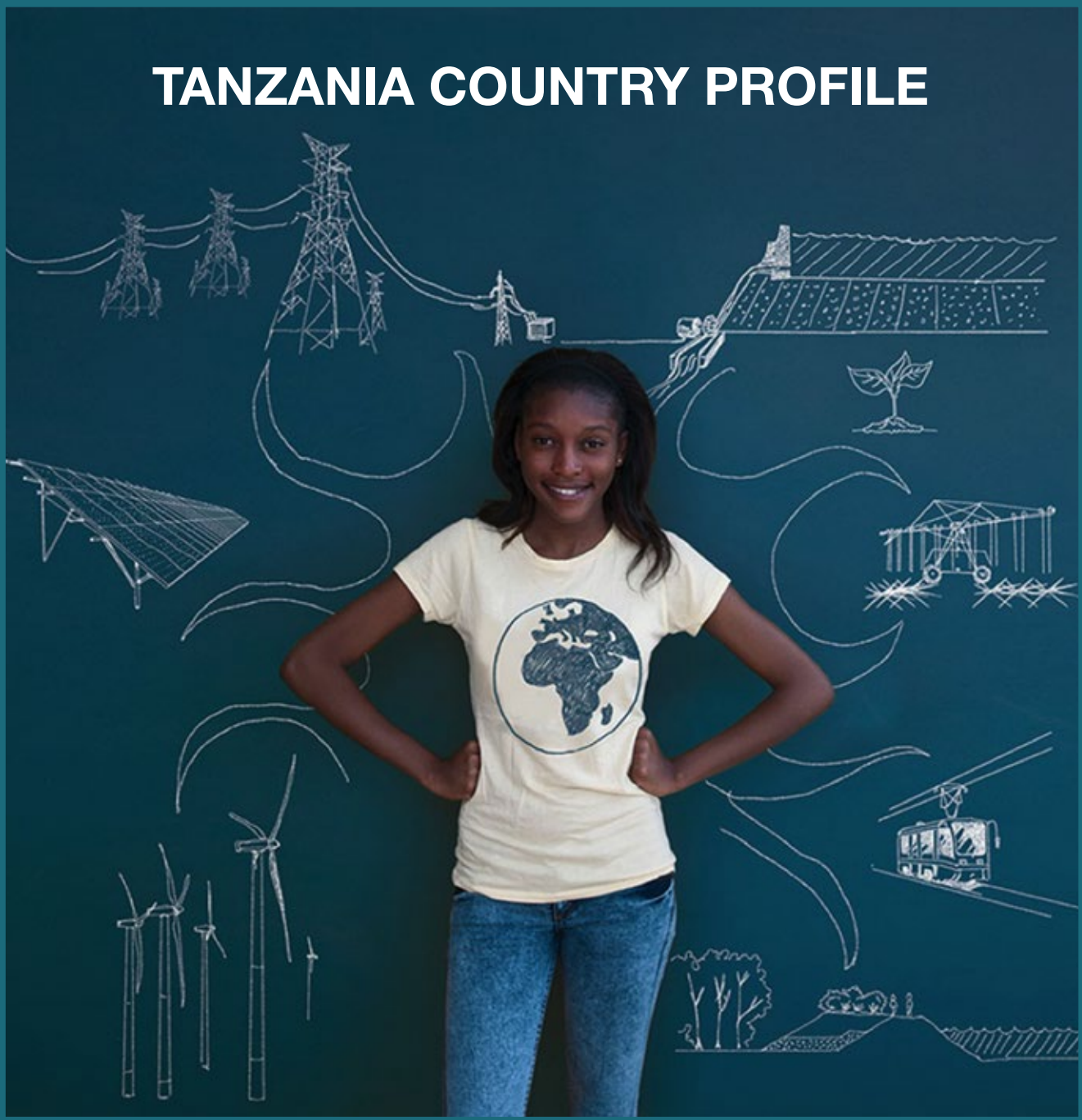
RENEWABLE ENERGY IN AFRICA

TANZANIA COUNTRY PROFILE



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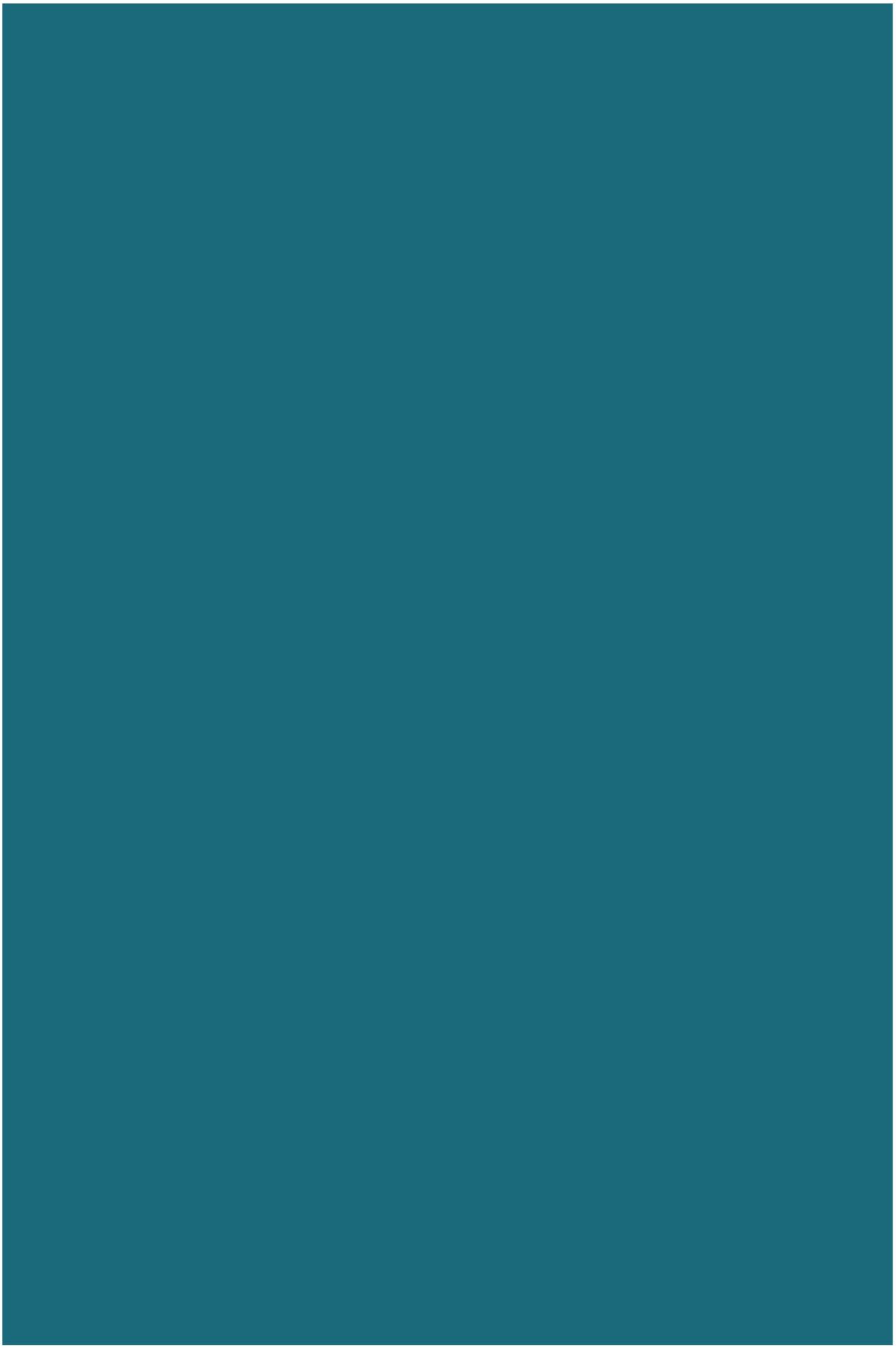
CLIMATE INVESTMENT FUNDS



Renewable Energy in Africa

TANZANIA COUNTRY PROFILE

2015

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Renewable Energy in Africa: TANZANIA Country Profile

This document is extracted from the Tanzania Investment Plan produced by the Government of Tanzania with support from the African Development Bank (AfDB) and the World Bank Group under the Scaling Up Renewable Energy Program in Low Income Countries, a program of the Climate Investment Funds.

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ACRONYMS AND ABBREVIATIONS

AFD	French Development Agency
AfDB	African Development Bank
ARGeo	African Rift Geothermal Facility
BEST	Biomass Energy Strategy Tanzania
CDM	Clean Development Mechanism
CIF	Climate Investment Funds
COSS	Cost of Service Study
COSTECH	Tanzanian Commission for Science and Technology
DFID	UK Department for International Development
E&S	Environmental and Social
EPP	Emergency Power Producer
ESIA	Environmental and Social Impact Assessment
ESMF	Environmental and Social Management Framework
EWURA	Energy and Water Utilities Regulatory Authority
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GIZ	German Technical Cooperation Agency
GWh	Giga watt per hour
HDI	Human Development Index
IEA	International Energy Agency
IFC	International Finance Corporation
IP	Investment plan
ILS	Information and Lessons Sharing
IPP	Independent Power Producer
JICA	Japan International Cooperation Agency
KWh	Kilo watt per hour
LED	Light Emitting Diode
MDBs	Multilateral development banks
MEM	Ministry of Energy and Minerals
MEPI	Multidimensional Energy Poverty Index
MTOE	Million tons of oil equivalent
MTPY	Million tons per year
MWh	Megawatt hour

NGO	Non-governmental organization
NORAD	Norwegian Agency for Development Cooperation
PPP	Public Private Partnership
PSMP	Power System Master Plan
PV	Photovoltaic
RAP	Resettlement Action Plan
RE	Renewable energy
REA	Rural Energy Agency
REF	Renewable Energy Fund
RPF	Resettlement Policy Framework
SIDA	Swedish International Development Cooperation Agency
SPP	Small Power Producer
SPPA	Small Power Purchase Agreement
SREP	Scaling Up Renewable Energy Program
TANESCO	Tanzania Electric Supply Company
TAREA	Tanzania Renewable Energy Association
TASF	Transactions Advisory Services Facility
TaTEDO	Tanzania Traditional Energy Development Organisation
TBS	Tanzania Bureau of Standards
TEDAP	Tanzania Energy Development and Access Project
TZS	Tanzanian Shilling
UNDP	United Nations Development Program
UNFCCC	United Nations Framework Convention on Climate Change

Currency Exchange Rate - March 2014 - 1 USD = TZS 1’639

ACKNOWLEDGMENTS

This country profile is part of the work undertaken by the African Development Bank (AfDB) in the context of its new Strategy 2013-2022, whose twin objectives are “inclusive and increasingly green growth”. The Bank mobilizes climate finance — including from the Climate Investments Funds, the Global Environment Fund and other funding instruments — for its regional member countries and provides technical assistance for them to embark on a low carbon, climate resilient development pathway.

The CIF-AfDB team coordinated by Mafalda Duarte, Chief Climate Change Specialist, has prepared this knowledge piece. The work was led by Florence Richard, Senior Climate Change Specialist, with support from Giorgio Gualberti, Renewable Energy Specialist; Umang Goswami, Private Sector Specialist; Anil Cabraal, Renewable Energy Specialist; Alemayehu Wubeshet-Zegeye, Chief Power Engineer; and Magdaline Nkando, Knowledge Management Specialist. The AfDB Tanzania Field Office provided support during the preparation of the Scaling-Up Renewable Energy Programme (SREP) Investment Plan, especially Stella Mandago, Senior Energy Specialist.

The CIF-AfDB team is grateful to the Government of Tanzania, national counterparts and non-governmental organization and private-sector representatives who contributed to this brief. More specifically, we would like to acknowledge the intensive work done by the national SREP Task Force in 2012/2013 for the preparation of the SREP Investment Plan (from which this brief is extracted) under the leadership of Eliakim C. Maswi, Permanent Secretary, Ministry of Energy and Minerals (MEM), and Edward Ishengoma, Assistant Commissioner for Renewable Energy, MEM. The Task Force included Kato Kabaka, Tanzania Electric Supply Company Limited (TANESCO); Ng’anzi Kiboko, Energy and Water Utilities Regulatory Authority (EWURA); Mkoma Masanyiwa, MEM; Jacob Mayalla, MEM; Anastas Mbawala, EWURA; Ngereja Mgejwa, MEM; Elineema Mkumbo, Rural Energy Agency (REA); Taramaeli Mnjokava, Geological Survey of Tanzania; Msafiri Mtepa, EWURA; Felix Ngamlagosi, EWURA; Gissima Nyamo-hanga, REA; and Vestina Rwelengera, REA.

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This country profile was peer reviewed by Julian Blohmke, Renewable Energy Specialist, AfDB; and Stella Mandago, Senior Energy Specialist, AfDB.

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We hope that the information provided in this document will contribute to mobilizing additional investors and partners in financing low-carbon development in Tanzania.

FOREWORD

Tanzania is endowed with diverse renewable energy resources, ranging from biomass and hydropower to geothermal, solar and wind. Much of this potential has not been fully exploited. If properly utilised, such renewable resources would contribute significantly to Tanzania's energy supply, thus moving the country closer to achieving middle-income status, as envisioned in the Tanzania National Development Vision 2025.

Recognising the potential contribution of renewable energy to the country's future energy mix, the Government of the United Republic of Tanzania is committed to foster the development of low-carbon energy initiatives, by harnessing the country's renewable-energy resource base. Renewable sources of energy, which are environmentally benign, can be utilized to improve access to sustainable, modern and cleaner energy services. Deployment of renewable energy technologies has the potential to contribute to job creation, income generation and the improved livelihoods of marginalised social groups, particularly women and children in rural areas.

As a result of climate change, Tanzania has witnessed increasingly unreliable rainfall patterns and more frequent and prolonged droughts over the past two decades. These, in turn, have affected the country's power sector due to its heavy dependence on hydropower. This situation has induced power crises and increased dependence on expensive and environment polluting fossil fuels most of which are imported. The aforementioned experiences provide a strong impetus for us to diversify our energy mix to attain a more robust and resilient energy supply that is less subject to oil price shocks.

No doubt, the Scaling-Up Renewable Energy Program is amongst several key interventions that Tanzania would have to promote in the years ahead as we strive to achieve energy security. Our ultimate goal is to attain universal access to modern energy services. Special attention shall be given to increasing power generation from renewable energy resources that are available in abundance in the country. This will lead to more than 75% of Tanzania's residents, majority of whom live in rural areas, to have access to electricity services by 2035. This approach is in line with the United Nations' Sustainable Energy for All initiative and its Post-2015 Global Sustainable Development Agenda.

I deeply appreciate the work undertaken by national stakeholders and various partners in preparing the SREP Investment Plan and this Tanzania Renewable Energy Country Profile, which well portrays the sustainable energy future needed by all Tanzanians.

Eng. N.C.X. Mwihava
Acting Permanent Secretary
Ministry of Energy and Minerals
Dar es Salaam, United Republic of Tanzania

EXECUTIVE SUMMARY

Tanzania is one of the pilot countries selected to benefit from the Scaling-Up Renewable Energy Programme (SREP) in low-income countries. The SREP, which operates under the Strategic Climate Fund, part of the Climate Investment Funds (CIF), aims to demonstrate the economic, social and environmental viability of a low-carbon development pathway. It does so by creating new economic opportunities and increasing energy access through the production and use of renewable energy.

The SREP Tanzania Investment Plan was prepared under the leadership of the Government of Tanzania (GoT), through a national task force led by the Ministry of Energy and Minerals (MEM) with support from multilateral development banks (MDBs). The plan was developed in line with the government's strategy for renewable energy development, as stipulated in the Tanzania National Development Vision 2025, the National Energy Policy of 2003 and the National Strategy for Economic Growth and Reduction of Poverty, as well as the key principles of the National Climate Change Strategy.

This renewable energy country profile is a knowledge product derived from the SREP Investment Plan. Its objective is to showcase to a wider public the renewable energy status of the country, its development options, and opportunities and constraints.

Energy sector challenges

Tanzania's energy sector faces a number of significant challenges. Amongst the most crucial are:

- **Increasing electricity demand**. Although Tanzania's current per capita electricity consumption is 104.79 kWh (2014), demand is increasing rapidly owing to accelerating productive investments

(industry and mining, above all) and an increase in consumption by connected users and newly connected households. National electricity access rate in 2014 was 36% (11% in rural areas) and the Power System Master Plan (PSMP) updated in 2012 expected the country to reach 75% by 2035. Installed capacity is projected to increase seven-fold to meet demand. The country is also developing a SE4All Action Agenda, setting its energy objectives for access, renewables and energy efficiency for the year 2030.

- **Risk of disruption to generation and associated electricity price shocks due to the increasing unpredictability of hydropower**. Changing rainfall patterns and recent droughts have dramatically reduced large hydropower output. This has resulted in extensive load shedding and the running of expensive emergency fossil fuel–based power plants as base load. Large hydro currently comprises 35% of total generation capacity, down about two-thirds from a decade ago.
- **Uncertain creditworthiness of the utility**. For the past several years, the electric utility, Tanzania Electric Supply Company (TANESCO), has suffered from poor technical and financial performance. A prolonged drought in 2012 has resulted in widespread load-shedding and subsequent acquisition of high cost emergency generation, aggravating its financial situation and, consequently, its ability to invest. The government is addressing these issues with both short- and medium-term measures whose positive impact is, nonetheless, unlikely to be seen until a few years from now.
- **Low access to reliable electricity**. Electricity connection is estimated at 24% nationally, and only 11% in rural areas. Access to modern energy services is vital to agricultural productivity, income generation and education. Women, who shoulder a disproportionate responsibility for household fuel and water collection, food preparation and agriculture, are especially affected by an unreliable energy supply.
- **The vastness of the country coupled with low population density makes grid extension too expensive for many difficult-to-reach areas**. This, in turn, creates significant market potential for off-grid electrification schemes that could be implemented with the participation of small power producers (SPPs). Government's objective is to provide additional access to 250,000 people each year to reach the targeted energy access rates.
- **Health risks and environmental degradation from household reliance on biomass energy**. In 2009, biomass represented 88.6% of total energy consumption, most of it used by the residential sector to meet household cooking needs. The incomplete combustion of fuel wood in traditional biomass stoves results in indoor air pollution, which is linked to respiratory and other diseases that disproportionately affect women and children. The loss of forest cover from charcoal production, with nearly 1 million tons consumed annually, is estimated at about 100,000-125,000 hectares.

