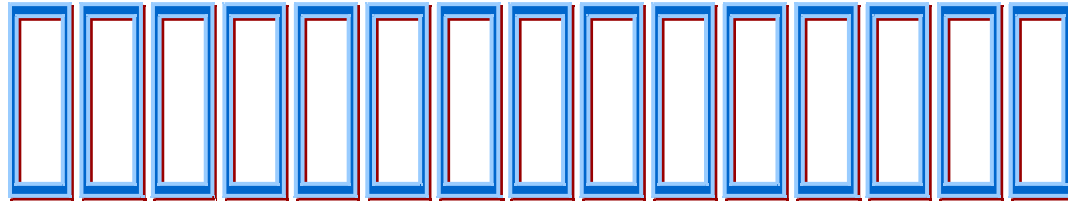
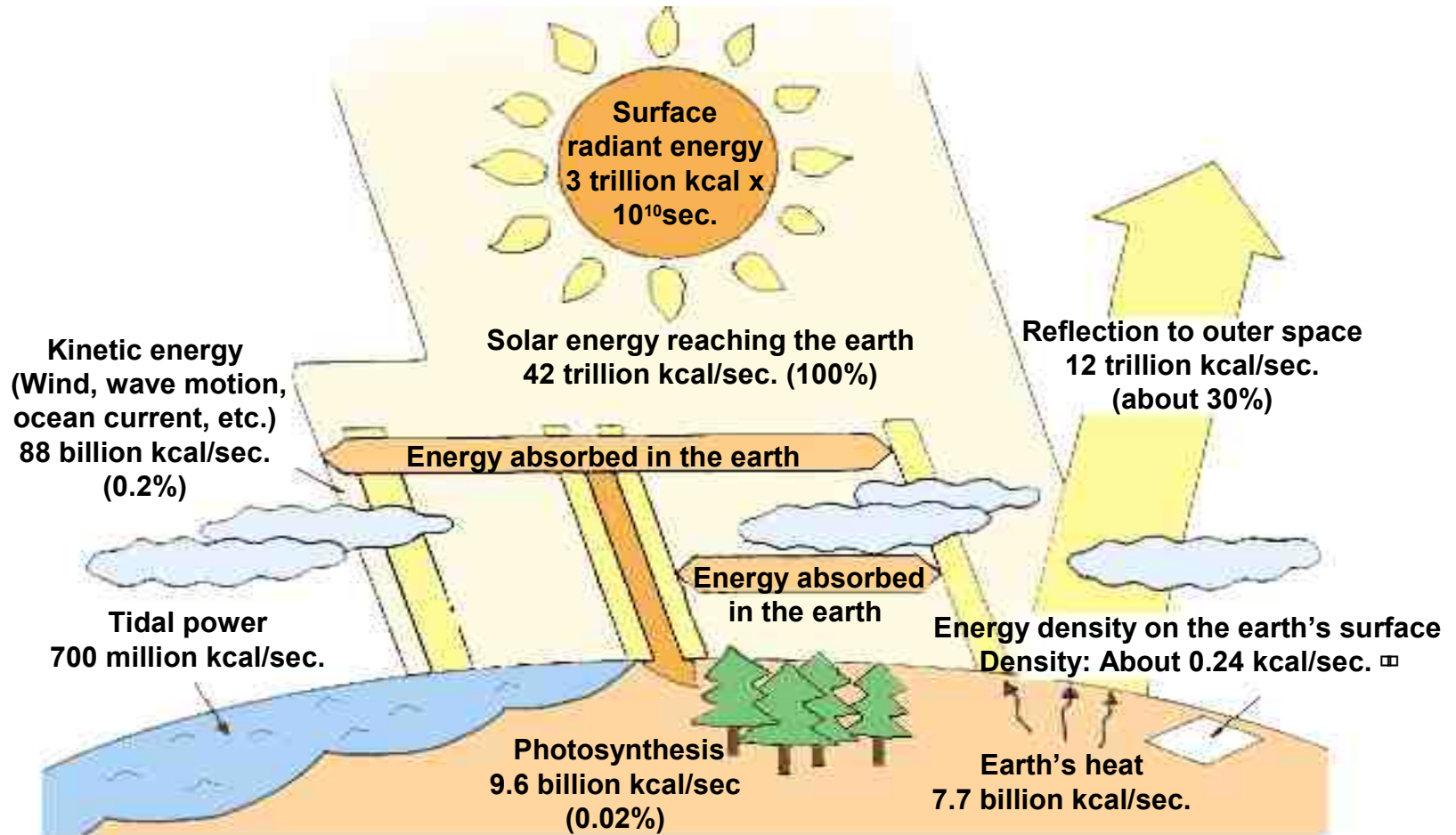


# Solar Power Generation



# What is Sunlight Energy?



If all the solar energy reaching the earth could be transformed to electrical energy...  
⇒it would be possible to secure the amount of electricity needed for  
one year's global consumption within an hour.

# What Is Electric Power W (Watt)?

If compared to a waterfall ...



**Current**  
= Quantity of water flowing

**Voltage**  
= Height of the waterfall

**Electric power (W)**

= Height of the waterfall  
x Quantity of water flowing

= Voltage x Current

The higher the waterfall is  
and the greater the quantity  
of flowing water is, the higher  
the power becomes.

