AFRICA RENEWABLE ENERGY FUND

Case study: Small hydro development in Uganda

April 2018
Outline

- Berkeley Energy Uganda
- Uganda power sector foundations
- IPP milestones
- Key documents and terms
- Benefits of small hydro
- Berkeley Energy activity in Cameroon
Berkeley Energy Uganda

Berkeley Energy has developed, constructed, operated and managed 4 hydro projects in Uganda totalling 110MW, which makes us the market leader in small/medium hydro in the country.

13 MW Bugoye
Operational since 2009

14 MW Kikagati
In construction, COD Q2 2020

41 MW Achwa 2
In construction, COD Q4 2018

42 MW Achwa 1
In construction, COD Q2 2020
Uganda power sector foundations

Well designed sector unbundling was the prerequisite for sector reform

- The 1999 Electricity Act unbundled the state-owned Uganda Electricity Board, into:
  - Uganda Electricity Transmission Company Limited, owns the transmission assets (>33kV) and acts as single buyer
  - Uganda Electricity Generation Company Limited, which owns the state generation assets, and
  - Uganda Electricity Distribution Limited, which owns the distribution network (<33kV)
- A 20-year private concession was signed in 2005 for Umeme to operate the distribution of electricity.
## Uganda power sector foundations

Independent regulator and Ministry of Energy played within their clearly defined roles and responsibly managed the sector to ensure a stable environment.

| Independent regulator | - The Act also created the Electricity Regulatory Authority ("ERA"), which acts as an independent regulator and provides regulatory oversight to the sector;  
|                       | - ERA issues feasibility permits for projects under development and generation licences once projects have completed feasibility studies, which stipulate clear requirements;  
|                       | - ERA monitors the supply and demand forecasts of the sector and determines which projects can be issued permits and licences. |
| Cost-reflective tariff | - The end user tariff is cost reflective and considers all of the costs in the system including generation, deemed generation, transmission and distribution;  
|                       | - ERA undertakes quarterly reviews of the tariff. |
| Clear policy framework | - Ministry of Energy and Mineral Development, in consultation with sector stakeholders, is responsible for establishing new policy;  
|                       | - Clear policy decision was taken to encourage new IPPs to ensure long term sustainability of supply. |
IPP milestones

Sound policy and regulatory activity, together with well-run electricity distribution, has created the basis for IPP development. Systematic approach to small hydro sector has resulted in very strong investor activity.

Unbundling of Electricity Sector
1999

Renewable Energy Law introduced. Tariff too low to make projects viable
2007

Introduction of GET FIT mechanism providing bankable framework and subsidy
2013

GET FIT catalyses projects to proceed outside of framework
2015-2020

2005
Private concession Umeme to operate distribution

2007
First large IPP in country: 250MW Bujagali hydro

2009 - 2013
First small hydro IPPs negotiated on a bilateral basis: Bugoye (2009), Mpanga (2010), Ishasha (2011) and Kabalega (2013)

2015-2020
Projects proceed through GET FIT mechanism

2020
320 MW across 29 small renewable energy IPPs are in progress
Approximately 320MW is being delivered across 29 small renewable energy IPPs, using hydro, solar and bagasse technologies, owned by a diverse set of investors.
## Key documents and terms

**GET FIT introduced template documents and tariff support to catalyse projects**

<table>
<thead>
<tr>
<th>GET FIT</th>
<th>KFW backed programme to catalyse small renewable energy IPPs. It introduced a standardised Power Purchase Agreement and Government Support Agreement and provided a tariff subsidy to facilitate projects.</th>
</tr>
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</table>
| **Power Purchase Agreement ("PPA")** | **Short-term Liquidity Support**: UETCL provides a bank guarantee of 2-3 months revenue that the IPP can draw in the event of late payment;  
**Deemed Energy**: IPP is to be paid if it is able to produce electricity. IPP’s investment is based on it being able to produce when it is available and hence it cannot take the risk that the grid or offtaker is not able to take its energy.  
**Limited Penalties**: capped and reasonable penalties for late delivery of project and low availability that take into account the risk being taken by the IPP |
| **Government Support Agreement** | **Support**: Provision of support by the government for obtaining key permits and land  
**Free transfer**: Facilitate the free transfer of funds necessary to implement the project  
**Termination payments**: Government to make acquire the plant through specified termination payments in the event of termination of the PPA or Government Support Agreement with specified values to be agreed for i) political force majeure, ii) other force majeure, iii) Government events of default and iv) IPP events of default. |
Benefits of small hydro

