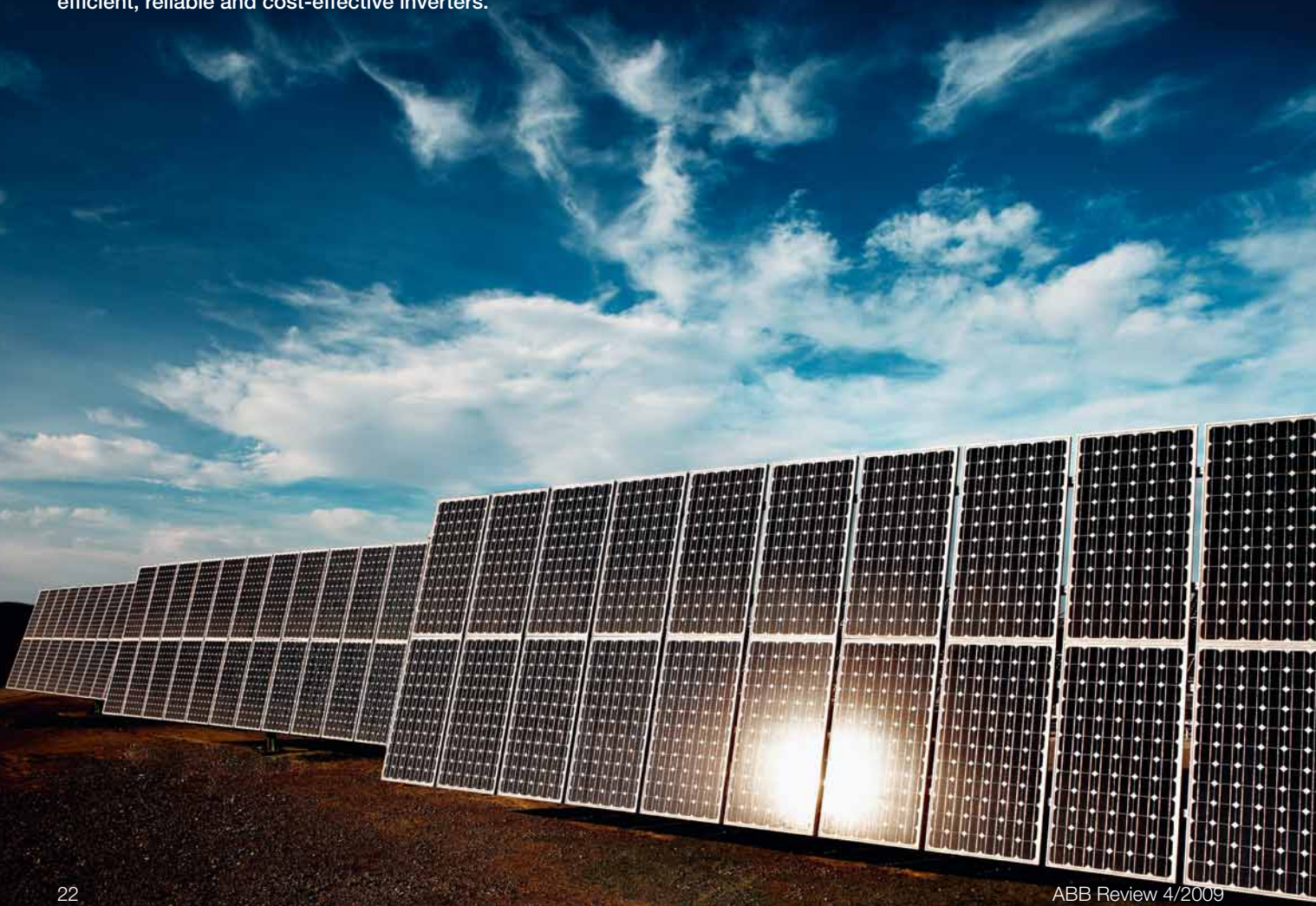


From light to power

Presenting ABB's first solar inverter
Jyrki Leppänen

Solar energy is witnessing a truly stunning growth. Today, about 4,500 MW¹⁾ of photovoltaic capacity is being installed annually worldwide – a figure that was below 100 MW in 1996 – and this expansion is continuing exponentially. The rapid spread is driven by national incentives: mainly by so-called feed-in tariffs. This combination of environmental and industrial policy is causing the market to grow and hence the cost of photovoltaic modules and other components of the photovoltaic value chain to drop. Photovoltaic energy is now rapidly approaching grid parity – the point at which the price per kWh of photovoltaic energy matches that from conventional sources.

