SOLAR-TO-GATE PROJECT IMPLEMENTATION AT DOUALA AIRPORT, CAMEROON

THE EXPERIENCE OF ADC SA

CAPACITY BUILDING FOR CO2 MITIGATION
FROM INTERNAL AVIATION

FOURTH SEMINAR
MOMBASA, KENYA, 12-14 DECEMBER 2018

Mazarin Hervé MINTSA
Director, Safety Quality and Environnement

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WHO WE ARE

1-1 ADC SA AT A GLANCE

- Aéroports du Cameroun (ADC S.A) is a semi-public company founded in 1993.
- Its activities started on October 1, 1994.
- Its head office is in Yaoundé-Nsimalen
- Two **(02)** main missions:
  - **Management**, operation, renewal and development of land, works, buildings, installations, equipment and materials, as well as the provision of all the services necessary or useful for the operation of **sevent (07)** airports.

- Provide **ground handling services** at these airports

1-2 VISION (2017 – 2021)

- Make airports of the concession reference platforms in Africa and contribute to the development of Cameroon.

- ADC SA has set up a Safety, Quality and Environment Section since february 2012.

1-3 STRATEGIC AXES

- Modernize infrastructure, facilities and equipment;
- Improve the economic and financial performance of airports;
- **Pursue the implementation of an environmental protection policy**;

- To raise the quality of service to standards International;
- Improve human resources management and promote corporate culture.

ENVIRONMENTAL POLICY AND ACTION PLAN FOR CO_2 MITIGATION - AIRPORTS

2-1 PURSUE THE IMPLEMENTATION OF AN ENVIRONMENTAL PROTECTION POLICY

- Development of an **Environmental Policy**

Aéroports Du Cameroun S.A.

Yaoundé, on 22 MARS 2018

INTEGRATED MANAGEMENT POLICY

The durability of our activities is part of a sustainable development approach, the foundation of our integrated policy. In this regards, ADC S.A AVEC C.A has set for the period 2017-2021 strategic objectives of integrated management applicable to its airport management and ground handling activities. Safety and security are our operational priorities. We are committed in developing, implementing, maintaining and constantly improving strategies and processes to ensure that all our airport and ground handling activities maintain a high level of safety, security, quality and environmental performance and meet or wherever possible exceed regulatory requirements, applicable norms and best practices.

The axes highlighted in the framework of this ambition are:

a) **Integrated Management System**: Develop and implement a formal Integrated Management System applicable to all our activities for the success of which all the company staff must mobilize. Integrate safety, security, quality and environmental management in all business processes, strategic direction and decision making, aligning them with the priorities of our business lines.

- **Environmental and Social audits** undertaken at Douala and Yaoundé-Nsimalen and approved by our Ministry in charge of Environment

REPUBLIQUE DU CAMEROUN
Paix – Travail – Patrie

MINISTERE DE L'ENVIRONNEMENT, DE LA PROTECTION DE LA NATURE ET DU DEVELOPPEMENT DURABLE

CCE/AES N° _____ du _____

REPUBLIC OF CAMEROON
Peace – Work – Fatherland

MINISTRY OF ENVIRONMENT, PROTECTION OF NATURE AND SUSTAINABLE DEVELOPMENT

CERTIFICAT DE CONFORMITÉ ENVIRONNEMENTALE
CERTIFICATE OF ENVIRONMENTAL COMPLIANCE

Le Ministre de l'Environnement et de la Protection de la Nature et du Développement Durable,
The Minister of Environment, Protection of Nature and Sustainable Development

Vu la loi n° 96/12 du 5 août 1996 portant loi cadre relative à la gestion de l'Environnement ;
Mindful of Law n° 96/12 of the August 5th, 1996 relating to the management of the Environment;
Vu le décret n° 2013/0172/PM du 14 février 2013, fixant les modalités de réalisation des audits environnementaux et sociaux ;
Mindful of Decree n° 2013/0172/PM of 14 february 2013 to lay down terms and conditions for conducting environmental and social audit;
Vu l'arrêté n°001/MINEPDED du 09 Février 2016 fixant les différentes catégories d'opérations dont la réalisation est soumise à une évaluation environnementale stratégique ou à une étude d'impact environnemental et social ;
Mindful of the order n°001/MINEPDED of February 9th, 2016 fixing the various categories of operations whose realization is subjected to a strategic environmental evaluation or to an environmental and social impact assessment;
Considérant le rapport du Comité Interministériel de l'Environnement
Considering the report of the Inter-ministerial Committee for the Environment
Considérant les nécessités de service
Considering the needs for service

Certifie que / Hereby Certifies as follows:

LA SOCIÉTÉ AEROPORTS DU CAMEROUN (ADC) B.P: 13 615 YAOUNDE-CAMEROUN, a respecté la règlementation en matière d'audit environnemental et social, pour les installations et activités de l'Aéroport International de Yaoundé-Nsimalen.
ADC COMPANY P.O. BOX: 13 615 YAOUNDE-CAMEROUN, *has complied with the regulations in the area of environmental and social audit for the facilities and activities of the Yaounde-Nsimalen International Airport.*

Au vu du Plan de Gestion Environnementale et Sociale dudit Audit, il est délivré le présent Certificat de Conformité Environnementale pour servir et valoir ce que de droit.
Based on the Environmental and Social Management Plan of the said Audit, this Certificate of Environmental Compliance is issued to serve wherever needs arises.

REPUBLIQUE DU CAMEROUN
Paix – Travail – Patrie

MINISTERE DE L'ENVIRONNEMENT, DE LA PROTECTION DE LA NATURE ET DU DEVELOPPEMENT DURABLE

CCE/AES N° 000086 du 25 JUIN 2018

REPUBLIC OF CAMEROON
Peace – Work – Fatherland

MINISTRY OF ENVIRONMENT, PROTECTION OF NATURE AND SUSTAINABLE DEVELOPMENT

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Le Ministre Délégué

Dr Nana Abdoulaye Lydiko

2-1 PURSUE THE IMPLEMENTATION OF AN ENVIRONMENTAL PROTECTION POLICY

- Development and Implementation of **Waste Management Plans** at Douala and Yaoundé-Nsimalen

- **Disposal of PCBs**: (Persistent Organic Pollutants) in accordance with Stokholm Convention : found in mainly in old transformers
  - Projet funded by: UN environment gef GLOBAL ENVIRONMENT FACILITY INVESTING IN OUR PLANET
  - Implemented by Ministry of Environment, Protection of Nature and Sustainable Development, with contribution from industry (National Power Supplier, Airport, etc).

2-2 CAMEROON ACTION PLAN FOR CO_2 MITIGATION

Cover Page

2-2-1 OVERVIEW OF ACTION PLAN AIRPORTS COMPONENT

	Mesures	Impact de GES en 2014	Méthodologie utilisée
1	Installation des lampes LED en remplacement des ampoules classiques au niveau de l'éclairage des aires de trafic des aéroports de Douala et de Yaoundé-Nsimalen	95,4 t eq. CO_2 évitées	Rules of Thumb 48 projecteurs de 500W 63 projecteurs de 1000W et 2000W
2	Construction des voies de circulation (deuxième bretelle à Douala)	22,5 t eq. CO_2 évitées	EBT Temps sauvé : 20 s B767 : 61 opérations B737 : 1 327 opérations
3	Augmentation du nombre de GPU pour permettre de débrancher les GAP de bord	526,5 t eq. CO_2 évitées	EBT Temps fonctionnent réduit du GAP: 0,5h 1 048 opérations
4	Réhabilitation des centrales électriques	1,12 t eq. CO_2 évitées	Méthodologie Etat
5	Installation des panneaux photovoltaïques dans les aéroports de Douala et Yaoundé-Nsimalen	A déterminer	A déterminer
6	Installation des lampes à tubes sans amorçage 18W en remplacement des ampoules classiques 36W au niveau de l'éclairage dans aéroports de Douala et Yaoundé	210 t eq. CO_2 évitées	Méthodologie Etat 9000 lampes classiques de 36W. Economie de 6,48kwh/mois/ lampe6, 48*12*9000*0,0003
7	Réduction de la demande en électricité (Favoriser les éco-gestes)	A déterminer	A déterminer
8	Remplacement et modernisation du matériel d'assistance (Push back, tapis bagages, tracteur)	A déterminer	A déterminer
9	Construction de l'autoroute Yaoundé-Nsimalen	Non quantifiable	Aucune

2-2-2 CONSTRUCTION OF TAXIWAYS
(2nd TAXIWAY DOUALA INTL AIRPORT) - MAI 2016

Vue avant – en provenance de la piste vers l'aire de trafic

2-2-3 REPLACEMENT ET MODERNIZATION OF GROUND SUPPORT EQUIPMENT) – 2016, 2017, 2018

- Motorized GSE acquired in 2016, 2017 and 2018
- Additional motorized GSE to be acquired in 2019

