




GRID PARITY



Utility Scale  Solar
greenpowerconferences

Milan, 23-24 February 2010

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www.kenergia.com





Kenergia

Kenergia Srl is an Italian leading group active as “PV Investor Assistant” along all the PV development phases

Kenergia
<ul style="list-style-type: none">• Technical Advisor• Owner Engineer

Kenergia Sviluppo
<ul style="list-style-type: none">• Plant Designer• Plant Developer

Wise Energy
<ul style="list-style-type: none">• Asset management



Grid Parity Project Association

An “independent” non profit organization established in Rome in march 2008.

A dedicated group of representatives of important companies members of the Executive Committee.

The only interdisciplinary group of experts working together to improve the knowledge of the conditions for PV competitiveness.



Grid Parity Project Association



BNP PARIBAS
FORTIS



SUNPOWER

www.kenergia.com



The medium term PV scenario

- Rapidly decreasing Feed in Tariff (2011-2013)
- Continuous decreasing of module costs
- Increasing PV interest by large Utilities
- Long term uncertainties without a level of Grid Parity
- Increasing interest in the level of competitiveness of large PV plant



The medium term PV scenario

Grid Parity could be calculated from two different extreme conditions:

a) Small PV plants on domestic roofs

b) Large PV plants Ground Mounted



Kenergia Sviluppo

Has developed an innovative project that meets the market, financial and political requirements, thanks to its size and RTN connection point:





Pluritechnology 40MW PV Power Plant
in the southern Italy: one of the best local
condition to evaluate the real cost of PV kWh.



GRID PARITY **1**

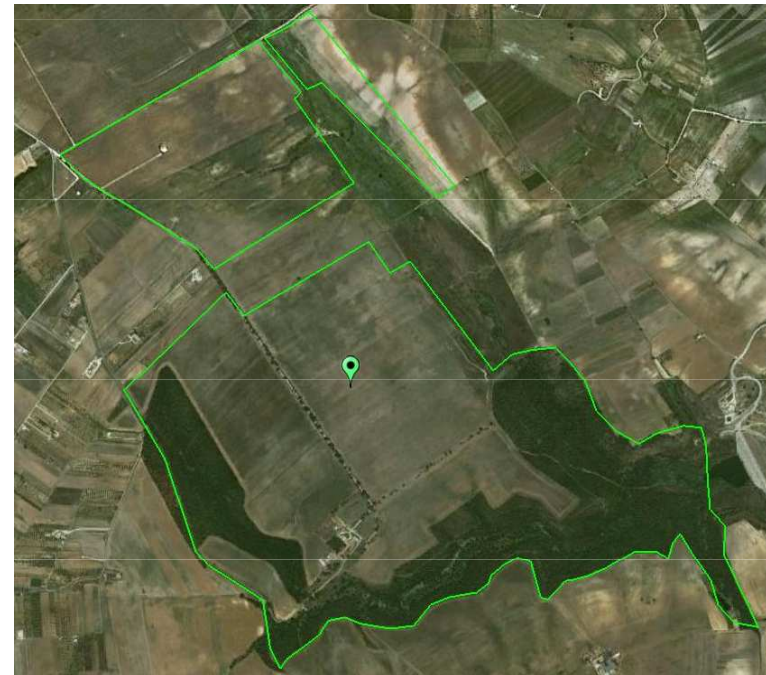
- *Location:* Gravina in Puglia (Bari), Puglia
- *Proprietary Area:* 200 hectares of level land at 400 mt altitude available





- *Following the Environmental restrictions analisis:*

- hydrogeological
- territorial extended use
- gas pipeline
- wooded areas
- architectural old building
- reservoir





