



INSTALATION OF 200 MW IN PV FACILITIES IN CUBA



UNION ELECTRICA

WIND
FARMS



PV FACILITIES



HYDROELECTRIC



THERMOELECTRIC



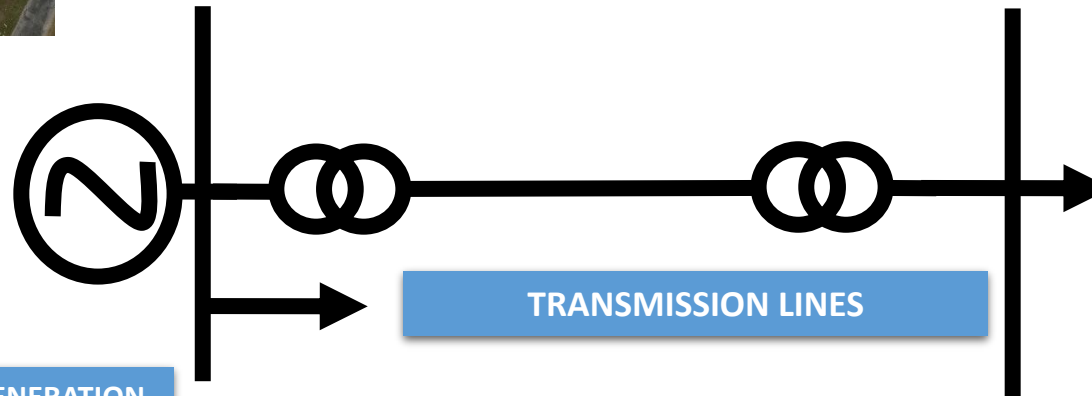
DISTRIBUTED GENERATION



DISTRIBUTION GRID

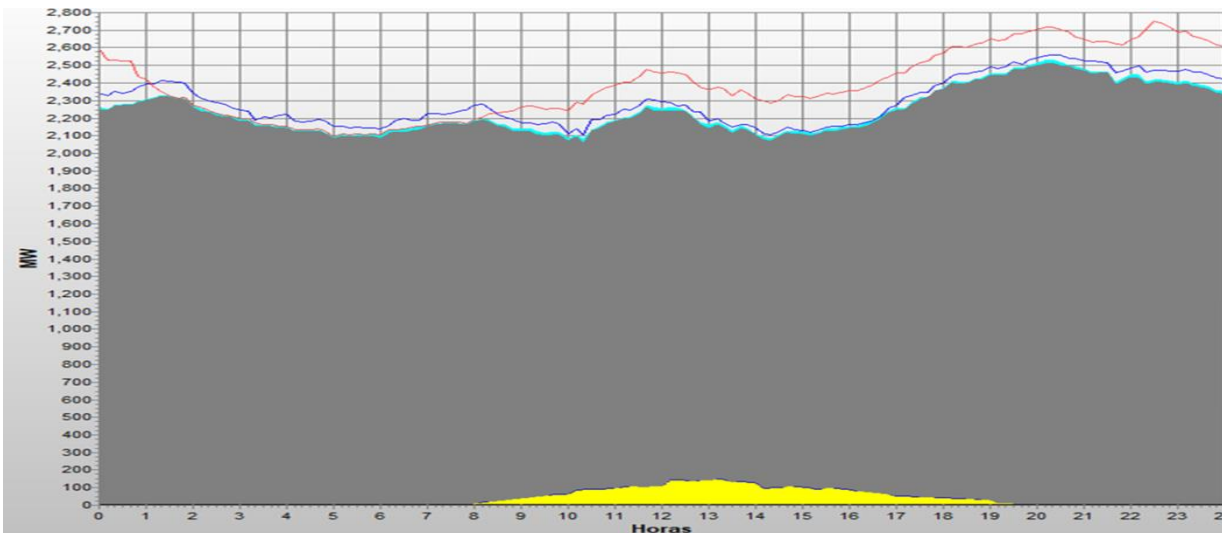


COMERCIALIZACION



TECHNOLOGY	MW POWER	SYNCHRONIZED INSTALLATIONS
Photovoltaic Parks	254.9	74
Hydroelectric Power Plants	66.14	40
Wind	11.47	4
Total	332.57	118