2-2-4 OTHER MEASURES ON THE ACTION PLAN

- Feasibility study actually in progress at Yaoundé-Nsimalen and Garoua International Airports for the replacement to LED technolgy of:
  - Passenger and Cargo Terminals Indoor lighting;

  - Apron Floodlighting;

  - Streetlights;

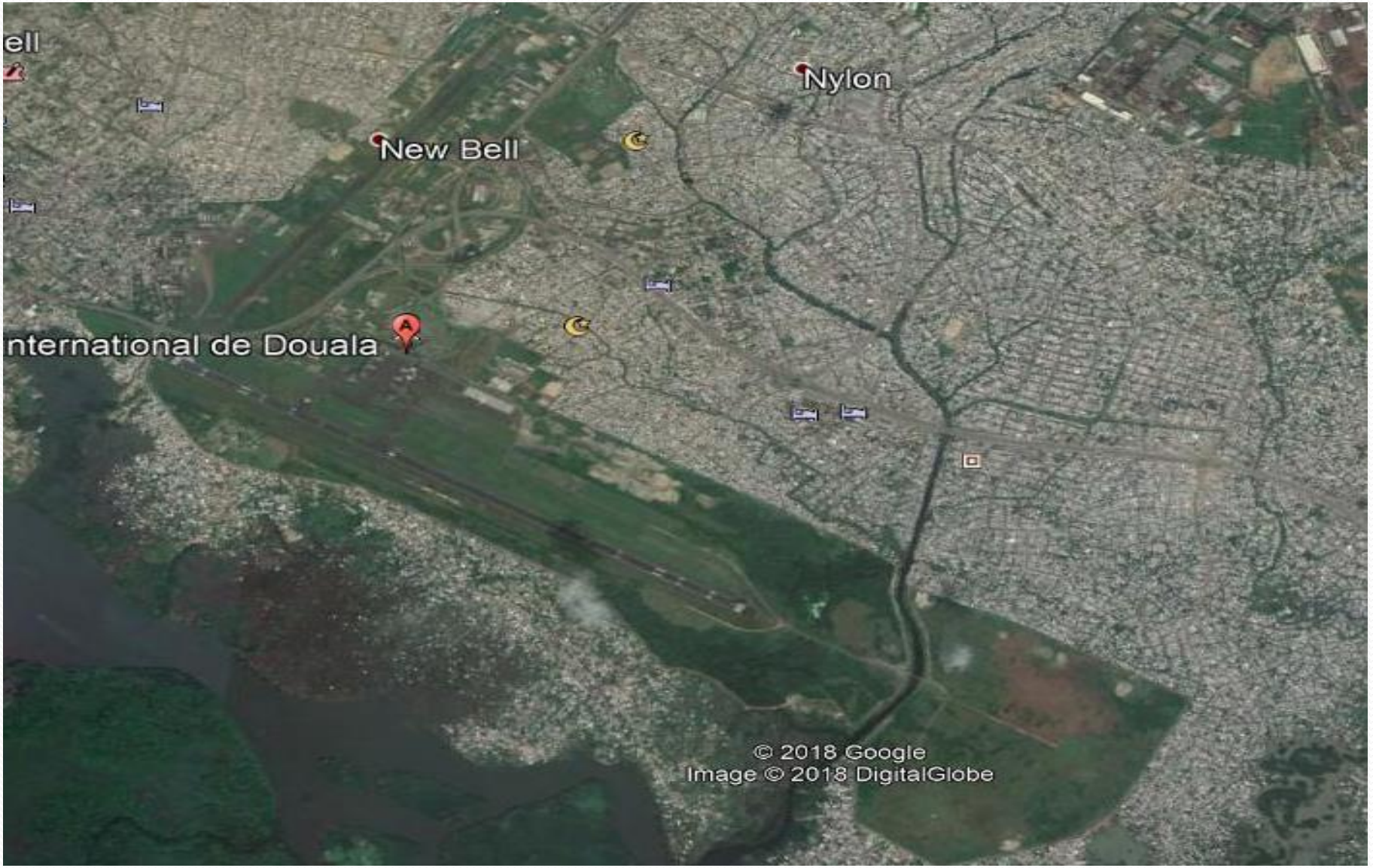
- Rehabilitation of power station also in progress and Yaoundé-Nsimalen

2-2-4 OTHER MEASURES OF THE ACTION PLAN

- Airport Highway under construction (to be delivered early 2020)

PARTICULARS OF DOUALA INTERNATIONAL AIRPORT

3-1 AERIAL VIEW OF THE AIRPORT

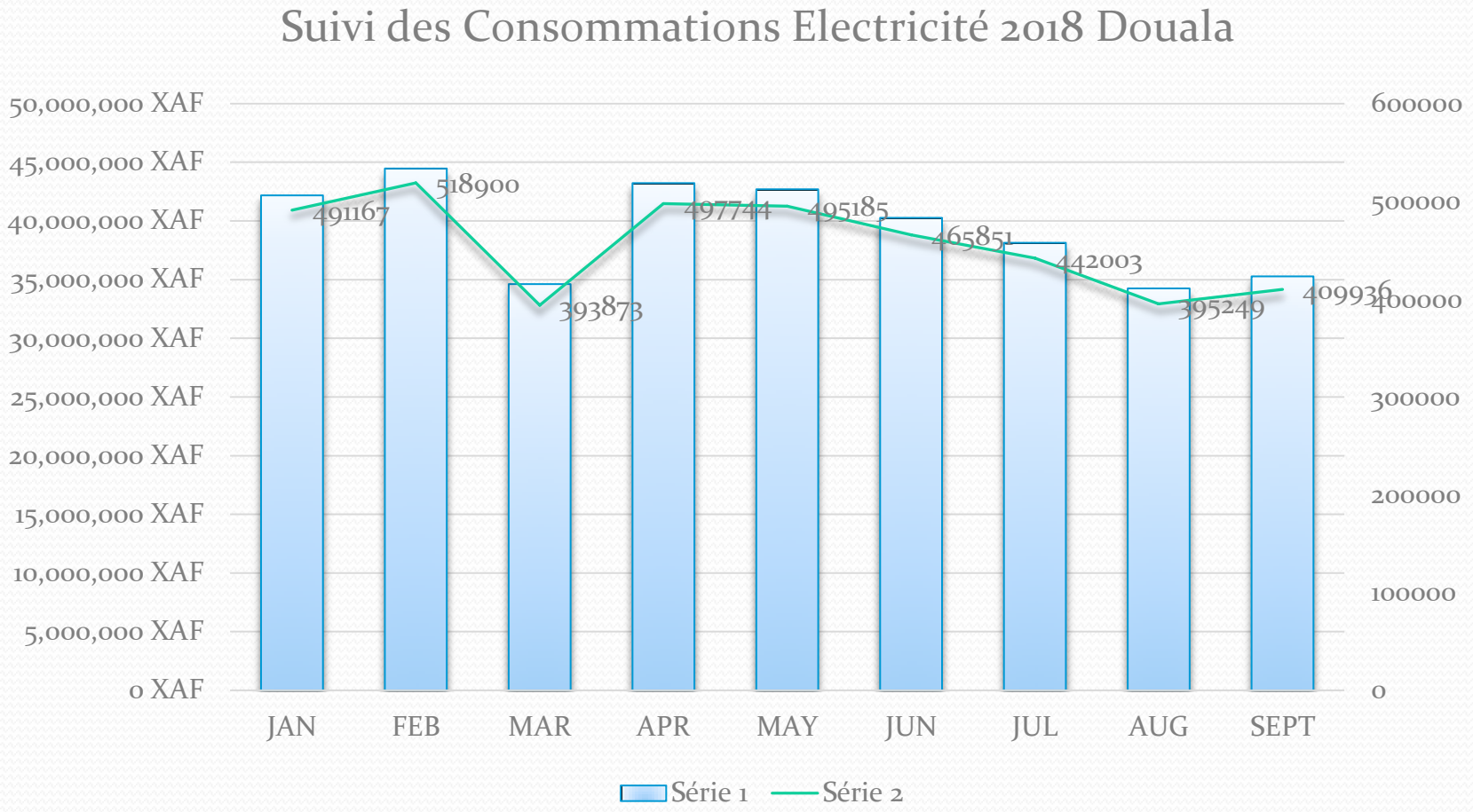


3-2 FACTS AND FIGURES

- Opened on June 27th, 1977
- Area covered: 1500 ha
- 01 passenger terminal
- 19 airlines
- 03 mobiles GPU
- 06 boarding bridges (only 02 in service) without fixed GPU
- Trafic (2017)
  - Movements: 20 442 aircraft movements
  - Passengers handled (without transit): 1.1 millions pax
  - Cargo and Mail: 16500t

