, but to training young persons and giving them an opportunity for a livelihood and ensuring that our people are getting power.

The project has been a success, as we are positively touching the lives of people in many different ways."

Dr. Richard Masika, former ATC Rector (2019)

Photo: Multiconsult (2019)

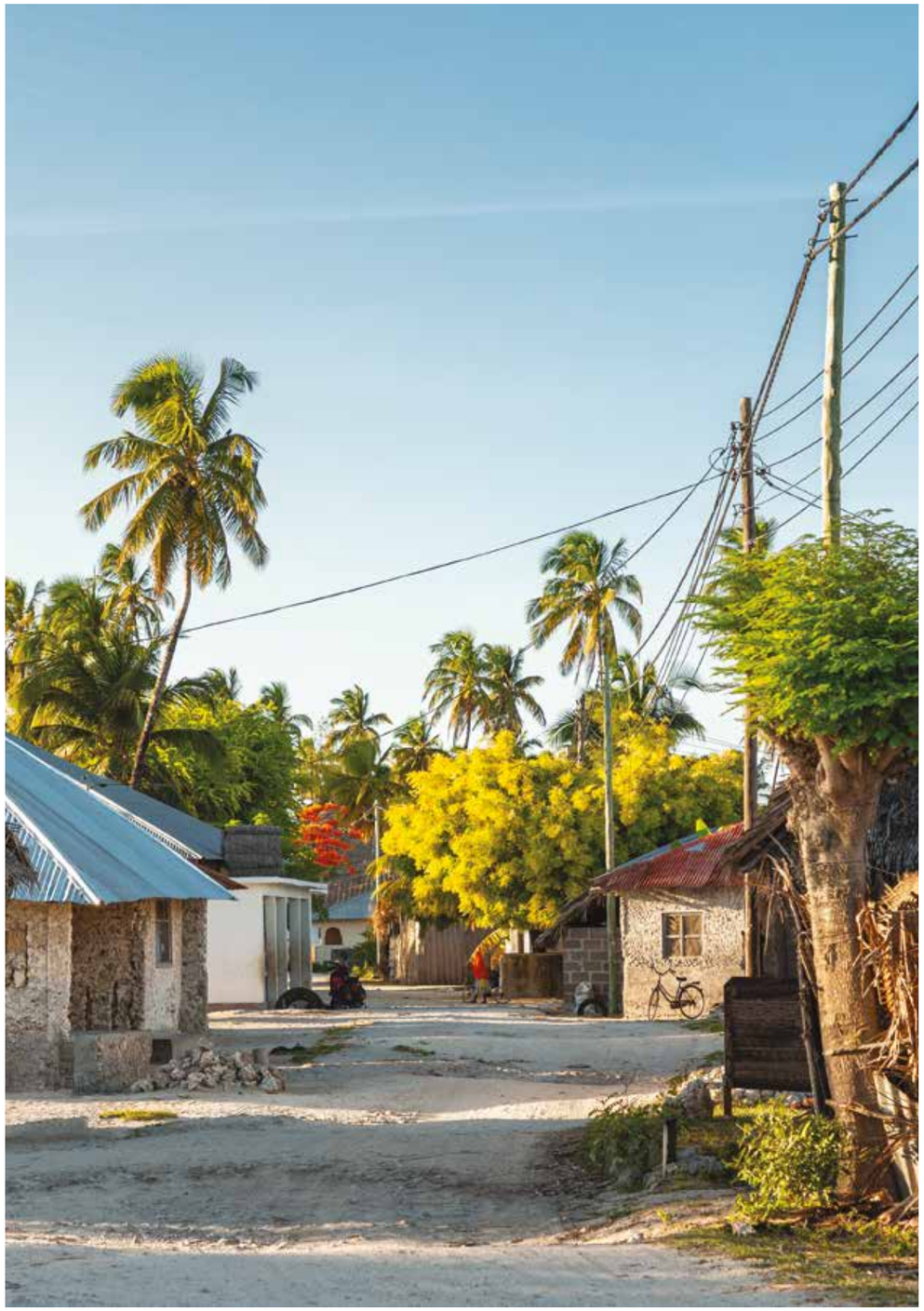
Photo: Espen Røst (2019)

Name Eng. Hilder Makelemo
Profession Structural Civil Engineer

“I started my own business as I wanted to challenge myself and felt I could not utilize my full potential and experience by being employed in someone else’s company. The support for the SEAP programme allowed me to finish the training where I learned a lot and gained valuable experience.”

ENG. HILDER MAKELEMO

Eng. Hilder Makelemo is the co-founder and technical director of HIGO Investment, an engineering consultancy company supporting civil works projects with tendering and supervision of construction of infrastructure projects such as roads, bridges and water towers. One of their main clients is the Tanzania Rural and Urban Roads Agency, TARURA. Eng. Makelemo received support through the Structured Engineers Apprenticeship Programme (SEAP) and was registered as a professional engineer in 2014. She worked for a couple of years for the government before deciding to start her own business.



Jambiani village, Zanzibar island, Tanzania. Photo: Dariusz Jarzabek/Shutterstock

6. Electrification of Zanzibar

Since independence, Zanzibar has made enormous progress towards its goal of universal access to electricity.
From a very limited fossil fuel based grid in the capital city, Zanzibar has expanded the grid so that today, approximately half of all households are actually connected to the grid and 82 percent of the population lives within its reach (access). The electricity is supplied from Mainland through two sub-marine cables, one to Unguja and one to Pemba, and Zanzibar has initiated plans to invite private investors in utility scale solar PV generation.

Norway has contributed to:

- Electrifying 232 villages
- Building more than 1,100 km of electricity distribution lines
- Supplying Pemba Island, with a population of more than 400,000, with electricity from the Mainland
- Building institutional capacity of the state-utility ZECO
- Improving health and education services, as well as improving security and welfare in villages
- Increasing revenue for local businesses

INTRODUCTION

Since the mid-1980s, Norway has supported programmes that strengthen and expand the electricity sector in the semi-autonomous Zanzibar.

Located just off the coast of Tanzania, Zanzibar's economy, with two main islands, Unguja and Pemba, has traditionally relied on agriculture and fishing. Tourism, however, has become an increasingly important economic activity. While there were less than 20,000 tourists visiting Zanzibar in 1984[41], the number surpassed 500,000 in 2018[42] and continues to grow, enabled in part by the expansion of the electricity grid and more stable and reliable electricity supply.

RURAL ELECTRIFICATION

Unguja Island was supplied with electricity via a sub-sea cable from the Mainland already in 1980[43], but consumption of electricity was low at the time as the distribution network only reached the main town and not villages in rural areas where 80% of the population lived.

In 1986, Norway and Zanzibar agreed to cooperate on expanding the electricity distribution network in rural areas in Unguja Island. The programme continued through several phases until 2010, eventually also including Pemba Island.

41 (TanzaniaInvest.com, 2006
42 (World Bank, 2019)
43 The cable was laid by the Norwegian company Standard Telefon & Kabelfabrik, financed by a supplied credit from the Norwegian Export Credit Agency.

