Smart buildings
A step in creating smart cities

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Dedicated to my father

A steadfast mountain and supporter of me throughout my life

Dedicated to my mother

The stone of patience that taught me the alphabet of life

Dedicated to my brothers

My kind companions, my life

Foreword

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Energy generation strategy from renewable energies

Briefly about renewable energy

Experts, consider energy as the driving force of all-round economic development in all countries and how to use available energy resources is the main factor in the economic development of post-manpower societies.

Concerns about environmental change, coupled with rising fossil fuel prices, have led to legislation that allows renewable sources to be exploited and commercialized. Renewable energy refers to the types of energy that, unlike non-renewable energy, have the ability to be recovered in nature.

Solar energy, wind, geothermal, biomass, hydrogen and fuel cell, oceanic and hydropower are among the renewable energies. Exhaustion of fossil and nuclear fuel resources and the destruction of the environment by pollutants resulting from the exploitation of these energy resources, the option of using and developing the use of renewable energy has become a necessary and inevitable, but the use of renewable energy sources faces a major challenge, and that is the high cost of their energy. The technology of using renewable energies is relatively new, and addressing these energies in terms of research and acquiring technical knowledge and making them economical is inevitable for any nation. Energy

experts and planners around the world agree that renewable energy should play a better role than it does today in providing the energy needed by human societies.

Energy production from ocean currents

Ocean current energy is a type of ocean energy and from renewable energy sources that is obtained from the kinetic energy of the ocean current. Such as: Golf Stream. Although not currently used industrially, it potentially has a lot of energy that can be used for production, and this is while these currents are more predictable than wind and sun.

The possibility of using ocean currents as an energy source first attracted attention in the mid-1970s, after the first oil crisis. In 1974, several concept papers were presented at the MacArthur Energy Workshop, and in 1976, British General Electric company conducted research on ocean current energy. This study concludes that ocean current energy needs to be further investigated to determine its larger dimensions. Shortly afterwards, the ITD team in Britain conducted a research program that included a one-year operation test of the Darius Blue Rotor, which was installed in Juba, the capital of South Sudan, on the White Nile River. The 1980s

saw a number of small research projects evaluating ocean current power systems.

The main countries where the research was conducted are the United Kingdom, Canada and Japan. Between 1992 and 1993, the Tidal Stream Energy Review company identified several specific sites in British waters with flow rates of up to 58 TWh per year. The results of this study showed that the use of ocean current energy sources is able to meet 19% of the need for electricity in Britain. Between 1994 and 1995, the EUJOULE CENEX project identified more than 100 offshore sites in Europe, ranging in size from 2 to 200 square kilometers, most of which had a power density of more than 10 megawatts per square kilometer. The British government and the European Union have both committed themselves to complying with agreements reached in international negotiations on global warming. As a result, in order to comply with such agreements, an increase in electricity generation from large-scale renewable sources will be required.

Ocean currents have the potential to supply a significant portion of future electricity demand in EU countries. A study of 106 possible sites for the installation of tidal turbines in the

EU showed that there is a good potential for generating power of about 50 TWh per year. If these energy sources are used successfully, the required technology can form the basis of a new industry for clean energy production in the 21st century.

Other technologies in offshore energy applications

There are several types of open source devices that can be used in marine energy applications. Many of them are the new generation of water mill or similar.

There are two types of water turbines, one of which is selected according to need. These turbines have a horizontal axis and a vertical axis (both can be fixed to ground or variable).

Ocean energy can be extracted in four ways:

1. Marine current energy
2. Wave energy
3. tidal energy
4. ocean thermal energy conversion

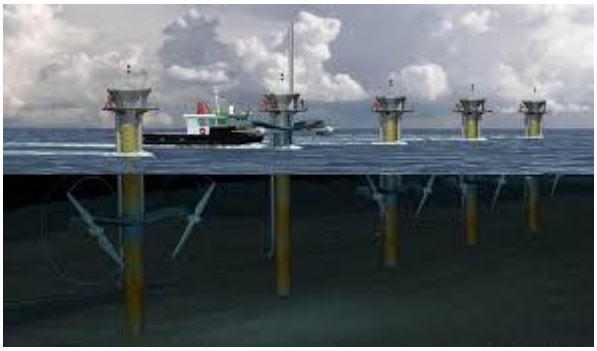
Energy of water currents

The ocean water is constantly moving. Ocean currents move in a variety of patterns that are influenced by wind, water salinity, tail, ocean floor map, and land rotation. Ocean currents are generated by wind and heat near the equator due to the sun, but some of these currents are caused by differences in water density and salinity. These currents are relatively constant and flow in only one direction. Although ocean currents travel at less than wind speeds, they carry a significant amount of energy due to the high density of water. Water is 800 times more denser than air, so for the same surface area, water at 12 mph exerts the same pressure as wind at 110 mph.

