Solar-At-Gate Pilot Project – A Proven Energy-Saver

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INTRODUCTION

Cameroon is a country located in Central Africa. It is often described by many as "Africa in Miniature" due to its incredible geographical and human diversity as it exhibits all major climates and vegetation of the continent.

Cameroon has three international airports namely Douala, Yaoundé-Nsimalen, and Garoua. Douala is the main one, handling about 20,442 aircraft movements and 1,100,000 passengers per year. It is operated by Aéroports du Cameroun (ADC) S.A which is also the sole ground handler at the airport.

In 2016, ICAO selected Douala International Airport to implement a pilot project named "Solar-at-Gate", in which a solar photovoltaic (PV) plant would be connected to a gate electrification system comprising of an electric Pre-Conditioned Air (PCA) unit and a Ground Power Unit (GPU).

The pilot project was inaugurated by the Ministry of Transport, on 10 January 2019 with the aim of demonstrating the use of clean and renewable energy technology for the provision of ground support to international aircraft operations at the airport. The project is now a showcase that highlights concrete actions that may be replicated by other airports to contribute to ICAO's aspirational goals for CO_2 emission reduction from international civil aviation.

The newly built plant is the first Megawatt scale and first grid-connected installation of a solar PV system in Cameroon. The Solar-at-Gate project is the second of its kind in Africa after Mombasa Moï International Airport, Kenya.

BACKGROUND

In 2013, ICAO and EU launched a joint assistance project on capacity building for CO_2 mitigation from international civil aviation in 14 selected States --12 of them from the Africa region and two from the Caribbean region.

The Solar-at-Gate project, which was planned from 2014 to 2018, had the following three main objectives:

- Support the voluntary development and submission of State Action Plans on CO_2 emission reduction from international civil aviation in accordance with ICAO recommendations by improving the capacity of the national civil aviation authorities and other stakeholders.
- Set-up in each selected State, an Aviation Environmental System (AES) – information technology software and hardware that facilitate data collection and the monitoring of CO_2 emissions from international aviation at the State level.
- Identify **and evaluate priority** mitigation measures contained in selected State Action Plans, and implement the selected measures.

To achieve the first objective, in December 2015, Cameroon became one of the first selected States to submit its Action Plan for CO_2 mitigation to ICAO. That Action Plan was developed in accordance with ICAO doc 9988. It included an "**airport improvements**" category comprised of nine measures, among which were the construction of solar power plants at Douala and Yaoundé-Nsimalen international airports. The Action Plan also included a request for technical and financial assistance of these solar mitigation measures.

In response to Cameroon's strong commitment to this, and in-line with the third objective, in 2016 ICAO selected Douala International Airport as platform to implement the pilot "Solar-at-Gate" project.

DESCRIPTION OF THE PROJECT

The Solar-at-Gate project at Douala International Airport was a project entirely funded by the European Union for an amount of US$1.3 million with the objective to demonstrate the use of solar energy for the provision of ground power and the preconditioning of air for aircraft at the gate.

This solar-powered electrical equipment allows international flight aircraft to switch off their fuel-powered Auxiliary Power Unit (APU) when parked at the gate, thus reducing carbon dioxide (CO_2) emissions from international aviation activities.

Initially, the scope of the project was to:

- Build a ground-mounted solar PV array/farm of 500kWp supported by a battery storage system.
- Procure and install a Gate Electrification System comprising an electric Ground Power Unit (GPU) and an electric Pre-Conditioned Air (PCA).

Because ADC SA was committed to purchasing, installing, and commissioning the Gate Electrification System, ICAO and ADC SA agreed to increase the capacity of the initial photovoltaic array/farm from 0.5MWp to 1.25MWp, but with no battery storage system.

ICAO was therefore responsible for the implementation of a procurement process for the design, supply, installation, and commissioning of the solar PV plant. That 1.25MWp installation was composed of:

- Solar PV array/farm with 3840 polycrystalline PV modules of 325Wp laid across 1.4 hectares of land near the control tower.
- Twenty solar PV inverters of 60kW capacity.
- Medium Voltage Station with a transformer 400V/15kV.
- Solar PV monitoring and performance system.
- Two educational kiosks that provide real-time readings from the solar PV plant to airport users (i.e., active power, cumulated power, and savings in CO_2 emissions).

ICAO was also responsible for project management, and it recruited a solar expert to provide technical assistance. To ensure the durability of the project, training on solar was provided to ADC SA engineers and the contractor was required to provide preventive and corrective maintenance for two years. Because the solar PV plant produces less than the full energy requirements of the airport, the airport consumes 100% of the solar energy produced by the solar PV plant, and the national grid provides the balance.

The completed facility was commissioned by ICAO, Cameroon Civil Aviation Authority, and ADC SA on 13 February 2019.

FIGURE 1: Solar-at-Gate project installation at Douala International Airport, Cameroon

BENEFITS

Thanks to the solar PV plant, 25% of the energy demands of the airport are now satisfied by renewable energy.

Since the commissioning of the project, the solar PV plant has generated 351 MWh and saved more than 245 tons of CO_2 which is equivalent to planting 2,450 trees.

The solar PV plant has also saved about US$17,000 per month on the electricity bill.

In addition, the use of an electric GPU has reduced aviation fuel burn at the gate.

It is expected that by the end of the year, the solar-at-gate project will have saved a total of around 3800 tons of CO_2. It is estimated that about 2600 tons of that will be attributable to international civil aviation (assuming 10 flights per day using the GPU). This is equivalent to planting 38000 trees, thus demonstrating ADC SA's contribution to reductions in environmental degradation.

EVOLUTION OF PROJECT IN THE UPCOMING YEARS

Inspired by the success of this project, ADC SA has set a short term goal to procure additional equipment and expand the solar PV plant from 1.25MWp to 2MWp using the available remaining space on the site. This will involve procuring an additional electric GPU for the airport and commissioning a study into the feasibility of installation a battery storage system in order to significantly improve the availability of energy. Such a battery storage system will provide an alternative to fuel generators, thus reducing CO_2 emissions even more, and providing greater independence from rising fuel prices.

For future years, ADC SA is also considering replicating the solar-at-gate project at its two other international airports and also building solar PV plants at its four national airports: Maroua-Salak, Ngaoundéré, Bertoua,and Bamenda.

For Garoua International Airport, ADC SA has signed an agreement with a solar company for the construction and operation of a solar PV plant of 30 MWp covering 70 hectares of airport land to accommodate the power requirements of North Region of Cameroon. ADC SA will lease the land to the solar company and in return the solar company will build an additional solar PV plant of 500 kWp with a battery storage system to ADC. The construction work of this project is expected to begin by the end of 2019. Garoua International Airport was chosen for four main reasons:

- The project aims at resolving the huge energy deficit of the North Region of Cameroon;
- Garoua city and the North Region have one of the best solar irradiance in Cameroon;
- Garoua International Airport itself is very close to national grid High Transformer facilities;
- Garoua International Airport has enough space available.

CONCLUSION

Cameroon's ICAO-EU Solar-at-Gate project is an excellent practical example of CO_2 mitigation measures at work and one that airports worldwide can learn from. Through its participation in this project, Cameroon has taken an active role, under the auspices of ICAO, to reduce its CO_2 emissions as part of the international aviation industry's effort to reduce aviation emissions globally.

As a result of ADC SA's participation in this joint ICAO-EU Assistance Project for CO_2 mitigation, it is now ready to assist all airports in the region in the implementation of other solar-at gate projects as part of ICAO "Buddy Programme".