COOPERATION BETWEEN EU AND MEDITERRANEAN PARTNER COUNTRIES IN THE ENERG SECTOR

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ATHENS 22& 23 February 2016

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CASE STUDIES & APPLICATIONS-MENA REGION

Mt Athos, Greece:

1.The Hybrid Energy System of the Simonos Petras Monastery

Source: Holy Monastery of Simonos Petras

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To the present day, the Athonite peninsula is not connected to the electrical utility grid on the Greek mainland.

A grid connection of Mt. Athos would require high initial and maintenance expenses due to the isolated location of the peninsula, the often difficult weather conditions and the widely scattered consumers in an area, which is difficult to access.

The Monastery of Simonos Petras covers its electric energy demand since 1991 almost exclusively by renewable energy sources (RES)

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Old 1991

An integrated hybrid system consisting of

- ✓ • a photovoltaic power system
- ✓ • a battery bank
- ✓ • an hydroelectric plant
- ✓ • a Diesel generator set

interconnected via an UPS backbone is able to cover a peak demand up to 150 kW.

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The solar plant is located at 650 m altitude in the mountain area of the monastery grounds, about 1600 m away from the monastery complex. The solar generator constitutes out of two subarrays with each approx. 45 kWp.

Maximum Output 91 kWp (Standard conditions)

- ✓ DC current with a nominal voltage up to 600 V is transferred via cable to the power house near the monastery
- ✓ A small house on the southern border of the PV-field shelters partial array- and load switches as well as other equipment, necessary for a safe array operation.
- ✓ Special attention in the array layout has been given to lightning protection, (IEC 1024 and DIN/VDE 57185/6.3.2).

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- ✓ The Hydroelectric Power Station provides a maximum output of about 40 kVA.
- ✓ It features a single nozzle Pelton turbine with a nominal head of about 330 m.
- ✓ The Hydro system may cover the monastery's electricity needs on a 24 hr.-basis provided there is a sufficient water supply.
- ✓ It is operated by a local PLC which communicates with the overall SCADA system

- ✓ The energy flow from the two solar fields to the battery is regulated by two DC/DC converters applying a maximum power tracking algorithm and I-U charging characteristics.
- ✓ Each Converter consists of 8 parallel step down converters with high frequency PWM ("Buck" switching regulator topology). The units are microprocessor controlled and synchronized.
- ✓ The control unit monitors in real time all analog inputs and outputs applying an MPPT algorithm, securing under all environmental conditions (i.e., insolation, temperature) a maximum energy transfer to the battery bank.

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- ✓ The battery bank in the power house near the monastery is used as an energy store for the night or for days with low or no sunshine, as well as for equalizing the energy output of the solar array, the latter being unevenly distributed over the day.
- ✓ It consists of 200 maintenance-free lead-acid cells, serially interconnected to form one sole, large battery.
- ✓ The battery has a storage capacity of 600 kWh at a rated voltage of 400 V.
- ✓ With the battery being in fully charged condition, up to two bad weather days may be covered at moderate power consumption.

- ✓ The whole technical equipment is sheltered in the “power house”, being especially built in the traditional style near the monastery.
- ✓ In the power house’s control room are located charge controllers, UPS, main power panels and switchgears as well as control- and automation equipment.
- ✓ The rooms for the battery bank and for the motor generator are specially furnished (explosion protection and sound isolation, respectively).

