

Africa-EU Renewable Energy Cooperation Programme (RECP):
Higher Education for Renewable Energy

Country Mapping



Tanzania

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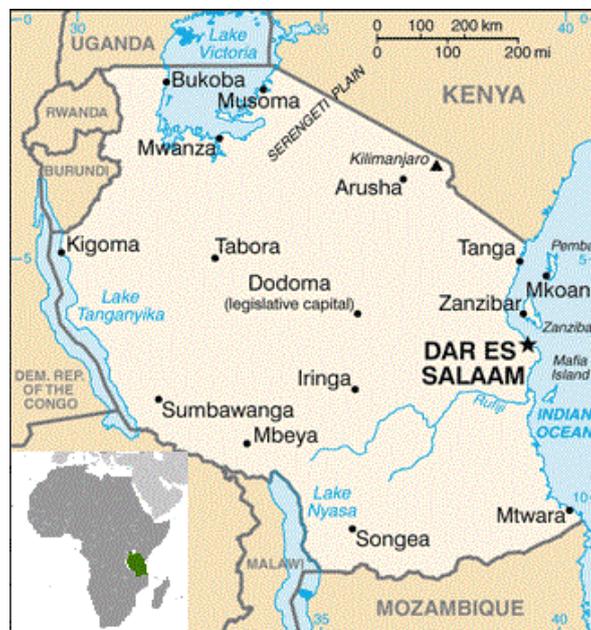


Figure 1: Map Tanzania (own development) (CIA, 2014)

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1 Tanzania at a Glance

1.1 Population and Geography

Table 1: Population (World Bank, 2014a), (National Bureau of Statistics, 2013), (Laurea University, 2015), (CIA, 2014)

Population, total (2013)	49,253,126
Population, growth (2013)	2.8%
Population density (2013)	56 / km ²
Urban population (2013)	28%
Life expectancy at birth (2013)	63 years
Major Cities	Dodoma (capital), Dar es Salaam, Mwanza, Arusha
Language:	Official: English, Swahili (de facto) Other: Arabic, many local languages
Ethnic Groups:	Bantu (95%, more than 130 tribes), Other African (4%), Asian, European, Arab (1%) Zanzibar: Arab, African, Arab/African-mixed
Religion:	Christian (30%), Muslim (35%, main belief in Zanzibar), Indigenous beliefs (35%)

Table 2: Geography and Climate (CIA, 2014)

Location	Eastern Africa, bordering the Indian Ocean, between Kenya and Mozambique
Area	947,300 km ² , of which 885,800 sq. km is land and 61,500 sq. km water surface, incl. the islands of Unguja, Pemba and Mafia
Neighbouring Countries	Burundi, Democratic Republic of the Congo, Kenya, Malawi, Mozambique, Rwanda, Uganda and Zambia
Climate	Varies from tropical along coast to temperate in highlands
Terrain	Plains along the coast; central plateau; highlands in north and south
Natural hazards	flooding on the central plateau during the rainy season; drought; limited volcanic activity in the North (Mt. Ol Doinyo Lengai; elev. 2,962 m)

1.2 Government and Legislation

Table 3: Government system Tanzania (CIA, 2014), (Laurea University, 2015), (Transparency International, 2013)

Official name	United Republic of Tanzania
Conventional short form	Tanzania
Form of state	Federal presidential constitutional republic
Administrative divisions	30 regions; Arusha, Dar es Salaam, Dodoma, Geita, Iringa, Kagera, Pemba North, Zanzibar North, Katavi, Kigoma, Kilimanjaro, Pemba South, Zanzibar Central/South, Lindi, Manyara, Mara, Mbeya, Zanzibar Urban/West, Morogoro, Mtwara, Mwanza, Njombe, Pwani (Coast), Rukwa, Ruvuma, Shinyanga, Simiyu, Singida, Tabora, Tanga
Chief of state	President Jakaya KIKWETE (since 2005)
Head of Government	The same as chief of state
Parties as distributed in the National Assembly by seats (mainland only)	CCM: 259, CHADEMA: 48, CUF: 34, NCCR-M: 4, other: 7, Zanzibar representatives: 5
Independence	1961 (mainland) and 1964 (Zanzibar & Pemba)
Corruption perception index ¹	33 (Rank 111 of 177)

After gaining independence from Britain in 1961 and 1964 respectively, the former colonies of Tanganyika and Zanzibar joined to form the United Republic of Tanganyika and Zanzibar on 26th April 1964, later renamed to United Republic of Tanzania. Zanzibar kept a semi-autonomous state with its own president, national assembly and judiciary system.

The first independent government embarked on a socialist model of development as a one-party state under the leadership of Mwalimu Julius Nyerere, one of Africa's most respected leaders well acclaimed for his visionary education policies.

In 1992, Tanzania finally became a multi-party democracy and held its first elections in 1994. Since then, the Chama Cha Mapinduzi (CCM; "Revolutionary Party") won the elections for four successive five year terms with a strong, though decreasing majority of votes (Manson, 2013).

Tanzania is well known for a track record of political stability, but its ruling party CCM, the longest ruling party in power in Africa, is facing increasing resentment. Support for the main

¹ The corruption perception index is developed by Transparency International. A value of 0 is counted as highly corrupt and 100 as very clean.

opposition party Chadema is growing in the urban centres, and it won 27% of votes during the 2010 elections. In 2015, current president Kikwete has to step down, and it might be the first time in Tanzanian history that a strong opposition is faced (Manson, 2013).

