Renewables in Developing nations

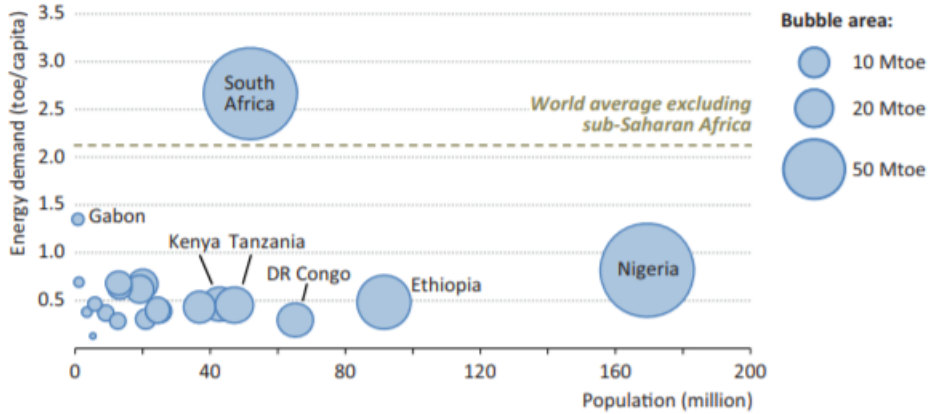
Africa and its Energy plans

- Ethiopia, Kenya and Uganda are among the most populous countries in East Africa, and have the largest populations both with and without access to electricity.
- In West Africa, electricity access rates range from below 20% in Liberia, Sierra Leone, Niger and Burkina Faso
- to more than 50% in Senegal and above 70% in Ghana.
- More than 90 million people in Nigeria (55% of the population), do not have access to (grid) electricity. However, the widespread use of back-up generators suggests that the population without.
- For those that do have electricity access in sub-Saharan Africa, average residential electricity consumption per capita is 317 kWh per year (225 kWh excluding South Africa). 4% of the worlds totals
- Installed grid-based power generation capacity in Africa has been steadily increasing in recent years and reached 158 gigawatts (GW) in 2012.

Africa's Power Demands

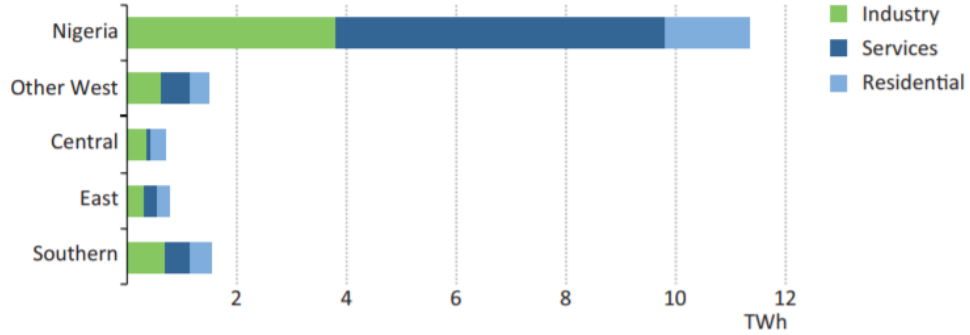
- Grid-based electricity supply is insufficient to meet electricity demand in sub-Saharan Africa.
- It is reported to be unavailable for 540 hours per year on average (6% of the year), but this figure is much higher in some countries, such as Nigeria, Guinea and the Central African Republic.
- The unreliability of the grid is a serious problem in all generating countries
- Dependence on Generators is real in West-African nations for power.

