Increasing Energy Demand

ACCORDING TO THE INTERNATIONAL ENERGY ASSOCIATION, the worldwide demand for electrical energy is growing every year and energy consumption will increase by more than 60% over the next 20 years. The threat to the environment caused by the rise in emissions is a serious issue on global political and economical agendas.

Increased environmental awareness and limited fossil energy resources are the driving force behind the escalating importance of renewable energy. The solution to growth in energy consumption can be delivered – not by creating more, but by wasting less. Renewable energy sources have enormous potential to contribute to this global goal, as they are sustainable and can be used locally.

The International Energy Agency (IEA) has forecast that by 2030 renewable energy can account for over a quarter of energy consumption worldwide. Other experts estimate that it could even reach the figure of 50% by 2050. As a core technology, the semiconductor industry will play a large role in this. After all, the reliability of plants – as well as a high degree of efficiency and minimal losses when converting electrical energy in the networks – is largely dependent on this industry.

All products are available in green (RoHS compliant).
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Wind Power Energy

With 55% of the overall installed capacity at the end of 2008, Europe is a leader in the generation of wind power. For the next five years, forecasts predict that the US and China alone will account for over 50% of newly-installed wind turbine capacity. This industry is expected to develop strongly and all over the world with global newly-installed capacity expected to double between 2008 and 2020, from 30GW/year to 60GW/year*.

Power semiconductors are a vital component used in wind turbine converters. Power electronic converters enable the efficient conversion of the variable frequency output from the generator to a fixed frequency appropriate for the grid in the region concerned.

The next page outlines a number of examples illustrating the crucial role played by Infineon products in this field. More detailed information about the Infineon product areas referred to here can also be found on our website at www.infineon.com. The relevant links are listed next to the details for each product group.

* Source: Emerging energy research (EER)
Technologies

- Induction generator with softstarter
- Double fed induction generator
- 4Q synchronous generator with permanent magnets
- 2Q synchronous generator, external excited
- HVDC

System Concepts

INDUCTION GENERATOR
A simple induction generator connects to the grid through softstarter, which consists of bipolar (thyristors and diodes) products.

DOUBLE FED INDUCTION GENERATOR
Another concept for wind turbines. A specially constructed double fed induction generator controlled by a back-to-back converter. Usually, the converter converts only 1/3 of the generator nominal power.

SYNCHRONOUS GENERATOR
Permanent magnets or externally excited synchronous generator with back-to-back converter or rectifier plus inverter. The converter converts 100% of the generator nominal power.

Product Groups

- IGBT Modules – www.infineon.com/PowerModules
- Power Blocks – www.infineon.com/DiodeModules
- Diode and Thyristor Discs – www.infineon.com/diode_discs
- Stacks – www.infineon.com/stacks
Photovoltaic Energy

At the end of 2008, 14GW of solar power was installed worldwide, representing less than 1% of total electricity production worldwide. The industry was lead by Europe with 80% of installed capacity. Forecast analysts expect the annual newly-installed capacity to treble between 2008 and 2013 – from 5GW/year to 15GW/year. Most growth will come from the US, south-western Europe and Asia*).

Improving efficiency is the number one objective in the field of photovoltaics: ways of converting solar energy into electricity more efficiently are required in order to optimize the technology’s cost-effectiveness. Efficiency gains of as little as one percent can still yield enormous returns in this segment.

Infineon provides a comprehensive portfolio of high-performance products – including CoolMOS™, IGBTs, silicon carbide, IGBT modules and driver ICs – to help customers achieve their aims. These high-performance products boost the reliability and efficiency of inverters for photovoltaic applications. As the leader in high-efficiency technologies, Infineon assists customers in realizing photovoltaic inverter efficiencies of up to 99%.

A number of examples illustrating the application of Infineon products in this field are presented on the following pages. More detailed information about the Infineon product areas named here can also be found on our website at www.infineon.com. The relevant links are listed next to the details for each product group at the end of the photovoltaics section.

*) Source: IMS, London
Off-grid Photovoltaic Systems

REMOTE SYSTEMS
Infineon offers a broad portfolio of low-voltage MOSFETs with outstanding features for autonomous systems with specific industrial functions in a power range from 10 – 200W. For applications as beaconing, road signposting, isolated telecom weather stations, detection systems, urban furniture and wireless monitoring systems, the Infineon OptiMOS™ family is the right choice:

- World’s lowest $R_{\text{DS(on)}}$ enables highest efficiency
- Industry’s highest power density
- Best switching performance
- Very low $Q_g$ and $Q_{gd}$
- Lowest board space consumption
- System cost improvement
- Easy-to-design-in

With regard to lighting applications such as traffic signs, traffic lights, street lamps or garden lights, Infineon offers a broad portfolio of benchmark power devices: TRENCHSTOP™ IGBTs, OptiMOS™, CoolMOS™, Small Signal Products, EiceDRIVER™ and Lighting ICs:

- Highest efficiency and highest power density
- Lowest board space consumption
- System cost improvement
- Best quality for long system life and highest reliability

RURAL ELECTRIFICATION
With regard to domestic mini electrical networks like mini grids and solar homes with a power range between 500W and 3000W, Infineon has an outstanding portfolio of different products such as CoolMOS™, Silicon Carbide Schottky Diodes – thinQ!™, TRENCHSTOP™ IGBTs, Microcontroller, EiceDRIVER™, Lighting ICs and Modules:

- Highest efficiency and highest power density
- Lowest board space consumption
- System cost improvement
- Best quality for long system life and highest reliability
On-grid Photovoltaic Systems

Infineon has the portfolio to offer solutions for high-efficiency solar inverter designs. We are the one-stop shop for high-performance power-silicon discretes with TRENCHSTOP™ IGBTs, CoolMOS™, Silicon Carbide (SiC) Schottky diodes plus core-less transformer Driver ICs. We have tailor-made the portfolio specifically for the high-performance solar market, so designers have the best power devices available.

SOLAR PLANTS
Solar plants produce electricity en masse and sell it to networks. The power range is from a few kilowatt to 10MW and more. Infineon power modules such as EasyPACK, EconoPACK™, EconoDUAL™, 62mm, PrimePACK™, IHM and Stacks such as ModSTACK or PrimeSTACK deliver outstanding features and benefits for your application:

- Best-in-class IGBT and MOSFET chips for ultimate efficiency
- Customizable solution with EasyPACK & EconoPACK™ power modules
- PressFIT for easy and reliable mounting with EasyPACK & EconoPACK™
- Plug-and-play solution with Stacks solution

BIPV – BUILD INTEGRATED PHOTOVOLTAIC AND MOUNTED SYSTEMS
The BIPV (Building integrated PhotoVoltaics) refers to systems and concepts in which photovoltaics, as well as having the function of producing electricity, also take on the role of construction elements. The power range is in the small kilowatt scale. With CoolMOS™, Silicon Carbide Schottky Diodes – thinQ!™, EiceDRIVER™ and TRENCHSTOP™ IGBTs, Infineon offers the best solutions for sunshades, flat roofing, façades, skylights, tiles and noise barriers:

- Highest performance and integration for a compact design
- System cost improvement
- Best quality for long system life and highest reliability
- Tailor-made solutions
- Benchmark switching behavior
Technologies

SINGLE PHASE PV INVERTER
- PV single phase w/o transformer
- PV single phase with 50Hz transformer
- PV single phase with high frequency transformer

THREE PHASE CENTRAL INVERTER

Product Groups

- CoolMOS™ – www.infineon.com/coolmos
- EiceDRIVER™ – www.infineon.com/eicedriver
- ICs – www.infineon.com/driver ICs
- IGBTs – www.infineon.com/discretes
- Lighting ICs – www.infineon.com/lighting
- Low-voltage MOSFETs – www.infineon.com/mosfets
- www.infineon.com/optimos
- Microcontroller – www.infineon.com/microcontroller
- Modules – www.infineon.com/PowerModules
- Supply ICs (V_reg, DCDC) – www.infineon.com/lv_regulators
- www.infineon.com/dc_dc_converter
- thinQ™ – www.infineon.com/sic

Trenchstop™
CoolMOS™
SiC (not shown)
IGBT (not shown)

EconoPACK™ plus
EconoDUAL™ 3
EasyPACK (not shown)

EiceDRIVER™
Driver

EconoPACK™ 4
Three level NPC in
EasyPACK (not shown)

Modules & Stacks
Hydro Power Energy

HYDRO POWER could be an important storage resource in the future for “Smart Grid”. That’s one reason why this renewable energy also shows a high potential for future growth for the power semiconductor market.

There are three distinct types of power station that convert the energy from moving water into electrical energy: conventional storage, pumped storage and run-of-the-river. Although not yet widely used, tidal power has potential for future electricity generation. Tides are more predictable than wind energy and solar power. Furthermore, wave power – another renewable power source in an experimental stage – could be very interesting for the deployment of semiconductors in the future.

The electrical output of a hydroelectric power station also depends on the efficiency of the turbines and generator. Power semiconductors are a core technology for hydroelectric generation and help to satisfy the demands for efficient power generation. High-voltage direct current transmission, in which a direct current line links the alternating current grids of the generator and distributor, is the most electrically efficient way to transmit large quantities of power over the long distances involved. The high-voltage thyristors and high-voltage IGBT components provided by Infineon for use in the rectifiers and inverters required for such arrangements have become established world market leaders on account of their high efficiency and quality, and excellent reliability.

This next page outlines a number of examples illustrating the role played by Infineon products in this field. More detailed information about the Infineon product areas named here can also be found on our website at www.infineon.com. The relevant links are listed next to the details for each product group.