1.3 Economy and Infrastructure

Table 4: Economic figures Tanzania (World Bank, 2014a), (UNDP, 2013), (CIA, 2014)

Overview			
World Bank Rating	Low income		
Human Development Index (2013)	0.488 (Rank: 159/182)		
GINI Index (2012)	37.8		
Population living below poverty line	43.5%		
Currency	Tanzanian Shilling TZS (1 US\$ = approx. 1600 TZS)		
Economic Indicators	2011	2012	2013
GDP (in current Billion US\$)	23.87	28.25	33.23
GDP per capita PPP (constant 2011 international \$)	--	1,596	1,656
GDP growth (annual %)	6	7	7
GDP per capita growth (annual %)	3.3	3.7	3.8
Unemployment, total (% of total labour force) (modelled ILO estimate)	3.5 (or 11% (National Bureau of Statistics, 2013))	3.5	--
Unemployment, youth (% of total labour force aged 15-24)	6.6	6.5	--
Ease-of-doing-business index (1 = most business friendly, 185 = least friendly)	133	134	--
Inflation, consumer prices (annual %)	12.7	16	7.9
Structure of Economy	2011	2012	2013
Agriculture, value added (as % of GDP)	28	28	27
Industry, value added (as % of GDP) (incl. Manufacturing as % of GDP)	25 (10)	25 (10)	25 (10)
Services, value added (as % of GDP)	47	47	48

The UNDP World Development Report positions Tanzania as one of the better performing countries within the “low human development group” (HDI rank 159) with better results in health and education, but worse in terms of GNI (UNDP, 2013).

Agriculture accounts for a quarter of GDP and provides work to 80% of the workforce. However, it only grows 4% annually, while only a small number of fast growing, capital intensive sectors drive total GDP growth: Communication, financial services, construction, manufacturing and retail trade. The government is stimulating growths in these areas by heavily investing in infrastructure development and opening up markets for private competition, e.g. for aviation and financial services (World Bank, 2014).

Tanzania does not boast with abundant mineral resources, but some large natural gas reserves have been found in the southern part recently (BBC, 2014). Other sectors with great potential include tourism, manufacturing and trade (African Economic Outlook, 2012)

Frequent power-cuts and a serious shortage of energy supply have been identified as the main obstacle for faster growth of industries by AfDB, OECD, UNDP and others. The main challenges for the Tanzanian economy include higher job creation within its growth sectors, especially for youth and women, improve drought resilience of its agriculture, develop physical infrastructure and provide sufficient energy to allow its industries to grow faster (African Economic Outlook, 2012).

Table 5: Infrastructure Tanzania (Laurea University, 2015; CIA, 2014)

Railways	3,700 km
Roads	91,000 km, of which 6,500 km are paved
Airports	106, of which 11 are paved Major airports: Dar es Salaam, Zanzibar, Kilimanjaro
Telephones (main lines in use) (2011)	161,100
Telephones - Mobile cellular (2012)	27.22 million
Internet users (2009)	678,000

Major seaports are Dar es Salaam and Zanzibar; the port of Dar es Salaam is a major international port in terms of container and tonnage, and in fact a key trans-shipment centre for East Africa, along with Mombasa in Kenya. Lake Tanganyika, Lake Victoria, and Lake Malawi are important avenues of commerce with neighbouring countries; the rivers are not navigable (CIA, 2014).

Most infrastructure is aging. However, Tanzania’s road and rail networks provide sufficient basic access throughout the country and are of high strategic importance for neighbouring countries (Laurea University, 2015). There are currently several major donor-backed projects underway to upgrade and improve physical infrastructure (CIA, 2014).

Since 2010, Tanzania is connected to the submarine SEACOM and EASSy fibre-optic cables and supplied with cheap and fast bandwidth. Its telephone fixed-lines infrastructure is inadequate, but mobile and internet infrastructure and providers are growing rapidly. The ICT sector is supported by a very proactive policy framework and new services such as mobile payment systems are on the rise (Tanzania Invest, 2014).

2 Energy and Renewable Energy

2.1 Overview

Table 6: Tanzania Energy Overview (World Bank, 2014a), (IEA, 2013), (IRENA, 2010)

	2001	2011
Energy use (TWh)	165	241
Energy production (TWh)	155	224
Net import of energy (% of Energy use)	6	7
Electricity consumption (TWh)	2.11	4.27
Electricity production (TWh)	2.75	5.30
Electricity consumption (kWh/ per capita)	60	92
Total electricity capacity (MW) (EIA: US Energy Information Administration, 2014)	862	845
Electric power transmission and distribution losses (% of output)	26	19
Access to electricity (% of total population)	--	15% ²
% of urban population	--	46%
% of rural population	--	4%
Electricity production by source: (% of total production):		
Hydro	94.5%	49.3%
Natural Gas	0	48.8%
Renewable Energy excl. Hydro	0	0
Coal & Oil	5.5%	1.9%
Share of population using solid fuels (2009)	90%	

² 18.4 in 2013 (ESMAP, 2014)

More than an overwhelming 90% of Tanzania’s energy needs are still met by traditional biomass, which means fuel wood use in rural areas and charcoal in urban areas. Even in the largest city of Dar es Salaam, 70% of households use charcoal for their daily needs. Electrification in Tanzania is extremely low and underdeveloped, even by average African standards. Being a relatively large country by population, this breaks down to a per-capita consumption of less than 100 kWh. In comparison, this is less than the per-capita consumption of DR Congo, or only 15% of the Zambian one.

As of May 2014, Tanzania’s total installed generation capacity was 1,583 MW, composed of hydropower 561 MW (35%), natural gas power plants of 527 MW (34%) and liquid fuel power plants of 495 MW (31%). Tanzania imports only a small but rising amount of its energy, which mostly consists of transport fuels, plus about 16 MW of electricity from Uganda (10 MW), Zambia (5 MW) and Kenya (1 MW). The country has to import all its fluid fossil fuels, which results into a high and volatile price.