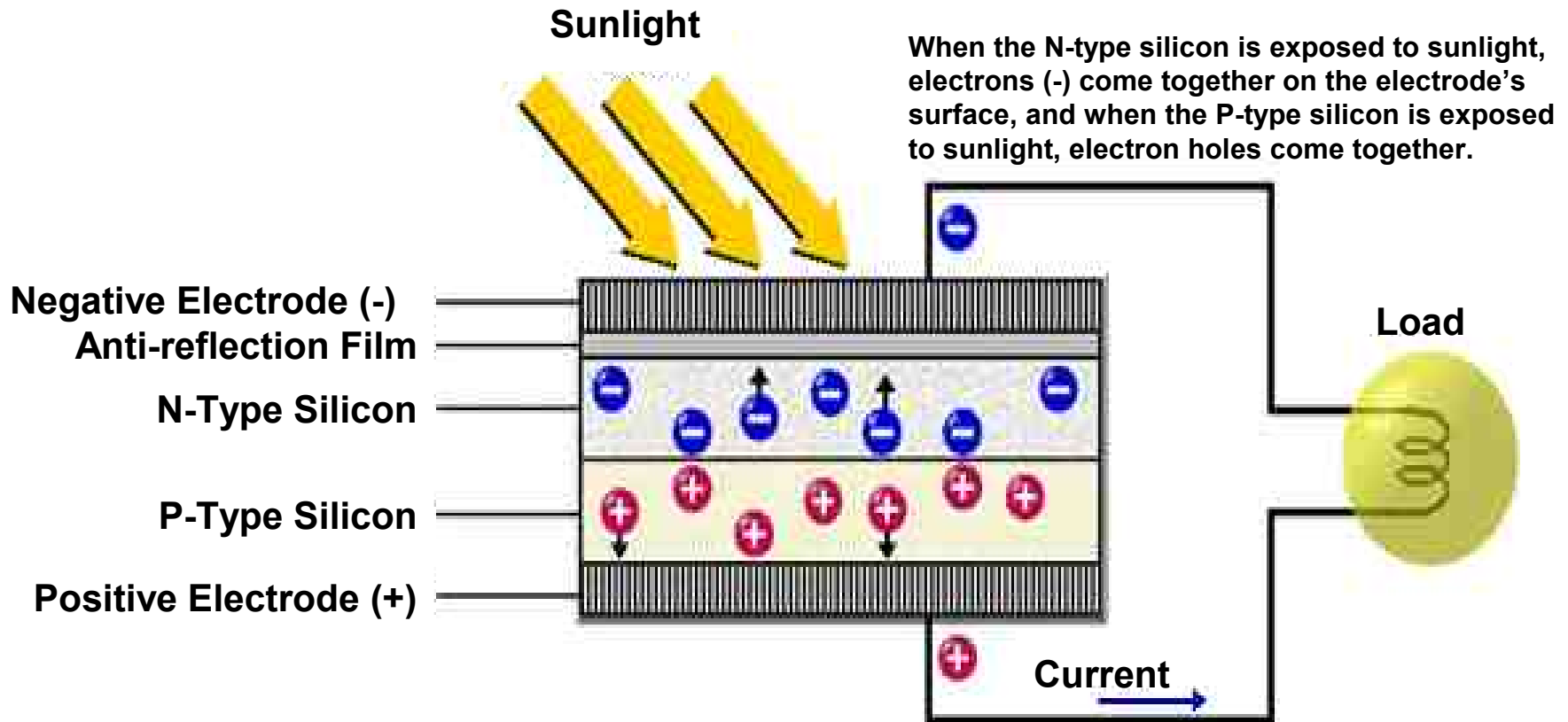
**\*What is 100W?**

If voltage is 100V, 1A of current becomes necessary.

