R&D UK Centre - Team

Virunga Park Electrification

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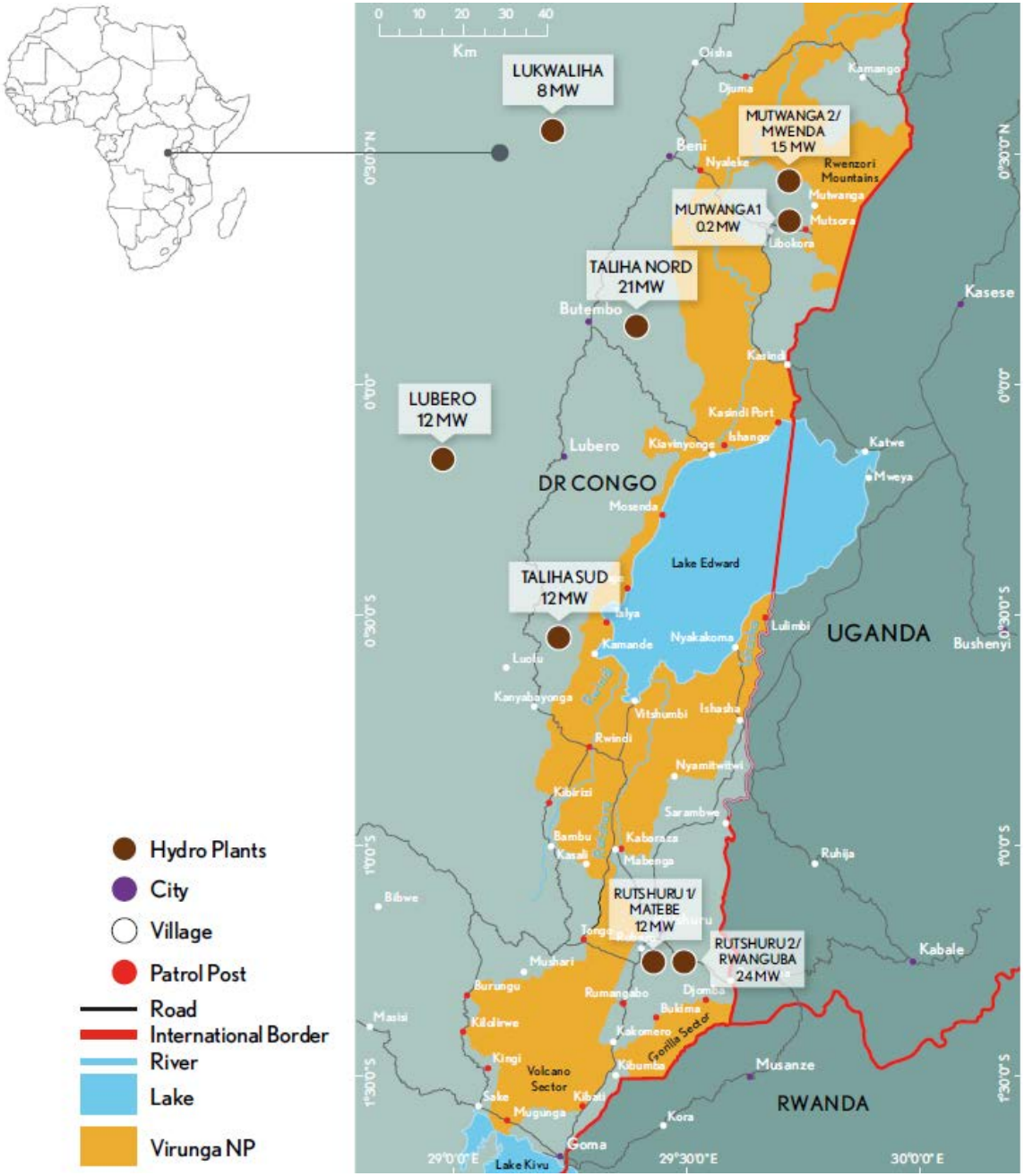
Disclaimer note: The work in this presentation was carried out by a due diligence team working at Ove Arup on behalf of CDC. For further information on the project please contact CDC enquiries@cdcgroup.com

Project Overview

Virunga National Park

Design, development, ownership and operation of eight Hydro Power Plants (HPP) and associated distribution networks to supply homes and local businesses in the area.

