



# GOPV project

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



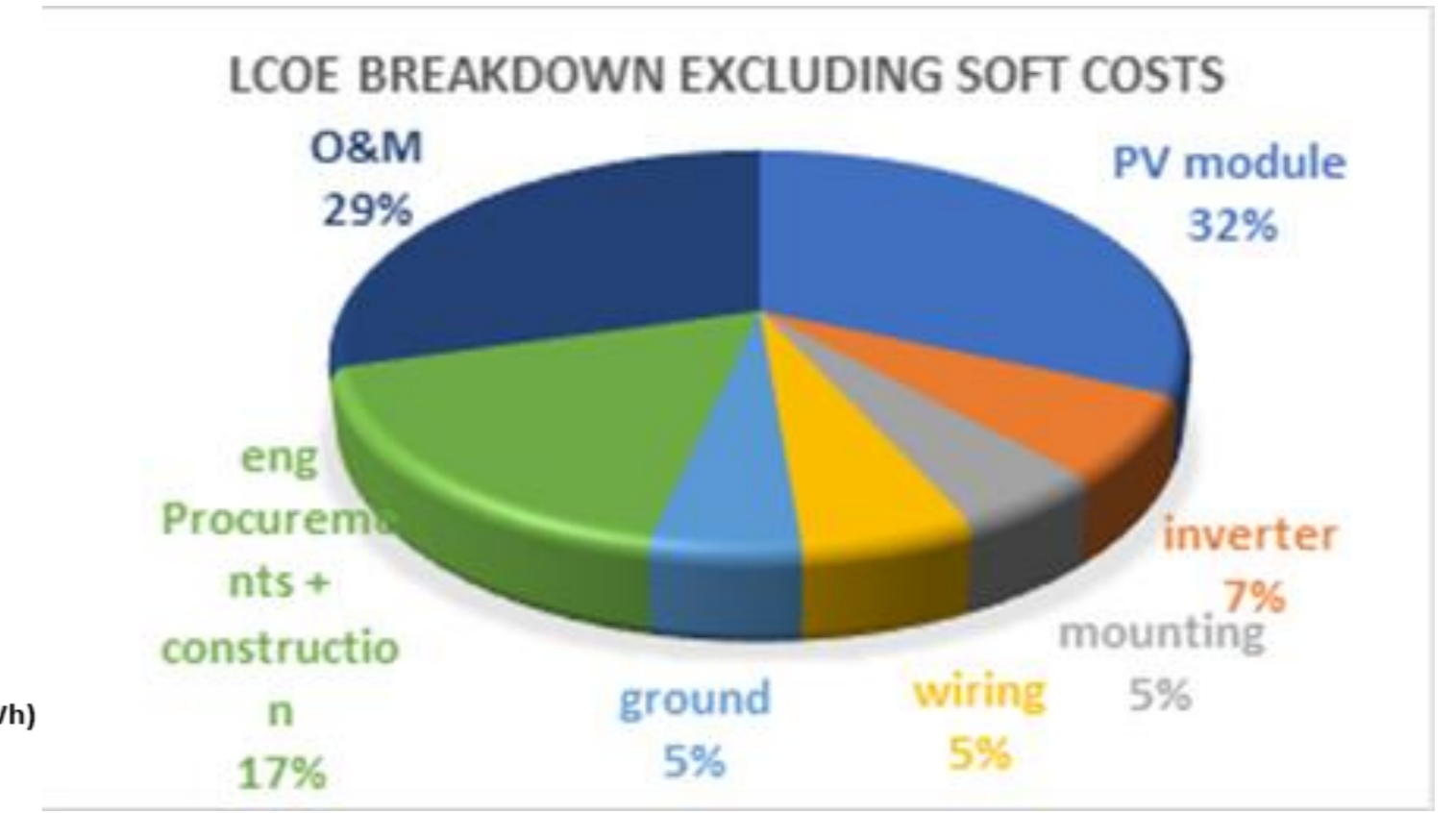
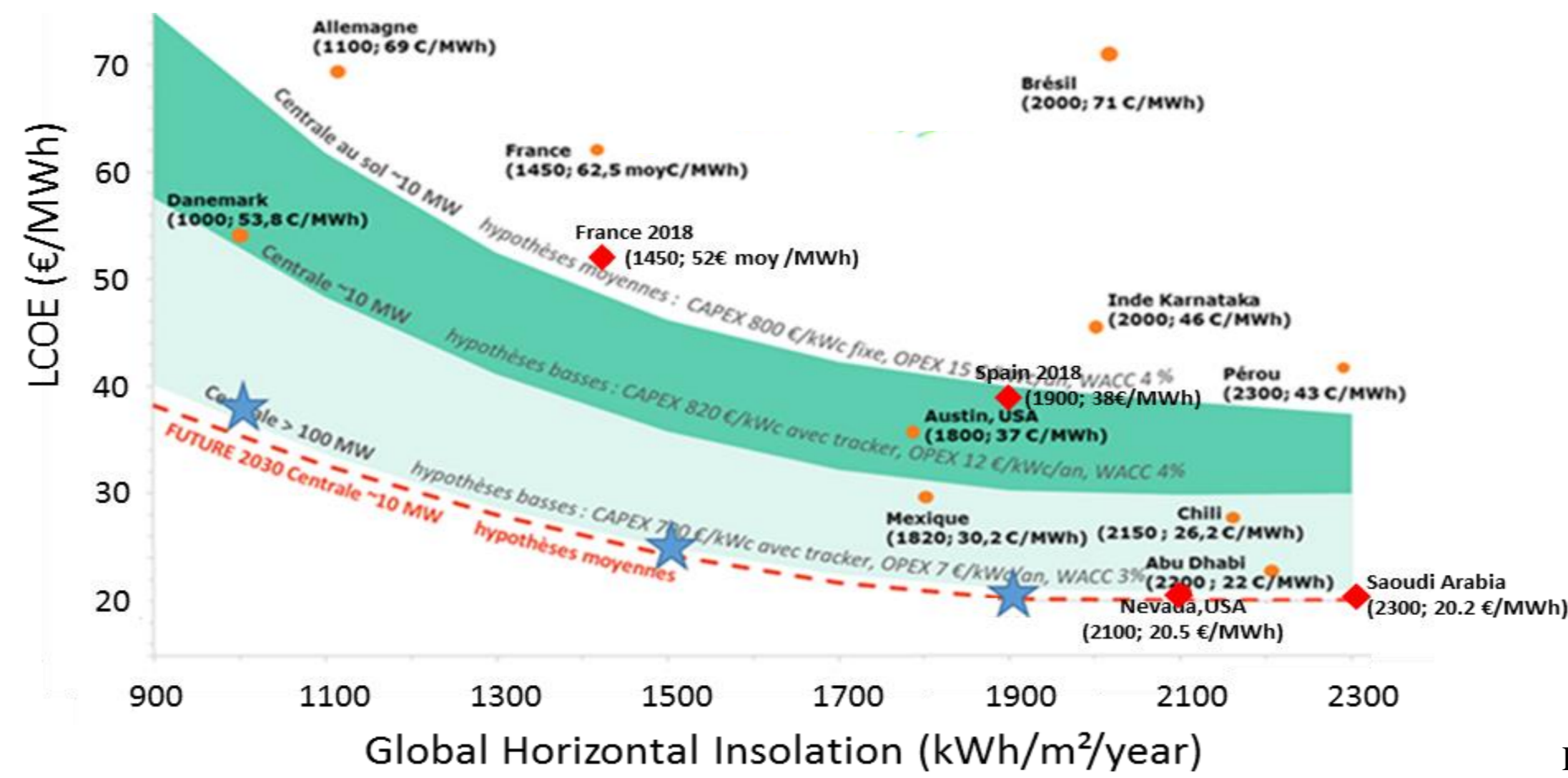
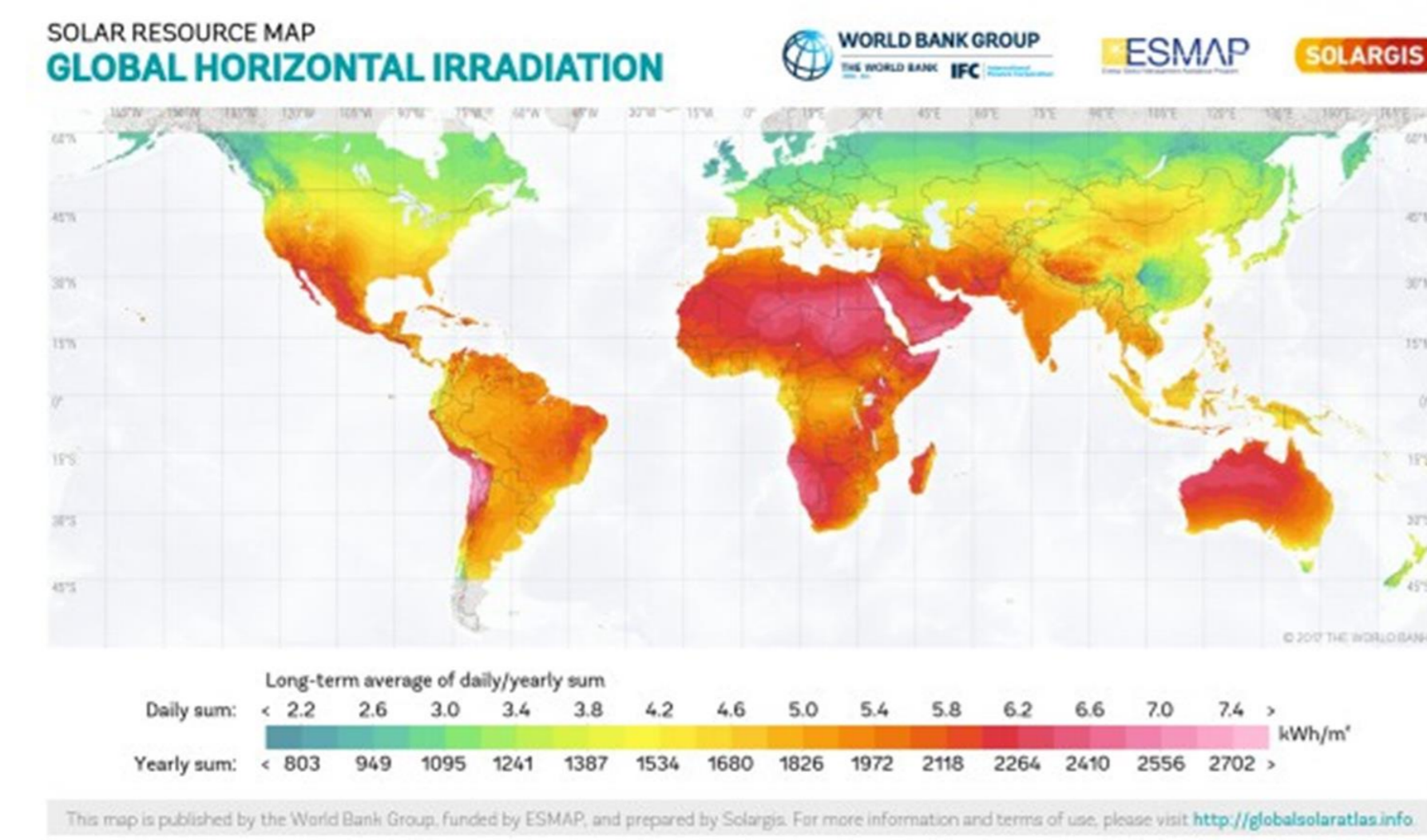
1- CEA-Liten, Grenoble, France (RTO) 2- Enel Green Power, Roma, ITALY (IND) 3- REFU Elektronik, Pfullingen, GERMANY (IND) 4- EPFL, Lausanne, SWITZERLAND (RTO) 5- LEITAT, Terassa, SPAIN (RTO) 6- Mondragon Assembly, Aretzabaleta, SPAIN (IND) 7- Convert Italia, Roma, ITALY (IND) 8- TECNALIA, San Sebastian, SPAIN (RTO) 9- RSE SPA, Milano, ITALY (RTO) 10- GXC Coatings GMBH, Goslar, GERMANY (IND) 11- INES-PFE, Le Bourget du Lac, France (ASS)

