DEMOCRATIC REPUBLIC OF CONGO

TRANSMISSION AND DISTRIBUTION IN THE DEMOCRATIC REPUBLIC OF CONGO

This project was implemented by ICF under the USAID Energy Efficiency for Clean Development Program (EECDP) Leader Award

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Estimates show only 2% of the rural population and 19% of the urban population in the country has access to electricity, with a national average electrification rate of approximately 9%.

INTRODUCTION

Reliable access to electricity requires sufficient electricity generation and transmission and distribution (T&D) infrastructure. Effective enhancement of T&D infrastructure is dependent on understanding current and potential future electricity generation sources as well as current and projected peak demands. ICF was engaged by USAID to identify and develop conceptual plans for expanding, enhancing and augmenting T&D infrastructure in the Democratic Republic of Congo (DRC) with the key objective of identifying solutions that can improve energy access to hinterland cities in the DRC.

In February, 2017, USAID EECDP carried out an energy supply assessment for four major cities/population centers (Kikwit, Kananga, Tshikapa and Mbuji-Mayi) in the DRC under two scenario frameworks. The Scenario 1 Framework involved the development of local supply resources and the Scenario 2 Framework involved the development of the Inga III project (part of the Grand Inga) and augmented HVDC/AC transmission lines. By calculating current and potential future projected supply sources and peak demands, the project identified five transmission solutions (three under the Scenario 1 Framework and 2 under the Scenario 2 Framework) that can improve the long-term electricity access and reliability for the four focus cities. These solutions were summarized in individual project fact sheets to be used in building investment interest.

Framework Overview

1. Assess the electric power sector in the DRC

The DRC has rich renewable energy potential, but substantial unmet electricity demand. Only 9% of the population has access to electricity with 19% electrification rates in urban areas and 2% rates in rural areas. The project identified resources and solutions with the potential to both influence energy production and improve energy access in the future. The assessment covered the following topics:

- Assessing regulatory structure
  - Société Nationale D'électricité (SNEL) is the state owned enterprise in the DRC with a mandate for electricity generation, transmission, distribution and trading of power.
  - The Electricity Law of 2014 created three new institutions[1] and broke SNEL's monopoly by opening up the country to independent power producers.

[1]Electricity Regulation Authority, National Electrification Fund, and National Rural Electrification Agency

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Projects with the best potential to meet demand, and provide long-term energy access and reliability were identified by analyzing projected demand and potential supply options for the cities of Kiwit, Kananga, Tshikapa, and Mbuji-Mayi.

- Assessing existing and proposed hydropower plants
  - Nearly 98% of the country's electricity (a total installed capacity of 2,590 MW) is currently produced by hydroelectric plants. Only half of the capacity is available at any given time due to breakdown and maintenance issues.
  - There are five hydropower units in construction or in active development with the combined potential installed capacity of 5,264.5 MW.
- Determining potential of other renewable energy sources
  - Solar has a high energy potential but there are no grid-scale plants in the country.
  - Biomass accounts for nearly 95% of the primary energy consumption in the country, but there are no central biomass-based power plants.
  - Wind resources are adequate to develop grid networks, but there are no central wind-based power plants.
- Assessing existing transmission networks in the DRC
  - There is currently no interconnected national transmission grid network in the DRC.
  - There are three interprovincial/regional grid networks operated by SNEL: West (between Central Congo and Kinshasa/Inga site), East (North and South Kivu), and South (Haut-Katanga and Lualaba) networks.
- Selecting focus cities for the project
  - Four cities were selected for this project based on their location along the Inga-Kolwezi power route, their large populations, and their rising energy demands: Kikwit (in Kwilu province); Kananga (in Kasai-Central province); Tshikapa (in Kasai-Central province); and Mbuji-Mayi (in Kasai-Oriental province).

2. Develop demand projections and determine supply-side resources for the focus cities

To assess current and future energy needs, the project projected the expected demand for the cities through 2035 taking into account expected per capita electricity demand, projected population, load factor and reserves requirement. Additionally, existing and potential hydropower sites for the four cities were assessed. These analyses resulted in the following estimates for each of the four cities:

- Kikwit
  - Projected peak demand increases from 116 MW in 2016 to 293 MW in 2035.
  - The total rated capacity of potential hydropower units is approximately 2.2 MW.
- Kananga
  - Projected peak demand increases from 111 MW in 2016 to 281 MW in 2035.
  - The total rated capacity of potential hydropower units is approximately 36 MW
- Tshikapa
  - The projected peak demand increases from 301 MW in 2016 to 762 MW in 2035.
  - The total rated capacity of potential hydropower units is approximately 184 MW.
- Mbuji Mayi
  - The projected peak demand increases from 294 MW in 2016 to 744 MW in 2035
  - The total rated capacity of potential hydropower units is approximately 106 MW.

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Development of an AC transmission line "backbone" would improve electricity access and reliability, and serve as a regional grid network to distribute power generated in central provinces. It would require building a 220 kV AC line connecting the cities of Kikwit–Kananga–Tshikapa–Mbuji-Mayi, and is expected to be 400 miles long (approximately 650 km).