Traditionally, nearly all electricity is produced by hydropower in Tanzania, but this becomes increasingly difficult due to changing rainfall patterns and resulting lower water levels. Several drought-related power crises have occurred since the 1990s. During the past decade, natural gas has become the new hope for the sector, and already accounts for nearly half of all electricity production today. Most importantly, substantial reserves of natural gas have recently been discovered in the South of Tanzania. The total discoveries of natural gas from the onshore natural gas fields are about eight trillion cubic feet (TCF) and these are located at Songosongo, Mnazi Bay, Mkuranga, Kiliwani North and Ntorya. Currently, only the Songosongo and Mnazi Bay onshore gas fields are supplying gas for downstream activities.

2.2 Energy Policy

Table 7: Tanzania Energy Policy (Reegle, 2014; IRENA, 2010; REN21, 2014)

Organisations responsible for energy policies	Ministry of Energy and Minerals (MEM)
Energy regulator	Energy and Water Utilities Regulatory Authority (EWURA)
Government Agency	Rural Energy Agency (REA)
Energy policy publications	Energy and Water Utilities Regulatory Authority Act (2001) National Energy Policy (2003) Rural Energy (Agency) Act (2005) Electricity Act (2008/2009) Guidelines on Biofuels (2010/2011)
Targets to increase use of	14% RE by 2015 ³

³ No details given whether this figure excludes hydropower

Renewable Energy	75% electrification by 2035 (ESMAP, 2014)
Subsidies/Incentives for RE	<p>Feed-in tariffs for RE small power producers (100 kW to 10 MW)</p> <p>Tax incentives possible (REN21, 2014)</p> <p>SREP pilot country: 719 million US\$ to be invested in RE up-scaling (United Republic of Tanzania, 2013)</p>

Since 2001, the Energy and Water Utilities Regulatory Authority (EWURA) regulates the power sector as an autonomous body. The Ministry of Energy of Minerals (MEM) is charged with setting and reviewing the overall energy policies and strategies of the country.

The Rural Energy Act led to the establishment of the Rural Energy Agency in 2008. It is tasked to oversee rural electrification and, together with the MEM, implements solar PV and some planned pico/micro-hydro projects, using the Rural Energy Fund (REF) initiated by the same act. Both REA and REF are governed by the Rural Energy Board (REB).

The National Energy Policy was last revised in 2003. It explicitly states the purpose of mitigating climate change and conserving forest reserves by promoting efficient biomass technologies. Except this statement, the policy is often criticised for not specifying concrete RE targets.

Since 2008, there is a feed-in tariff scheme for small-scale RE power producers up to 10 MW. Above that, individual PPAs have to be signed. There are different tariffs for national grid and mini-grid supply, which are adjusted annually based on the avoided cost of conventional energy. It varies according to season: The 2012 average was 9.3 US\$ cents/kWh and 29.4 US\$ cents/kWh for mini-grids (Meza, 2013).

More recently, the MEM released “Guidelines for Sustainable Liquid Biofuels Development in Tanzania” (Tanzania Natural Resource Forum, 2011). There is said to be great potential for agro-fuels production (jatropha, sugarcane, and palm) in Tanzania and its growth is supported by the agricultural development strategy of the government. So far, there have been mixed experiences and topics such as land grabbing are often being discussed in this context (Oakland Institute, 2012).

The underdeveloped energy sector has been identified by national and international key stakeholders as the major hindrance for faster economic growth (African Economic Outlook, 2012). As such, there are several exciting initiatives underway: Tanzania has been chosen as pilot country for the Scaling-Up Renewable Energy Program (SREP) that is operating under the Strategic Climate Fund as part of the Climate Investment Funds (CIF) initiated and largely funded by the Multilateral Development Banks (i.e. World Bank Group, AfDB, ADB, EBRD, IDM). A 2013 investment plan by the Tanzanian government shows the planned investment of 719.25 million US\$ in two projects: Geothermal power development and Renewable Energy for Rural Electrification (RERE) (United Republic of Tanzania, 2013).

The establishment of a stakeholder network for renewable energy, i.e. Tanzania Solar Energy Association (TASEA), in 2000 was very instrumental in pushing for exemption of Value Added Tax (VAT) on solar and wind energy equipment. This network was then renamed as Tanzania Renewable Energy Association (TAREA) and remains to be crucial for renewable energy stakeholders including NGOs, private companies, professional bodies and individuals but also government agencies. Although no detailed study has been done on the impacts of the exemption of VAT on solar and wind energy equipment, accessibility of such equipment has increased with reference to the rural population that is not connected to the grid.

2.3 Renewable Energy

2.3.1 Potential and Projects

Hydro: Hydropower has been the main source for electric power generation in Tanzania so far. As of 2014 hydropower still accounts for 38% (560 MW) of Tanzania's installed capacity (1,500MW) (Lazimah, 2014). Tanzania mainly has hydro power potential in the Rift Valley escarpments in the West, Southwest and Northeast of the country. During the past two decades, the hydroelectric supply became very unreliable due to decreasing water levels. Droughts frequently cause power crises in the urban centres and even sometimes force factories to temporarily close and lay-off workers. Unfortunately, fluctuations cannot easily be balanced out with imports as the neighbouring countries equally rely on unpredictable hydropower sources.

There is 4.7 GW assessed potential and 3.2 GW confirmed capacity of hydroelectricity. Only 15% of the assessed potential has been developed so far, but several new projects are currently underway.

Currently, 480 MW of small hydropower potential resources has been assessed. However, less than 25 MW has been developed and most of the developed small hydropower projects are owned by private entities (GIZ, 2009) and are not connected to the national grid.