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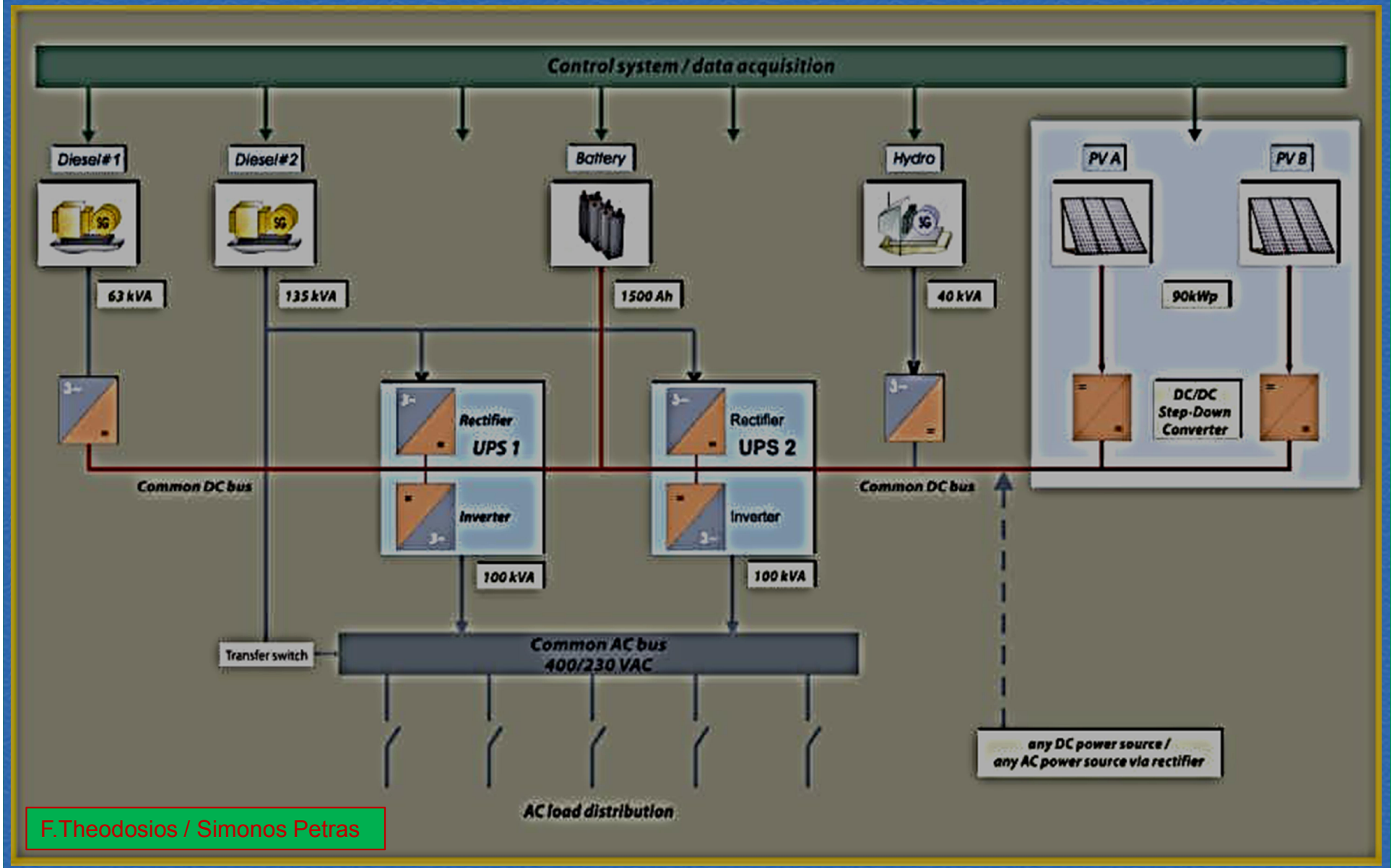
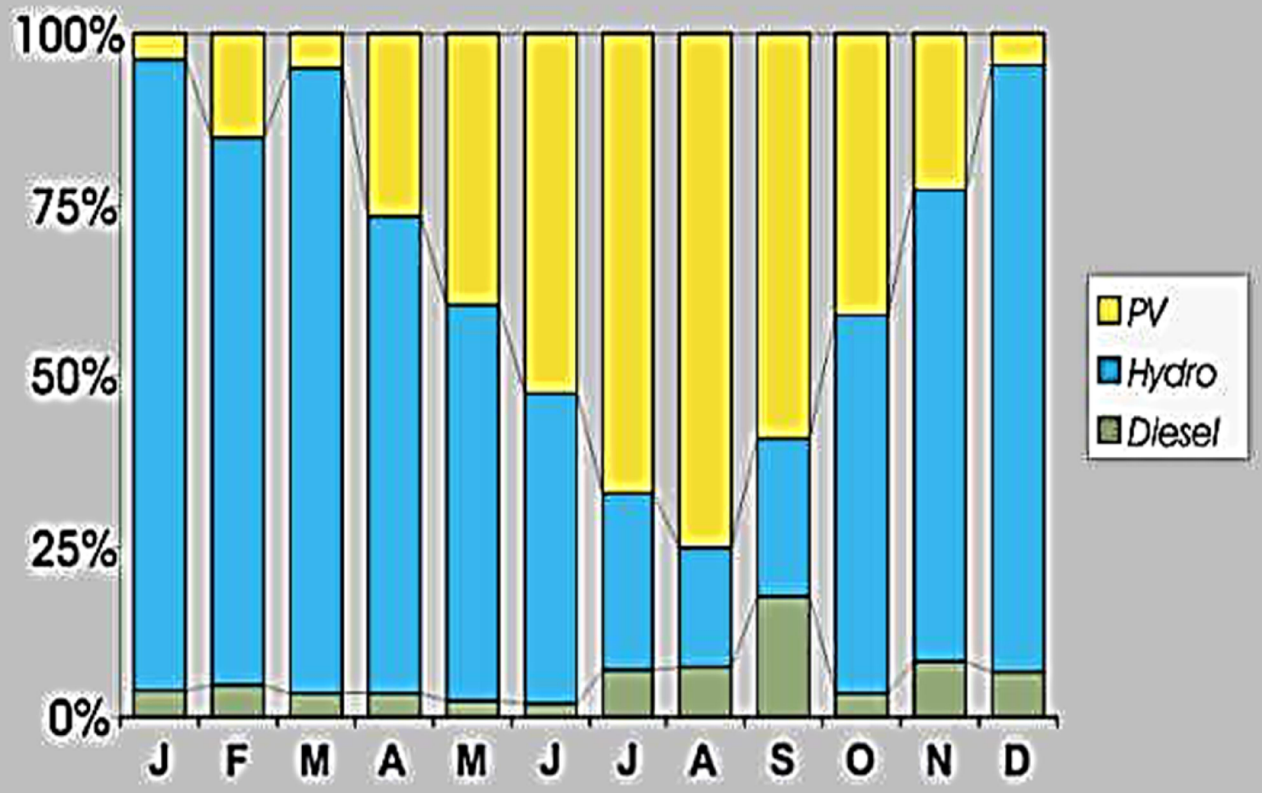