ABOUT ZANZIBAR

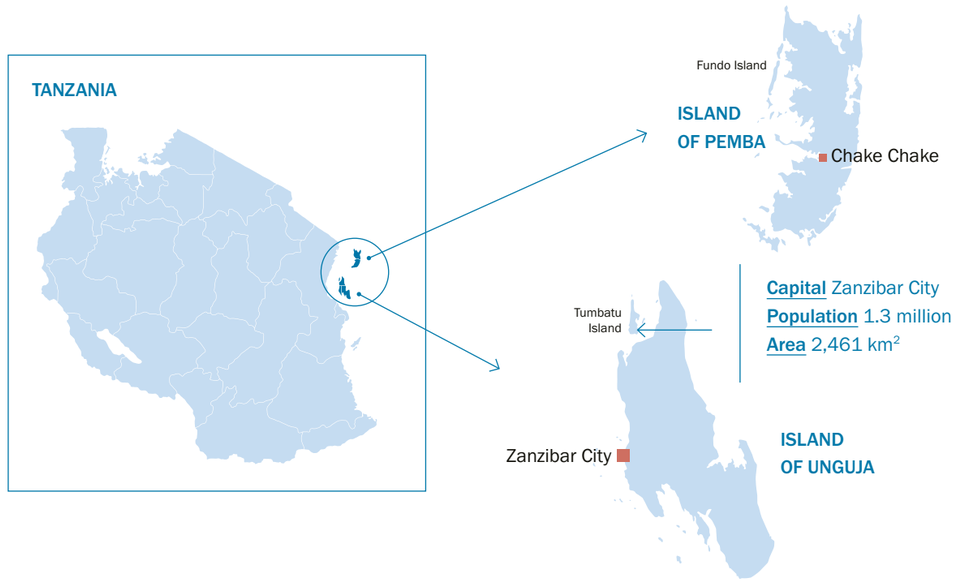
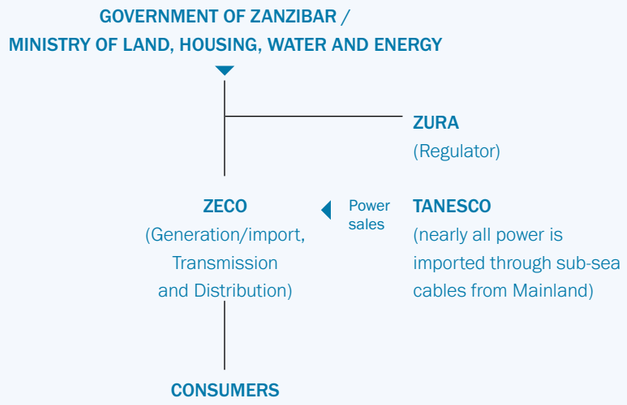
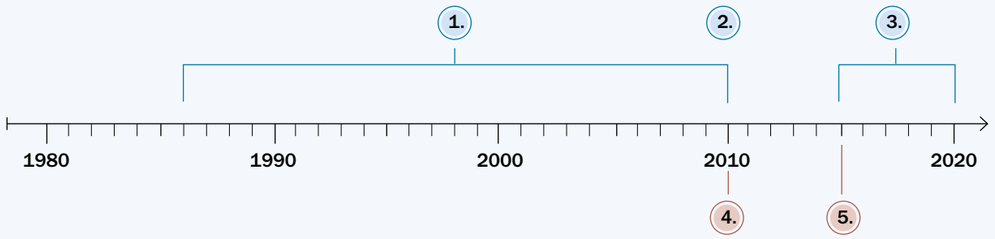


Figure 11 Zanzibar energy sector overview



PROJECT OVERVIEW



MAIN PROJECTS

1. **1986 to 2010** Electrification projects over four phases on Unguja and Pemba of pumping stations, one hospital, one hotel, small-scale industries, health stations, dispensaries, clinics and 232 villages. **NOK 180 million.**

2. **2010** Inauguration of sub-sea cable between Mainland and Pemba, connecting a population of 360 000 to the national grid and emergency diesel power implemented in Unguja. The projects were partially in response to insufficient power supply following years of increasing access. **NOK 325 million.**

3. **2012 to 2020** ZECO maintenance capacity building, including maintenance on distribution grid. **NOK 82 million.**

ASSESSMENTS

4. **2010** Prof. Tanja Winther publishes the book, The Impact of Electricity – Development, Desires and Dilemmas, noting the significant and positive impact of electrification but also some associated economical and societal challenges.

5. **2015** Independent impact assessment concludes that roads and access to electricity has had a positive impact on power supply, health facilities, schools, education and private sector development.

Photo: Ken Oppran (2015)

Pemba: When it became clear that an electric cable was coming to Pemba, Mohammad Abdelle Fum took initiative to start a soap factory with an investor group made up of 20 local women and 30 local men. The factory exports to Zanzibar, Arusha and Oman, among others.

Photo: Multiconsult (2019)

"... Norway has been the champion for the Energy sector in Zanzibar for over 30 years. The cooperation between Zanzibar and Norway is one of the greatest success stories within energy on the African continent. Currently the grid reaches 85% of Zanzibar. Without the support from Norway we would not even have reached half that number. Rural electrification has been a key enabler for the strong growth in the tourism industry. Most of the 300+ hotels on Zanzibar are located outside the cities. They would not have been there without the rural electrification programme. Now the main challenge is to connect even more consumers to the existing grid. The government´s ambition is 100% connectivity by 2032, but with support from development partners we hope to reach universal access even earlier."

ENG. MOHAMED ABDULAH MOHAMED,
DIRECTOR OF ENERGY AND MINERALS (2019)

The early stages of the rural electrification project focused on supplying electricity for social services that would serve rural communities such as water pumping stations, health centres and clinics. Later stages focused mostly on electrification of villages (to connect households and businesses), which has been the biggest component of the rural electrification programme. The final stage also included preparatory work for the sub-sea cable between Mainland and Pemba.

On-the-job training of ZECO staff was emphasized throughout the electrification programme, for instance in planning, procurement, bush-clearing, transportation logistics, pole erection and laying wires. The training aimed to ensure maximum human capacity development in the various phases of project implementation. Project staff were also trained in management and accounting skills.

With the support of various partner countries, around 80% of the population in Zanzibar live within reach of the grid[44]. The goal of the government is to achieve 100% connection to electricity by 2032, as only about half of the population were actually connected as of 2018[45], even though the majority are within reach of the grid.

44 ZECO (2018)
45 Ibid.

ELECTRICITY ACCESS VS. CONNECTION

Access rates refer to households that are within reach of the electricity grid but do not give any indication on how many of those are physically connected. There could be different reasons why households with access are not connected, but often this is due to affordability of both connection fee and tariffs.

Connection rates refer to the households that are physically connected to the grid and can receive and consume electricity in their homes.

FEMALE SURVEYORS

The project company, Noremco, hired local surveyors to map out where the distribution lines should be built. Surveyors were selected based on exam results at the end of a training course. To ensure equal opportunity, there was an equal number of men and female course participants. In the end, all five women that underwent the training were selected along with two men.

Eng. Wanja Khamis Hemed began her career as a surveyor/land designer with Noremco in 1991 to work on the rural electrification projects, drawing up distribution lines on Pemba and Unguja Islands based on the surveys conducted. She worked on the project for ten years, first with Noremco and then as a ZECO employee from 1996. She was also part of a team who was running an information campaign during the last electrification phase to communicate with people the "arrival of electricity". She currently works as Staff Development Officer in ZECO.