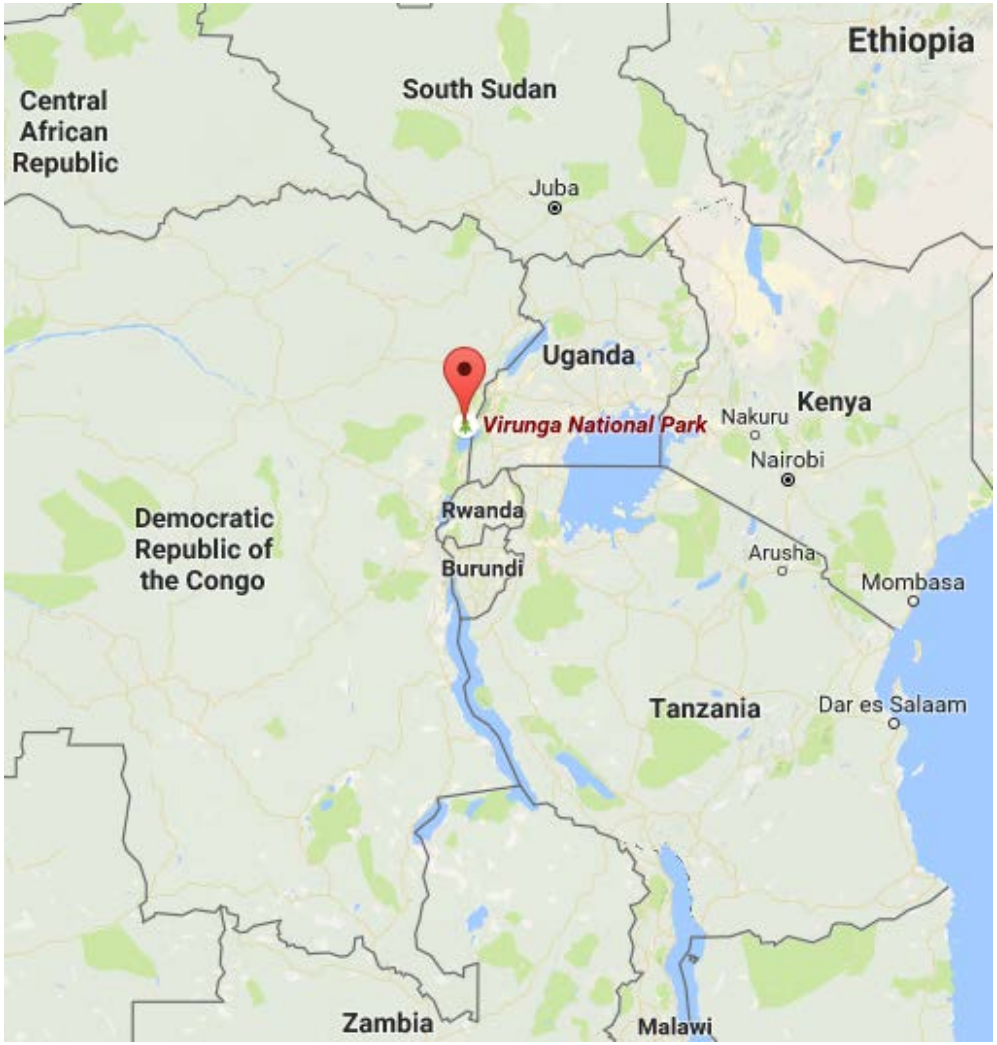


The Virunga National Park

Geography

Located in the Democratic Republic of Congo, the Virunga National Park is the oldest national park in Africa.

