GOPV project

A global approach to lower the cost of PV electricity via bifacial tracked modules.

GOPV: Global Optimization of integrated PhotoVoltaics system for low electricity cost

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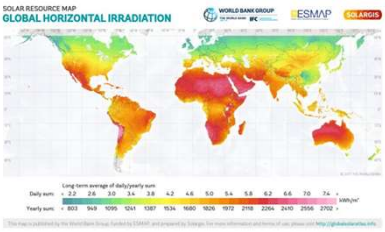
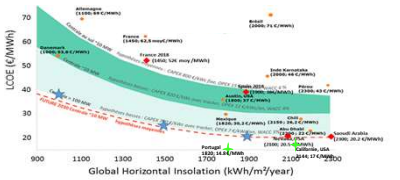
Global Objective GOPV aims to **demonstrate an integrated 500 kW PV system** reaching a competitive **electricity cost of 0.02 €/kWh** for irradiation levels of 1900 kWh/m²/year GHI in Southern Europe.

The proposed system will consist of **three single components - module, tracker and inverter** - whose combined advanced features will enable substantial enhancement of performance and reduction of cost, necessary to accelerate the large-scale deployment of PV installations in subsidy-free scenarios.

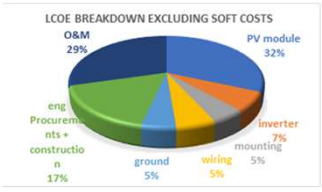
SOLAR ELECTRICITY : SOA & FORECAST





LCOE as function of Global Horizontal Insolation (GHI) for reference scenarios* and the position of some power purchase agreements concluded in 2016 [●], 2017-2018 [◆], 2019 [+]
★= LCOE values calculated for GOPV technology.

CVT ANCRE, Etude GP4, 2017



Estimated Breakdown of LCOE for PV plants > 100 kW in EU and US

DETAILED TECHNICAL OBJECTIVES

GOPV quantified objectives at system level (for GHI= 1900 kWh/m²/year).

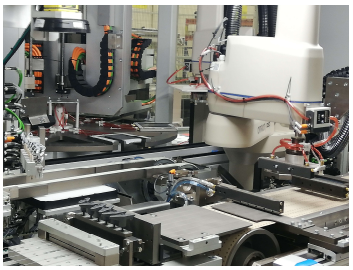
Underlying objectives	Target	Baseline (§2.1.1)	GOPV Gain
Annual energy production rate	2360 kWh (AC)/KW	1700 kWh(AC)/kWp	+39 %
Service lifetime	35 years (1 inverter change)	25 years (2 inverter changes)	+10 years
CAPEX (excl. EPC)	0.38 €/W	0.47 €/W [9]	- 0.09 €/W
OPEX	10 c€/W/year	12 c€/W/year	- 2 c€/ kWp/year
Overall objectives	Target	Baseline	GOPV Gain
LCOE	0.02 €/kWh	0.04 €/kWh	- 0,02 €/kWh
EPBT (module)	1 year	1.4 years	-40 %

Development of advanced components

PV plant cost element	GOPV developed component	Main characteristics	Targeted cost	Targeted lifetime
Module	Bifacial HJT modules	400W + bifaciality ≥ 90%	0,22€/W	35 years
Tracker	1 axis tracker	Built with alternative materials to hot dip galvanized Steel	0,11€/W	35 years
Inverter	SiC based string inverter	166 kVA + Energy efficiency ≥ 99%	0,04€/W	17.5 years
O&M	Advanced fault detection & diagnostics tool	Energy availability ≥ 99.5%	10k€/MW/Year	-

Module developments

To reduce material use (silver, copper, silicon, encapsulant) and mechanical stress
A soft interconnection process and automated equipment is being developed

