

# Energy for Life

## COUNTRY PROFILE



Tanzania 2010





# Energy for Life

## COUNTRY PROFILE

Tanzania 2010

Authors: Dr.-Ing. Johanne Hanko, Dipl.-Ing. Cindy Völler

Date:17/02/2011

Istituto Oikos Onlus (Italy), DGS (Germany), Oikos Cooperação e Desenvolvimento (Portugal),  
Fundación Ecología y Desarrollo - Ecodes (Spain), Terre Solidali Onlus (Italy), Nature Trust (Malta),  
Oikos East Africa (Tanzania), Pangea (Brazil), COMPED (Cambodia), CDEA (Laos), 2010

**Figure 1 (Front cover): Map Tanzania, Source:**[http://www.mapcruzin.com/free-maps-tanzania/tanzania\\_sm\\_2008.gif](http://www.mapcruzin.com/free-maps-tanzania/tanzania_sm_2008.gif)

## **List of content**

1	Background information .....	6
1.1	Country data .....	6
2	RES targets .....	8
2.1	Status of the renewable energy market.....	9
2.2	Energy legal framework in Tanzania .....	9
2.3	Supporting laws and policies.....	10
2.4	Key supporting factors.....	10
2.5	CDM projects in Tanzania .....	12
3	Current status of RES .....	13
3.1	Energy related data .....	13
3.2	Current situation .....	13
3.3	Biomass energy installed and identified systems.....	20
3.4	Hydroelectric installed and identified systems .....	20
3.5	Solar installed and identified systems.....	21
3.6	Wind energy installed and identified systems .....	21
3.7	Other renewable energy sources installed and identified systems .....	21
4	Potentials of RES in Tanzania .....	22
4.1	Biomass Energy Resource potential .....	22
4.2	Hydro Energy Resource potential.....	22
4.3	Solar Energy Resource potential .....	23
4.4	Wind Energy Resource potential.....	23
4.5	Other renewable energy sources potentials.....	24
5	References .....	25
5.1	Related links .....	27

## List of figures

<b>Figure 1 (Front cover): Map Tanzania, Source:</b> <a href="http://www.mapcruzin.com/free-maps-tanzania/tanzania_sm_2008.gif">http://www.mapcruzin.com/free-maps-tanzania/tanzania_sm_2008.gif</a>	3
Figure 2: Population growth 2003 to 2025	7
Figure 3: Climate and weather in Tanzania	7
Figure 4: Energy production by type.	15
Figure 5: Electricity demand projections 2010 - 2033	16
Figure 6: Current and planned coverage of the National electricity grid 2010	16
Figure 7: Uses of Natural Gas in 2008	19

## List of tables

Table 1: Trends in Budgetary Allocation and actual disbursement for the Energy Sector, 2005/06-2009/10 (in TShs millions)	11
Table 2: Electrification rate developments from year 2000 - 2009	15
Table 3: Electricity Generation expansion plan 2011 – 2030	17
Table 4: Proposed priority Projects during 2010 – 2016 (in USD million)	17
Table 5: Long term transmission plan	18
Table 6: Line upgrade	19
Table 7: Existing biomass fuelled power plants in Tanzania	20
Table 8: Energy generation potential from excess bagasse 2004	22

# 1 Background information

## 1.1 Country data<sup>1</sup>

Location of country:	Eastern South America, bordering the Atlantic Ocean
GPS:	6 00 S, 35 00 E
Total area:	947,300 sq km
Capital:	Dodoma
Currency:	Tanzanian shilling
Language:	Kiswahili or Swahili (official), Kiunguja (name for Swahili in Zanzibar), English (official, primary language of commerce, administration, and higher education), Arabic (widely spoken in Zanzibar), many local languages
Religion <sup>2</sup> :	mainland - Christian 30%, Muslim 35% (Zanzibar - more than 99% Muslim), indigenous beliefs 35%
Population:	41,892,895 (2010) - 75% rural population (2008).
Population density <sup>3</sup> :	41 persons per sq. km (2006 est.)
Climate:	varies from tropical along the coast to temperate in the highlands north and south
Temperature <sup>4</sup> :	average temperature 23°C, High 32°C in October and low 15°C during the months of June and July
Precipitation <sup>5</sup> :	892 mm (35.1 in) rainfall per year, or 74 mm (2.9 in) per month
Terrain:	mostly plains along the coast, a central plateau and highlands in north and south
Elevation:	lowest point: Indian Ocean 0 m, highest point: Kilimanjaro 5,895 m.
GDP <sup>6</sup> :	USD 1,400 per capita per year (2009)