3-3 ELECTRICITY CONSUMPTION PROFILE- 2018

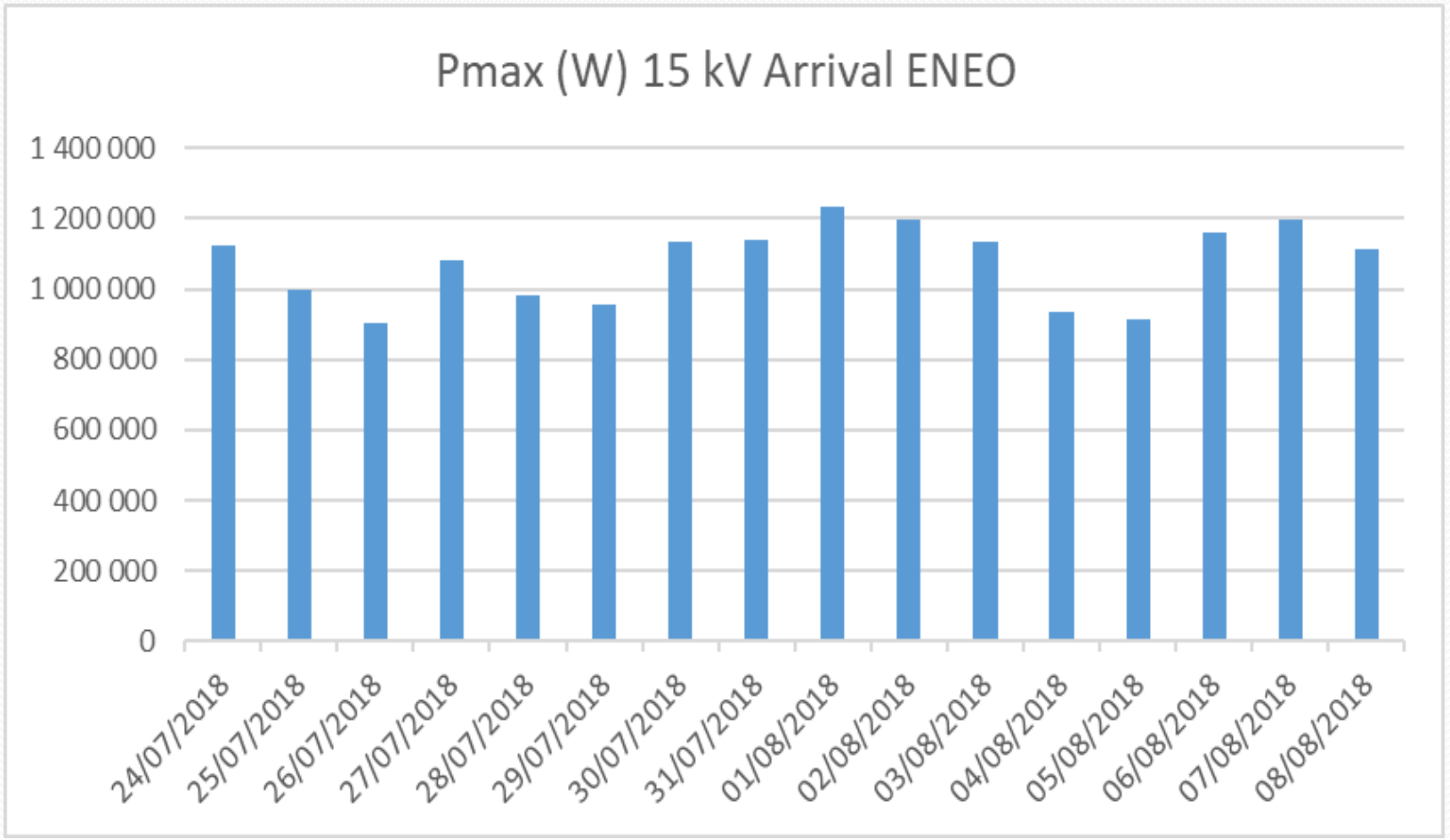
Active Energy cummulated - What we pay every month for Douala to the National Electricity Provider ENEO



- **Mean consumption: 455 000 kWh/month, around 70 000 USD to pay to ENEO**

3-3 ELECTRICITY CONSUMPTION PROFILE- 2018

Peak Active Power Consumption



3-4 FORECASTING ELECTRICITY DEMAND

TERMINAL MODERNIZATION PROJECT – Commencing Early 2020

- Will generate additional needs of about de 500kW (peak consumption) and 5000kWh per month

- 07 new boarding bridges with 400Hz fixed electric-powered GPU.

- For CO_2 mitigation plan, two (02) benefits:
  - Increase the number of GPU: at least 300t of CO_2/year reduction (over the 562t for all the airports)
  - If the GPU are powered by solar energy, the carbon footprint will be signficantly reduced.

- Use of LED technology for indoor lighting anc floodlighting

SOLAR-TO-GATE PROJECT IMPLEMENTATION AT DOUALA

4-1 NEEDS IN LINE WITH CO_2 MITIGATION ACTION PLAN

- Powering the new upcoming fixed-GPU on boarding bridges and mobile electrical GPUs

- Powering cargo and passenger terminal indoor lighting, apron floodlighting and streetlights

- Replacement of existing lighting by LED technology to benefit fully from the project

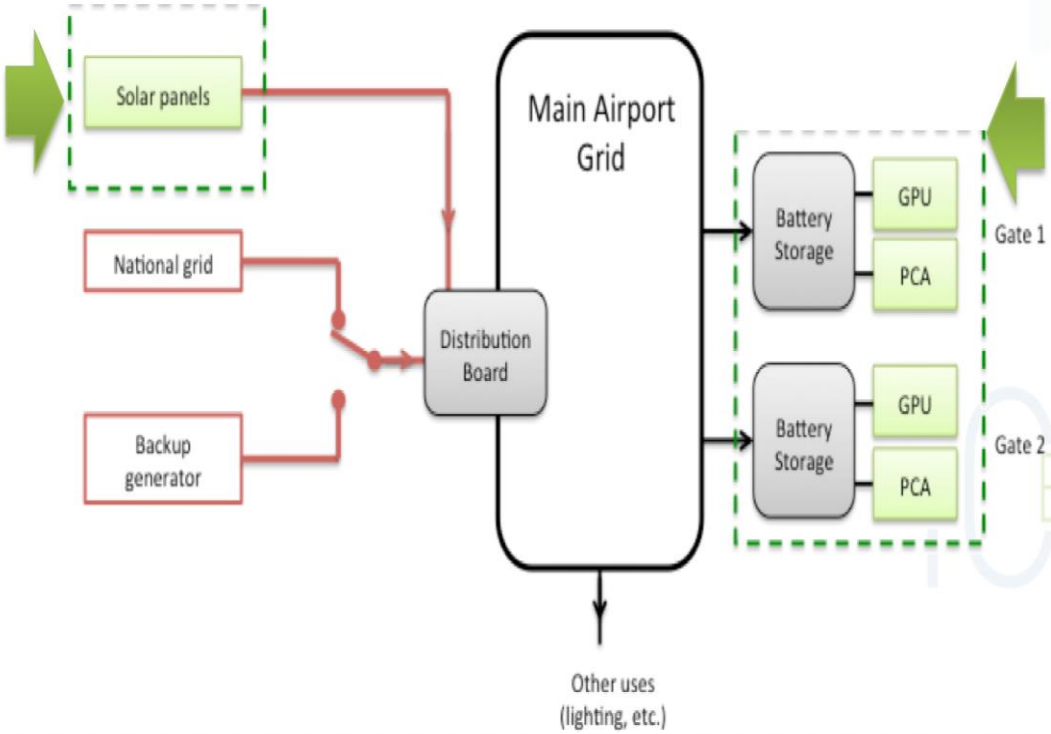
- Powering other airport equipement (baording bridge, conveyors, lift, elevators, etc.) ?

4-2 ICAO-EU SOLAR-TO-GATE PROJET CONCEPT

- **Goal**: To demonstrate CO2 emissions mitigation through the use of solar energy to power GPU and PCA at the gate.