**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/m<sup>2</sup>/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



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

LCOE as function of Global Horizontal Insolation (GHI) for reference scenarios\* and the position of some power purchase agreements concluded in 2016 (●), 2017-2018 (◐).  
★ = LCOE values calculated for GOPV technology.  
\*CVT ANCRE, Etude GP4, 2017

## DETAILED TECHNICAL OBJECTIVES

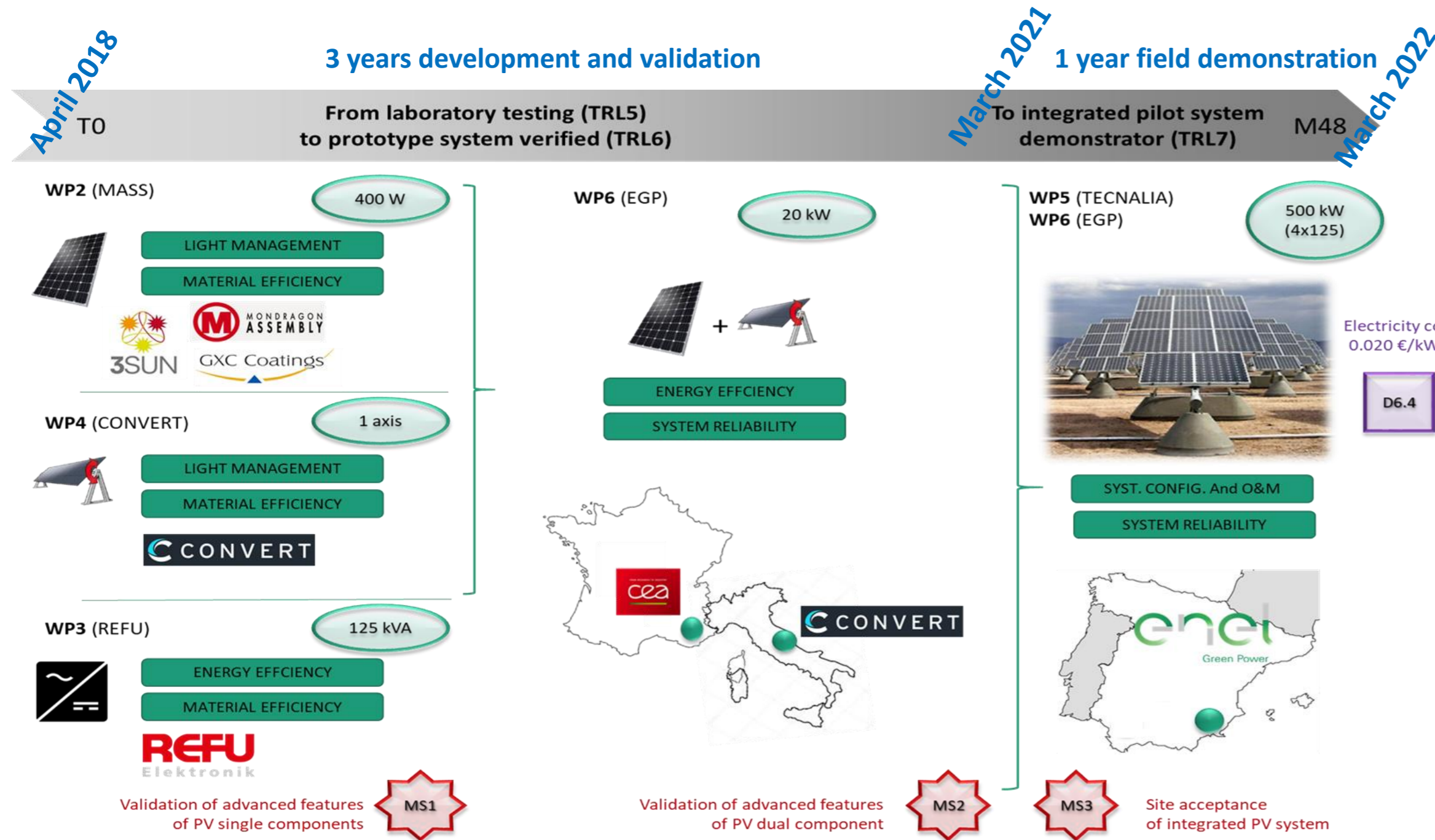
GOPV quantified objectives at system level (for GHI= 1900 kWh/m<sup>2</sup>/year).