Several aspects of quantifiable project benefits that can be recognised locally and at a macro level

| Distributed power generation | Additional energy supplied to the grid, thus reducing dependence on thermal power generation |
|                            | Small, manageable increments in capacity that can be added in step with demand growth |
|                            | Improvement in quality of power delivered through the grid |
|                            | Reduction of transmission and distribution losses |
|                            | High level of production from a hydro renewable energy source |

| Localised development       | Job creation during construction and operation. Significant training and skills transfer |
|                            | Local infrastructure: roads and power supply. Boosting electrification in underserved areas |
|                            | Community projects, e.g. schools, health centres, etc as prioritised by the community |

| Economic benefits           | Foreign direct investment that boosts country/sector standing as investment destinations |
|                            | Tax revenue during construction and operation |
|                            | Creation of assets whose longevity will benefit the country in decades to come |

| Environmental and social considerations | Run of river hydro design with much lower impact than conventional hydro dam projects |
|                                         | Adherence to high international standards of environmental and social governance in project development and delivery |
Berkeley Energy activity in Cameroon

Berkeley Energy is replicating its hydro delivery strategy in Cameroon

- Berkeley Energy has identified and is evaluating six hydro project sites in the South-West region near the city of Kumba
- MoU was signed with the Government of Cameroon in September 2017 for these projects
- The following key steps have been achieved:
  - Established a Cameroon company and a local development team with presence in the region;
  - Actively engaged with village communities and signed MoU with local authorities representing them;
  - Carried out preliminary hydrology and grid studies based on available data;
  - Installed flow gauges in the rivers in order to substantiate the hydrology study;
  - Brought in a technical partner to accelerate the feasibility studies;
  - Carried out topographic survey.
ÉLABORATION DE LA FEUILLE DE ROUTE POUR LA PROMOTION DES ÉNERGIES RENOUVELABLES EN AFRIQUE CENTRALE

Yaoundé, le 18 avril 2018

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Expert en Energie – CEEAC
Email: jkoutele@gmail.com
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1 – Bref aperçu de La CEEAC
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   b) Potentiel en Energies Renouvelables
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3 – Perspectives
4 – Objectifs globaux
5 – Conclusions
La CEEAC en Afrique:
Superficie: 6,6 Millions Km²
Population: 163 Millions d’habitants
(en 2015)
a) La CEEAC (Suite)

- **Création:** octobre 1983
- **Siège:** Libreville – Gabon
- **Mission:** Promouvoir et renforcer une coopération harmonieuse et un développement dynamique, équilibré et auto-entretenu dans tous les domaines de l’activité économique et sociale.
- **Vision stratégique:** Place explicitement l’Energie parmi les axes prioritaires pour l’intégration régionale (d’ici 2025)
b) Potentiel en Energies Renouvelables de l’Afrique Centrale

- **Massif forestier**: le 2ᵉ au monde (302 Millions ha)
  - Importante biomasse

- **Hydroélectricité**: 150 000 MW environ, représente 58% du potentiel africain (avec 100 000 MW en RDC; 23 000 MW au Cameroun)

- **Solaire**: Dont le flux varie entre 5 et 7,5 KWh/m²/jour

- **Eolien**: Vitesse moyenne du vent: 6 m/s
S’agissant du solaire

Le flux solaire varie entre 5 et 7,5 KWh/m²/jour

- Le gisement solaire est important en Angola, au Cameroun, en RCA, et au Tchad, favorable à l’implantation de centrales solaires.
- Les autres Etats de la CEEAC peuvent accueillir des équipements décentralisés.

Source: Livre Blanc CEEAC / CEMAC

Issu du Laboratoire US des EnR
Le gisement éolien, peu important en Afrique Centrale, pourrait néanmoins participer au mix énergétique de la région, notamment au Cameroun, Centrafrique, Congo, Gabon, Guinée Equatoriale, Sao Tome & Principe et Tchad.