<sup>1</sup> The world fact book, 2010

<sup>2</sup> YWAMA, 2011

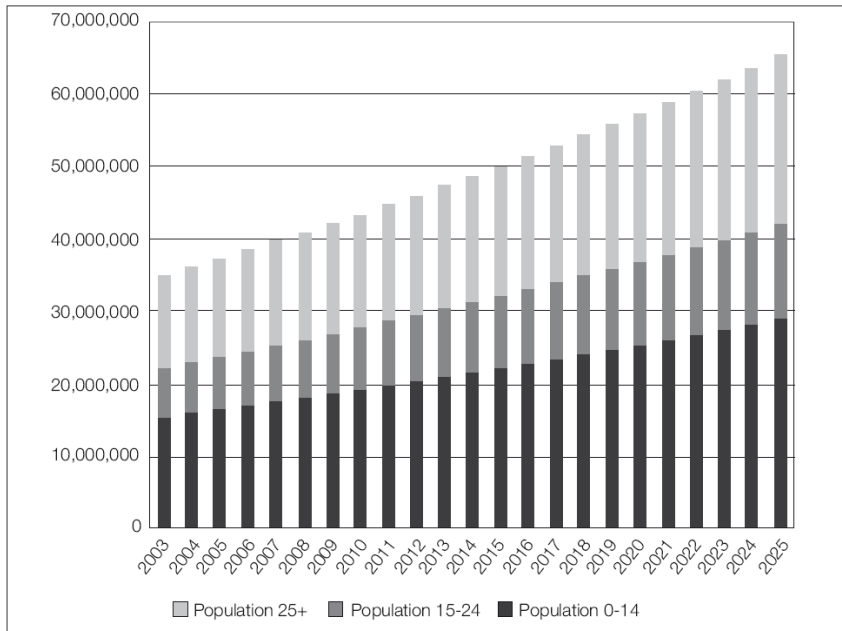
<sup>3</sup> REPOA, 2011

<sup>4</sup> World weather and climat graphs..., 2011

<sup>5</sup> Idem

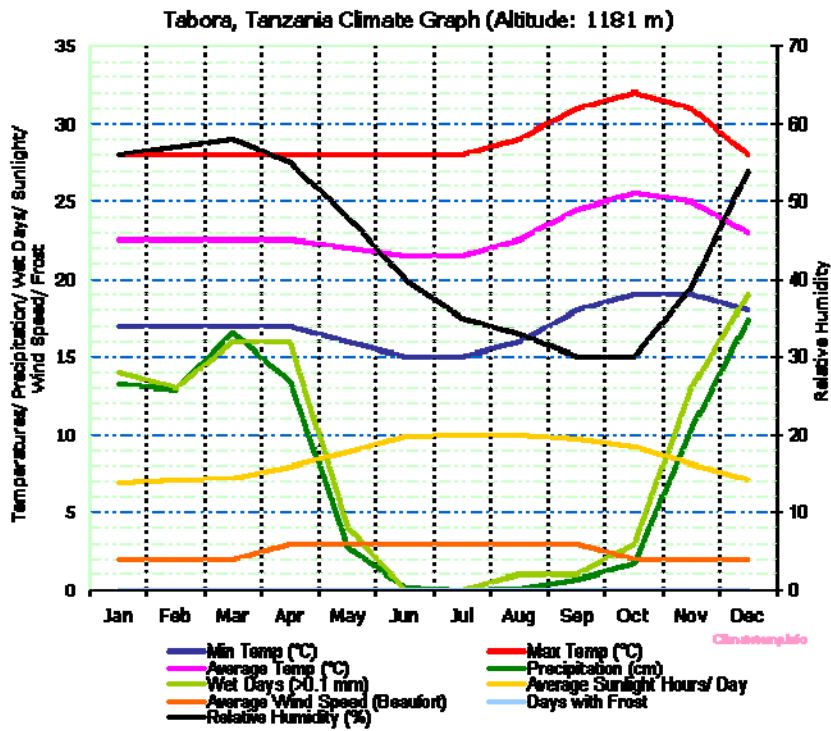
<sup>6</sup> The world fact book, 2010

Figure 2: Population growth 2003 to 2025



Source: Mwakapugi, Samji, Smith, 2010

Figure 3: Climate and weather in Tanzania



Source: World weather and climate graphs..., 2011

## 2 RES targets<sup>7</sup>

In addressing issues of energy access to the underserved and in line with other national policies, Tanzania:

- is establishing the Renewable Energy Fund (REF) to provide capital subsidy to bring down investment costs as to enhance affordability for modern energy services including rural electrification;
- has liberalized the petroleum industry to encourage fair competition,
- petroleum law is currently being reviewed to take care of experiences, new developments and challenges in the sector;
- electricity sub-sector has been undergoing reforms to allow more private sector participation in delivering modern energy services to customers. The power generation side allows the participation of Independent Power Producers (IPPs) and so far about 290 MW installed capacity is being generated by IPPs. Currently the vertically integrated state owned power utility is being ring-fenced into three operational entities namely; generation, transmission and distribution;
- is committed to promoting renewable energy technologies so as to reduce reliance on fossil fuels. In July 2005, all taxes on solar energy appliances and small scale wind turbines were removed;
- recently commissioned consultants to conduct energy audits in selected government buildings with a purpose to identify energy saving and conservation opportunities;
- tested a number of renewable energy technologies, experiences show potential for scaling up of such technologies. The technologies include: Biogas; Solar electricity (photovoltaic); Biomass briquetting; Efficient cooking stoves; Efficient charcoal production kilns; Liquid biofuel production; Wind mill for water pumping; Small scale hydropower; Biomass Co-generation using wood or bagasse; and Solar thermal (cookers, water heaters and crop dryers). Other technologies are to be ascertained based on results of resource assessments that are underway.
- converted 112 MW jet fuelled power plant to run on natural gas and installed 78 MW additional natural gas fired capacity. Plans are underway to convert 100 MW diesel fuelled power plant to run on natural gas;
- replaced heavy fuel oil with natural gas at one of the three cement processing factories. Natural gas is also being used in some Dar es Salaam based brewery, textile, glass and steel

---

<sup>7</sup> UNEP, 2011



processing factories, and is in the process of establishing an Energy and Water Utilities Regulatory Authority (EWURA).

## **2.1 Status of the renewable energy market<sup>8</sup>**

Notwithstanding the availability of natural gas and coal in Tanzania, there is also a high potential for hydropower, solar and biomass. However, Tanzania is currently one of the world's lowest levels of electricity consumption per capita. Off-grid solutions appear to be the most feasible solution in order to meet the country's growing demand. As such, investment opportunities are growing for developing hydropower dams, solar photovoltaic systems, biomass based co-generation in sugar, wood and tea factories as to provide electricity to the rural populations<sup>9</sup>.

The following investment opportunities have been identified in the energy sector<sup>10</sup>:

- Rural Electrification;
- Exploration of petroleum;
- Generation, transmission and distribution of electricity;
- Development of new and renewable energy resources; and
- Promotion of energy efficiency and conservation initiatives

## **2.2 Energy legal framework in Tanzania<sup>11</sup>**

The power sector in Tanzania is controlled by the national utility Tanzania Electricity Supply Company Ltd (TANESCO). The Energy and Water Utilities Regulatory Authority (EWURA) is an autonomous multi-sectoral regulatory authority established in 2001 by the Energy and Water Utilities Regulatory Authority Act, Cap 414 of the laws of Tanzania. It is responsible for technical and economic regulation of the electricity, petroleum, natural gas and water sectors. The functions of EWURA include among others, licensing, tariff review, monitoring performance and standards with regards to quality, safety, health and environment. EWURA is also responsible for promoting effective competition and economic efficiency, protecting the interests of consumers and promoting the availability of regulated services to all consumers including low income, rural and disadvantaged consumers in the regulated sectors.

---

<sup>8</sup> Arcadia Market Commentary, 2009

<sup>9</sup> MEM, Overview of Energy Sector, 2011

<sup>10</sup> Idem

<sup>11</sup> MEM, Overview of Energy Sector, 2011

## 2.3 Supporting laws and policies

In 1992, the government of Tanzania promulgated the National Energy Policy already referring to renewable energy directly or implicitly stating in its main objectives<sup>12</sup>:

- to have affordable and reliable energy supply covering the whole country
- to promote diversification of energy resources in order to optimise the hydro-thermal mix and to lessen dependence on hydro electricity.
- to promote regional grid inter-connections through regional cooperation to ensure electricity reliability, security and quality as well as power exchange in the region
- to reform the market for energy services and establish an adequate institutional framework which facilitates the investment, expansion or services, efficient pricing mechanisms and other financial incentives.
- to enhance the development and utilisation of indigenous and renewable energy sources and technologies.
- to adequately take account of environmental considerations for all energy activities.
- to increase energy education and build gender-balanced capacity in energy planning, implementation and monitoring.

The 2003 Policy, in contrast with the 1992 policy which focused mostly on maximising energy generation using local resources with priority on hydro power, placed emphasis on the diversification of energy resources. The Government has enacted the New Electricity Act, 2008 which encourage private sector's participation in generation and distribution of electricity hence curtail TANESCO monopoly and increase competition<sup>13</sup>.

## 2.4 Key supporting factors

The Ministry of Energy and Minerals (MEM) established Rural Energy Agency (REA) and Rural Energy Fund (REF) to mobilize coordinate and facilitate both private and public initiatives towards rural energy development. REA through its Rural Energy Fund is intended to provide capital subsidies to buy down the cost of energy services and thereby reduce the risks to project developers envisioned to include communities, companies, local governments and others that are ready and capable of investing in the provision of modern energy services in rural areas<sup>14</sup>.