The park features a stunning landscape of volcanic mountains including the Nyiragongo volcano and the world's largest lava lake. The park is also home of one of the last two remaining populations of the mountain gorilla.



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Virunga National Park

History and Background

The Democratic Republic of Congo has a long history of exploitation of natural resources, extreme poverty and political instability.

Despite vast freshwater resources, only 26% of the population has access to safe drinking water (in rural areas the access level goes down to 17%).

Following the end of Mobutu's reign, the Congolese Civil Wars began in 1996 and devastated the country. The wars involved 9 African Countries and resulted in the death of 5.4 million people.

The province of North Kivu where the Virunga Park is located has been at the epicentre of the wars. It is estimated that in the past two decades, over two dozen armed groups have been operating in the area.

More recently the Park was at the centre of additional unrest following oil and gas exploration.

Virunga National Park

History and Background

The area is densely populated by 4 million people mainly farmers. Following years of conflict, today the population lives in poverty and has access to critically inadequate infrastructure.

Any action aimed at improving the quality of life and addressing economic development for the area needs to consider also the rich local biodiversity and the conservation agenda for the park.

The Virunga Foundation

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Project Description

Approach to Electrification in the Virunga Park

- Design, development, ownership and operation of eight HPPs and associated distribution networks (microgrids) to supply homes and local businesses in the area
- Opportunity to interconnect the 8 HPPs with their microgrids to form a macrogrid
- Develop the full commercial model of the project

The client CDC is the UK's Development Finance Institution (DFI) wholly owned by the UK Government.

The project is being funded through the Department for International Development (DFID)' s Impact Acceleration Facility which aims at creating economic opportunities and sustainable development in Sub-Saharan Africa and South Asia areas.

Project Description

The status of the project

- The Mutwanga HPP (0.38MW) is fully developed and operational.
- The Matebe HPP (12.6MW) is constructed and part commissioned. The associated network is currently being built and in the process to be commercialised.
- The Lubero and Taliha Nord HPPs are in the feasibility stage. Construction for Lubero is currently planned to start for this year (e.g. remedial and ground preparation works).