Whereas early photovoltaic applications typically supplied energy to off-grid applications, large arrays of photovoltaic panels are increasingly being built specifically to feed energy into the grid. Their grid connection requires efficient, reliable and cost-effective inverters.



ABB's new solar inverter, the PVS800 series central inverter **1**, is designed to be used in both large ground-mounted photovoltaic power plants and photovoltaic systems installed on commercial and industrial buildings. The modular inverters convert the DC that is provided by the photovoltaic modules into AC suitable for the grid. At present, the PVS800 central inverter is available for three power ratings: 100, 250 and 500 kW.

Photovoltaic applications represent an extremely demanding market. As costs and reliability are important enablers to their viability, inverters must not only deliver the highest levels of reliability, but are required to be cost and energy efficient, compact, long-lasting and easy to install. Furthermore, they must operate under extreme environmental conditions, coping with considerable temperature and humidity ranges.

To be permitted to supply power to the grid, the inverter must fulfill stringent demands.

ABB addressed these demands by developing an inverter based on its successful and widely used family of industrial drives, drawing on a plethora of experience and proven concepts. The PVS800 central inverters are based on a drive platform that is used in wind power applications. Whereas industrial drives are typically based on two converters connected by a DC link, a solar inverter requires only a single converter, and also differs in terms of its control and protection requirements.

The inverters are engineered to provide reliable operation for at least 20 years, supported by ABB's proven maintenance and service concepts.

The highlights of the new central inverter product range include:

- Proven technology platform, assuring high reliability and a long operating life

- Compact and modular design, requiring less space and enabling fast and easy installation
- State-of-the-art industrial design, leading to high overall efficiency
- Wide range of remote and local communication, with one supplier for all options
- Life-cycle service and support through ABB's extensive global service network, providing rapid support anywhere in the world

Inverter design

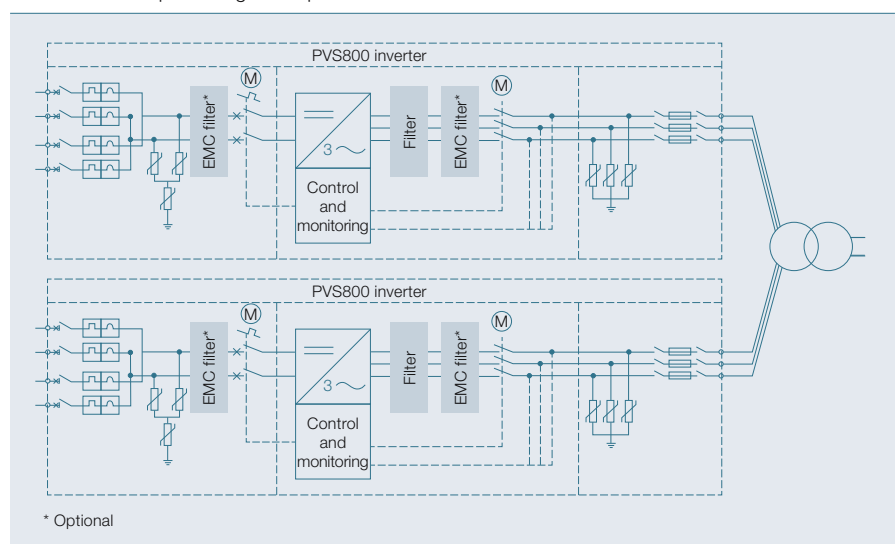
The general design of the inverter is shown in **2**. To be permitted to supply power to the grid, the installation must fulfill stringent demands. This is reflected in the inverter's built-in

safety and protection features on both the AC and DC sides and power-factor compensation. The inverter is equipped with surge protection on both AC and DC sides and with grid-monitoring technology, which is optimized to specific country-dependent requirements. Additionally, the ABB central inverter can meet present and coming grid-support requirements with its reactive power-factor compensation, power reduction and low-voltage ride-through functionalities. These permit, for example, support of the grid during network instability. The inverter has fieldbus interfaces (Modbus, PROFIBUS, CANopen and Ethernet) permitting local and remote monitoring and control.