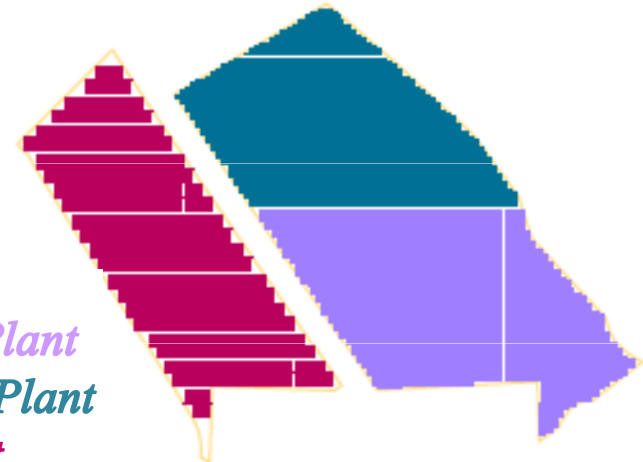
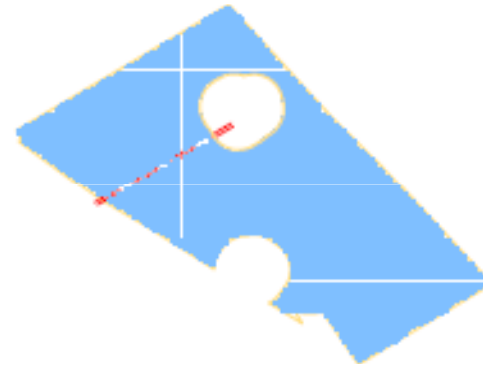
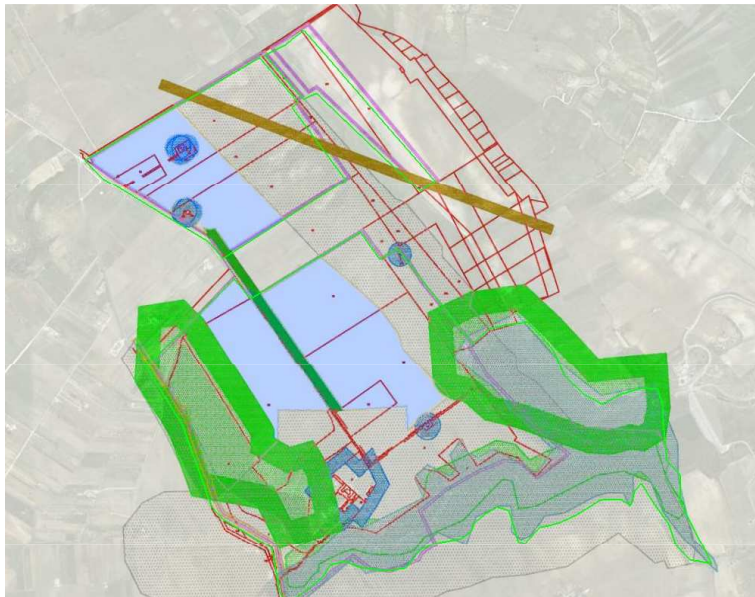
The PV plant has been divided into **four 10 MWp sub-sections** and designed using **four different technologies and plant desing:**

- 1. Base Case HQ PV Plant*
- 2. High Efficiency PV Plant*
- 3. Monoaxial PV Plant*
- 4. Thin Film PV Plant*



GRID PARITY

1



- 1. Base Case HQ PV Plant*
- 2. High Efficiency PV Plant*
- 3. Monoaxial PV Plant*
- 4. Thin Film PV Plant*



Connection to the RTN

- Currently Kenergia Sviluppo has obtained and accepted the Terna STMG
- GP1 will be connected to the grid at a new station (150kV/380kV) in construction at few km of distance



Design Criteria for GP1

- Maximization of Plant lifetime
- Maximization of the Performance Ratio
- Minimization of yearly maintenance
- Utility scale
- Most accurate site selection
- “Zero stop” of plant production