Project Description

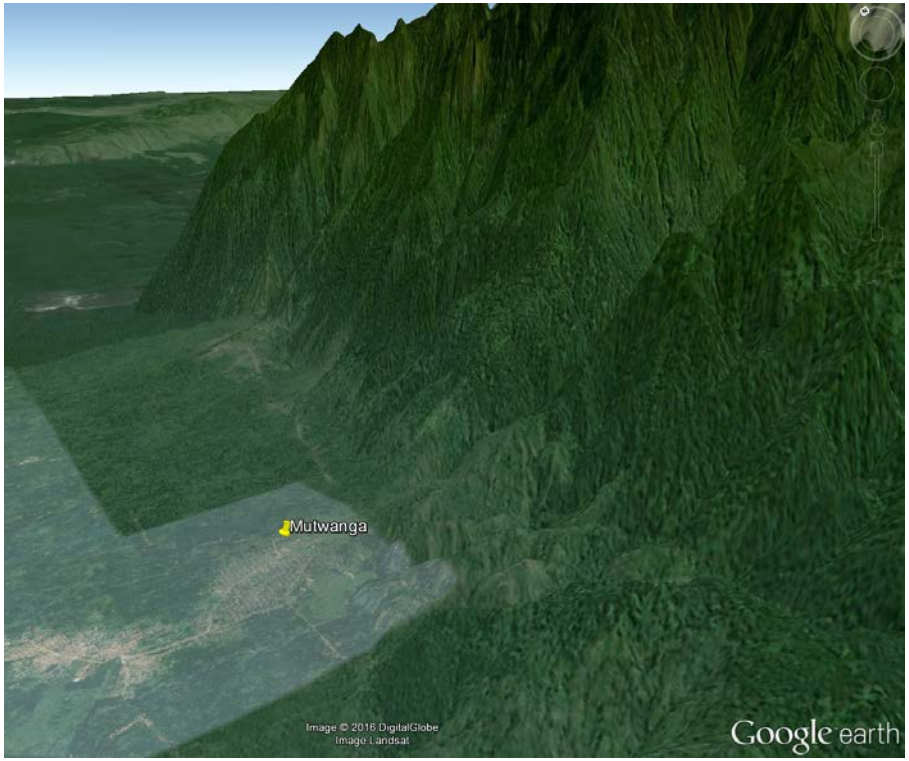
Mtwanga

The Mtwanga plant is a mini-HPP (run of river) commissioned in August 2013 with a capacity of 0.38MW.

This is the first project and was intended to be a pilot from which to gain experience and build local expertise.

This is a much smaller project compared with the other projects.

Designed to serve a projected population of 35,000 inhabitants across the town of Mtwanga, the plant is currently serving 528 customers of which 112 are commercial/business customers.



Project Description

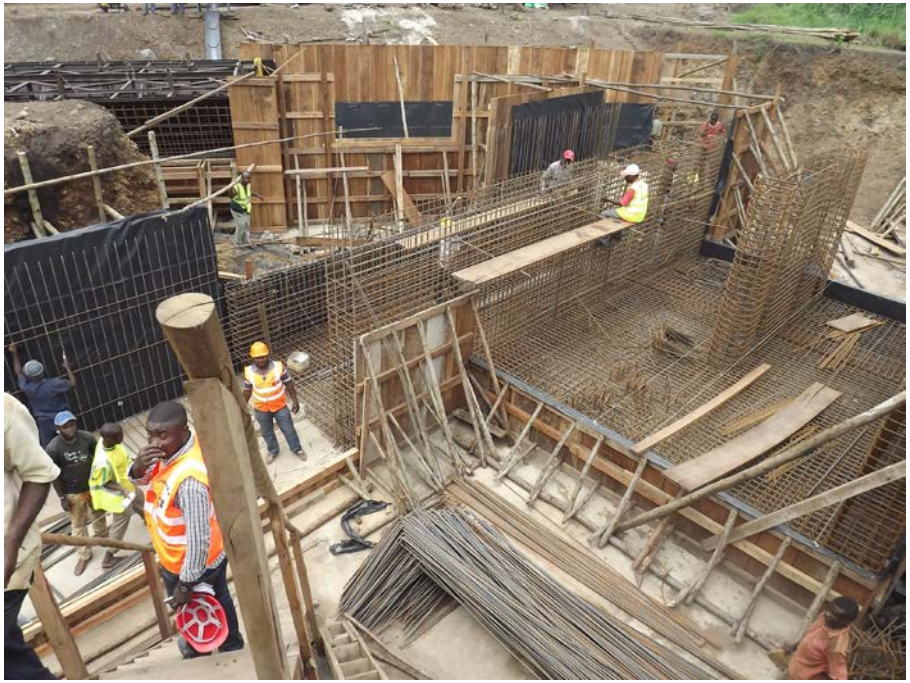
Mtwanga

The microgrid comprises a very simple radial network with limited protection selectivity and automation.

Designed around limited historic data on river water flows, the plant power output is currently below its rated capacity. This has the potential to impact PPAs.

No environmental flows requirement was taken into consideration.

Design and installation of the project completely carried out by the local Virunga team. This ensured proper monitoring, control and training of local workforce. **Lessons learnt are passed onto the next project.**



