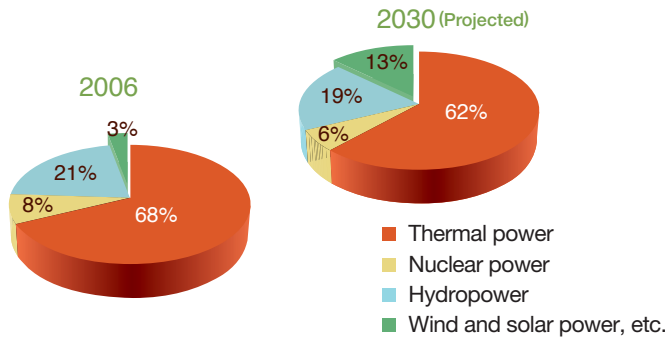


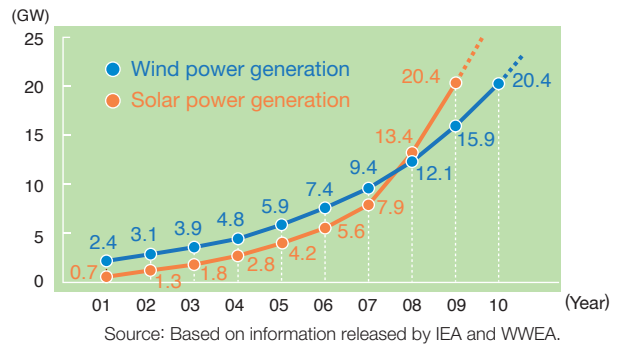
# Approach to energy creation

In the "environmental energy" domain, we will concentrate on electric power conversion devices that apply our existing AC drive technology with the aims of energy conservation and effective use of natural energy. To that end, we will advance our business from the dual perspectives of energy conservation and energy-creating. We are also working on drive systems for electric vehicles, which are expected to be widely adopted as one approach to solving environmental and energy problems.

## ●World Electric Power Consumption



## ●Rapidly Growing Environmental and Energy Markets



## 1 Energy-creating Products

We announced the Enewin series of large-scale wind-power generation equipment in May 2010. And our PV1000 power conditioner for solar power generation realized the highest level of conversion efficiency in the industry. Products such as these can be expected to make major contributions to heightened efficiency in wind and solar power generation. We have begun actively expanding this business, and have also placed electrical equipment for small-scale wind-power generation, charging and discharging equipment capable of providing a stable power supply from stored electricity, the Enewell-CEV rapid charger for vehicle-mounted batteries, and other such products on the market. Yaskawa efforts in energy-creating will be introduced here and will focus on the individual markets for solar-power generation systems, small-scale wind-power generation systems, and large-scale wind-power generation systems.



### Energy-creating Products

## For the Market of the Large-Scale Wind-Power Generation

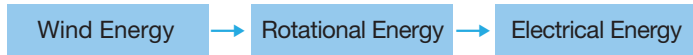


Efforts being pursued to increase the profitability of the market for the wind-power generation include increasing rated output through economies of scale, development of wind turbines that support low wind speeds, and offshore wind-power generation. A common trend in these projects is the move toward larger wind turbines.

As wind turbines are progressively converted to larger sizes, constraints from strength and cost aspects become issues. It therefore becomes necessary to heighten the performance and efficiency of the equipment, and to reduce the size and weight of generators and other such electrical equipment. There are also demands for environmental durability and maintenance reduction.

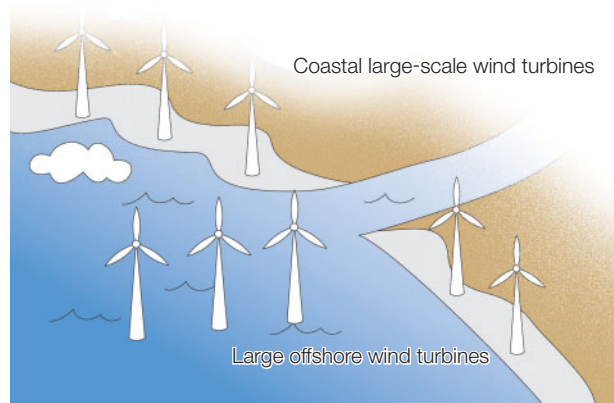
Yaskawa is responding to these kinds of needs by developing the Enewin series system electrical equipment for large-scale wind-power generation and providing it to the market.