The total power of ocean currents is estimated at about 5 TW, which is about the same as global electricity consumption. However, energy extraction is practiced only in limited areas where currents near the ocean (coasts) are concentrated or in straits and narrow passages between the Landform Islands and the lowlands and highlands. Therefore, only a small part of the total energy can be converted into electrical energy or another form of energy.

The current power is proportional to the cube of flow velocity. For tidal currents near the inlet of the river and in

the channels between land and island, the velocity of the flow changes sinusoidally with time and with a period that depends on the various components of the tide. Sites that are suitable for operation are economically viable and have a maximum flow rate of more than 1/5. For sites with non-oscillating currents, the maximum flow rate may be 1.



Most resources are in Europe and around the UK, Ireland, Greece, France and Italy. In these areas, 106 locations have been identified and it is estimated that using modern technology can supply 48 (trillion watts per hour) of European electricity. High potential sites have been identified in the Philippines, Japan, Australia, North Africa and South America.

The fastest non-tidal ocean currents are carried out by complex processes involving the absorption of solar radiation

by the atmosphere and the ocean. This is done by transforming and redistributing from the equator to the poles by moving air and water currents, and finally concentrating ocean currents on the western edges of the ocean (or east coast) as the earth rotates. The Gulf Stream in the Atlantic Ocean, the Kuroshi in the Pacific Ocean (Japan), and the Agul assomali on the east coast of Africa are the main marine flow systems.

Energy extraction technology from water currents

A very common way to exploit water currents is to use a turbine that is placed perpendicular to the direction of flow in the seabed or hung from a floating platform.

There are challenges to using the energy of currents, including:

1) Create cavitation on the devices causes a decrease in efficiency.

2) Impact on the marine environment and change in sediment transport pattern

3) Reliability (because maintenance costs are high)

4) Corrosion and erosion of devices in water due to environmental salinity

planning the use of flows energy requires the protection of aquatic species from damage due to rotation of the turbine blades. Also, considerations of slowing down the flow by extracting energy from the flow of local effects, such as changes in the composition of the river inlet, can affect aquatic species.

Wave energy

Wave energy can be considered as a concentrated form of solar energy. Winds are created by the temperature difference of the earth, and by blowing over a large area of water, part of their energy is converted into waves.

The amount of energy transmitted and the size of the resulting wave depend on the wind speed, wind blow duration , and the distance that the wind has blown over it . Approximately 100 solar power is converted into waves with a power of 5010 kw.

The global power of the waves is estimated at 8000800000 trillion watts per year (Tw110). Areas with favorable waves are located at latitude 30, where regular winds blow. The available power is proportional to the square of the wave height and the wave period. Wave energy is at its highest in the winter months.

Wave energy is the conversion of potential and kinetic energy in a wave. The cyclic motion propels the energy wave forward.

Energy extraction technology from waves

Here we classify the devices used to harness the energy of the waves according to their location:

1) Shoreline devices

2) Near-shore devices (fixed on the ocean floor)

3) Off shore devices

Coastal devices:

Oscillating water column

It is an underwater structure in which air above the surface of the water is trapped and the incoming waves cause the water column to oscillate, causing the turbine to move.

Generate energy from wind energy

Wind energy is the energy of moving air. When the sun's rays reach the uneven surfaces of the earth unevenly, it causes changes in temperature and pressure, and as a result of these changes, wind is created. Also, the Earth's atmosphere transfers heat from the tropics to the polar regions due to the movement of the Earth's position, which also causes wind. Ocean currents do the same thing, accounting for 30% of the world's total heat transfer. On a global scale, these atmospheric currents act as a powerful agent for heat transfer. The Earth's epoch can also generate double the energy to

establish semi-permanent patterns of planetary currents in the atmosphere.

Advantages of wind energy

▪ No need for wind turbines for fuel, which reduces the consumption of fossil fuels.