Key achievements

Over the past decade, Tanzania has taken important steps to create the enabling conditions for the development of renewable energy resources.

- **Policies, legislation and institutional framework**. Government has instituted a range of energy sector reforms, a major aim of which has been to attract private sector investment to boost electricity supply. Key policies and legislation include the Energy and Water Utilities Authority Act, 2001 and 2006; National Energy Policy, 2003; Rural Energy Act, 2005; Electricity Act, 2008; and the Public Private Partnership Act. No. 18, 2010. Additional legislation has focused on biomass

energy, environment and land. Outcomes from these efforts are beginning to have a profound, positive effect on renewable energy development. These include the establishment of the Rural Energy Agency (REA) and related Rural Energy Fund (REF); establishment of the Energy and Water Utilities Regulatory Authority (EWURA); and application of the SPP Programme with a specific feed-in-tariff mechanism. Particularly important energy policy documents are the Power Sector Master Plan (PSMP), the Rural Electrification Investment Prospectus and the Big Results Now (BRN) initiative. In this context, the GoT has expressed its intention to reform the power sector and has drafted a strategy whose approval is foreseen in mid-2014.

- **Private sector and NGO participation**. The private sector — independent power producers (IPPs) and SPPs — has become a key contributor to economic growth in numerous sectors. Currently, independent power projects contribute about 40 % of the national grid's effective generating capacity. Instituting the regulatory framework for SPPs has resulted in 3 SPPs selling power to the grid, one selling to a TANESCO isolated mini-grid and 11 additional SPPs signing SPP agreements (SPPAs) with TANESCO, which are in different stages of development.[1] In addition, various non-governmental organizations (NGOs) promote access to sustainable and renewable energy.
- **Contribution of development partners**. There is a well-coordinated and inclusive consortium of development partners who are committed to supporting sustainable energy development in Tanzania; this translates into a Joint Energy Sector Working Group with members from government and development partners who aim to achieve results in coherent manner.
- **Environmental and social aspects**. MEM and REA have policies and procedures in place to ensure compliance with social and environmental safeguards, which are guided by the National Environment Management Council. The REA recognizes the centrality of women in its energy access programmes and is working with the World Bank's Gender and Energy program to mainstream gender into its organization and operations.
- **Rural energy access expansion**. Outcomes of the off-grid component of the World Bank-supported Tanzania Energy Development and Access Project (TEDAP) have included TANESCO signing SPPAs with 11 developers to supply 46 MW of power; and TANESCO signing letters of intent with another six developers for 31 MW of power, with four SPPs already in operation. The REA performance-based grant support to mini-grid and stand-alone systems and the innovative Lighting Rural Tanzania project will benefit more than 100,000 households. The REA is processing additional grant co-funding to prepare 60 mini-grid projects and stand-alone solar projects to benefit many more consumers.

Renewable energy viability

In early 2014, Tanzania's electricity installed capacity on the main grid is 1,591.02 MW. Should business-as-usual prevail, 9 GW of additional power will be needed by 2035 to meet demand and replace older facilities. According to the PSMP, future energy needs will be met by coal (41%), large hydro (35%), and oil and gas (21%). Much of the early capacity requirements would be met by oil and gas generators; both require shorter lead times than coal and large hydro, which would predominate in later years. Despite the high potential of other renewable energy to provide lower-cost electricity using locally available resources, only 3% is considered in the PSMP. This is due to insufficient resource information needed for investment decisions and inadequate planning and project development.

1 These include Andoya; EA Power; Kikuletwa II; NextGen Solawazi; Sao Hill; Tulila; Lung'ali; TanGulf, Mapembasi; Symbion- KMRI Kigoma; and Bwelui.

Given that Tanzania's main electricity demand centres are located far from major gas and coal areas, transmission costs and losses are bound to be high. This — combined with the risks associated with over-dependence on large hydro — makes a portfolio of highly diversified power sources with a wide geographical spread highly desirable.

The Rural Electrification Investment Prospectus estimates that mini grids and off-grid options might be more cost-effective for serving about half of the rural population. The prospectus will define the least costly path for grid electrification. It will also identify those districts and communities that cannot be cost-effectively reached by grid and therefore should be targeted for private sector–driven, off-grid electrification investments.

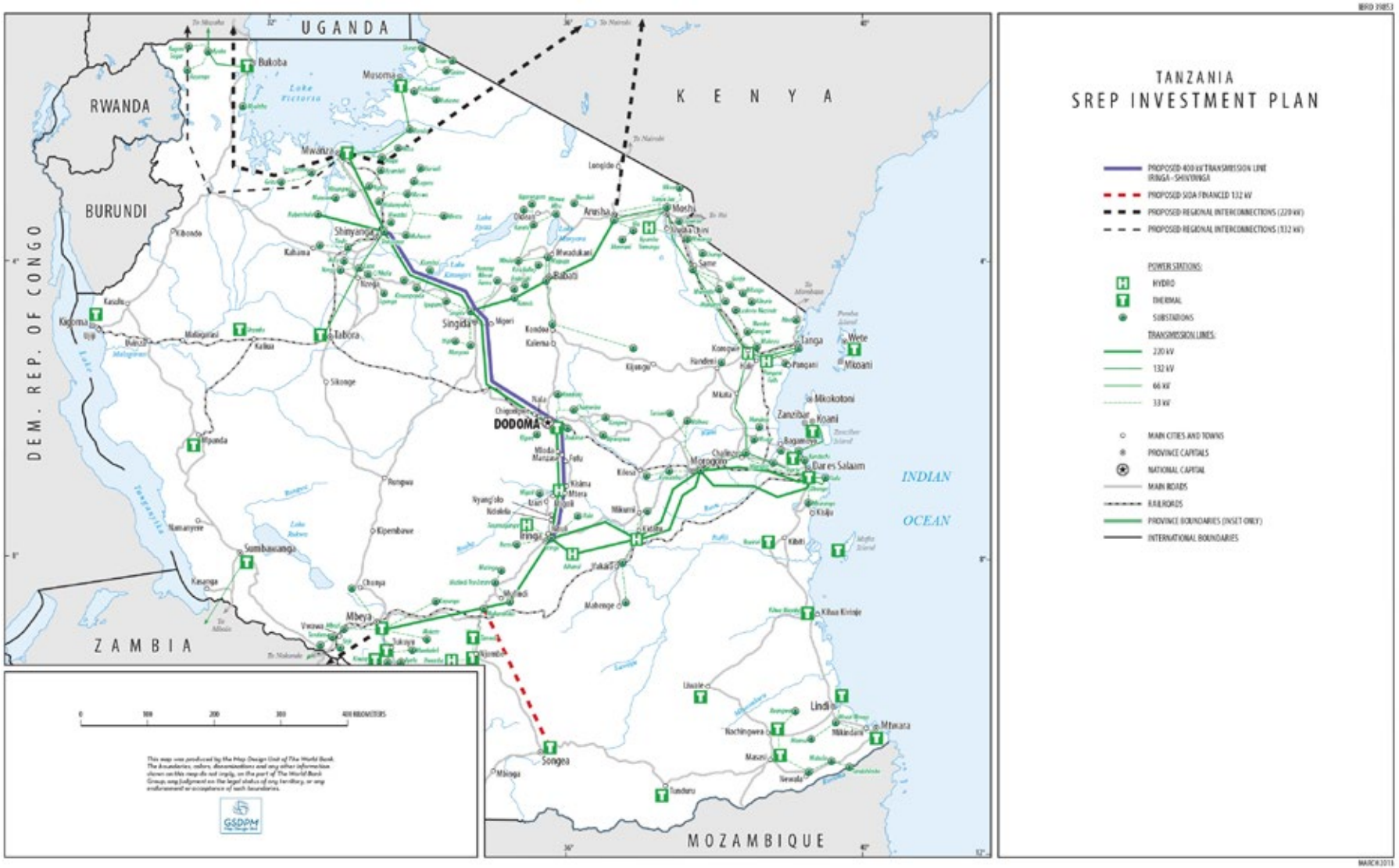
Constraints to renewable energy development

Tanzania is endowed with abundant, high-quality renewable resources, which could play a significant role in meeting the county's energy needs. Currently, however, renewable energy (excluding large hydro) accounts for only about 4.9% of generation capacity.

A series of constraints must be addressed for the country to fully exploit its potential:

- **Institutional, regulatory and legal**. The limited role of renewable energy in the PSMP reflects inadequate data availability and unavailable power planning tools and methods to more effectively integrate renewable energy options, especially distributed generation. The policy and regulatory framework for renewable energy is incomplete. For example, there are no feed-in tariffs or other clear incentives for renewable energy larger than 10 MW, and there is not yet a specific legal and regulatory framework in place for geothermal development. There is also a lack of incentive to develop mini-grid projects due to the uncertainty of grid expansion. In addition, unregulated biomass resource extraction from forests has led to unsustainable harvesting of firewood and charcoal.
- **Knowledge and capacity**. Tanzania has limited expertise in undertaking feasibility studies, detailed design and construction of renewable energy power plants. There is limited information on the needed quality and duration of resources, especially wind, mini-hydroelectricity and geothermal. Sound forest resource information and sustainable harvesting plans are lacking. Consumers are unaware of product standards, available technology choices and efficient alternative production methods.
- **Economic and financial**. Renewable energy projects generally have a high capital cost, and typical financing instruments available on the Tanzanian market are not well-suited to the development of renewable energy projects, which require low cost, long-term debt. The banking sector and investors have limited experience with financing renewable energy projects.

Although these barriers are still powerful, Tanzania has been making serious efforts to modernize its energy sector and foster renewable energy adoption and energy access. The availability of safe, reliable, sustainable and reasonably priced energy services has been a constraint in the past and is an opportunity for the future of the country. In terms of price, renewable energies are competitive with fossil fuel generation, but they are still largely unexploited. Their contribution to both centralized and decentralized energy services can be much higher than present values and current business-as-usual plans, bringing benefits that are not only economic but also social and environmental.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Lake Malagarasi
0 100 200 300 400 KILOMETERS
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GSDPM
TANZANIA
SREP INVESTMENT PLAN
PROPOSED 400 kV TRANSMISSION LINE IRINGA - SHINYANGA
PROPOSED SIDA FINANCED 132 kV
PROPOSED REGIONAL INTERCONNECTIONS (220 kV)
PROPOSED REGIONAL INTERCONNECTIONS (132 kV)
POWER STATIONS:
HYDRO
THERMAL
SUBSTATIONS
TRANSMISSION LINES:
220 kV
132 kV
66 kV
33 kV
MAIN CITIES AND TOWNS
PROVINCE CAPITALS
NATIONAL CAPITAL
MAIN ROADS
RAILROADS
PROVINCE BOUNDARIES (INSET ONLY)
INTERNATIONAL BOUNDARIES
MARCH 2011

KEY ENERGY FIGURES

Topic	Indicator	Unit	2000	2012	Source
Socio-Economic	Population	Units & yearly growth	34.0 mln. 2.5%	47.8 mln. 3.0%	WDI
	Urban/Rural Population Shares	%	22.3% urban 77.7% rural	27.2% urban 72.8% rural	WDI
	GDP/per capita	USD- constant 2005/PPP*	304.4 USD 868.5 USD PPP	483.5 USD 1379.6 USD PPP	WDI
	GDP growth	%	4.9 %	6.9%	WDI
	Poverty headcount 1.25USD	%	84.6%	67.9% (2007)	WDI
	Poverty Gap	%	41.6%	28.1% (2007)	WDI
Access and Consumption	Electricity Access (urban/rural)	%	n.a.	11% rural	GoT
	Electricity Access (national)	%	n.a.	36% (2014)	GoT
	Electricity Consumption per capita	kWh/p.c.	58.2	104.79 (2014)	GoT
	Electricity Demand and growth	GWh/average annual growth	1980 GWh	4272 GWh 6.11% average yearly growth	Calculated
Production	Installed Base	MW		1564 MW	IP
	Share of Hydro	%		36%	IP
	Share of Other RE	%		2%	IP
	Share of gas/coal/fuel	%		32% gas 29% oil	IP
	Imports of fuels	(% of imports)	18.6%	32.2% (2011)	WDI
	Net Imports of electricity	(% of production)		0.9%	IP
External Financing	Aid for the energy sector from 2000	USD	1755 USD millions (2012 prices)		OECD CRS
	FDI for the energy sector from 2000	USD	841 USD millions		World Bank PPI

* Purchasing Power Parity

I.

COUNTRY CONTEXT

I. COUNTRY CONTEXT

Tanzania is a large country with diverse ecosystems and climatic zones. It is endowed with abundant natural resources but is already showing vulnerabilities to climate change and extreme weather events, including droughts and floods. The mean temperature is projected to rise, and rainfall is expected to change its traditional patterns. The current population is at 44 million and rising at 2.9% per year. Urbanisation is increasing, and the majority of the population lives in rural areas. Tanzania has experienced sustained economic growth since 2000. Its economy is largely service-oriented, with tourism accounting for half of GDP, while agriculture employs around two-thirds of the work force and generates around one-quarter of GDP.

Geography and climate

The United Republic of Tanzania is the largest country in the eastern Africa region with an extension of 945,000 km2, including mainland and the Zanzibar islands. It has a tropical climate with regional variations. The north and east of the country have two wet seasons, from October to December and from March to May, while the rest of the country has one wet season from October to April/May. Tanzania is endowed with abundant natural resources, including river basins and forests, but it is already experiencing vulnerability to climate change and extreme weather events. Droughts have recently affected the country and undermined its hydroelectric capacity, while the world famous glacier on top of Kilimanjaro Mountain is disappearing at an impressive speed. According to the UNDP Climate Change Profile, temperatures are forecasted to rise between 1.5 oC to 4.5 oC by 2090, and rainfall is expected to increase in areas with two wet seasons and decrease in the centre and south of the country[2].

Political context

Tanzania has been independent since 1961 (Tanganyika since 1961 and Zanzibar since 1963), and in 1964 the two countries merged to form the United Republic of Tanzania. The country is organised in 30 administrative regions; the president is elected directly, together with the national assembly. Tanzania had a mono-party political system of socialist inspiration from independence until the 1980s. It allowed other parties to become active in 1992 and held its first multiparty elections in 1995. The president and the National Assembly are elected for five years and, as per the constitution, the next election will be conducted in 2015.

Socio-economic demographic context

Tanzania has a total estimated population of 44.9 million (2012 figure)[3]. The current rate of population growth is 2.9% per year. If this trend continues, the population will reach

64 million by 2025 and 83 million by 2035. However, the growth rate is expected to slow as economic development progresses. Today, about three-fourths of Tanzanians live in rural areas; by 2035, it is projected that urban populations will have increased, although rural dwellers will still constitute the majority of residents.

2 McSweeney, C., New, M. & Lizcano, G. 2010. UNDP Climate Change Country Profiles: Tanzania. Available: http://country-profiles.geog.ox.ac.uk/

3 According to the National Bureau of Statistics (www.nbs.go.tz/).

Tanzania's economy experienced sustained growth rates between 2000 and 2012 (an average of 6.7% a year) and GDP per capita passed from 868 to 1379 (US$2005, PPP) during the same period[4]. In terms of poverty indicators, according to government, the poverty headcount ratio (share of the population below basic needs poverty line) declined only marginally from 35% to 33%[5] between 2001 and 2007, despite GDP growth.