●The Mechanism of Wind Power Generation

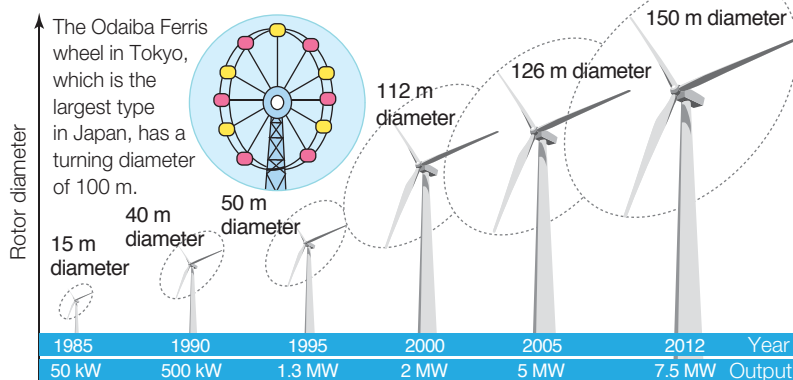


- Wind hits the blades and makes them rotate.
- The rotating shaft (rotor) turns.
- The rotation is made faster by a multiplying gear.
- That rotation is transmitted to the generator and converted to energy.

The wind energy is increased in proportion to the cube of the wind speed and the rotor area (wind-receiving area). The wind turbine efficiency is said to be 40 to 45%.



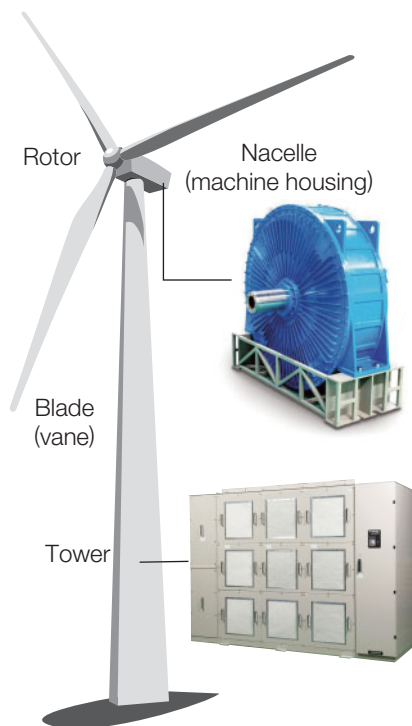
●Wind turbines grow larger and greater in capacity



●Market Needs for Large-Scale Wind Turbines

- ➔ Higher voltage as capacity is increased
- ➔ Greater efficiency in conversion of generated electric power
- ➔ Reduction in size and weight of electrical products
- ➔ Environmental durability against lightning, salt damage, vibration
- ➔ Longer life, maintenance reduction

●Structure of the Large-Scale Wind Turbine



System Electrical Products for Large-scale Wind-power Generation



The Enewin takes the energy obtained from the large-scale wind turbine and uses a high-efficiency generator and generation converter to convert it for output as high-quality AC power that is synchronized with the power grid from the electric utility companies. The Yaskawa power generation converter is the only such equipment in the world that embodies a practical implementation of Medium-voltage Matrix Converter technology, and it has realized electric power conversion efficiency of 98% or more.

Main Features

- Higher voltage  
Generator and converter changed from 690 V to 3 kV high-voltage specification
- Compact, lighter weight  
Permanent magnet synchronous generator using rare earth magnets  
Converters that do not need main circuit capacitors or harmonic filters
- Improved efficiency  
Synchronous generators have permanent magnets for enhanced efficiency  
Converters using the AC-AC system provide output current that does not include any harmonics
- Environmental durability  
Salt damage countermeasures using varnish and special coatings  
Vibration countermeasures using vibration-proof structure
- Reduced maintenance, lower total cost  
Converter with reduced need for maintenance parts because there is no capacitor and the current is lower (voltage is increased)