The MBSH⁴ programme aimed to build 3.2 MW micro hydro power generation capacity between 2011 and 2014 with an investment amount of 13.4 million USD, supported by the United Nations Industrial Development Organization, Global Environment Facility, and national actors. In total, nine plants were planned with Andoya being the largest one (1,000 kW), followed by Tandala, Uliwa and Chita with 400 kW each (Adebayo, Sovacool, & Imperiale, 2013).

Geothermal: Tanzania is a member of the Rift Valley programme Africa Rift Geothermal (Mwangi, 2008) that is involved in geothermal energy studies and receives funding from GEF/UNEP. Also, the SREP programme identified geothermal development as a main focus of investment.

⁴ Mini-Grids Based on Small Hydropower Sources to Augment Rural Electrification

Currently, there is a known potential for geothermal power at a magnitude of 650 MW in 50 identified sites. 15 sites thereof could become economically viable developments, the largest being in Mbeya with a potential of 100 MW. However, geothermal development has been under dispute because it may adversely affect lakes and water sources of some of the country's major natural reserves that are also used for tourism.

Solar: Throughout the country, there is high average solar irradiation. PV power mainly plays an important role in rural electrification programs as stand-alone solutions for far-off areas. There is a still small but increasing number of small- to medium-sized distributors and private as well as donor/government backed programs exist (Meza, 2013).

Biomass: As the main source for primary household energy needs, biomass resources are highly pressured and recently receive growing attention throughout the country. New attention is mainly given to the development of large-scale agro-fuel crop farming as part of agricultural development strategies (Oakland Institute, 2012). A few small-scale biogas programs are underway, too (SNV, 2014).

Wind: There is potential for wind power along the coast that has been mapped by TANESCO, the national utility. A study conducted by MEM, TANESCO and DANIDA in the year 2007 revealed potential sites for wind power generation with average wind speeds greater than 8 m/s. Despite of lack of large scale wind power generation projects, recently there has been a number of small scale wind turbine installation at various sites.

2.3.2 Markets and Jobs

"Tanzania National Electric Supply Company (TANESCO) has the role of generating, transmitting, and distributing electricity to all parts of the country. TANESCO operates the grid system and isolated supply systems in Kagera, Kigoma, Rukwa, Ruvuma, Mtwara and Lindi" (Reegle, 2014).

There are several independent power producers (IPPs) in the relatively liberalised Tanzanian market who mainly produce electricity from petroleum or natural gas and sell to TANESCO or operate own mini-grids. Major players are Independent Power Tanzania Limited (IPTL), Symbion and Agrreko. Songas, Artumas Group & Partner and APR Energy are also involved in the market (Laurea University, 2015).

"Private investors (IPPs and EPPs) in the power sector contribute by 40% to the installed capacities [...] A number of private companies are engaged in small renewable power development to sell power to TANESCO and/or sell directly to retail customers. [...] 2 plants, TPC and TANWAT, are run on basis of biomass and sell the power to the grid (19.7 MW in total). The 4 MW hydropower plant Mwangi is supplying power to the nearby rural villages with excess being sold to TANESCO" (AHK, 2013).

There are several barriers for private investors, especially a lack of information about future grid development plans by the government. Further, the feed-in tariff scheme does not offer guaranteed returns. Moreover there is mistrust in the private sector: due to its immaturity

and its questionable ability to deliver results the public sector often considers working with private sector as an admission of failure (GIZ, 2013).

Despite this reluctance in private sector engagement (not only in the RE field) an increasing number of collaborations is being established in the energy sector. “An Energy Sector Support Programme is currently in preparation, focusing on renewable energy and the management of the recently discovered natural gas fields in southern Tanzania. The Government is engaged with development partners and the private sector to develop the appropriate legal structures and fiscal policies that are required in order to exploit its domestic reserves of natural gas, coal reserves and hydro-power potential. The Public Private Partnership Act of 2010 and the PPP Regulations of 2011 provide a reasonable framework” (GIZ, 2013).

A target market study for Solar PV & Wind Power in Tanzania has been conducted by the German Chamber of Industry and Commerce Abroad. The grid-connected market is at the very early stages in Tanzania. Due to really low electrification rates and high electricity costs the pico-PV and solar home systems market are and will be predominant in the field of RE. A promising diffusion of professional markets in the tourism and telecommunication sectors as well as off-grid business will most likely foster the deployment of RE (in particular solar PV).

Mining industry, commercial manufacture as well as construction (green buildings) will lead in the medium to long term the on-grid markets, where the diffusion of isolated grids could provide an interesting entry point. There are about 30 companies, including project developers, wholesalers and distributors active in the solar PV sector in Tanzania. The sector is very fragmented and lots of new players have been entering the market recently (AHK, 2013).

A number of foreign companies, for example German companies, are also gaining market penetration in Tanzania. Many times they have local partners, for installation and service as well as for business development. Some examples are: Energiebau Solarstromsysteme, Harmonic Systems Ltd., Juwi, MobiSol and SolarKiosk (AHK, 2013).

The wind energy sector is at very early stage of development and will likely follow the solar PV sector and the market advancements in Kenya. “Large scale generation projects suffer from a low credit rating of the overall electricity sector. Off-grid wind projects suffer from a lack of competent companies, extremely high project costs, and a lack of available equipment” (AHK, 2013).

As far as biogas technology is concerned, after its introduction in 1975 by Small Industries Development Organization (SIDO), production has been increasing from year to year (10,000 biogas plants installed in September, 2014), mainly fostered by the Tanzania Domestic Biogas Program (TDBP, public-private partnership) and the establishment of construction companies, e.g. Biogas Constructions Enterprises (BCES) who constructed 83% of the total plants in 2013 (ABPP, 2014).

