

Characterization Of The Ecosole HCPV Tracker And Single Module Inverter

Becar srl (Beghelli group)



ECOSOLE: Beghelli's High Concentration PV

- *ECOSOLE (Elevated COncentration SOLar Energy), is one of the largest European Demonstration projects in solar photovoltaic*
- *Focused on the design and realization of a new low cost **HCPV (High Concentration Photo Voltaic) generator** made of high efficiency PV modules with:*
 - *SoG (Silicone on Glass) fresnel lenses,*
 - *III-V solar cells,*
 - *low cost solar tracker with distributed inverters approach*
- *Demonstration of new high throughput methods for the industrial large scale productions, at very low manufacturing costs*
- *The project, started in August 2012 will be completed within 2015*



ENER/FP7/295985/"ECOSOLE" –
The project has received funding
from the European Union Seventh
Framework Programme



ECOSOLE: Beghelli's High Concentration PV

The project is led by the Italian company BECAR (BEGHELLI group)

The ECOSOLE project includes relevant scientific and industrial international partners:

- *ENEA (Agenzia nazionale per le nuove tecnologie, l'energia e lo sviluppo economico sostenibile, Italy),*
- *UPM (Universidad Politécnica de Madrid) (UPM),*
- *Ben-Gurion University of the Negev (Israel),*
- *TECNALIA (Spain),*
- *EVONIK Industries AG (Germany),*
- *AUREL SPA (Italy),*
- *OEC AG (Germany),*
- *PLAMTEX d.o.o. (Slovenia)*



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The ECOSOLE Generator

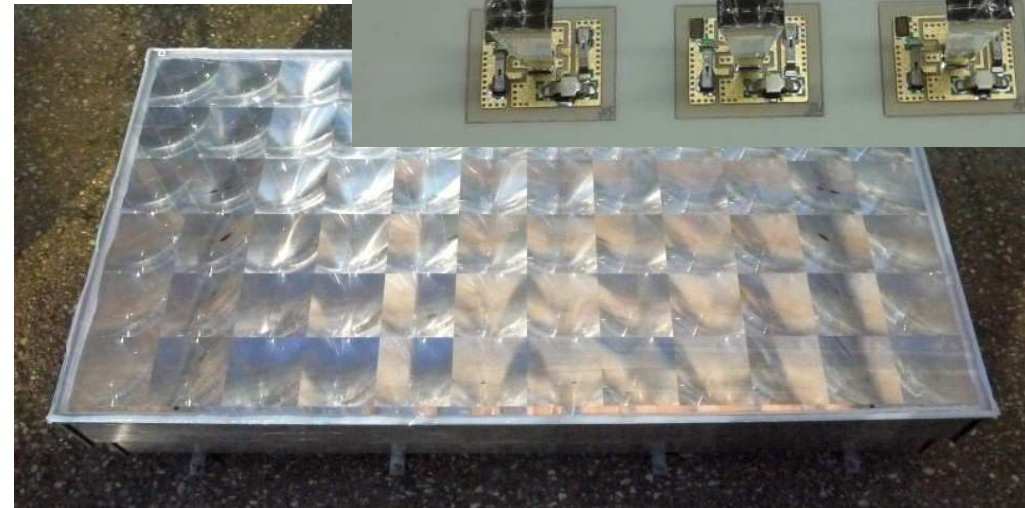
ECOSOLE is a new competitive HCPV (High Concentration Photo Voltaic) generator designed for high DNI solar regions, based on SoG (Silicon on Glass) Fresnel lenses. To achieve high efficiency levels and low costs, the design has exploited:

- *high concentration optical setup (>1100 X),*
- *simple low cost novel cell assembly technology,*
- *lightweight efficient heat management,*
- *efficient module's assembly machineries, testing equipments and binning for reduced mismatch,*
- *novel module and array materials and assembly techniques,*
- *single module inverter,*
- *optimized precision tracker*