**Generator**  
Housed inside the nacelle, this converts the rotational energy from the motor into electrical energy.

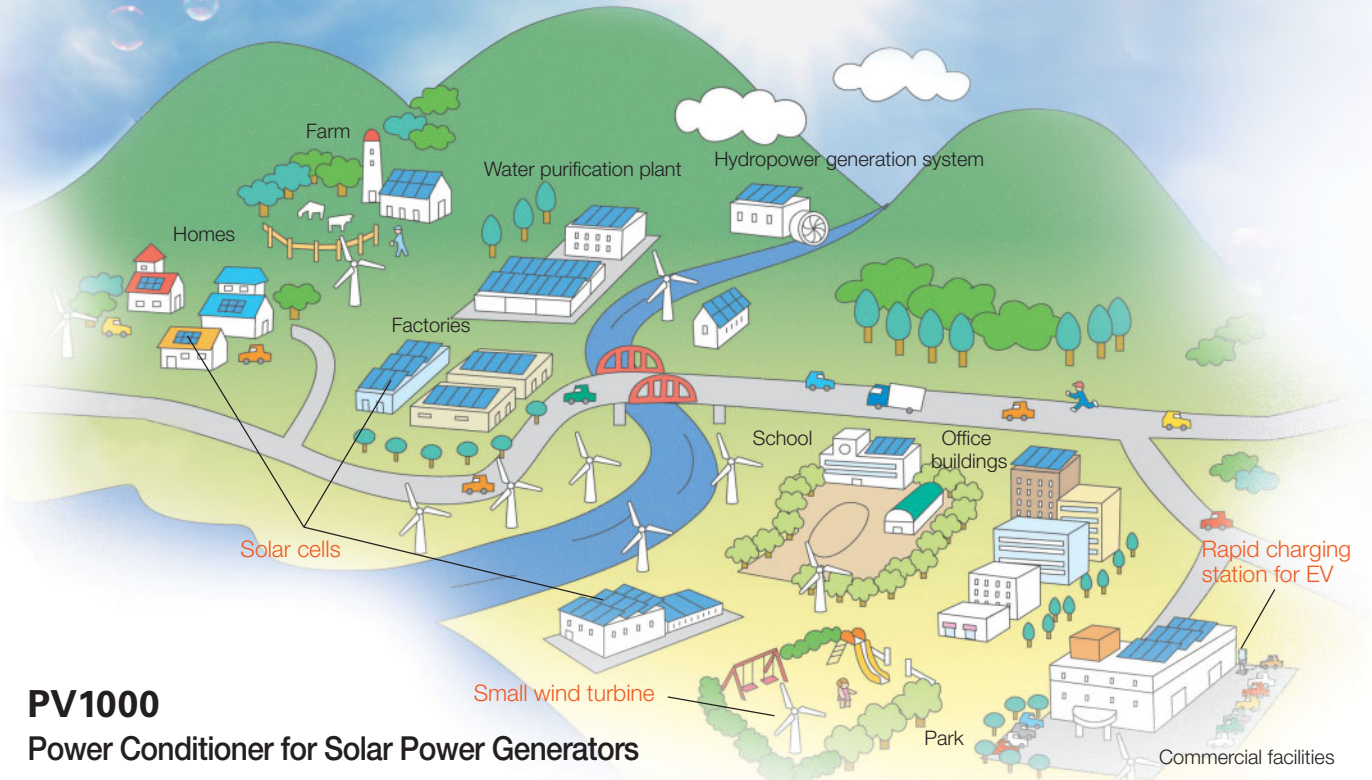
**Wind Power Generator Converter**  
Housed in the lower part of the tower, this uses a direct AC-AC converter to convert the generated electric power to the required voltage and frequency.