---

<sup>12</sup>Mwakapugi, Samji, Smith, 2010

<sup>13</sup>MEM, Overview of Energy Sector, 2011

<sup>14</sup>Idem

**Table 1: Trends in Budgetary Allocation and actual disbursement for the Energy Sector, 2005/06-2009/10 (in TShs millions)**

Financial Year	Development Programme	Allocation		Actual Disbursement		Actual Disbursement as % of Allocation	
		Domestic	Foreign	Domestic	Foreign	Domestic	Foreign
2005/06	TANESCO	-	27,440.4	-	22,625.1	-	82.4
	Rural Electrification	1,850.0	26,169.5	1,850.0	19,761.0	100.0	75.6
	Renewable Energy	125.0	1,717.0	50.0	1,117.7	40.0	65.0
	Total	1,975.0	55,326.9	1,900.0	43,503.8	96.2	78.6
2006/07	TANESCO	191,936.0	113,588.0	900.0	15,230.3	0.4	13.4
	Rural Electrification	21,376.0	43,360.0	2,476.0	1,790.3	11.6	4.6
	Renewable Energy	484.0	4,822.0	336.0	525.6	69.4	10.9
	Total	213,496.0	161,770.0	3,712.0	17,546.2	1.7	10.8
2007/08	TANESCO	191,850.0	88,722.2	630.0	14,603.0	0.3	16.5
	Rural Electrification	1,720.0	8,929.7	1,680.0	8,101.3	97.7	90.7
	Renewable Energy	293.0	2,221.4	360.3	524.5	123.0	23.6
	Total	193,863.0	99,873.3	2,670.3	23,228.8	1.4	23.3
2008/09	TANESCO	78,712.5	59,530.0	164,570.2	17,951.2	209.1	30.1
	Rural Electrification	11,378.5	-	4,178.5	-	36.7	-
	Renewable Energy	198.0	1,636.3	198.0	1,010.7	100.0	61.8
	Total	90,289.0	61,166.3	168,946.7	18,961.9	187.1	31.0
2009/10	TANESCO	47,615.2	42,413.3	11,002.6	-	23.1	-
	Rural Electrification	29,031.0	7,833.0	12,000.0	-	41.3	-
	Renewable Energy	1,200.0	1,602.6	850.0	-	70.8	-
	Total	77,846.2	51,848.9	23,852.6	-	0.6	-

Source: Mwakapugi, Samji, Smith, 2010

As a follow-up to launching the National Energy Policy in 2003, efforts are underway to formulate a comprehensive energy strategy. In addition to the REA & REF, other elements of the strategy that are being executed include the finalization and implementation of the New power Legislation, reviewing and updating the National Power Systems Master Plan, Developing a Rural Electrification Master Plan, implementation of pilot projects on removal of barriers to renewable energy development and preparations of a World Bank and Swedish International Development Cooperation Agency (Sida) supported Programme on Energizing Rural Transformation.

## **2.5 CDM projects in Tanzania**

As of January 2011, no project has been submitted for the Clean Development Mechanism (CDM) projects emission reduction scheme of the United Nations<sup>15</sup>.

---

<sup>15</sup> UNFCCC, 2010

### 3 Current status of RES

#### 3.1 Energy related data

Electrification rate: <sup>16</sup>	less than 14% of the total Tanzanian population has access to electricity; 2-3% of the rural population has electricity (2010)
Electricity consumption: <sup>17</sup>	3,182 billion kWh (2007)
Actual electricity consumed: <sup>18</sup>	46 kWh per annum per capita
Electricity cost residential: <sup>19</sup>	USD 0.034 for initial 50 kWh USD 0.11 per kWh for more than 50 kWh less than 283.4 kWh
Installed capacity: <sup>20</sup>	1,219 MW (hydropower 561 MW, Thermal 658 MW)
Electricity generation in 2009: <sup>21</sup>	3.786 billion kWh
Electricity projection in 2020: <sup>22</sup>	2,200 MW
Main power generation sources:	90% biomass base fuels (wood-fuel and charcoal) from both natural forest and plantations, 10% of commercial energy includes 8% from petroleum and 2% electricity (from hydro, natural gas, diesel, solar, biomass and others) <sup>23</sup>

#### 3.2 Current situation

Renewable energy resources offer great potential for Tanzania, and are certain to play a significant role in the electrification development of the country. The wide range of available renewable energy sources offers sustainable and accessible energy to the local populations while protecting their environment.

At present, the following renewable energy technologies are being developed, promoted and disseminated<sup>24</sup>:

- Small scale hydropower
- Modern biomass technology [co-generation, improved stoves,
- Improved charcoal production, thermal-chemical gasification, briquettes, liquid biofuel production, etc.];

<sup>16</sup> NORAD, 2011

<sup>17</sup> The World Fact Book, 2011

<sup>18</sup> AREED, 2011

<sup>19</sup> Tanesco, 2011

<sup>20</sup> MEM, Overview of Energy Sector, 2011

<sup>21</sup> REPOA, 2011

<sup>22</sup> Mwakapugi, Samji, Smith, 2010.

<sup>23</sup> MEM, 2011

<sup>24</sup> MEM, Overview of Energy Sector, 2011

- Solar energy;
- Wind for mechanical and electrical power;
- Development of liquid biofuels to supplement use of petroleum fuels.

In addition, considering the fact that a unit energy saved is much cheaper and more environmental, energy efficiency and conservation is also being promoted by the Ministry in collaboration with other stakeholders.

Currently in Tanzania, approximately 46% of the total installed capacity (1,219 MW) is from hydro power while of the remaining is from thermal. It is estimated that less than 5% of the power generated is coming from renewable energy that is not hydro.

### ***Electricity***

It is estimated that 14% of the population of Tanzania has access to electricity. The electricity demand is projected to triple by the year 2020 due to the important growth in the commercial, industrial, agriculture and residential sectors. Tanzania has an installed capacity of about 1219 MW, of which hydropower comprise 561 MW and thermal 658 MW. More investments are needed to ensure the increasing energy demand<sup>25</sup>.

As of the year 2009, only 14% of the population in Tanzania had access to electricity, these being mainly located in urban areas. Dar es Salaam has the highest access to electricity with 55% of households connected compared to only 2.5% of rural households<sup>26</sup>. The following table shows the electrification rate increase since the year 2000, which proves that more than double the population has electricity, which is a substantial increase over the past 10 years. Nevertheless, there is still a lot to be done.

---

<sup>25</sup>MEM, Overview of Energy Sector, 2011

<sup>26</sup> Mwakapugi, Samji, Smith, 2010.