2.4 Conclusion: Barriers, Trends and Patterns

The country is not only in dire need of national capacity building and knowledge development in RE to serve the future expected massive growth of the sector; it also identified a lack of nationally available skills for the improvement of the regulatory frameworks (United Republic of Tanzania, 2013).

There are several drawbacks for private investors into the market, especially a lack of information about future grid development plans by the government, which increase uncertainty. Further, the feed-in tariff scheme does not offer guaranteed returns. If the costs of gas-based electricity generation decrease, the FIT will equally reduce and even PPAs are not able to prohibit this risk. Even though there is a FIT floor price at 9-10 US\$ cents/kWh, the chances are that Tanzania will exploit and extremely cheaply utilise their local new-found natural-gas reserves. This could impact heavily on the future FITs.

The Tanzania Report concluded that “questions have been raised concerning the lack of private sector investment into long-term electricity generation capacity. The current low level of electricity tariffs makes the construction of large capacity power plants unfeasible, as evidenced by TANESCO's operating loss of 18 million US\$ in 2010, whilst charging an average tariff of 8.6 US\$ cents/kWh” (Laurea University, 2015)

Furthermore, the current energy shortage threatens many more jobs in industries dependent on stable and reliable energy supply.

3 Education and Higher Education

3.1 Primary and Secondary Education

The education sector in Tanzania follows a 7-4-2 system, comprising of a primary, a lower secondary and an upper secondary level. Primary education is free of charge and compulsory and follows two years of pre-primary education which usually starts in the age of five years. In order to join the secondary level, pupils have the national Primary School Leaving Examination (Tanzania Government, 2014).

The secondary cycle starts with ordinary level with a length of four years. The selection of the students is based on the performance in the Primary School Leaving Examination. After successful completion of the advanced secondary level and depending on their grades, students may continue at a higher education institution. Others may join public or privately owned colleges, e.g. for teacher training (Kilimanjaro Educational Support Services).

The enrolment ratio for primary, secondary and tertiary education is shown in Table 8:

Table 8: Gross Enrolment Ratio in the primary, secondary and tertiary education sector (Unesco Institute for Statistics, 2014)

	Primary Education	Secondary Education	Tertiary Education
Gross Enrolment Ratio	93% (2012)	35% (2012)	3,9% (2012)

The gross enrolment ratio for primary education rose from 2003 with a peak at 111% in 2008 to decrease in the following years to the level of 2003. It seems that the focus of education shifted to the secondary and tertiary sector. In the secondary sector a rise in the enrolment ratio from six per cent in 1999 to 35% in 2012 can be noticed. For tertiary education the ratio increased from 0.9 per cent in 2003 to 3.9% in 2012. The enrolment ratio for tertiary education is below the Sub-Saharan average of 6.1% and far below the world average of 24% and the preferred 40% needed for economic take off (Unesco Institute for Statistics, 2014).

3.2 Higher Education

3.2.1 Shape of higher education

The post-secondary education system comprises tertiary and higher education. Tertiary education is dedicated to semi-skilled qualifications, whereas higher education institutions (universities and university colleges) offer highly skilled qualifications (Kotecha, Wilsom-Strydom, & N Fongwa, 2012).

At present, there are 14 public higher education institutions, which account for about 55% of all higher education enrolments, with 30 privately-owned and accredited universities or colleges accounting for about 45% (SARUA, 2012). These are listed in Table 9:

Table 9: Public and private universities in Tanzania (Tanzania Commission for Universities, 2014)

Public higher education institutions	Private higher education institutions
Ardhi University	Catholic University of Health and Allied Sciences
Mbeya University of Science and Technology	Hubert Kairuki Memorial University
Muhimbili University of Health & Allied Sciences	International Medical and Technological University
Mzumbe University	Mount Meru University
Nelson Mandela African Institute of Science and Technology	Muslim University of Morogoro
Open University of Tanzania	Sebastian Kolowa Memorial University
Sokoine University of Agriculture	St. Augustine University of Tanzania
State University of Zanzibar	St. John's University of Tanzania
University of Dar es Salaam	St. Joseph University in Tanzania
University of Dodoma	Teofilo Kisanji University
Dar es Salaam University College of Education	Tumaini University Makumira
Mkwawa University College of Education	United African University of Tanzania
Moshi University College of Cooperative and Business Studies	University of Arusha
University College of Education Zanzibar	University of Bagamoyo
	Zanzibar University
	Archbishop Mihayo University College of Tabora
	Iringa University College
	Jordan University College
	Josiah Kibira University College
	Kampala International University (Dar es Salaam Constituent College)
	Kilimanjaro Christian Medical College
	Mwenge University College of Education
	Ruaha University College
	St. Francis University College of Health and Allied Sciences
	St. Joseph University College of Agricultural Sciences and Technology
	St. Joseph University College of Information Technology
	St. Joseph University College of Management and Commerce
	Stefano Moshi Memorial University College
	Stella Maris Mtwara University College
	Tumaini University Dar es Salaam College

At the public universities, it can be observed that the majority of enrolments listed in Table 10 are in Education but there is the lowest level of enrolment in master and doctoral studies as well. Among the major fields of study agriculture has the lowest enrolment. Although the science, engineering and technology (SET) is in policy focus the level of enrolment remains fairly low (SARUA, 2012).

Table 10: Student enrolment by major field of study and level of study (SARUA, 2012)

	Undergraduate	Postgraduate < Masters	Masters	Doctoral
Agriculture	640	0	101	10
Business, management and law	9,935	1,035	2,528	24
Education	14,569	61	96	1
Health sciences	1,628	0	302	4
Humanities and social sciences	11,596	877	599	16
Science, engineering and technology	7,852	607	202	44

Enrolment at the postgraduate level accounts for a very small proportion of the total enrolment in public universities in Tanzania. While there are more than 46,000 enrolments at undergraduate level, there are fewer than 4,000 students registered for master’s degrees and only 99 pursuing doctoral studies in Tanzanian public higher education institutions.