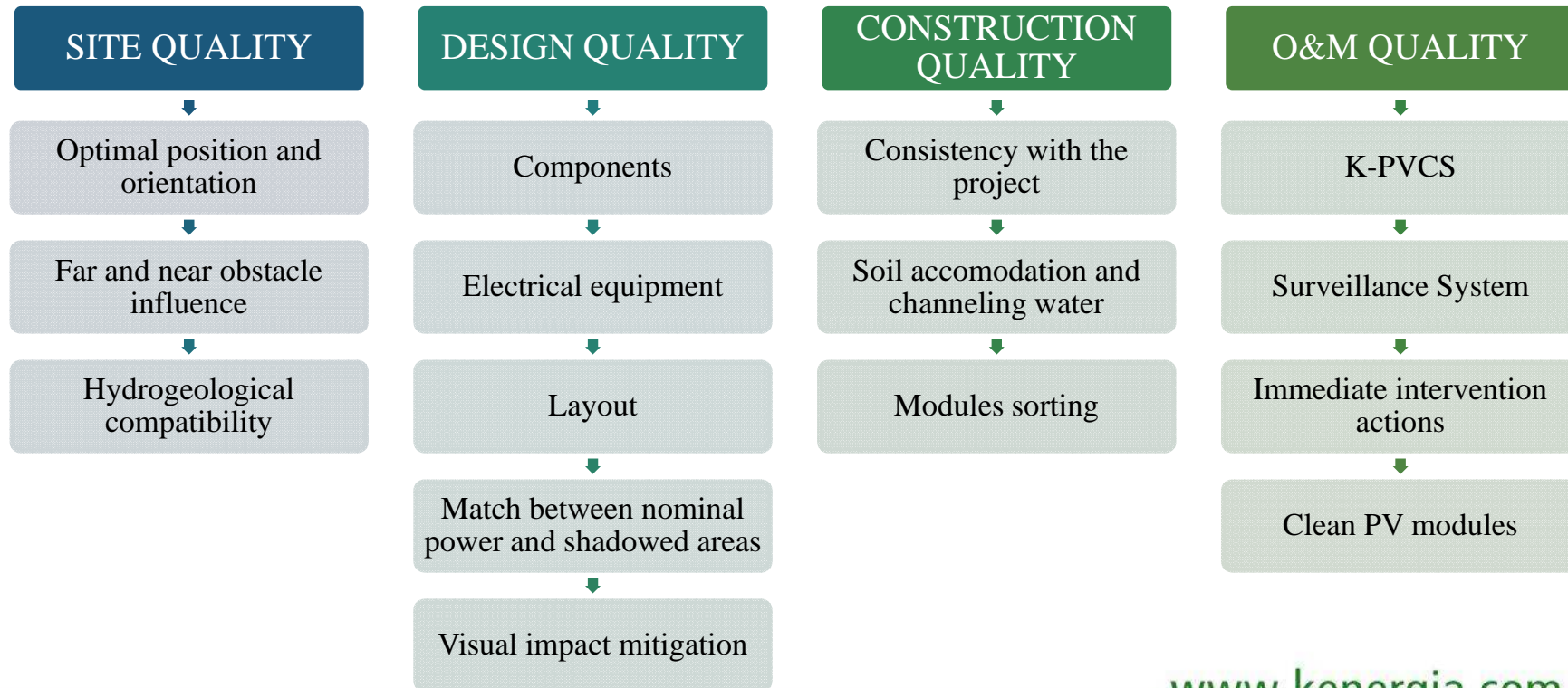
Support to the design criteria

- High Quality Kenergia Protocol applied to all components and layouts
- Fine “tuning” of the remote control system (K-PVCS)
- Immediate response to any small failure



High Quality Kenergia Protocol

Designed following the concept of **quality research** through all **development stages**, to which it applies





Each sub-section will be equipped with:

