MARTIFER
SOLAR

ECREEE Regional Forum on the ECOWAS Solar Energy Initiative – ESEI

ADVANTAGES OF PV SYSTEMS – CAPE VERDE CASE STUDY

PRESENTING…

PREVIOUS CONSIDERATIONS - SOLAR PV PLANTS IN AFRICAN COUNTRIES

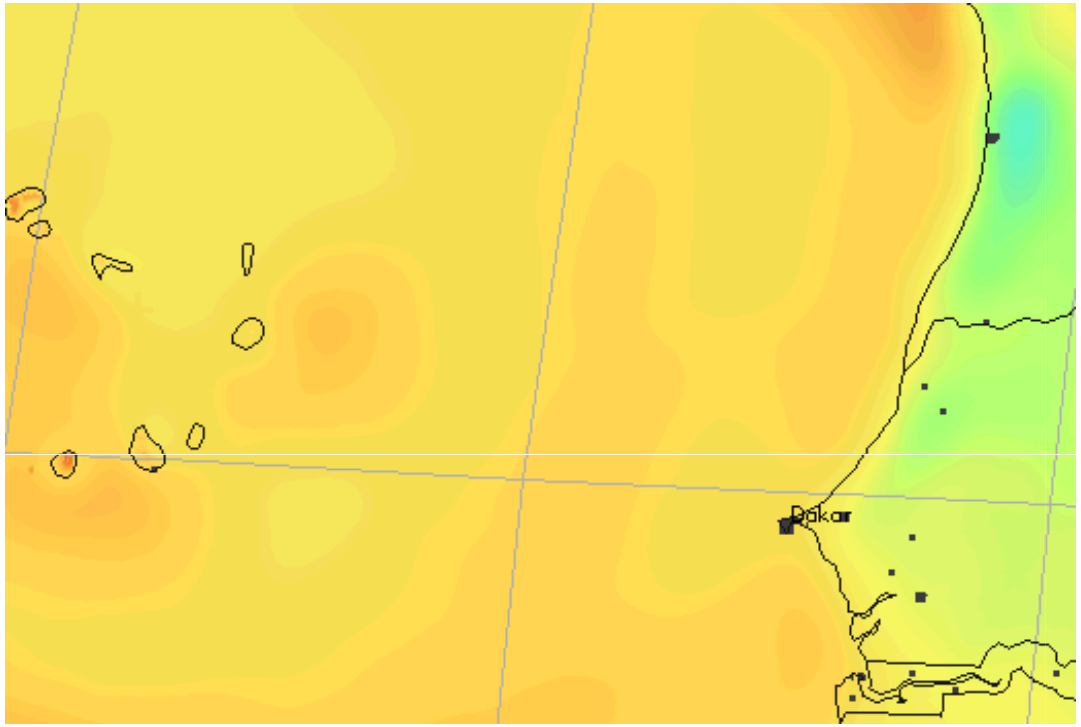
COMPARATIVE PHOTOVOLTAIC VS DIESEL GENERATORS

CASE STUDY - CAPE VERDE PV PLANT

CAPE VERDE | UTILIZATION OF PHOTOVOLTAIC TECHNOLOGY

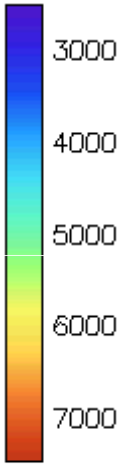
CAPE VERDE | GENERAL CONTEXT

UTILIZATION OF SOLAR RESOURCE



HORIZONTAL IRRADIATION

YEARLY SUM OF GLOBAL HORIZONTAL IRRADIATION



CAPE VERDE, LIKE MOST AFRICAN COUNTRIES, HAVE EXCELLENT SOLAR IRRADIATION CONDITIONS !