3. Develop supply-demand projections for the focus cities

Two mutually exclusive scenarios were developed to determine potential approaches for meeting projected electricity demands for the four cities. These include:

- Scenario 1 – develop local resources
  - Assumes that local supply resources, including potential energy sites within a 100 km radius of each city, will be developed by 2020.
  - Any remaining power requirements will be supplied through existing AC transmission lines.
- Scenario 2 – Inga III Development
  - Assumes that the proposed 4800 MW Inga III hydropower project will be completed by 2025.
  - Power from Inga III would supply hinterland cities through augmented AC and HVDC transmission lines.

4. Identify which potential projects improve long-term energy access and reliability in the four cities

Using the two scenarios, five projects were identified that resulted in the greatest increase in energy access, grid reliability or transfer capacity for the lowest costs. These projects are:

- Scenario 1 – develop local resources
  1. For each of the four cities, construct local, collector-type transmission line networks to supply power from local hydropower projects to the city center. This would improve grid reliability and energy access.
  2. For Kikwit, construct a distribution system emerging from the city's local collector system to enhance access to power at the household level.
  3. Between Kikwit–Kananga–Tshikapa–Mbuji-Mayi, construct an AC transmission line "backbone" to improve electricity access and reliability for the entire country and to serve as a regional grid network to distribute power generated in Central provinces.
- Scenario 2 – Inga III Development
  4. Construct a second HVDC line parallel to the existing Inga – Kolwezi line to double the transfer capacity from Inga site to cities in central and southern provinces of DRC. The project also provides the option of connecting cities in the hinterland and exporting power to other countries.
  5. Extend the AC "backbone" in project 3 in either direction to complete an AC "backbone" line from Grand Inga site across the country to its south eastern regions to improve reliability and electricity access to hinterland cities. Also, being an AC line, it is easier to tap into the line to supply to major load and population centers in the hinterland.

Project Accomplishments

- Projected capacity and demand for the four focus cities, Kikwit, Kananga, Tshikapa and Mbuji-Mayi, based on hydro-generation within 100 miles of each city
  - The expected demand was projected through 2035 for each of the cities, taking into account expected per capita electricity demand, projected population, load factor and reserves requirement.
  - Existing and potential hydropower sites for the four cities were also assessed.
  - The total rated capacity of potential hydropower units near each of the cities is far below the projected demand for each of the cities in 2035.

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One of the five investment projects identified would double the transfer capacity from Inga III site to cities in Central and Southern provinces of the DRC by constructing a second HVDC line parallel to the existing Inga – Kolwezi line. Estimated cost: $1254 m 2015 USD.

- Developed 2 sceneries to meet projected energy demand for each of the four selected cities
  - Scenario 1 assumes that local supply resources, including potential energy sites within a 100 km radius of each city, will be developed by 2020 and remaining power requirements will be supplied through existing AC transmission lines.
  - Scenario 2 assumes that the proposed 4800 MW Inga III hydropower project will be completed by 2025 and that power from the project will supply hinterland cities through augmented AC and HVDC transmission lines.
- Developed five potential investment T&D projects to improve long-term electric access and reliability of the four cities
  - Scenario 1 – develop local resources
    1. Improve grid reliability and energy access by constructing a local collector transmission network for each individual city. Estimated cost: $190 m 2015 USD.
    2. To enhance household power access in Kikwit, construct a distribution concession system. Estimated cost: N/A.
    3. To improve electricity access and reliability for the entire country, construct an AC transmission line "backbone" between Kikwit–Kananga–Tshikapa–Mbuji-Mayi. Estimated cost: $415 m 2015 USD.
  - Scenario 2 – Inga III Development
    4. To double the transfer capacity from Inga site to cities in Central and Southern provinces of the DRC, construct a second HVDC line parallel to the existing Inga – Kolwezi line. Estimated cost: $1254 m 2015 USD.
    5. To complete an AC "backbone" line from Grand Inga site across the country, extend project #3 AC "backbone" in either direction. Estimated cost: $1623 m 2015 USD.

Recommendations for Replication and Scaling-up

- Conduct primary research on areas related to the study (i.e. per capita electricity demand, load factor and reserves requirement etc.) to ensure that data and information are as accurate as possible.
  - Planning is difficult due to the lack of information available. Many demand studies have been done and projections vary widely.
  - Currently lacking an authoritative, credible study to determine these factors.
- Need to standardize equipment and installation practices across the DRC to ensure stable prices and accurate pricing estimates
  - Price analyses are complicated by wide variation in costs across the DRC. Equipment varies across provinces resulting in wide cost variations.
- Need to work with power companies and government agencies to develop protocols and systems that allow for households to pay for electricity
  - Most households live on a day-to-day basis and cannot afford to pay for internal house wiring or small appliances.
  - Provide small appliances to customers and incorporate costs in the tariff.
  - Install pre-paid meters, insuring customers only use what they can afford to pay for.
- Need to work with the DRC government to attract private development capital for the identified projects
  - Current DRC taxes are currently too high to attract development capitol.
  - Tax incentives or lower taxes would increase potential investors.