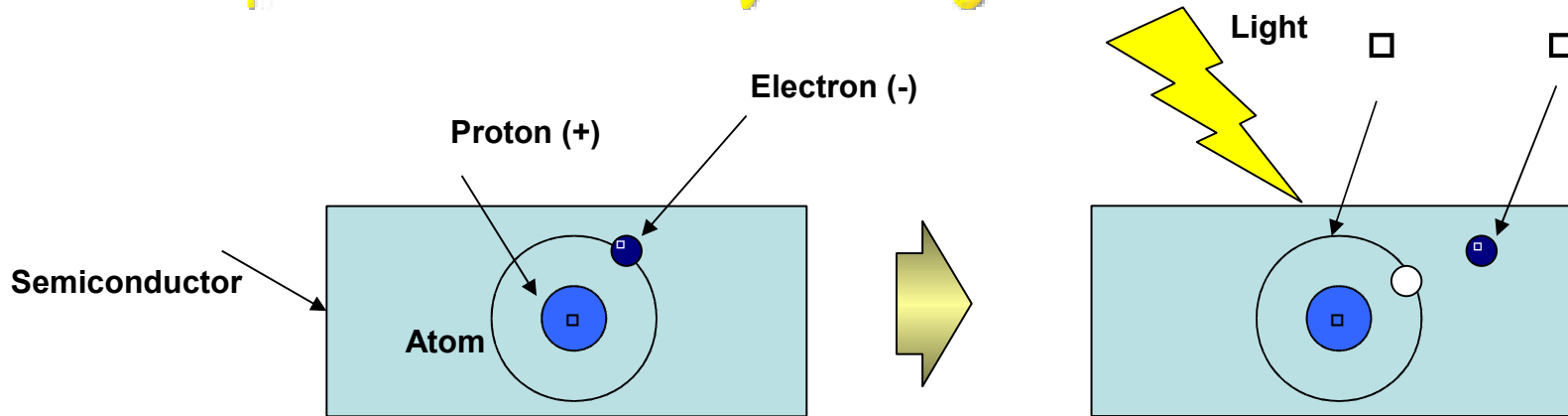
**\*What does 100WH mean?**

It means that if voltage is 100V, 1A of current flows for an hour.

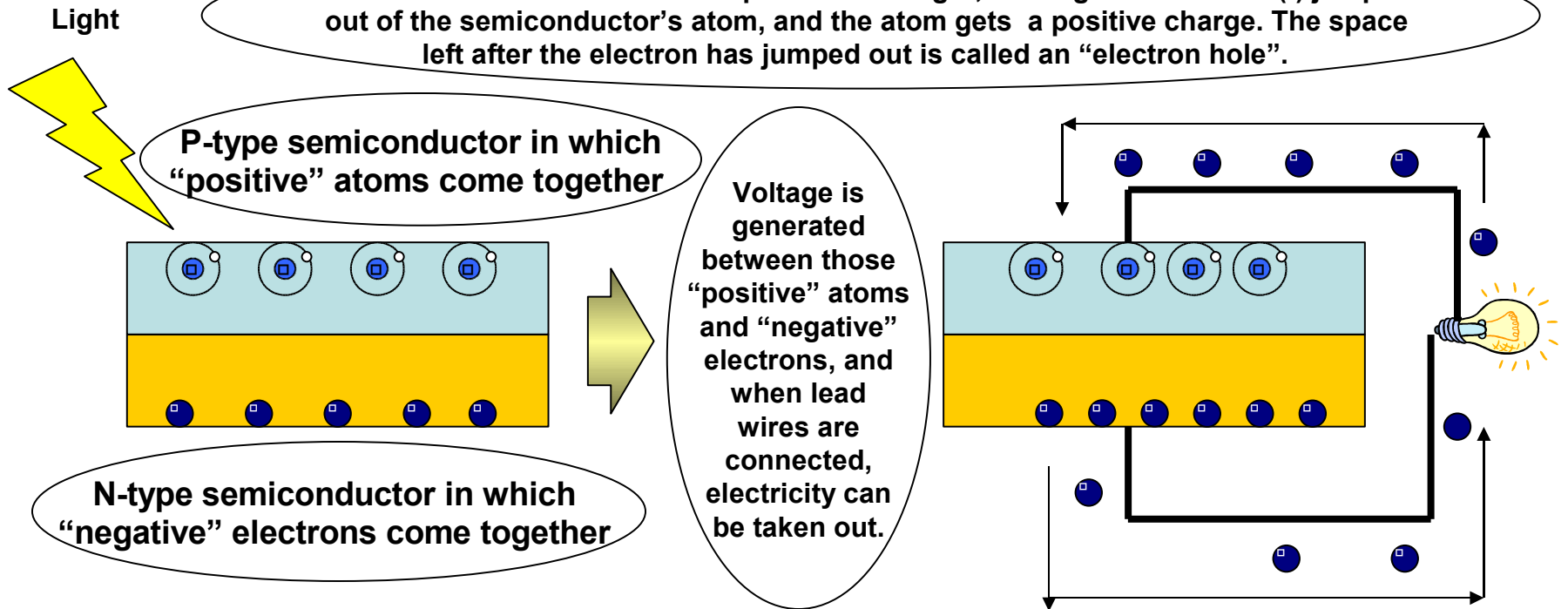
# Principle of Light Being Transformed into Electricity



# Principle of Electricity Being Generated



When the semiconductor is exposed to sunlight, the negative electron (-) jumps out of the semiconductor's atom, and the atom gets a positive charge. The space left after the electron has jumped out is called an "electron hole".



# Why Solar Power Generation Now?

## 1. Inexhaustible Energy

Solar energy falling on the earth endlessly

Solar energy for an hour being comparative to global consumption of energy for 1 year



No concern about solar energy running out

## 3. Pollution-Free System

Neither is noise generated, nor is CO2 emitted during operation

The thermal power station is the worst source of pollution, emitting CO2 which is one of the main causes for global warming.

A 3kW system for residential house use can reduce carbon discharge by 540 kg per year. (In comparison with oil-based thermal power)

## Solar Power Generation

## 2. Cost-Free Energy

Energy available free of charge

Energy that is available easily and free of charge at any place on the earth .

- Solar power generation is a private power generation with effective utilization of the roof space and cost-free solar energy.

