

# PV Inverter Trends

MARKET & TECHNOLOGY REPORT - DECEMBER 2010

***A comprehensive analysis on the first standardization steps in the PV inverter industry, evaluation of the market forecasts and positioning of the different business players***

## OBJECTIVES OF THE REPORT

This updated version of Yole's PV inverter trends report presents a comparison between what we had previously anticipated and what really happened; and also the new integration that will take place in an inverter.

Last year, we described the evolution of the 4 main parameters of an inverter (size, efficiency, cost and reliability). We will see in this report, that the inverter – as important as it is – is more than ever considered as the sub-system of a more important one: the PV plant.

We have also reviewed our position on some aspects, especially the micro-inverters, which we anticipated more promising than what has really appeared in 2010.

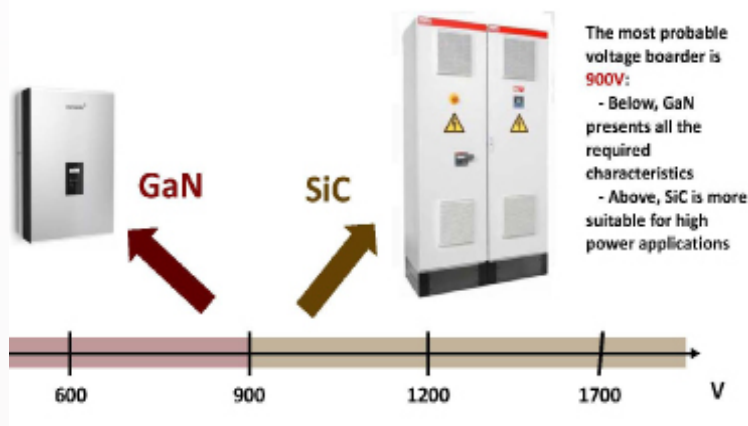


Figure 1: It is that 900V will be the border between SiC and GaN based power modules for PV inverter: it also corresponds to a differentiation between residential plants and large PV installation.

## TECHNICAL TRENDS

In addition, technology development is being investigated (advanced cooling system for large size inverters, gallium nitride-based devices for conversion, laminated Busbars for conduction,...).

This year we also included details on the integration of new functionalities, because it is what we have seen all along 2010.

Functionalities tend to improve the global return on investment (ROI) of the PV plant, as well as efficiency and reliability or reducing cost:

- Anti-theft
- On-site aging effect measurement
- Voltage, current, temperature monitoring
- Protection, in case of maintenance
- Communication

We had anticipated that monitoring at cell-level would appear early 2011, but actually, it will not appear until 2 or 3 years from now. The main reason for this delay is that it does not rely on inverters-like

manufacturers, but on cell manufacturers, who are not ready yet to provide such technical solutions. At the plant level (PV inverter environment), architectures are slowly getting standardized, especially on the European market where feed-in tariffs (FIT), although less interesting, define a typical size of installation (3kW in France and Italy, about 5kW in Germany,...).

Last year, it was difficult to establish an exact architecture of the industrial buildings-based PV plants: this year, we have seen mainly two "types" of architectures:

- Using up to 20kW inverters for installations up to 100kW
- Using large inverters for more than 100kW

The main consequence is a decrease of 20 to 50kW power range from inverter manufacturers and newcomers on the market, who do not target this value as a priority.

## MARKET TRENDS

The 2010 market has faced two major events: A decrease of FITs in most attractive countries (Germany, France, Italy, Spain,...), and an acceleration of signed contracts which has generated a shortage situation of largest PV inverter makers, like SMA, Kaco or Fronius.

As a main consequence to this shortage situation, these big players have responded by increasing their production capacity or focus on a specific market.

The other main consequence was the delivery time (up to 6 months in some cases), which has become an opportunity for new players to enter the European market:

- Reinforcement of US players
- Entry of other players who used to be in train or UPS business
- Arrival of Asian players, each with a competitive advantage: cost (for Chinese players), efficiency and reliability (for Japanese players).

In parallel to those major events, global PV market has increased, and PV inverter market has grown as well: we estimate it to reach €3 billion by the end of 2010, mainly driven by Europe. USA is keeping on growing, especially on the large building installations and China has planned significant projects to fit with their expansion and to also get rid of their stock.