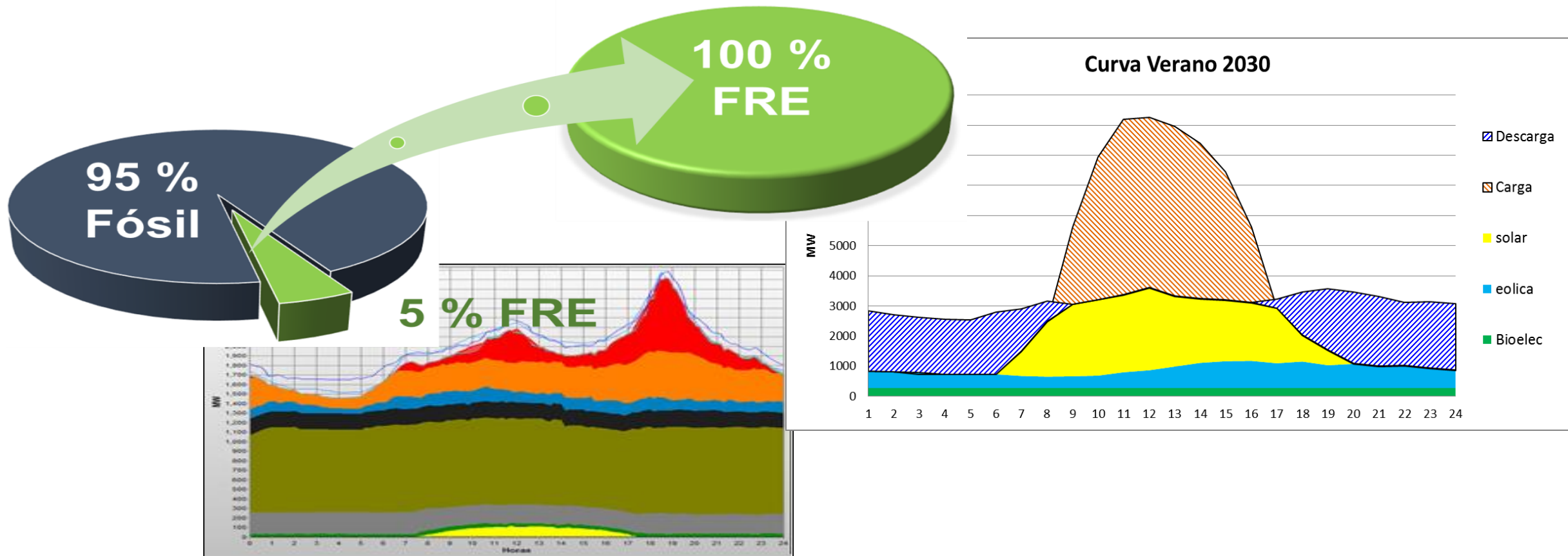
- The availability of these facilities, photovoltaic above 99% and wind and hydroelectric plants above 70%



- Currently, technologies with RE provide 5.2% of the generation to cover midday demand.
- The average generation contributed by the photovoltaic at midday was 155.64 ± 11 MW and a maximum value of 178.64 MW.

STRATEGIC SOLUTION

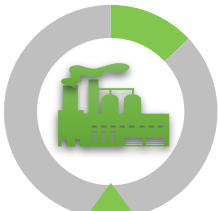
In the latest update of Unión Eléctrica Development Program (UNE), the goal is projected to obtain 37% of generation with Renewable Energy Sources in 2030 and continue the uninterrupted development of these technologies until reaching 100% generation of electricity in the country, with a high integration of solar photovoltaic, wind and energy accumulation. In the case of photovoltaics, it must reach an installed power of 2104 MW by this date.



POLITICS AND STRATEGIC VISION OF THE COUNTRY



BIOELECTRIC



612MW

WIND



807MW

PSFV



2104 MW

PCHE



56MW

ENERGY =

fifteen%

9%

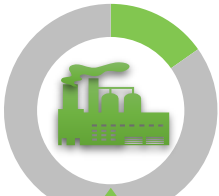
12%

1%

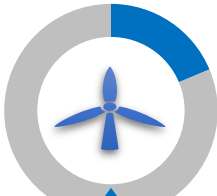
= 37%

RESULTS

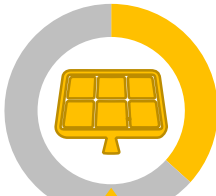
- Produce 9 thousand GWh /year
- Replace 2.3 million tons of fuel/year
- 8.5 million tons of CO₂ avoided per year.



612MW



1 800 MW



13 thousand
MW



56MW

ENERGY =

18%

23%

58%

0.8%

= 100%

RESULTS

- Produce 26 thousand GWh /year
- Replace 6.5 million tons of fuel/year
- twenty-one million tons of CO₂ avoided per year.