On the other hand there are many more applications for undergraduate and postgraduate studies than universities could accommodate. For the 2009/2010 semester there were about 30,000 applications for undergraduate studies but only 55 per cent of them could be accepted. For postgraduate studies only 45 per cent of 9,000 applications were accepted. So there is a big gap between the willingness to study and the availability of appropriate university places.

Therefore especially the places for postgraduate studies are rare and many applicants have to wait. So there is room for improvement by adding new master’s programmes.

3.2.2 Higher education policy

Higher education in Tanzania is under the responsibility of the Ministry of Education and Vocational Training. Further institutions involved in management and supervision of educational services include the Prime Minister’s Office, Regional Administration and Local Government, Communities, Non-governmental organizations (Tanzania Government, 2014).

The main policy framework for higher education in Tanzania is the Higher Education Development Programme (HEDP) for the period between 2010 and 2015. The HEDP builds on the Education Sector Development Programme (ESDP), changing the focus from primary

and secondary to higher education and recognising its role for the social and economic development. The following objectives are defined:

- “Establish a comprehensive and coordinated higher education system through undertaking institutional reforms
- Improve delivery of higher education through enhancement of relevance and diversification of curriculum, increased access, equity and quality.
- Enhance capacity of the higher education system so as to maintain and sustain all its functions effectively and efficiently.” (Ministry of Education and Vocational Training, 2010)

The HEDP defines key needs based on an increased social demand for higher education, which include:

- Increased growth in agricultural, manufacturing and other economic sectors
- Capacity building in new and emerging areas of science and technology
- Capacity building on higher education institutions
- Global competitiveness of higher education institutions
- Increased demand for skilled human capital
- Improved entrepreneurship skills
- Efficient and effective resource mobilisation
- Addressing problems related to poverty reduction
- Addressing cross-cutting issues such as democracy, gender, environment and health (Ministry of Education and Vocational Training, 2010).

Three main thematic areas - institutional reforms, service delivery and sustainability mechanisms – provide the framework for the implementation of the HEDP 2010–2015. The programme defines expected outputs and outcomes with specific targets and activities for each thematic area. “Thus, higher education in Tanzania has been accorded an increasingly important place on the national agenda, and a supportive policy environment has been put in place as the basis from which the sector can grow” (Kotecha, Wilsom-Strydom, & N Fongwa, 2012).

3.2.3 Quality assurance

The improvement of the quality of higher education in Tanzania plays a significant role in the HEDP. The programme defines the following significant quality challenges:

- Overcrowding due to increased student enrolments
- Inadequate teaching and learning facilities
- Poor learning technique, as most institutions still use traditional old teaching and learning methods
- Inadequate supply and use of books and other relevant materials

- Under-qualified staff due to a lack of doctoral level teaching staff
- Less competent entrants to the universities due to missing scientific practice in science subjects and English language deficits of school leavers (Ministry of Education and Vocational Training, 2010)

The definition of quality standards and the accreditation of institutions and the degree programmes is under responsibility of the Tanzania Commission for Universities (TCU). All universities must put a review system in place, which involves self-evaluation, peer evaluation, student appraisal, as well as management review and evaluation. Nevertheless, the HEDP document reports that many higher education institutions do not have quality assurance units. According to Kotecha et al, six of the eight universities participating in a study have quality assessment mechanisms in place, which include internal evaluations on a regular or occasional basis. Most of the universities provide staff development measures (Kotecha, Wilsom-Strydom, & N Fongwa, 2012).

3.2.4 Higher education staff

A significant share of the academic staff at Tanzanian higher education institutions is under-qualified (see Table 11); only about half have doctoral degrees. Nevertheless, compared to other countries in Sub-Saharan Africa this number is relatively high (Kotecha, Wilsom-Strydom, & N Fongwa, 2012).

Table 11: Highest level of qualification for academic and research staff (SARUA, 2012)

	Undergraduate	Postgraduate < Masters	Masters	Doctoral
Agriculture	22	0	51	103
Business, management and law	88	21	201	155
Education	70	0	62	18
Health sciences	60	0	174	339
Humanities and social sciences	117	0	336	608
Science, engineering and technology	234	0	257	435
Other	4	0	10	5
Sum	595	21	1,091	1,663

3.2.5 Funding of higher education

Since 2004, the expenditure on education remains on a level of 20% of the total government expenditure, which is an expenditure of \$11,743.9 (PPP) per student (Unesco Institute for Statistics, 2014).

3.2.6 Research output

The research output at Tanzanian public universities remains low with less than 600 publications (see Table 12). Peer-reviewed journal articles account for the largest part of the research output (Kotecha, Wilsom-Strydom, & N Fongwa, 2012).

Table 12: Research output (SARUA, 2012)

Category of research output	2008	2009	2010
Peer-reviewed journal articles	277	280	260
Peer-reviewed books	11	12	17
Peer-reviewed book chapters	6	11	11
Patents	2	2	4
Other: Workshops and seminar presentation, dissertations	258	234	249

3.3 Renewable Energy Higher Education

There are several universities which offer courses for energy related topics. The programmes offered by public universities are shown in Table 13.

Table 13: Energy related programmes in public high education institutions

University or related college	Programme
Mbeya University of Science and Technology	Bachelor of Engineering in Electrical
The Nelson Mandela African Institute of Science and Technology (NM-AIST)	Sustainable Energy Science and Engineering Master's and PhD in Sustainable Energy Science and Engineering
The Open University of Tanzania	Bachelor of Science in Energy Resources
University of Dar es Salaam	Bachelor of Engineering in Electrical Engineering
College of Engineering and Technology (University of Dar es Salaam)	Master of Science in Renewable Energy Engineering Master of Science in Power Electronics and Electrical Drives Master of Science in Energy Engineering

In Tanzania there is a solid basis for additional masters programmes related to renewable energy, since some bachelor programmes could give the needed background.