1. Système solaire photovoltaïque

Fournit de l'énergie propre au réseau de l'aéroport



2. Système électrification à la porte

Fournit de la puissance au sol et la climatisation à l'avion à la porte

4-3 GENERAL OVERVIEW OF THE PROJECT

- ICAO is responsible for the implementation of a procurement process for the design, supply, installation and commissionning of the Solar Power System and project management:
  - Solar PV Array System;
  - Solar PV inverters;
  - Solar PV monitoring and performance system;
  - 01 High voltage transformer station (Medium Voltage Station);
  - Two (02) educational kiosks;
  - Training to engineers;
  - Preventive and corrective maintenance for two (02) years.
- One expert (M. **Steve Barret**) to provide advices and contribute to the global process;
- All stakeholders (CCAA and ADC SA) should be involved from the early stage of the project til the commissionning;
- Constraints: Time: 1.5 years; Budget: **1.3 millions USD**.

4-4 PROJETS COMPARISON: DOUALA vs MOMBASA

DOUALA PROJECT

- Capacity: 1 MWp
- ADC SA to purchase, install and commission a Gate Electrification System (GPU and ACU)
- No Battery Storage System
- Ground-mounted System
- When there is power outage due to ENEO, the PV system do not injects into the airport grid

MOMBASA PROJECT

- Capacity 500 KW
- GPU and ACU included in the project
- Battery Storage System included
- Ground-mounted System
- When there is power outage due to the Electricity Provider, the PV system does not injects into the airport grid

4-5 SIGNATURE OF AN MOU BETWEEN STAKEHOLDERS

- MoU signed between ICAO-CCAA and ADC

ICAO | Cameroon Civil Aviation Authority | Aéroports Du Cameroun S.A.

MEMORANDUM OF UNDERSTANDING

BETWEEN

THE CAMEROON CIVIL AVIATION AUTHORITY,

AEROPORTS DU CAMEROUN, S.A

AND

THE INTERNATIONAL CIVIL AVIATION ORGANIZATION

This Memorandum of Understanding (hereinafter referred to as the "MoU") is entered into by and between:

The International Civil Aviation Organization (hereinafter referred to as "ICAO"), having its headquarters in Montréal, Québec, Canada; and,

The Cameroon Civil Aviation Authority (hereinafter referred to as "CCAA"); created by Law N°2013/010 in its Article 16 (1) of 24 July 2013 relating to civil aviation in Cameroon; and,

Aéroports du Cameroun, S.A., (hereinafter referred to as "ADC").

ICAO, CCAA and ADC are hereinafter collectively referred to as the "Participants" and individually as the "Participant".

PREAMBLE

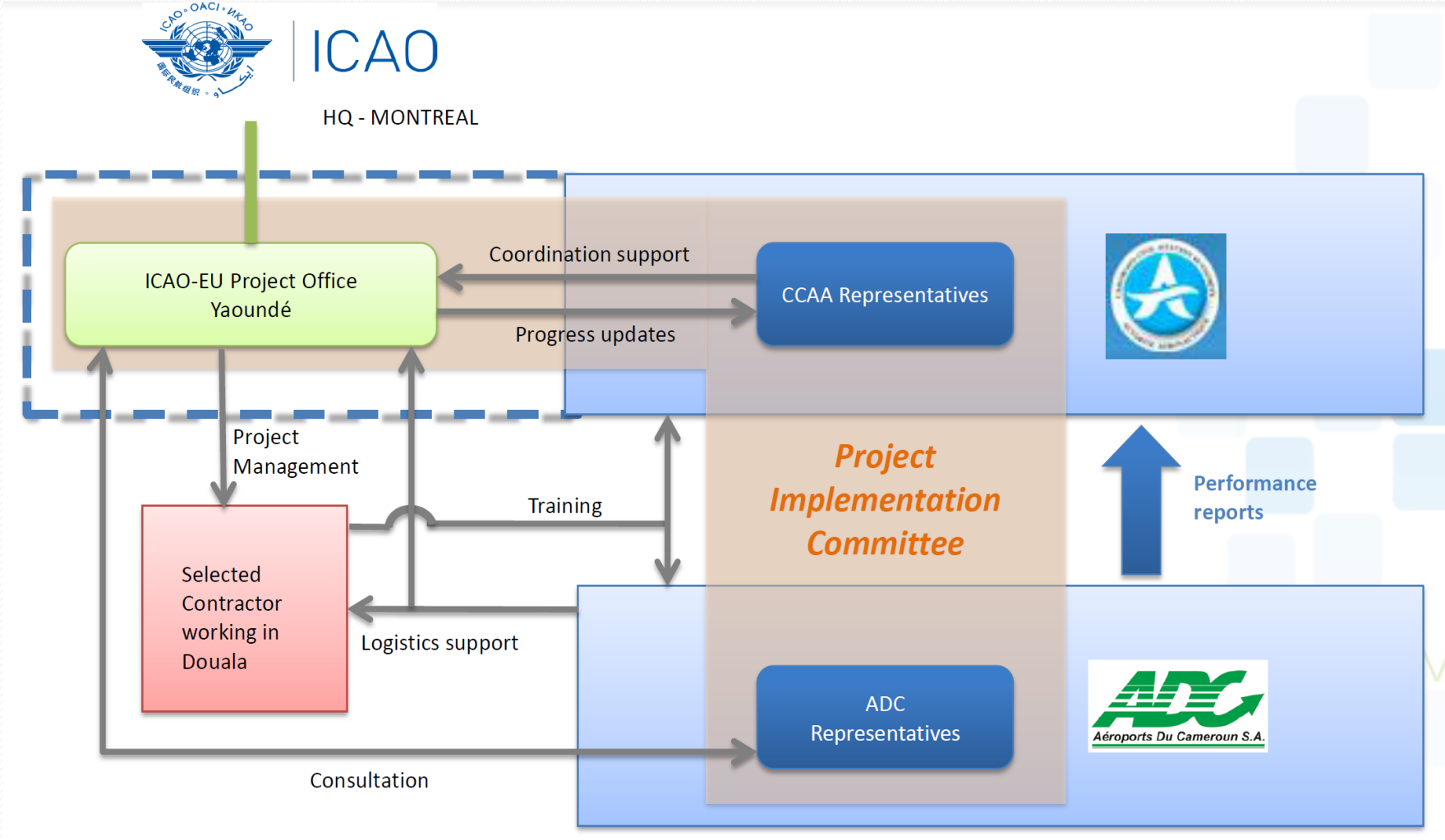
WHEREAS ICAO, a specialized agency of the United Nations, was created in 1944 to promote the safe and orderly development of international civil aviation throughout the world. ICAO sets Standards, Recommended Practices and guidelines necessary for the safety, security, efficiency and regularity of international civil aviation and serves as the forum for cooperation in all fields of civil aviation among its Member States;

WHEREAS ICAO and the European Union (EU), represented by the European Commission, have signed an agreement for the implementation of the *Capacity Building for CO_2 Mitigation from International Aviation* Assistance Project (ICAO-EU Assistance Project), which aims to contribute to international, regional and national efforts to address growing CO_2 emissions from international aviation in selected States in the African and Caribbean regions;

WHEREAS the ICAO-EU Assistance Project encompasses three areas of activities: to develop and submit robust State Action Plans on CO_2 emissions reduction activities, establish aviation CO_2 emissions inventories, and support the implementation of measures to reduce fuel consumption and emissions;

1

4-6 SCHEMATIC DESCRIPTION OF THE COORDINATION MECHANISM FOR THE PROJECT



4-6-1 PROJET TEAM AT THE NATIONAL LEVEL

- **National Projet Implementation Committee** set up at the early beginning of the project

- 02 focal points for ADC SA nominated:
  - Mazarin Hervé MINTSA: Director Safety, Quality and Environment
  - Jacob BAHAYANG MBARGASO: Douala Airport Director

- Additional members of the Committee:
  - Rep. Ministry of Transport
  - Rep. Ministry in charge of Energy

Ref.: ENV 8/1.1

Ms. Paule Avomo Assoumou Koki
Director General
Cameroon Civil Aviation Authority
B.P. 6998
Yaoundé
Cameroon

MAY 29 2017

Dear Ms. Koki,

I wish to refer to your letter, reference 001673/L/CCAA/DG/DTA/CEAVE, from 22 May 2017, nominating the representatives from Cameroon Civil Aviation Authority (CCAA) and Aéroport du Cameroun (ADC) to participate on the Project Implementation Committee under the Memorandum of Understanding (MoU) between CCAA, ADC and the International Civil Aviation Organization (ICAO), regarding the installation of a solar photovoltaic system and gate electrification equipment in Douala International Airport entitled, "The Douala Project".