"The Project educated staff about technical issues. Trainers were brought in from outside to Zanzibar and this capacity building has proved very valuable to ZECO and Zanzibar. Norway ensured that women were recruited as surveyors for the project. The Norwegian project managers also listened to us women and took our opinions into account," recalls Eng. Hemed.

The four female colleagues that started with her still work for ZECO.

Eng. Wanja Khamis Hemed
Photo: Multiconsult (2019)

REDUCING NUMBER OF DEATHS

The hospital in Chake Chake, the capital of Pemba Island, is the second largest hospital in Zanzibar, with 19,000 patients per month. Before the construction of the subsea cable from Pemba to Mainland, the hospital could experience blackouts for up to one month at a time, when the industrial diesel oil generators serving the grid in Pemba were out of order. This meant high costs for the hospital as they had to run back-up diesel generators. The hospital is reliant on electricity for using various equipment, lighting to extend opening hours and running the operation theatre among other things. During some periods, the back-up generators would also stop running, leaving the hospital without electricity all together.

"The risk of "Death on the [operating] table" (DoT) is much higher during the periods when the hospital is without power. We have seen that the number of DoTs have gone down since the commissioning of the Pemba-Tanga cable."

Dr. Ali Omar Khalifa, Doctor in Charge at Chake Chake Hospital, (2019)

Both Photos: Solveig Midttun Bæra (2019)

Photo: Solveig Midttun Bæra, (2019)

"The social aspect has always been at the heart of the cooperation with Norway."

ENG. MOHAMMED JUMA OTHMAN, ZECO PEMBA BRANCH MANAGER (2019)

THE IMPACT OF ELECTRICITY – DEVELOPMENT, DESIRES AND DILEMMAS

Professor Tanja Winther at the Centre for Development and Environment at the University of Oslo studied the impact of electrification in Zanzibar in the village of Uroa on Unguja Island in particular (electrified in 1990). Prof. Winther published her findings in the book *"The Impact of Electricity – Development, Desires and Dilemmas"* in 2010.

She found that the impact of electrification was significant and positive, providing access to services such as water, health services, safety (with public lighting in the streets), as well as access to new appliances and technology (light, TV, refrigerators, blenders, etc.). Easier access to water also freed up women and girls' time which had previously been spent on fetching water, and more girls were able to attend school.

Prof. Winther also observed examples of how electricity was used to generate income by selling goods and services, such as shops with lights and refrigerators, ice, storage and freezing of fish, and so on.

In the traditionally polygamous society of Unguja, men were also found to be taking fewer wives because of the financial commitment required to connect each house to the grid (cost of connection) where each wife had her own household. Furthermore, access to television and other social activities leading to later bedtimes seemingly reduced sexual activity and resulted in lower birth rates.

Prof. Winther also identified challenges. For example, the connection cost was relatively expensive in a community where average incomes were low and could lead to indebtedness and becoming financially dependent on the state. Furthermore, monthly electricity meter readings gave public institutions access to people's homes which could feel intrusive and not entirely unproblematic in a society that has at times felt politically undermined. Consumers with low income also became vulnerable to even small increases in the electricity tariff.

Electrification could also create social differences between those that can afford electricity and those who cannot, which often are those who are already most marginalized and vulnerable.

“The Project has been critical for capacity building in ZECO Branch in Pemba. During [the Rural Electrification] phase IV, the Project Manager was the only international expert whereas all the other project staff were local. Many project staff already worked for ZECO, and others were recruited by ZECO after the project. The commissioning of the Tanga–Pemba sub-sea cable was the single most important event during my 40 years at ZECO. It solved the problem.”

SALIM MASOUD SALEH, FORMER ZECO BRANCH MANAGER IN PEMBA (EMPLOYED BY ZECO FOR 40 YEARS, 22 YEARS AS BRANCH MANAGER) (2019)

PEMBA SUB-SEA CABLE – POWER SUPPLY FROM MAINLAND

By mid-2000s, it became evident that the greatest challenge to increasing consumption of electricity in Pemba was insufficient and unreliable power supply which was limited to just three 1.7 MW diesel generators. Zanzibar therefore requested Norway’s support to expand the scope of the rural electrification project to include running a sub-sea cable from the Mainland to Pemba.

Norway agreed to support the cable on the basis that the project was expected to improve social and economic development in rural areas of Pemba, as well as ease the environmental impacts of the diesel plant.
The 33 kV cable (with a capacity of 25 MVA) was inaugurated in 2010. It was a challenging technical feat, running more than 70 kms in the sea through depths of up to 850 metres but was completed on time and budget.

Norway, Tanzania and Zanzibar co-financed the cable with around NOK 300 million and NOK 100 million respectively.

An independent assessment of the Pemba sub-sea cable project, the rural electrification programme and a rural road improvement project on Pemba financed by Norway during the same period, concluded that all projects had had a substantial positive impact on the welfare of the population of Pemba. In particular, it had a positive impact on power supply stability, health and school service provisions, private sector development, as well as on the political climate, as illustrated by the figure 12, see page 74.

Old IDO generators. Photo: Solveig Midttun Bæra (2019)

The 77 km long sub-sea cable to Pemba on the boat, ready to be unwound into the sea. Photo: John Alvsvåg (2009)

The sub-sea cable brought ashore on Pemba. Sea levels vary significantly at high and low tide, meaning that the work had to be meticulously planned and executed. Photo: John Alvsvåg (2009)

Inauguration of the Pemba cable on June 3, 2010. Politicians from the sitting government and the opposition shared the stage to celebrate. Eng. Maulid Shiraz Hassan, current ZECO Head of Planning, recalls that it was impossible to find somewhere to sleep in Chake Chake (the capital city of Pemba), as people were coming from all over the island, as well as Unguja.
Photo: Multiconsult (2010)

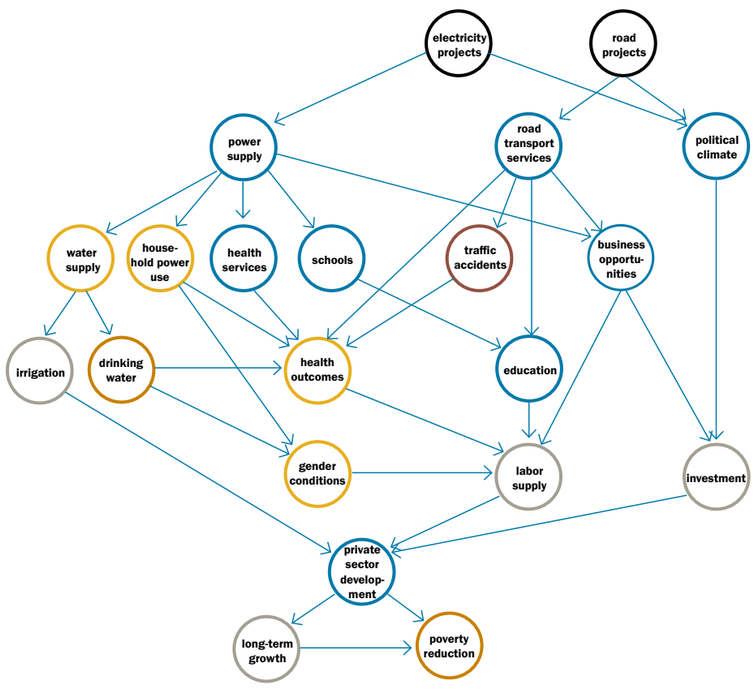


Figure 12 *Source: (ILPI, 2015)*

CAPACITY BUILDING ON MAINTENANCE

A review carried out in 2009 based on inspections of older parts of the distribution network[46], documented that there were insufficient routines, a lack of planning procedures, as well as deficient resources and capacity for maintenance (especially preventive maintenance) in ZECO. Norway therefore agreed to support capacity building on maintenance and upgrading of the network to reduce outages and improve the quality of electricity supply.