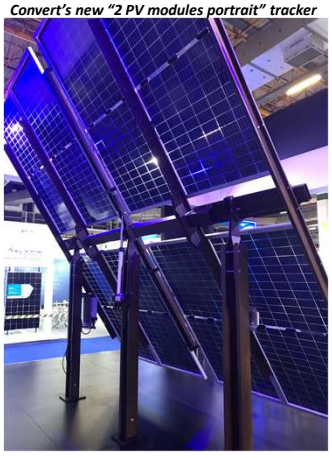


- Multi-technology interconnection :
  - epoxy and acrylic ECA (up to 1800 cells/h)
  - IR welding at 2500 cells/h
- Multi-ribbon technology
  - Ribbon width down to 0,6mm
  - Up to 8 ribbons
- Thin cells compatible
  - Down to 120µm thickness
- Half-cells compatible

Tracker developments

To improve light harvesting of bifacial modules and decrease cost of ownership
A new tracker design and use of low cost structure materials is being developed

Convert's new "2 PV modules portrait" tracker

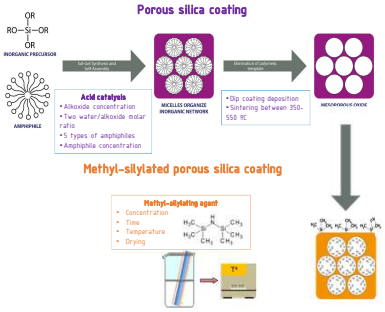


- Extensive use of weathering steel for tracker structural elements
- Design and tracking strategy adapted to bifacial modules
- Sizing of weathering steel elements adapted to environment aggressiveness to guarantee 35 years service lifetime

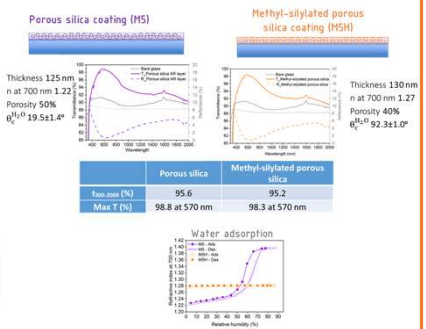
Module developments

To improve light harvesting and reduce cleaning operation frequency
A long-lasting dual anti-reflective/anti-soiling coating is being developed

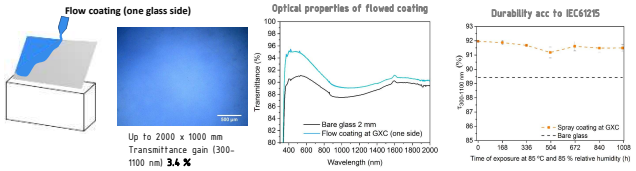
Acid-catalyzed sol-gel approach combined with evaporation induced self-assembly (EISA)



Properties of AR coated glass



Industrialization at GXC Coatings: MS coating



Up to 2000 x 1000 mm
Transmittance gain (300-1100 nm) **3.4 %**

Economic impact of GOPV developments

Continuous assessment of LCOE to validate GOPV developments

	Today	GOPV scenario at M15	
Performance Ratio (PR)	82,59%	86,24%	+4,4%
CAPEX	0,73 €/Wp	0,56 €/Wp	-23,8%
OPEX	10,4 k€/MWp	8,76 k€/Mp	-15,7%
Production (0)	2047 MWh/MWp	2326 MWh/MWp	+13,6%
LCOE	3,78 c€/kWh	2,44 c€/kWh	-35,5%

Today Scenario
- Totana (Murcia)
- PV system lifetime, 30 years
- Discount rate: 6,5%, with no inflation, simplified model
- For the OPEX costs, real money without inflation
- DEGRADATION: Y1= 2,5%, Y2-Y5: 0,625%, Y6-Y30: 0,715%
- No bifaciality

GOPV Scenario
- Totana (Murcia)
- PV system lifetime, 35 years
- Discount rate: 6,5%, with no inflation. Simplified model
- For the OPEX costs, real money without inflation
- DEGRADATION: Y1-Y35: 0,4% annual linear degradation.
- 90,1% bifaciality and 30% albedo

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