Source: « Livre Blanc CEEAC/CEMAC »
c) Etat des lieux (secteur électrique)

- Capacité installée en EnR (en 2014):
  - en Hydroélectricité : 5 183 MW, soit (67%)
  - Autres EnR: Non déterminée

- Taux d’électrification globale (2012): 36,9%
  - Urbain: 61,8%
  - Rurale: 10,6%

- Consommation moyenne (2014): 196,6 KWh/hab./an
Protocole – Coopération en matière d’NRJ entre États

Ce Protocole vise entre autres:

- L’harmonisation et la coordination entre les États, de leurs Politiques et activités dans le domaine de l’NRJ.
- La coopération entre États pour l’inventaire la planification l’aménagement l’exploitation et la distribution de l’NRJ hydroélectrique des principaux bassins fluviaux et leurs affluents.
- La coopération entre États dans la recherche et la mise en valeur des ressources d’EnR telles que: Solaire, Eolien, Géothermie, Biomasse.
2– Actions en cours

- Elaboration de la Politique Energétique de l’Afrique Centrale (processus en cours).
- Elaboration de la Feuille de Route pour la promotion des EnR en Afrique Centrale (rédaction en cours);
- Étude de faisabilité en vue la création et l’opérationnalisation d’une structure en charge des EnR en Afrique Centrale
- Étude de faisabilité pour développement sites hydroélectriques de Booué et Tsengue Leledi
Feuille de Route – promotion des EnR en AC

Sur Appui de IRENA, les actions ci-après ont été menées:

- Elaboration des TDR pour le recrutement d’un Consultant individuel
- Démarrage activités en janvier 2018
- Visites dans 4 des 11 Etats membres de la CEEAC (Gabon, Cameroun, Congo et Rwanda)
- Questionnaire adressé aux Etats
- Rapports en cours de rédaction par ledit Consultant
- Atelier de validation à organiser au Rwanda
- Adoption par les Chefs d’Etat et de Gouvernement de la CEEAC en juillet 2018
Mission du Consultant

- Établir un état des lieux et un diagnostic complet et fiable du sous-secteur des énergies renouvelables en Afrique Centrale ;
- Présenter la vision, les défis à relever pour promouvoir le secteur des Énergies Renouvelables, y compris les micro et mini-réseaux électriques à base d’Énergies Renouvelables, et formuler les propositions de stratégie possibles pour relever les défis identifiés ;
- Définir les perspectives de développement des énergies renouvelables à moyen et long termes ;
Résultat attendu

Doté l’Afrique Centrale d’une Feuille de Route pour la promotion des Energies Renouvelables
Poursuivre le développement de partenariat / coopération pour la mise en synergie des initiatives Énergétiques dans l'espace Communautaire (IRENA, ONUDI, ONU-HABITAT, CER, CUA/NEPAD, ONU, PNUD, SE4ALL, UE, Charte Internationale pour l’Energie, etc.)
4 – Objectifs globaux

- Assurer l’accès universel aux services énergétiques modernes pour les populations
- Contribuer à l’accroissement du taux d’accès à l’électricité : 54% (2030)
- Valoriser les ressources des EnR
5 – CONCLUSION

Le potentiel en EnR de l’Afrique Centrale est immense mais très faiblement exploité (hors mis la biomasse), en cause notamment :

- Cadre institutionnel inapproprié;
- Manque de moyens financiers;
- Des coûts initiaux élevés en capital;
- Secteur privé: peu développé

Il convient de:

- Prendre des mesures incitatives pour accroître les investissements;
- Développer les systèmes décentralisés à partir des EnR
MERCI

POUR VOTRE

AIMABLE ATTENTION

Jean KOUTELE,
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REGIONAL WORKSHOP
Central Africa

Developing Skills to Accelerate Renewable Energy Deployment

ISO 50001 Energy Management System

April 17-19, 2018
Yaounde, Cameroon

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ISO 50001: Understanding the Context

- Industry utilizes very complex systems, consisting of equipment and their human interface to meet the production needs of the business.

- Existing ISO standards for quality management practices (ISO 9001) and environmental management systems (ISO 14001) have successfully stimulated continual efficiency in the industrial sector.

- According to the IEA, manufacturing industries can improve their energy efficiency measures by 18 to 26%, while reducing the sector’s CO2 emissions by 19 - 32%, based on proven technology and energy management systems.

- This is especially true in developing countries and emerging economies that still lack national energy management standards as well as policies and mechanisms to achieve improved efficiency in the industrial sector.
Objectives of the ISO 50001

• The purpose of an energy management system standard is to provide guidance for industrial and commercial facilities to integrate energy efficiency into their management practices

• ISO 50001 enables organizations to establish systems and processes necessary to take a **systematic** approach to achieve **continual** improvement of energy performance (energy efficiency, use, consumption and intensity)

• ISO 50001 establishes an international framework for industrial, commercial, or institutional facilities, or entire companies

• Lead to reductions in energy cost, greenhouse gas emissions and other environmental impacts.
**Scope**


- It is a *voluntary* international framework for the effective and sustainable management of energy in any organization large or small

