WORLD SMALL HYDROPOWER DEVELOPMENT REPORT 2013

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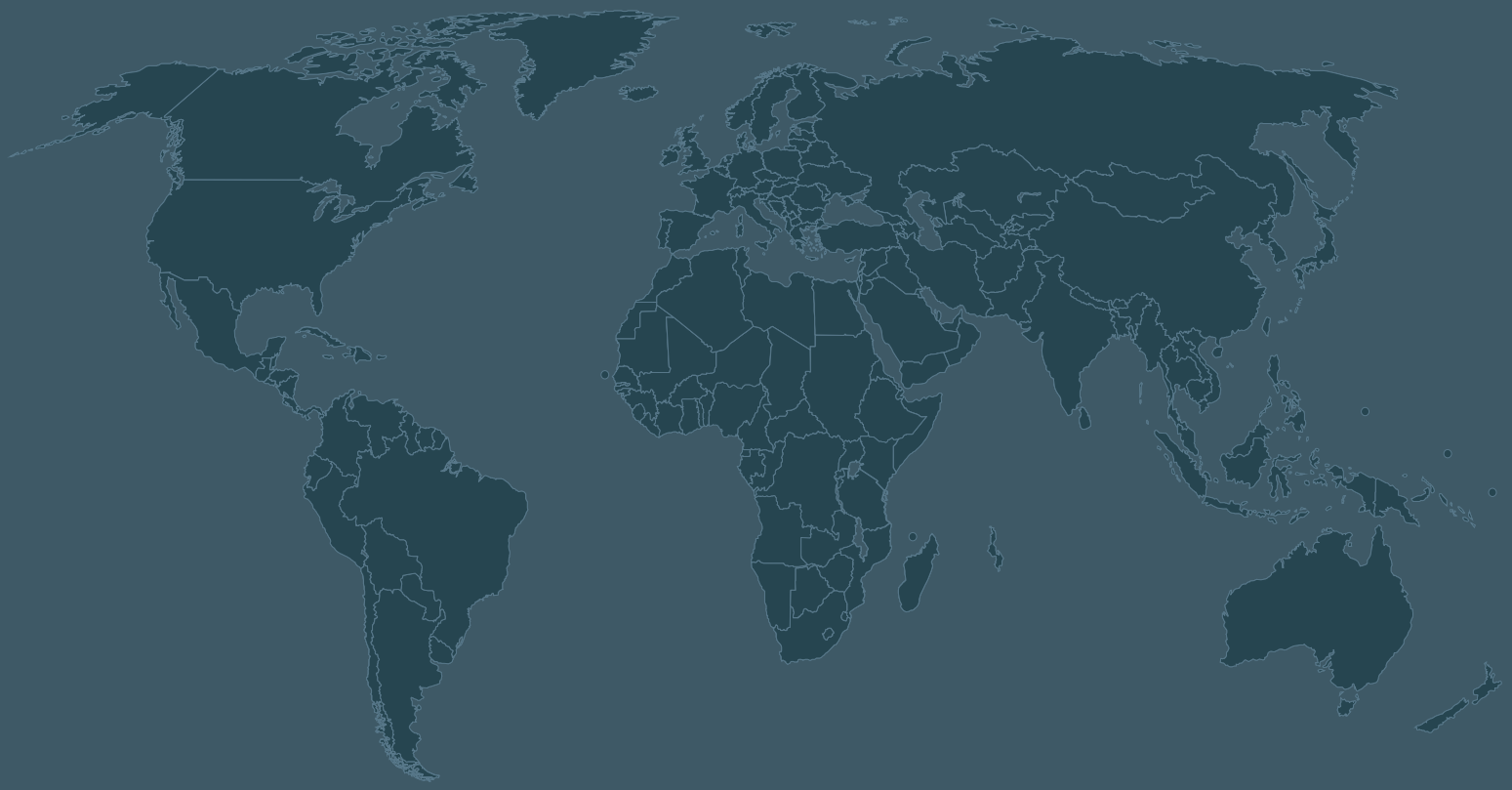
EASTERN AFRICA



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1 Africa

1.1 Eastern Africa

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Introduction to the region

The East African region comprises 20 countries, 14 of which use small hydropower at various degrees (see countries listed in table 1). The East African Power Pool (EAPP) plays an important role in the future of energy within the region. One of the main objectives of EAPP is to share grid connections to enable the flow of power from areas of abundance to areas of deficit.