Figure 1.11 ▷ Population and per capita energy demand by country in sub-Saharan Africa, 2012



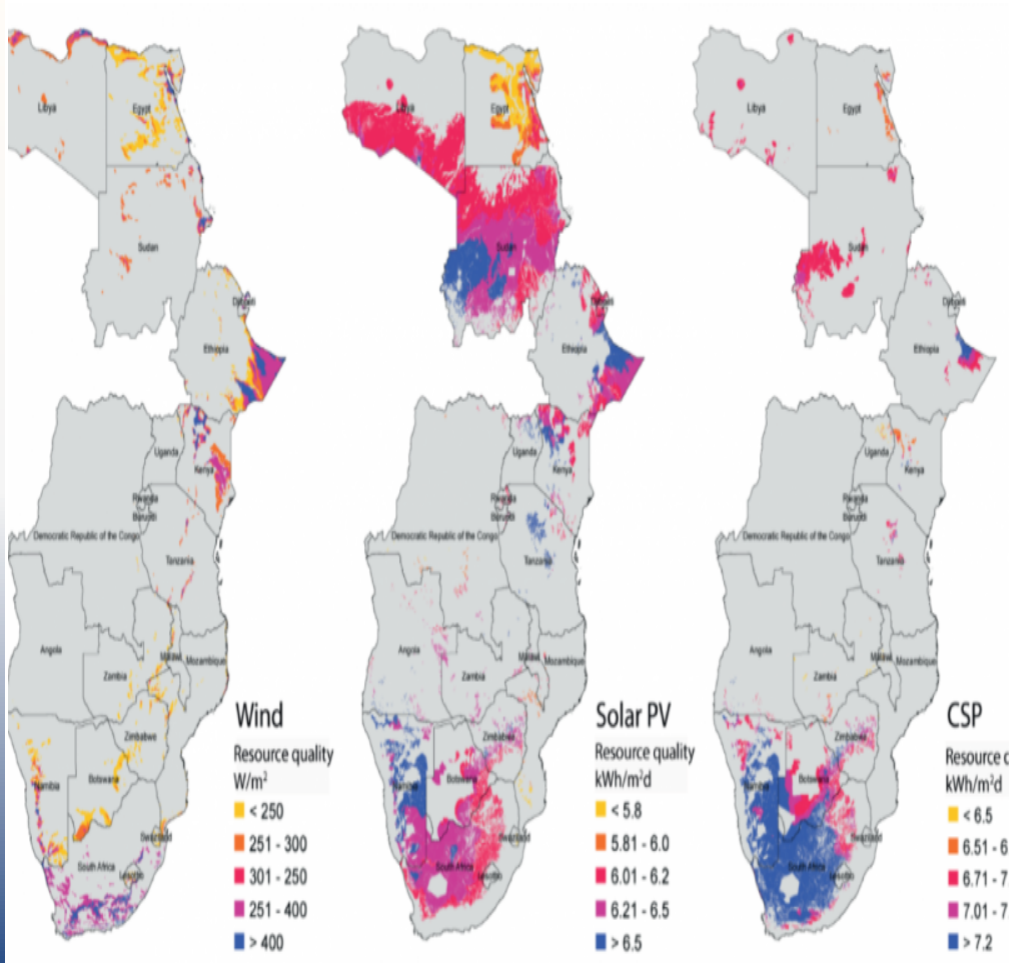
Note: The size of the bubble indicates the relative size of total primary energy demand.

Figure 1.15 ▷ Electricity demand met by back-up generators by sub-region, 2012



Africa's Energy potential

- The Energy Revolution
- Africa's potential for renewable energy production is extensive.
- Africa has a rather extensive and expensive job to create distribution grids across the continent.



The location and energy potential, in terawatt hours, of eastern and southern African renewable resources (wind, solar photovoltaic and concentrating solar power). Credit: UC Berkeley

African energy

https://www.youtube.com/watch?v=-1EjiWqNtCk

Africa and creating power

- Although almost 89% of the world has access to electricity
- Africa has an average of about
- An energy deficit has effectively stunted Africa's development, with an estimated 70 percent of people in sub-Saharan Africa without reliable access to electricity.
- IDA & IBRD stand for countries that are taking on developing or reconstructing their nations
- Sub-Saharan Africa has more people living without access to electricity than any other world region – more than 620 million people, and nearly half of the global total