Energy-creating Products

# For the Market of the Solar Power Generation

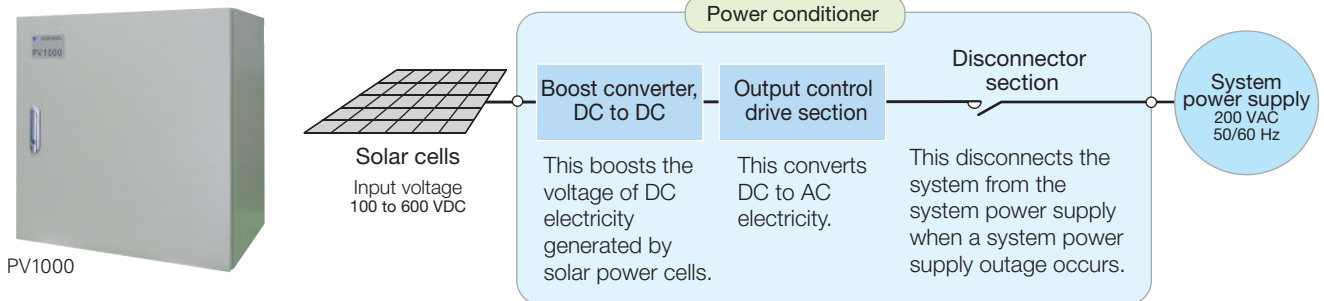
The question of how the electric power generated by solar cells can be converted to AC power without waste is crucial. Yaskawa power conditioners realize the high conversion efficiency of 94%. The use of 3-level Control, which is a proud Yaskawa accomplishment, and other such AC drive technology makes it possible to raise the efficiency and reduce the size of our power conditioners.



## PV1000 Power Conditioner for Solar Power Generators

A power conditioner boosts the DC voltage obtained from solar cells, converts it to high-quality AC voltage that is synchronized with the power grid from the electric utility companies, and outputs that power to the system power supply.

### System Structure



### Main Features

• High-efficiency control

Highest level of conversion efficiency in the industry realized by the world's most advanced high-efficiency power conversion technology developed with general-purpose AC drives

• Broad input voltage range

Capable of operating with maximum 600 VDC input voltage  
Capable of providing rated output at 250 VDC or higher

• Auto-run function

Equipped with auto-run function for emergency load operation during system power outages

• JET\* certification (pending for single-phase models)

\* : Japan Electrical Safety & Environment Technology Laboratories



## Energy-creating Products

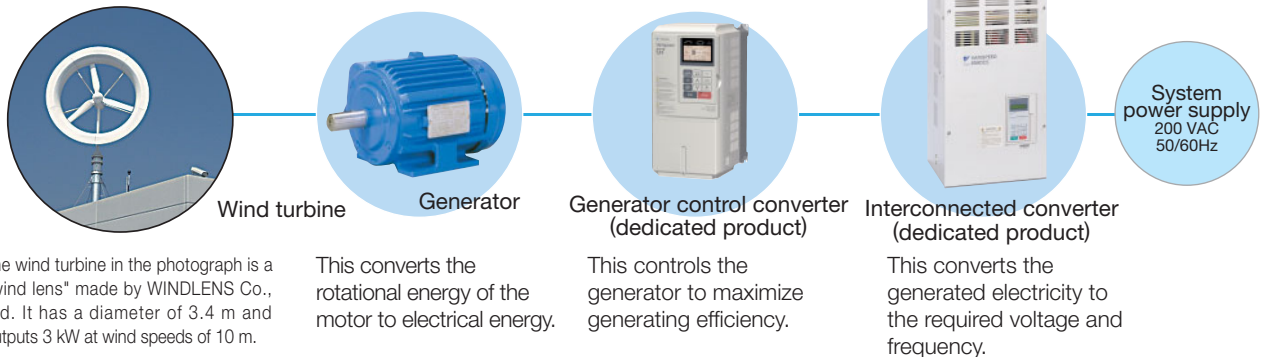
# For the Market of the Small-Scale Wind-Power Generation

### Small-scale Wind-power Generator

Many small-scale wind turbines are located in urban and other built-up areas, where the wind speed and wind direction can sometimes fluctuate drastically due to the influence of the ground surface and buildings. Measures for turbine control become necessary in order that power can be generated safely and stably in these kinds of unstable wind conditions. Yaskawa has realized control for maximum efficiency with generator control converters that adapt to fluctuations in output.

These efficiently convert wind energy into electricity and output it to the system power supply of the electric utility companies.

### System Structure



Note: The wind turbine in the photograph is a "wind lens" made by WINDLENS Co., Ltd. It has a diameter of 3.4 m and outputs 3 kW at wind speeds of 10 m.