▪ free wind energy

▪ Ability to supply part of the electricity demand

▪ Relatively lower price of wind energy in the long run

▪ Diversify energy sources and create a sustainable energy system

▪ No need for water

▪ No need for a lot of ground for installation

▪ Creating employment

▪ No environmental pollution

Inefficiencies in the use of wind energy

▪Landscape effect:

One of the biggest obstacles to exploitation of wind energy is its environmental impact. Many people say that wind turbines are visually unpleasant and noisy; Especially because they are located in beautiful areas outside urban areas. But it must be said that a coal-fired generator will certainly be noisier and uglier than wind turbines. The continuous sound of wind turbine tower turbines is an important issue for those who are close to them. The sound of these generators can now be controlled with the help of three-blade gears and turbines.

▪ Birds:

The operation of wind turbines can harm birds. This damage can occur in the form of birds being killed as a result of collisions with towers or rotor blades, or through breeding disturbances or bird sanctuaries near the turbine.

▪ Sound:

The disturbance caused by the sound produced by wind turbines is perhaps the most important limiting factor in installing wind turbines in the vicinity of residential areas.

The sound emission of wind turbines is obtained from mechanical and aerodynamic components. The aerodynamic

contribution of the sound produced is a function of wind speed.

▪Telecommunication interference:

Wind turbines disturb the electrical waves in the environment. These waves may be reflected, propagated, or be broken by wind turbines, interfering with telecommunications.

▪ Safety:

Wind turbine accidents are rare but occur like other industrial activities. In most cases, these accidents occur when technicians try to stop wind turbines.

● Types of wind turbines

Modern wind turbines can be divided into two groups:

1) Wind turbines with horizontal axis

2) Wind turbines with vertical axis

Home wind turbines consist of an engine, a generator and usually a sequence. As the wind passes through the vanes, the rotor captures the kinetic energy of the wind and converts it into rotational motion, causing the generator to rotate. The rotor can have two or three blades. Three-bladed rotor is more

common. The amount of energy that a turbine can produce depends primarily on the diameter of the rotor. The turbine frame consists of a strong axial rod on which the rotor, generator and tail are mounted. The task of the sequence is to always keep the direction of the turbine towards the wind.

Wind turbines with independent functions can be used, or they can be connected to a power grid or even combined with a solar cell system. An independent turbine is commonly used to pump water or communications, although in windy areas homeowners and farmers can also use turbines to generate electricity.

At the applied wind energy scale, a large number of turbines are usually built close together, thus forming a wind farm.

●Types of applications for wind turbines

Non-power plant applications include:

▪Drainage air pumps that are used for the following:

1. Providing drinking water to animals in remote areas

2. Small-scale irrigation

3. Shallow watering for aquaculture

4. Supply of domestic water

5. Use of small wind turbines as a power generator

6. Battery charge

▪Single wind power plants to supply electricity to residential, commercial, industrial or agricultural units

▪Wind electricity farms to supply part of the grid electricity demand

● Economic study of wind energy use

Today, wind energy technology is available in many countries and has been identified as the cheapest way to generate electricity from solar energy derivatives. The cost of energy produced depends on environmental and practical factors, as well as the type of machine used.

Various studies on the price of wind energy use show that although the cost of wind machines increases with size and their estimated power, but the cost per kilowatt of energy decreases. It should be noted that there are restrictions on choosing large devices. For example, if the final speed of the windshield blade reaches the speed of sound or more, it will

cause the machine to heat up and wear out, and the machine will fail quickly. In addition, it should be tried that the wind machines have a lower main cost (the cost of building a rotor, rig, etc.) and should be installed in places with significant wind and the machine should be adjusted for practical wind speed.

Getting a car that works for all wind speeds is more expensive. Conventional wind machines are primarily used to prevent the consumption of other fuels during windy days and are used in conjunction with other energy generators.

If the wind machine is used as the only source of energy, energy storage devices should be used alongside wind machines. By adding storage devices, the price of electricity generated may increase dramatically.

In evaluating wind farms, project costs and revenues, payback period, price of generated electricity and internal rate of return on capital are the final indicators for a complete comparison of the various components. As we pursue sustainable development to expand our electricity supply system, we must consider all the costs and social benefits of each generator. It should be noted that among the economic

and non-economic benefits, only the cost of disposal of environmental pollutants and treatment of harmful gases emitted from fossil power plants can be included in the calculations. These costs actually cover all the environmental effects of pollutants in the short and long term, such as the production of hydrocarbor and other toxic gases, soil and water pollution, and acid rain and greenhouse gas emissions.