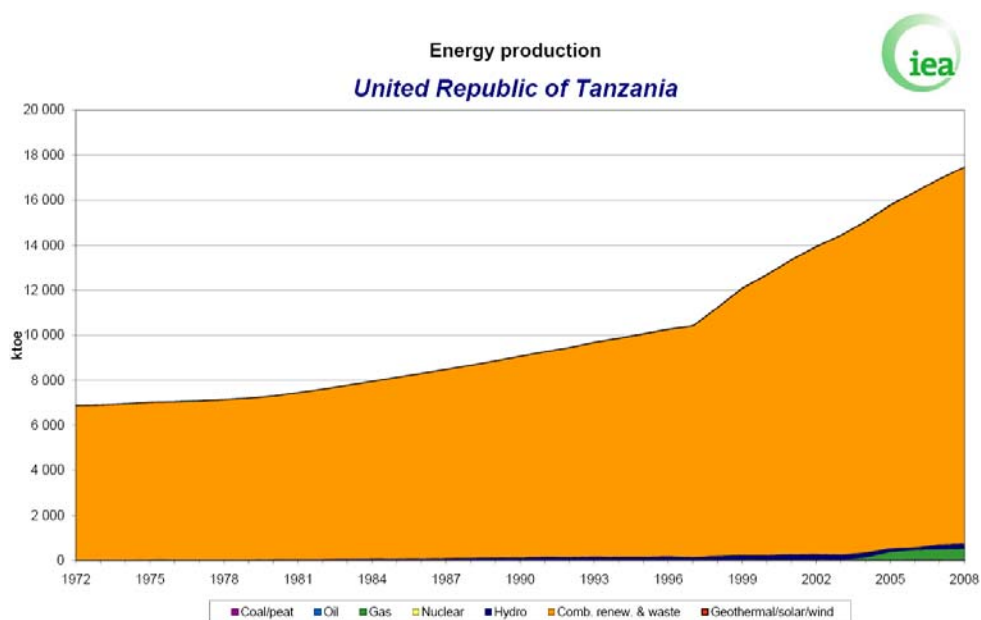
**Table 2: Electrification rate developments from year 2000 - 2009**

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Peak demand (MW)	430	465	475	506	509	552	603	653	694	755
Installed capacity (MW)	785	885	885	885	861	953	958	1,226	905	1,051
Generation (GWh)	2,539	2,797	2,912	3,207	3,390	3,665	3,588	4,212	4,422	3,834
- of which hydro	2,148	2,605	2,722	2,551	2,013	1,781	1,439	2,524	2,649	2,242
- of which thermal	391	192	190	656	1,376	1,884	2,149	1,688	1,773	1,592
Imports (Uganda, Zambia) (GWh)	27	28	34	41	46	50	61	60	52	41
Cumulative losses as % of generation	21	17	19	26	29	30	26	24	25	26
Number of customers	415,692	457,032	476,895	539,076	563,423	605,246	654,180	686,000	725,000	750,000
Electrification rate per population (%)	6.0	6.4	6.5	7.1	8	8.2	10	10.6	12	14

Source: REPOA, 2011

Energy in Tanzania is mainly produced by biomass, which includes fuel wood and charcoal, accounting for 85% of the total energy consumption in Tanzania. More than 80% of the energy derived from biomass is in fact utilized in rural areas. Approximately 10% of the energy consumed is supplied from commercial sources such as petroleum, hydropower, natural gas and coal; electricity accounts for 5% of the total energy consumption<sup>27</sup>.

**Figure 4: Energy production by type.**

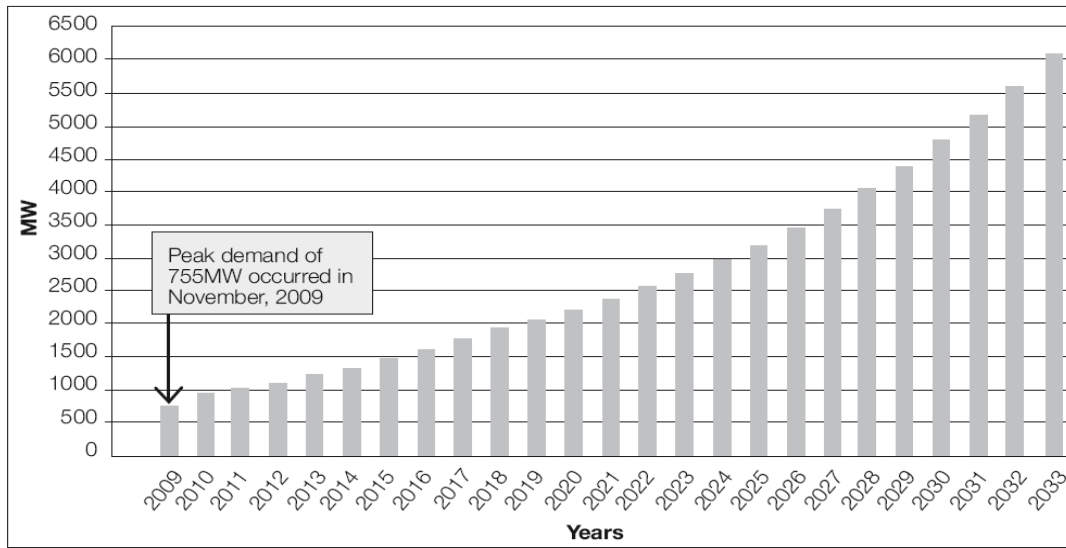


© OECD/IEA 2010

Source: IEA, January 2011

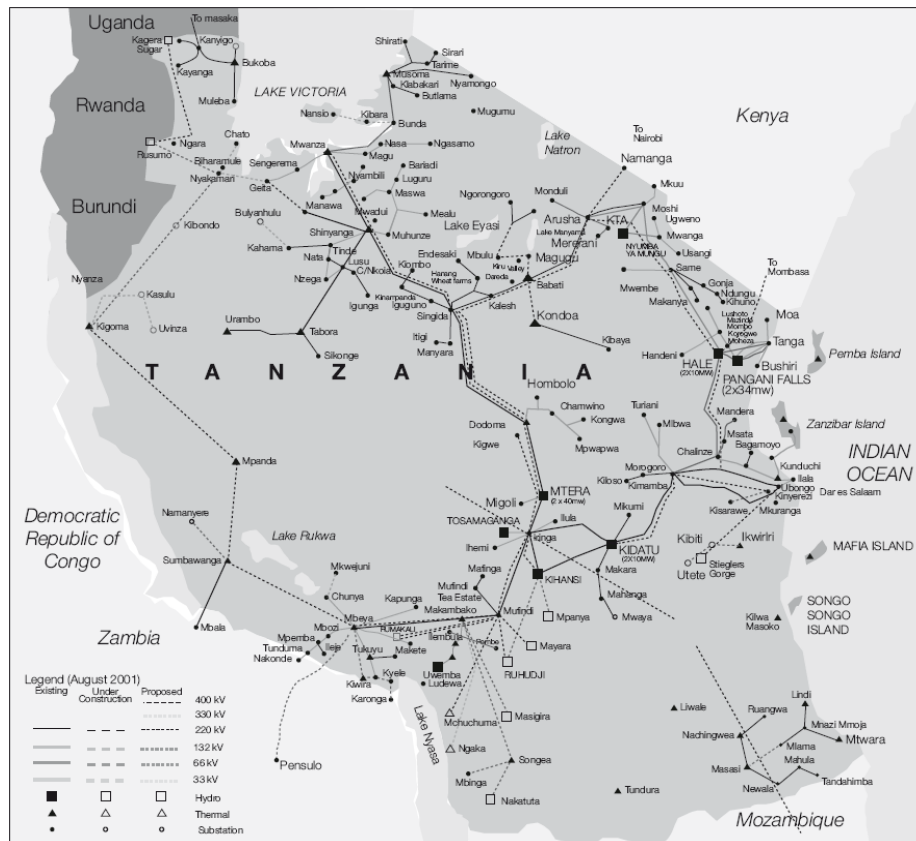
27 Mwakapugi, Samji, Smith, 2010.