## 4. Less Wasteful System

No infrastructure construction needed for energy transport

The electricity generated at an electric power station is transmitted to our houses by power cables through several substations. About 61% of the generated electricity is lost on its way (due to attenuation), and what we can use is only 39% of the transmitted power. □


# Fossil Fuel - minable years & reserves

## The Need for Solar Energy

Nowadays we must think on a worldwide scale about such issues as dealing with global warming and reducing emissions of carbon dioxide. Solar energy, which has few resource limitations and minimal adverse environmental impact, will surely become more and more essential to our lives in the years ahead.

### 《Remaining Fossil Fuel Supply in Number of Years and Extractible Volume》

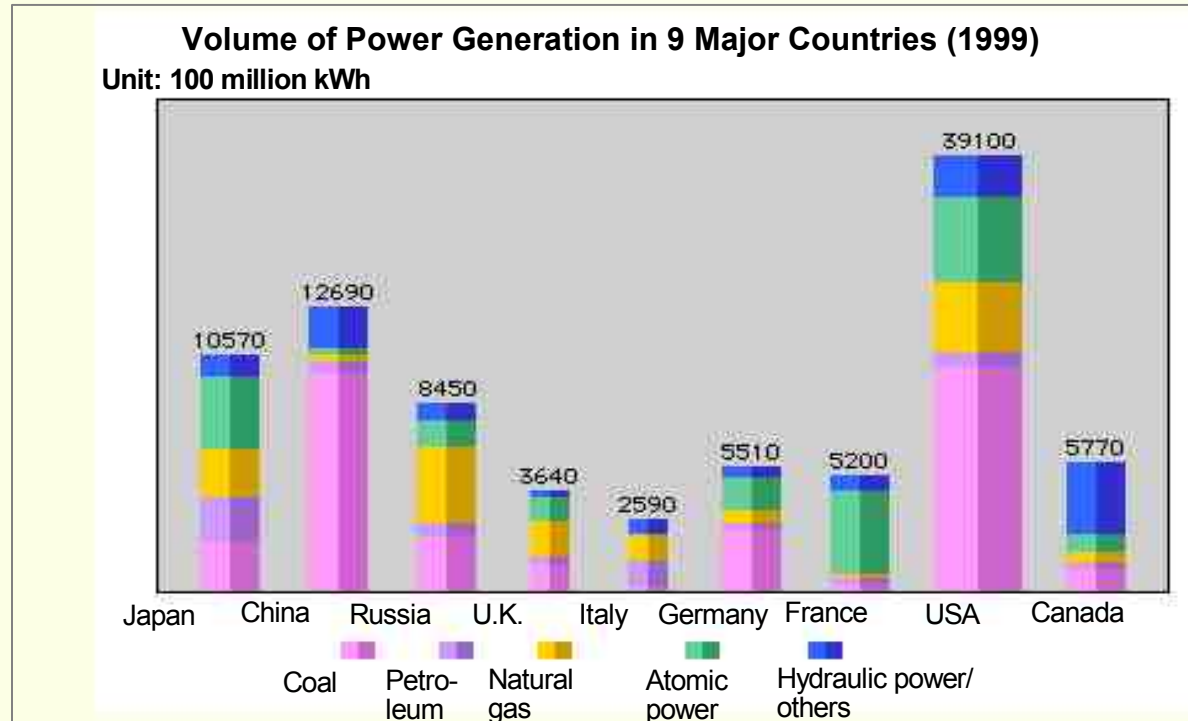
| Fossil Fuel                       | Petroleum                         | Uranium                           | Natural Gas                       | Coal                            |
|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|---------------------------------|
| Runs out in<br>(Date of estimate) | <b>43</b> years<br>(January 1998) | <b>72</b> years<br>(January 1997) | <b>62</b> years<br>(January 1998) | <b>231</b> years<br>(Late 1993) |
| Extractible<br>volume             | 1,195<br>billion barrels          | 4.36<br>million tons              | 144<br>trillion cubic meters      | 10,316<br>trillion tons         |