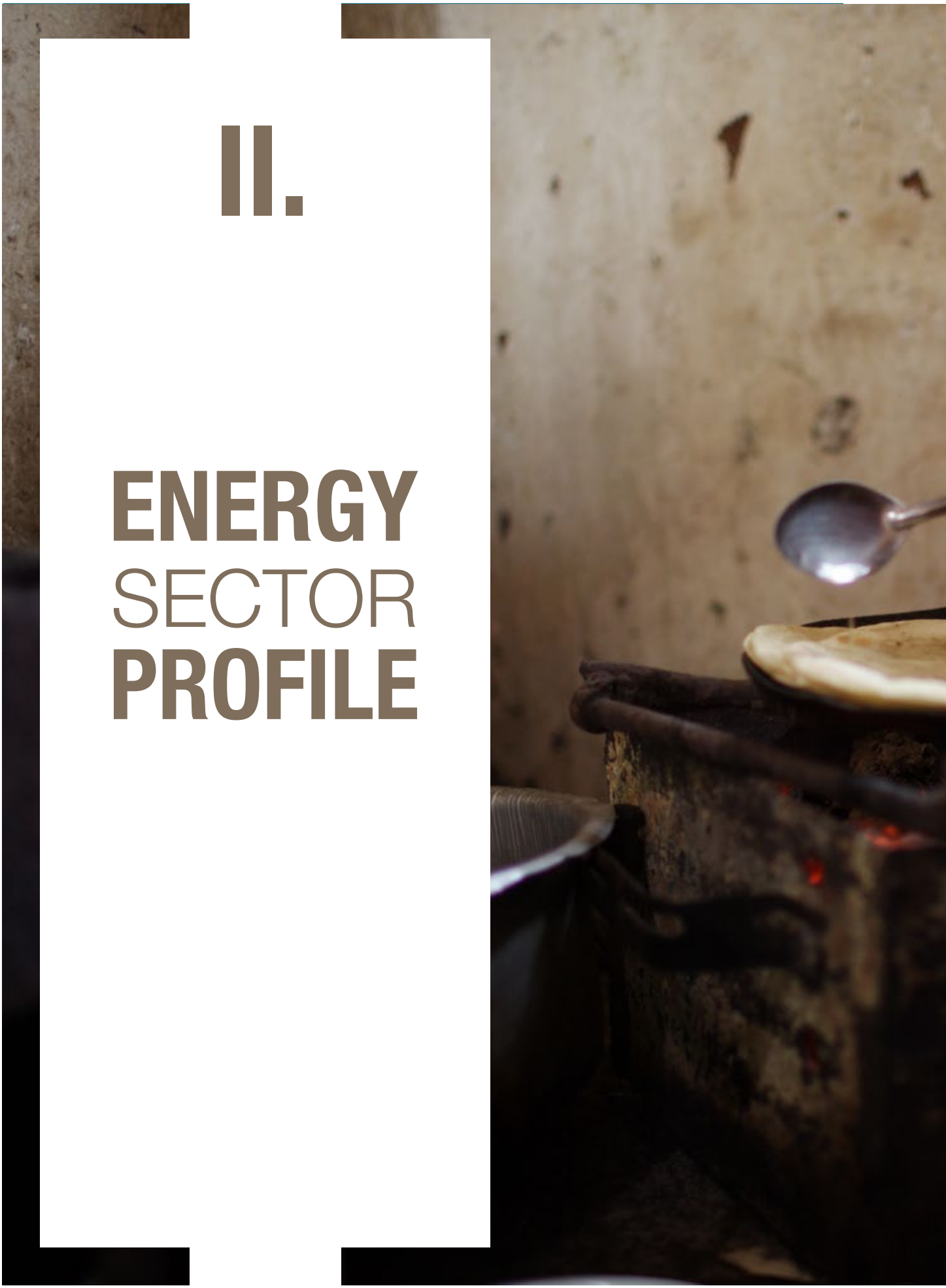
Sound macroeconomic policies, market-oriented reforms and debt relief have ensured a positive environment for the country's steady economic growth. Tanzania's economy depends heavily on the service sector, particularly tourism, which accounts for nearly half of GDP. Agriculture accounts for nearly one-quarter of GDP, employing two-thirds of the work force. Other key growth sectors are construction, manufacturing and mining. The country has significant underdeveloped mineral reserves, whose planned development will contribute to economic growth and increased energy demand[6].

The country's short- and medium-term development plans encourage sustained growth based on private sector development, with the objective of becoming a middle-income country with a diversified and semi-industrialised economy.

4 http://data.worldbank.org/country/tanzania
5 National Bureau of Statistics Ministry of Finance June, 2013 — Tanzania in Figures.
6 Tanzania has an estimated 140 million tons (MT) of gold reserves, 536 MT of coal, 42 trillion ft.3 of gas reserves, and abundant reserves of other minerals.

II.

ENERGY SECTOR PROFILE



II. ENERGY SECTOR PROFILE

The energy sector in Tanzania is still dominated by traditional biomass for domestic uses, mainly harvested and processed in unsustainable ways. Electricity access and consumption are low but increasing at a fast pace. Electricity is planned to reach 75% of Tanzanians by 2035, and energy demand will have a ten-fold increase thanks to domestic, industrial and mining loads. A recent energy crisis caused by reduced hydropower generation has caused extensive load shedding and led to the hiring of emergency generators. In the next few years, large investments are foreseen both in generation and transmission, and IPPs will privately fund many new power plants.

Energy sector description

The energy sector in Tanzania is largely dominated by biomass, accounting for 88% of a total 20.7 million tons of oil equivalent (MTOE) of the total primary energy supply in 2011[7]. Fuel imports reached 1.6 MTOE and represented 32% of total imports to the country[8]. In 2011, energy consumption per capita was 0.48 tons of oil equivalent (TOE), one of the lowest rates in the world and only two-thirds of the average consumption in sub-Saharan African developing countries.

The residential sector accounts for most of the energy used, the vast majority of which consists of biofuels and agricultural waste; 80% of biomass used in the residential sector is for household cooking, with about half of annual charcoal consumption occurring in Dar es Salaam. Petroleum products comprised 8.1% of total final consumption, whilst electricity accounted for just 1.9%.

Only about 36% of the country's population has access to electricity in 2014. Some obtain access through stand-alone solar photovoltaic (PV) systems and mini-hydro grids operated by local NGOs and faith-based groups. The first few privately run, mini- and micro-grids have emerged in response to the enabling financing and regulatory framework that government has put in place. Private diesel generators are, in part, meeting significant pent-up demand.

Current status of electricity sector

Tanzania's electricity sector is fast transforming to sustain the country's development needs and to address its vulnerabilities through policy reforms and large public and private investments.

Electricity in the country is provided by a central grid, owned by the state utility TANESCO, and by isolated mini grids in remote areas. A process of interconnecting the grids is slated to be completed by 2019, together with the reinforcement and upgrading of actual lines.

Electricity production has been dominated to date by large hydro. However, in recent years, due to extensive droughts in the country, their contribution to the total supply has fallen dramatically. This has forced the utility to use extensive load shedding, thermal power plant for base load, and hire emergency power installations, at a considerable financial cost. A long-term strategy to expand production and transmission capabilities is in place, and installed peak capacity is forecasted to increase seven-fold by 2035.

Demand for electricity and electricity access are still very low but fast growing. The share of access to electricity is 36% (GoT 2014), and the government is committed to an accelerated electrification program to add 250,000 customers a year.. Demand is also forecasted to increase due to the energy requirements of mining and industry and to catch up with actual unmet necessities.

7 See IEA - 2014 - Energy Balance of Tanzania - http://www.iea.org/statistics/statisticssearch/report/?&country=TANZANIA&year=2011&product=Balances

8 World Bank 2014 - http://data.worldbank.org/indicator/TM.VAL.FUEL.ZS.UN

The electricity regulatory system allows and encourages the private sector to participate in various ways. Several IPPs are active in Tanzania, selling wholesale electricity to the state-owned utility, TANESCO. A special regulatory framework with simplified procedures and standardised contracts has been created for SPPs that have an installed capacity of less than 10 MW. The aim is to increase rural electrification and the use of local renewable energy sources.

Electricity demand

Tanzania's per capita electricity consumption is very low, 104.79 kWh per year in 2014 (MEM), less than half of the consumption of low-income countries. That said, consumption is increasing rapidly owing mainly to accelerating productive investments and a growing population.

The PSMP (2010–35) anticipates that Tanzania's electrification status will rise to at least 75% by 2035, whilst demand from connected customers will increase significantly as Tanzania reaches middle-income status, as stipulated in the Tanzania National Development Vision 2025.

TANESCO anticipates major demand increases from several mining operations, liquefied natural gas (LNG) plants, factories and water-supply schemes. Peak demand capacity is projected to increase rapidly, from about 1,000 MW in 2013 to about 4,700 MW by 2025 and 7,400 MW by 2035. Production is projected to increase ten-fold, from 4,175 GWh in 2010 to 47,723 GWh in 2035.

Electricity supply

The country's installed electricity generation capacity was 1,564 MW (as of March 2013), of which 1,438.24 MW are available from the main grid, with the balance of 125.9 MW accounted for by SPPs, mini grids and imports. About 65% of grid generation capacity is from thermal (33% from natural gas and 32% from oil), whilst 35% is from large hydropower. The rest comes from small renewable-energy power and imports (Table 1).

Table 1. Power Generation Capacity - March 2013.

Source	TANESCO	IPP	EPP	SPP	Total	Percent
Hydropower	553.0	-	-	-	553.0	35
Small hydro (< 10 MW)	8.8	-	-	4.0	12.8	0.8
Oil (Jet-A1 and diesel)	88.3	163.0	205.0	-	456.3	29
Gas	252.0	249.0	-	-	501.0	32
Biomass	-	-	-	27.0	27.0	1.7
Imports	14.0	-	-	-	14.0	0.9
Total	916	412	205	31	1,564.1	100
Percent	59	26	13	2	100	

Source: TANESCO 2013.
Note: IPP = Independent Power Producer, EPP = Emergency Power Producer, SPP = Small Power Producer.

The contribution of the private sector is significant and encouraged. Only 59% of total capacity is supplied by TANESCO, while IPPs and Emergency Power Producers (EPPs) provide 26% and 13% respectively, which they sell wholesale to TANESCO.

SPPs are independent producers with a capacity inferior to 10 MW. They account for 2% of total capacity. They may sell electricity wholesale to TANESCO or to retail consumers. In addition, private, diesel-based captive generation is estimated at 300 MW nationally, with costs exceeding US¢35 per kWh (not accounted for in Table 1)[9].

Large hydropower as a share of total capacity declined by nearly two-thirds between 2002 and 2006 (from 98% to 40%), and now stands at 35% of available capacity, with output declining due to extended droughts.

This situation has necessitated extensive load shedding and the running of expensive thermal power plants as base load. To overcome power shortages until 2016, government expects that significant thermal capacity will need to be added in the short term. The 2012 PSMP foresees an addition between 2013-2017 of a 2,168 MW gas power plant, 60 MW of heavy fuel oil (HFO), 400 MW of coal, 100 MW of wind, 60 MW of solar, 30 MW of cogeneration and 11 MW of small hydro (see Chapter 6 for planned investments through 2035).

Most are expected to be IPP projects. Excluded are SPP projects and the expected impact of the SREP on renewable energy. Geothermal is excluded from PSMP projections due to the uncertainty of the resource. The PSMP covers only grid-connected projects, while off-grid systems planning is covered under the Rural Electrification Investment Prospectus.

As a result of the aforementioned issues, and particularly due to the high costs of emergency generation, TANESCO is facing significant revenue shortfalls, which, in turn, is impacting its creditworthiness.

Electricity distribution

The electricity system in Tanzania includes the main grid, covering large urban centres and main routes, several independent mini-grids in rural areas and townships far from the central grid, and private diesel generation. In addition, TANESCO imports power from Uganda and Zambia (Figure 1).

Transmission and distribution lines are owned by TANESCO in the entire country. However, in some cases, SPPs are in charge of isolated micro- and mini-grids.

Several development projects are in place to extend and upgrade the transmission and distribution sectors to cope with expanding demand and supply, to interconnect the isolated grid, to increase international electricity trade with neighbouring countries and to improve the general reliability of the system. The network reached its limit capacity on several lines and is therefore being upgraded and expanded. The Tanzania Five Year Development Plan 2011-2016 includes 10 network projects for a total investment of almost TZS 4 trillion (around US$2,421 million); the PSMP foresees the reinforcement of the regional network integration.

Rural electrification coverage is low in Tanzania, with 11% of the rural population having access to electricity. TANESCO operates 20 diesel-based mini-grids, some of which are interconnected to bordering countries. Thirteen communities receive electricity from small-hydro mini-grids provided by faith-based institutions[10], and some use privately-procured or donor-supported solar home systems (SHSs).

The vastness of the country coupled with low population density in most regions makes grid extension an enormously challenging and expensive way to electrify rural areas.

In 2002, 80% of residents lived in areas where the population density was less than 70 persons per km^2, whilst half lived in regions with fewer than 40 persons per km^2. Population density has increased over the past decade, with distribution changes due to internal migration[11].

9 Ministry of Energy and Minerals, “Final Report on Joint Energy Sector Review for 2010/11,” September 2011.
10 GIZ, “Tanzania’s Small Hydro Energy Market: Target Market Analysis,” December 2009.
11 As of this writing, the 2012 census results were not yet available.

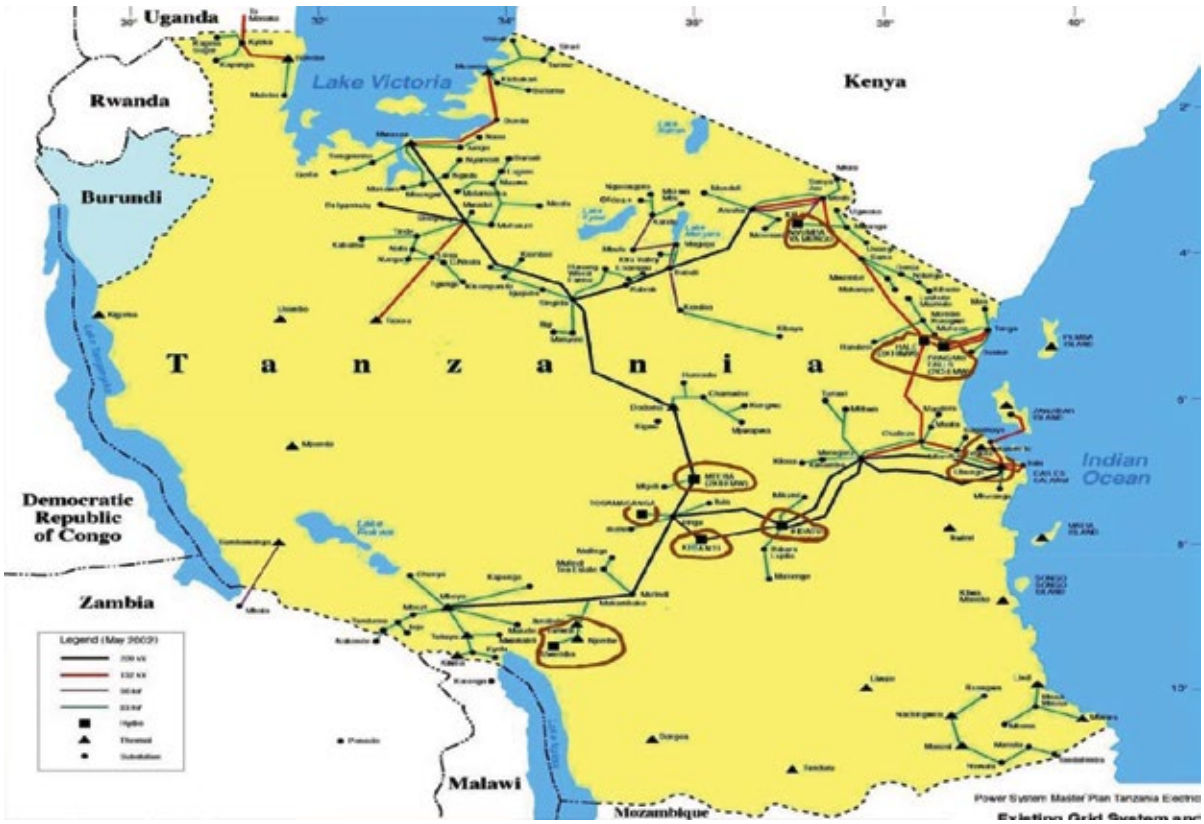


Figure 1. Existing Grid System (*Source: TANESCO*).

Government has set up a series of institutions, policies and projects to increase energy access in rural areas (see sections 4.2.3, 4.2.4 and 5.3). Initial results of the Rural Electrification Investment Prospectus show that about 46% of rural residents live close to the grid; 20%, far from it but in high-density population areas; and 33%, far away in low-density settlements (Table 2). Nevertheless, the rural electrification challenge remains daunting. Preliminary figures indicate that investments of about US$3.5 billion will be needed to increase the rural electrification ratio from 6.6% to 36.6%, and the urban rate from 34.2% to 75.7%. These estimates still need to be confirmed, however[12].

12 IED, "National Electrification Program Prospectus: Preliminary Discussion on the Draft Version," Presentation to the REA, May 2013.

Table 2. Rural Community Characteristics and Indicative Electrification Options: Preliminary Screening.

Characteristic	Population, 2012 (thousands)	Percent	Estimated number of households, 2012 (thousands)
TANESCO grid extension			
Up to 2 km from electrified settlement	10,217	23	2,085
Close to grid, low density	4,330	10	884
Close to grid, high density	6,050	14	1,235
Grid-connected subtotal	20,597	46	4,204
Mini grid			
Far from grid, medium density (125–250 residents/km	4,737	11	967
Far from grid, high density (250–1,000 residents/km	3,848	9	785
Very far from grid, very high density	522	1	107
Mini-grid subtotal	9,108	20	1,859
Stand-alone			
Far from grid, low density (< 125 residents/km	14,902	33	3,041
Stand-alone subtotal	14,902	33	3,041
Total	**44,607**	**100**	**9,104**

Source: IED, Preliminary GEO-SIM mapping for the REA Rural Electrification Investment Prospectus, January 2013.
Note: Assumptions are that population growth rates remain at 2.9 percent per year, population distribution remains unchanged, and the average household size is 4.9 persons. Estimates are preliminary as the study is ongoing.

Traditional/domestic energy

Domestic energy is dominated by the use of biomass in the form of wood or charcoal. The nearly 1 million tons of charcoal consumed each year require an estimated 30 million m^3 of wood. The average annual loss in forest cover attributed to charcoal production is estimated at 100,000–125,000 hectares[13], with 20–50 million tons a year in increased CO_2 emissions (depending on whether fuel-wood is removed from forests or other woodlands)[14].

Domestic energy, especially in rural areas, has a strong gender component. Access to modern energy services greatly improves the well-being of women and contributes to gender equality and poverty reduction. Gender issues are recognized in the Tanzanian Constitution, the Development Plan 2011-2016 and in the Vision 2025.