In addition, the cost of generating electricity from wind energy has dropped significantly in the last two decades. Electricity generated by wind energy in 1975 was 30 cents per kilowatt hour, but in recent years it has dropped to less than 5 cents. The development of new turbines will also lower prices. Germany, the United States, Spain, Denmark and India are also the leaders in the world, and the total capacity of wind turbines in the world by the end of 2004 is 616 / 47 GW.

In recent years, with the increase in the size of commercial turbines, their investment prices have decreased. The wind energy industry has various economic and social benefits, the most important of which are:

▪ No social costs

These costs are present in all conventional (fossil) energy options, but despite their significant amounts, they are not usually considered in economic studies. The World Wind Energy Association (WWEA) likens these costs to an iceberg whose massive and invisible volume is under water.

▪ Reduce reliance on imported energy sources

This is one of the most important reasons for the approach of industrialized countries to renewable energy and wind energy, but in oil-producing countries such as Iran can also be viewed from another perspective, and that is to increase export opportunities.

▪ Strengthen the social and economic structure of rural areas

Due to the nature of wind energy, which produces decentralized and often remote and rural areas, the development of this industry, both in capitalist and developed countries and in developing countries, will lead to obvious changes and developments in rural areas.

▪Job creation

Job creation in this industry is the most important among other energy industries. In Europe, installing one megawatt of

wind power creates 15 to 19 jobs, which could easily double in developing countries. In 2000, when the installed capacity of wind power in Europe was about 8,000 MW, more than half a million people were employed in the industry. The economic aspects of wind energy are quite different for different applications. The highest share in global energy will belong to grid-connected wind turbines.

In discussing the economic aspects of wind energy, the costs of energy production and the value of energy produced must clearly be considered quite separately.

- System shelf life

For economic studies of turbines, a useful economic life of 20 years is often considered, which is equal to the useful life of the system design. However, it should be noted that the proven useful life of the best turbines is currently 10 to 15 years.

●Operating and maintenance costs (O&M)

Annual O&M costs are often calculated as a percentage of total investment costs or electricity generation costs per kilowatt hour.

Since the wind energy potential is proportional to 3v (v wind speed), it is very important to choose places where the average annual wind speed is as high as possible and the constant wind blows frequently during peak hours. In order to be able to calculate the value of using wind in the energy consumption system, we must also know the time dependence of the wind regime. Constant wind, daily changes and wind source turbulence can be just as important as the average wind speed per year.

●Technical availability of the system

System availability is a fraction of the time per year that a turbine can potentially generate energy. A wind turbine may not be available due to repair activities or unpredictable breakdowns or accidents. Reliable figures on the availability of different types of wind turbines can only be provided if these figures are based on numerous experiences of wind turbine use over several years of operation. Only the United

States and Denmark have enough experience to provide such information.

When evaluating the availability of wind turbines, the progress made in improving the turbine should be reviewed simultaneously.

What is the value of wind energy?

The value of wind energy depends on the energy application and the cost of other options to cover the same application. According to power companies, this value can be defined as fuel costs, capacity and emissions that will be prevented if wind energy is used. In general, the amount of social perception and perception of this value is equivalent to net savings in total social costs.

- Fuel saving

When wind energy is connected to a power generation system, it reduces the electricity generated by other types of power generating units. Therefore, fuel consumption is saved.

The amount and type of fossil fuel saved depends on the composition of current and future electricity producers. On the other hand, fuel savings depend on the characteristics of

the production units and the amount of wind energy penetration in the entire power generation system.

●Capacity saving

Due to the wind speed variable, wind energy is often considered as a source of energy that has no capacity value, but the share of wind energy in the reliability of the entire power generation system is not zero. It is possible that, when conventional power plants are not available, wind farms are available.

Of course, this probability is lower than a conventional unit for a wind farm, but it indicates that wind energy has a limited capacity validity. Capacity validity can be calculated by examining the reliability of the entire system, and to determine the reliability of the entire system, statistical methods can be used by calculating the minimum capacity required with or without wind turbines in the power generation system. Wind energy capacity validity has been determined for different energy generation systems.