**Figure 5: Electricity demand projections 2010 - 2033**



Source: REPOA, 2011

**Figure 6: Current and planned coverage of the National electricity grid 2010**



Source: Mwakapugi, Samji, Smith, 2010



**Table 3: Electricity Generation expansion plan 2011 – 2030**

Project	Capacity (MW)	Estimated cost (US\$ Million)	Envisaged Commercial Operational Date (COD)	Resource
		<b>Short term</b>		
Ubungo EPP	100	100	2011	Gas
Mwanza MS Diesel	60	80	2011	Diesel
Wind	50	50	2012	Wind
Kiwira I	200	274	2013	Coal
Kinyerezi	240	216	2013	Gas
Rusumo falls	21	86	2015	Hydro
Interconnector I	200	760	2015	
		<b>Medium term</b>		
Ruhudji	358	495	2016	Hydro
Malagarasi	8	32	2016	Hydro
Mnazi Bay	300	660	2017	Gas
Mtwara Artumas	12	27	2017	Gas
Rumakali	222	456	2018	Hydro
Stiegler's Gorge I	300	873	2020	Hydro
Interconnector II	200	760	2021	
		<b>Long term</b>		
Stiegler's Gorge II	600	311	2023	Hydro
Ngaka	400	840	2024	Coal
Mchuchuma I+II	400	840	2025	Coal
Stiegler's Gorge III	300	255	2026	Hydro
Nyasa Coal	200	600	2027	Coal
		<b>Short term</b>		
Kakono	53	90	2027	Hydro
Mpanga	144	249	2028	Hydro
Masigira	118	209	2028	Hydro
Ikondo -Mnyera	340	641	2029	Hydro
Taveta -Mnyera	145	380	2030	Hydro

Source: Mwakapugi, Samji, Smith, 2010.

**Table 4: Proposed priority Projects during 2010 – 2016 (in USD million)**

Project	Cost	Sponsor		
		Government / DPs	PPP	Private
Ubungo EPP gas 100MW	100	100	-	-
Mwanza MS Diesel 60MW	80	80	-	-
Backbone NW Transmission 400Kv			-	-
Singida –Wind 50MW	50	-		50
Kiwira I coal 200MW	274	30	244	
Kinyerezi gas 240MW	216	100	140	
Rusumo hydro 21MW	86	86		
Ruhudji hydro 358MW	495	100	395	
Mnazi Bay gas 300MW	660	100	560	
Interconnector I 200MW	760	600	100	

Source: Mwakapugi, Samji, Smith, 2010.

## Transmission

The Tanzanian government already established a long term transmission expansion plan, as seen in the following table.

**Table 5: Long term transmission plan**

From	To	kV	Length (km)	Estimated cost ( \$ Million)
Iringa	Singida	400	200	90
Singida	Dodoma	400	210	94.5
Dodoma	Iringa	400	130	58.5
Morogoro	Tanga	400	200	72.0
Arusha	Tanga	400	335	120.6
Kiwira	Mbeya	220	120	28.1
Kinyerezi	Ubungo	220	15	2.9
Babati	Arusha	400	162	58.3
Singida	Babati	400	150	54.0
Iringa	Mufindi	400	130	58.5
Mufindi	Makambako	400	73	20.4
Ubungo	Stieglers	400	200	56.0
Mbeya	Rumakali	220	150	28.8
Makambako	Rumakali	220	200	38.4
Mufindi	Ruhudji	220	100	19.2
Kihansi	Ruhudji	220	150	28.8
Bulyankuru	Geita	220	150	28.8
Geita	Nyakanazi	220	133	31.1
Nyakanazi	Rusumo	220	95	18.2
Mwanza	Shinyanga	400	140	50.4
Mbeya	Makambako	400	147	41.2
Makambako	Mchuchuma	400	200	56.0
Mufindi	Mchuchuma	400	220	61.6
Stieglers	Dar es salaam	400	160	44.8
Dar es salaam	Morogoro	400	179	64.4
Stieglers	Mtwara	400	400	144.0
Ubungo	Dar es salaam	400	50	14.0
Rusumo	Kakono	220	150	28.8
Rusumo	Kyaka	220	168	32.3
Masigira	Makambako	220	180	42.1
Taveta	Ikondo	220	5	1.8
Ikondo	Mufindi	400	150	54.0
Kihansi	Mpanga	220	40	9.4
Arusha	Kenya Borders	400	150	54.0
Zambia borders	Mbeya	400	120	43.2

Source: Mwakupugi, Samji, Smith, 2010.

**Table 6: Line upgrade**

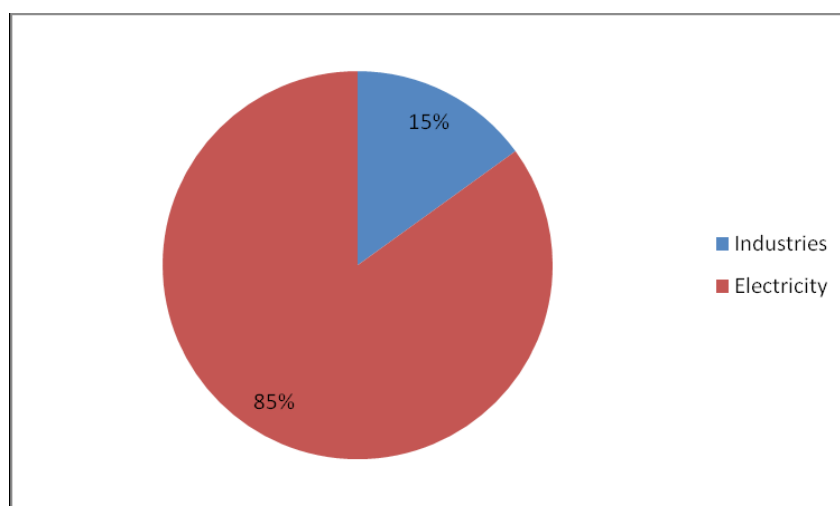
Line Upgrades				
Shinyanga	Bulyankuru	220		42.1
Dodoma	Mtera	220		34.6
Iringa	Kihansi	220		34.6
Mbeya	Makambako	220		34.6
Makambako	Mufindi	220		14.0

Source: Mwakapugi, Samji, Smith, 2010.

### **Natural gas**

Production of gas is now taking place at the Songo Songo and Mnazi Bay where gas is used in electricity generation and for thermal application in more than 25 Dar es Salaam based Industries<sup>28</sup>.

**Figure 7: Uses of Natural Gas in 2008**



Source: MEM, Overview of Energy Sector, 2011

### **Petroleum**

Exploration and production of petroleum is governed by the Petroleum [Exploration and Production] Act of 1980. Exploration of petroleum started in the early 1950s with BP, although no liquid hydrocarbon was found. However, three gas fields were discovered: Songo Songo, Mnazi Bay and Mkuranga gas fields. There are currently 14 exploration companies operating in the country.