PV FACILITIES INSTALLED



Caguagua 2, Villa Clara 4,4 MWp



Aguada, Cienfuegos 2,2 MWp



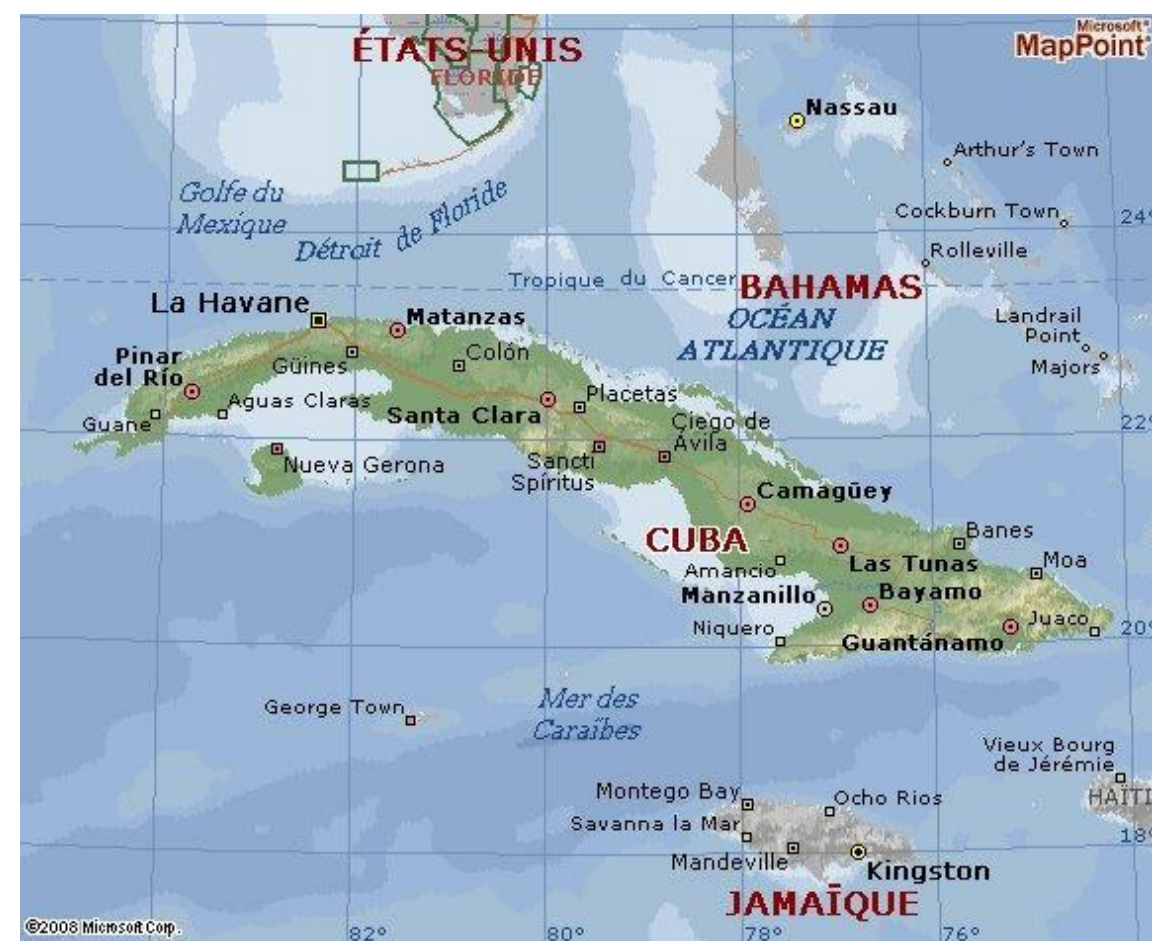
Yuraguanal 1, Holguín 2,2 MWp



Yuraguanal 2, Holguín 2,2 MWp

CUBAN GEOGRAPHY

CUBA IS THE BIGGEST ISLAND IN THE CARIBBEAN, LOCATED APPROXIMATELY AT THE CANCER TROPIC BETWEEN 23.45° AND 19° OF NORTH LATITUDE, EXTENDING FROM WEST TO EAST. ITS GEOGRAPHICAL POSITION BELOW THE TROPIC IS VERY FAVORABLE TO GET HIGHER VALUES OF SOLAR RADIATION.