CAPE VERDE | GENERAL CONTEXT

UTILIZATION OF SOLAR RESOURCE

- ELECTRICAL ENERGY HAS A MAJOR ROLE IN TRANSFORMING THE LIVES OF RESIDENTS AND TOURISTS
- AFRICAN COUNTRIES HAVE ABUNDANT SOLAR ENERGY RESOURCES
- LOW COSTS OF ELECTRICITY (MAINTENANCE COSTS)
- FACILITIES POSSIBLE AND FEASIBLE, EVEN IN AREAS OF DIFFICULT ACCESS
- IT IS A CLEAN ENERGY, NO SMOKE OR NOISE EMISSION INTO THE ATMOSPHERE

COMPARATIVE PHOTOVOLTAIC VS DIESEL | ADVANTAGES & DISADVANTAGES

DIESEL GENERATOR SYSTEM ADVANTAGES

- MARKET AVAILABILITY
- LOWER INITIAL COST
- SMALL AREA FOR GENERATOR'S INSTALLATION
- COST OF DIESEL FOR POWER GENERATION RELATIVELY LOW

DIESEL GENERATOR SYSTEM DISADVANTAGES

- SYSTEM THAT REQUIRES CONSTANT MAINTENANCE ACTIONS
- MAINTENANCE MAY INVOLVE THE DEPLOYMENT OF TECHNICAL EXPERTISE TO LOCAL, WHICH SOMETIMES IS NOT POSSIBLE IN A SHORT TIME
- SUPPLY OF FUEL NOT ALWAYS AVAILABLE ON TIME
- OPERATING COSTS SUBJECT TO VARIATIONS IN FUEL PRICES
- NOISE POLLUTION AND THE ENVIRONMENT

COMPARATIVE PHOTOVOLTAIC VS DIESEL | ADVANTAGES & DISADVANTAGES

PV GENERATOR SYSTEM ADVANTAGES

- RELIABLE SYSTEM
- LOW MAINTENANCE REQUIREMENTS
- FREE ENERGY
- AFRICAN COUNTRIES HAVE EXCELLENT SOLAR RADIATION CONDITIONS
- CLEAN ENERGY THAT DOES NOT POLLUTE (AIR POLLUTION AND NOISE POLLUTION NONEXISTENT)
- AVAILABILITY OF ELECTRICITY

PV GENERATOR SYSTEM DISADVANTAGES

- HIGHER UNAVAILABILITY IN THE MARKET, SO FAR
- HIGHER INITIAL COST
- BIGGER AREA FOR INSTALLATION OF THE GENERATOR

COMPARATIVE | PHOTOVOLTAIC SYSTEM VS OTHER RENEWABLES

RENEWABLE ALTERNATIVES TO PHOTOVOLTAIC COULD COME ...

- WIND
- HYDRO
- WAVES

HOWEVER, PHOTOVOLTAIC SYSTEMS…

- ALLOWS INSTALLATION IN THE SHORT TERM
- POSSIBILITY OF HAVING SEVERAL MW IN PRODUCTION IN LESS THAN ONE YEAR
- NO REQUIREMENT FOR LONG PRELIMINARY STUDIES
- NO SPECIAL REQUIREMENTS FOR INSTALLATION SITE
- GENERATION NEAR THE CONSUMPTION
  - NO COSTS WITH TRANSPORTATION OF ENERGY
  - NO REQUIREMENT FOR BUILDING COSTLY ENERGY TRANSPORTATION LINES

CASE STUDY | CAPE VERDE PV PLANT

IN THE CURRENT CASE STUDY WE HAVE CONSIDERED THE FOLLOWING CONDITIONS[1]:

- ONLY 1 MW CONSIDERED AS EXAMPLE FOR THE COMPARATIVE
- EXCHANGE RATE: **1 CV ESCUDO = 0,009 €**
- INFLACTION RATE: **1,50% / YEAR**
- GENERATORS CONSUMPTION: **0,28 L / kWh**
- COST OF FUEL (DIESEL FOR ELECTRICITY GENERATION): **0,82 € / L[2]**
- YEARLY INCREASE ON FUEL: **5 % / YEAR**
- DIESEL GENERATOR MAINTENANCE COSTS: **5% OF TOTAL COSTS WITH FUEL**
- GREEN CERTIFICATES VALUE: **NOT CONSIDERED**
- INITIAL COSTS OF DIESEL GENERATORS: **NO INITIAL COST**
- PV SYSTEM INITIAL COST: **3.750,00 € / kWp[3]**

1) The values presented in these case study are to be considered exclusively as reference values and not as definitive values.
2) Value of 2008
3) Cost of Turn-key solution, excluding custom taxes on imports.