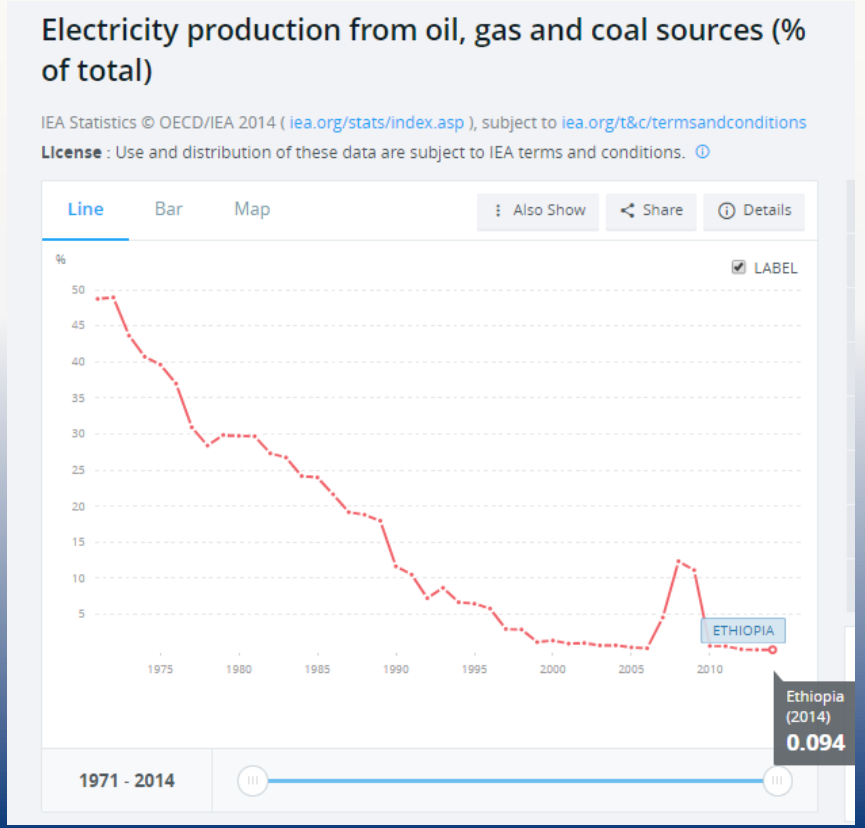
	1990	2000	2008	2009	2010	2011	2012	2013	2014	2015	2016
Middle East & North Africa	86.5	91.6	95.5	95.7	96.0	96.5	96.9	97.9	96.9	97.9	98.0
Middle East & North Africa (IDA & IBRD countries)	85.8	91.2	94.8	95.0	95.3	95.9	96.4	97.5	96.3	97.5	97.7
Sub-Saharan Africa (IDA & IBRD countries)	16.0	25.6	32.0	32.5	32.6	34.9	35.8	36.5	37.8	38.5	42.8
Sub-Saharan Africa (excluding high income)	16.0	25.6	32.0	32.5	32.6	34.9	35.8	36.5	37.8	38.5	42.8
Middle East & North Africa (excluding high income)	85.9	91.2	94.8	95.1	95.4	96.0	96.4	97.5	96.4	97.5	97.7
Sub-Saharan Africa	16.0	25.6	32.0	32.5	32.6	34.9	35.8	36.5	37.8	38.5	42.8

Reasons for Lack of Power

- due to poor maintenance which causes power stations to fall into disrepair.
- Many rehabilitation projects are ongoing, but much of the capacity in disrepair will never restart.
- Other factors also reduce the total capacity in operation, including lack of reliable fuel supply, particularly for gas, inefficient grid operations and insufficient transmission capacity.
- The effect of fuel supply limitations is made worse by the fact that the fleet of fossil fuel led power plants in sub-Saharan Africa consists largely of technologies with the lowest efficiencies, often favored due to their lower upfront capital costs.
- the fleet of coal-fired power plants employs low-efficiency subcritical technologies, with a fleet average efficiency of 34%.