The programme started officially in 2015 and will continue until the end of 2020, providing support of NOK 82 million, including rehabilitation of parts of the grid, establishing and training a maintenance unit, and developing an Electrification Master Plan.
The result was that between 2015 and 2018, the programme led to a significant reduction in both the average number and duration of unplanned outages for the 11 kV and 33 kV networks. ZECO reports that the maintenance work led to a significant reduction in both average number and duration of unplanned outages for the 11 kV and 33 kV networks.

ZECO employee Omar Ali climbing the power poles at Mgagadu in Pemba: The distribution lines are being upgraded from 11kV to 33kV, as part of the Capacity Building on Maintenance Project supported by Norway.
Photo: Solveig Midttun Bæra (2019)

EMERGENCY DIESEL POWER

The old sub-sea cable from 1979 between Unguja Island and the Mainland broke down for three months in 2009–2010, following a previous breakdown of one month in 2008. To provide critical emergency power to the island, Norway supported the acquirement of 32 high-speed diesel generators of 0,8 MW each.

A new 100 MW cable was installed in 2012, financed by The Millennium Challenge Corporation (an American foreign aid agency) to replace the old one, which has consequently been relegated to back-up capacity.

The generators, if properly maintained, provide an additional, albeit expensive, emergency back-up option of about 25 MW for Unguja. The generators are still in place but have not been in use or serviced due to costs.

The diesel generators at Mtoni, Unguja. Photo: Multiconsult (2019)

46 (Norconsult/Nordic Consulting Group, 2009)

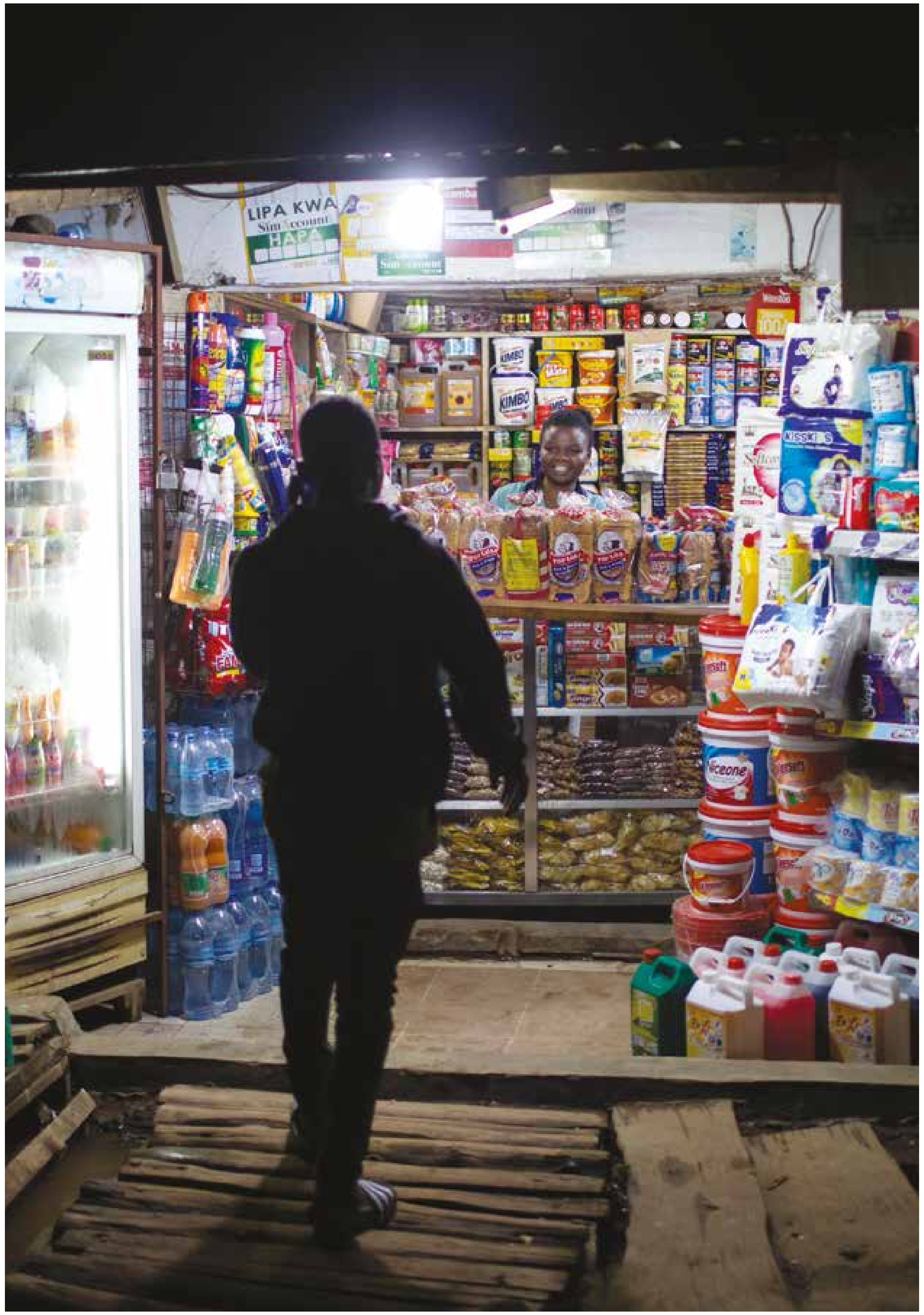


Photo: Espen Røst (2019)

7. The way forward

CAPACITY BUILDING

Norway recognises that building a professional, well-functioning and financially sustainable power sector ready to serve all Tanzanians, is a major long-term commitment. As this report highlights, the first three decades of Tanzania-Norway energy cooperation focused on building hydropower generation and the competence required for operation. The cooperation has undeniably provided an essential foundation of clean energy infrastructure, technical expertise and a large cohort of competent engineers and technicians in Tanzania. However, competence building is not a one-off activity - operation and maintenance is ongoing, and technology evolving. There is a continued need to further develop and institutionalize competence in these areas for the coming generations of Tanzanian energy experts. Many of the Tanzanian energy experts who have studied in Norway, are members of the Alumni Tanzania-Norway (Al-Ta-No) network. Al-Ta-No members meet regularly and today constitute an important part of the relationship between Norway and Tanzania. In 2021, the network will celebrate its five-year anniversary.