**Solar energy is clean and inexhaustible !**

# Volume of Power Generation in major countries of the world

## Volume of Power Generation in Major Countries of the World

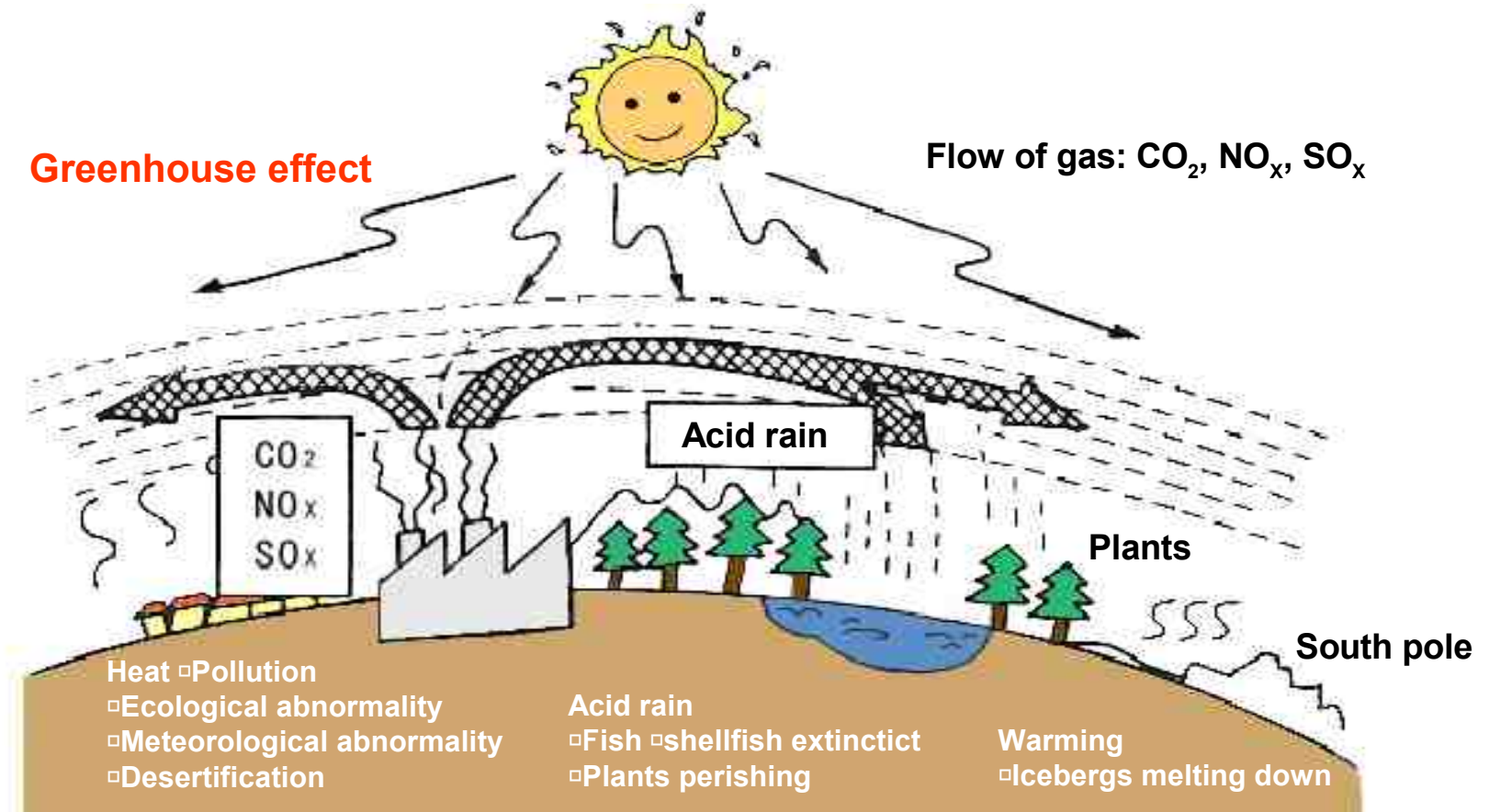


### Volume of power generation in 9 major countries

From the above graph, you can see what and how much energy is used to generate electricity. It is evident that hydraulic power is mainly used in Canada, atomic power in France and coal in China, and that all energy source are almost evenly used in Japan. Each figure on the top in the graph shows the volume of power generated in each country in the year 1999. By comparing of those figures, you can see that the USA is on the top, having a lead far away from China on the second position and representing about triple the volume of power generation in Japan.



# Consumption of Fossil Fuel Polluting Global Environments



Global warming :

The global temperature went up by 0.6° during the past 100 years.

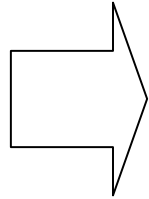
The average temperature is forecast to rise by 1.4 °-5.8° by the year 2100.

\*A 3KW system for residential use can reduce 540kg of carbon discharge per year.

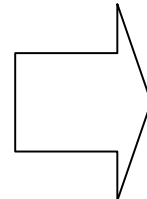
# Quantity of Electricity lost during Power transmission



100%



39%



Out of the volume of electricity generated at the power station, only 39% reaches households.

# Types of Solar Power Generation Systems

## Grid-Connected Type of Power Generation System

that sends electricity to and receives it from the electrical power company

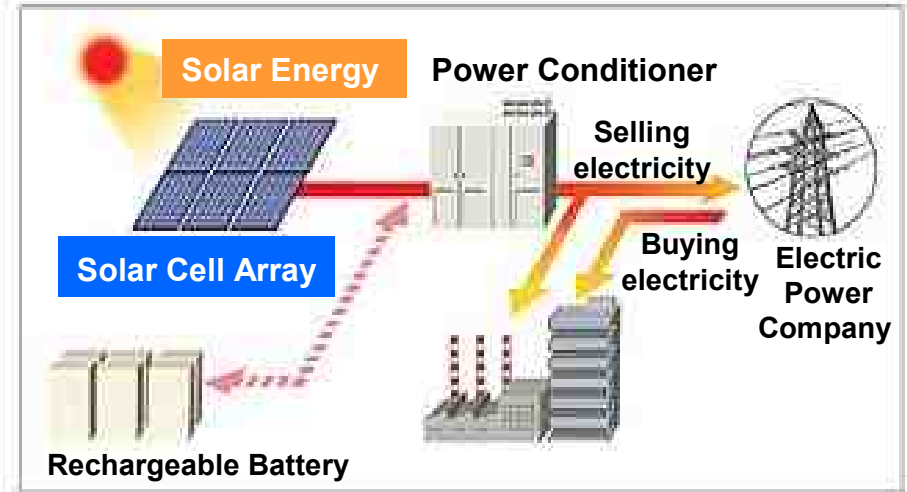
This is the most general system configuration. It generates electricity by making use of inexhaustible sunlight during the daytime, and in the nighttime, with no sunlight, or when the volume of power generation is not enough to cover the power consumption, it is possible to purchase electric power from the electric power company. On the contrary, any surplus power exceeding the volume of power consumption can be sold to the company.