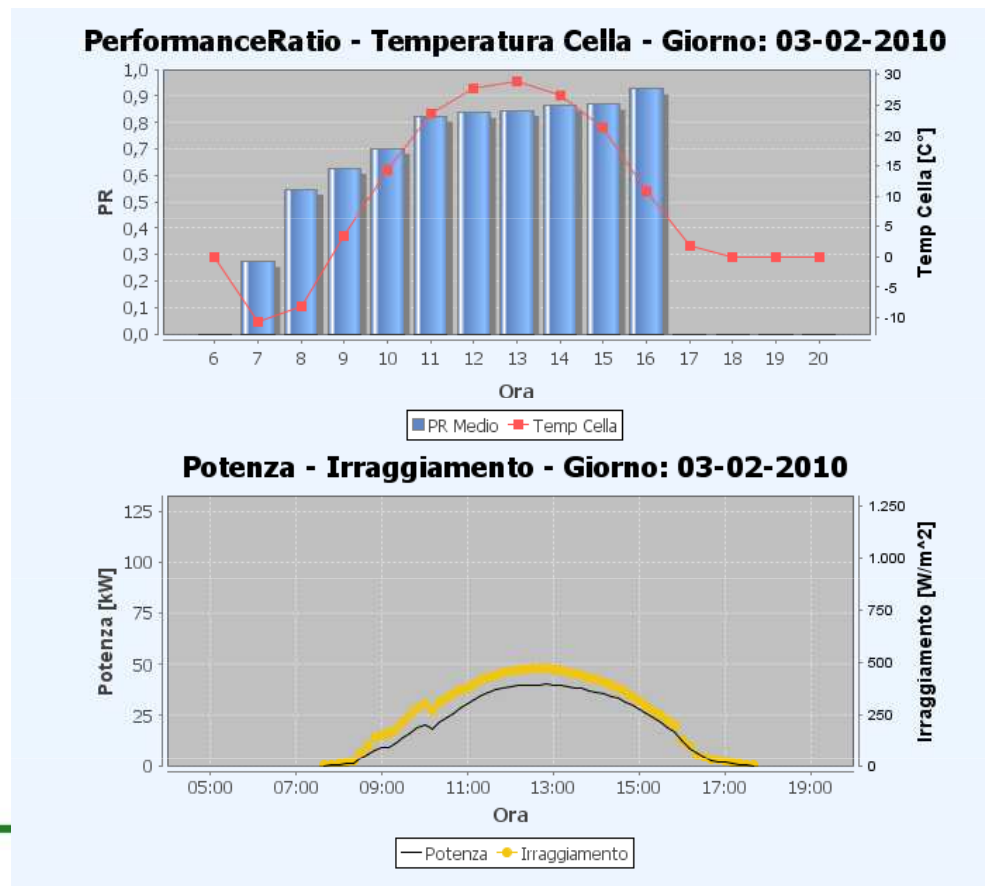
- The advanced PV Control System (**K-PVCS**)
- The new PV Prediction System (**K-PVPS**)
- The kWh cost evaluation system (**K-PV CES**)

in order to allow the timing analysis of the plant performances, to allow the best grid interaction and to evaluate the real kWh costs



The advanced PV Control System (K-PVCS)

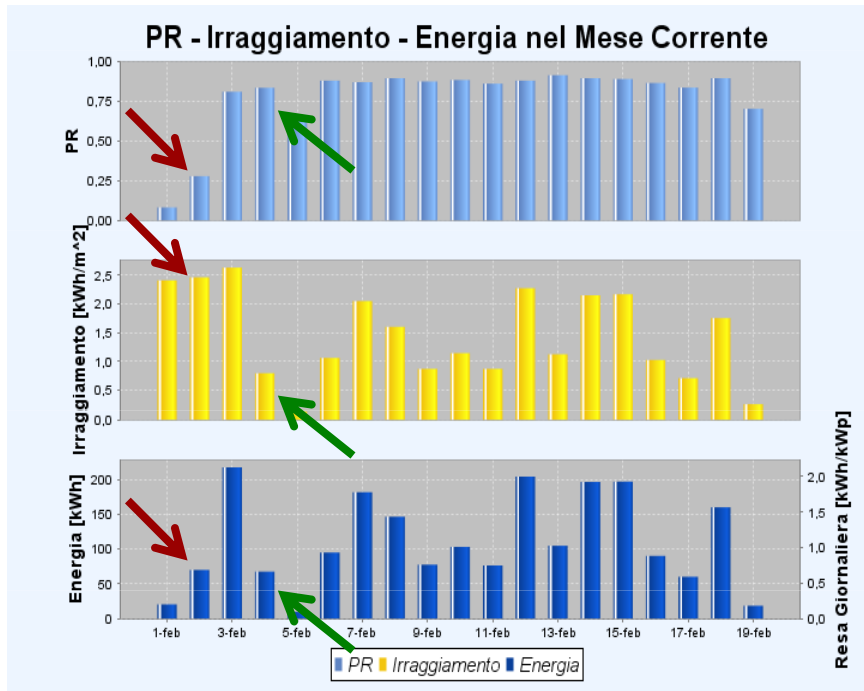
Monitoring and control of photovoltaic systems is essential for reliable functioning and maximum yield of any solar electric system.