In this regard, I am pleased to inform you that the Project Implementation Committee is officially established with the following members:

Name	Position	Organization
Mr. Akkum Ritzentelar	Head of the Division of Air Transport	CCAA
Mrs. Ndungo Olive	Environmental Research Assistant	
Mr. Minsta Mazarin Hervé	Director of Quality, Safety and Environment	ADC
Mr. Bahayang Mbargaso Jacob	Director of the Douala International Airport	
Mr. Eduardo Caldera-Petit	ICAO-EU Programme Coordinator	ICAO
Mr. Didier Moukalan	ICAO-EU Technical Consultant	

In accordance with Article VII of the MoU, this Committee will coordinate all the activities related to the implementation of the Douala Project, follow-up on its timely execution and report on the progress to each institution accordingly.

I thank you for your support and look forward to cooperating with you further on this project.

Yours sincerely,

Boubacar Djibo
Director, Air Transport Bureau

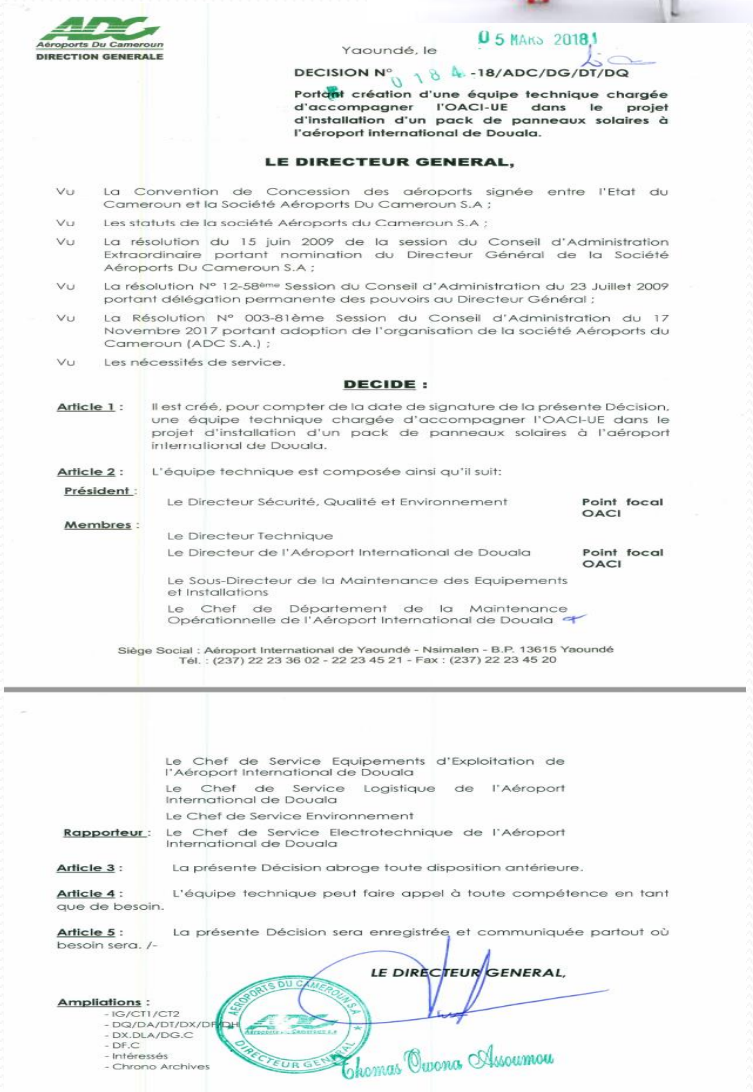
cc: Representative of Cameroon on the Council of ICAO

4-6-2 PROJET TEAM AT ADC SA LEVEL

- **Airport Implementation Committee** set up at the early begining of the project and amended several times

- ADC SA focal points members of the committee

- Additional member of the Committee:
  - Director in charge of Maintenance
  - Operational Maintenance Manager, Douala
  - Head of Electrical, Douala
  - Etc.



Aéroports Du Cameroun
DIRECTION GENERALE

Yaoundé, le 05 MARS 2018

DECISION N° 0184 -18/ADC/DG/DT/DQ

Portant création d'une équipe technique chargée d'accompagner l'OACI-UE dans le projet d'installation d'un pack de panneaux solaires à l'aéroport International de Douala.

LE DIRECTEUR GENERAL,

Vu La Convention de Concession des aéroports signée entre l'Etat du Cameroun et la Société Aéroports Du Cameroun S.A ;

Vu Les statuts de la société Aéroports du Cameroun S.A ;

Vu La résolution du 15 juin 2009 de la session du Conseil d'Administration Extraordinaire portant nomination du Directeur Général de la Société Aéroports Du Cameroun S.A ;

Vu La résolution N° 12-58ème Session du Conseil d'Administration du 23 Juillet 2009 portant délégation permanente des pouvoirs au Directeur Général ;

Vu La Résolution N° 003-81ème Session du Conseil d'Administration du 17 Novembre 2017 portant adoption de l'organisation de la société Aéroports du Cameroun (ADC S.A.) ;

Vu Les nécessités de service.

DECIDE :

Article 1 : Il est créé, pour compter de la date de signature de la présente Décision, une équipe technique chargée d'accompagner l'OACI-UE dans le projet d'installation d'un pack de panneaux solaires à l'aéroport International de Douala.

Article 2 : L'équipe technique est composée ainsi qu'il suit:

Président : Le Directeur Sécurité, Qualité et Environnement — **Point focal OACI**

Membres :
Le Directeur Technique
Le Directeur de l'Aéroport International de Douala — **Point focal OACI**
Le Sous-Directeur de la Maintenance des Equipements et Installations
Le Chef de Département de la Maintenance Opérationnelle de l'Aéroport International de Douala

Siège Social : Aéroport International de Yaoundé - Nsimalen - B.P. 13615 Yaoundé
Tél. : (237) 22 23 36 02 - 22 23 45 21 - Fax : (237) 22 23 45 20

Le Chef de Service Equipements d'Exploitation de l'Aéroport International de Douala
Le Chef de Service Logistique de l'Aéroport International de Douala
Le Chef de Service Environnement

Rapporteur : Le Chef de Service Electrotechnique de l'Aéroport International de Douala

Article 3 : La présente Décision abroge toute disposition antérieure.

Article 4 : L'équipe technique peut faire appel à toute compétence en tant que de besoin.

Article 5 : La présente Décision sera enregistrée et communiquée partout où besoin sera. /-

LE DIRECTEUR GENERAL,

Thomas Owona Assoumou

Ampliations :
- IG/CT1/CT2
- DQ/DA/DT/DX/DF/DH
- DX.DLA/DG.C
- DF.C
- Intéressés
- Chrono Archives