FURTHER ELECTRIFICATION OF TANZANIA

The last two decades have thus focused more on improving sector management, expanding the national grid and bringing power to rural areas. This has been vital and necessary input to ensure progress towards Tanzania achieving Sustainable Development Goal 7; increasing nationwide access to clean and affordable energy. Despite a strong growth in power production and new grid connections in recent years, many Tanzanians in rural areas still do not have access to electricity. Efforts to expand the national grid and connect more customers will remain a high political priority in Tanzania. Consequently, there is still a need to boost investment in new power generation in the years to come. The answers to this challenge may not be the same today as they were 50 years ago. Other renewable technologies are now remarkably more efficient and cheaper, with solar photovoltaic power costing about 80% less per kWh than just ten years ago . Given the large geographical size of Tanzania and the dispersed population, off-grid energy is well positioned to play an important role in reaching the rural population.

HOLISTIC APPROACH

There is still a need for a holistic approach to a sustainable energy sector development, grid expansion and continued efforts to connect more customers when going forward. New ways of thinking, new technology, new partnerships and close cooperation with private sector will be needed to ensure viable expansion of the low and high voltage national power system. A reliable, well-maintained and operated power system with cost reflective tariffs will be important to attract new investments in power infrastructure, and to deliver affordable electricity to Tanzanian households and businesses.

The role of the Government should be to ensure that private investors meet a well-functioning energy sector with a predictable legal framework to invest. To ensure future investments there is still a need for close dialogue and consultations between private and public stakeholders. Promoting Tanzania's clean energy resources will also be responding to the global efforts to tackle climate change and to secure an environmentally friendly development of the sector.

A similar holistic approach should be considered if Tanzania is to develop as a regional power hub through its membership in both the Eastern African Power Pool and the Southern African Power Pool.

TANZANIA AND NORWAY – STRONG ENERGY PARTNERS

Tanzania and Norway have developed a unique relationship within the energy sector over the last 50 years. The many interactions between Tanzanians and Norwegians during these years have been based on mutual trust and friendship, providing important achievements over time. The similarities between Tanzania and Norway in terms of natural resources, long distances and a widespread population, make the two countries well-suited partners for cooperation within the energy sector, also in the future. Norway will aim to continue to be a partner to Tanzania, when addressing future possibilities on the path to achieving SDG 7; universal access to clean, modern energy services – for all.

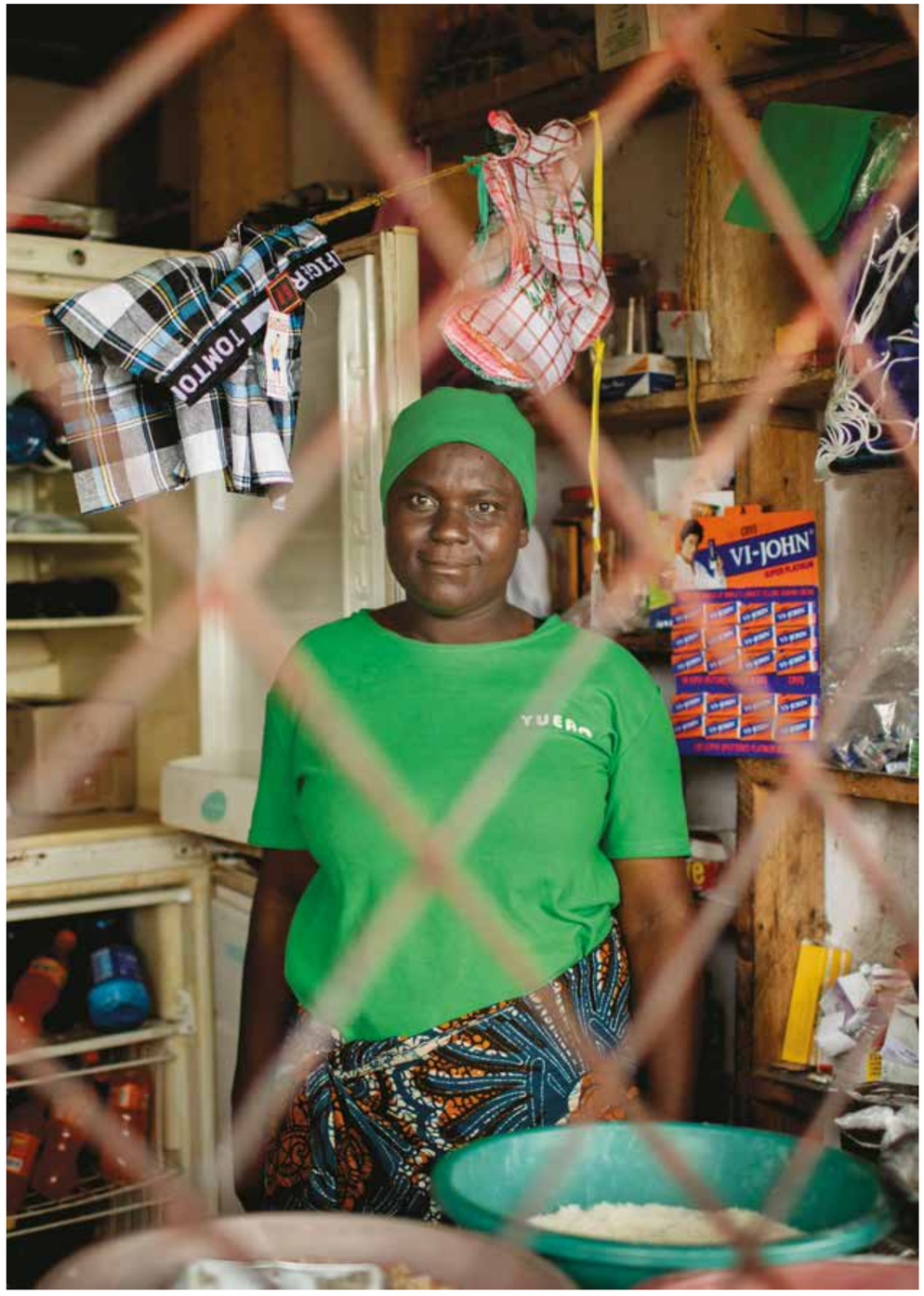
Appendix I – Methodology

This report is intended for a general audience with an interest in Tanzania's energy sector, and in the long-term energy cooperation between Norway and Tanzania. Upstream petroleum-related cooperation between Tanzania and Norway, such as the Oil for Development Programme is not included in the report.

The report is not an evaluation or formal review. The report is designed to mark 50 years of cooperation with focus on the most significant achievements over the years summarized in one document, interspersed with anecdotes and images. The report does not aim to provide a critical evaluation of the entire support or its impact, although it does note some challenges.

The report has been prepared based on a desktop review of existing material, literature and reports made available by the Norwegian Agency for Development Cooperation (Norad), the Royal Norwegian Embassy of Dar es Salaam, Multiconsult, the Tanzanian Ministry of Energy, TANESCO and the Rural Energy Agency, as well as interviews with key persons involved in Tanzanian and Norwegian energy cooperation over the years.

A more comprehensive list of the identified projects and programmes funded by the assistance for clean energy and the energy sector in Tanzania and Zanzibar is found in Appendix II.