1 The 250 kW PVS800 central inverter, showing its compact and slim design



2 Design and grid connection in a system consisting of two ABB central inverters. The inverters can handle input voltages of up to 900V.



Footnote

¹⁾ Figures are peak power production for 2009.

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A maximum power-point tracking (MPPT) algorithm ensures that the energy delivered to the grid from the solar modules is always maximized. This is required because the characteristic (current versus voltage) curve changes as a function of the available light and also of the temperature of the photovoltaic cells. MPPT assures that whatever the conditions, the cells are always working at the point where they deliver maximum power.

Grid connection

In the case of smaller installations, power is usually fed directly into the low-voltage distribution grid. Larger plants typically connect to the medium-voltage grid using a transformer

and switchgear (these are components that ABB can also supply). In some applications, ABB's central inverter topology allows the parallel connection of several inverters using the same transformer – an important cost-saving factor.

A bright outlook

Environmental awareness and falling costs mean the photovoltaic market is continuously growing, and also expanding to new countries. Many governments are supporting the spread of solar energy through advantageous feed-in tariffs. The idea behind these tariffs is that they make investment in clean-energy-generation capacity more attractive, so increasing the market

volume and driving down manufacturing costs. This approach has been extremely successful: It is estimated that within five years grid parity will be reached in locations with high solar insolation and high peak-time electricity prices, such as in California and Italy. Grid parity means that the price of photovoltaic electricity equals the retail price of grid electricity.

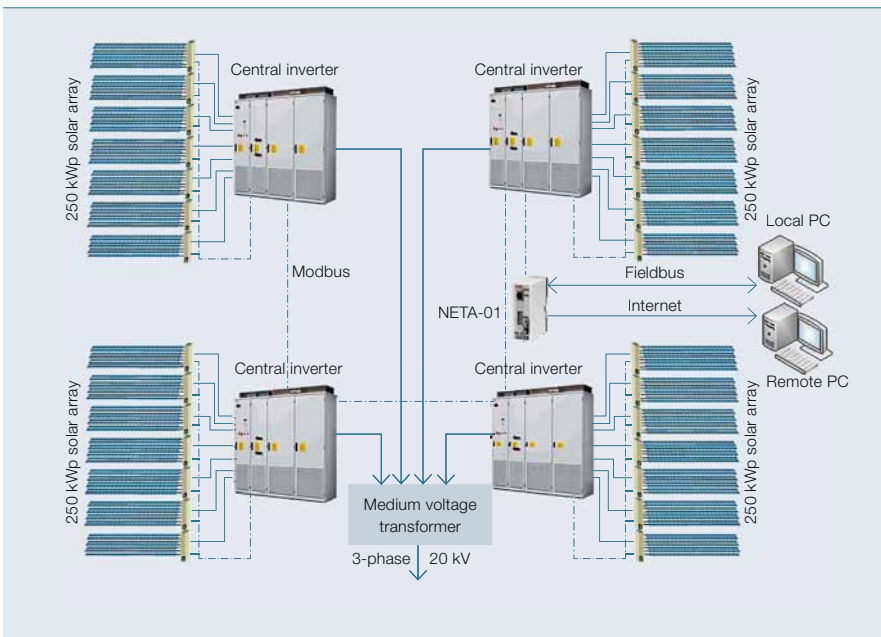
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Once grid parity has been reached, the solar markets will experience an even greater boom. While this is desirable from the point of view of reducing emissions and carbon dependency, the influx of photovoltaic electricity will pose challenges for the distribution network and also for the control of the grid. More advanced control strategies will be required. The response is smart grids. These are grids that are attuned to cope with decentralized generation, bidirectional power flows, optimized matching of supply and demand, and feature the associated advanced measurement, monitoring and control systems. ABB is at the forefront of developing, making available and supporting the technologies that will bring about the transition from conventional grids to smart grids. ABB's solar inverters are, of course, smart-grid compatible.

For more information on ABB and solar power, please visit www.abb.com/solar.

3 Data communication and connection of the ABB central inverter



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