In the year 2000, the government liberalised the petroleum downstream allowing oil marketing companies operating in the country to import and supply petroleum products. It is estimated that during the year 2008, Tanzania used approximately 1.7 million tonnes of petroleum products<sup>29</sup>.

<sup>28</sup> MEM, Overview of Energy Sector, 2011

<sup>29</sup> Idem

## Coal

Tanzania has 1,200 million metric tons, which could provide energy for paper mills, cement factories, agriculture and household consumption, and generation of power<sup>30</sup>.

### 3.3 Biomass energy installed and identified systems

More than 2000 biogas plants are reported installed in the country for both heating and lighting processes<sup>31</sup>.

The cogeneration installed capacity was estimated at 35.825 MW in the year 2004. During the year 2004, the energy generation potential from excess bagasse in sugar mills was about 99 GWh per year that is 3.5% of the national electricity generation<sup>32</sup>.

**Table 7: Existing biomass fuelled power plants in Tanzania**

Name of the Plant	Region	Power (MW)	Fuel
Kilombero Sugar Company K1	Morogoro	2 x 3 (ST)	Bagasse
Kilombero Sugar Company K2	Morogoro	1.2 + 2 x 0.8 (ST)	Bagasse
Mtibwa Sugar Estate	Morogoro	2.5 + 1.5 + 9.0 (ST)	Bagasse
Tanganyika Planting Company	Kilimanjaro	2.5 + 3.0 (ST)	Bagasse
Kagera Sugar Company	Kagera	2x2.5 (ST)	Bagasse
Sao Hill Saw Mill	Iringa	1.025 (ST)	Sawmill waste
Tanganyika Wattle Company	Iringa	2.5 (ST)	Woodlogs

Source: Gwang'ombe, April 2004.

### 3.4 Hydroelectric installed and identified systems

The country's hydro potential is estimated at 4,500 MW of which only around 563 MW is developed. It is estimated that 100 GWh/yr could be produced from micro/mini hydro systems. Currently only around 32 GWh/yr is produced from these smaller systems, many of which are private schemes run by religious missionaries<sup>33</sup>.

<sup>30</sup> The United Republic of Tanzania, 2011

<sup>31</sup> <http://regionalenergy-net.com>

<sup>32</sup> Gwang'ombe, April 2004

<sup>33</sup> Idem

### **3.5 Solar installed and identified systems**

Over the years, solar photovoltaics (PV) have been used for telecommunication, lighting, refrigeration, water pumping and powering other electronic equipment at individual residences, schools and health centers and rural dispensaries, TAZARA, TRC and missionaries. The estimated installed PV capacity in Tanzania in 2004 was around 550 kWp with an annual growth rate of about 20%<sup>34</sup>.

### **3.6 Wind energy installed and identified systems**

The interest in the use of wind in Tanzania started over 30 years ago with the installation of wind water pumps in the supply of water for human and animal consumption. Attempts were made to manufacture wind mills and to produce electricity but all were unsuccessful<sup>35</sup>.

Based on the available information much of the wind resource in Tanzania is located along coastlines, the highland plateau regions of the Rift valley, on the plains and around the Great Lakes. By 1996, about 129 windmills were installed but 40% of which were out of order. The known wind turbine installations amount to 8.5 kW<sup>36</sup>.

### **3.7 Other renewable energy sources installed and identified systems**

#### ***Geothermal***

No geothermal energy systems have been identified or installed in Tanzania.

#### ***Wave and Tidal***

No wave or tidal energy systems have been identified or installed in Tanzania.

---

<sup>34</sup> Gwang'ombe, April 2004.

<sup>35</sup> Windfair.net, 2010

<sup>36</sup> Gwang'ombe, April 2004.

## 4 Potentials of RES in Tanzania

### 4.1 Biomass Energy Resource potential

During 2004, Tanzania had a woody growing stock of about 4.39 billion m<sup>3</sup>, with a mean annual increase of 140 million m<sup>3</sup>. For the biomass residues there were approximately 15 million tonnes per year of crop residues, animal droppings from 14 million cattle, 11 million goats and sheep, etc., 200,000 ton of volatile solids of sisal waste and 1.1 million tonnes per year of forest residues. Much of this waste can be used directly as cogeneration fuel. The current energy generation potential from excess bagasse in sugar factories is about 99 GWh per year which is 3.5% of the national electricity generation. Specific study findings have revealed that Tanzania has the capacity to generate more than 200 MW of electricity per annum from sugarcane residues (bagasse), in sugar factories<sup>37</sup>.

**Table 8: Energy generation potential from excess bagasse 2004**

Factory	Capacity TCH	Steam	Bagasse required	Bagasse generated	Excess bagasse gen.-req.	Total excess bagasse	Potential steam	Potential Energy
		(t/hr)	(t/hr)	(t/hr)	(t/hr)	(t)	(t)	(GWh)
MSE	350.00	189.00	82.17	105.00	22.83	100,434.78	231,000.00	23.10
TPC	130.00	70.20	30.52	46.80	16.28	91,679.17	210,862.08	21.09
K 1	80.00	40.00	18.18	41.60	23.42	103,040.00	226,688.00	22.67
K 2	100.00	50.00	22.73	40.00	17.27	76,000.00	167,200.00	16.72
Kagera	60.00	30.00	13.64	30.00	16.36	72,000.00	158,400.00	15.84
						<b>TOTAL</b>		<b>99.42</b>

Source: Gwang'ombe, April 2004.

### 4.2 Hydro Energy Resource potential

The country's hydro potential is estimated at 4,500 MW of which only around 563 MW is developed. It is estimated that 100 GWh per year could be produced from micro/mini systems<sup>38</sup>.

37 Gwang'ombe, April 2004.

38 Idem

### 4.3 Solar Energy Resource potential<sup>39</sup>

Sunlight hours

- average of 3,107 hours of sunlight per year
- average of 8.5 hours of sunlight per day
- average sunlight hours 6.9 hours per day in January
- average sunlight hours 10.0 hours per day in July & August.

Radiation intensity<sup>40</sup>: 4.6 kWh/m<sup>2</sup>/day

### 4.4 Wind Energy Resource potential

Studies show that wind resources in the Singida region along the national power grid could support wind farms with installed capacity of up to 500 MW<sup>41</sup>.

The wind speed ranges from 0.9 to 4.8 m/s. At some locations, on the spot measurements show wind speed reaching up to 12m/sec.<sup>42</sup>.

A new and first ever wind energy farm for electricity production system (24 wind turbines) is to be installed in 2011. It is to be located in the central town of Singida at a cost of US\$120 million and will add some 50 megawatts of electricity to the national power grid, with an expansion capacity up to 300 megawatts. The plant is owned by the state-run National Development Corporation (NDC), which holds 51% stake in the project and a privately owned company, Power Pool East Africa Limited, holds the rest. An estimated 15 months is expected for its construction and as such, should start delivering electricity some time in the year 2012<sup>43</sup>.

Another project planned for 2011 is to build a 200 megawatt wind power farm, also in Singida. This one financed by a Korean group will include 100 turbines of up to 18.3 meters high<sup>44</sup>.