Kizase Saidi (33) runs a retail store with her husband in Kidomole Village. They sell chilled drinks and are saving to buy a more efficient fridge/freezer, expanding their product range to include ice-cream and homemade juices. Photo: Espen Røst (2019).

Appendix II – Project overview

Competence development and Capacity Building
Generation (primarily hydropower)
Electrification
Other

MAINLAND TANZANIA

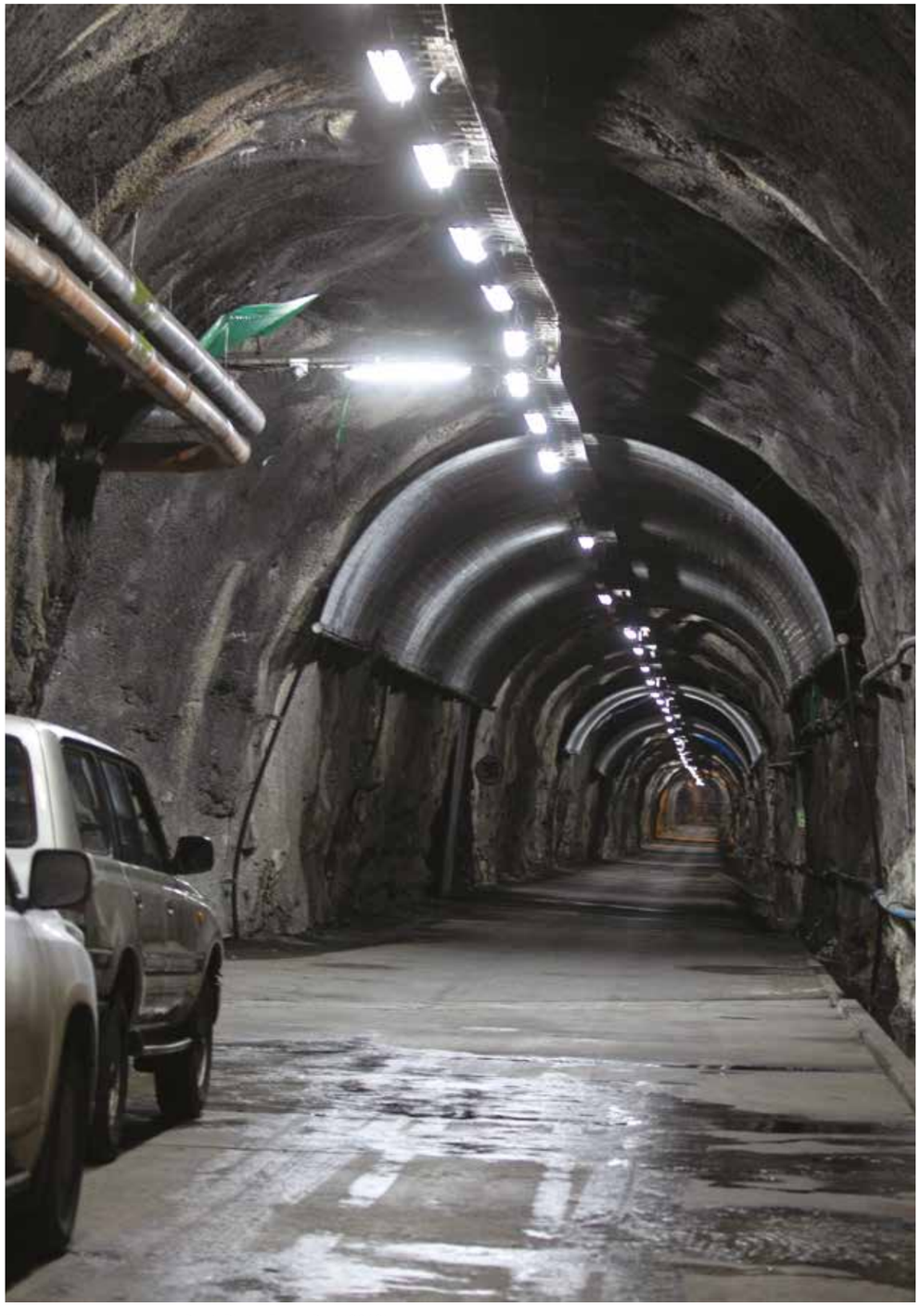
Project	Start	End	Description	Support (MNOK)
Norad Fellowship Program	1962	2005	Norway has offered fellowships to foreign students to take courses at Norwegian educational institutions since 1962 in fields where Norway has specialized competence. Several students from Tanzania have studied in Norway, for instance in the field of hydropower.	–
Studies and development of hydropower plant at Stiegler's Gorge	1970	1981	Norway supported a suit of technical studies for determining the potential for developing a large multipurpose project at Stiegler's Gorge in the Rufiji basin. The project was eventually found to be economically and environmentally unfeasible at the time.	150
Hydrological Survey of Western Tanzania	1971	1980	Norway assisted the Tanzanian government in implementing a hydrometerological survey of Western Tanzania. The objective was to investigate the parts of the country that up until then had no coverage of hydrological surveys. Six Norwegian experts were hired in the project, supported by Norway.	11.9
Pre-feasibility studies in Rukwa and Kigoma regions	1981	1983	Feasibility and pre-investment studies of small-scale hydropower developments in Kigoma and Rukwa, performed for TANESCO. Investigations undertaken in this feasibility study included power market, power transmission, hydrology, geotechnical and environmental impacts.	7.9
Rufiji Basin Hydropower Masterplan	1982	1984	Norway supported the development of hydropower masterplan for the Kilombero river in the Rufiji basin, which identified the Kihansi hydropower plant.	4.9
Mtera Hydropower plant	1984	1992	Norway co-financed the construction of Mtera hydropower plant (80 MW), commissioned in 1988, with World Bank and other development partners. Norwegian support was provided for turbines and transformers.	110
Feasibility studies of solar powered water pumps	1984	1985	Feasibility study on solar powered water pumps in rural townships in Tanzania.	0.1
Morogoro Fuelwood Stove Project	1984	1991	An NGO-run project, working with sustainable cooking to decrease deforestation and the use of coal. Norway supported approximately 80% of the costs.	0.6
Electrification Sumbawanga	1985	1985	Grants for deliveries of diesel generators and powerhouse for the supply of electricity to the town of Sumbawanga.	5.7
Pangani River Rehabilitation Project	1985	1990	Full rehabilitation of three existing hydropower stations located along the Pangani river in North East Tanzania: Hale, [Old] Pangani Falls and Nyumba ya Mungu. It was during this project that the opportunity to replace the power plant at Old Pangani Falls was identified.	42.4
New Pangani Falls hydro-power plant	1990	1995	Support to construction of New Pangani Falls hydropower plant (68 MW), commissioned in 1994, co-financed with Sweden and Finland.	345
Rehabilitation Mt. Meru sub-station	1991	1992	Support to rehabilitation of Mt. Meru sub-station, as part of World Bank financed power rehabilitation project.	17
Hydropower planning	1991	1996	Full feasibility study for hydropower on Rumakali river in Mbeya, including environmental study.	15.1
Emergency gas powered turbines	1992	1994	Norway and Sweden co-financed two gas turbines to provide emergency power during power scarcity in the early 1990s.	20