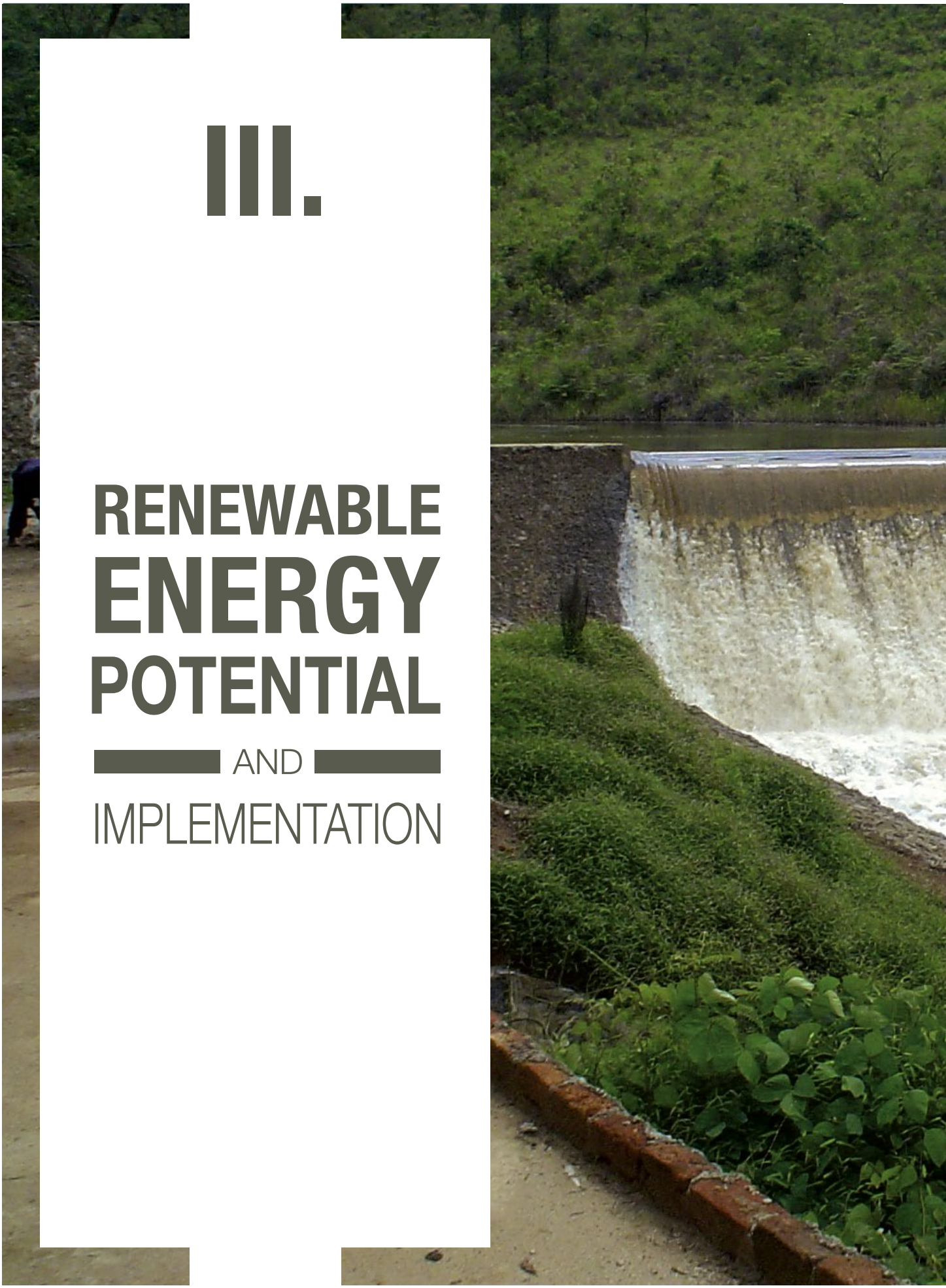
The World Bank, through the Africa Renewable Energy Access Program (AFREA), has worked with government to empower the REA on gender issues. This has resulted in the finalization of a gender strategy for REA and in capacity building to improve the integration of gender considerations into project development, implementation and evaluation[15].

13 The World Bank, "Environmental Crisis or Sustainable Development Opportunity? Transforming the Charcoal Sector in Tanzania," World Bank Policy Note, March 2009.
14 UN Food and Agriculture Organization, "Forest Resources Assessment and the State of the World's Forests," in Mongabay.com, Climate Change Monitoring (http://rainforests.mongabay.com/deforestation/tanzania.html).
15 http://africasd.iisd.org/news/esmap-assists-tanzanias-rural-energy-agency-in-gender-strategy-development-and-rollout/

Strengths	Weaknesses
Abundance of internal resources Large investments planned IPPs allowed SPPs for off-grid and grid generation	Difficulty coping with electricity demand Financial situation of TANESCO Widely dispersed rural population Domestic energy and energy gender issues
Opportunities	**Threats**
Sustained economic growth Regional integration	Climate change Fossil fuel (gas and coal) costs

III.

RENEWABLE ENERGY POTENTIAL AND IMPLEMENTATION



III. RENEWABLE ENERGY POTENTIAL AND IMPLEMENTATION

Tanzania has a high and mostly undeveloped potential for renewable energy (RE) sources. The only RE significantly exploited is large hydro and it has proven to be highly vulnerable to droughts in recent years. Nevertheless large hydro is projected to increase substantially in the next two decades and remain at about one-third of the total share. Small hydro also has great potential and it is particularly suited for remote rural areas. Several geothermal locations have been identified and with the support of SREP, commercial production will be developed, if viable. Solar energy is abundant and being developed for both off-grid and grid-connected solutions. Wind resources are being assessed and plans are to develop them by 2017. Biomass resources are mostly exploited in traditional and unsustainable ways, but the potential for using agro-residues for electricity generation is high and only partially exploited.

Renewable energy potential

Tanzania is blessed with abundant, high-quality renewable resources, which are largely untapped. Currently, the country's total generation capacity from renewable energy (excluding large hydro) is about 4.9%; this includes captive generation in sugar, tannin and sisal factories, solar and small hydro plants.

Large hydropower

Historically, hydropower has been the mainstay of Tanzania's national electricity system, with an installed capacity of 562 MW. However, intermittent river flows resulting from droughts have decreased its reliability as a power source.

Another key challenge facing hydropower development in Tanzania is the regional mismatch between hydro sites and major demand centres. Hydro generation facilities are located primarily in the southwest, whilst major demand centres are in the north, northwest and east. To realise the full potential of hydropower, weak transmission systems must be strengthened.

Tanzania intends to develop additional large-hydro capacity. Some of this capacity is located in areas currently set aside for wildlife conservation, as part of a national park. Estimates of potential additional capacity go as high as 4,000 MW, but the long-term reliability of the water flows has not been clearly established yet.

The PSMP includes 16 projects with a combined capacity of 3,000 MW. With the proposed capacity additions, large hydropower is still expected to exceed 30% of generation capacity after 2025[16], thus risking a repeat of drought-related supply disruptions. Adding other renewable energy sources to the generation mix could mitigate this risk.

Small hydropower

The assessed potential of small hydropower resources (up to 10 MW) is 480 MW. Installed, grid-connected, small-hydro projects contribute only about 15 MW. Most of the developed small-hydro projects are owned by private entities and are not connected to the national electricity grid. Five sites in the 300 kW–8,000 kW range are owned by TANESCO. Faith-based groups own more than 16[17] with 15 kW-800 kW capacity and an aggregate capacity of 2 MW.

16 MEM, "Power Systems Master Plan Update," November 2012.
17 GIZ, "Tanzania`s Small-Hydro Energy Market: Target Market Analysis," December 2009.

Of the 11 projects for which SPPAs have been signed, four are mini-hydro projects, with a combined capacity of 20.5 MW, whilst the others are biomass powered. In addition, TANESCO has signed letters of intent for six small hydro projects with a combined capacity of 29.9 MW. Several small hydro projects are also being developed as isolated mini grids and the MEM is conducting small hydro feasibility studies in eight regions: Morogoro, Iringa, Njombe, Mbeya, Ruvuma, Rukwa, Katavi and Kagera. Development partners are supporting several mini-micro grid projects throughout the country.

Geothermal energy

Tanzania has significant geothermal potential that has not yet been fully quantified. Estimates using analogue methods indicate a potential exceeding 650 MW, with most prospects located in the East African Rift System. Most geothermal prospects have been identified by their on-surface manifestation, mainly hot springs. Surface assessments started in 1976 and, to date, more than 50 sites have been identified.

Geothermal sites are grouped into three main prospect zones: northeastern (Kilimanjaro, Arusha and Mara regions), southwestern (Rukwa and Mbeya regions) and the eastern coastal belt (Rufiji Basin), which is associated with rifting and magmatic intrusions. Only the southwestern zone has undergone detailed surface exploration studies. In 2006 and 2010, MEM, in collaboration with the Geological Survey of Tanzania, the German Federal Institute for Geosciences and Natural Resources and TANESCO, carried out surface exploration and conducted detailed studies in the Ngozi-Songwe prospect in the Mbeya region. Geothermometers showed that the reservoir temperature exceeds 200 °C (Figure 2).

Recognising the potential of geothermal resources and their contribution to energy diversification, government formed a National Task Force on Geothermal Development. Its main task is to advise government on national geothermal resource development. Government intends to prepare a Renewable Energy Policy and Geothermal Energy Act to expedite and scale up geothermal development in the country.

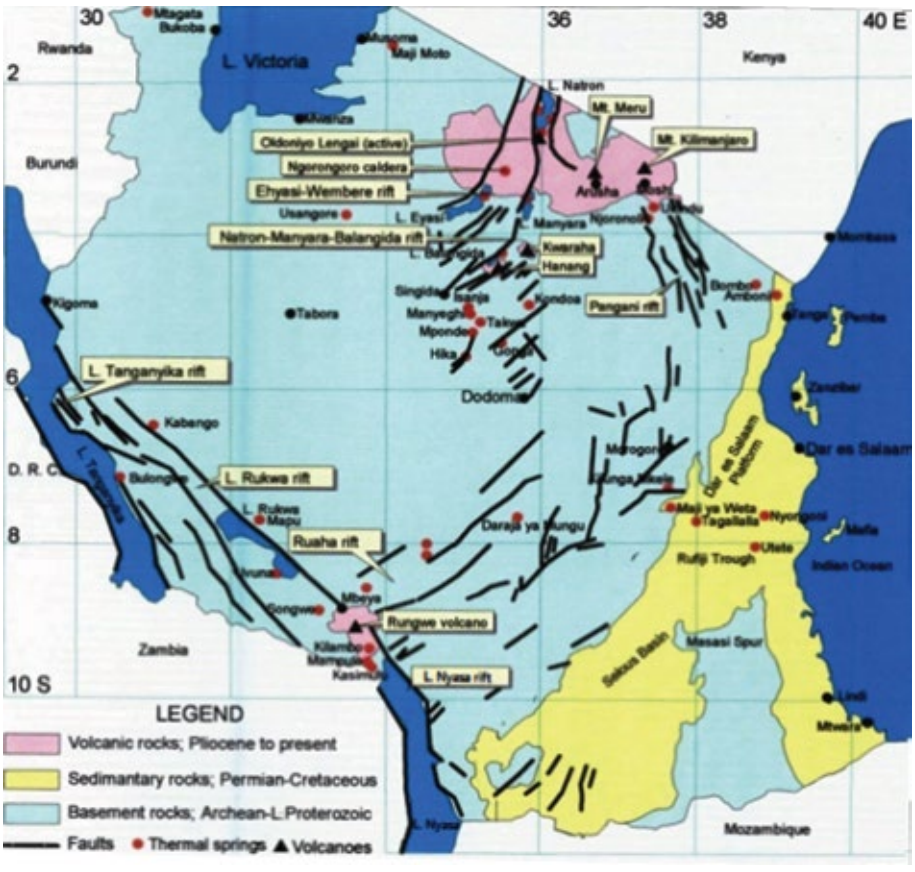


Figure 2. Distribution of Geothermal Prospects (Source: SREP investment plan).

The SREP program in Tanzania will make a substantial contribution to the development of geothermal energy. Public-sector support will be targeted at overcoming the higher-risk phases of exploration and development. It will also go towards a development project — developed mainly by the private sector — that could help catalyse the generation of about 100 MW, thus making geothermal energy a reliable, low-cost and significant contributor to Tanzania's electric power supply.

Wind

Several areas of Tanzania are known to have promising wind resources. In areas where assessments have been conducted, only Kititimo (Singida) and Makambako (Iringa) have been identified as having adequate wind speeds for grid-scale electricity generation. At Kititimo wind speeds average 9.9 miles per second and at Makambako they averaged 8.9 miles per second at a height of 30 m.

MEM, in collaboration with TANESCO, is conducting wind resource assessments in Mkumbara (Tanga), Karatu (Manyara), Gomvu (Dar es Salaam), Litembe (Mtwara), Makambako (Iringa), Mgagao (Kilimanjaro) and Kititimo (Singida). The REA is supporting wind measurements on Mafia Island (coastal region). MEM and TANESCO will conduct wind resource assessments in Usevya (Mpanda).

To date, four companies have expressed interest in investing in wind energy, namely Geo-Wind Tanzania, Ltd. and Wind East Africa in Singida, and Sino Tan Renewable Energy, Ltd. and Wind Energy Tanzania, Ltd. in Makambako. These companies are considering investments in wind farms in the 50–100 MW range.

Solar

Tanzania has high levels of solar energy, ranging between 2,800-3,500 hours of sunshine per year, and a global horizontal radiation of 4–7 kWh per m2 per day. Solar resources are especially good in the central region of the country, and it is being developed both for off-grid and grid-connected solutions.

Off-grid solar photovoltaics

To date, about 6 MWp (megawatt peak) of solar PV electricity has been installed countrywide for various applications in schools, hospitals, health centres, police posts, small telecommunications enterprises and households, as well as for street lighting. More than half of this capacity is utilised by households in peri-urban and rural areas.

Government, through the REA and various donors, has supported a number of solar PV programmes that target off-grid areas where the cost of lighting from solar is less than from a diesel generator or kerosene. As an example, the Sustainable Solar Market Package (SSMP) is a contracting mechanism that bundles the supply, installation and maintenance of PV systems for public facilities (*e.g.* schools and clinics) with requirements and incentives for commercial sale to households, businesses and other nongovernmental customers in a defined geographical area. Another example is REA's Lighting Rural Tanzania competitive grant programme (financed under AFREA and TEDAP), which supports private enterprises in developing new business models to supply affordable energy in rural areas.

Grid-connected solar photovoltaics

In central Tanzania, one MWp of solar PV generates about 1,800 MWh per year (net of losses) and requires about 1 hectare of land. Theoretically solar PV could generate large shares of electricity. On the basis of a 20% constraint on total national production in 2025, the potential for grid-tied solar PV could be about 800 MW[18]. Given that large-scale, grid-tied solar PV installations are being undertaken in some countries for under US$1,750 per kWp, its prospects in Tanzania should be excellent.

18 According to the PSMP, in 2025, coincident peak demand will be 4,700 MW, with noon peak about 85 % of nighttime peak demand (R. Vernstrom, "Long Run Marginal Cost of Service Tariff Study," Final Report to TANESCO, May 2010).

In the short-term, the PSMP envisages 120 MWp of solar in the power expansion plan by 2018. Several private firms have expressed interest in investing in 50–100 MWp of solar PV. NextGen Solawazi has signed an SPPA with TANESCO to supply 2 MWp of electricity from PV to an isolated grid. TANESCO has also signed a letter of intent for a 1 MWp isolated grid-tied PV project.

Solar thermal

Solar thermal energy has been used for generations in Tanzania for drying crops, wood and salt. Currently, solar dryers are used in the agricultural sector to dry cereals and other farm products, including coffee, pyrethrum and mangos.

Households and other institutions (*e.g.* hotels, hospitals, health centres and dispensaries) are the main users of solar water heating systems in Tanzania. Despite the potential of solar thermal and the demand for low-temperature water for both domestic and commercial applications, uptake is low. Lack of awareness, inability to mobilise financing, relatively lower priority given to such investments *(i.e.* water heating may not be a major cost relative to others) are some of reasons attributed to the low usage of solar hot water heating. Other more advanced solar technologies, such as concentrated solar power, are not present in the country.

Biomass

Biomass is Tanzania's single largest energy source, although much of it is produced in traditional and unsustainable ways. It is primarily used in the domestic sector. The sector is a major employer: an estimated 1 million people in the informal sector are engaged in charcoal preparation and supply. Because of weak enforcement and lack of awareness, much biomass from forests is harvested unsustainably. A 2010 World Bank report on charcoal in Tanzania reveals that a) some 100,000–125,000 hectares of annual forest loss is attributable to unsustainable charcoal production and b) the GoT is losing about US$100 million in annual revenue[19].

Biomass is presently used for grid generation (around 18 MW) and by the agro-industry to generate its own electricity (about 58 MW estimated). The potential for modern biomass uses is high, considering that the raw material available is abundant and includes: sugar bagasse (1.5 million MTPY), sisal (0.2 MTPY), coffee husk (0.1 MTPY), rice husk (0.2 MTPY), municipal solid waste (4.7 MTPY) and forest residue (1.1 MTPY). Further supplies can be obtained through sustainably harvested fuelwood from fast-growing tree plantations.

Small-scale uses of biomass for energy generation in rural areas are taking off. Under the SPPA programme, two biomass power projects are supplying power to TANESCO: TPC, a major sugar producer with an SPPA for 9 MW of power[20]; and TANWATT, a tannin producer with an SPPA for 1.5 MW. A third SPPA for 1 MW, the Ngombeni project, was commissioned in February 2014 to supply power to TANESCO's isolated grid on Mafia Island. TANESCO has signed SPPAs for three additional biomass projects with a total capacity of 9.6 MW.

Various development partners are supporting biomass-sector development. The EU is supporting the preparation of a Biomass Energy Strategy. The Norwegian Agency for Development Cooperation (NORAD) and the Swedish International Development Cooperation Agency (SIDA) are supporting institutional and legal frameworks for developing the bioenergy (biodiesel and ethanol) subsector. CAMARTEC is implementing a four-year, country-wide biogas programme (2009–13) supported by the Netherlands, which aims to construct 12,000 digesters of various sizes for household cooking and lighting and electricity production. The REA, under the TEDAP, is providing matching grants for development of several biomass mini- and micro-grids.

19 The World Bank, "Enabling Reforms: A Stakeholder Based Analysis of the Political Economy of Tanzania's Charcoal Sector and the Poverty and Social Impact of Proposed Reforms," June 2010.