This converts the rotational energy of the motor to electrical energy.

This controls the generator to maximize generating efficiency.

This converts the generated electricity to the required voltage and frequency.

### Main Features

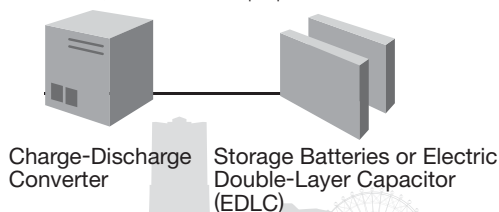
- **High-efficiency power generation**
  - Realizes high-efficiency power generation by an IPM\* generator  
\* : Interior Permanent Magnet
  - Realizes control that maximizes electric power output by efficient operation of the wind turbine even when wind speeds fluctuate
  - Improves capacity utilization by control for continuous operation even in high winds
- **Safety and reliability**
  - Monitors wind speed and rotating speed, enables runaway control to prevent excessive speed
  - Equipped with a powerful mechanical brake to keep the fan stationary without fail in storm winds
  - Remote monitoring control enables monitoring and operation from a remote location

## 2 Energy System-related Products



### Electric Power Stabilizing Charge and Discharge Device

This controls battery charging and discharging, and is used to stabilize the output of electric power generated from unstable natural energy, to level fluctuating loads, and other such purposes.



### Enewell-CEV Rapid Charger for Vehicle-Mounted Battery

This device uses electric power conversion technology to charge electric vehicles (EV) in a short time. It does not affect the surroundings with harmonics generated during electric power conversion or other such phenomena, so it can be located in residential neighborhoods and commercial areas that are convenient for EV users. The charging station portion can have a monitor or panel display attached for use in showing charger operation instructions, advertisements, and so on.

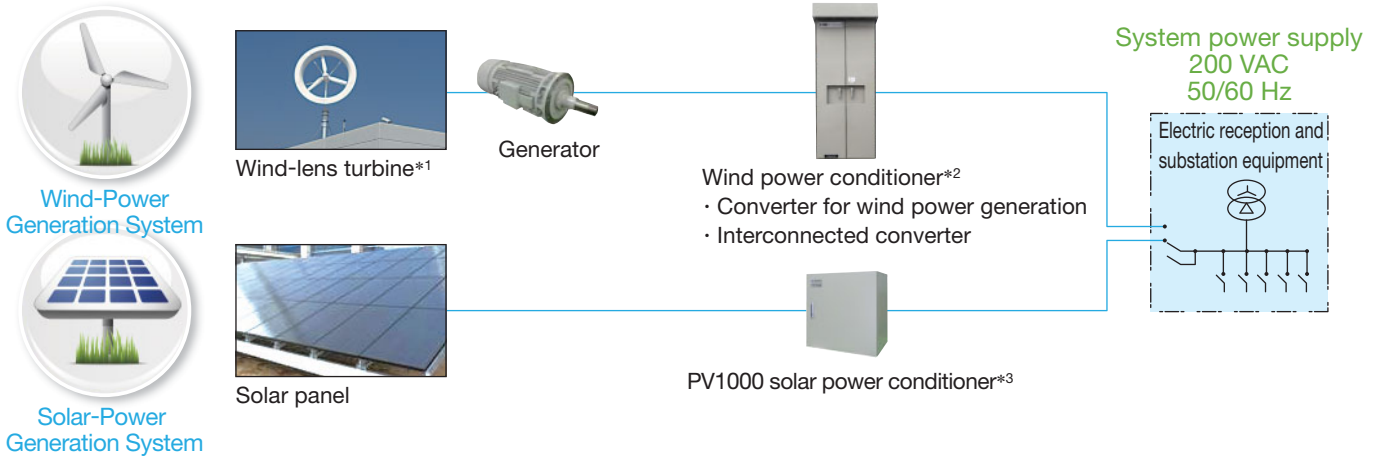


3 Examples of Solar-power and Wind-power Generation Systems : Kitakyushu City



Yaskawa is actively promoting efforts in the Environmental & Energy area as a main pillar of our new business fields. To date, we have placed a hybrid power system that uses both a solar-power and a small-scale wind-power generation system with a dedicated power conditioner and other Yaskawa electrical products at the Yukuhashi Plant, where we have demonstrated their efficiency and safety. Here we will introduce the case of our delivery of a solar-power generation system and a small-scale wind-power generation system at Yaskawa headquarters in Kitakyushu City. The systems we delivered are all interconnected, they furnish a portion of the electric power used at each facility, and they contribute to the ecological promotion by Kitakyushu, which aims to be the environmental capital of the world.