F.Theodosios / Simonos Petras

During the winter months, almost there is an abundance of water, the power Hydro plant covers most energy demand.

where In the summer season with unlimited sunshine, the solar system takes over the main needs.



The Diesel Generators are used for peak demands and backup, with usually less than 800 operating hours p. a.

Hybrid System, comparison of operating hours

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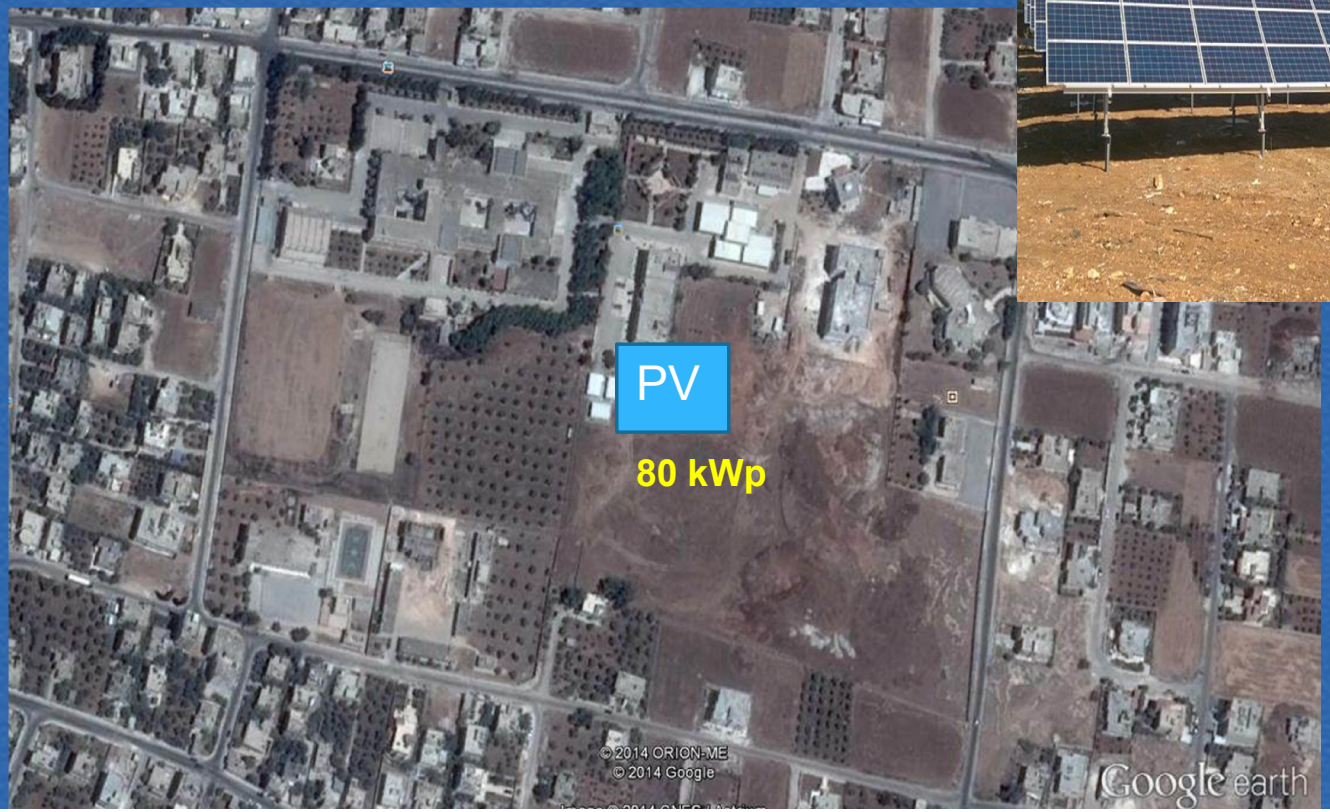
Machrek Energy Development-Solar