CASE STUDY | CAPE VERDE PV PLANT

PHOTOVOLTAIC SYSTEM:

Year	1	2	3	4	5	6	7	8	9	10
Production (kWh)	1.700.000	1.688.100	1.676.283	1.664.549	1.652.897	1.641.327	1.629.838	1.618.429	1.607.100	1.595.850
O&M Costs(€)	35.000	35.525	36.058	36.599	37.148	37.705	38.271	38.845	39.427	40.019
Accumulated Costs (€)	3.785.000	3.820.525	3.856.583	3.893.182	3.930.329	3.968.034	4.006.305	4.045.149	4.084.577	4.124.595
Generation Costs (€/kWh)	0,19	0,19	0,19	0,19	0,19	0,19	0,19	0,19	0,19	0,19

Year	11	12	13	14	15	16	17	18	19	20
Production (kWh)	1.584.679	1.573.587	1.562.572	1.551.634	1.540.772	1.529.987	1.519.277	1.508.642	1.498.081	1.487.595
O&M Costs(€)	40.619	41.228	41.847	42.474	43.111	43.758	44.414	45.081	45.757	46.443
Accumulated Costs (k€)	4.165.214	4.206.442	4.248.289	4.290.763	4.333.875	4.377.633	4.422.047	4.467.128	4.512.885	4.559.328
Generation Costs (€/kWh)	0,19	0,19	0,19	0,19	0,19	0,19	0,19	0,19	0,19	0,19

Notes: The values presented in these case study are to be considered exclusively as reference values and not as definitive values.
Values based on previous considerations. Depreciation of 20 years on the PV System.

CASE STUDY | CAPE VERDE PV PLANT

DIESEL GENERATOR:

Year	1	2	3	4	5	6	7	8	9	10
Production (kWh)	1.700.000	1.688.100	1.676.283	1.664.549	1.652.897	1.641.327	1.629.838	1.618.429	1.607.100	1.595.850
Generation Costs (€/kWp)	0,241	0,253	0,266	0,279	0,293	0,308	0,323	0,339	0,356	0,374
Accumulated Cost (€)	410.129	837.749	1.283.608	1.748.483	2.233.184	2.738.558	3.265.487	3.814.888	4.387.722	4.984.987

Year	11	12	13	14	15	16	17	18	19	20
Production (kWh)	1.584.679	1.573.587	1.562.572	1.551.634	1.540.772	1.529.987	1.519.277	1.508.642	1.498.081	1.487.595
Generation Costs (€/kWp)	0,393	0,413	0,433	0,455	0,478	0,502	0,527	0,553	0,581	0,610
Accumulated Cost (€)	5.607.726	6.257.024	6.934.015	7.639.879	8.375.849	9.143.208	9.943.294	10.777.504	11.647.294	12.554.179

Notes: The values presented in these case study are to be considered exclusively as reference values and not as definitive values.
Values based on previous considerations.