The region is shaped by noticeable plate tectonics giving rise to geographical features such as the Great Rift Valley, Lake Victoria and Mount Kilimanjaro. The climate varies widely from tropical, sub-tropical, equatorial to temperate and arid.[1] Since the end of colonialism, the region has continued to endure internal and external political conflict. In addition, the majority of the Eastern African countries are faced with unreliable electricity supply as a result of fallbacks of national grid leading in widespread use of alternative means to ensure a steady supply of electricity. Despite the political and social challenges and energy barriers, the region attracts significant levels of foreign investment and positive development throughout various sectors in the economy.

Table 1

Overview of countries in Eastern Africa

Country	*Population (million)*	*Rural population (%)*	*Electricity access (%)*	*Installed electrical capacity (MW)*	*Electricity generation (GWh/year)*	*Hydropower capacity (MW)*	*Hydropower generation (GWh/year)*
Burundi[abe]	10.557	89	2.7	52	242	50.5	155
Ethiopia[abe]	91.195	83	17.0	929	4 106	1 850.0	2 800
Kenya[abef]	43.013	78	16.1	1 480	6 692	761.3	2 170
Madagascar[abeg]	22.005	70	19.0	434	1 138	131.6	753
Malawi[abe]	16.323	80	9.0	315	1 676	300.0	1 100
Mauritius[abeh]	1.313	58	99.4	670	2 402	58.3	101
Mozambique[abe]	23.516	62	11.7	2 308	14 980	2 179.0	14 710
Réunion[abe]	0.800	-	-	650	2 546	120.5	633
Rwanda[abe]	11.690	81	6.0	69	160	54.5	130
South Sudan	10.625	..	..	..	..	..	..
Uganda[abi]	33.641	87	9.0	525	1 400	409.0	900
Tanzania[abe]	46.913	74	13.9	1 051	4 281	562.0	2 640
Zambia[ab]	13.817	64	18.8	1 750	9 597	1 518.0	9 879
Zimbabwe[abe]	12.620	62	41.5	1 990	7 723	700.0	5 521
Total	**338.028**	**-**	**-**	**12 223**	**56 943**	**8 694.7**	**41 492**

Sources:

a. Central Intelligence Agency[1]

b. National Electrification rates: International Energy Agency[2]

c. Clean Energy Information Portal – Reegle[3]

d. Burundi information: International Renewable Energy Agency. Renewable Energy Profiles[4]

e. The International Journal on Hydropower & Dams[5]

f. Kenya, Ministry of Energy[6]

g. Madagascar, Agence de Développement de l'Electrification Rurale[7]

h. Mauritius Ministry of Energy and Public Utilities[8]

i. Uganda Centre for Research in Energy and Energy Conservation[9]

Note: The electrification rate may be reported higher in the country report because national sources are used based on different assumptions, e.g. Zambia. South Sudan has attained its independence on 9 July 2011. Therefore, statistics for South Sudan were difficult to identify or not available at the time of writing.

Small hydropower definition

Countries' official small hydropower definitions are given in table 2.

Table 2

Classification of small hydropower in Eastern Africa

Country	*Small (MW)*	*Mini (MW)*	*Micro (kW)*
Burundi	..	..	..
Ethiopia	..	..	..
Kenya	1.00 – 10.00	0.10– 1.00	< 10
Madagascar	> 10.00	1.00 10.00	50 – 1000
Malawi	..	..	..
Mauritius	0.01 – 0.05	0.0025 – 0.01	< 0.0025
Mozambique	8.00 -15.00		
Reunion	..	..	..
Rwanda	..	..	..
South Sudan	..	..	..
Uganda	< 10.00	< 1.00	< 100
Tanzania	..	..	..
Zambia	1.00 - 10 .00	0.50 – 1.00	< 300
Zimbabwe	..	0.501 – 5.00	5 – 500

Sources: Most of these definitions were obtained through surveys conducted by ICSHP in 2011, except for Mozambique.

Regional overview

Hydropower plays an important role (above 80 per cent) in electricity generation in Burundi, Ethiopia, Zambia, Mozambique and Malawi and it produces a significant amount of electricity in Uganda, Zimbabwe, Tanzania, Madagascar and Kenya. The island topography of Seychelles is not suitable for hydropower, while in Djibouti, Eritrea, and Somalia, the complete or part desert climate in these countries, coupled with recurring droughts, are not conducive for hydropower development. Small hydropower development in the region is ongoing at a smaller scale:

- A master study plan on hydropower potential for Burundi exists since the 1980s. It includes small hydropower potential sites with capacities of up to 10 MW. Recent optimization studies have shown that these sites could achieve higher installed capacities with the current available technology.[10] Though a large small hydropower potential is known, means to develop the potential are scarce.
- Eritrea does not use any hydropower and its small hydropower potential has not been studied. However, feasibility studies to utilize micro and small hydropower in the inland river basin are required and would be beneficial, since only three per cent of the rural population has access to electricity.[11]
- Ethiopia, with a national electrification rate of 17 per cent, is making efforts in improving rural electrification, particularly off grid electrification, and developing new energy sources. Currently, a rural energy fund exists and its feed-in tariffs (FITs) schemes are in the draft form.
- In Kenya, interest in the development of small hydropower has increased in the last 12 years due to the inadequacies of grid based power supply. There is a commitment to use renewable energy, as can be seen from the FIT policy and National Renewable Energy Development Strategy. Additionally, there is a high private sector interest in small hydropower mainly via small hydropower use on tea plantations (i.e. United Nations Environment Programme project). The Government is motivated to remove legal and regulatory barriers (see country report).[12]
- Interestingly, Madagascar has a very high potential (2,600 MW), however, there is no information on existing small hydropower plants in Madagascar. According to the Rural Electrification Agency, there were four plants with individual capacities of up to 10 MW, with a total installed capacity of 22.51 MW. All of them need renovation since the commissioning about 25 years ago.
- In Malawi, a Renewable Energy Strategy is underway and a Master Plan for Rural Electrification was passed in 2003. It includes a list of potential micro hydropower sites. However, the development of small hydropower is slow and some of the existing small hydropower plants are not operating due to lack of maintenance instruments i.e. availability of spare parts and financial constraints. On the other hand, feasibility studies have been conducted in the past, but one of the main barriers is the lack of investors.
- In Mauritius, two small hydropower plants are under construction and expected to be completed by 2015 in addition to the existence of FIT support systems that are readily available.
- Mozambique's greatest hydropower potential lies on the Zambezi River basin with a growing interest to promote the use of small hydropower for isolated rural communities
- Réunion's hydro potential has been developed with remaining potential for only a few more micro power stations.[13]
- While Rwanda does not have a lot of existing small hydropower there is considerable micro hydropower potential available in the country.
- A non-verifiable source estimates that pre-war Somalia had 4.8 MW of installed hydropower capacity in the lower Juba valley; however, due to the political unrest of the country, no significant data is available.
- In South Sudan, the development of the hydropower sector is not realized due to political and social unrest.
- In Uganda, the development of small, micro- or mini-hydro "has not been very systematically

conducted". Seven projects with a total of 60 MW small hydropower capacities have been announced.[14] Based on the National Renewable Energy Policy, a government programme with an ambitious target of 100 MW hydropower capacities, by 2017, is being anticipated, from mini- and micro-hydropower.

- Tanzania has a substantial small hydropower potential with areas of high potential located in Southern and Western highlands. The Tanzania Electric Supply Company Limited (TANESCO) is currently in the process of developing the available resources.
- The hydropower potential of Zambia is estimated at 6,000 MW, of which 1,858.5 MW has been developed. Development of small hydropower is usually conducted by the private sector.
- The total installed small hydropower capacity in Zimbabwe is unknown. However, some information from certain small hydropower plants has been obtained from the private sector.

The installed small hydropower capacity in Eastern Africa is estimated at 186 MW, while the potential is estimated at 6,208 MW, including Kenya's gross small hydropower potential of 3,000 MW (table 3). Additionally, some countries do not have data available on their small hydropower capacity potential (i.e. Madagascar and Zambia).

Table 3
Small hydropower up to 10 MW in Eastern Africa
(Megawatts)

Country	*Potential*	*Installed capacity*
Burundi	54.0	15.84
Ethiopia	1 500.0	6.15
Kenya	3 000.0	33.00
Madagascar	..	22.51
Malawi	15.0	5.80
Mauritius	9.5	8.70
Mozambique	1 000.0	2.10
Réunion	..	11.00
Rwanda	38.2	23.20
South Sudan	at least 5.0	..
Uganda	210.0	22.42
Tanzania	310.0	25.00
Zambia	..	31.00
Zimbabwe	120.0	1.92
Total	6 261.7	208.64

Source: See country reports
Note: Ethiopia has more than 600 potential sites, but its potential is not known. Madagascar has a small hydropower potential of up to 2,600 MW, however it defines small hydropower as above 10 MW. The above reported potential for Mozambique may include plants larger than 10 MW.