## Independent Type of Solar Power Generation System

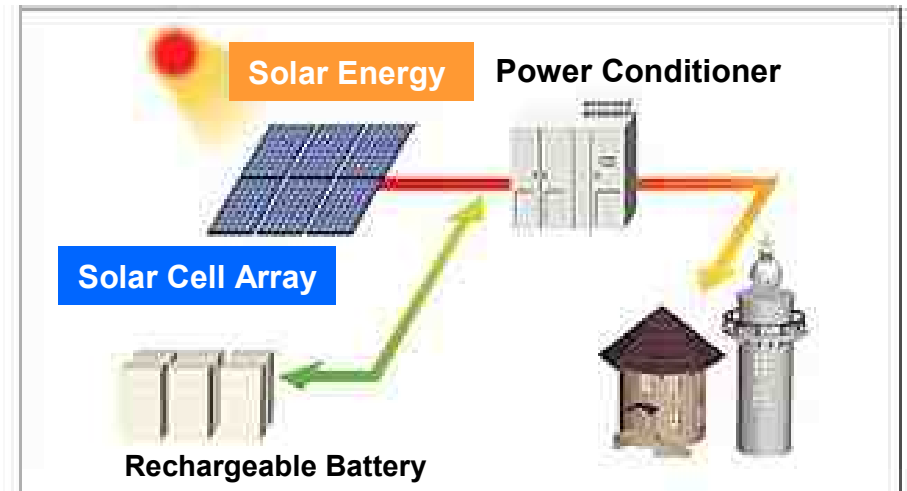
using no electricity from the electric power company

This is an independent system that does not use any electricity from the electric power company. It accumulates electric power that is generated by the solar cells in a rechargeable battery during the daytime, and supplies that electric power according to its demand.

### Grid-Connected Type of Power Generation System



### Independent Type of Solar Power Generation System

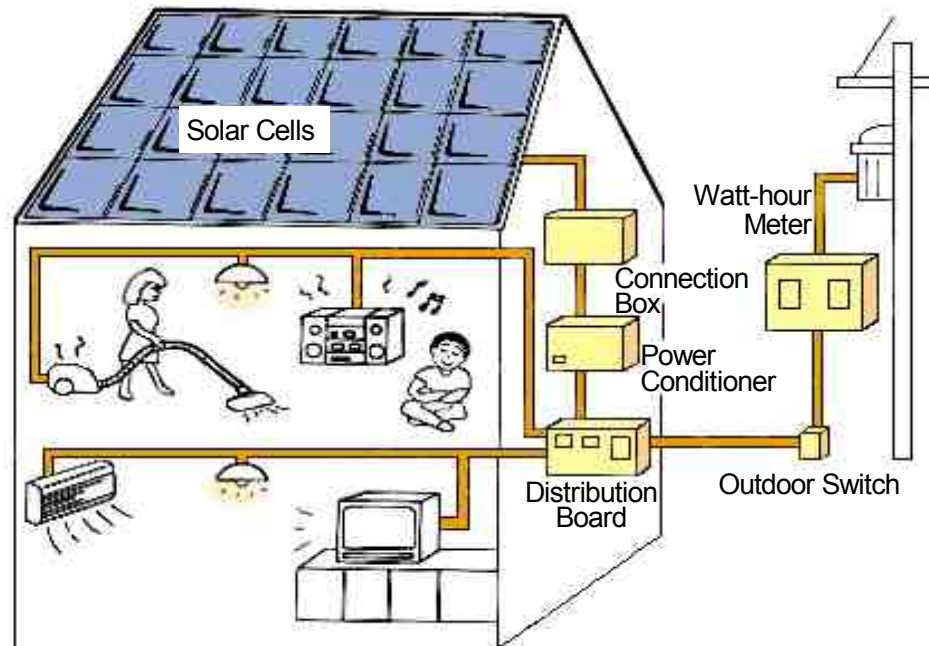


# Solar Power Generation System for Residential Use

A solar power generation system for residential use can convert DC generated by the solar cells into the same electricity (AC) as the electric power company by using a power conditioner, and can supply electricity for various types of HA products.

Also, as the solar power generation system is connected to the electric power company by cable, if the generated power exceeds the power consumption, surplus electricity can be transmitted to the electric power company for purchase. At night or whenever the generated power runs short, you can get a supply of electricity from the power company as usual.

This system is called a “Grid-Connected PV System”, which facilitates sending electricity to and receiving it from the electric power company automatically.