- Its application assists organizations in *reducing energy consumption* through the utilization of international best practices, measurement and reporting disciplines, continuous improvement and promoting energy efficiency throughout the supply chain

- It therefore helps to *reduce greenhouse gas emissions and operational costs* of the organization

- It is not an energy efficiency plan (but requires to establish one)
ISO 50000- Family of Standards


ii. ISO 50002:2014 Energy audits - Requirements with guidance for use

iii. ISO 50003:2014 Energy management systems - Requirements for bodies providing audit and certification of energy management systems

iv. ISO 50004:2014 Energy management systems - Guidance for the implementation, maintenance and improvement of an energy management system

v. ISO 50006:2014 Energy management systems - Measuring energy performance using energy baselines (EnB) and energy performance indicators (EnPI) - General principles and guidance

vi. ISO 50015:2014 Energy management systems - Measurement and verification of energy performance of organizations - General principles and guidance
ISO 50001: Plan-Do-Check-Act
Management Responsibility

Goal

• In addition to providing general support, top management should provide the necessary resources such as time, personnel, financial, materials, etc. for the effective implementation of the EnMS.

• Top management commitment is crucial to the successful implementation of the EnMS.

• It must be communicated and made visible to the entire organisation to encourage active participation of all staff members in adhering to the EnMS.
Energy Policy

Goal

- Cornerstone for implementing and improving an organisation’s EnMS and energy performance within its scope and boundaries

- Provides a statement of the high level overview of management’s intent that members of the organisation should apply to their work activities

- Provides a framework for an organisation to set energy objectives and targets and associated energy management action plans to further improve its energy performance
EE Obligations are Highly Cost Effective

- Efficiency programmes save 9x more carbon per consumer GDP than carbon taxes or prices

Cumulative CO₂ Emissions Saved by: Increasing Rates 3%; and Increasing Rates 3% to Fund Energy Efficiency (UK Example)

- It is not an energy efficiency plan (but requires to establish one)

Source: Regulatory Assistance Project (2012)
Some examples of case studies real savings

Companies who have voluntarily adopted an energy management plan have achieved major energy intensity improvements. Some examples include:

• Dow Chemical achieved 25% improvement ($4B savings) within five years from 2005 to 2015
• United Technologies Corporation reduced global GHG emissions by 46% per revenue dollar
• Toyota’s North American (NA) Energy Management Organization has reduced energy use per unit by 23%
• Maple Leaf Foods – Company wide structured multifaceted approach to energy efficiency initiated in 2001: 6% reduction in Energy intensity + $12.5 Million in savings achieved to date
Example of case studies in Nigeria
The Power Scenario in Nigeria

- 4,500 MW operational **installed capacity** for about 190 Mio people (South Africa: 44,000 MW for 55 Mio people)
- **Power outages** of approx. 8-10 hours per day
- Technical and non-technical **losses**: 55%
- 40-60% of households (more than 90 Mio people) without **electricity access**
- About **8,000 MW** of privately installed **Diesel generators**
- Electricity supply one of the top-three **barriers to doing business** in Nigeria (World Bank Ease of Doing Business Report)
i. Support the formulation and implementation of relevant energy policies

ii. Create awareness on energy management systems among policy makers, facility managers and the general public

iii. Create discussions with key stakeholders on the adaptation of ISO 50001 standards by SON

iv. Develop a strategy for ISO 50001 adoption and implementation

v. Build capacities of policy makers in for the implementation, monitoring and evaluation of EnMS in the industrial sector;

vi. Train and certify ISO 50001 energy mangers, a group selected eligible professional staff from MAN, NACCIMA, SMEDAN member industries; SON

vii. Creation of Energy Efficiency Networks (EEN)
Partners of the Project

Project implemented by:

- Government of Nigeria (Federal Ministry of Industry, Trade and Investment (FMITI), Standards’ Organisation of Nigeria (SON), Federal Ministry of Power, Works and Housing (FMPWH))

- Industries’ Associations (MAN, NACCIMA, SMEDAN)
The Need for Energy Management

i. How much percentage could be saved?

- Most industrial enterprises that have implemented EnMS achieved average annual energy intensity reductions of 2-3% against 1% reduction of business as usual (IRL, NETH, DEN, SWE, USA)
- For companies new to energy management, savings during the first 2 years are 10-20%
- In many African Countries, potential savings can be up to 40% of total energy costs
What is the share of energy cost in your organisation?