●Save publications

During normal operation of wind turbines, there is no release into the air, water or soil. In almost all power generation systems, these emissions are caused by burning fossil fuels. This means that for every energy generated by wind turbines, fossil fuel consumption is saved and a certain amount of pollution is prevented from being emitted. The amount of prevented emissions depends on the composition of the generating units in the area and the measures taken to reduce emissions.

●Costs of fuel, capacity and emissions saved

Based on the cost savings in fuel, capacity and emissions, the amount of cost savings that can be achieved by exploiting wind energy can be calculated. According to the Energy Supply Organization, these calculations indicate the value of wind energy.

Usually, just saving on publishing can also be turned into cost savings. In some studies, these cost savings are estimated by researching the cost of damage to plants, animals, building materials, and humans due to acid rain, increased greenhouse effects, and so on. In some other studies, cost savings are calculated by estimating the cost of applying additional

emission reduction methods to conventional power plants to achieve the same amount of emission reduction that results from wind energy utilization.

Use of solar energy and solar panels in the building

Solar energy is one of the free sources of clean energy without any environmental damage, which is used today due to the energy crisis and the minimization of pollution. Today, due to the lack of quality materials and proper insulation in construction, the amount of energy consumption and waste in the building is very high. The cost of fossil fuels and other energy sources is very high and the occupants of the building have to pay exorbitant costs to pay the bills. But solar energy is an available and free source that can be used for a variety of building purposes. For example, this type of energy is used to heat the water needed by radiators to provide heating in the building or to generate electricity. Cooling and heating systems and solar water heaters significantly reduce energy consumption in the building and play an effective role in the life of the building. Basically, solar systems are also equipped with an auxiliary system so that they can be used when necessary when the amount of solar energy is not enough to supply the energy required by the building.

How solar cells work

From Solar cells, the required energy of the building can be provided by using thermal absorption method and photovoltaic method. In the method of thermal absorption, heating and water supply of the building is used through receiving, storing, distributing and converting energy into heat. In this method, the maximum amount of solar energy is received by the reflection of light from the surfaces of solar cells, but in the photovoltaic method, solar energy is converted into electrical energy and the electricity required for heating, cooling systems and electrical devices is provided.

Application of solar panels

Home heating

One of the uses of solar cells is to supply hot water for heating systems in the building. Water pipes installed on the roof pump water into the building after heating.

Energy saving

A typical solar system includes solar panels, a converter to convert direct current (DC) to alternating current (AC), equipment for installing panels of the roof, and a performance monitoring system to track power generation. A battery can be added to this equipment. But what is the function of this battery?

When the solar system installed on your building generates more electricity than the building consumes, the excess electricity generated can be stored in a battery, charged, and used on cloudy days or at night when there is no sunlight and charged it again on sunny days. The larger the battery capacity used, the more energy can be stored in it.

In addition to using batteries to store surplus electricity, there are two other ways to store solar energy:

1.The first way is in molten salt (liquid salt). The heat energy from concentrated sunlight can be stored at high pressures in these salts, and when needed, heat can be transferred from the molten salt to the water by a heat exchanger to provide the steam needed to movement a turbine.

2. The second is to harness and store solar energy in order to use sunlight to produce fuel.

For example, a photoelectrochemical cell uses solar energy to break down water molecules and convert them into oxygen and hydrogen gases that can be stored as fuel. These gases are then combined to generate electricity in a device called a fuel cell. An interesting feature of this method of energy storage is that the by-product of this cell is water.

Heating pool water

The pool is one of the great entertainments, the warm water of which excites you on winter days and conveys a calming feeling to you. Using solar cover, you can easily heat the pool water and enjoy being there. The hot water heating system consists of heating plates installed on the roof and after absorbing the sun heat, it directs it to the pool.

Hot water supply

Instead of using gas or electric water heaters, solar energy can be used to heat the building water. The use of solar panels is the most cost-effective way to supply hot water and plays an effective role in reducing gas and electricity consumption.

Air conditioning systems

Using fans and solar ventilation systems can significantly optimize energy consumption and reduce running costs. Air conditioners such as toilets, kitchens, bathrooms and air conditioners that work during the day have high energy consumption, so in order to reduce the cost of bills and use solar renewable energy from solar panels are used provide energy for ventilation systems.

Provide outdoor lighting

Using solar panels, you can charge the batteries during the day and use them at night to light the lamps that are installed in the building and gardens. With this method, the traffic route will be lit at night and the residents will not be confused.