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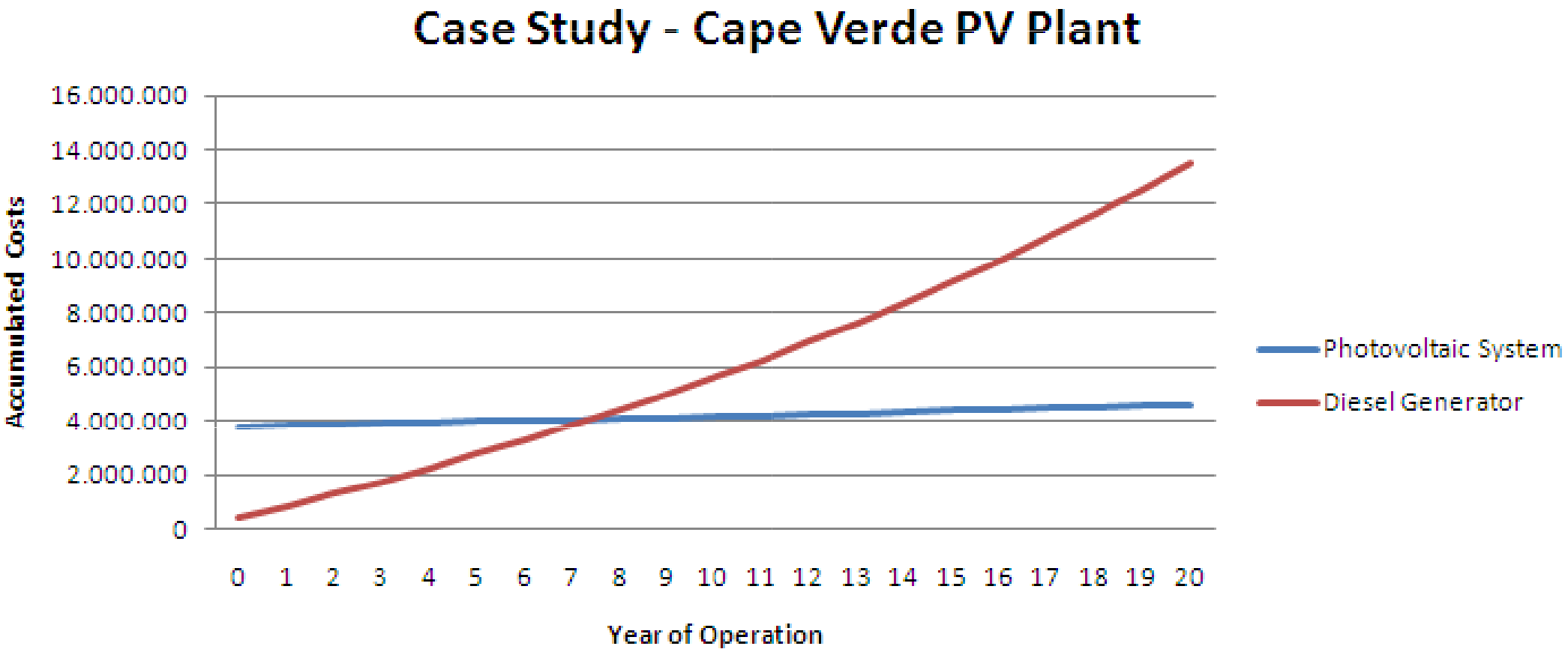

CASE STUDY | CAPE VERDE PV PLANT

CONCLUSIONS & GLOBAL ANALISYS

- COST OF GENERATION WITH PV: **~0,19 €/ kWh** (WITH 5% LOAN OVER 20 YEARS AND 0% TAXES ON INVESTMENT)
- CURRENT DIESEL GENERATION COSTS: **~0,24 €/ kWh**
- COST OF PRODUCTION WITH DIESEL IN 20 YEARS (WITH PREVIOUS CONSIDERATIONS): **0,61 €/ kWh**
- FOR EACH 1 MW OF PV SYSTEMS INSTALLED:
  - **AFTER 20 YEARS THERE IS A REDUCTION OF ~8 MILLIONS EUROS IN PRODUCTION COSTS**

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CHALLENGES & SUCCESS FACTORS:

WHEN WE ARRIVE WE FOUND:

- EXTREMLY SALTY ENVIRONMENT
- SPECIALIZED MANPOWER DIFFICULT TO FIND
- ISOLATION
- INITIAL LOGISTICAL DIFFICULTIES
- MARITIME INFRASTRUCTURES WITH SOME LIMITATIONS
- LACK OF PROCEDURES / MECHANISMS/ ROUTINES

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BUT SUCCESS CAME WITH:

- ACCURATE MATERIAL AND EQUIPMENT SELECTION
  - **MARTIFER MODULE HAS THE CERTIFICATION FOR STANDARD IEC 61701:2005 FOR SALT MIST CORROSION**
- KNOW HOW TRANSFER TO LOCAL SUBCONTRACTORS
- PLANNING
- DILIGENCE
- ANTICIPATION
- PERSISTENCE
- IMPLEMENTATION OF PROCEDURES / MECHANISMS/ ROUTINES

CASE STUDY | CAPE VERDE PV PLANT

I PRESENT YOU THE BIGGEST PHOTOVOLTAIC INSTALLATION IN THE AFRICAN CONTINENT !

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