The MSc in Renewable Energy at UDSM is the only full-fledged RE Master in the country. It has a close cooperation with the RE Master at Makerere University in Kampala, Uganda, and has been supported by the Norwegian NOMA programme between 2008 and 2011. A total

of 72 participants enrolled in the programme between 2007 and 2013, thereof 26 female students (Kimambo, 2014).

The Swedish International Development Organisation (SIDA) has been supporting the UDSM and in particular this Masters Programme from 2009 until 2015. In 2014 SIDA and UDSM agreed on a cooperation programme (2015-2020), in order to foster research and capacity building “by resolving constraints to results delivery in key growth sectors” (UDSM, 2014, p. 9). Besides capacity building on Masters and PhD level for the oil and gas industry this comprises also the renewable energy field and in particular the support (i.a. scholarships) for the above mentioned Renewable Energy Master at UDSM (UDSM, 2014).

Additionally, there is the development of the Nelson Mandela African Institution of Science and Technology (NM-AIST), based in Arusha, with a Master’s programme in Sustainable Energy Sciences and Engineering (SESE). Yet, the current state of its development is not quite clear (NM-AIST, 2015).

3.4 Conclusion and Recommendations

In the last two decades higher education in Tanzania has expanded significantly. There has been an increase in the number of public and private higher education institutions and in the number of students enrolled in post-secondary institutions.

Even with this growth the structure of the academic staff is in a better condition than in other Sub-Saharan countries. Half of the staff has a doctoral degree. The size of the tertiary education sector will grow steadily in the next years. But although the science, engineering and technology (SET) is in policy focus the level of enrolment remains fairly low.

Against the background of a significant restructuring of energy policy with its focus on strengthening electrification in the country (SREP focuses on geothermal and Off-grid electrification), fostering the qualification of Master and PhD students in this area is of high importance. Any activity addressing Renewable Energy Higher Education in Tanzania should consider UDSM and should coordinate any concept with the activities of the Norwegian and Swedish development approaches. The already implemented RE Master at UDSM with the strong link to Makerere University / Uganda and its looser coupled connections to Mozambique and Ethiopia is a promising and already established approach to build up regional capacity. Furthermore, any supportive activity should consider the resuscitation approach for the RE Masters in Zimbabwe and the starting of a RE Masters at the University of Rwanda.

4 References

- ABPP. (2014). *Africa Biogas Partnership Programme - Tanzania*. Retrieved April 24, 2015, from <http://africabiogas.org/tanzania/>
- Adebayo, E., Sovacool, B. K., & Imperiale, S. (2013). It's about dam time: Improving microhydro electrification in Tanzania. *Energy for Sustainable Development*, 17(4), pp. 378 - 385.
- African Economic Outlook. (2012). *African Economic Outlook 2012: Tanzania*. Retrieved August 14, 2014, from <http://www.africaneconomicoutlook.org/fileadmin/uploads/aeo/PDF/Tanzania%20Full%20PDF%20Country%20Note.pdf>
- AHK. (2013, July). *Target Market Study Tanzania - Solar PV & Wind Power*.
- BBC. (2014, Juli 29). *Tanzania Profile*. Retrieved August 14, 2014, from <http://www.bbc.com/news/world-africa-14095776>
- CIA. (2014). *Tanzania overview CIA World Fact Book*. Retrieved August 04, 2014, from <https://www.cia.gov/library/publications/the-world-factbook/geos/tz.html>
- EIA: US Energy Information Administration. (2014). *International Energy Statistics*. Retrieved August 09, 2014, from <http://www.eia.gov/cfapps/ipdbproject/iedindex3.cfm?tid=2&pid=2&aid=7&cid=TZ,&syid=2001&eyid=2011&unit=MK>
- ESMAP. (2014). *Renewable Energy Resource Mapping Tanzania*. Retrieved August 15, 2014, from <http://www.map.ren21.net/PDF/ProfilePDF.aspx?idcountry=173>
- GIZ. (2009). *Tanzania's Small Hydro-Energy Market. Target Market Analysis*. Retrieved from <http://www.giz.de/fachexpertise/downloads/gtz2009-en-targetmarketanalysis-hydro-tanzania.pdf>
- GIZ. (2013). *Cooperation with the Private Sector in Tanzania - Country Report 2013*. Retrieved from <http://www.giz.de/expertise/downloads/giz2013-en-tanzania-country-report.pdf>
- IEA. (2013). *World Energy Outlook 2013: Energy Access Database*. Retrieved August 14, 2014, from <http://www.worldenergyoutlook.org/resources/energydevelopment/energyaccessdatabase/>
- IRENA. (2010). *Renewable Energy Country Profile Tanzania*. Retrieved August 10, 2014, from <http://www.irena.org/REmaps/countryprofiles/africa/tanzania.pdf>
- Kilimanjaro Educational Support Services. (n.d.). *Tanzania Education System*. Retrieved August 22, 2014, from http://www.google.de/url?sa=t&rct=j&q=&esrc=s&source=web&cd=10&ved=0CHoQFjAJ&url=http%3A%2F%2Fwww.kess.co.tz%2Fsesco_files%2FTZ%2520Education%25

20System%2520Revised.ppt&ei=-
vb1U4X1Hif_4QSY5IDgBg&usg=AFQjCNHy5NFunObdLz9ohygt-
GWZgT8fw&sig2=Ba8etzxZvtHCYmVI