---

39 World weather and climate graphs..., 2011

40 AGORES, 2011

41 Reuters, 2010

42 Gwang'ombe, April 2004.

43 2010 Reuters, 2010

44 Windfair.net, 2010

## 4.5 Other renewable energy sources potentials

### *Geothermal*

Based on preliminary exploration, current estimates indicate a geothermal potential of 650 MW in Tanzania<sup>45</sup>.

### *Wave or Tidal*

A preliminary study was conducted in 2006 on the tidal power of submerged channels of Dar es Salaam coastal waters showing that currents on the sandbank and the tidal flat, in water depths from 0.5 to 3.0 meters, are directed opposite the main tidal current in the deeper waters. Current velocities vary during a tidal cycle and are strongest in the middle of the cycle. Generally, velocities on the tidal flat are around 0.1 m/sec. During the SE monsoon winds are only half that during the NE monsoon winds. In the submerged channels, below 6 meters, velocities are more than 0.5 m/sec. In the deepest part of the test area, velocities reach 1.5 m/sec. The mass flux reached 20 m<sup>3</sup>/sec. In the submerged channels and decreased with decreasing depth<sup>46</sup>.

Tanzania has a coast line of 800 km on the Indian Ocean, thus offering good potential for wave and tidal energy production<sup>47</sup>. The country wide energy potential has yet to be evaluated.

---

<sup>45</sup> Think Geoenergy, 2010

<sup>46</sup> AJOL, 2011

<sup>47</sup> Mpogole Kusiluka, Marcian Kongela, 2009



## 5 References

### *Books*

Gwang'ombe, F. R. D. Renewable energy technologies in Tanzania, Biomass-based cogeneration, second draft report, Dar es Salaam, Tanzania, April 2004

Mpogole Kusiluka, Moses & Marcian Kongela, Sophia, Prospects for Sustainable Construction Practices in Tanzania, Paper Presented at European Real Estate Society Conference 24 – 27 June, 2009, Stockholm

Mwakupugi, Arthur; Samji, Waheeda; Smith, Sean. The Tanzanian Energy Sector: The potential for Job creation and productivity gains through expanded electrification. Research on poverty alleviation, Special paper 10/03 ILO, 2010.

### *Internetsources*

A Global Overview of Renewable Energy Sources, AGORES, Tanzania - Energy Strategies in Tanzania, [http://www.agores.org/POLICY/GLOBAL\\_STRATEGY/AFRICA/Tanzania/default.htm](http://www.agores.org/POLICY/GLOBAL_STRATEGY/AFRICA/Tanzania/default.htm), January 2011

Africa Rural Energy Enterprise Development, AREED, Tanzania, The Energy Sector in Tanzania, <http://www.areed.org/country/tanzania/energy.pdf>, February 2011

African journals online, AJOL, <http://ajol.info/index.php/wiojms/article/view/28501/5179>, January 2011

Arcadia Market Commentary, Renewable Energy August 2009 Development in Emerging Markets, <http://www.arcadia4u.com/commentaries/200908-Arcadia%20Market%20Commentary.pdf>, August 2009

Clean Development Mechanism (CDM) programme, UNFCCC, [http://unfccc.int/kyoto\\_protocol/mechanisms/clean\\_development\\_mechanism/items/2718.php](http://unfccc.int/kyoto_protocol/mechanisms/clean_development_mechanism/items/2718.php), February 2011

International Energy Agency, IEA, Statistics and Balances, <http://www.iea.org/statist/index.htm>, January 2011

Ministry of Energy and Minerals, MEM, <http://www.mem.go.tz/modules/documents/index.php?&direction=0&order=&directory=EnergySector>, January 2011

Ministry of Energy and Minerals, MEM, Overview of Energy Sector, <http://www.mem.go.tz/modules/documents/index.php?action=downloadfile&filename=OVERVIEW%20OF%20ENERGY%20SECTOR%202010.pdf&directory=Energy%20Sector&>, January 2011

Norwegian Agency for Development Cooperation, NORAD, Thematic areas, Energy, Clean Energy, Where we are, Tanzania,

<http://www.norad.no/en/Thematic+areas/Energy/Clean+Energy/Where+we+are/Tanzania>,

February 2011

Research on Poverty Alleviation, REPOA, Mwakapugi, Arthur; Samji, Waheeda; Smith, Sean. The Tanzanian Energy Sector: The potential for Job creation and productivity gains through expanded electrification. Research on poverty alleviation, Special paper 10/03 ILO,

[http://www.repoa.or.tz/documents\\_storage/Publications/sp%2010-3%20NOV2010HR.pdf](http://www.repoa.or.tz/documents_storage/Publications/sp%2010-3%20NOV2010HR.pdf), 2010

Reuters, Tanzania plans \$120 million, 50 MW wind power project,

<http://www.reuters.com/article/idUSTRE6BR1QR20101228>, December 28, 2010

TalkTalk, Tanzania, Hutchinson country facts,

<http://www.talktalk.co.uk/reference/encyclopaedia/countryfacts/tanzania.html>, February 2011

Tanzania Electricity Supply Company, Tanesco, Services, Tariffs, Electricity Charges, January 2011

The United Republic of Tanzania, Energy, <http://www.tanzania.go.tz/energyf.html>, February 2011

The world fact book, Central Intelligence Agency (CIA), Tanzania,

<https://www.cia.gov/library/publications/the-world-factbook/geos/tz.html>, last updated on

January 20, 2011

Think Geoenergy, Malawi, Mozambique and Tanzania with geothermal potential,

<http://thinkgeoenergy.com/archives/4326>, April 02, 2010

United Nations Environment Programme, UNEP, The United Republic of Tanzania, Energy and Environment in Tanzania, <http://www.unep.org/GC/GCSS-IX/DOCUMENTS/Tanzania-1G-EnergyGen.doc>,

January 2011

Windfair.net, industry News, Tanzania - Wind power development in 3rd decade,

<http://www.windfair.net/press/8040.html>, September 19, 2010

World weather and climat graphs..., Tanzania, What is the Climate, Average Temperature/

Weather in Tanzania?, <http://www.climatetemp.info/tanzania/>, February 2011

Youth With A Misson Africa, YWAMA, Tanzania, <http://www.ywamafrica.org/East/>, February 2011

## 5.1 Related links

### *Government organizations*

Organization	Web site
State House	<a href="http://www.tanzania.go.tz">http://www.tanzania.go.tz</a>
Prime Minister's Office	<a href="http://www.pmo.go.tz">http://www.pmo.go.tz</a>
Vice President's Office	<a href="http://www.tanzania.go.tz/ministri&lt;br/&gt;esf.html">http://www.tanzania.go.tz/ministri esf.html</a>
President's Office Public Service Management	<a href="http://www.utumishi.go.tz">http://www.utumishi.go.tz</a>
President's Office, Planning Commission	<a href="http://www.mipango.go.tz">http://www.mipango.go.tz</a>