Solar dryer

In solar dryers, the process of drying food and clothes can be done easily using solar energy.

Solar desalination system

When saline water is evaporated by low heat of the sun, the salts remain and Evaporated water can be reused using water desalination methods. This method can be used in areas where the water is salty and does not have access to fresh water.

As mentioned above, using a solar system saves money. We will now fully explain how this system can save you money in several ways, which are mentioned below:

1.Using this energy is actually a kind of investment

It is true to say that many of the things you do to improve your building does not create value for them as much as the money spent. But using solar energy actually saves you money every month you get a bill. Because you pay a fixed fee per month and less than usual.

In countries where the use of solar energy is more common, investing in a solar system will give their home exactly the same cost or more value and it helps a lot, when they are trying to sell their home. A study in California shows that the collective impact of this work is such that home buyers are willing to pay $ 15,000 more for a home with a medium-sized solar system.

Therefore, it is possible in our country that you will get back your investment money when you sell your house and you will save a lot of money.

2. Solar energy has a fixed cost for you

Your monthly electricity bill may always indicate an increase or decrease in your consumption, but the cost of the solar system is fixed, and if you have one of these systems, you will pay a fixed monthly fee.

3. With this system, you can sell your productive energy

If your home solar system generates more energy than you consume, you can make money by selling that extra energy to the grid.

4. In any case, money must be spent

Whether you spend your money on buying and installing a solar system or pay it on a monthly basis, you will have to spend it anyway. But keep in mind that although the initial cost of a solar system may be high, the cost of operating, maintaining and depreciating it is very low and the profit will be returned to you in a short time.

The beauty of the building

Photovoltaic solar cell panels can be used to replace or complement a typical building facade. Usually, these cells used in the facade of the building are installed vertically and therefore reduce the access to the solar energy source, which, of course, if this facade is used in a large area of the building, can compensate for the decrease in energy intake.

Solar cells can also be used in canopies or indented designs on the facade of the building, thereby improving access to direct sunlight in addition to providing shade.

These cells can be used as a replacement for roofing (plastic or wooden or clay pieces that cover the roof instead of the gableroof) on the roof of the building. Due to this, these cells can be installed on existing buildings and give it a new and beautiful look, thus increasing its value at the time of sale. For example, using photovoltaic cells as a skylight is an economical yet beautiful design.

There are two ways to use solar cells in a building:

1. Common solar panels composed of a number of photovoltaic cells.

2. Materials that are used instead of the usual and traditional materials for roofing, windows and building facades.

Ordinary solar panels, while useful, also have their drawbacks. These panels can be large and bulky and can be easily seen because they are installed on the roof of the house, on the other hand, they may not be resistant to harsh weather conditions and also reduce the beauty of the overall appearance of the building.

photovoltaics combined with the building (BIPV) solve many of these problems. BIPVs are materials that have replaced conventional and traditional materials and are used as solar cells in covering parts of the building such as roofs, windows, facades . These types of combination cells are increasingly being used in new structures because they can reduce the cost of building materials due to their excellent durability.

BIPVs can create a new design that the future is moving towards, and of course enable the distribution of electricity inside as well as the natural light of the interior.

Combined photovoltaic cells are usually made of stained glass, and in fact, in addition to the main application, can also be used to beautify the facade of the building.

These combined cells can be a on the roof of the house instead of the usual panels. They are designed to collect solar energy during the hours when sunlight hits the ground, while protecting the building instead of the usual roof. Combined cells are used in all types of architecture, including private homes, commercial buildings, industrial structures and even government buildings, and their popularity and reputation is increasing day by day.

In the case of building facades, as the first thing that comes to the viewer's eye, the issue of beauty is a significant and important issue. Today, in addition to the main purpose of using solar cells, architects want to use them for the beauty of their structure. It is interesting to know that these cells in any shape, design, size and color can be made and provided to the manufacturers.

In another application, these cells can be used for canopies and their angle and direction can be adjusted to receive the most energy from the sun while creating shade.

Another application of these cells is in the design of skylights, whose task is to provide light and electricity simultaneously for part of the interior of the building. Due to the existence of transparent and opaque solar cells, very beautiful and spectacular architectures can be created for this purpose. This type of solar cell used around the world shows that solar energy can be intelligently and beautifully applied to a wide range of architectures.