- Environmental parameters:
 - Ambient temperature
 - Module temperature
 - Solar radiation
- Energy production
- Performance Ratio
- Analysis and Report
- Alert



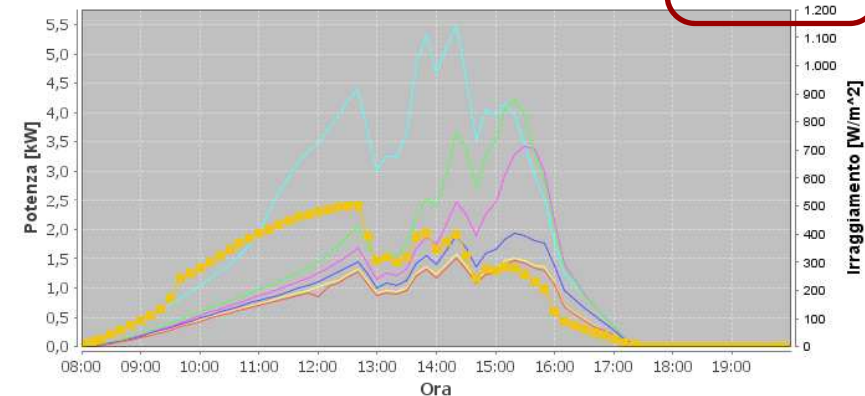
K-PVCS



A low PR on 2/2/2010 depends on inverters underperformance

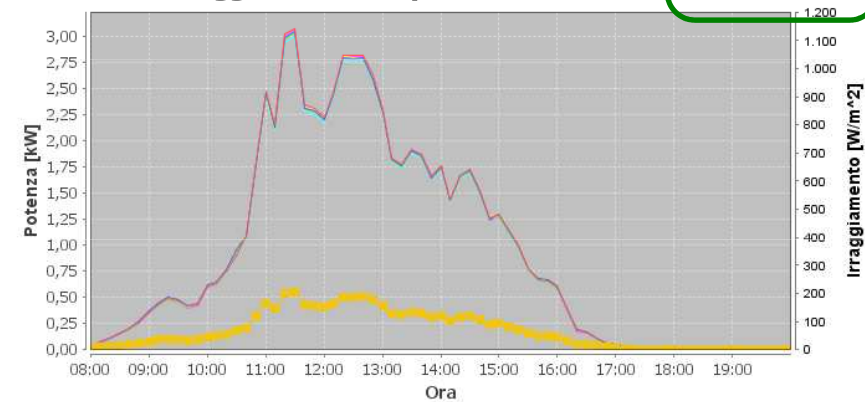
Inverters trend alignment is present in standard condition

Potenza - Irraggiamento - Impianto: Flero - Giorno: 02-02-2010



■ Irraggiamento ■ 295000P2109 ■ 295100P2109 ■ 298100P2109 ■ 298300P2109 ■ 298400P2109
■ 298800P2109

Potenza - Irraggiamento - Impianto: Flero - Giorno: 04-02-2010



■ Irraggiamento ■ 295000P2109 ■ 295100P2109 ■ 298100P2109 ■ 298300P2109 ■ 298400P2109
■ 298800P2109



K-PVPS

PV energy is unpredictable and discontinuous

No easy match between PV production and electricity demand

Difficulties in Day-Ahead Market

Grid overloaded problems



**K-PVCS allows the day-ahead energy rating production
makes pv energy predictable and competitive**



The new PV Prediction System (K-PVPS)

**to predict the electrical productivity for
“the day before” Electric Market (Mgp)**

Our one month test with the K-PVPS on a 1 MW PV plant has predicted the energy production of the day ahead with an “error” well below the GSE requirements.