Ethiopia and Electricity generation

- Population: currently sits at 102.4 million people
- With 43% having access to electricity
- Electricity production 56771 GWh
- ➢ Country in the horn of Africa➢ Total area - 1.13 km2
- ➢ ~ 100 million inhabitants, 2.3%growth rate/year
- ➢ Average annual GDP growth rate ~ 10 % -
- However they produce almost no electricity from oil, gas and Coal sources
- They emit 7.8 million metric tons of CO2 from the consumption of fossil fuels
- Ethiopia current emits 11599 kt in 2014 but is steadily been climbing recently.



Ethiopia and renewables

- Installed Capacity: 4,206 MW

- Hydroelectric: 3,743 MW (89%)
- Wind: 337 MW (8%)
- Thermal: 126 MW (3%)
- Ethiopia's Growth and Transformation Plan (GTP) Under GTP I (2010-2015), hydro power projects were constructed to increase the installed generation capacity from 2,000 MW to 10,000 MW.
- Currently the country has approximately 4,290 MW of installed generation capacity. GTP II (2015-2020) aims to increase generation capacity by more than 10,000 MW to over 17,000 MW

Organic water pollutant (BOD) emissions (kg per day per worker)
4.53

Access to clean fuels and technologies for cooking (% of population)
2 %

Energy production (kt of oil equivalent)
353254

Electricity production from coal sources (kWh)
0 kWh

Electricity production from hydroelectric sources (kWh)
56199000000 kWh

Electric power transmission and distribution losses (kWh)
5676000000 kWh

Electricity production from natural gas sources (kWh)
0 kWh

Electricity production from nuclear sources (kWh)
0 kWh

Electricity production from oil sources (kWh)
363000000 kWh

Electricity production (kWh)
56771000000 kWh

Energy use (kt of oil equivalent)
374702

Combustible renewables and waste (metric tons of oil equivalent)
348241

Electric power consumption (kWh)
51095000000 kWh

CO2 emissions from cement production (thousand metric tons)
1148

CO2 intensity (kg per kg of oil equivalent energy use)
0.2398

CO2 emissions from fossil-fuels, total (thousand metric tons)
7888

CO2 emissions from gaseous fuel consumption (kt)
0

CO2 emissions from gas flaring (thousand metric tons)
0

CO2 emissions (kg per 2000 US$ of GDP)
0.2631 kg/usd

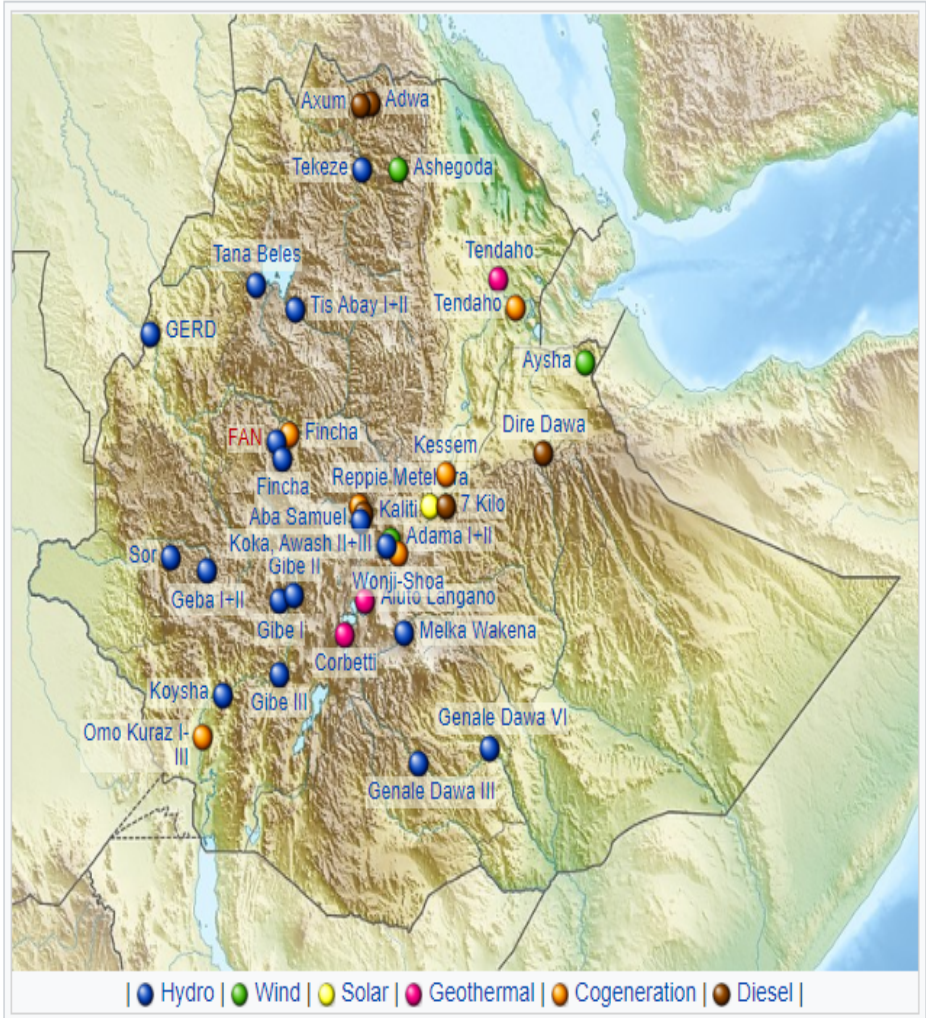
CO2 emissions (kt)
11599

CO2 emissions from liquid fuel consumption (% of total)