Promoting and implementing innovative solar technologies
in public buildings and industrial facilities



2.Al-Huson University map (Hybrid Smart System)

Existing Electrical System at Al- Huson University College (Single Line Diagram)

T: Transformer
OHL: Over Head Line
UGL: Under Ground Line
M: kWh Meter
ATS: Automatic Transfer Switch
DG: Diesel Generator

Before the implementation of the Project

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MED SOLAR
Machrek Energy Development-Solar
Promoting and implementing innovative solar technologies in public buildings and industrial facilities

Project funded by the EUROPEAN UNION

المركز الوطني لبحوث الطاقة
National Energy Research Center

Royal Scientific Society
Amman Jordan 1970

General Description

✓Purpose of the project

The aim of the project is to make a short installation guide for the EMS and other elements required for the monitoring and control of the PV pilot plant in Al-Huson University College, Habaka, Jordan.

✓System requirements

The system hardware requirements are linked to the PV power plant data requirements and to control the performance of the different elements. In brief these are:

- Meteorological data.
- Monitoring and control of different generation

Monitoring and control of the generation sources

I. Grid dependent inverters:
4 x SMA Power Control Module

II. Battery inverter:
Normally supplied with the inverter Sunny Island

III. DG/Genset 1 (250Kva):
✓Power analyzer Webdom Satelite
✓Split core current transformers 400/1 or 400/5

VI. Automatic transfer Switchs (ATS):
✓16 Ch Isolated Digital Inputs

Meteorological sensors

The meteorological sensors are listed below:

- Irradiance Sensor
- Ambient temperature Sensor
- PV Module temperature Sensor
- Temperature of the technical room.

IV. Mains:
✓Power analyzer Webdom Satelite
✓Split core current transformers 1500/1 or 1500/5

V. Khawarizmi bulding and Administration building and reverse power protection of the genset:
✓Power analyzer Webdom Satelite
✓Split core current transformers 1250/1 or 1250/5

