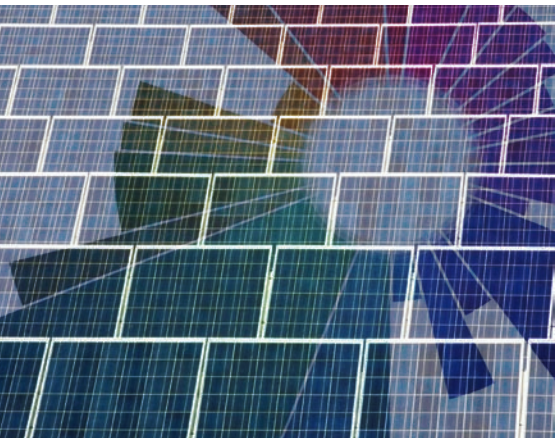
CALL 2010

Project profile

ERG

Energy for a green society: from sustainable harvesting to smart distribution, equipment, materials, design solutions and their applications



The growth of interest and proliferation of applications in sustainable energy have highlighted the need for further research into the development of photovoltaic cells and into the techniques employed for harvesting, storing and distributing the electricity produced. The ENIAC JU project ERG combines the expertise of leading specialists in this field with the aim of establishing European companies as world leaders. The project will improve the efficiency of solar cells, optimise the energy generated by photovoltaic systems, reduce power-converter losses and enhance energy-management strategies.

Sub Programme

- Nanoelectronics for energy efficiency
- Design methods and tools for nanoelectronics
- Silicon process and integration for nanoelectronics

By the end of 2008, total world energy consumption was 15 TWh while installed photovoltaic (PV) capacity was just 16 GW. To make a significant contribution to worldwide energy demand, the PV industry must produce terawatts. The need for exponential growth in PV, as required by the EU 20-20-20 climate targets and general EU energy policies, creates formidable technological challenges. These require substantial developments in energy harvesting including distributed generation, efficient power conversion and power management.

The ENIAC JU project ERG will encompass the whole solar energy supply chain, including solar cells, innovative energy extraction – harvesting – techniques, high efficiency power conversion and management of energy distribution within smart grids. The target is to address different classes of application from individual households to small local areas, as well as application-specific 'local grids' such as those found in healthcare and automotive domains.

A new solar cell family

As the first stage, ERG will focus on the design and development of innovative solar cells. This will include:

- Ultra-thin – 20 micron – silicon wafer PV cells;
- Silicon hetero-junction cells with tandem/multi-junction and hetero-junction contacts;
- Novel architectures such as back contact;
- Novel materials for silicon hetero-junctions, anti-reflective coating and passivation dielectrics; and
- Novel approaches to screen printing and laser processing, with the focus on back-contact cells.

Totally printable dye-sensitised-solar cells (DSSC) offer a promising low-cost alternative to silicon. ERG will work on: printable electrolyte to replace liquid electrolyte; advanced titanium dioxide electrodes; and counter electrodes to meet high performance DSSC applications. The overall objective is to demonstrate DSSC products for commercial applications.

In the next stage, the project will optimise use of the energy generated by PV systems. It will concentrate on power-management electronics for silicon cell panels and on micro-electromechanical systems for concentrated PV (CPV) cells. All supply chains will be considered for optimum energy exploitation by maximum power point tracking and power conversion improvement at the module/segment levels for both PV and CPV generators. The study will develop various end-user profiles, providing innovative alternatives for direct grid connection, energy storage and e-mobility support.

As the final stage, ERG will generate behavioural models for individual components of the smart grid. This will allow development of optimal energy-dispatching and battery-charging algorithms using as input parameters the signals from sensors distributed across the network, connected typically – but not exclusively – through a wireless communications infrastructure.

Conversion efficiency

The energy generated by a PV facility is typically direct current low voltage, making necessary a DC/DC or DC/AC power conversion, and it is non-continuous, requiring sometimes local storage buffering before distribution through the grid. The goal is to improve further the whole supply chain, pushing the efficiency of the high performance PV cells to exceed 20% and approach 25%; reducing the losses for the AC/DC and DC/DC conversion by 20%, achieving 90% efficiency for the battery – slow charge – and 91% for the overall grid.

The future smart-energy grid will need coherent management of incoming power, power distribution and outgoing power at local and global level – that is country or even continent wide – including present and future devices such as the upcoming millions of batteries for electric vehicles plugged-in at home or in charging facilities.

ERG will develop an innovative solution to optimise the local smart grid in terms of power management and co-generation, power consumption and overall efficiency enabling real-time energy metering and billing control.

Range of applications

By considering the full solar energy supply chain, ERG is expected to improve the industrial state of the art in solar cell efficiency, in the optimisation of energy generated by photovoltaic systems, in the reduction of losses in power converters and in energy-management strategy.

A full set of demonstrators, including innovative PV cells, novel conversion systems for PV and CPV inverters and network demonstrators, based on a household and an industrial application, will complete the project.

Involvement of user companies, design centres, universities and institutes will contribute to the establishment of a solid electronics design base for Europe and help create a set of standards for this very promising energy sector.

Energy efficiency

Partners:

- Applied Materials Italia
- Boschman Technologies
- Chemnitz University of Technology
- Compel Electronics
- Enecsys
- Fraunhofer Gesellschaft
- Infineon Technologies
- Italian University NanoElectronics Consortium (IUNET)
- LEITAT
- National Research Council (CNR)
- NXP Semiconductors The Netherlands
- ON Semiconductor Belgium
- Politecnico di Torino
- POWERTEC
- RWTH Aachen University
- Sincrotrone Trieste
- Slovak University of Technology Bratislava
- SMA Solar Technology
- SolarPrint
- SolarTec International
- STMicroelectronics Italy
- Telefunken Semiconductors
- Tyndall National Institute, University College Cork
- University of Bologna
- University of Calabria
- University of Catania
- University of Sheffield

Project co-ordinator:

- Francesco Gennaro, STMicroelectronics Italy

Key project dates:

- Start: June 2011
- Finish: May 2014

Countries involved:

- Belgium
- Italy
- Ireland
- Germany
- The Netherlands
- Slovakia
- Spain
- United Kingdom

Total budget:

- €25.7 million

Details correct at time of print but subject to possible change. Updates will be included in the project summary at the end of the project.

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