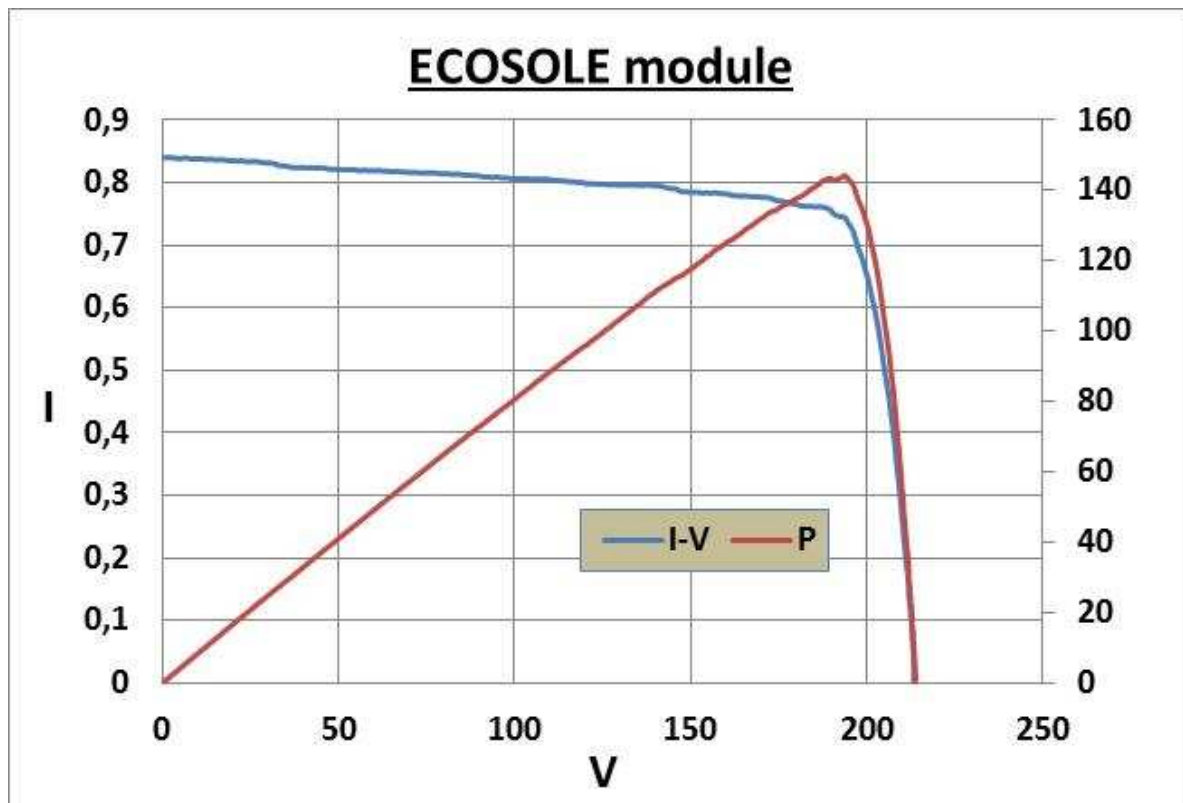
ECOSOLE HCPV module

- Silicon on glass lenses, 92x92mm
- High optical efficiency (> 85%)
- Geometric concentration >1100 X
- Dielectric SOE
- Acceptance angle $\pm 0.5^\circ$
- III-V triple junction cells, with 42% efficiency @ 1000 suns
- Peak power:
200W @ 1000W/mq DNI AM1.5
- MPP Voltage: 200V
- MPP Current: 1.00A
- Size: 1142 x 590 x 200 mm
- Operating temperature:
-40°C to +85°C
- Net Conversion efficiency: 32%
- Weight: 10kg