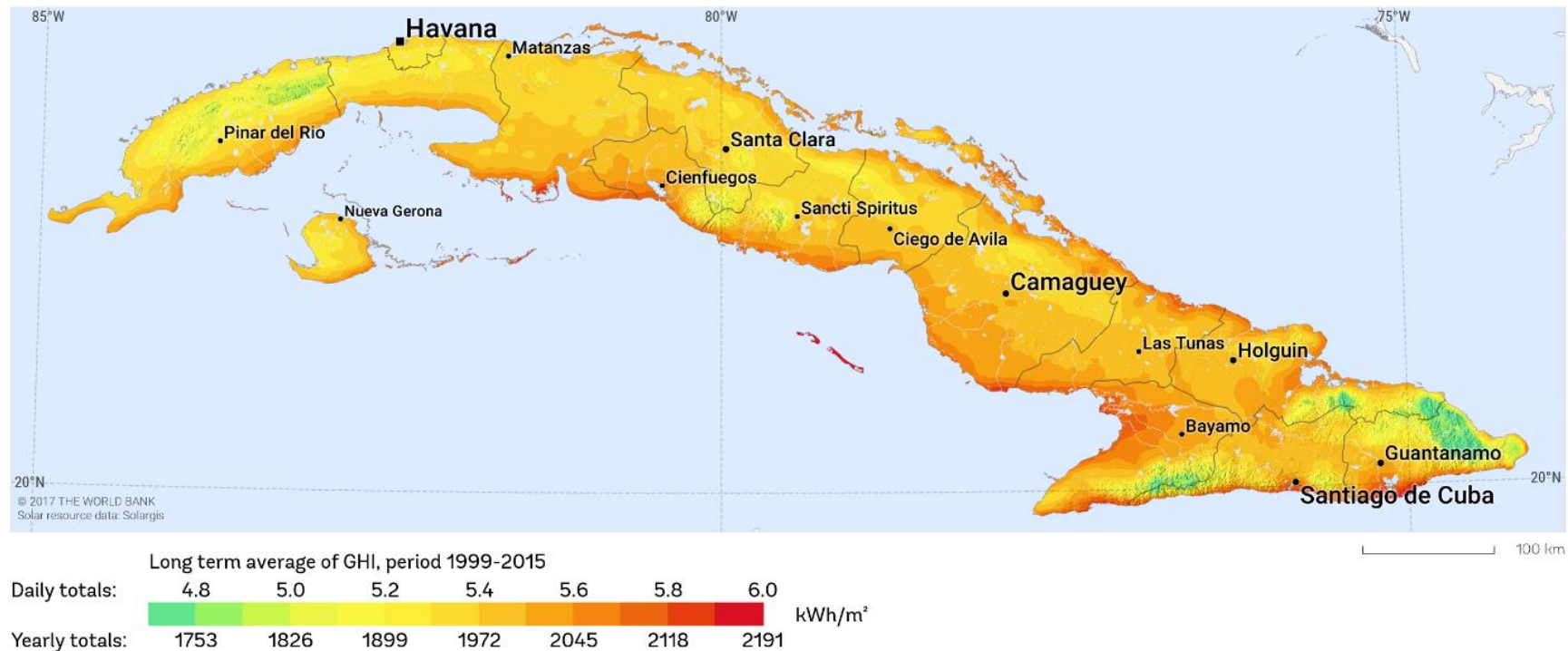
WEATHER

- ANNUAL AVERAGE TEMPERATURE OF 25°C
- ANNUAL AVERAGE OF HUMIDITY OF 80 %

PHOTOVOLTAIC POTENTIAL

- INCOMING ENERGY 5.8 kWh/m²/day
- INCOMING POWER 1.44 kW/m²

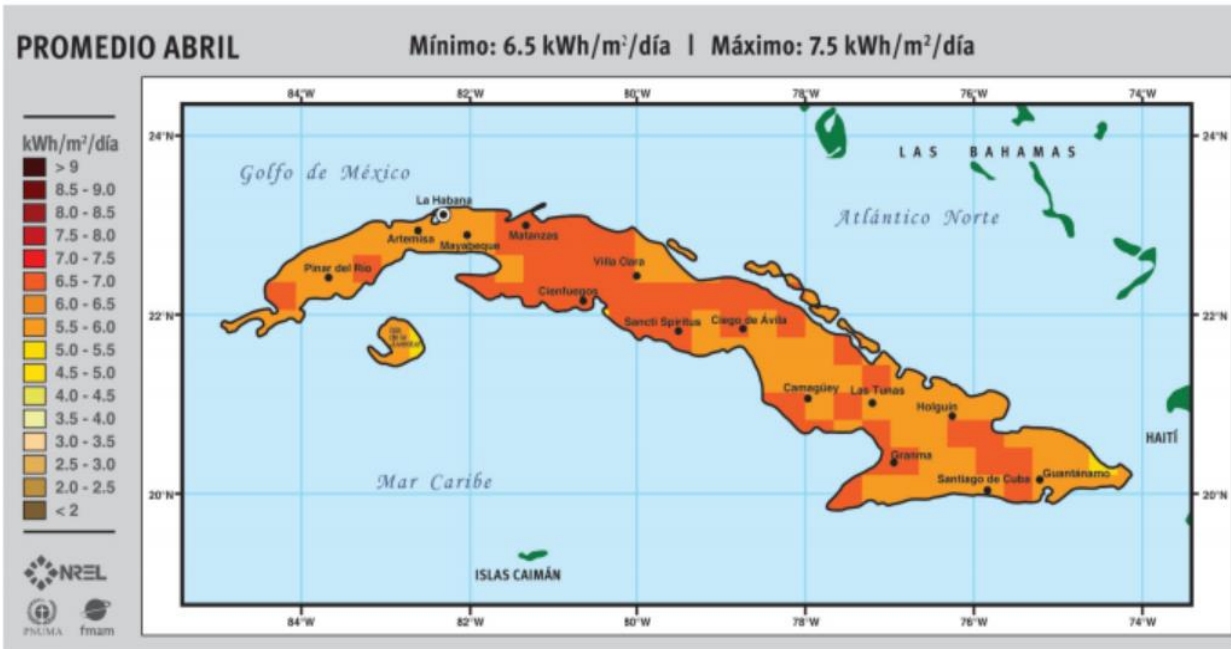
SOLAR RADIATION AT CUBA



IRRADIACIÓN GLOGAL INCIDENTE EN LA SUPERFICIE