Competence development and Capacity Building
Generation (primarily hydropower)
Electrification
Other

Project	Start	End	Description	Support (MNOK)
Kihansi Hydropower plant	1994	2002	Support to construction of Kihansi hydropower plant (180 MW), commissioned in 1999, and transmission lines to Iringa 97 km and Kithadu 128 km. Co-financed with World Bank and other development partners.	380
Kidatu Rehabilitation	1997	1999	Support to second phase of rehabilitation of Kidatu hydropower plant, co-financed with Sweden (Sida).	40
Transmission line Mbala-Sumbawanga	1997	2004	Support for a 66 kV transmission line between Mbala, Zambia and Sumbawanga, Tanzania, in order to supply power to Sumbawanga, replacing diesel generators.	68.9
Support for sub-stations	1999	2003	Support for Chang'ombe and Kunduchi/ Mtongani sub-stations.	24.1
NOMA and EnPE educational and research programmes	2006	2020	Institutional cooperation between educational institutions in Norway and African partner countries aimed at building institutional capacity in institutions in the partner countries and exchange of knowledge and persons between Norway and Africa. In Tanzania, this has included establishing a master programme in Renewable Energy at UDSM (2008), and research cooperation including PhD students at UDSM in renewable energy topics such as hydropower and solar.	–
Development of modern cooking technologies	2007	2012	Norway supports the NGO TaTEDOs programme "Integrated Modern Energy Services for Sustainable Development and Poverty Reduction". The aim is to enhance access to sustainable modern energy technologies and services for consumptive and productive needs in households, small-medium enterprises and social service centres in eight regions.	12
Feasibility Study of Makambako Wind Farm	2009	2009	Feasibility study in cooperation with Norsk Vind Energi AS on how to develop Makambako wind farm in Tanzania. Activities includes grid system analysis and technical wind engineering.	1.1
Development of biofuels policy framework	2009	2011	Support for a project that aims to initiate the creation of a sustainable institutional framework in response to the rapidly emerging biofuel industry. The immediate objective is to put in place the policy, legal, regulatory and institutional framework to support and regulate the development of a sustainable biofuels industry of Tanzania.	6
Twinning TANESCO and Statnett – Institutional Cooperation	2010	2014	Support to a Twinning Arrangement between TANESCO and Statnett, to assist TANESCO in efficiently carrying out their tasks to reach the goals set for the energy sector in Tanzania.	37
Professional Development of Women Engineers in Tanzania	2010	2021	The objective of the project is to contribute to sustainable socio-economic development in Tanzania by promoting gender balance in professional training and empowering women engineers to confidently hold and manage responsibilities in government, industry and business. Support given through Engineer's Registration Board (ERB).	30.3
Emergency Repair Project	2011	2018	An emergency repair project for TANESCO's five major hydropower plants (Mtera, Kidatu, New Pangani Falls, Nyumba ya Mungu and Kihansi).	69.3
Ruhoi geothermal power plant	2012	2012	Support to geothermal resources exploration studies and associated project works in Ruhoi in Utele Area.	0.4
Kenya-Tanzania Interconnector	2012	2012	Feasibility study of 400 kV Kenya-Tanzania Interconnector. NELSAP project.	19

Competence development and Capacity Building
Generation (primarily hydropower)
Electrification
Other

Project	Start	End	Description	Support (MNOK)
Private sector development in biomass technology	2012	2017	Personnel exchange (Peace Corps) to share knowledge on biomass technology and strengthen business development in rural biomass gasification systems in Tanzania and Uganda.	1.4
Profitable and climate-friendly utilization of biowaste	2013	2016	Support to developing utilization of rice husks and other biowaste for production of renewable energy while creating additional income earning opportunities for smallholders and developing synergies between food and energy production and agriculture and nearby towns. Implemented by TaTEDO.	3
Tanzania-Zambia Interconnector	2013	2017	Feasibility study of 400 kV Tanzania-Zambia Interconnector. NELSAP project.	18.6
Support to the Rural Energy Agency	2013	2021	Programme funding for electricity access and renewable energy investments in rural areas through the Rural Energy Fund (REF) administered by the Rural Energy Agency (REA). Three approved projects: Backbone, Biogas and Densification Project. Support of NOK 700 million has been awarded for the period but is not fully disbursed at the time of writing.	700
Technical Assistance Energy Sector Subsidy Policy	2014	2014	Technical assistance to the formulation of a comprehensive energy sector subsidy policy.	0.8
Feasibility study Mini-Kihansi hydropower plant	2014	2015	Feasibility study for a mini hydropower plant to utilize the environmental flow from Kihansi hydropower plant.	0.8
Power system stability study	2014	2016	Power system stability study with the objective of assessing the capability and supply reliability of the power system, for the purpose of mitigating the potential impacts that could be caused by introducing intermittent power generation sources.	0.7
Support to training centre for hydropower at Arusha Technical College	2014	2019	Technical cooperation for development of Kikuletwa power station as a hydropower training centre and for electricity generation, as well as training lecturers and building a micro turbine testing lab.	29
Kakono hydropower plant	2018	2018	Feasibility study to evaluate multi-purpose opportunities of Kakono hydropower plant.	0.65
The UDSM-NTNU Mobility Program in Energy Technology	2019	2023	The UDSM-NTNU mobility programme aims to have mutual exchange visits of professors, staff, master students (23 from UDSM, 16 from NTNU), PhD students (Two from UDSM). The programme particularly supports master programmes developed with Norway's support (e.g. renewable energy master at UDSM).	–



Tunnel, Kihansi Hydropower Plant. Photo: Espen Røst (2019)

Competence development and Capacity Building
Generation (primarily hydropower)
Electrification
Other

ZANZIBAR

Project	Start	End	Description	Support (MNOK)
Rural Electrification Phase I	1986	1988	Support to electrifying five pumping stations, one hospital, one hotel, small-scale industries and an unspecified number of households on Unguja.	15
Rural Electrification Phase II	1988	1991	Support to electrifying pumping stations, health stations and dispensaries, and villages on Unguja.	25.5
Rural Electrification Phase III	1991	1994	Support to electrifying villages on Unguja and Pemba.	36.5
Rural Electrification Phase IV (incl. extension)	2003	2010	Support to electrifying villages on Unguja and Pemba, refurbishment of the Wesha power station in Pemba, preparatory work for sub-sea cable from Pemba to Mainland and constructing sub-sea cable to Tumbatu Island.	103
33 kV sub-sea cable between Mainland and Pemba	2009	2010	Support to sub-sea cable from Pemba to Mainland.	300
Emergency diesel generators Unguja	2009	2010	Support to 32x0.8 MW diesel generators on Unguja for emergency power and back-up capacity.	25
ZECO Maintenance Capacity Building (incl. extension)	2012	2020	Capacity building on maintenance, including maintenance on distribution grid.	82