●System Configuration



School New Deal  
Solar-Power Generation System

10 kW × 3 schools

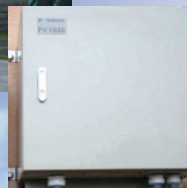
The Japanese government announced the School New Deal plan in 2009 as a way to comprehensively upgrade the educational environment to make it suitable for 21st-century schools. Kitakyushu has responded by installing solar-power generation equipment in its primary and lower secondary schools. This includes the first solar-power generation system from Yaskawa, already installed at three schools, and we are contributing to the building of safe, secure, environmentally friendly schools.



Solar Panels:  
Panel surfaces have protective netting attached because they are installed on athletic fields.



Power generation display



Power conditioner\*3



Hiagari Drainage Treatment Center, Kitakyushu  
Large-Scale Solar-Power Generation Systems

75 kW × 2 systems

As an environmental model city, Kitakyushu has positioned its drainage treatment centers as energy recycling centers for the region. The Yaskawa large-scale solar-power generation systems were delivered in March 2011. The solar panels were installed in the space above the drainage treatment facility in the plant, making effective use of the facility.



Yaskawa's first high-capacity power conditioner\*3 (100 kW × 2 sets)



## Kyushu Human Media Creation Center Hybrid Power Generation Systems

Small-scale wind-power generation 3 kW × 1 unit  
Solar power generation 10 kW × 1 system

The Kyushu Human Media Creation Center seeks to reduce 20% of CO<sub>2</sub> emissions from standard buildings by introducing new energy and building energy management. As part of this program, a Yaskawa hybrid power system that uses both a solar-power and a small-scale wind-power generation system has been installed. They are generating electricity efficiently, with the power being used for lighting and other such purposes, and they are contributing to reduction of electric power consumption.



Small-scale wind-power generation

Solar power generation



Generator monitoring system: This system monitors operating status and displays power generation status on a monitor in the Center.  
(made by Yaskawa Information Systems Corporation)



## Kitakyushu Environment Museum Small-Scale Wind-Power Generation Systems

3 kW × 1 unit

The Environment Museum is a facility provided by Kitakyushu as a comprehensive center for citizen learning and exchange about the environment. The museum installed a Yaskawa small-scale wind-power generation system to promote citizen learning about the environment and environmental education programs in primary and lower secondary schools.



Wind power conditioner\*2 installed on a rooftop



Display monitor installed inside the Center entrance



Remote operation and monitoring panel installed in the staff office



Wind-lens turbine\*1 installed at the front entrance (visitors' entrance)

Explanation of terms:

- \*1: This is a registered trademark of WINDLENS Co., Ltd.
- \*2: This equipment feeds the electric power generated by wind power generators into the electric power grid, creating power that ordinary electrical equipment can use.
- \*3: This equipment boosts the DC voltage obtained from solar cells, converts it into high-quality AC voltage that is synchronized with the power grid from the electric utility companies, and outputs it to the system power supply.

## Participation in the “Kitakyushu Smart Community Creation Project”

Yaskawa is participating in the Kitakyushu Smart Community Creation Project in Kitakyushu. This is one of the operational trials being conducted under the Master Plans for the Demonstration of Next-Generation Energy and Social Systems, an initiative by the Ministry of Economy, Trade and Industry to investigate the smart grid, which is a next-generation electric power grid.

We are actively engaged in the demonstration of small-scale

wind-power generation and other new energy as well as in systems development of charging facilities and other such activities by means of the stepped-up adoption of new energy, the introduction of energy conservation systems in buildings and structures, the efficient utilization of energy through regional management systems, and the improvement of traffic systems and other such social systems.