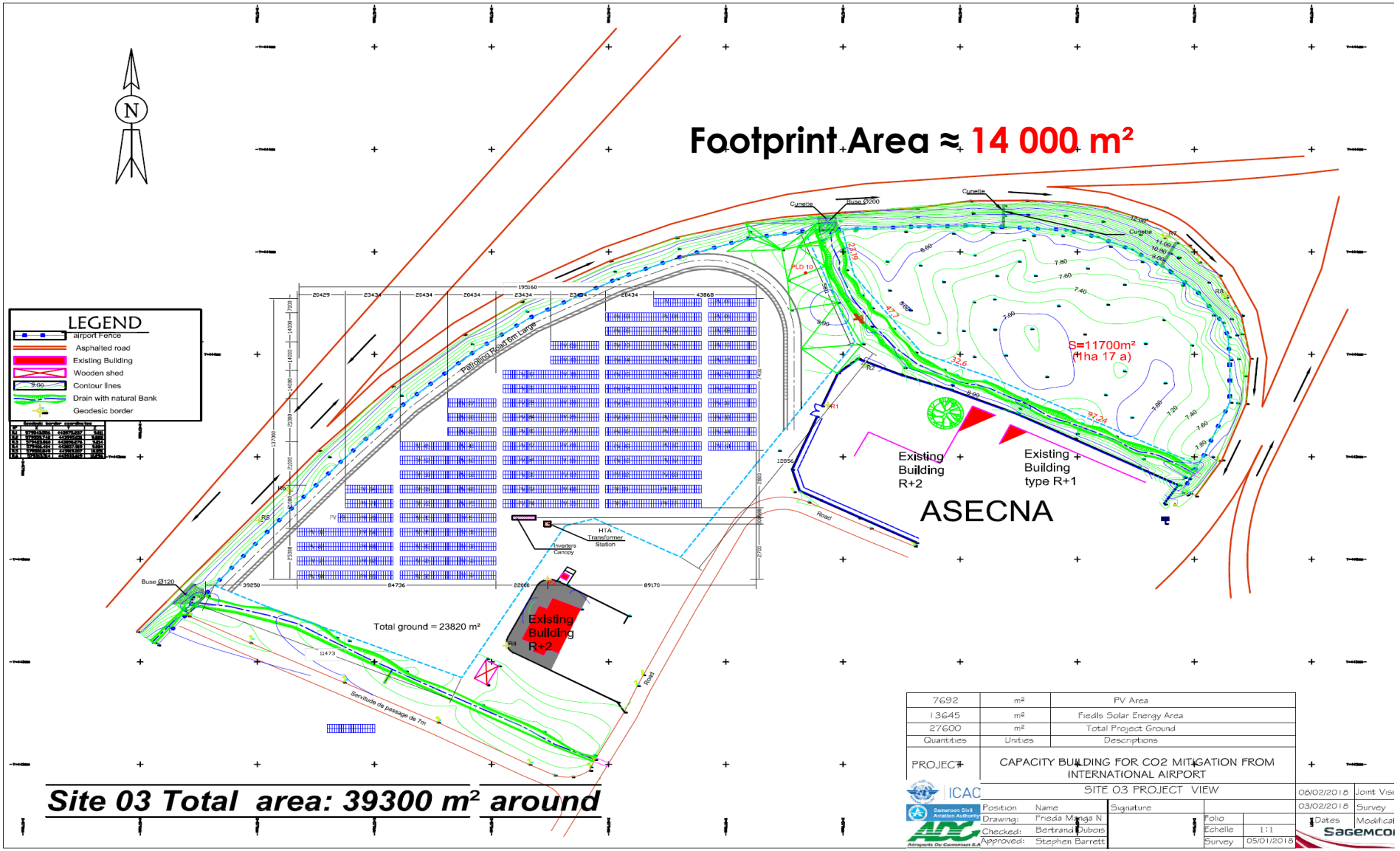
4-7 CONTRACTOR SELECTION: OPEN TENDER

- Tender launch: March 14th, 2017
- Technical meeting Douala: April 6th, 2017
- 09 bidders (submit their proposal)
- Contract awarded to: **Sagemcom Energy & Telecom SAS: 1 432 340 USD**
- Contract sign off: **Jan 16th, 2018**

4-8 SCHEDULE AND KEY DATES

- Kick Off Meeting: February 1st, 2018
- 08/02/2018-04/04/18-30/05/18: 03 meetings SAGEMCOM – ADC -ENEO
- Final approval of SDD: May 11th, 2018
- January 10th, 2019: Inauguration of Solar Power System by ICAO – Ministry of Transport
- End January/Early February 2019th: Commissionning after testing

4-9 OVERALL PV LAYOUT



4-10 TECHNICAL DESCRIPTION

- 3840 x **PV modules** 325Wp / Global power = 1,25 MWp
- 20x **Combiner boxes** DC
- 20x **Inverters** SMA STP 60 kW
- 1x High Voltage Transformer Station (**MVS**) 400V/15kV
- 1x **High voltage cell** to connect to airport main distribution board at 15KV
- 2x **Ligthning rods**
- 2x **Educational kiosks**
- 1x **Monitoring and data acquisition system**

4-10-1 SOLAR PV ARRAY

- PV array: 3840 modules TWINKLE TD672P TWINKLE TD672P Polycrystalline Dual Glass 72 Cell Series
- PV Farm footprint: 7692 m²
- Out: 1,25 MWp

20 combiner box DC

- Inside the PV array

4-10-2 INVERTERS AND MVS

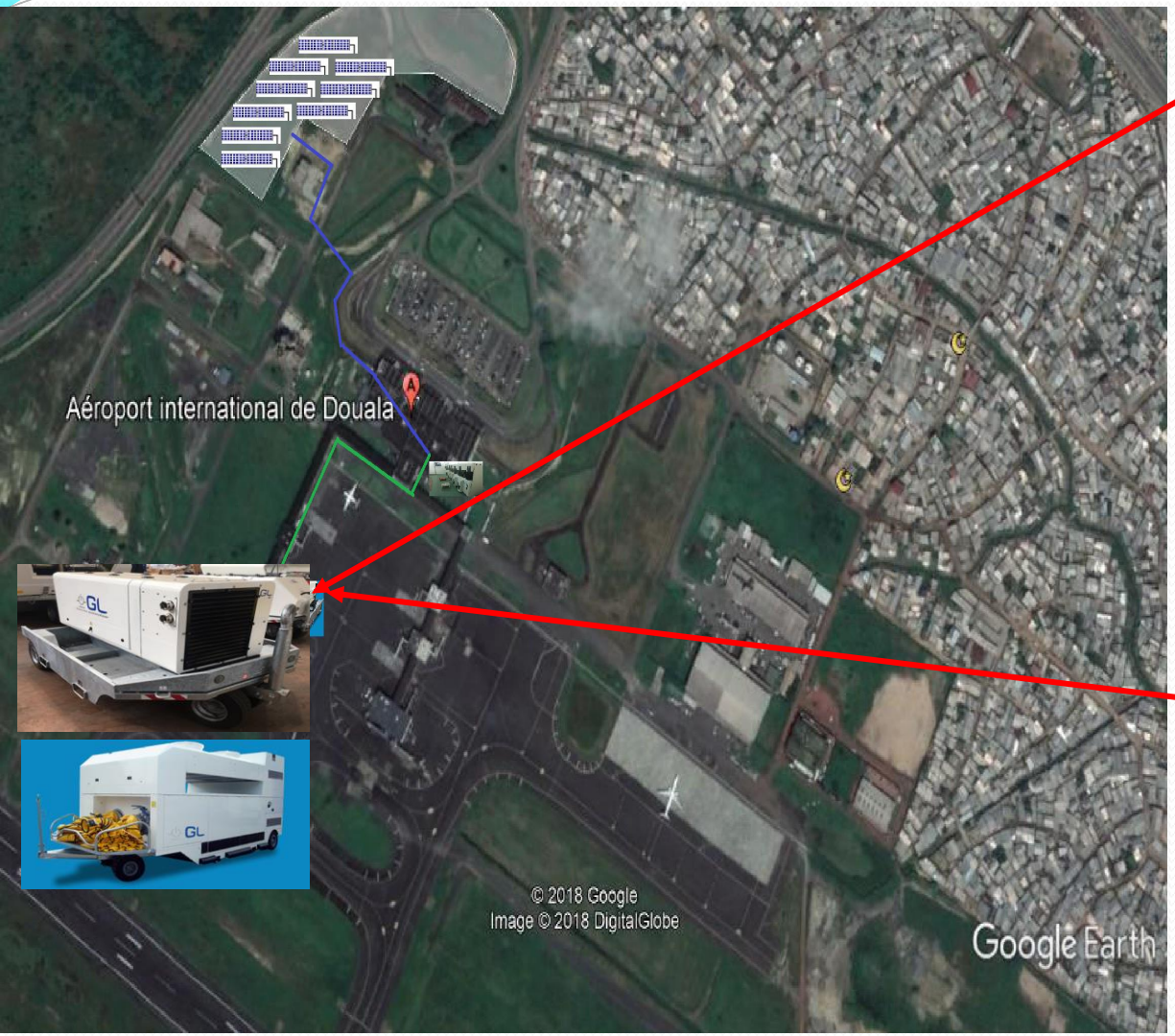
20 Inverters SMA STP 60 kW

- 5 in one column below
- 4 columns
- 3 cables: DC, AC, Monitoring

01 High Voltage Transformer Station (MVS)

- 400V/15kV

4-10-3 ELECTRICAL GPU AND ACU



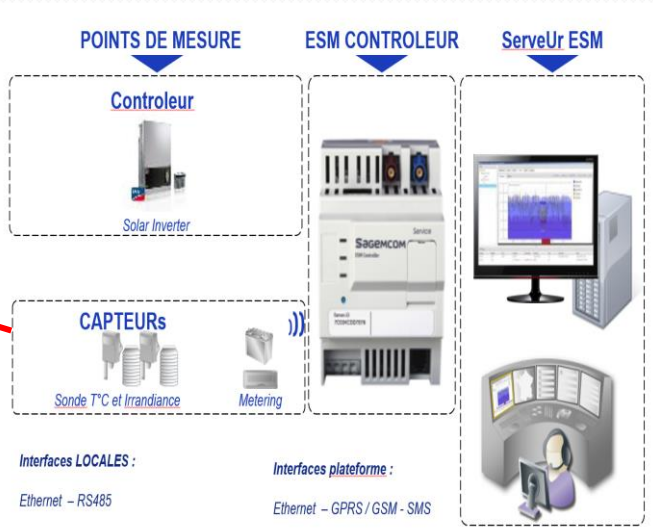
GPU: Guinault SA 180

- 50/60Hz: 400V – 3 phases – 250A
- 400 Hz 115/200V: power rating 180kW

ACU: Guinault CF 30

- Nominal air flow rate: 3.0 kg/s
- Cold air outlet temperature: -5/+5 °C

4-10-4 MONITORING SYSTEM AND DATA ACQUISITION



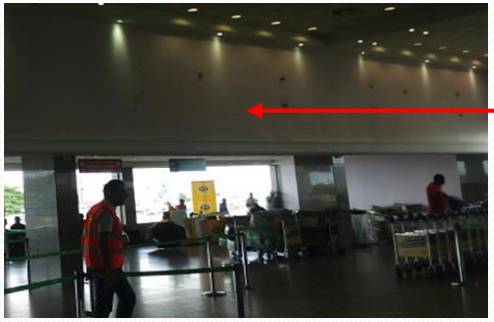
ESM Vision components:

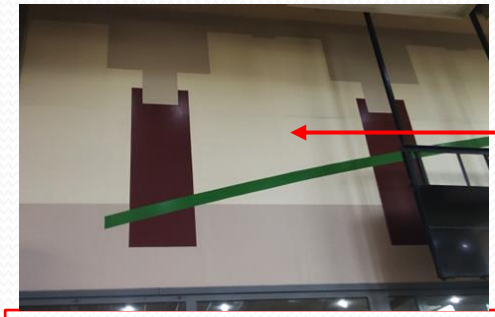
- Sensors every where to measure (e.g. on PV modules)
- Controllers on solar inverters
- ESM Controller
- Server at the airport server room

ESM Vision function:

- Meaasure points
- Alarms
- Report and KPIs

4-10-5 EDUCATIONAL KIOSKS

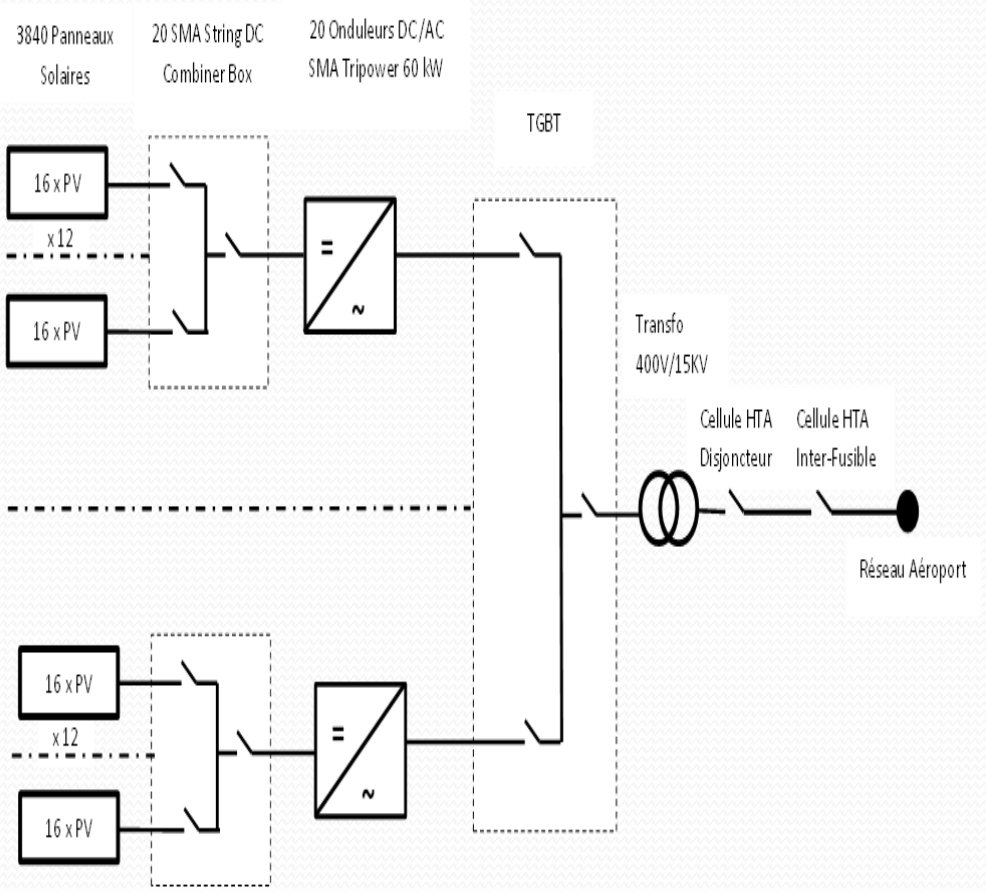




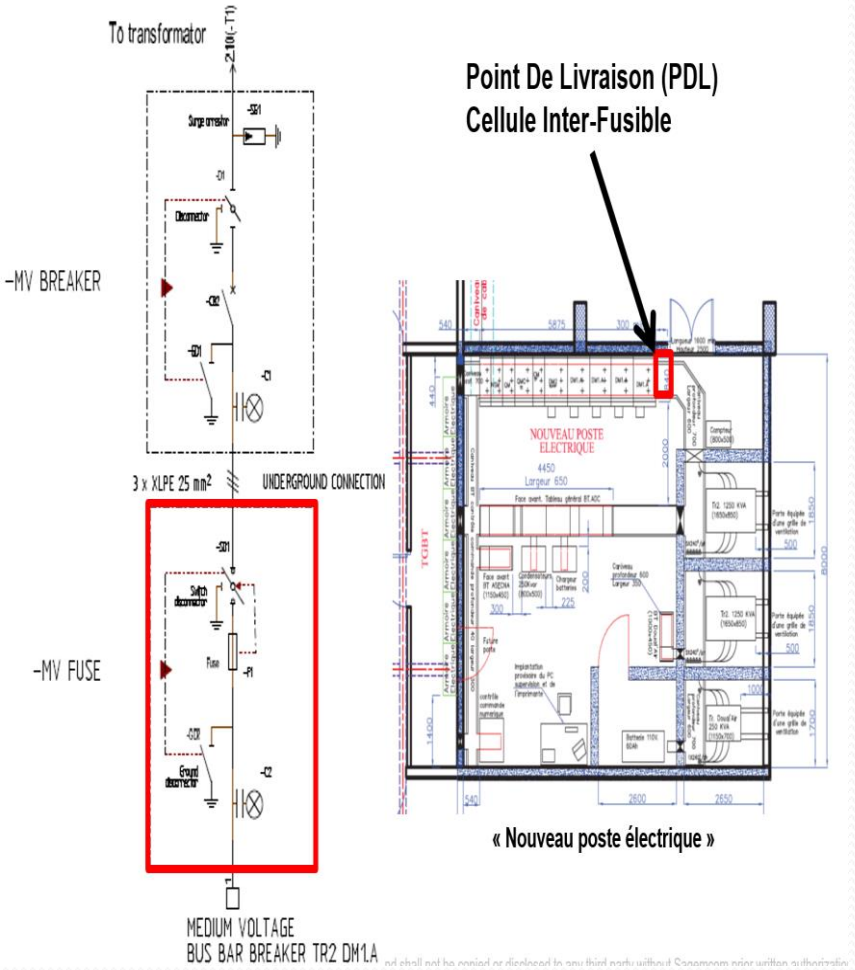
02 Educational Kiosks: Screens with dimensions (2.0x1.5)m, inside pax terminal (1 departure, 1 arrival)

4-11 SOLAR FINAL LAYOUT ON SITE

4-12 ELECTRICAL ARCHITECTURE



Electrical architecture of Solar Power Plant



Connection to airport grid 15kV

4-13 SOME PICTURES OF THE PROJECT

4-13 SOME PICTURES OF THE PROJECT

PROJECT ISSUES, CHALLENGES AND BENEFITS

5-1 ISSUES AND CHALLENGES

- Other official duties and priorities: ICAO aerodrome certification as NCLB safety initiative
- Getting Cameroon Customs taxes exemption letter
- Logistics concerns (Sea transport and slow port clearance process (freight forwarder)): Shipment from China, Germany, France and spain
- Delay in the manufacturing of some equipment: Medium Voltage Station
- Work executed during the rainy season

- Wildlife Hazards

5-1 ISSUES AND CHALLENGES (aspects not considered)

- **Issue 1**: Solar array constructed in a swampy place (Standing water, flooding, mud)