20 Although only about 3 MW are currently supplied.

Climate change risks and opportunities for renewable energy

The country prepared a National Adaptation Program of Action in 2007, highlighting the vulnerability of the energy sector and proposing risk reduction strategies[21].

Hydroelectricity and biomass are vulnerable to changes in rainfall, extreme weather events and rising temperatures. In Tanzania rainfall has fallen off overall, whilst the frequency of below-average rainfall has risen. Meteorologists have observed an intensified severity of extreme weather events, including dry and wet spells. This makes predicting seasonal weather patterns increasingly challenging[22].

The World Bank, with UK Department for International Development (DFID) co-funding, is carrying out the Tanzania Hydropower Vulnerability Assessment. The study is evaluating recent hydrology trends and the potential impact of both climate change and non-climate change factors, such as watershed management.

Adaptation and risk mitigation measures for the energy sector include: diversifying energy sources; improving biomass energy conversion efficiency; increasing the adoption of end-user, energy-efficient technologies (lamps, cook-stoves etc.); and protecting hydropower water catchments.

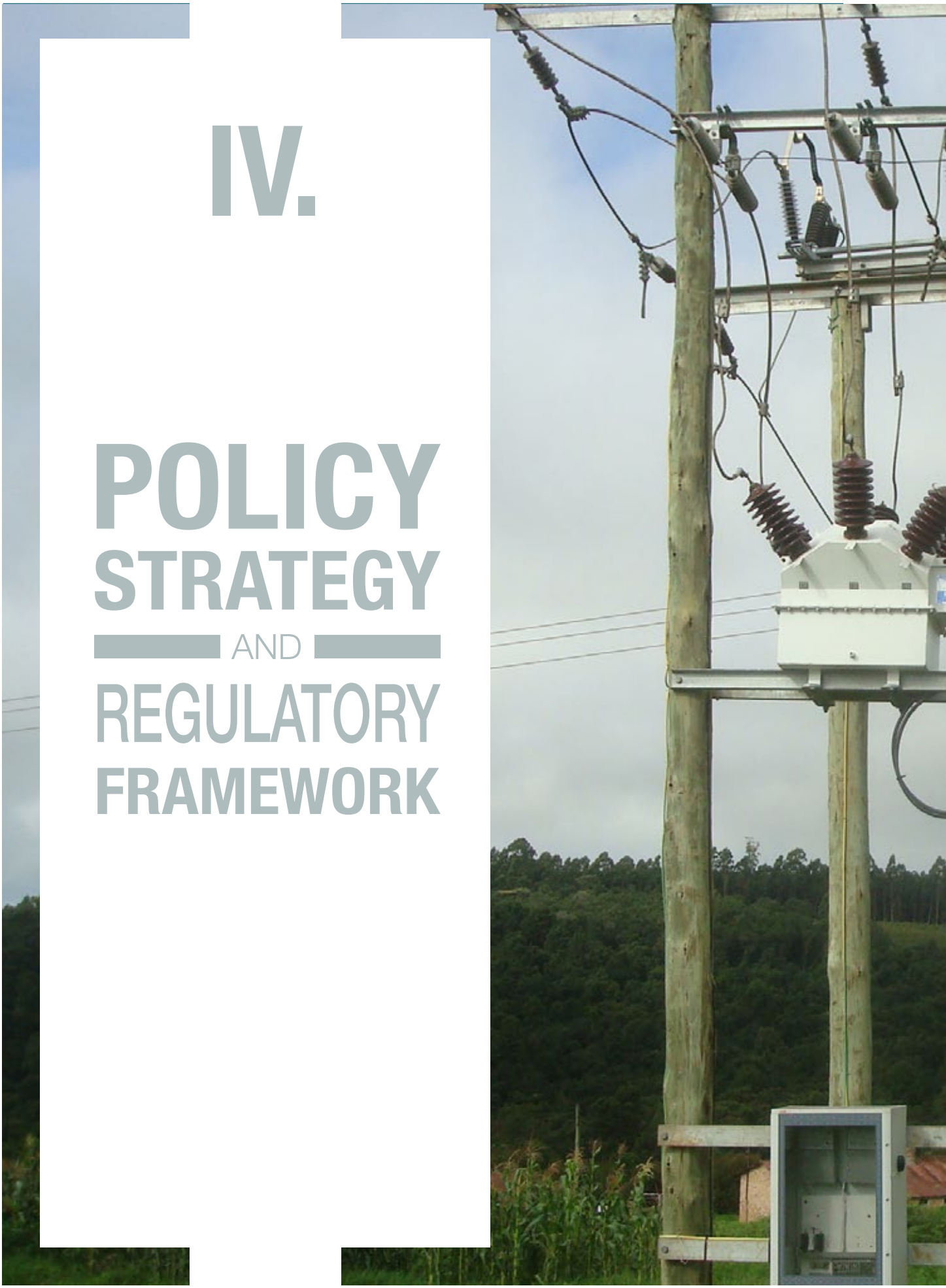
Strengths	Weaknesses
Large RE potential for hydro, solar, wind, biomass and geothermal Experience in hydro and solar development RE available for rural access in remote areas	Hydro undermined by droughts Distance between hydro sites and consumption centres Unsustainable collection and uses of biomass
Opportunities	**Threats**
Growth opportunities for all technologies Geothermal could be implemented for the first time Wind opportunities are being assessed Sustainable biomass and agro-residue opportunities for electricity generation, biogas and briquettes	Climate change and extreme weather events could undermine RE potential, especially hydro and biomass Site conditions for geothermal energy still have to be fully explored The grid should be prepared for intermittent RE sources

21 United Republic Of Tanzania National Adaptation Programme of Action (NAPA), 2007.

22 Saiguran Loisulie, "Vulnerability of the Tanzanian Hydropower Production to Extreme Weather Events," Sokoine University of Agriculture, Faculty of Science, Department of Physical Sciences, Morogoro.

IV.

POLICY STRATEGY AND REGULATORY FRAMEWORK



IV. POLICY, STRATEGY AND REGULATORY FRAMEWORK

Energy is a central pillar of economic and social development in Tanzania and its importance is fully recognised by government. To strengthen and modernize the sector, a series of profound policy reforms are transforming the way in which energy is produced, consumed and regulated in the country. The reforms include the creation of a new regulatory entity and a new energy policy that encourage private participation through IPPs and SSPs as well as rules for their participation in rural electrification efforts. During this process, tariffs were raised to cover costs, but connection fees were reduced to accelerate the expansion of the user base.

Mainstreaming energy & RE into national development policies

The development of energy infrastructure is one of the pillars of Tanzania's Development Plan 2011-2016 as well as Tanzania's Vision 2025. Energy has been a constraint for sustainable development in the country, hindering the private sector and limiting a great part of the population to the use of traditional energy sources. A series of energy reforms have been put in place to allow the sector to expand and cope with the needs of a growing population with energy access, and an economy in rapid growth. In particular, government is intervening to put the power sector on a more sustainable path. Four complementary sets of measures are being established:

- Shift the energy mix away from an expensive, emergency, oil-based power supply to more efficient and lower-cost generation. This would reduce the cost of electricity supply and mitigate the risks of major shocks to the power system, such as droughts and oil-price hikes. In the near term, this shift would focus primarily on gas and, over the longer term, on a combination of gas, coal and renewable energy (including large hydro). Government has prioritized the Mtwara gas pipeline and two gas-fired plants of 380 MW capacity for immediate execution[23].

- Restructure sector institutions and strengthen investment planning, procurement, and contracts management. This would include increasing market competition in power generation and leveraging private investment through IPPs procured through solicited and competitive bidding processes. It would also include restructuring TANESCO and developing a new incentive structure (e.g. performance contracts). An energy reform strategy and a roadmap for implementation are being drafted. The draft included in the BRN initiative foresees extensive changes to the structure of the energy sector, including unbundling, commercialisation and an end to government subsidies.

- Balance energy demand and supply in a cost-effective manner. TANESCO has committed to reducing distribution and transmission losses to 15.08% by 2015 (from 17.76% in 2012).

- Address TANESCO's financial gap through government-supported financing arrangements and revenue-enhancing measures, while medium-term measures are being put in place. MDBs and development partners are supporting these actions. For example, in March 2013, the World Bank approved the US$100 million Tanzania First Power and Gas Development Policy Operation, whose objectives are to (i) strengthen the country's ability to bridge the financial gap in its power sector, (ii) reduce the cost of power supply and promote private-sector participation in the sector and (iii) strengthen the policy and institutional framework for managing the country's natural gas resources. The African Development Bank (AfDB) is currently looking at a complementary intervention and has already approved a first tranche of US$50 million in December 2013 to assist with the reform program.

23 Government of Tanzania, "Vision 2025: Big Results Now," Presentation of the results of the Energy Lab, April 2013.

Energy policies

Energy policy and strategic framework

As early as 2003, the GoT reiterated, through its National Energy Policy, the objective of reducing dependence on fossil fuels for power supply, suggesting the development of renewable energy options. Government has been keen to provide an impetus to both the geothermal and natural gas subsectors as a way of diversifying the energy mix. To create a legal and regulatory framework conducive to investment, it has instituted a range of energy-sector reforms, a major aim of which has been to attract private investment to boost electricity supply and thus meet demand.

Some of the key policies and legislation governing Tanzania's energy and renewable energy sectors are:

Energy and Water Utilities Authority Act 2001 and 2006. These were promulgated to establish a regulatory authority (Energy and Water Utilities Regulatory Authority (EWURA)), empowered to: (i) promote effective competition and economic efficiency; (ii) protect consumer interests; (iii) protect the financial viability of efficient suppliers; (iv) promote the availability of regulated services for all consumers, including low-income, rural and disadvantaged groups; and (v) enhance public knowledge, awareness and understanding of regulated sectors.

National Energy Policy 2003. The broad objective of this policy is to ensure the availability of reliable and affordable energy supplies and their rational and sustainable use to support national development goals. This policy unequivocally stated, as early as 2003, the national commitment to sustainable energy production and use. Specific objectives are to: (i) enhance the development and utilisation of indigenous and renewable energy sources and technologies; (ii) adequately take into account environmental considerations for all energy activities; and (iii) increase energy efficiency and conservation in all sectors.

Other key themes in the policy include: (i) development of a market economy for energy in the country; (ii) institutionalisation of a clear regulatory regime for the energy sector to aid development; (iii) rectification of unbalanced gender impact from inferior energy services; (iv) development of a clear financial regime for the sector; and (v) balancing revenue generation and costs of service.

Rural Energy Act 2005. This act established the Rural Energy Board, Rural Energy Fund (REF) and REA. It is responsible for promoting improved access to modern energy services in rural areas of mainland Tanzania and, through the REF, providing grants to developers of rural energy projects and to TANESCO for rural grid distribution investments.

Electricity Act 2008. This act established a general framework for the powers of MEM and EWURA. It defined key parameters for EWURA with regard to tariff-setting criteria and procedures, criteria for awarding provisional and permanent licenses, monitoring and enforcement activities, requirements for ministerial plans and strategies for rural electrification, dispute resolution procedures and a process for determining the possible future reorganisation of the electricity sector.

Public Private Partnership Act No. 18 of 2010. This act set forth the responsibilities and obligations of the parties, penalties, remedies, financial management and control requirements, public-party available assistance and dispute resolution. It established Public Private Partnership (PPP) coordination units within the Tanzania Investment Centre and Ministry of Finance.

Policies and legislation influencing biomass energy. These include Guidelines for Sustainable Harvesting and Trade in Forest Produce, 2007; New Royalty Rates for Forest Products, 2007; Community-Based Forest Management Guidelines, April 2007; Joint Forest Management Guidelines, April 2007; Charcoal Regulations, 2006; Forest Act, 2002; Subsidiary Legislation to the Forest Act, 2002; National Forest Programme, 2001; National Forest Policy, March 1998; and Biofuels Guidelines, 2010.

Environmental and land policy and legislation influencing renewable energy development. These include the Environmental Management Act, 2004; National Land Policy, Ministry of Lands and Human Settlements Development, 1997; and National Environmental Policy, 1997. There is also an ongoing study on subsidy policy.

Renewable Energy Policy and Geothermal Energy Act. Once these documents are finalized, they will contribute to development of the sectors.

Tariffs

In January 2012, Tanzania raised its electricity tariffs by 40.29%; despite this increase, TANESCO continues to incur losses owing to its heavy reliance on high-cost emergency generators contracted after a prolonged drought. The drought significantly reduced hydropower availability, forcing the utility to resort to widespread load shedding[24]. In January 2014 another tariff increase of 39.19% was approved.

The current tariff for general usage is KWh 0.16 USD/per KWh plus service fees and taxes[25]. The Energy and Water Utilities Regulatory Authority (EWURA), which regulates TANESCO's retail tariffs, conducted a Cost of Service Study (COSS) in November 2012. The study was part of its assessment of adopting a multi-year, cost-reflective tariff scheme that could bring certainty and attract investment to the Tanzania electricity supply industry[26]. Results show that TANESCO customers enjoy comparatively lower tariffs than customers in neighbouring countries.

Whilst a low social tariff is available to customers using up to 75 kWh a month, few in that beneficiary group have been able to take advantage of it owing to the high connection fees, which have barred many potential customers from gaining access. In December 2012, the connection fees were significantly reduced. The household connection fee, paid upfront to TANESCO, starts at approximately TZS 177,000 (about US$110) for a rural customer and TZS 320,960 (US$200) for an urban customer, down from US$300. This reduction is expected to accelerate grid electrification efforts.

Rural electrification

REA is the lead agency responsible for rural electrification and development of renewable energy to supply rural communities. The REF – with budgetary support from the GoT and contributions from a surcharge on grid electricity sales – and development partners co-finance rural and renewable energy electrification schemes implemented by TANESCO and the private sector; NGOs and communities supporting renewable energy–based mini grids; and stand-alone solar solutions. The mini grids powered by mini-hydro and biomass power plants are either stand-alone or connected to the TANESCO grid and operated by private entities[27].

In addition, REA is the implementing agency for a number of donor-financed projects. REA and TANESCO are implementing the World Bank and Global Environment Facility (GEF)–assisted Tanzania Energy Development and Access Project (TEDAP). TEDAP has supported the creation of an enabling environment, developed performance-based financing instruments and provided capacity building for SPPs selling power to TANESCO or retail customers (through mini grids). In addition, various other donors are supporting or contemplating support for off-grid electrification. SREP will contribute to rural electrification for 400,000 households with renewable energy sources, leveraging private investments and addressing barriers to investments through targeted support.

24 At the peak of the crisis in mid-2011, Tanzania experienced up to 18 hours of load shedding per day in certain parts of the country.
25 Source: TANESCO - http://www.tanesco.co.tz/index.php?option=com_content&view=article&id=63&Itemid=205
26 EWURA, "Determination of Multi-Year Cost Reflective Electricity Tariffs in Tanzania," Discussion Paper, November 2012.
27 Connection to the TANESCO grid offers the advantage of using the grid for balancing supply and demand.

Small power producers regulation

EWURA has promulgated a system made of regulations, standardised contracts, and avoided cost–based, non-negotiable tariffs pertaining to private, small (under 10 MW), renewable-energy power projects to supply the TANESCO grid and enable these entities to supply electricity directly to isolated rural communities. SPPAs, SPP tariff methodology and tariffs, interconnection guidelines and SPP implementation rules issued by EWURA enable private entities to invest in renewable power projects for both grid-connected projects and isolated grids. As a result, 11 SPPAs have already been concluded with TANESCO, thus paving the way for the further development of rural and small renewable-energy generation projects. SPP tariffs are updated annually, based on TANESCO's avoided cost, so they do not negatively impact TANESCO's financial situation.

Policies promoting private investments for the energy sector

Tanzanian energy policy actively encourages private investments in the sector. The private generation of electricity accounts for more than 40% of the available installed base (Table 1) and private producers are expected to continue to contribute to the total energy mix both with larger IPP and SPPs. Leveraging of private funds is also expected to play a role in rural electrification, through stand-alone or grid-connected projects. A set of simplified procedures, including tariffs, has been put in place for SPPs to produce electricity for the grid and for off-grid solutions. Despite these advancements, the policy and regulatory framework for renewable energy is yet incomplete. For example, there are no feed-in tariffs or other clear incentives for renewable energy larger than 10 MW, and there is no specific legal and regulatory framework in place for geothermal development. There is also a lack of incentive to develop mini-grid projects due to uncertainty around grid expansion. The National Public Private Partnership Policy foresees that PPP projects might arise from international competitive bidding or unsolicited bidding, but mostly the latter. Currently, EWURA is conducting a study to review the feed-in tariff to an extended customer base and for renewable energy specific technologies.

Trade barriers and trade policies (tariff and non-tariff barriers in RE technologies)

Government has shown its support to renewable energies also through its tax and tariff policies. To make solar PV more attractive, value added tax and import tax for main solar components have been removed, reducing their cost to final consumers.

International agreements on energy

Tanzania is part of the East African Power Pool (EAPP) and currently imports less than 1% of its electricity from neighbouring countries Uganda, Zambia and Kenya, where it also exports limited amounts. EAPP's strategy is to strengthen the interconnections of the electricity systems of its 10 member countries to achieve least cost generation and better capability to serve the expanding regional market. EAPP interconnections can contribute to the inclusion of RE in the national grids, removing the small size limits of national markets and allowing a better integration of variable energy sources.

Future interconnection lines could include a Zambia-Tanzania-Kenya interconnector and imports of hydroelectricity from Ethiopia via Kenya. The latter is in a more advanced state; power from Ethiopia could be available in Tanzania as soon as 2016, with support from AfDB, World Bank (WB), Japan International Cooperation Agency (JICA) and the French Development Agency AFD.

