Electricity Economic Model of the African Continent

(5) (Open Source) Modellierung
Robert GAUGL[1(1)], Udo BACHHIESL[(1)], Sonja WOGRIN[(2)]
[(1)] Graz University of Technology, Institute of Electricity Economics and Energy Innovation
[(2)] Institute for Research in Technology, School of Engineering, Comillas Pontifical University

Motivation and Research Question

This paper takes on modelling Africa's current electricity system and the arising challenges to cover the annual increase in demand in a sustainable way. We give an overview of the power transmission system and the pathway of the five power pools to form integrated electricity markets with centralised trading to increase reliability and leading to cost-effective electricity generation.
To build a model of the African electricity economy, the transmission system, which is based on open-source data, is combined with a database of Africa's existing power plants using a GIS-approach.

Methods

The general purpose of power pools is to facilitate electricity interchange between members. In Africa, currently five power pools are operated with several countries participating in multiple pools as can be seen in Figure 1. [1]
For participating countries it is possible to create a more robust power grid and power market. The advantages of the economies of scale can also be used by pooling resources in generation, transmission and distribution of electricity. In order for power pools to work they require (1) development of cross-border interconnections between the countries in order to connect the national grid to the power pool and to be able to exchange the traded electricity, (2) a common legal and regulatory framework and (3) multi-country organisational structures that plan, harmonise and develop a framework for cross-border electricity trading. [2]

Figure 1: African power pools and their participating countries [3].

To model the African electricity economy, we rely on open source grid data from OpenStreetMap [4]. The dataset is converted using the tool developed in [5] to convert it to a format we can use in our desired electricity model. The resulting electricity grid of Africa is depicted in Figure 2 on the left.
Power plant data originates from [6] and is converted into a format that is readable for our chosen electricity model using a PYTHON-Script developed for this task. Due to lack of GPS data, the location of the power plants is determined using a geocoding algorithm to convert the address into longitude and latitude information. The resulting power plant data can be seen on the right side of Figure 2.

[1] Inffeldgasse 18/II, 8010 Graz, Phone: +43 316/873-7904, robert.gaugl@tugraz.at

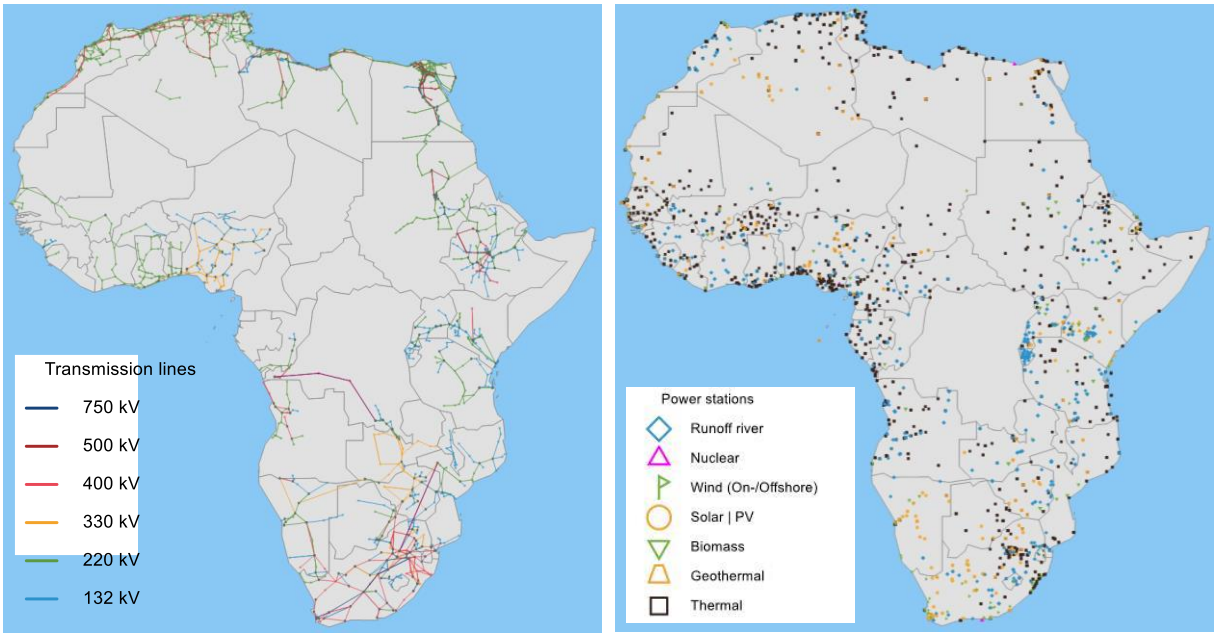

Figure 2: Africa's electricity infrastructure: transmission lines (110 kV and up; left) [4] and power plants (right)

Conclusion

The development stage of the African power pools is very different. The North African (COMELEC) and Southern African Power Pools are already very far advanced, whereas the Central African Power Pool is the least advanced due to a lack of infrastructure and policies.
In order to examine the future of the African electricity market, we develop an electricity model and present the current status in this work. As a first step the grid and power plant data has been collected and converted to be used in our electricity model. The full paper will present detailed information on the challenges to get the model to work and discuss the first results.

Literature

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