ECOSOLE HCPV module

First test at Enea

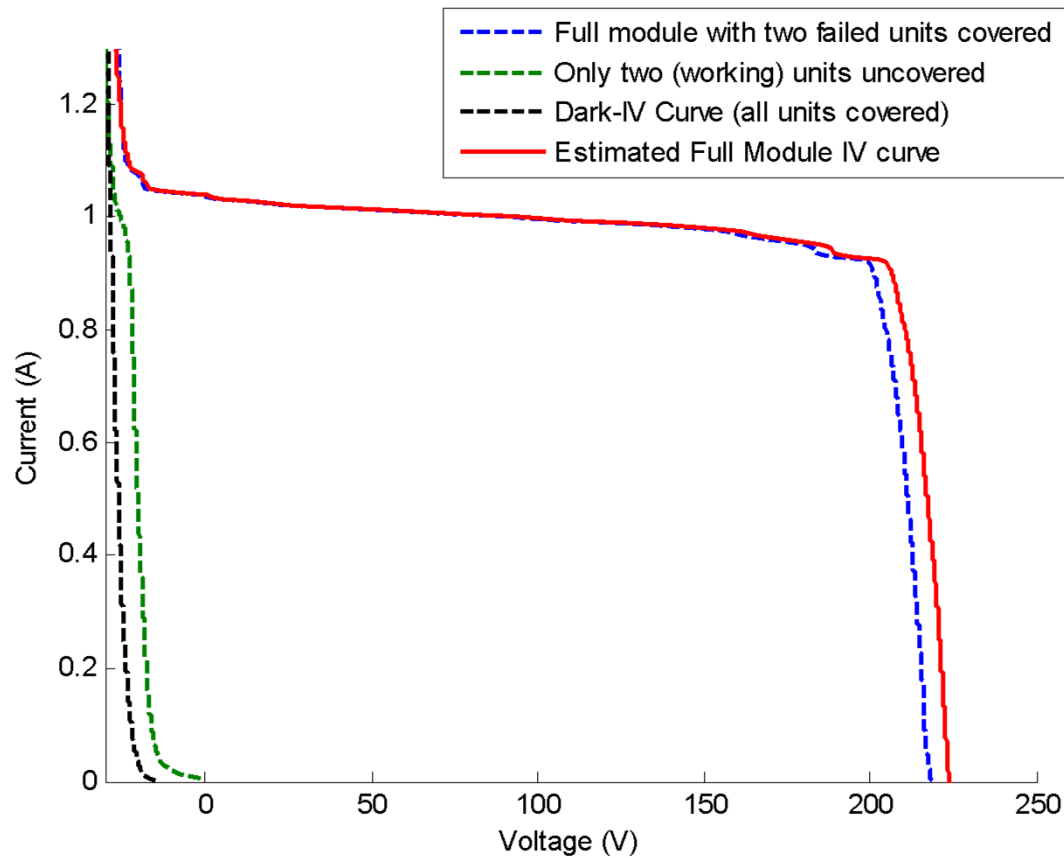


$P = 194W @ STC$, conv eff = 31.8%



ECOSOLE HCPV module

First test at UPM



V_{OC} :	224 V
I_{SC} :	1.04 A
P_{MP} :	188 W
V_{MP} :	205 V
I_{MP} :	0.92 A
FF:	81.0 %
Eff:	32.3 %*



ECOSOLE Module Inverter

- *Each HCPV module has its own DC/AC inverter with 230V AC output*
- *94% efficiency*
- *The maximum available power is always extracted from each module*
- *High reduction of mismatching effect*
- *No system's partial shadowing problems*
- *The inverter outputs are connected in parallel and routed to the three phase 400VAC grid*