- Kimambo, C. (2014, July). MSc. in Renewable Energy, presentation at the EUEI PDF workshop in Kigali.
- Kotecha, P., Wilsom-Strydom, M., & N Fongwa, S. (2012). *A Profile of Higher Education in Southern Africa - Volume 2: National Perspective*. Retrieved August 20, 2014, from <http://www.sarua.org/files/publications/SARUA%20leadership%20Dialogue%20Series/SARUA%20Profiles%20of%20HE%20Vol%202.pdf>
- Laurea University. (2015, April 27). *Tanzania Report*. Retrieved from <https://www.laurea.fi/dokumentit/Documents/Tanzania%20Country%20Report.pdf>
- Lazimah, J. (2014, January). *Energy Sector Initiatives in Tanzania, Presentation at the Low Carbon Development Workshop*. Retrieved from <http://www.fes-sustainability.org/sites/default/files/u43/lazimah.pdf>
- Manson, K. (2013, September 30). *Financial Times: Three issues loom over Tanzania's political scene*. Retrieved August 14, 2014, from <http://www.ft.com/cms/s/0/79f4cd34-1ebe-11e3-b80b-00144feab7de.html#axzz3ANlkVCbr>
- Meza, E. (2013, November 21). *Special Report Africa: Tanzania, Mozambique*. Retrieved August 14, 2014, from pv magazine: http://www.pv-magazine.com/news/details/beitrag/special-report-africa--tanzania--mozambique_100013524/#axzz2tz5QmyeG
- Ministry of Education and Vocational Training. (2010). *Higher Education Development Programme 2010 - 2015*. Retrieved from http://www.tanzania.go.tz/egov_uploads/documents/Higher_Education_Development_Programme_2010-2015_sw.pdf
- Mwangi, M. M. (2008). *The African Rift Geothermal Facility (ARGeo)*. Retrieved from <http://www.os.is/gogn/unu-gtp-sc/UNU-GTP-SC-08-05.pdf>
- National Bureau of Statistics. (2013). *Tanzania in Figures*. Retrieved August 12, 2014, from http://www.nbs.go.tz/nbs/takwimu/references/Tanzania_in_figures2012.pdf
- NM-AIST. (2015, June 12). *The Nelson Mandela African Institution of Science and Technology*. Retrieved from About Us: http://www.nm-aist.ac.tz/about_us.html
- Oakland Institute. (2012, September). *Understanding Land Investment Deals in Africa*. Retrieved August 14, 2014, from http://www.oaklandinstitute.org/sites/oaklandinstitute.org/files/OI_Land_Deals_Brief_Sun_Biofuels.pdf
- Reegle. (2014). *Energy Profile Tanzania*. Retrieved August 15, 2014, from <http://www.reegle.info/countries/tanzania-energy-profile/TZ>

- REN21. (2014). *Renewables Interactive Map Country Profile: Tanzania*. Retrieved August 09, 2014, from <http://www.map.ren21.net/PDF/ProfilePDF.aspx?idcountry=173>
- SARUA. (2012). *Tanzania Data profile 2012*. Retrieved August 21, 2014, from <http://www.sarua.org/files/Country%20Reports%202012/Tanzania%20data%20profile%20Eng.pdf>
- SNV. (2014, April). personal comment F. ter Heegde.
- Tanzania Commission for Universities. (2014). *The Tanzanian Commission for Universities*. Retrieved August 21, 2014, from http://www.tcu.go.tz/images/pdf/Recognised_Universities_Colleges_Centres.pdf
- Tanzania Development Support. (n.d.). *Educational System in Tanzania: Challenges and Perspective*. Retrieved August 22, 2014, from <http://tdsnfp.org/wp-content/uploads/2013/06/Education-system-in-Tanzania-.pdf>
- Tanzania Government. (2014). *Government Portal*. Retrieved August 21, 2014, from <http://www.tanzania.go.tz>
- Tanzania Invest. (2014). *Tanzania Telecom Sector News*. Retrieved August 13, 2014, from <http://www.tanzaniainvest.com/telecoms/news>
- Tanzania Natural Resource Forum. (2011, Februar 18). *Guidelines for Sustainable Biofuels*. Retrieved August 15, 2014, from <http://www.tnrf.org/en/node/21700>
- Transparency International. (2013). *Corruption Perceptions Index 2013*. Retrieved August 13, 2014, from <http://cpi.transparency.org/cpi2013/results/>
- UDSM. (2014). *Towards Enhanced Sustainability of Strategic Research and Innovation Systems for Inclusive Development in Tanzania*. Retrieved from New Framework for Sida Support to UDSM: 2015-2020: <http://www.sidaresearch.se/media/20113/udsm%20concept%20note-2015-2020%20-final%20version%20-%20270814.pdf>
- UNDP. (2013). *Human Development Report 2013*. Retrieved August 05, 2014, from <http://www.undp.org/content/dam/undp/library/corporate/HDR/2013GlobalHDR/English/HDR2013%20Report%20English.pdf>
- Unesco Institute for Statistics. (2014). *Country Profiles - United Republic of Tanzania*. Retrieved August 21, 2014, from <http://www.uis.unesco.org/DataCentre/Pages/country-profile.aspx?code=TZA®ioncode=40540>
- United Republic of Tanzania. (2013, Mai). *Scaling-Up Renewable Energy Programme (SREP): Investment Plan for Tanzania*. Retrieved August 14, 2014, from https://www.climateinvestmentfunds.org/cif/sites/climateinvestmentfunds.org/files/SREP_Tanzania_Investment_Plan_Design.pdf
- World Bank. (2014). *Tanzania Overview*. Retrieved August 11, 2014, from <http://www.worldbank.org/en/country/tanzania/overview>

World Bank. (2014a). *World Bank Database*. Retrieved August 04, 2014, from databank.worldbank.org