In the next Italian Feed in Tariff (2011-2013) there will be a 20% premium for energy prediction



The kWh Cost Evaluation System (K- PVCES)

Our model takes into account both:

Technology Factors

- Module cost
- BOS and installation cost
- Performance Ratio
- PV plant lifetime

Market Factors

- Financing and cost of capital
- Cost and timing of authorizations
- Cost of peak electricity (gas peakers).
- Local electricity billing policy
- Cost of land
- Local solar radiation
- Clarity and reliability of the regulatory framework

Adopted by





Base case for GP1

- Capex: 3,24 €/MW
- O&M: 15K€/MW
- Corporate tax (Ires+Irap): 31,4%
- Lifetime: 30 years
- Estimated kWh cost: 0,12 €/kWh



Price/Cost comparison

- Centralized Production (gas peakers) **0,15** €/kWh
- Annual (2009) average price at GME **0,082** €/kWh
- kWh cost (estimate) at GP1 **0,12** €/kWh



The economical aspect

- GP1 will benefit of all cost reduction for the different technologies
- The investment in the HQ protocol, K-PVCS, K-PVPS will be highly compensated by the general cost reduction
- Total investment in the order of 130 million euros
- IRR of full equity option over 12%



The economical aspect

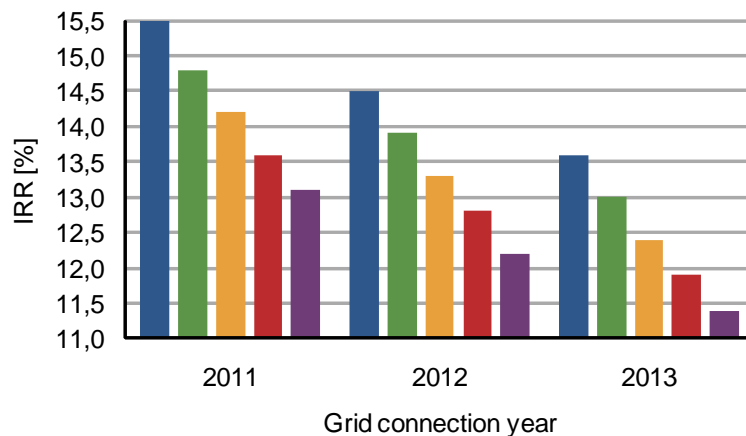
IRR trend of the PROJECT

	2011	2012	2013
2.800	15,5	14,5	13,6
2.900	14,8	13,9	13
3.000	14,2	13,3	12,4
3.100	13,6	12,8	11,9
3.200	13,1	12,2	11,4

IRR Trend of the EQUITY
(equity 20% - debt 80%)

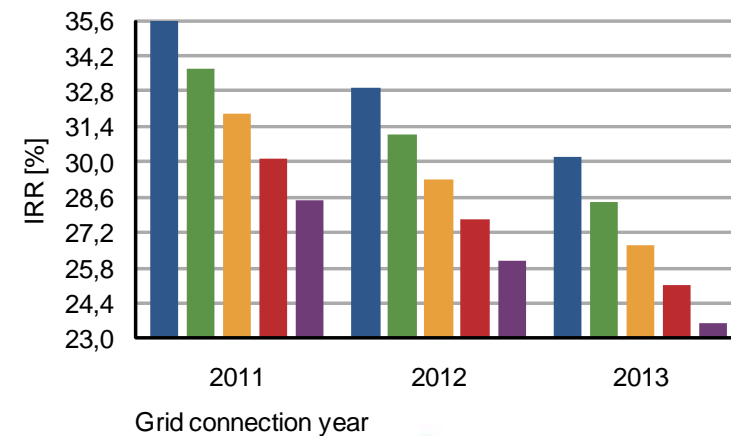
	2011	2012	2013
2.800	35,6	32,9	30,2
2.900	33,7	31,1	28,4
3.000	31,9	29,3	26,7
3.100	30,1	27,7	25,1
3.200	28,5	26,1	23,6

PROJECT IRR



Total investment value
[k€/MWp]

EQUITY IRR





GRID PARITY **1**

A world premiere project that:

- will guarantee a IRR more than 12%*
- will allow a field comparisons among different technologies*
- will demonstrate that PV plant will become a competitive source of electricity*