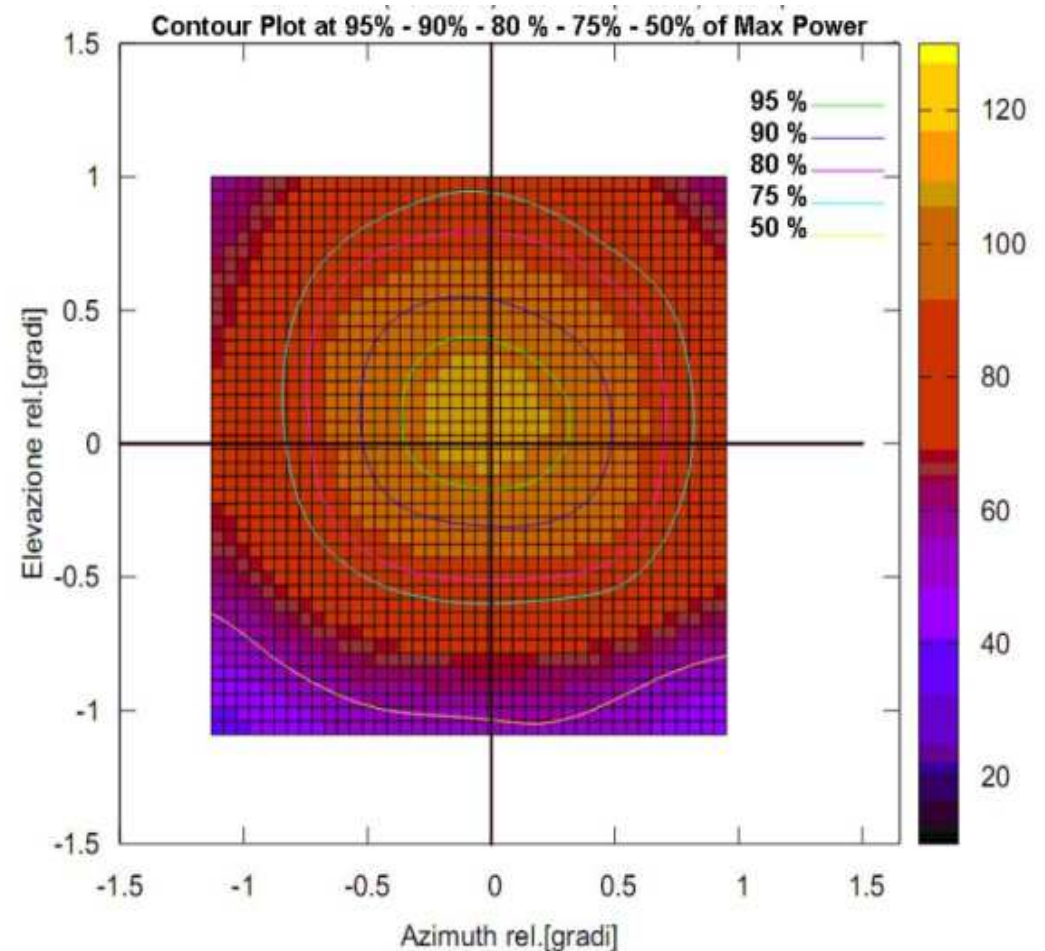
ECOSOLE Hybrid solar tracker

- *Specifically designed for this HCPV application*
- *High accuracy bi-axial solar tracker (tracking error $<0.1^\circ$)*
- *Galvanized steel*
- *Electric brushless motors driven by integrated electronic control*
- *Hybrid tracking algorithms: sun_camera+ephemeris*



ECOSOLE solar tracker characterization

- *Tracker scan*
- *“Automatically analyze the angular performance of the whole tracker”*
- *For each offset angle the maximum power output of each module is calculated and the maximum power output of the whole generator is then calculated*
- *Angular accuracy checked within 0.1°*