*) Source: ABS Energy Research, London
Technologies

Depending on system and power demands in the different technologies for current generation, the following Infineon products are suitable:
- High pressure plants
- Medium pressure plants
- Low pressure plants
- Tidal power
- Wave power
- HVDC transmission
- Generator excitation

Product Groups

- Power Modules – www.infineon.com/PowerModules
- Diode Discs – www.infineon.com/diode_discs
- Power Blocks – www.infineon.com/DiodeModules
Geothermal Energy

THE GLOBAL INSTALLED CAPACITY for geothermal power generation was 9,732MW in 2007. Geothermal energy is one of the most productive renewable energy resources, as it remains constant throughout the seasons and is also immune to the effects of weather or climate. Geothermal energy is also available 24 hours a day, making it particularly attractive for electricity generation.

The generation process involves the pumping of hot water (at least 100°C) up from deep below the surface and using it to heat a cooling agent in a closed-loop system. The cooling agent evaporates and the resulting vapor drives turbines that generate the electricity. There are various methods of generating electricity from geothermal energy, including heat pumps, geothermal collectors and geothermal probes. Infineon supplies semiconductors for the efficient conversion of the electricity generated in geothermal systems. These highly-efficient and reliable products deliver optimal performance.

The next page outlines a number of examples illustrating the role played by Infineon products in this field. More detailed information about the Infineon product areas named here can also be found on our website at www.infineon.com. The relevant links listed next to the details for each product group.
Technologies

Depending on system and power demands in the different technologies for current generation, the following Infineon products are suitable:

- ORC technique (Organic Rankine Cycle)
- Kalina technique
- HVDC transmission

LAYOUT OF GEOTHERMAL POWER PLANT

Product Groups

- Power Modules – www.infineon.com/PowerModules
- Diode Discs – www.infineon.com/diode_discs
- Power Blocks – www.infineon.com/DiodeModules
Biomass Energy

GENERATING ELECTRICITY from biomass is still a relatively new technology and has strong growth potential given the high prices demanded for oil and gas. The amount of electricity fed into the grid in Germany from biomass-fired generation quadrupled from 3.2 billion to 18.6 billion kilowatt hours just between 2005 and 2006*).

There are various methods of generating electricity from biomass. Burning solid biomass to drive steam turbines and engines, and gasifying biomass to fire gas turbines. The different ways of transforming biomass into electrical power include fuel cells, Stirling engines and gas turbines. Biomass can even combine heat systems and electricity generation systems. Infineon provides a large range of efficient semiconductor products required by conversion systems.

The next page outlines examples illustrating the role played by Infineon products in this field. More detailed information about the Infineon product areas referred to here can also be found on our website at www.infineon.com. The relevant links are listed next to the details for each product group.

(*) Source: Website of the German Federal Ministry of Economics and Technology, Section V C 4, Villemombler Str. 76, 53123 Bonn
Technologies

Depending on system and power demands in the different technologies for current generation, the following Infineon products are suitable:
- Burning solid biomass method
- Gasifying biomass
- Fuel cells

Product Groups

- Power Modules – www.infineon.com/PowerModules
- Diode Discs – www.infineon.com/diode_discs
- Power Blocks – www.infineon.com/DiodeModules
E-Mobility (Renewable Transport)

E-MOBILITY HAS AN IMPORTANT ROLE to play in reducing future CO₂ emissions. The CO₂ emissions of electric vehicles, for example, vary depending on the ultimate source of the energy used. If this energy comes from renewable resources, the vehicle’s emissions could fall all the way to 0g/km. A vehicle powered by electricity generated by conventional means, on the other hand, would produce CO₂ emissions of approximately 85g/km, despite having no internal combustion engine on board.

Energy efficiency and emissions reduction are vital factors for the future in the E-mobility field, not least because of their significance for the broader global energy balance. All carmakers around the world are working on concrete solutions and prototypes.

Infineon addresses these market segments and meets their requirements with best-in-class competencies and a wide array of power management technologies, thereby enabling the highly-efficient, intelligent and optimal use of energy.

Infineon provides innovative and optimized semiconductors for all drive concepts, with products suitable for applications ranging from battery management to motor convertors, and charging technologies to efficient injection. Potential cuts in CO₂ emissions of up to 100% (in the case of an electric vehicle charged using solar or wind energy) can be achieved with these advanced solutions.

This page outlines a number of examples illustrating the application of Infineon products in this field. More detailed information about the Infineon product areas referred to here can also be found on our website at www.infineon.com. The relevant links are listed next to the details for each product group.
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## Product Groups

- Bridge Drive ICs – www.infineon.com/bridge_driver_IC
- HITFET™ – www.infineon.com/hitfet
- MOSFETs – www.infineon.com/mosfets
- NovalithIC™/TrillithIC – www.infineon.com/novalithic
- Speed PROFET™ – www.infineon.com/profet
- Supply ICs (V\textsubscript{reg}, DCDC) – www.infineon.com/lv_regulators
  www.infineon.com/dc_dc_converter
- IGBT Modules – www.infineon.com/PowerModules
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