- IRRADIATION VALUES OF 1700 a 2100 kWh/m² TROUGH YEAR.
- IRRADIATION VALUES OF 4.8 a 5.6 kWh/m² TO AVERAGE DAY

SOLAR RADIATION AT CUBA



APRIL

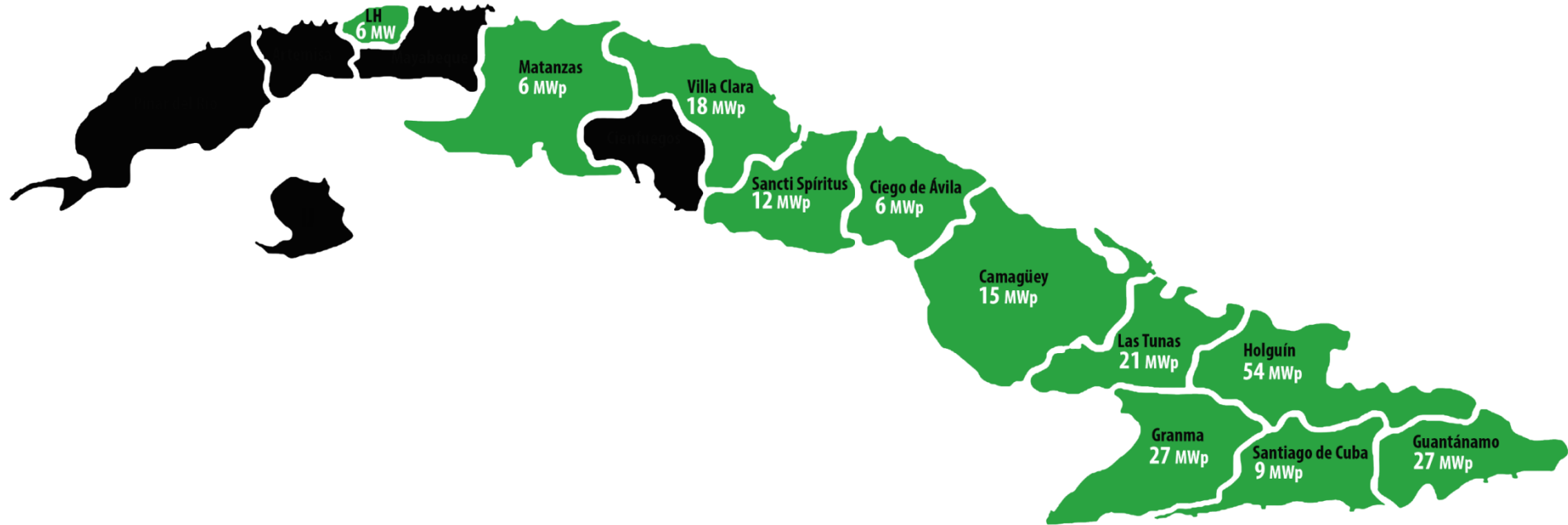
- MAXIMUM RADIATION MONTH OVER HORIZONTAL SURFACE .
- MAXIMUM 7,5 kWh/ m² /DAY
- MINIMUM 6,5 kWh/ m² /DAY