Project Description

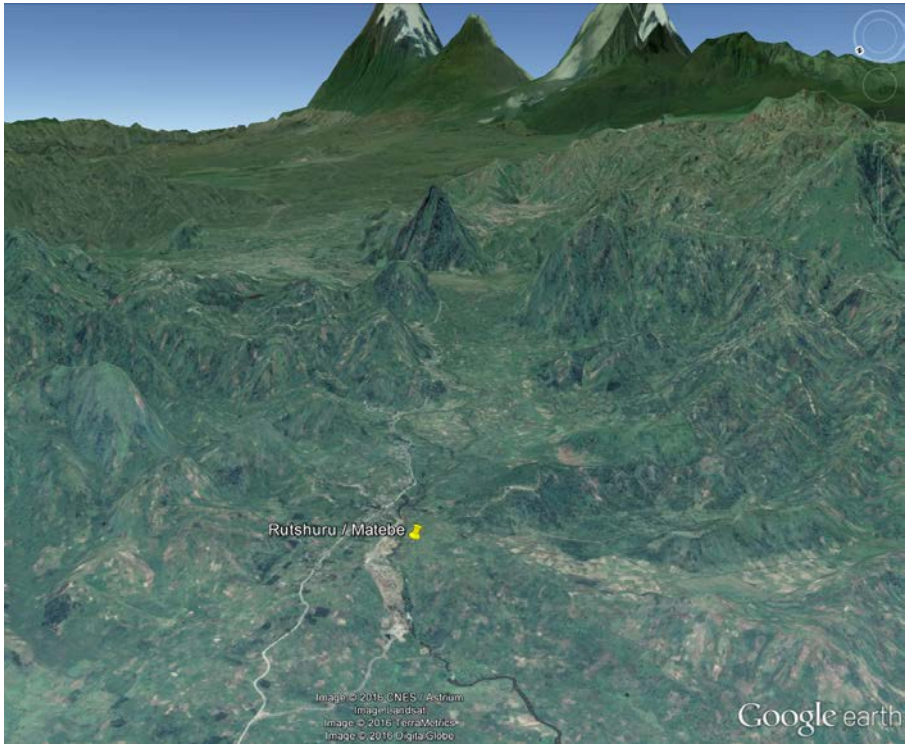
Matebe

The Matebe plant has a 12.6MW capacity (three turbines with a capacity of 4.8MW each). One turbine is commissioned with the other two and the full site planned to be commissioned din the coming months.

The plant is larger than the previous project and it is developed to service a population of 1.5m in the Rutshuru area.

The project on time and on budget is being designed and implemented by the Virunga team.

The network is still under development, with a 40km MV line built to date, which connects the HPP at Matebe to the town of Rugari.



Project Description

Matebe

Designed based on limited water flow measured data. Further monitoring was carried out in 2014 and 2015 to help better assessing the plant annual output and seasonality.

PPAs should to be based on 10% environmental flows, 80% plant efficiency and seasonal water flows.

Staff are trained both locally and abroad. A comprehensive scheme is implemeted to train and retain local workforce.

Management plans to keep ownership and O&M of plant and network while having a third part company to take care of the commercial aspects of operating the network, such as meter collection.

As part of the commercialisation of the project, it is currently being considered extending the existing MV lines by an additional 30km to transmit an additional 5MW to Goma. **Plan for a flexible network!**

Project Description

Future HPPs and Macrogrid

The next two plants to be developed and currently at feasibility stage are Lubero and Taliha Nord. Lubero HPP has a capacity of 11.5MW which is planned to be used to supply Lubero city, surroundings areas and Butembo (40km connection).
Taliha Nord HPP has a capacity of 20.6MW which is planned to supply the city of Butembo.

Several issues have been identified with these plants and are expected to be resolved as the design progresses including:

- lack of accessibility to the sites and the requirement to build roads and reinforce existing roads (e.g. concerns around a bridge connecting the area to Uganda which might not be able to carry the turbine alternator. Solutions include dismantling the alternator into smaller parts, or transporting the equipment via boat.)
- requirement to build a small airstrip for the Virunga SARL plane, which is used to transport equipment between sites.

A road is planned to be built alongside the border of the Virunga National Park to the Taliha Nord site. This is to act as a dual purpose of highlighting the park border and provide additional access to the HPP.

The Virunga Team is committed to develop local infrastructure as a part of the wider plan for a sustainable development of the park.