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	Current source string inverter	125 kVA + Energy efficiency ≥ 99%	0,05€/W	20 years
O&M	Advanced fault detection & diagnostics tool	Energy availability ≥ 99.5%	10k€/MW/Year	-

## STEPWISE DEVELOPMENT PLAN UP TO LARGE SCALE DEMONSTRATOR



## BIFACIAL HJT MODULES DEVELOPMENTS

Overall objective: 72 cells module, ≥ 400 W @ STC, bifaciality ratio ≥ 90%, cost ≤ 0.22 €/W, lifetime ≥ 35 years



SOA HIT bifacial module developed in AMPERE

### Power up to 400W:

- Multi-ribbon approach: up to 10 ribbons, targeted width < 0.3 mm (development of stringer) fingers (cell) width down to 0.04mm

- Low optical losses: reduction of thickness of encapsulation materials  
Implementation of highly transparent encapsulation materials  
Dual anti-reflective-soiling coating

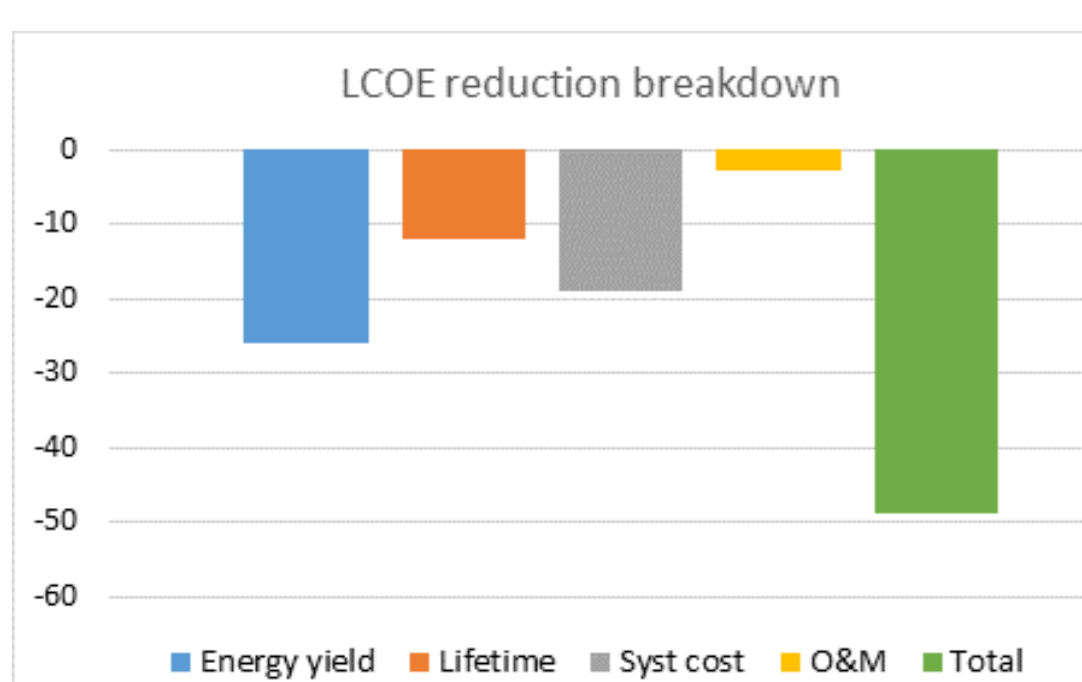
### Cost down to 0.22€/W (projected for GW factory)

- Reduction of materials consumption: thin silicon cells (100-110 μm)  
silver for cell metallization / 2  
reduced thickness for encapsulation materials