Strengths	Weaknesses
Wide ranging energy reforms implemented Private sector participation Reduced connection fees PV equipment tax exempt Active rural electrification policies	Tariffs raised but yet not sufficient for cost-recovery for TANESCO
Opportunities	**Threats**
RE Policy and Geothermal Energy Act in preparation Further integration into the EAPP	Low credit worthiness of TANESCO discourages financers and private investors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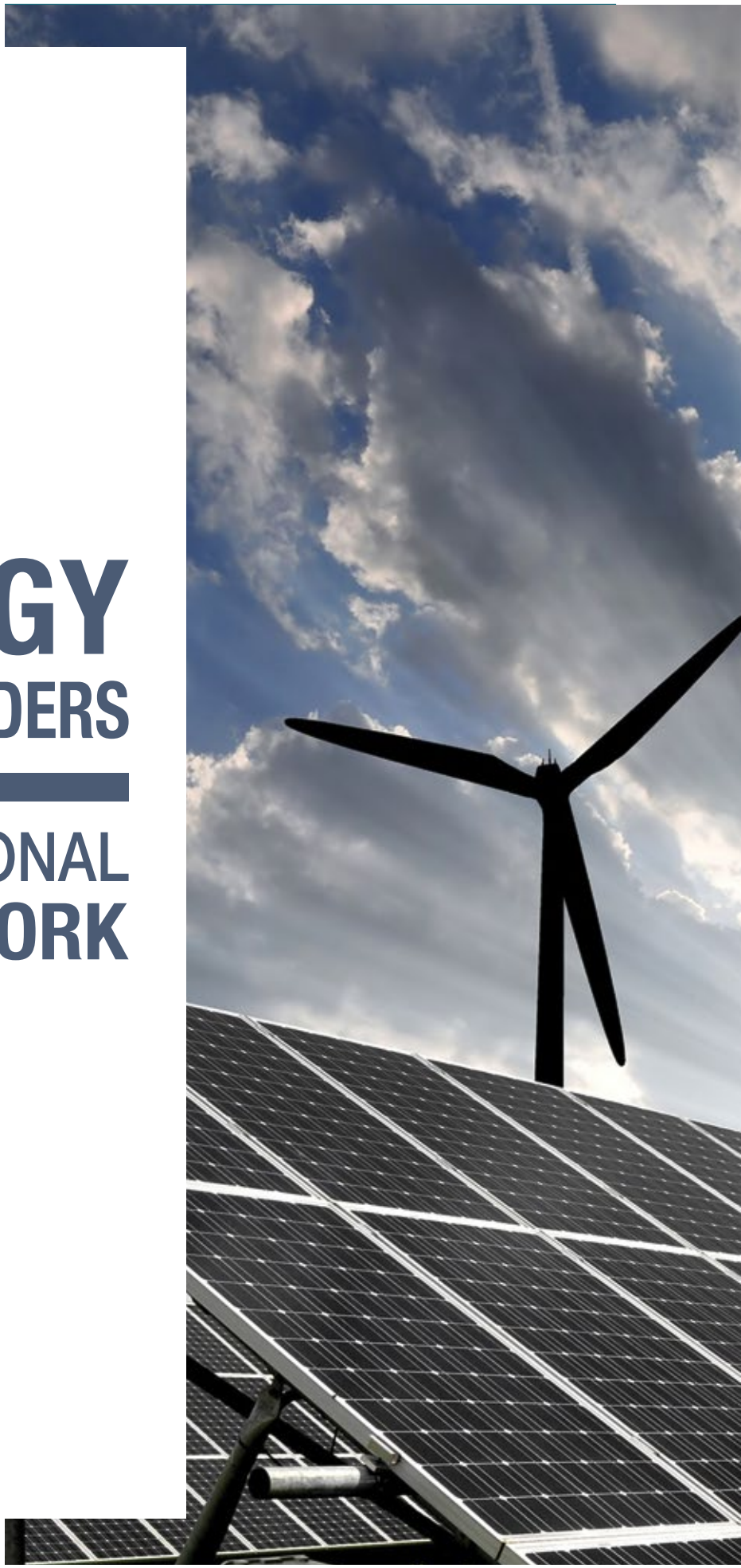
V.

ENERGY STAKEHOLDERS AND INSTITUTIONAL FRAMEWORK



V. ENERGY STAKEHOLDERS AND INSTITUTIONAL FRAMEWORK

The Tanzanian energy sector is characterised by a plurality of stakeholders. Extensive reforms are being planned. At present, the main player — the energy utility, TANESCO — acts as producer, transmitter and distributor of electricity. It is also the single buyer from IPPs. SPPs may directly serve customers in areas not covered by TANESCO. REA oversees developments in rural areas while an independent regulatory agency, EWURA, is setting the rules for tariffs, licensing, monitoring and standards. Other stakeholders include donors, private companies, NGOs, universities and faith-based groups. Foreseen reforms are expected to unbundle TANESCO into two to three companies, create an independent system operator and halt government subsidies.

Structure of the energy sector

Tanzania's energy sector comprises various stakeholders, including national institutions, private-sector operators and NGOs. At present, the system is divided in two segments, the national interconnected grid and the zones under REA's responsibility (Figure 3).

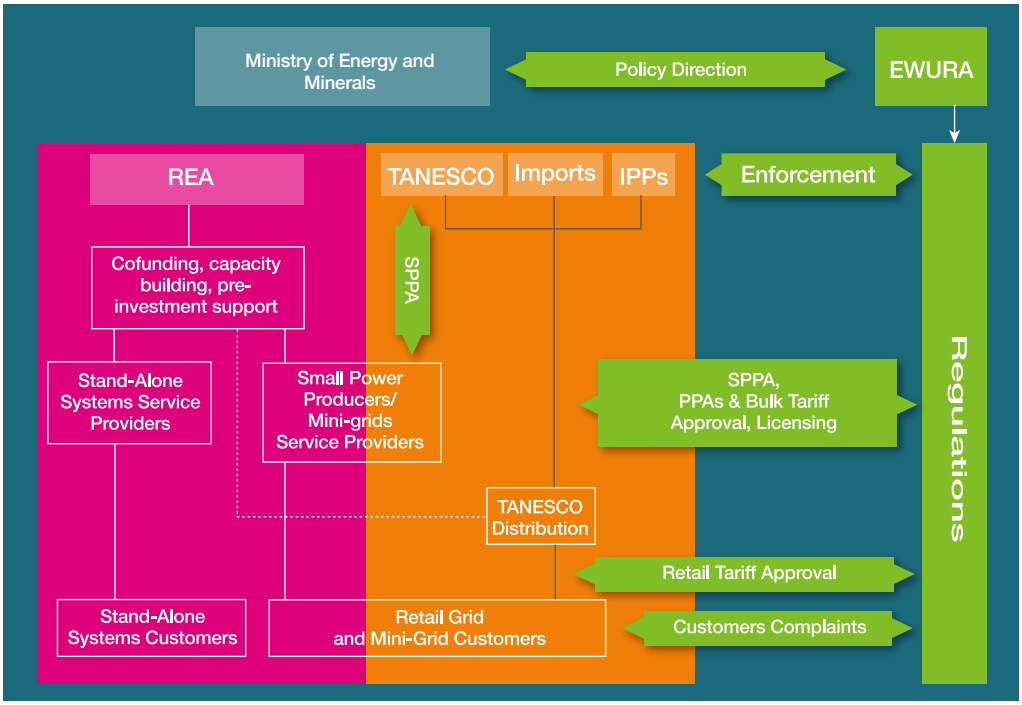


Figure 3. Institutional Framework and Market Structure of the Electricity Sector.

In already served zones, TANESCO operates as a vertically integrated utility that, in addition to its own generation resources, acts a "single buyer" from IPPs or SPPs and sells to its own customers. In the zones under REA's responsibility, SPPs may sell power directly to customers.

Ministries with energy competences

MEM is mandated to develop energy and mineral resources and manage the sector. It is responsible for the formulation and articulation of policies to create an enabling environment for stakeholders. Promoting renewable energy is part of its mandate. MEM plays an essential policy guidance role, complementing other major players (i.e. REA, TANESCO, EWURA, private companies, NGOs and financiers).

Other governmental bodies with energy competences

REA is an autonomous body under the MEM that became operational in October 2007. Its principal responsibilities are to (i) promote, stimulate, facilitate, and improve modern energy access in rural areas of mainland Tanzania for economic and social development; (ii) promote rational and efficient production and use of energy and facilitate the identification and development of improved energy projects and activities in rural areas; (iii) finance eligible rural energy projects through the Rural Electrification Fund; (iv) prepare and review application procedures, guidelines, selection criteria, standards and terms and conditions for the allocation of grants; (v) build capacity and provide technical assistance to project developers and rural communities; and (vi) facilitate the preparation of bid documents for rural energy projects.

Energy regulator

EWURA is an autonomous, multi-sector regulatory authority established by the Energy and Water Utilities Regulatory Authority Act. It is responsible for the technical and economic regulation of Tanzania's electricity, petroleum, natural gas and water.

EWURA has a broad spectrum of powers comprehensive of licensing, tariff review, monitoring performance and standards with regards to quality, safety, health and environment. It is mandated to make sure concurrence is real, and protect consumers, promoting access to regulated services for the entire population, including low income, rural and disadvantaged consumers.

Energy utility(ies) operating in the production, transmission and distribution segment

Tanzania Electric Supply Company. TANESCO, a public company, is the country's principal electricity generator, transmitter and distributor. Currently, it provides nearly 60% of the effective generating capacity of the national grid. TANESCO is responsible for generation, transmission and distribution, serving customers on the main grid and in 20 isolated grids.

TANESCO's financial performance has been deteriorating in recent years. A combination of dilapidated distribution systems, high levels of network loss, reduced hydropower output, electricity tariffs below cost recovery level, low network voltages, heavy use of emergency power producers and inadequate investment have negatively impacted utility revenues. At the same time, since 2002, the cost of electricity generation has been continuously increasing, along with a growing reliance on thermal energy.

The BRN proposes a drastic restructuring of TANESCO. Following this plan, TANESCO would be first split into two to three profit and cost centres that would evolve into two to three different companies and further divide into smaller generation and distribution enterprises. Eventually, each company will have to be profitable, a cost-reflective tariff should be applied, TANESCO's debt should be repaid and the GoT would no longer subsidy the sector (Figure 4).

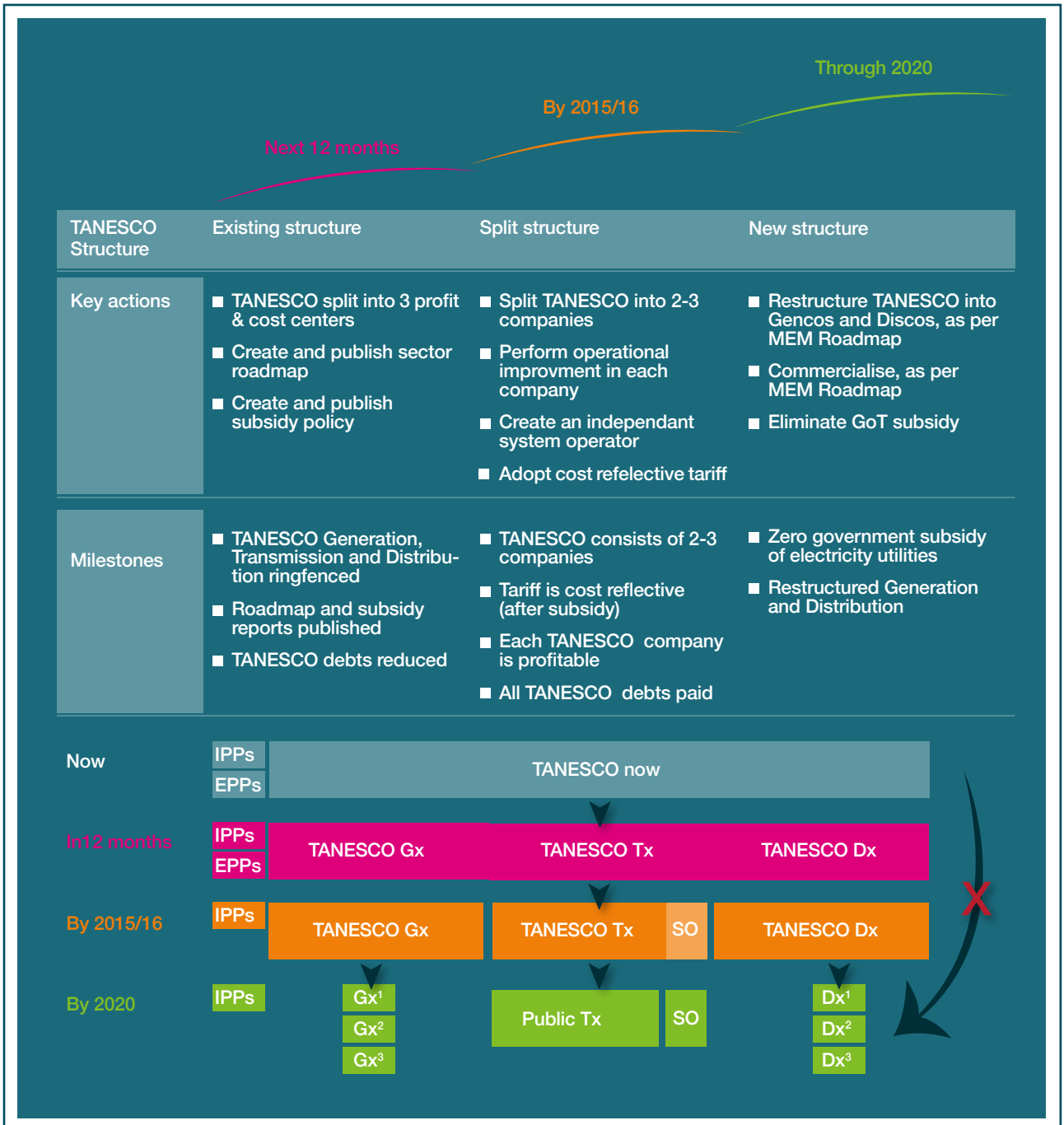


Figure 4. Proposed Energy Reforms (*Source BRN - Energy Lab, 2014*).

Other private companies

Independent Power Producers and Emergency Power Producers. Currently, six IPPs and EPP projects are active in the country: Symbion (Ubungu, Arusha and Dodoma) operates three, while IPTL, Songas and Aggreko operate the others. Together they contribute to approximately 40% of the national grid's effective generating capacity. Several other private power companies are in the process of developing large-scale hydro, solar, wind and geothermal projects.

Small Power Producers. Various private companies are engaged in small renewable power development under the SPPA to sell power to TANESCO or sell directly to retail customers. Many of these firms are already working in rural areas in such enterprises as tea, sugar, sisal and tannin, amongst others. Currently three SPPs are selling power to the grid and an additional eight SPPAs have been signed with TANESCO.

NGOs and training institutions active in the area of energy

Universities and Research and Training Institutions. Various universities and research and training institutions focus on building human capacity for the energy sector. These include the University of Dar es Salaam, Dar es Salaam Institute of Technology, Mbeya Institute of Science and Technology, Arusha Technical College and the Vocational Education Training Authority (VETA).

Non-governmental Organisations. Various NGOs promote access to sustainable and renewable energy. For example, the Tanzanian Renewable Energy Association (TAREA) brings together stakeholders in the renewable energy sector to promote renewable energy options. The Tanzania Traditional Energy Development and Environment Organisation (TaTEDO) has been promoting access to sustainable energy since the early 1990s. Other NGOs include the Tanzania Engineering and Manufacturing Design Organisation, WODSTA (efficient stoves promotion), Solar Innovations of Tanzania, AMKA Trust and CARE-Tanzania[28].

Though not specifically classified as renewable energy organisations, a number of faith-based organisations utilise renewable energy to meet the rural energy needs of their communities.

Donors/financing institutions

Tanzania's financial system includes a banking sector with many commercial banks, which, with support from development partners, are looking increasingly at opportunities to finance renewable energy and energy efficiency projects. With the advent of the Small Power Programme, WB established a US$23 million credit line under TEDAP, providing long-term liquidity to local commercial banks for re-financing small renewable energy projects. The first two renewable energy mini-grid projects have been financed through this credit line. The REA also provides performance-based grants to buy down mini-grid connection costs. Public sector financing of TANESCO comes directly from government, the REA, and multilateral and bilateral lenders and donors. TANESCO also borrows from commercial banks for working capital. IPPs, EPPs and SPPs bring their own financing, both equity and debt, some of which is sourced externally. Equity funds are still rare in Tanzania, although some regional equity funds are looking into investment opportunities under the SPP program. Also, AFD approved a line of credit for renewable energy through Bank of Africa for about €20 million.