- Most industrial enterprises that have implemented EnMS were at energy costs of 8-15% of total operational costs (IRL, NET, DEN, SWE, USA, CAN)

- In most african countries, energy costs can be up to 40% of production costs

- In Germany, energy costs need to be at 16% of the revenue in order to receive tax benefits by implementing an EnMS
What are the major challenges in energy management?

- **Arbitrary generator sizing:** Under-loading generator set results in efficiency drop, fuel wastage, and impaired availability; while on the other hand, overloading a generator results in winding burnout. The best recommendation is to load generator set at 75-80% of its total rated power for optimum efficient operation, and not to be operated with a load less than 30% for more than one to two hours.

- **Unsustainable procurement:** Procurement of inefficient equipment (used appliances, second hand), procurement of energy guzzling equipment (incandescent bulbs, unlabeled appliances etc.)

- **Inefficient processes:** Idling machineries, unavailability of energy policy, untapped free contributors (day lighting, natural ventilation, solar PV etc.)

- **Wrong approach to energy efficiency measures:** lack of technical know-how in identifying unproductive energy consumption, non-consideration of sustainable building design
40% of CO₂ emissions is due to producing electricity

Source: Good Practice Guide 84 Managing and Motivating Staff to Save Energy
Typical Energy Efficiency Networks (EEN)

- **EEN Carrier**
  - Initiation
  - Monitoring
  - Promotion
    (e.g. association, utility, local authority)

- **Experts**
  - Implementation
  - Facilitation / moderation
  - EE consultancy

- **Cooperation principles**:
  - Voluntariness (commitment)
  - Partnership (trust)
  - Collaboration (common issues)

- **Companies**
  - 5-15 organisation
  - Active participation
  - Sharing best-practices
  - and prepared to „invest“ into EE
Example of case study: Compressed Air

- Body cleaning is a common use of compressed air—however, it is a very costly energy waste!

- This gentleman wastes about 10,000 USD per year
Compressed Air System

For a typical air compressor, the energy consumption represents 75% of the lifetime cost of operation, and so energy efficiency should be the priority for reducing the total costs of compressed air.

Life cycle costs of compressed air system
## Air Leakage Energy Losses and Costs

<table>
<thead>
<tr>
<th>Hole diameter (in)</th>
<th>Flow rate (SCFM)</th>
<th>Power loss (HP)</th>
<th>Demand loss (kW/mo)</th>
<th>Energy loss (kWh/yr)</th>
<th>Leak cost ($/yr)</th>
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</table>

@ 8 bar, 720 hours/year, 0.06 USD/kWh

### Conversion Table

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Air Leakage Energy Losses and Costs
Air leakage measurement

Soft Drink Bottling Plant

Average Demand (400 cfm)  Peak Demand (550 cfm)

Leaks/Nonproductive Loads: 200 cfm ≈ 50% of average demand

$37,440 annual energy cost
Industrial energy efficiency examples

• A high efficiency motor will have about 3-5% higher efficiency than a standard motor.
• Rewinding is cheaper and quicker than buying a new motor, but: Reduced efficiency by more than 1% (up to 4%) each time!
Industrial energy efficiency examples

- You can’t manage what you don’t measure!

- Studies in Europe show that most industrial enterprises that have implemented energy measurement and monitoring schemes achieved average annual energy savings of 2-3%
Industrial energy efficiency examples

- Technology is only as smart as the operator – your employees are the most valuable asset in energy efficiency!

- Continuous awareness raising and training can lead to energy savings of 1-2% per year
In Summary: ISO50001 can achieve:

- Management focus
- Systematic activity
- Actively managing energy use and costs, reducing exposure to rising energy costs
- Obligation to train and raise awareness
- Obligation to provide resources
- Document savings for internal and external use
  (e.g. emission credits, legal reporting requirements)
- Reduce GHG emissions without negative effect on operations
- Continuity through changes of personnel
Promoting EnM within various Policy contexts

- **Energy Management within Broader Policy Framework**
- **Mandatory Energy Management Policies**
- **Voluntary Energy Management Programs**
Initial Questions for you

i. What is the share of energy cost in your organisation?

ii. How much percentage could be saved?

iii. What are the major challenges in energy management?

iv. What are the existing energy policies to promote, develop and implement EE measures in the domestic, industrial and building sectors
Group work:

Questions:

1. Give some Opportunities and challenges to the implementation of EnMS based on ISO 50001

2. Name the 3 utmost policy areas you think are required for the promotion and implementation of ISO 50001
References

- ISO 14001 Environmental management systems- Requirements with guidance for Use