### *Ministries*

Ministry of Energy and Minerals	<a href="http://www.mem.go.tz">http://www.mem.go.tz</a>
Ministry of Finance	<a href="http://www.mof.go.tz">http://www.mof.go.tz</a>
Ministry of Foreign Affairs and International Co-operation	<a href="http://www.mfaic.go.tz">http://www.mfaic.go.tz</a>
Ministry of Health and Social Welfare	<a href="http://www.moh.go.tz">http://www.moh.go.tz</a>
Ministry of Home Affairs	<a href="http://www.moha.go.tz">http://www.moha.go.tz</a>
Ministry of Industry, Trade and Marketing	<a href="http://www.mitm.go.tz">http://www.mitm.go.tz</a>
Ministry of Information, Youth, Culture and Sports	<a href="http://www.hum.go.tz">http://www.hum.go.tz</a>
Ministry of Works	<a href="http://www.infrastructure.go.tz">http://www.infrastructure.go.tz</a>
Ministry of Communication, Science and Technology	<a href="http://www.mst.go.tz">http://www.mst.go.tz</a>
Ministry of Justice and Constitution Affairs	<a href="http://www.sheria.go.tz">http://www.sheria.go.tz</a>
Ministry of Labour and Employment	<a href="http://www.kazi.go.tz">http://www.kazi.go.tz</a>
Ministry of Lands, Housing and Human Settlements Developments	<a href="http://www.ardhi.go.tz">http://www.ardhi.go.tz</a>
Ministry of Livestock and Fisheries Development	<a href="http://www.mifugo.go.tz">http://www.mifugo.go.tz</a>
Ministry of Natural Resources and Tourism	<a href="http://www.mnrt.go.tz">http://www.mnrt.go.tz</a>
Ministry of Water	<a href="http://www.maji.go.tz">http://www.maji.go.tz</a>

Ministry of Agriculture, Food Security and Co-operatives	<a href="http://www.kilimo.go.tz">http://www.kilimo.go.tz</a>
Ministry of Community Development, Gender and Children	<a href="http://www.mcdgc.go.tz">http://www.mcdgc.go.tz</a>
Ministry of Defence and National Service	<a href="http://www.modans.go.tz">http://www.modans.go.tz</a>
Ministry of East African Co-operation	<a href="http://www.meac.go.tz">http://www.meac.go.tz</a>
Ministry of Education and Vocational Training	<a href="http://www.moe.go.tz">http://www.moe.go.tz</a>
Ministry of Transport	<a href="http://www.infrastructure.go.tz">http://www.infrastructure.go.tz</a>

### ***Institutions***

<b>Organization</b>	<b>Web site</b>
Bank of Tanzania (BOT)	<a href="http://www.bot-tz.org">http://www.bot-tz.org</a>
Board of External Trade (BET)	<a href="http://www.bet.co.tz">http://www.bet.co.tz</a>
Economic and Social Research Foundation (ESRF)	<a href="http://www.esrftz.org">http://www.esrftz.org</a>
Higher Education Students Loan Board (HESLB)	<a href="http://www.heslb.go.tz">http://www.heslb.go.tz</a>
National Bureau of Statistics Tanzania (NBS)	<a href="http://www.nbs.go.tz">http://www.nbs.go.tz</a>
National Development Cooperation (NDC)	<a href="http://www.ndctz.com">http://www.ndctz.com</a>
National Examinations Council of Tanzania (NECTA)	<a href="http://www.necta.go.tz">http://www.necta.go.tz</a>
National Housing Corporation	<a href="http://www.nhctz.com">http://www.nhctz.com</a>
Public Service Pensions Fund (PSPF)	<a href="http://www.pspf-tz.org">http://www.pspf-tz.org</a>
Registration Insolvency and Trusteeship Agency (RITA)	<a href="http://www.rita.go.tz">http://www.rita.go.tz</a>
Tanzania Airport Authority (TAA)	<a href="http://www.tanzania-airports.aero/index.htm">http://www.tanzania-airports.aero/index.htm</a>
Tanzania Bureau of Standards (TBS)	<a href="http://www.tbstz.org/index.htm">http://www.tbstz.org/index.htm</a>
Tanzania Civil Aviation Authority (TCAA)	<a href="http://www.tcaa.go.tz">http://www.tcaa.go.tz</a>
Tanzania Communication Regulatory Authority (TCRA)	<a href="http://www.tcra.go.tz">http://www.tcra.go.tz</a>
Tanzania Education Authority (TEA)	<a href="http://www.tea.or.tz">http://www.tea.or.tz</a>
Tanzania Employment Services Agency (TaESA)	<a href="http://www.taesa.go.tz">http://www.taesa.go.tz</a>

Tanzania Food and Drugs Authority (TFDA)	<a href="http://www.tfda.or.tz">http://www.tfda.or.tz</a>
Tanzania Investment Centre (TIC)	<a href="http://www.tic.co.tz">http://www.tic.co.tz</a>
Tanzania Meteorological Agency (Mamlaka ya Hali ya Hewa Tanzania)	<a href="http://www.meteo.go.tz/index.htm">http://www.meteo.go.tz/index.htm</a>
Tanzania National Business Council (TNBC)	<a href="http://www.tnbctz.com">http://www.tnbctz.com</a>
Tanzania Parliament	<a href="http://www.parliament.go.tz">http://www.parliament.go.tz</a>
Tanzania Petroleum Development Corporation (TPDC)	<a href="http://www.tpdz.com">http://www.tpdz.com</a>
Tanzania Ports Authority (TPA)	<a href="http://www.tanzaniaports.com/index.htm">http://www.tanzaniaports.com/index.htm</a>
Tanzania Revenue Authority (TRA)	<a href="http://www.tra.go.tz">http://www.tra.go.tz</a>
Tanzania Socio-economic Database	<a href="http://www.tsed.org">http://www.tsed.org</a>
Tanzania Tourist Board (TTB)	<a href="http://www.tanzaniatouristboard.com">http://www.tanzaniatouristboard.com</a>

### ***International organizations***

Banco Interamericano de desarrollo	<a href="http://www.iadb.org">www.iadb.org</a>
Food and Agriculture Organization of the United Nations	<a href="http://www.fao.org">www.fao.org</a>
International Energy Agency	<a href="http://www.iea.org">www.iea.org</a>
International Monetary Fund	<a href="http://www.imf.org">www.imf.org</a>
JICA - Japan International Cooperation Agency	<a href="http://www.jica.org">www.jica.org</a>
United Nations Development Programme	<a href="http://www.undp.org">www.undp.org</a>
World Bank	<a href="http://www.worldbank.org">www.worldbank.org</a>

### ***Other information sites***

Central Intelligence Agency, USA	<a href="http://www.cia.gov">www.cia.gov</a>
Climate & temperature	<a href="http://www.climatetemp.info">www.climatetemp.info</a>
Index Mundi	<a href="http://www.indexmundi.com">www.indexmundi.com</a>
Internet World Stats	<a href="http://www.internetworldstats.com">www.internetworldstats.com</a>

NASA Atmospheric Science Data Center	<a href="http://oesweb.larc.nasa.gov">http://oesweb.larc.nasa.gov</a>
Probe International	<a href="http://www.probeinternational.org">www.probeinternational.org</a>

# A sustainable Future is made of simple Things!



This project is funded by  
The European Union