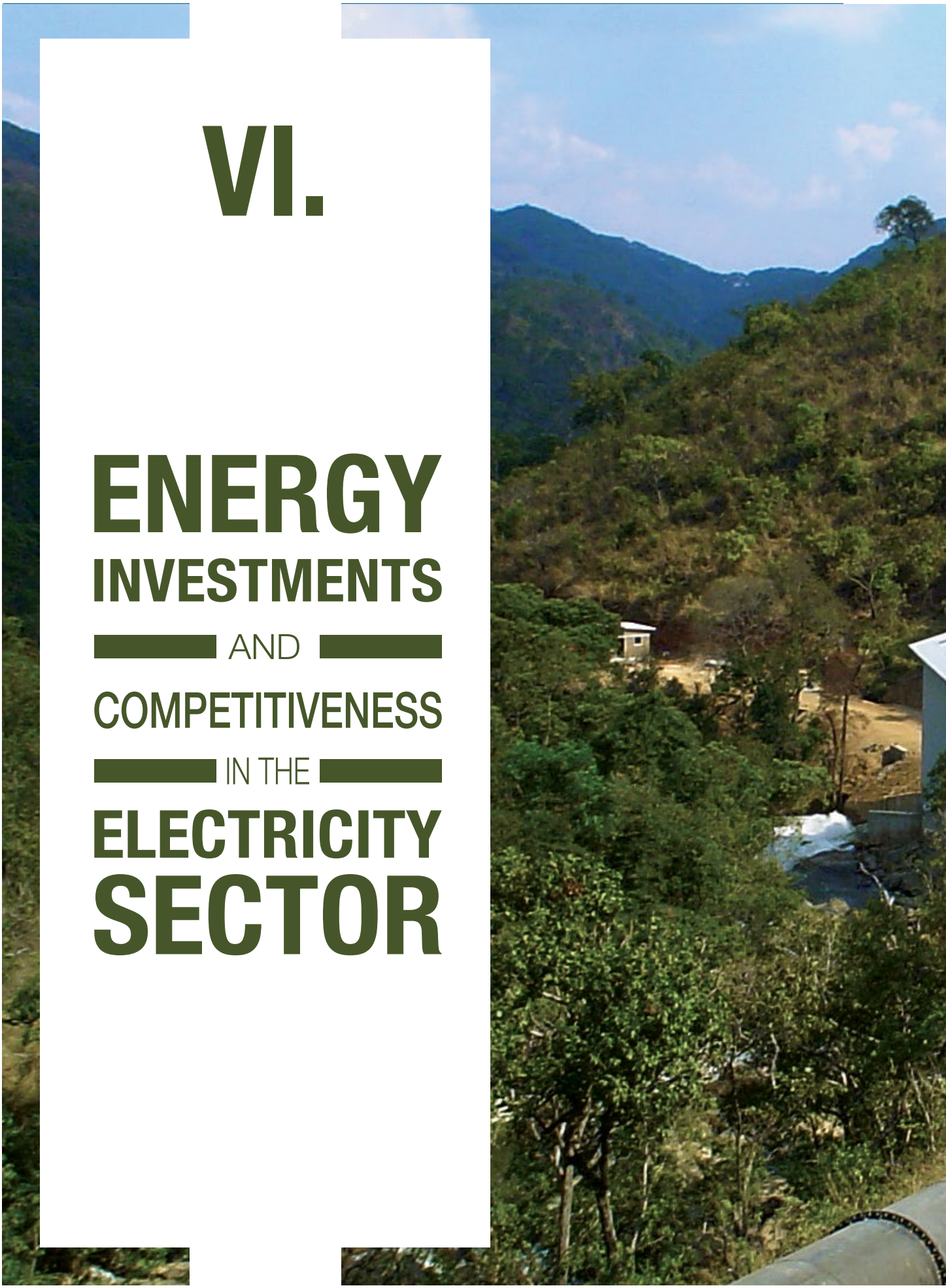
Tanzania has received significant energy-sector support from its development partners, whose harmonized assistance is aligned with national priorities and strategies. Tanzania has a well-coordinated working group of development partners involved in the energy sector, chaired by WB. The group meets regularly to discuss key sector issues and challenges, as well as development partners' approaches and interventions.

28 A complete list is provided in the TAREA directory (http://tarea-tz.org/index.php/membership/general-infomration).

Strengths	Weaknesses
Multi-player institutional framework Independent energy regulator REA Private actors Donor coordination	TANESCO Financial situation
Opportunities	**Threats**
Profound energy reforms proposed Opportunities for new players in power generation and rural electrification	Development and private finance predictability

VI.

ENERGY INVESTMENTS AND COMPETITIVENESS IN THE ELECTRICITY SECTOR



VI. ENERGY INVESTMENTS AND COMPETITIVENESS IN THE ELECTRICITY SECTOR

Renewable energies are competitive for electricity generation in Tanzania, especially hydro, geothermal and biomass. For off-grid solutions, RE are the lowest-cost option. The investments foreseen for the next decade will largely concentrate on coal and natural gas power plants and the only RE under wide development is large hydro. With the help of many donors, Tanzania is developing SREP that would help the take-off of geothermal energy and rural electrification through RE sources. Both donor support and foreign direct investment for the energy sector have been substantial in the last decade.

Competitiveness of RE grid-connected generation

RE sources are competitive for grid connected electricity generation in Tanzania. A supply curve based on the economic levelized cost of electricity in Tanzania is shown in Figure 5. The horizontal axis represents the cumulative capacity additions anticipated in the PSMP 2012 Update plus the renewable energies with potential in Tanzania. The vertical axis represents the weighted average levelized economic cost of electricity from each class of generation technologies. All renewable energy options have economic levelized costs of US¢12 or less per kWh, with geothermal (should the resource be proven) at about US¢ 6–8 per kWh. These cost estimates are indicative, based on the typical costs for each technology. Financial and economic costs will differ, depending on the cost and tenor of financing, taxes, duties and

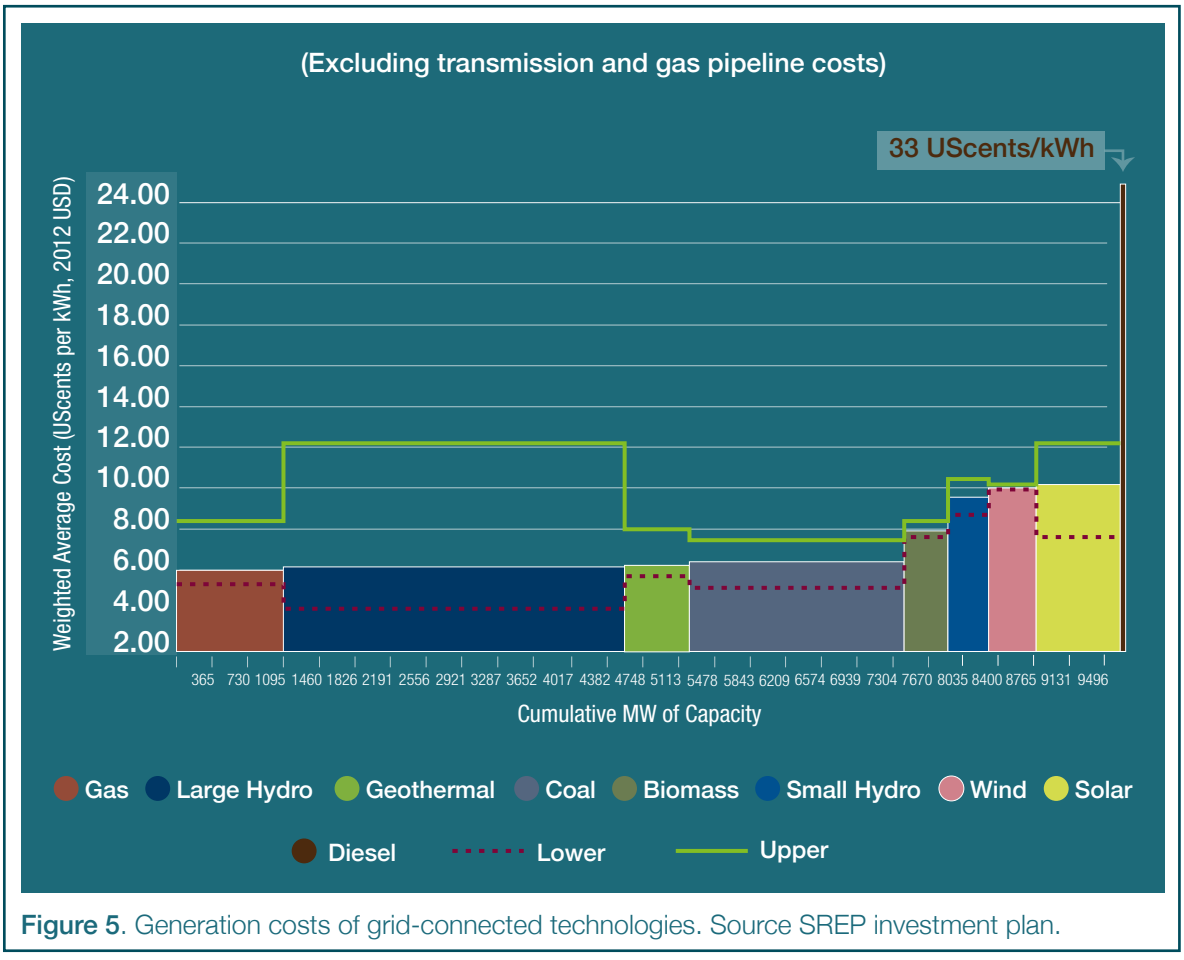


Figure 5. Generation costs of grid-connected technologies. Source SREP investment plan.

subsidies. Transmission costs are excluded because they are site-specific and project locations cannot yet be identified. The attractiveness of generation sites, whether renewable energy or fossil energy–based, could be lessened if sites are located far from the grid or main load centres.

Figure 5 is based on available data from existing or planned projects in the PSMP, while estimates for RE projects are based on current and projected future costs. The upper and lower bounds in levelized electricity cost are based on variances in the cost and performance of the technologies and fuels as reported in the PSMP and estimated for RE technologies. There is considerable variation as individual project costs vary; in the case of renewables, earlier projects will have a higher cost compared to later ones as cost reductions are expected.

Although the supply curve is relatively accurate in terms of current and projected costs, it does not fully reflect the potential contribution of renewables. The cost of natural gas and coal is based on current national costs with no escalation, although these costs are lower than international benchmarks. Solar has been constrained by the grid capacity to absorb it, though the resource itself is virtually unlimited. Biomass capacity does not include purpose-grown fuelwood plantations, and the true potential of geothermal and wind is still unconfirmed.

If the resource is proven, geothermal energy is competitive with gas-powered generation without the risks associated with future gas-price increases. Thus, any stations built will be substantially immune to future inflation. Its principal cost is associated with the risks of exploration. In terms of solar PV, costs have fallen sharply over the past few years and are expected to decline further to under US$1,000 per kWp in the near future. Wind is a somewhat more mature industry thus its costs are not expected to decline dramatically in the future. However, better characterisation of the wind resource could result in lower costs than estimated here.

Competitiveness of RE off-grid generation

Much of the country lacks access to grid electricity supply. In late 2012, the Rural Electrification Investment Prospectus study estimated the population split by electrification options. Early results indicate that, if the 2025 goal of 50% electrification is to be achieved, about half of the rural population might be better served by mini grids (20%) and off-grid options (30%). Given its relatively high fuel and operating costs, diesel is generally not the most economically viable option; in the future, most of these grids may have to rely on renewables, such as hydro, biomass (thermal or biogas) and solar (where diesel/solar hybrid systems may be more appropriate).

An indicative comparison shows that the cost of electricity using renewable-energy mini grids can be lower on a levelized economic cost basis (Table 3)[29]. These estimates are based on the current prevailing costs in Tanzania

Table 3 - Economic Levelized Cost of Electricity in Mini Grids from Various Energy Sources (Busbar Cost).

Factor	Unit of measure	Isolated diesel generator	Small hydropower plant	Biomass power plant	Solar PV with battery	PV-battery diesel hybrid
Levelized electricity cost at generator	US$ per kWh	0.59	0.23	0.29	0.71	0.53

Source: SREP Task Force calculations.

29 The financial cost will differ, depending on the financing terms and such factors as taxes, duties and subsidies.

Mini grids face further challenges surrounding the economics of electricity distribution, billing and payment collection. Thus, it is likely they will be developed mainly in areas with one or more anchor commercial clients and/or TANESCO, which can buy/sell bulk power in conjunction with the RE generation supplying the mini grid and thus justify the bulk of the generation investment. Distribution to households, generally low energy users, is likely to be marginally economic in many circumstances. Village micro-grids could serve small villages with relatively high population densities for which mini-grids are not viable[30].

About one-third of the population may need to use stand-alone or micro-grid technologies[31], such as solar PV, if they are to benefit from electrification in the short-to-medium term. The primary determinant would be whether load densities in these dispersed communities are too low to justify a mini grid. Various solar PV options compare favourably with kerosene lighting in terms of payback period and the amount of lighting delivered. If the added value of PV systems for charging mobile phones (and other uses requiring rechargeable or disposable batteries) is taken into account, then the preference for solar PV solutions becomes self-evident. Tanzania has experience in such solutions with about 6 MWp of off-grid solar PV deployed.

For about half the rural population, RE represents the future of electrification if the 2025 goal is to be achieved. In this way, remote rural communities can benefit from electricity services far sooner than if they were to wait for the arrival of national grid extension.

The Rural Electrification Investment Prospectus will define a least-cost investment plan for 2013–22, aimed at electrifying 1,200 development centres (about 6,000 localities) with the highest potential. Preliminary information suggests that at least 1,600 localities will require off-grid solutions, preferably mini grids. In addition, 5,500 localities will not be electrified even by 2022 and may therefore require pre-electrification solutions, such as SHSs and lanterns, or perhaps micro grids. The prospectus will guide the SREP off-grid electrification investments.

Prioritization of energy investments

Tanzania prepared two plans for energy sector development. The long-term PSMP, prepared in 2012, set the future development up to 2030. The BRN Initiative is a short-term program aimed at accelerating certain actions and investments from 2014-2017.

The Big Results Now Initiative

Through the BRN initiative, GoT decided to fast track several energy investments to be achieved by June 2016:

1. Complete 14 major power projects;
2. More than double TANESCO's base capacity to reach 2,260 MW;
3. Increase TANESCO's revenue by 50%;
4. Install more than 3,000 km of Hi-Vo power lines;
5. Replace 3.2 million inefficient light bulbs;
6. Provide electricity access to 5 million more Tanzanians;

30 Solar PV micro grids are under development in Tanzania.

31 Micro grids consist of a small, low-voltage (e.g. 12–48V), centralised solar PV array with a battery to serve a small number of customers (e.g. 5–10) located in the immediate vicinity of the power plant. Pre-payment meters or other devices are used to simplify billing and collection.

7. Increase consumption to 238 kWh/capita;
8. Eliminate EPPs.

The BRN proposes to achieve these objectives through three sets of actions:

1. Deliver more energy from existing assets and phase out EPPs. This will be achieved through the acceleration of the Mtwara pipeline, better dam management at Mtera, a reduction in technical and non-technical losses, a reduction in EPP cost and reliance, and the introduction of demand management.
2. Finalise new generation, transmission and distribution projects. Projects able to be completed in the short term will be prioritised with a Ministerial Delivery Unit to monitor implementation and use of alternative funding. GoT, PPPs and the private sector will fund the new power projects and the transmission projects will deliver the additional electricity generated. (Figures 6 and 7)
3. Restructure the sector. The BRN proposes to unbundle TANESCO and make the sector financially viable. (Figure 4 and paragraph 5.5)

The Power System Master Plan 2012-2030

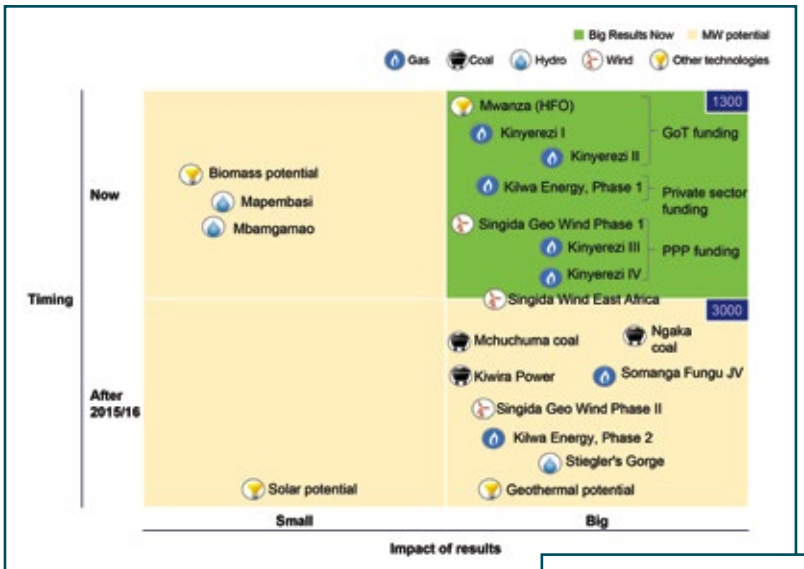


Figure 6. BRN - Priority power investments.

The PSMP is a long-term plan to drive investment through 2030. Prepared in 2012, it foresees more than 9 GW of additional installed capacity, which will be needed by 2035 to meet demand and substitute power plants at their standard retirement time. The PSMP is a business as usual case, and it prioritizes projects and technologies on the base of a series of economic, environmental and social indicators. In the absence of any changes in policy or of specific RE promotion projects, it is foreseen that the contribution of RE sources other than large hydro would be minimal. Only 2.7% of additional capacity (260 MW) would be sourced from biomass, wind and solar, while 37% would come from large hydro. In contrast, the "business as usual" case designed in the PSMP indicates a clear prioritization of investments in thermal generation through coal (40%) and gas (23%). (Figure 6)

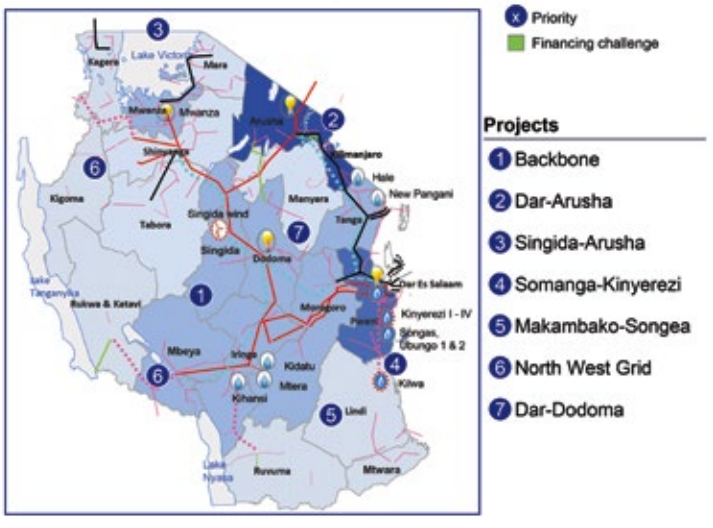


Figure 7. BRN priority distribution investments.