Project Description

Macrogrid

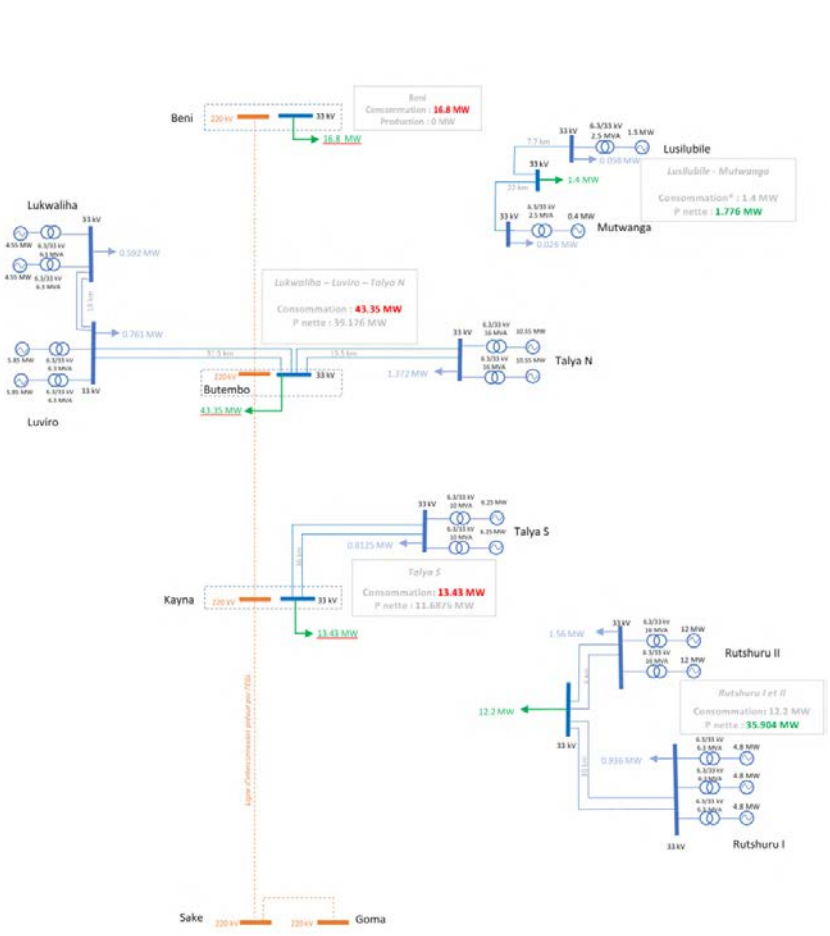
A study is currently underway to look into the possibility of connecting multiple HPPs. This will align with a larger 220kV network currently planned by the L'Energie des Pays des Grands Lacs (EGL) in the area.