69.46 %

CO2 emissions (metric tons per capita)
0.1191

Power production in Ethiopia

- Ethiopia ranks #1 in Africa's Hydropower production
- consists of 12 major hydro-powerplants in its fleet
- HYDROPOWER GENERATION 9,674 GWh
    - 4054MW installed capacity
- New Zealand has a hydro power generation of 5,346 MW.
- Africa has massive hydropower capacity, of which less than 7% has been harnessed.



Power plants in Ethiopia (under construction / operational) ≥ 1 MW_e installed capacity (as of 2017)

Equatorial Guinea

- Produces 439 GWh
- 77.44% is the share of renewable capacity in the total capacity
- Has 127 MW of Hydropower installed
- Has a population of 2.04 million people
- 67.86% has access to electricity
- 44.8% from renewables large room for growth

Renewable energy consumption(% in TFEC)
7.82 %

Access to Non-Solid Fuel (% of rural population)
24.73 %

Access to Non-Solid Fuel (% of urban population)
100 %

Traditional biomass consumption
3851

Marine energy consumption
0

Modern biomass consumption
0

Hydro energy consumption
21.97

Liquid biofuels consumption
0

Solar energy consumption
0

Geothermal energy consumption
0

Waste energy consumption
0

Biogas consumption
0

Renewable energy consumption
5277

Total electricity output
439

Renewable energy electricity output
197

Renewable electricity
44.87 %

Total installed generation capacity (GW)
0.164

Renewable energy installed capacity (GW)
0.127

Share of renewable capacity in total capacity
77.44 %

Total primary energy supply
149950

GDP (2011 USD PPP)
25984668967

Energy intensity level of primary energy (MJ/$2005 PPP)
2.21

Primary energy intensity - Compound Annual Growth Rate
4.74 %

Total final consumption
13261

Energy intensity level of final energy (MJ/$2005 PPP)
0.5103

Final energy intensity - Compound Annual Growth Rate
-0.628 %

Energy intensity level of primary energy (MJ/$2011 PPP GDP)
2.63

Access to electricity, urban (% of urban population)
100 %

Access to electricity (% of population)
67.56 %

Renewable electricity output (% of total electricity output)
44.87 %

Renewable energy consumption (% of total final energy consumption)
6.38 %

GDP per unit of energy use (PPP $ per kg of oil equivalent)
15.8

GDP per unit of energy use (constant 2005 PPP $ per kg of oil equivalent)
16.77