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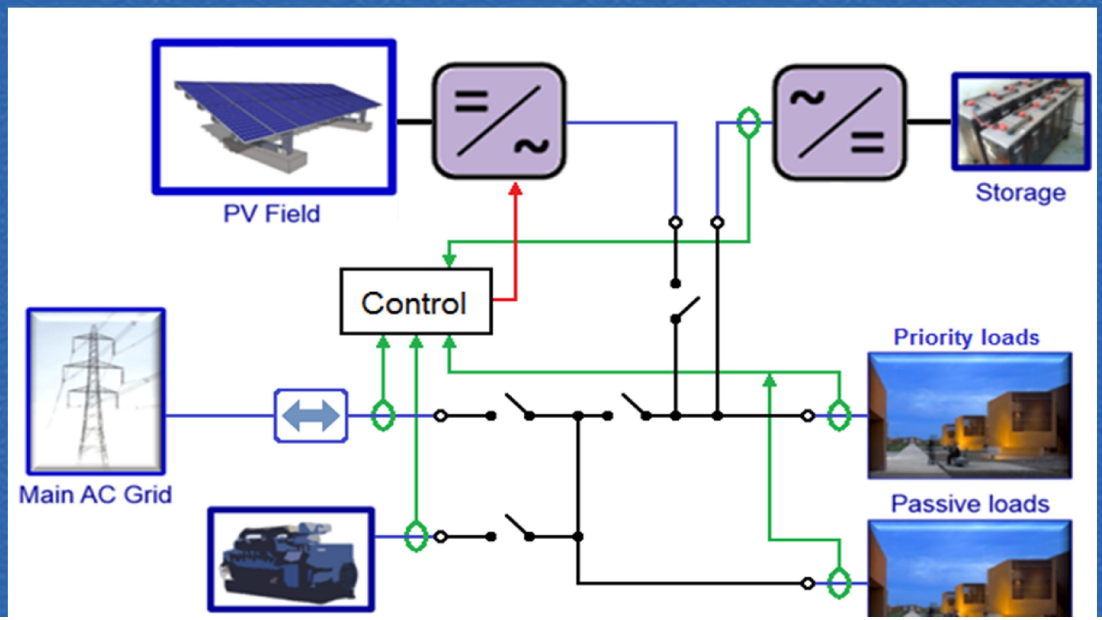
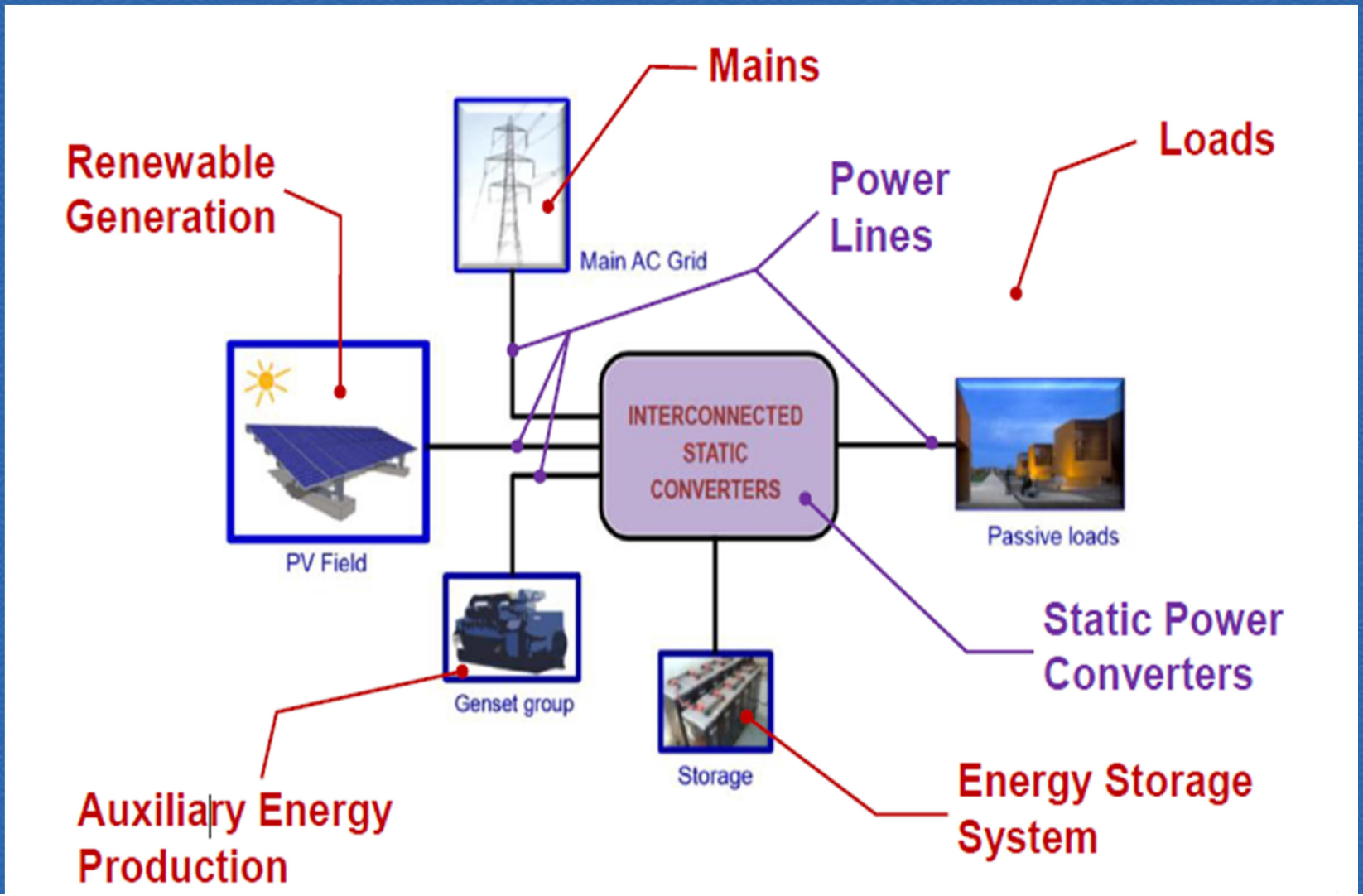