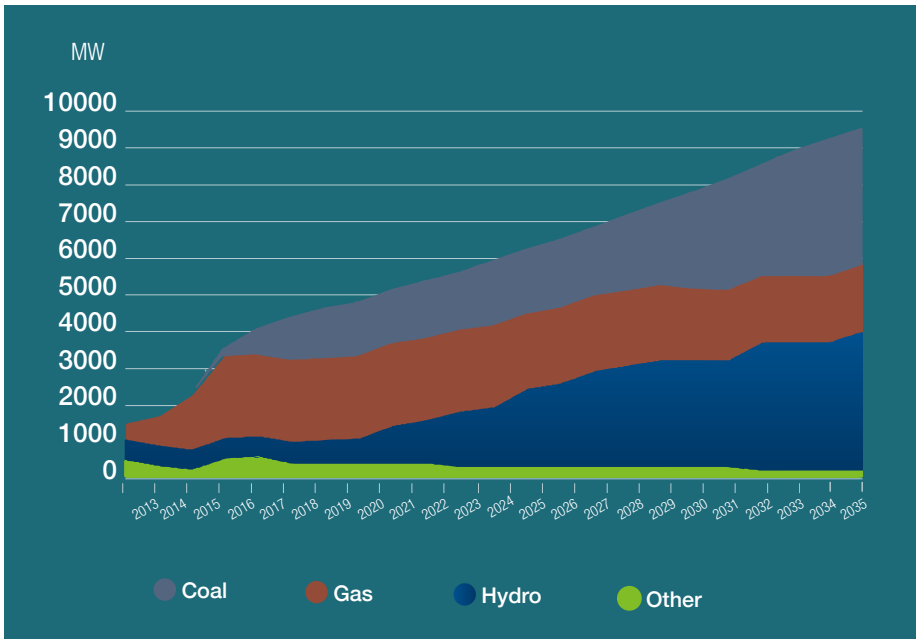


Figure 8. Changes in grid connected electricity production sources (Elaboration on PSMP 2012).

The PSMP included a short-term power expansion plan for 2012-2017, aimed specifically at a rapid catch-up with background growth in demand. It foresees around 3 GW of new installed base coming on line, largely gas power plants (71%) and coal (13%). The plan expects around 7% of new hydro, wind and solar capacity.

The long-term expansion plan foresees higher RE development. The PSMP identified 3 GW of new hydro projects and 260 MW of other RE (wind, solar and biomass). The share of hydro in total installed capacity is foreseen to grow after 2018 and reach around 40% by the end of the following decade.

The above figures do not include the implementation of the SREP Investment plan, whose areas of intervention will be:

1. Geothermal Power Development. SREP resources will be used to reduce geothermal resource uncertainty, partly mitigate development risks, and improve sector governance and capacity to encourage the private sector to invest in and supply dependable and cost-competitive geothermal electricity. Such supplies can counter the increased unpredictability of hydropower output, release other energy sources that have high-value alternative uses, and reduce global and local environmental damage.

2. RE for Rural Electrification. The SREP would catalyse the private sector in supplying RE in rural areas to contribute to the 2035 national goal of increasing electricity access to 75% of the population. The programme would focus on mini-grid, micro-grid and stand-alone renewable-energy electricity supply (mainly solar PV systems) to more remote and dispersed communities. In those areas, the only alternatives are high-cost diesel and expensive yet poor-quality service supplied by kerosene and disposable batteries.

Foreign direct investments and clean development mechanism

Attracting foreign direct investment (FDI) for energy infrastructure is an objective of national development policies and the PSMP. According to the WB Private Participation in Infrastructures Database, between 2000 and 2011, Tanzania hosted 11 FDI projects in the electricity sector for a total of US$841 million (of which US$707 million is in physical assets)[32]. The foreign investments have interested exclusively independent producers and EPPs in thermal generation activities (mainly through natural gas). New FDI in the RE sector is foreseen in the SREP and the PSMP, which could be of interest to the wind, biomass, solar and geothermal sub-sectors.

Tanzania has few carbon finance projects; there are three registered Clean Development Mechanism (CDM) projects (in landfill, hydro and biomass) and three under validation[33]. There is also one small-scale CDM Program of Activities (CDM PoAs) approved (on Solar PV water purification). Another three CDM PoAs are at validation stage, including one from REA to support the development of SPPs and improve rural access to energy through renewable energy sources. However, opportunities to broaden the use of CDM instruments are presently limited due to the low price of certified emission reductions (currently less that €0.50 per ton of CO_2 certified emissions reduction).

Development aid for energy projects

Aid to Tanzania's energy sector has grown considerably in the last decade, surpassing US$1.5 billion in commitments between 2003 and 2012. Aid rose, in particular, after 2007 and has been largely focused (76%) on improving transmission lines and energy policy (13%)[34]. The main donors have been WB-IDA (30%), the US (18%), Japan (12%), Sweden (10%), Norway (9%) and AfDB (8%).

For the immediate future, international aid will continue to support the Tanzanian energy sector at a substantial level. Donors' multi-year energy-sector commitment through 2016–17 totals about TZS 1.5 trillion (US$1 billion), of which approximately US$350 million is for renewable energy[35]. In addition to technology-specific assistance, donors will provide sector-wide support.

In this context, NORAD and SIDA are expected to provide significant funding to the Rural Energy Fund, while AFD has established a €20 million credit line for renewable and rural energy. In addition, DFID has a £30 million regional soft loan facility that can finance renewable energy investments. JICA and KfW, the German government-owned development bank, are also providing support to renewable energy, particularly for geothermal development. DFID is preparing a regional mini-grid facility for Tanzania. The U.S. Agency for International Development and KfW are also contemplating support to mini grids. Furthermore, the European Union has supported five mini grids in Tanzania and is considering funds for scaling up these interventions.

Strengths	Weaknesses
Economic competitiveness of RE sources for grid connected and off-grid solutions Strong donor support and FDI inflows CDM implementation Short- and long-term investments planned	Following the "business as usual" scenario, only large hydro will be developed
Opportunities	**Threats**
Investment opportunities in RE	Still limited experience with RE other than large hydro

32 http://ppi.worldbank.org/
33 Cfr UNEP Risoe Centre - CDM Pipeline and PoA Pipeline http://cdmpipeline.org/
34 Source - Elaboration on OECD - CRS Database, January 2014 update.
35 According to the latest PSMP, the required financing through 2017 is about US$10 billion, plus US$3.5 billion for rural electrification through 2022. However, the delineation of costs between government and development partners has not yet been defined. Current development-partner support is about 7-10 % of the required investments.

VII.

RE DEPLOYMENT BARRIERS AND POSSIBLE MITIGATION MEASURES

VII. RE DEPLOYMENT BARRIERS & POSSIBLE MITIGATION MEASURES

RE is a great opportunity but it encounters several barriers related to institutional or policy issues, knowledge and capacity gaps, and economic and financial factors. GoT, with support from development partners, is developing mitigation measures that include better planning tools and effective policy reforms, strengthening of institutional and human capacity, and financial incentives.

Institutional, policy, regulatory and legal frameworks

Barriers	Mitigation measure	Primary relevance
Uncertainty about the future direction of power-generation investment planning; i.e. the PSMP baseline plan has a limited role for renewable energy (large hydro), reflecting inadequate data and unavailable power planning methods that could more effectively integrate a wide range of renewable energy options, especially distributed generation.	PSMP planners require access to more effective planning tools and better planning processes. Some progress is being made. For example, the Rural Electrification Investment Prospectus explicitly considers distributed renewable energy generation. Future revisions to the PSMP will improve its consideration of renewable energy.	All renewable energy
Project developers face multiple risks in developing renewable energy projects in Tanzania, including off-taker risk (particularly TANESCO), currency risks (if power purchase agreements in TZS), and resource uncertainty.	Considerable progress has been made in reducing regulatory risks, especially for SPPs (under 10MW), but similar work is now needed for larger-scale renewables. TANESCO needs revitalisation to become financially sustainable, with a cost-reflective tariff. In the interim, risk-mitigation mechanisms against TANESCO's default/late payment risk need to be developed. Government can invest in resource assessments (*e.g.* geothermal, wind, small hydro and biomass) and make this information publically available.	All renewable energy
Complex formal requirements linked to preparation and approval of renewable energy projects, resulting in lengthy time required to bring financial closure to smaller projects.	Investments in renewable energy are still relatively new in Tanzania. The policies, regulatory and administrative processes, and financial incentives are not yet tested. Administrative processes are quite lengthy and need to be mainstreamed. Further institutional capacity strengthening and streamlining of processes are required. The REA could play a facilitating role (*e.g.* becoming a one-stop shop for rural electrification projects). Also, more comprehensive transaction advisory services or funding are needed. More broadly, government must address constraints facing IPPs, and, in fact, it has committed to do so.	All renewable energy
Lack of information and uncertainty about grid extension plans results in worries about grid encroachment and increases the risks borne by private companies in developing mini-grid projects.	The Rural Electrification Investment Prospectus will identify areas for grid extension and renewable-based, mini- and off-grid supply opportunities.	Mini grids and stand-alone off-grid renewable

Biomass resource extraction from forests is virtually unregulated, which leads to unsustainable harvesting of fuelwood and charcoal. The current regulatory and enforcement environment and the move to other energy sources have not proven effective. Also, there is little awareness of the need to operate sustainably.	Mitigation measures include improving revenue collection methods and providing funds and training to local governments to improve sector supervision, using fiscal incentives to support sustainable harvesting practices and strengthening capacities for monitoring and enforcement.	Biomass

Knowledge sharing and capacity issues

Barriers	Mitigation measure	Primary relevance
Pre-investment and transaction costs for renewable energy, including resource assessment and feasibility studies, are high.	REA matching-grant support programmes should be expanded and adapted to the needs of a scaled-up program. The current project-by-project approach is time intensive with high transaction costs; bundling services would mean delivery of better-quality services at lower cost—a key aim of SREP IP off-grid electrification. Cost-shared assistance should be provided, possibly converting it to equity/debt on successful financial closure.	All renewable energy, especially SPPs and mini grids
Tanzania has limited expertise in undertaking feasibility studies, detailed design and construction. It is difficult to find qualified staff willing to be posted in remote locations.	Building human and institutional capacity requires expanding specialised training, supporting local educational and sector institutions that deal with renewable energy, supporting partnerships with international firms through South-South and North-South exchanges, and developing implementation models that can deliver services more efficiently.	All renewable energy
There is a lack of renewable resource information on needed quality and duration.	Resource assessment work should be expanded for geothermal and should cover biomass and solar resources (wind resource monitoring is ongoing). Hydro resource characterisation for mini grids should be expanded. Information should be easily accessible to developers.	All renewable energy
Low-cost, small solar lighting products sold directly to customers may be of low quality, and customers may be unable to discriminate between well- and poorly-made products.	Building on the outcomes of the Lighting Africa Program can create public awareness of high-quality products and thus encourage their marketing and sale.	Off grid
Extraction enforcement is lacking in forests, which are easily accessible and provide low- or no-cost fuelwood supplies.	Alternatives to unsustainable wood extraction include better resource information, adoption of sustainable harvesting plans, community forestry, support of efficient charcoal production and more effective wood pricing.	Biomass
Consumers lack access to better and more affordable alternatives to charcoal and fuelwood.	Solutions include pilot testing and market development of more efficient charcoal production, briquetting, improved cookstoves, and biogas and other alternative fuels, working in partnership with the Global Alliance for Clean Cookstoves and others.	Biomass

In terms of economic and financial issues

Barriers	Mitigation measure	Primary relevance
Renewable energy projects have a high capital cost. Technologies are capital intensive and the period for pre-investment, financial closure and construction is of long duration. The types of financing and financing conditions available domestically are not well suited to the development of renewable energy projects.	By increasing access to long-term financing through commercial banks, the high capital expenditure can be spread over a longer period. Transaction advisory services can be expanded to assist local developers in finding equity partners. Thus, WB or similar credit lines should be extended and scaled up. Partial risk guarantee instruments can be offered to cover off-taker, currency and other commercial risks that foreign equity partners may require.	All renewable energy
Revenues are uncertain. For projects that sell power to TANESCO, there is a risk of payment delay.	Government is engaging with its development partners and TANESCO to help resolve the current problem. The WB has approved the first tranche of a policy operation to help ease TANESCO's financial burden. This will facilitate repayment of overdue accounts. Both of the proposed SREP projects plan to establish risk guarantees to avoid TANESCO payment delays to the private sector. AfDB has approved the first tranche; WB approved the second one in March 2014.	Grid-connected IPPs and SPPs
Rural residents spend a significant portion of their income on energy services yet have limited ability to pay for electricity connections and consumption under traditional billing arrangements *(i.e.* end of the month or every three months).	Output-based grants can be used to buy down a portion of the capital cost of off-grid services. Credit and/or pay-as-you-go solutions can be offered so that households can spread out system payments over time, mirroring current spending on energy services, such as kerosene for lighting or battery-charging for mobile phones.	Mini-grids and off-grid
The informal nature of the fuelwood/charcoal industry and low incomes make it difficult to gain access to capital needed to improve production, develop sustainable wood sources and reduce consumption by using more efficient devices.	Microfinance organisations, coupled with technical assistance and technology transfer, can be used to provide financing.	Biomass

APPENDIX

Main stakeholders' contacts

National Bureau of Statistics	http://www.nbs.go.tz
Ministry of Energy and Minerals (MEM)	http://www.mem.go.tz
Rural Energy Agency (REA)	http://www.rea.go.tz
Energy and Water Utilities Regulatory Authority (EWURA)	http://goo.gl/4y3hOL
Tanzania Electric Supply Company (TANESCO)	http://www.tanesco.co.tz
Tanzania Renewable Energy Association (TAREA)	http://www.tarea-tz.org
Tanzania Traditional Energy Development and Environment Organisation (TaTEDO)	http://www.tatedo.org
Tanzania Engineering and Manufacturing Design Organisation (TEMDO)	http://www.temdo.or.tz
Women Development for Science and Technology (WODSTA)	http://www.wodsta.org

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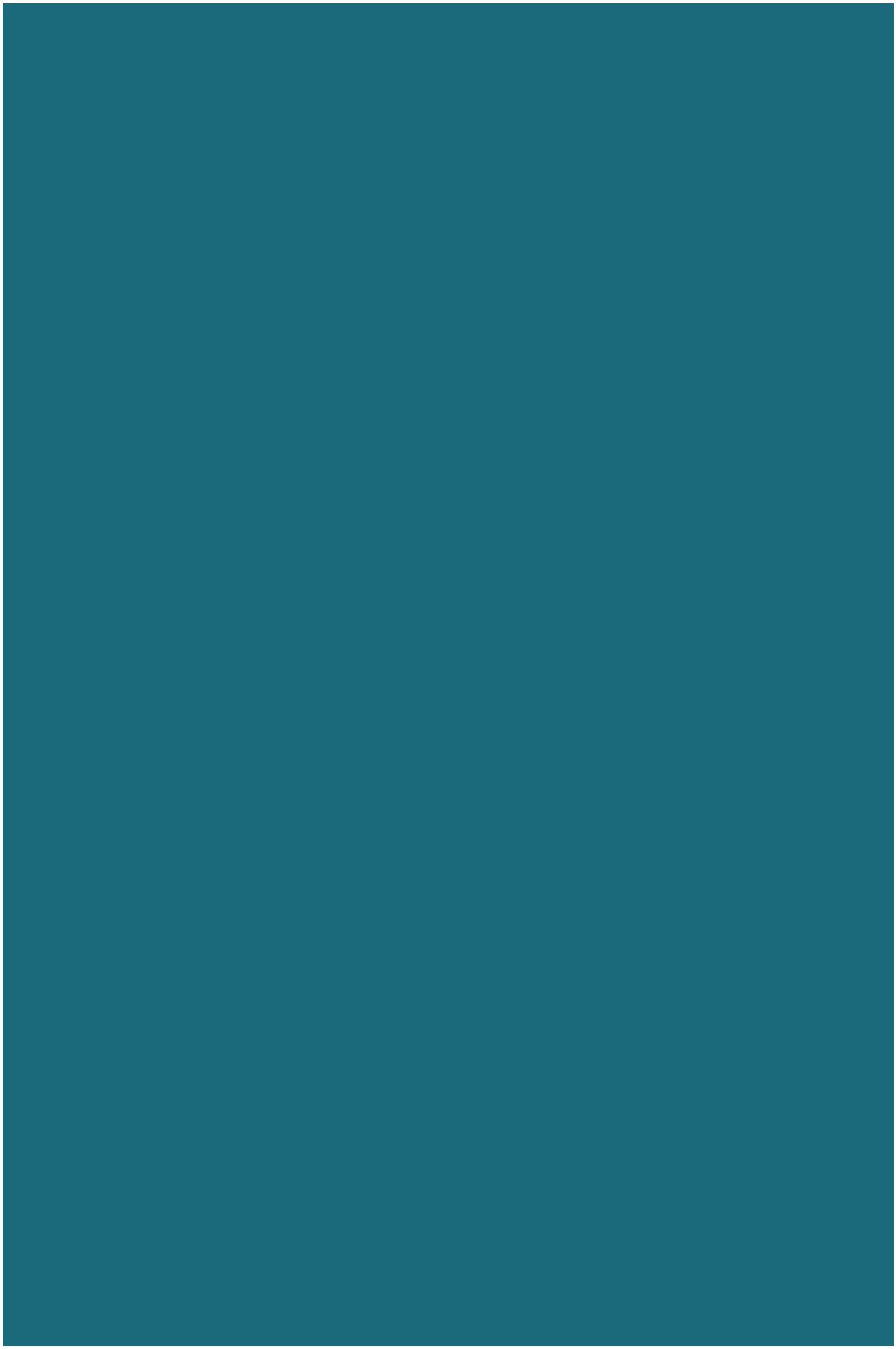

RENEWABLE ENERGY IN AFRICA

TANZANIA COUNTRY PROFILE

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