ECOSOLE HCPV generator

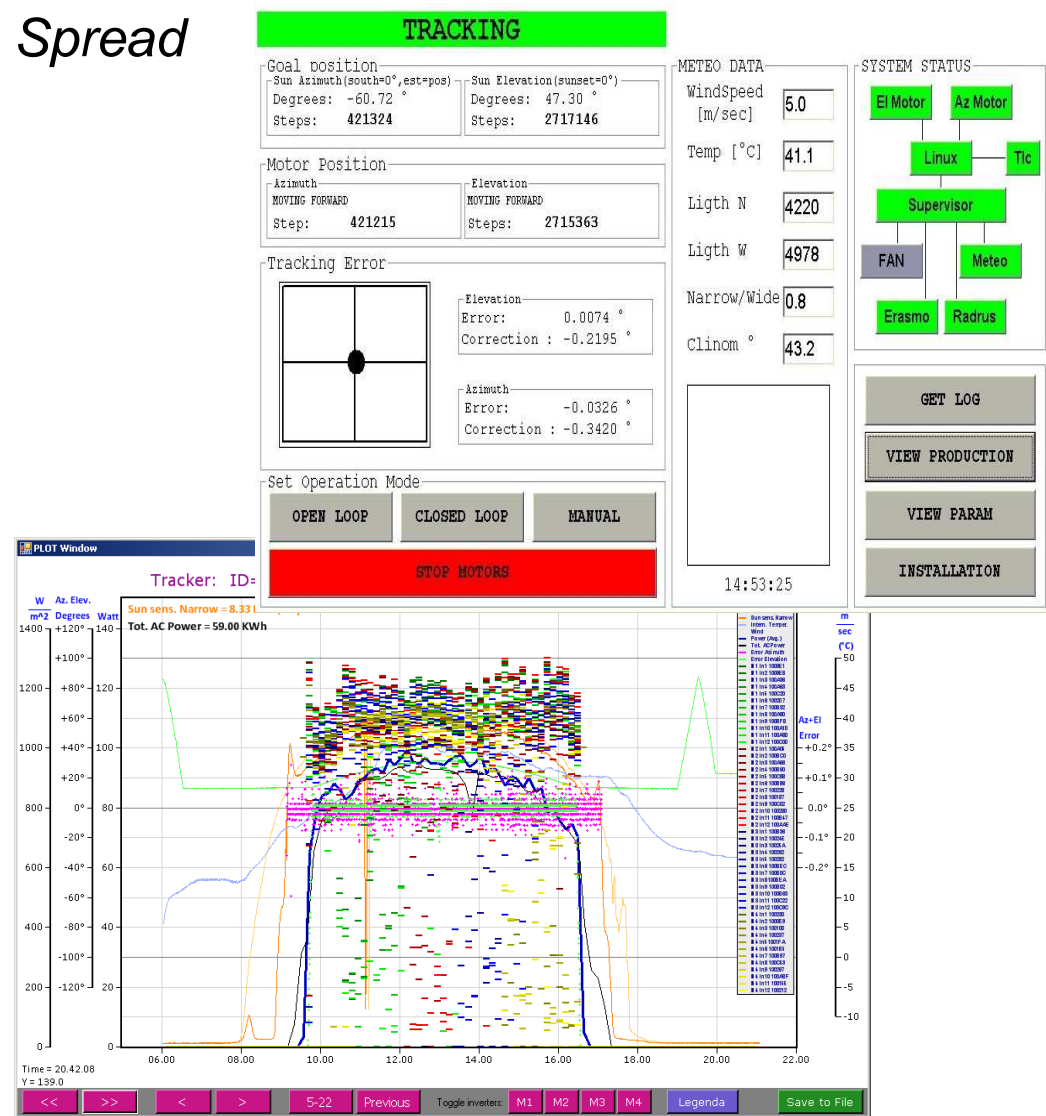
- *Generator's nominal peak power $\approx 28000\text{w}$ @ $1000\text{ W/mq DNI, AM1.5}$*
- *144 HCPV modules with single module converters*
- *Total weight 5400kg*
- *Size $\approx 15 \times 7.5\text{ m}$ (104 sqm)*
- *Integrated tracker control system*
- *Can turn upside down for easy maintenance*
- *Expected AC efficiency 30%*



ECOSOLE HCPV System control

Precise remote monitor and control, via Spread Spectrum Radio and Ethernet, of:

- *Tracker angular position*
- *Each single module DC output, graphic*
- *Each single module I-V curve (as snapshots)*
- *Tracker's operating modes*
- *Plant's DNI*
- *Plant's wind speed*
- *Temperature*



References

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