### Lifetime extended to 35 years

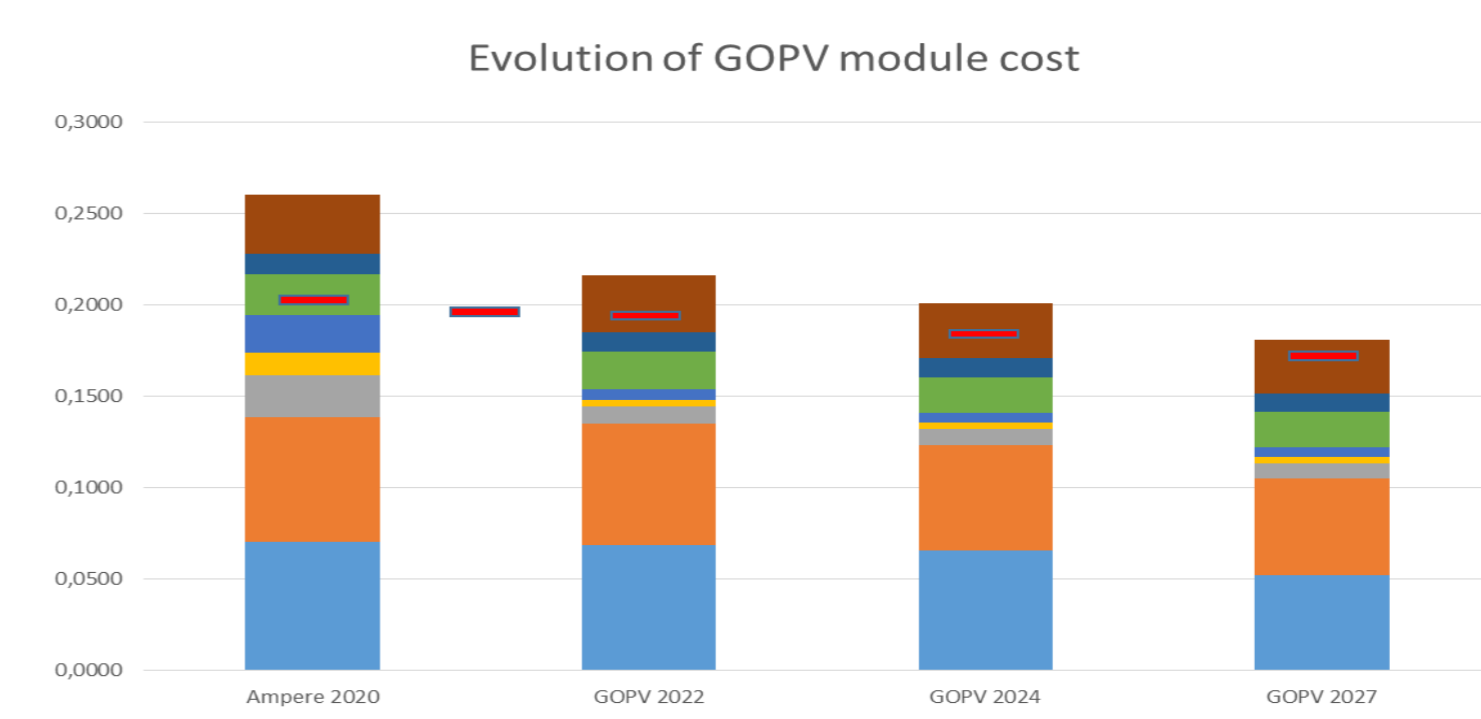
- Low-stress interconnection pattern and process
- Glass-glass architecture
- Highly durable AR-AS coating

## CONTRIBUTIONS TO LCOE REDUCTION



**Main assumptions used for LCOE calculations:**  
PV plant: 10 MW, insolation= 1900kWh/m<sup>2</sup>/year (southern Europe)  
Financial conditions: WACC=7%, Equity ratio 20 %, Debt interest rate 5% on 15 years duration.  
**Reference scenario for 2017:** PERC+ monofacial module (60 cells,300Wp) at 0,33€/W, Fix mounting at 0.08 €/W, inverter at 0.06€/W + replacement cost, O&M at 0.012€/W/year.  
**GOPV scenario for 2022:** 'GOPV' module (72 cells, 400Wp) at 0.22€/W, GOPV 1 axis tracker at 0.11€/W, inverter at 0.05 €/W + replacement cost, O&M at 0.010€/W/year.

## CONTRIBUTIONS TO LCOE REDUCTION



Evolution of GOPV module cost from 2022 to 2027 (€/W) and comparison to AMPERE 2020 project. Red bars correspond to ITRPV LCOE projections