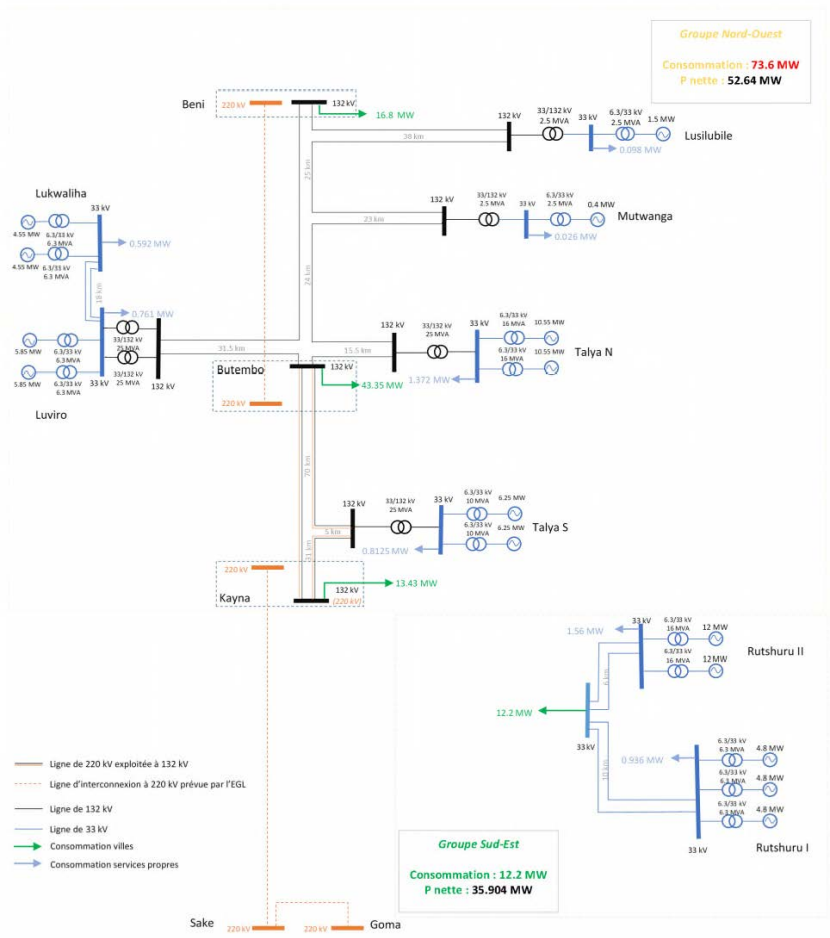
Network interconnection increases the system reliability, distributes power capacity where required and smoothens overall system load demand profiles as typically the maximum and minimum loads are not so peaky. Interconnection of plants supplied by different rivers improves the overall system performance as not all river might have the same water flows during the seasons.

Creating an interconnected network, however, increases the overall system complexities and requires a number of interventions. The main issue would be to avoid retrofitting some of the existing plant in order to accommodate the interconnection.

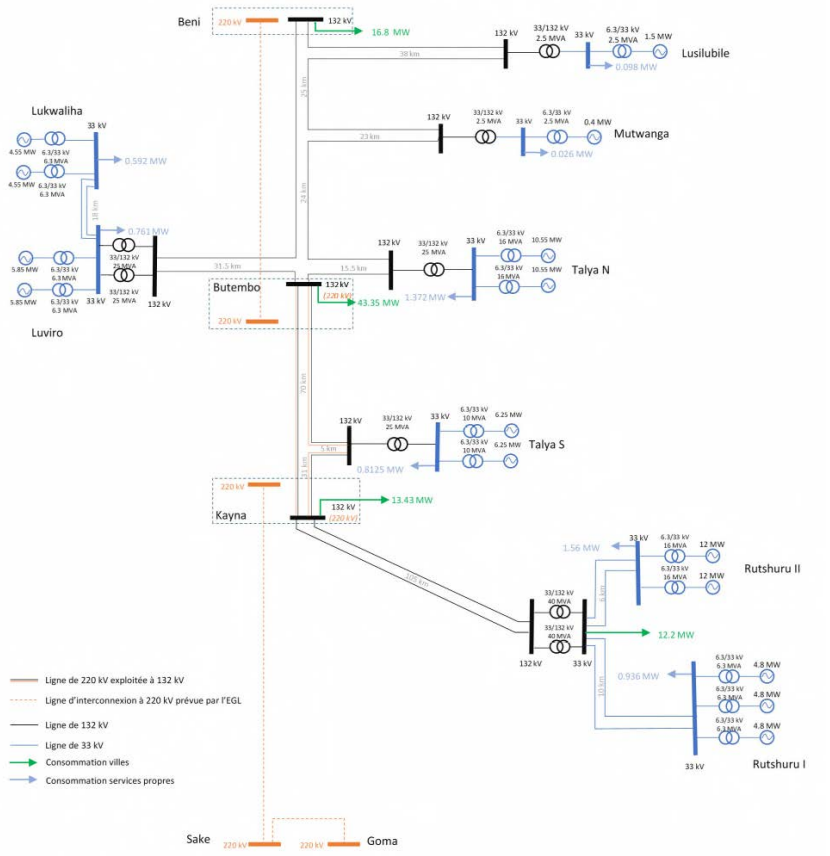
Although this needs to be considered as part of the aim to connect the full network, it is also relevant to the current plan of connecting the Lubero and Taliha Nord networks, which is understood to be required to commercialise the Lubero HPP due to the relatively low load in Lubero town.