Energy Management System (EMS)

Al-Huson University map (Hybrid Smart System)



System Energy sources

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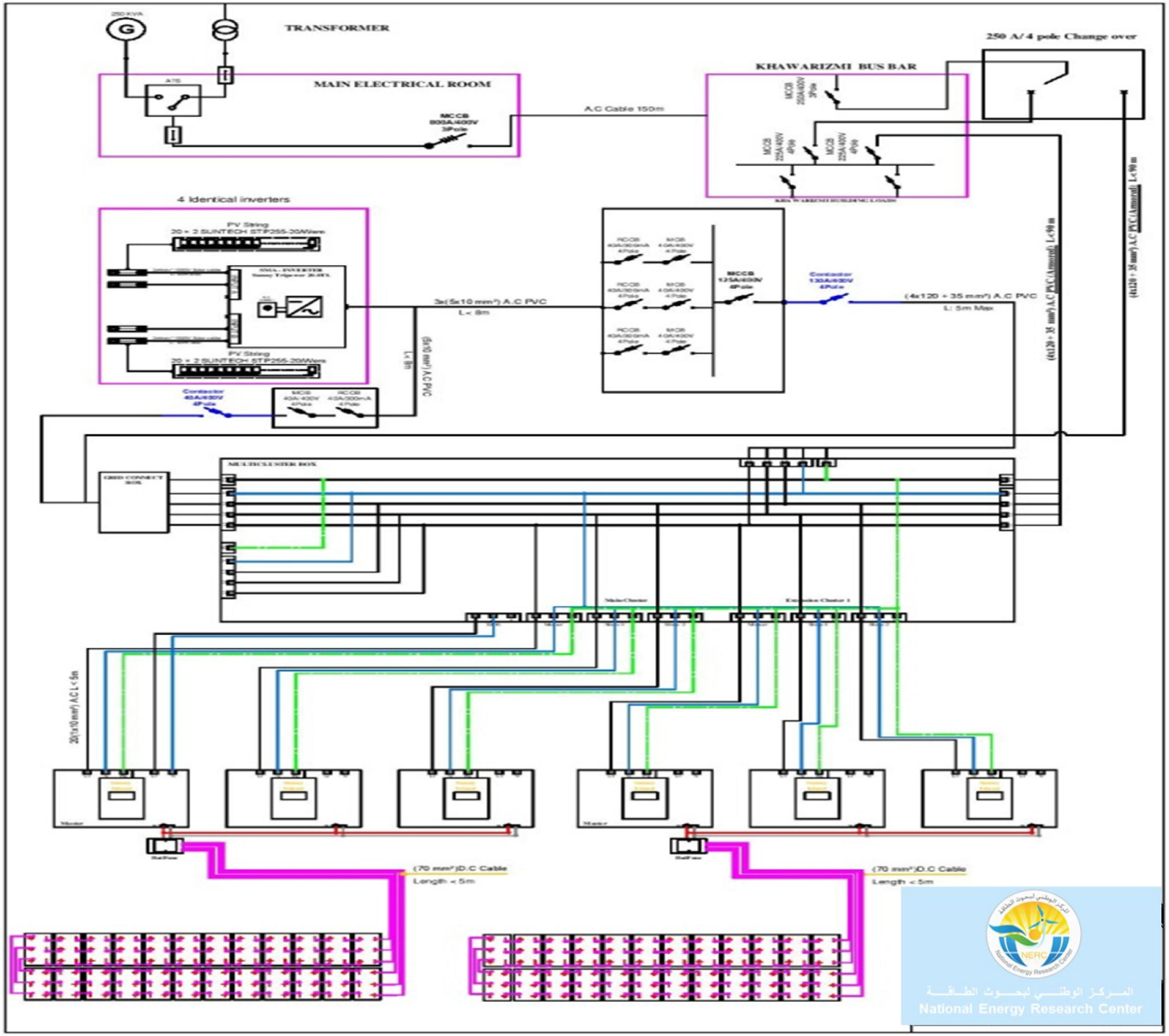
Al-Huson University map (Hybrid Smart System)