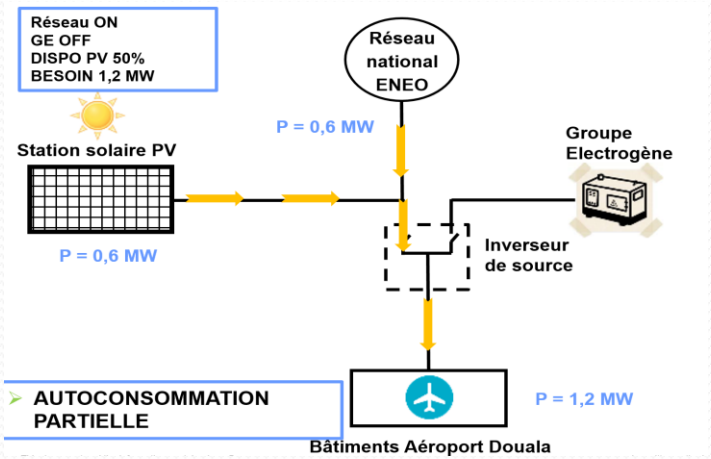
- **Solution 1**: Construction of an additional drain and raise the cable pull chambers

- **Issue 2**: Grass growing under the modules

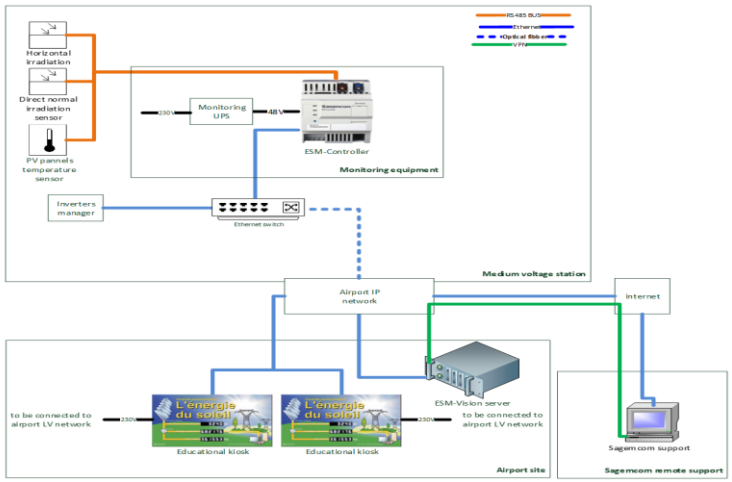
- **Solution 2**: Development and implementation of a proper grass management plan

5-1 ISSUES AND CHALLENGES

- **Issue 3**: Connection to the utility grid

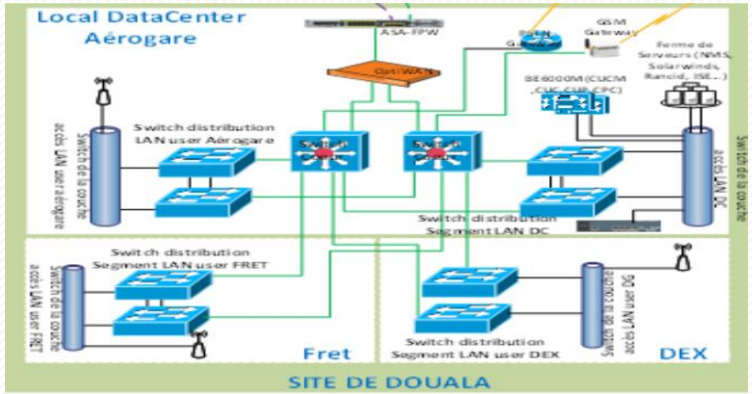


- **Issue 4**: Connexion to the IT network of the ESM Vision



- **Solution 3**: Several meetings with ENEO to find a solution (explain to conception, design and purchase relevant protections.

- **Solution 4**: Use ADC SA internal IT network and switchs and configure the VPN connection.



5-2 BENEFITS

- Reduction in CO2 emissions from international civil aviation (2600 t/year)
  - Eliminate aviation fuel burn at gate
  - Provide power from renewable energy
- Co-benefit: reduces NO_x improving local air quality
- Cost savings:
  - at least 25,000 USD savings per month, 300,000 USD per year
  - after 5-6 years, the total cost of the projet is covered
- Enhanced network with industry, especially Solar PV system industry
- Enhanced teamwork

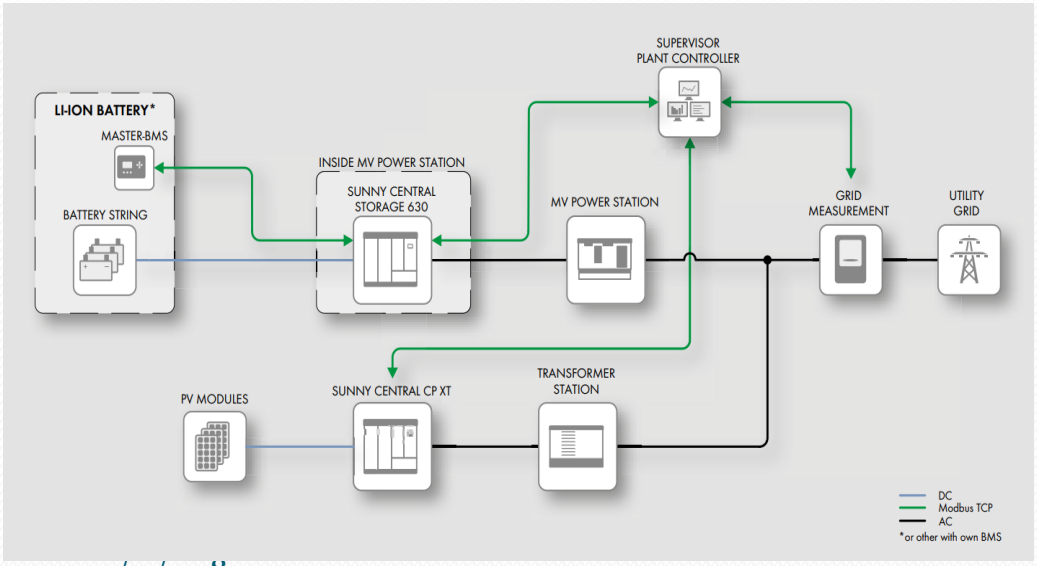
5-3 LESSONS LEARNED

- Connection of Solar PV System to the utility grid (ENEO, ADC SA): the first project of its kind in Cameroon;
- Coordination and Teamwork is key;
- Strong commitment and continuous engagement of all stakeholders is necessary to speed up the implementation of the project and to overcome challenges
- Drainage can be a serious concerns if not properly addressed
- Do not neglate logistics and port cleareances as they can have a huge impact on deadlines

ADC SA ENVIRONMENT FUTURE PROJECTS

6-1 FUTURE

- In short term add a Battery Storage System to the Solar PV System
  - As an alternative to fuel generators
    - No CO_2 emissions
    - Significant cost saving (TCO less then fuel generators)
    - Geater independance from rising fuel or energy prices
  - To be able to power critical parts of the airport with clean energy at night (serves as a UPS)
  - To be totaly independant from the utility grid (ENEO): in case of a power outage from utlity grid, batteries provide backup power to tighten the output of the PV system and ensure a continuous power supply



6-1 FUTURE (Following)

- Replicate Solar PV system projects to other airports: Yaoundé-Nsimalen, Maroua-Salak, Ngaoundéré, Bertoua & Bamenda starting and possible expansion at Douala starting in 2020

- Develop, implement and maintain full Waste Management Plans and Douala and Yaoundé-Nsimalen (2019)

- Replace of lighting (streetlights, indoor terminal lightd and apron floodlighting) with LED technology at Douala, Yaoundé-Nsimalen and Garoua in 2020

- Participate in the review of Cameroon CO_2 Mitigation Action Plan in 2019

- Plant trees at airports located in northern region in 2019 (Maroua-Salak and Garoua) to promote ecological restoration (operation green Sahel)

6-2 FUTURE - GAROUA INTERNATIONAL AIRPORT PROJECT (Construction to begin in 2019)

- ADC SA to lease land to **EB SOLAIRE SA** for the construction and operation of a Solar Power System for the North Region

- **Capacity**: 30 MWp
- **Area covered**: 70Ha
- ADC SA to secure 500 kWp of solar energy with battery storage system supplied and installed by EB SOLAIRE SA

6-3 SPECIAL THANKS

- European Union for having funded the Project
- ICAO President and ICAO Council
- ICAO Environment Team for very strong commitment, availability and full support to meet the project objectives
  - Mrs. Jane **HUPE**,
  - M. Eduardo **CALDERA-PETIT**
  - M. Didier **MOUKALAN**
  - M. Christelle **BRAUN**
  - Others in Backoffice

- ICAO Technical Consultant **Steve Barret** for its advices and availabillity
- **CCAA, and Ministry in charge of Energy** for their full support

THANK YOU FOR YOUR ATTENTION

A door opened to the world