The Greening the Tea Industry in East Africa (GITEA) project by UNEP initially conducted pre-feasibility studies of 19 potential small hydropower sites in in Kenya, Malawi, Rwanda, Tanzania, and Uganda. Ten sites were selected for further studies and six demonstration projects were identified with the need of an additional investment of close to US$22 million for implementation. Supported by local banks and UNEP's funding, hydropower plants are being developed in key tea areas of Kenya, while the Dutch Government is helping to finance a facility in Rwanda. Plans are being finalized for more plants in Tanzania and Malawi. UNEP also supported preparation of FIT policies for renewable energies in Kenya and Tanzania. Under these policies, national grid utilities are obliged to buy renewable energy from all eligible participants, and to promote investment in hydropower.

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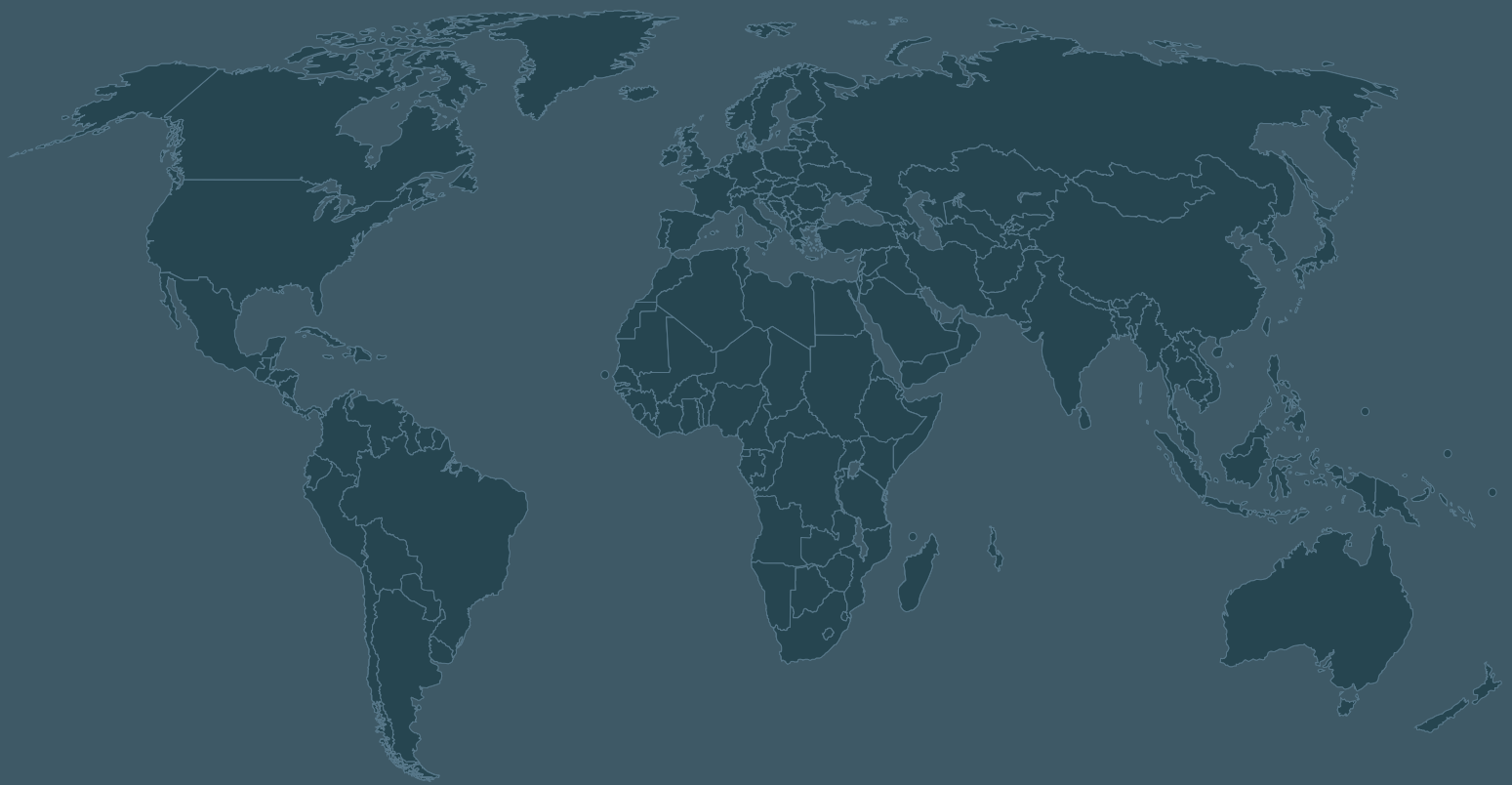

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