Appendix III – Sources and contacts

TANZANIA

Name	Organization	Role
Eng. Leonard R. Masanja	Ministry of Energy	Commissioner for Renewable Energy and Electricity
Mr. Innocent Luoga	Ministry of Energy	Assistant Commissioner for Renewable Energy and Electricity
Eng. Masudi Senzia	Arusha Technical College	Rector
Mr. Daudi Mtavangu	Arusha Technical College	Project Manager Hydropower training
Dr. Eng. Richard J. Masika	Former Arusha Technical College	Former Rector
Eng. Amos Maganga	Rural Energy Agency	Ag. Director General
Adv. J. Kalolo – Bundala	Rural Energy Agency Board	Board Chairperson
Eng. Elineema N. K. Mkumbo	Rural Energy Agency	Ag. Director of Policy Planning & Research
Dr. Gideon H. Kaunda	Former Rural Energy Agency Board	Former Board Chairperson
Dr. Lutengano Mwakahesya	Former Rural Energy Agency	Former Director General (2007 – 2016)
Eng. Bengiel Msofe	Former Rural Energy Agency	Former Director Technical Services (retired from REA November 2018)
Ms. Justina Uisso	Rural Energy Agency	Director Planning + policy
Ms. Grace C. Mathew	Rural Energy Agency	Manager for Capacity Building, Productive Use of Energy
Mr. Nicolaus Moshi	Rural Energy Agency	Ag. Planning and Policy Manager
Mr. Joseph Sambali	Rural Energy Agency	Gender & Energy Specialist
Eng. Costa L. Rubagumya	TANESCO Head Quarters	Senior Manager Strategic Planning
Eng. Felchesmi Mramba	Former TANESCO	Former Managing Director
Eng. Steven Mahenda	TANESCO Pangani Falls	Plant Manager
Eng. Delfina Patrice	TANESCO Pangani Falls	Electronics and Telecommunications Engineer (and ERB SEAP participant)
Eng. Patrick Lwesya	TANESCO Kihansi	Plant Manager
Eng. Yonah D. Mwasajone	TANESCO Kihansi	Plant Principal Engineer
Eng. William Stephen Mlita	TANESCO Kihansi	Generation Engineer
Eng. Daniel Ndila	TANESCO Kihansi	Planning Engineer
Juma Kimera	TAWIRI Kihansi Station	Lab Technician
Eng. Prof. Ninatubu M. Lema	Engineers Registration Board	Chairman
Eng. Patrick Barozi	Engineers Registration Board	Registrar
Eng. Veronica F. Ninalwo	Engineers Registration Board	Assistant Registrar - PDA
Eng. Margaret T. Munyagi	Engineers Registration Board (/ CASSOA Board Member)	First Female Engineer Registered in Tanzania, former board member ERB
Mr. Fredrick Tunutu	Energy For Impact	Project Manager Productive Use of Energy
Mr. Stephen Mariki	N/A	Independent Consultant
Prof. Cuthbert Kimambo	UDSM	Pro-Rector for Research

ZANZIBAR

Name	Organization	Role
Mr. Ali Khalil Mirza	Ministry of Lands, Housing, Water, and Energy	Permanent Secretary
Eng. Mohamed Abdulah Mohamed	Ministry of Lands, Housing, Water, and Energy	Director of Energy and Minerals
Mr. Khamis M. Omar	Ministry of Finance and Planning	Permanent Secretary
Eng. Hassan Ali Mbarouk	ZECO	General Manager
Eng. Maulid Shiraz Hassan	ZECO	Head of Planning
Eng. Wanja Khamis Hemed	ZECO	Staff Development Officer
Eng. Batuli Ali	ZECO	Maintenance Unit Support Project Coordinator
Eng. Salim Masoud Saleh	Former ZECO	Former Branch Manager in Pemba
Eng. Mohammed Juma Othman	ZECO	Branch Manager in Pemba
Eng. Maulid Iddi Juma	ZECO	System Administrator

NORWAY

Name	Organization
Mr. Oddvar Espegren	Former Hafslund
Mr. Even Sund	Former Norad
Mr. Jon Lomøy	Former Norad
Mr. Torbjørn Nielsen	NTNU
Ms. Hilbjørg Sandvik	Former NTNU
Ms. Gunn Oland	NVE
Mr. Kjell Repp	Former NVE
Mr. Egil Skofteland	Former NVE
Mr. Alf Adeler	Former NVE
Mr. Jan Lindemark	Multiconsult/Norplan
Mr. Trond Aas	Multiconsult/Norplan
Mr. Joakim Arntsen	Multiconsult/Norplan
Ms. Linn Silje Undem	Multiconsult/Norplan
Mr. Dag Larsson	Former Tanelec
Mr. Petter Fergestad	Former Tanelec
Mr. Kåre Moen	UiO
Ms. Tanja Winther	UiO
Mr. Kjell Havnevik	UiA
Ms. Carole Rosenlund	ICH

RESPONSIBLE FOR ENERGY PORTFOLIO AT THE NORWEGIAN EMBASSY IN DAR ES SALAAM[48]

Name	Period
Børge Olav Romsloe	2018–
Neema Michael Shayo	2017–
Kathrine Vestbøstad	2015–2018
Fredrik Berglien Werring	2013–2015
Geir Yngve Hermansen	2011–2015
Ørnulf Strøm	2008–2011
Marianne Damhaug	2008–2010
Inger Anette Sandvand Dahlen	2007–2010
Britt Hilde Kjølås	2005–2008
Jan Erik Rasmussen	2002–2005
Arne Olsen	1999–2002
Asbjørn Nordbø	1996–1999
Alf Adeler	1992–1996
Arne Hollerud	1989–1992

48 Prior to 1989 the portfolio was mainly administered from Oslo and there was nobody with a particular responsibility for energy at the embassy

Esther Francis is a nurse in Hondogo village (Chalinze District, Pwani Region). The dispensary where she works now has electricity which means that medicine and vaccines can be refrigerated and birthing facilities have lighting at night. Photo: Espen Røst (2019)

Appendix IV – List of abbreviations

ATC	Arusha Technical College
EAPP	Eastern Africa Power Pool
EnPe	The Norwegian Programme for Capacity Development in Higher Education and Research for Development within the Fields of Energy and Petroleum
EPP	Emergency power producer
ERB	Engineers Registration Board
EWURA	Energy and Water Utilities Regulatory Authority
GDP	Gross domestic product
GNI	Gross national income
GWh	Gigawatt hours
HDI	Human development index
HPP	Hydropower Plant
HV	High voltage
IPP	Independent power producer
Km	kilometre
kV	kilovolt
LV	Low voltage
MoE	Ministry of Energy Tanzania
MV	Medium voltage
MW	Megawatt
NELSAP	The Nile Equatorial Lakes Subsidiary Action Program
NFP	Norad Fellowship Program
NOK	Norwegian krone
NOMA	Norad's Programme for Master Studies
NTNU	Norwegian University of Science and Technology
NVE	Norwegian Water Resources and Energy Directorate
ODA	Official development assistance
PUE	Productive Use of Energy
REA	Rural Energy Agency
REDP	Rural Electrification Densification Project
REF	Rural Energy Fund
SAPP	Southern African Power Pool
SEAP	Structured Engineers Apprenticeship Programme
SPP	Small power producer
TANESCO	Tanzania Electric Supply Company Limited
UDSM	University of Dar es Salaam
USD	US dollar
ZECO	Zanzibar Electricity Corporation

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