	Average max efficiency	Cost	Reliability	Additional features adoption policy
	~ 96%	0,19 – 0,2€/W	5 – 10 years	
	~ 97%	0,22€/W	10 – 15 years	
	~ 97,5%	0,2 – 0,21€/W	10 – 15 years	
	~ 98%	~ 0,25€/W	< 20 years	

Figure 2: Geographical PV inverter quality comparison

As an opposite trend, inverter cost is decreasing considerably and today's market in Europe

(from a distributor or integrator perspective) hardly accepts over 0.24€/W solutions. Chinese makers (like Sungrow) can thus easily access the market while Japanese competitors meet issues.

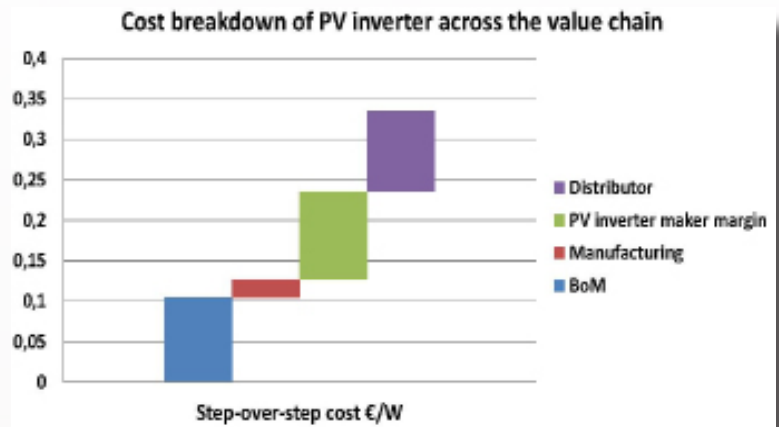


Figure 3: Cost breakdown of PV inverter across the value chain

Another important trend that we have validated in 2010 is the new comers' strategy to first establish on the large sized inverters and then enter the residential one: ABB, Ingeteam or Schneider are concretes examples of it.

Last but not least, all the power optimization solutions are meeting issues to penetrate the market, for several reasons:

- Too expensive solutions
- Not very well defined position in the supply chain
- No clear advantages in dynamic conditions.

However, those players are pushed by impressive investments and according the sales done by a majority, it is still hard to understand how their value is created and will be profitable, even if some of them seem to show good results.

Of course, improving the efficiency of a PV plant is an added value. And now, the most challenging point will be to know their position in the supply chain: will they be a "unique type" of player, assuming that each of them claims a different technology and different advantages? Or will they be vertically integrated by the inverter makers?

## COMPANIES MENTIONED IN THE REPORT

SMA, Fronius, SEPSA, Ingeteam, Enphase, Enecsys, Kaco, MasterVolt, Schneider Electric, Xantrex, SolarMax, SolarMagic, Siemens, PowerOne, AEG, Danfoss, GreenPower IC Lab, ISET, Fraunhofer ISE, Mitsubishi Electric, ABB, Semikron, MicroSemi, Ixys, Vincotech, Infineon, PetraSolar, Sunsil, Yamaichi Electronics, Ferraz Shawmut, Socomec, PVPowered, Tepco, Comverge, SemiSouth, Siba, SolarBridge, Schneider Electric, Conergy, Sunpower, Firstsolar, PhotoWatt, Siliken, etc...

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- Integrators
- Start-ups involved in PV inverter business
- Companies involved in inverter business and looking to enter PV inverter business
- Inverter manufacturers

## BIO



**Brice Le Gouic** works at Yole Développement on market and technology analysis in the fields of power electronics and related applicative markets.

He was granted a Master of Science degree in semiconductor physics and microelectronics from the National Institute of Applied Sciences in Toulouse, France.

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- Component reverse engineering & costing analysis

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- In-depth analysis & Quarterly Technology Magazines:
- MEMS Trends- 3D Packaging - PV Manufacturing - Efficien'Si
- Online disruptive technologies website: [www.i-micronews.com](http://www.i-micronews.com)
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