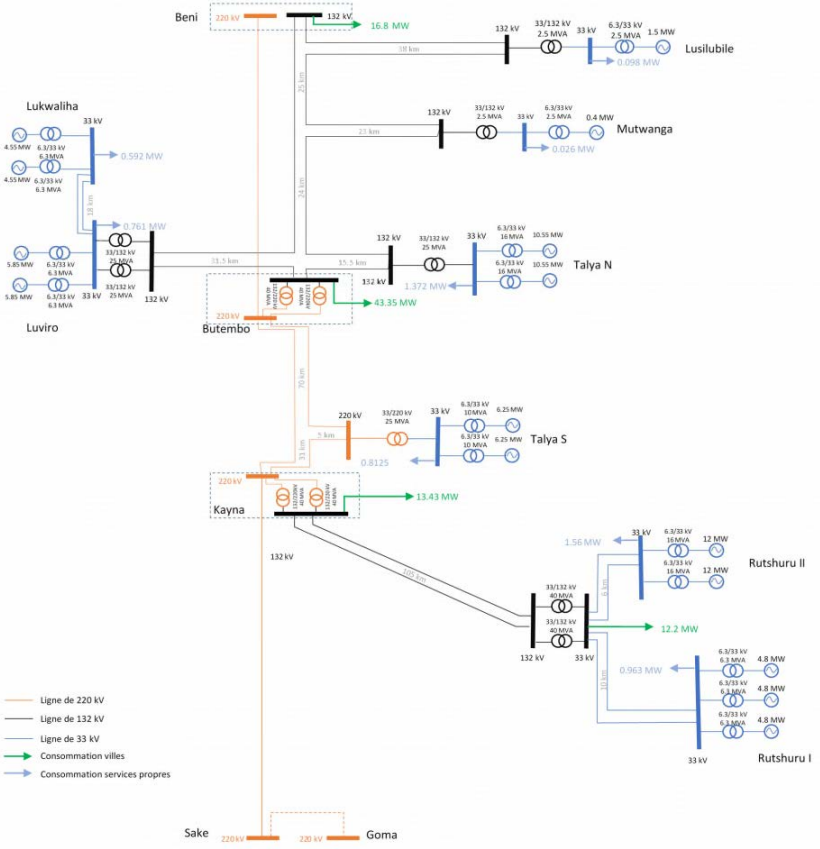
Project Description





Project Description





Key Lessons Learnt

- It is a challenge to collect large sets of historic measured data. This can have an impact on PPAs which could result in penalties during periods of low river flows.
- Keep into account environmental flows assumptions (recommended 10% in line with the European Small Hydropower Association Guidance Document)
- Planning infrastructure and site access routes are an opportunity to improve and expand the local transport infrastructure. Better infrastructure is key to economic development.
- Flexibility in network planning to allow for extensions driven by commercial drivers.
- Striking a balance between network redundancy and reliability, capex costs and O&M is, as expected, a challenge.
- Sometimes, local, “sustainable” solutions, might not be the most suitable ones. Initially the project installed wooden poles as a more sustainable and locally sourced material. However it was determined that these were rotting and are now being replaced by steel pole. As a result, Management has resolved that steel poles will now be used across all the projects.

Key Lessons Learnt

- The phased approach to the electrification of the Virunga Park is key in making sure that the project performance constantly improves and that learnings can be shared and implemented on the next project
- Having a local core team involved in the projects ensures that proper monitoring and control are implemented while training and developing a local skilled force.
- As more projects are being delivered the procurement and supply chains improve, spare parts can be shared and workforce can be deployed across sites.
- Good record on project time delivery and budget keeping can build the confidence of potential investors.

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