## □ Solar Power Generation □

# Terms frequently used about Solar Power Generation

### ■ “PV”

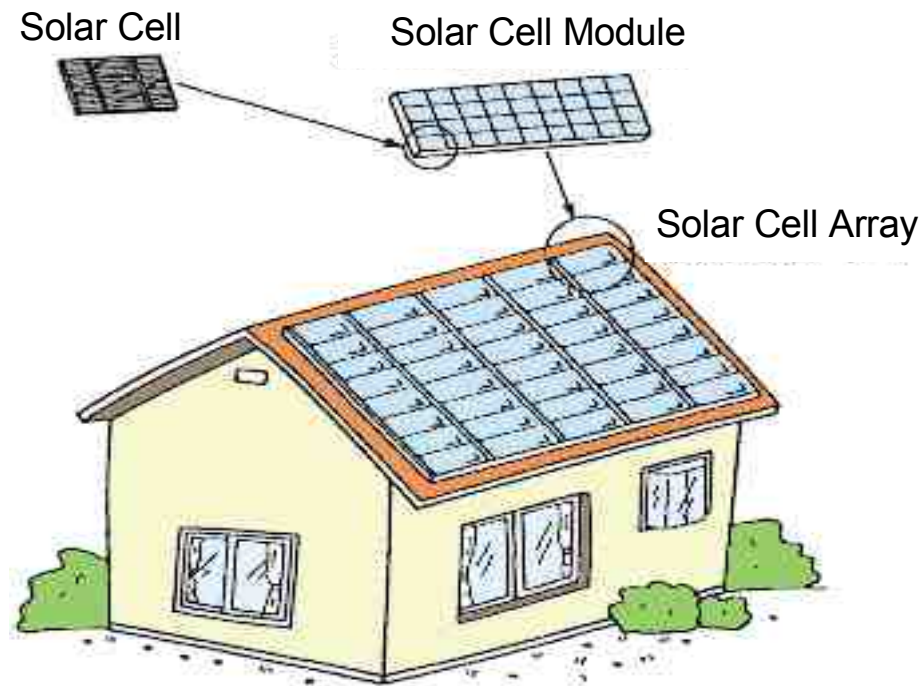
This is an abbreviation of “Photovoltaic”, and it means “Solar Cell “ in general.

### ■ “Cell”, “Module”, “Array”

**Cell** refers to a smallest unit that functions as a solar cell. It is a thin silicon plate, measuring about 10cm, 12.5cm or 15cm square or round in general (in a crystal system).

**Module** refers to an arrangement of cells that are connected together and housed in a package so that voltage can be taken out conveniently. A module is the smallest unit or construction work.

**Array** refers to an arrangement of modules embedded on a mounting base so that higher amounts of electricity can be taken out.



# What is a Conversion Efficiency?

- It represents at what rate the energy input to solar cells can be converted into electrical energy.

For a simple example:

After 100 seeds (“light”) were sown, 10 plants (“electricity”) were raised.

The conversion efficiency in this case is 10%.

- \*1 The conversion efficiency of solar cell modules is computed in the following formula:

$$\text{Conversion Efficiency} = \frac{\text{Nominal module max. output (W)} \times 100}{\text{Module dimensions (m)} \times 1,000 / \text{m}^2}$$

Transition of Solar Cell Conversion Efficiency



# What is a Power Conditioner?

## ■ Power Conditioner

AC is generally used in households, offices, factories, etc., but a solar cell or rechargeable battery outputs DC.

Accordingly, in order to practical use electricity that is generated by a solar cell or that from a rechargeable battery, it is necessary to convert DC into AC.

The equipment for making such conversion is a “Power Conditioner“. In addition, the Power Conditioner not only works to convert DC into AC, but also controls the frequency, voltage, current, phase, effective and ineffective power, synchronization, output volume (fluctuations in voltage, higher harmonic waves), etc. The power conditioner has the following functions:

**“Automatic Stop of Operation”, “Max. Power Follow-up Control”,  
“Independent Operation Prevention”, “Automatic Voltage Adjustment”**