System Energy sources

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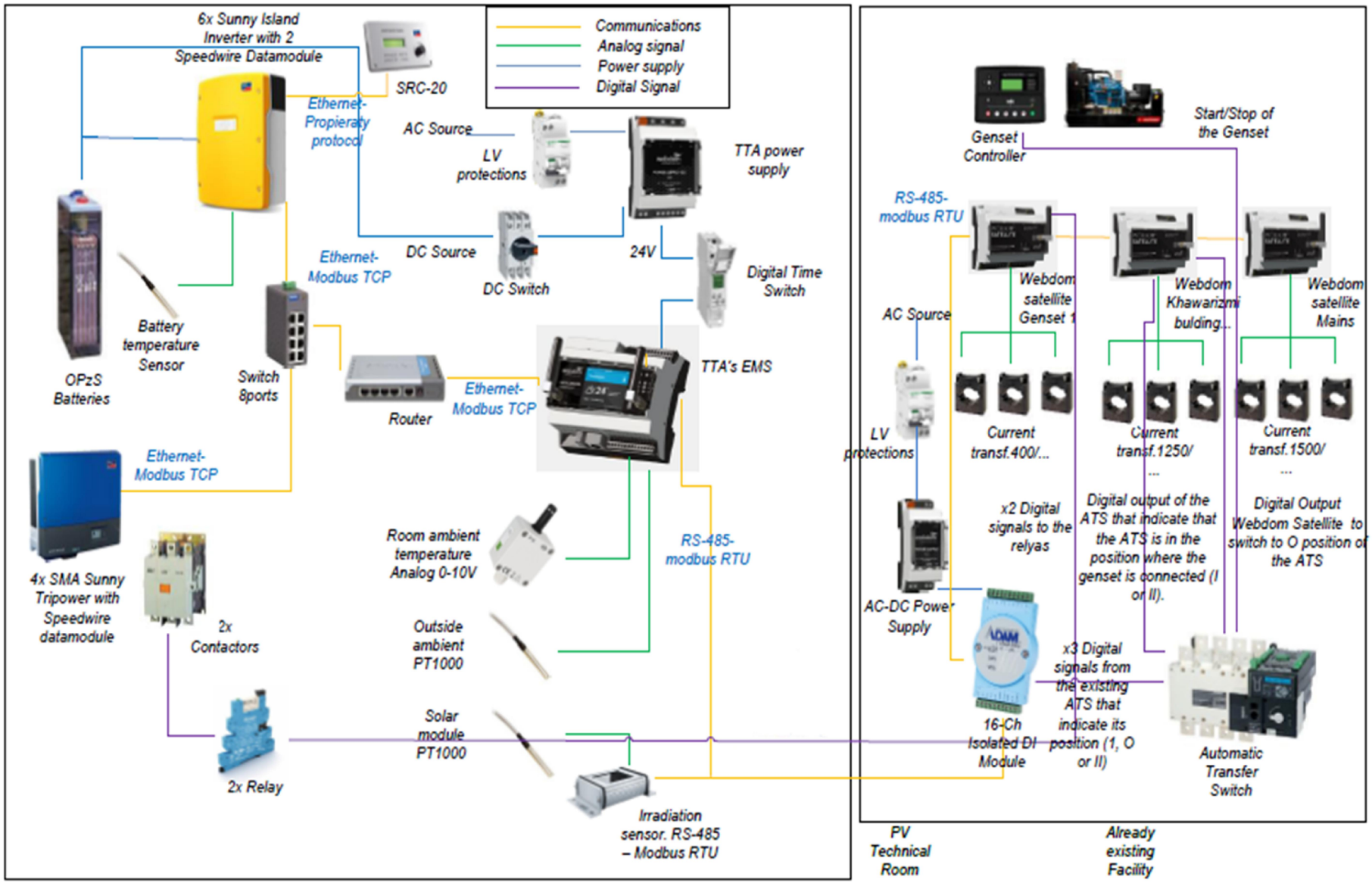

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THANK YOU FOR YOUR ATTENTION

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