DECEMBER

- MINIMUM RADIATION MONTH OVER HORIZONTAL SURFACE .
- MAXIMUM 5,5 kWh/ m² /día
- MINIMUM 4,5 kWh/ m² /día

PROJECT DESCRIPTION



200 MWp IN PV FACILITIES

- 11 PROVINCES INVOLVED
- 28 PV FACILITIES
- 1.20 Pn RATIO
- REDUCE IMPORTATIONS OF FOSIL FUEL
- STRENGTHEN ELECTRICAL SYSTEM
- REDUCE NEGATIVE ENVIROMELTAL IMPACT
- APPROXIMATE COST OF THE PROJECT IS **190 MILLION USD** THAT WILL BE USED IN IMPORTS.

PROJECT DESCRIPTION



ENVIROMENTAL ADVANTAGES

- DO NOT PRODUCE GREEN HOUSE GASES EMISSIONS
- DO NOT PRODUCE SONOROUS POLUTION
- DO NOT PRODUCE HAZARDS SUBSTANCES
- MINIMIZE NEGATIVE ENVIROMENTAL IMPACT

SOCIAL ADVANTAGES

- JOB CREATION TO QUALIFICATED WORKFORCE
- IMPROVEMENT OF LIVING CONDITIONS AND COMUNITY DEVELOPMENT.
- INCREASE PHOTOVOLTAIC CULTURE AND COMMITENMET TO THE ENVIROMENT.
- HEALTH IMPROVEMENT DUE TO MINIMIZE GASES EMISSIONS.

PROJECT DESCRIPTION



TECHNICAL REQUIREMENTS & CONSIDERATIONS

- VOLTAGE LEVEL 34.5 OR 13.8 kV
- SELECT AREAS THAT MINIMIZE FLOOD RISKS
- OPTIMIZATION LAY OUT TO IMPROVE LAND USES.
- MINIMIZE INVESTMENT PRICES
- DO NOT INTERFER WITH OTHER USES OF THE LAND.
- APPROX STEP-OUT TRANSFORMER TO THE CONNECTION POINT.
- TAKE ADVANTAGES TO THE EXISTINGS CAPACITIES IN NATIONAL INDUSTRIES

PROJECT DESCRIPTION



GENERAL LAY OUT GUIDE LINES

- PV MODULES OF POLY CRISTALINE SILICIUM
- PV MODULES OF 320 Wp OR HIGER
- 15 DEGREES OF TILT WITH 0 DEGREES OF AZIMUTH.
- LANDSCAPE ARRANGEMENT OF PV MODULES.
- PV STRUCTURES OF GALVANIZED STEEL TO PREVENT RUST.
- FAVOR INCHIN SOLUTIONS
- PV INVERTER ON GRID TYPE
- STEP-UP TRANSFORMERS IN THE OUTPUT OF PV FACILITIES.
- CONTROL ROOM WITH SCADA SYSTEM

MAIN CONCLUSSIONS



- DIVERSIFICATION OF THE ENERGY MATRIX BY REDUCING DEPENDENCE WITH A GENERATION OF 300 000 MWh AND CONSUMPTION OF FOSSIL FUELS FOR ELECTRICITY GENERATION.
- WILL BE REPLACED ANNUALLY **78 000 TON FOSSIL FUEL**, AVOIDING THE EMISSION OF **264 840 TON OF CO2**.
- PROMOTES ENVIRONMENTAL CULTURE IN THE POPULATION.
- LOW COSTS ARE OBTAINED CONSTRUCTION AND OPERATION THAT MAKE THIS COMPETITIVE PROJECT.
- THE PROJECT GENERATES NEW JOBS AND BETTER LIVING CONDITIONS AND COMMUNITY DEVELOPMENT.