# Power Conditioner functions



Corner Module (Left)  
NE-050BL



Standard Module  
NE-100BC



Corner Module (Right)  
NE-050BR

Example

1st System: 100V/50W

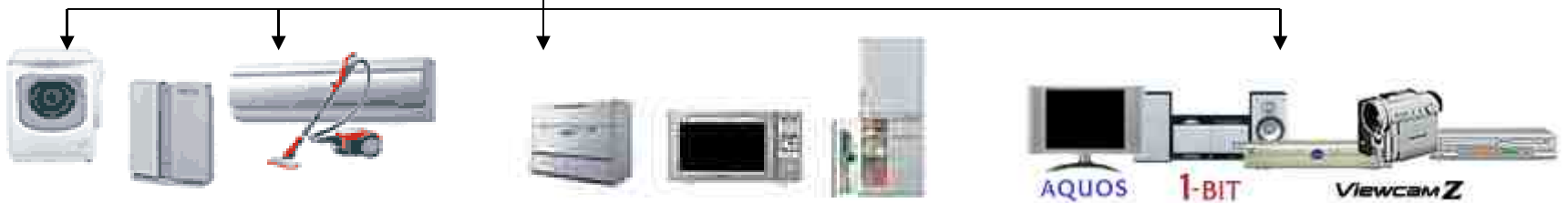
2nd System: 200V/100W

3rd System: 90V/40W



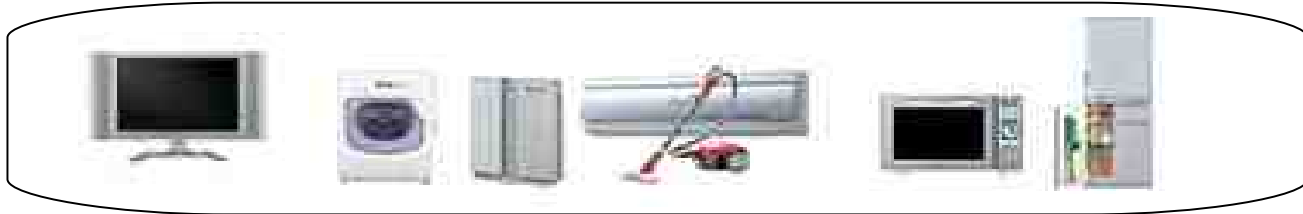
- \*DC ⇒ AC conversion
- \*Voltage control among systems
- \*Frequency □Phase □Current control
- \*Output quality control □□□□□
- \*Fail-safe device function, etc.

Distribution Board





# What does a System Integrator do?



Corner Module (Left)  
NE-050BL

Standard Module  
NE-100BC

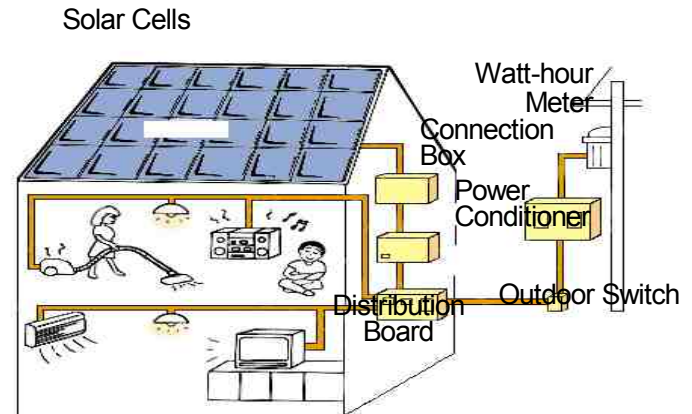
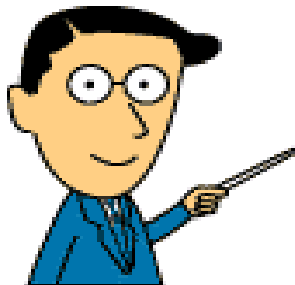
Corner Module (Right)  
NE-050BR

Module



Power conditioner

Taking the volume of power consumption, installing conditions, etc. into account, the system integrator proposes an optimal combination of equipment and method of installation.



# Modules for residential use

## NE "Yosemune" series

**New**

Standard Module

Poly-crystal **NE-100BC**

Module Conversion Efficiency: **13.2%**

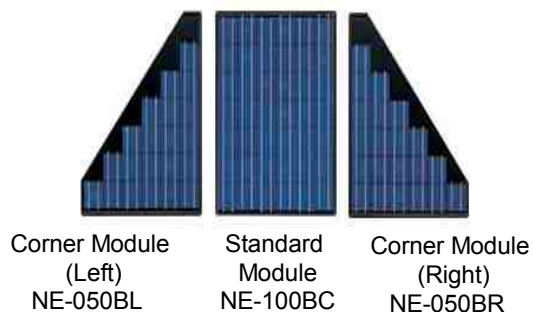
Nominal Max. output: **100W**

Corner Module (Left) (Right)

Poly-crystal **NE-050BL/BR**

Module Conversion Efficiency: **10.2%**

Nominal Max. output: **50W**



## ND "Yosemune" series

**New**

Standard Module

Poly-crystal **ND-146CM**

Module Conversion Efficiency: **12.7%**

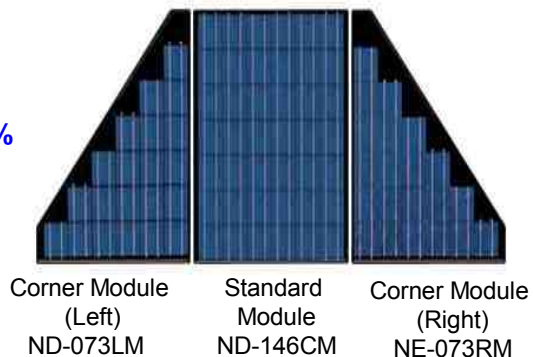
Nominal Max. output: **146W**

Corner Module (Left) (Right)

Poly-crystal **ND-073LM/RM**

Module Conversion Efficiency: **9.7%**

Nominal Max. output: **73W**



# Power Conditioner for residential use



Compliance with input: 6 □12 modules  
Compliance with input: 4 □6 modules  
Compliance with input: 5 □9 modules



Compliance with input: 6 □12 modules  
Compliance with input: 4 □6 modules  
Compliance with input: 5 □9 modules



**JH40JV**

Rated Output: **4.0kW**

