

Implemented by INNOVATION ENERGIE DEVELOPPEMENT GROUP

# Context & Objectives



Under 25 % of Cambodia's rural population has access to grid-based electricity and there are a number of village micro-grids that are often powered by inefficient diesel generators.

Electricity tariffs are among the highest in the world (around 20 US cents on grid and up to 80 cents off grid), a factor preventing massive improvement of the connection rate, and hence economic and social development of these rural areas.

Therefore, the Royal Government of Cambodia is currently facing 2 major challenges:

• Improving energy access, mainly by grid extension,

• Decreasing electricity tariff, especially for off-grid customers.

With strong economic growth, the country is now counting on private sector participation to reach ambitious policy target in term of investment for the power sector, which is considered as a main pillar of economic development.

The objective is to reach 70 % of rural households by 2030 from 15% today, through private sector participation in both distribution networks and renewable energy.

However, the off-grid tariff is still high due to the fact that electricity is mostly from village mini-grids that are often powered by diesel generators. In addition, local Rural Electrification Enterprises (REE) tend to limit investment on power generation considering the risk that their localities will be soon reached by the national grid. Those constraints have strong impact in terms of energy access to the poorest, sustainability of the service and GHG emissions.

The IED GROUP is developing, constructing and operating biomass units between 250 kW and 2MW in order to demonstrate technical sturdiness viability of the business model and to contribute to the establishment of a conductive regulatory framework.







Biomass Gasification for Rural Electrification in Cambodia

### NOVEMBER 2015

# **Project Organisation**

IED is an independent engineering firm incorporated in 1988, active in sustainable energy development and rural electrification in more than 40 countries across Africa and Asia.

In 2011, the IED group was restructured and diversified trough the establishment of an investment arm, IED Invest. IED Invest is an actively managed long-only fund investing exclusively in emerging country markets, developing small, decentralized or grid connected power generation plants using renewable energy sources, and gives concrete form to the term public-private partnership, particularly in the geographical areas where IED has been established for a number of years.

In Cambodia, IED-Invest is the investor and owner of the installation. IED-Invest provides the capital and mobilizes the necessary loans, and thus is the grant recipient.

In Cambodia, the local branch IED-Invest Cambodia is in charge of power plant operation, under the supervision of CCDE for the technical, legal and financial aspects. CCDE (Cambodia, Development Engineering Co.) is a consulting firm created in 2006 and subsidiary of IED.



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## **Results and perspectives**

### **PROJECT IMPLEMENTATION PHASES**

### Phase 1: Biomass power plant to supply local minigrid

IED Invest developed his first project in Siem Reap province in 2012, using rice husk gasification to supply power to the Char Chuuk village mini-grid in Angkor Chum. The challenges of this project were to meet the load fluctuations, to provide a system that enables a reliable 24/7 service at a cheaper end user tariff than with fuel, and to find adequate solutions to address wastewater environmental issues.

The Char Chuuk power plant is equipped with a gasifier imported from India, a gas treatment line and two engines (150 kW Dual fuel engine and 70 kW 100% gas engine). This was the first Cambodian gasifier to se 100% gas generation and includes a water treatment plant to clean the processed water, and function in a closed circuit. A local team has been trained to operate the system and to ensure its maintenance.

Thanks to the project, service hours were extended from 16 to 24 hours a day, while decreasing the end user tariff by 25%. Increase in capacity, funding of distribution network and tariff reduction resulted in the number of households connected to the mini-grid rising from 400 to 1,100 in the year following to the installation of the biomass gasifier. Lower cost for improved service represents positive social impacts through income generating opportunities and wider energy service affordability.

### Phase 2 : Modification to run in grid injection mode

The system was designed as a decentralized production plant, but the construction of a new 22 kV transmission line connected Char Chuuk to the national grid 2013, five years before initial plan. Because of premature coming of the national grid, the power plant could not continue to operate in isolated mode.

Therefore the power plant was connected to a 22 kV MV line by the adding of a synchronization panel and since this date only the 100% gas engine is running, the whole production being sold to the grid operator. The modification of existing genset was successfully done thanks to strong collaboration with local contractors.

IED strengthened the maintenance procedures and performance through the development of a software to monitor all the different aspects of operation: operations and sales indicators (power production, sales, biomass consumption), invoicing, technical parameters (auxiliaries consumption, line losses, efficiency, problems), maintenance schedule, spare parts managements, expenditures,... Detailed reports are automatically generated on a monthly basis.

#### Phase 3: Increase of capacity to support quality service and improved waste water management

Considering fixed operation costs, lower feed-in tariff and the request of MV grid operator for help to maintain adequate voltage at the end of the MV line, IED Invest decided to increase the generation capacity to a total of 220 kW by adding a second gasifier and gas engine.

The new power plant has been located a few kilometers from initial site. The main challenges were to reduce capital investment by working with local manufacturers, and solve the problem of process water treatment. The treatment process on the first site was undersized and the chemicals required were impossible to find on the local market.

The main results of this new phase of the project are:

- Limitation of voltage drop in the area through local power injection:
- Improvement of power plant profitability;
- Design of a water treatment plant with sufficient efficiency to run in a close-circuit;
- Local electricity demand supplied from biomass waste.

Since start of operation, more than 1 GWh of electricity based on renewable energy has been produced and around 20 gualified technicians trained for operation and maintenance.

Thanks to substantial efforts, major success in technology innovation and adaptation were achieved:

- development of partnerships with local constructors and suppliers,
- design of a water treatment plant for 24/7 operation,
- adapting gensets to load fluctuations in isolated mode and synchronization in grid injected mode,
- training of technicians for autonomous maintenance,...

Hence this project, through the different steps of its development has proven the sustainability of a business model for a power plant based on biomass gasification, designed to supply power to an isolated mini-grid in a first phase, and to the interconnected grid in a second phase.

Based on the success of the Char Chuuk project, EDC (utility) and EAC (regulator) are highly interested in up-scaling this experience over the country, to supply local mini-grids or support service quality at the tail end of the grid.

The challenge for IED-Invest now is to:

- Upscale and replicate the model and number of power plant to reach business viability of IED-Invest Cambodia through scale / number of operations;
- Pursue dialogue with the policy makers to catalyze and accelerate the establishment of a framework leading to further involvement of the private sector in gasification (and more broadly renewable energy based) mini grids and grid support activities for remote communities.

Currently a unit of 2 x 1 MW is under development with the objective of meeting the above two goals using rice husk & woody biomass and others.

## Financial Model

The approach being very innovative (technology, gas and water treatment, business model) development, transaction and investment costs require grant support till a viable and secure solution is operational. IED Invest has benefitted from the support of UNIDO, REEP and FFEM. The grant component is reducing over time (from 60% to 30% now) and balance financing is raised through equity and commercial loans.



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