

Review

# Unleashing Sustainable Energy: The Sun, Earth's Largest and Most Powerful Source

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**Abstract:** Solar energy is energy that the Sun radiates into space and towards the Earth. The sun is the largest and most powerful source of energy. Solar energy can be used for heating, lighting and cooling of houses and other buildings, generating electricity, heating water, and in various industrial processes. Most forms of renewable energy come directly or indirectly from the Sun. The total solar energy that is sent to the Earth annually is greater than the energy that can be obtained from the total reserves of coal and oil. Most of this energy is converted indirectly into energy production processes, and a smaller part serves as a direct source of energy.

**Keywords:** Sun, Solar Energy, PV, Renewable Energy, Energy Efficiency

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## 1. Introduction

At an average rotational radius across the Sun of  $1.49 \cdot 10^{11}$  m and with an average radius of 6,378 km, the Earth receives an immense amount of solar radiation, approximately  $1.73 \cdot 10^{14}$  KW, far exceeding the collective power needs of its entire population [1]. This constantly obtained power, that's known as incident sun radiation and shortened to insolation, integrates to a complete power of  $5.46 \cdot 10^{21}$  MJ per year, or more than one hundred million instances the overall power utilized by earthlings in a year. This tremendous amount of energy is abundant, free of charge, nearly uniformly distributed and to be had to all international locations and population of the planet. However, simplest a totally small fraction of the incident sun radiation is used by the Earth's population. Passive sun heating structures provide with area heating and warm water a low fraction of the homes, primarily in OECD nations, whilst thermal sun power plants and photovoltaic cells offer a small fraction of the electricity consumed. Despite its low usage at present, and due to the large quantities of power reaching the Earth, sun energy is a prime alternative energy source and has the capacity to supply a totally high fraction, if not all, of the electricity used by the Earth's population.

The impact of solar technology on society has, so far, been small, with one most important exception—the usage of solar panels to power spacecraft [2]. In the United States, for example, much less than one-tenth of 1 percentage of the nation's electricity supply comes from solar generating stations.

But if the contribution made by means of solar energy technology has been modest in comparison with many different greater traditional energy sources, the equal can't be stated for claims approximately its potential. For many years, advocates of solar power have downplayed the problems worried in harnessing the Sun's energy, who prefer rather to are expecting short and significant adoption of various solar technologies.

The Sun's energy is diffuse, and at Earth's surface it's also intermittent and unreliable. Consequently, whilst fossil fuel-fired technology has been advanced that allowed customers to provide big quantities of warmth on every occasion and anywhere they wanted, human beings anywhere followed them. Homes, factories, and public buildings have been built with little regard

for the Sun as a supply of warmth. Interest within the Sun as an energy source waned as in line with character energy usage soared. This revolution in energy usage began with coal; next was oil, and different energy sources quickly followed. Some designers continued to construct with the Sun in mind, but only where and when the price of fossil fuels was high.

## 2. Availability

### 2.1 Solar Energy

Solar energy is to be had everywhere on Earth and may be accumulated without problems with transportable gadgets [3]. This benefit minimizes the troubles of transporting fuel or transmitting electricity from point of manufacturing to point of use. Solar energy is nonpolluting and clean. It produces no air or water pollutants. There isn't any trouble removing dangerous wastes. No mining or drilling is needed (except for the mining of a suitable source of silicon in the first place). The maximum essential benefit of solar energy is that it is virtually inexhaustible. The energy source—the sun—can't be owned and monopolized, as fossil fuels have become because of the unequal geographic distribution of known reserves.

Of course, solar energy also has its drawbacks. Sunlight, being a dilute energy source, requires large amounts of land for certain applications, together with crucial station power plants. This can also additionally pose a trouble in a few regions, together with wherein natural world safety is a concern, or in city regions with very excessive prices of obtaining land. A second disadvantage is the inconsistency of direct daylight as an energy source. Not only night, however clouds and seasonal changes have an effect on the rate at which direct daylight may be accumulated. Erratic daylight creates the want for strategies of storing energy till it is needed. Backup structures the usage of different energy sources might be had to deliver sun houses or workplaces all through extended durations of horrific climate when stored energy might be depleted. A feasible trouble with the large-scale use of indirect solar plants is the generation of thermal pollutants, simply as is true with any technology using steam turbines. Indirect solar plants also require cooling water, which can be costly or scarce in desert areas.

The huge use of solar energy is restricted by means of the excessive prices of the solar collector and the photoelectric cells and, for that reason, much less aggressive than different renewable and non-renewable energy sources available now in the world [4]. In addition, business solar modules usually have efficiencies of 15%, because approximately one-sixth of the daylight striking a module generates electricity. However, solar technology is suitable for programs wherein direct sun radiation is excessive. The many forms of structures under development (such as parabolic troughs, power towers, and dish/engine structures) for distinct markets range in step with the awareness gadgets, energy conversion strategies, storage options, and different layout variables. Exploitation of solar energy requires daylight situations which are specific to certain regions of the world only. In Europe, the best zones for solar power development plans are within the Mediterranean regions covering Spain, the south of France and Italy.

Solar energy refers primarily to the usage of sun radiation for realistic ends together with sun heating, sun photovoltaic (PV), sun thermal power, sun architecture, and synthetic photosynthesis. However, it's important to highlight that all renewable energies, aside from geothermal and tidal, derive their energy from the sun.

Solar technology are extensively characterised as either passive or active depending on the way they capture, convert, and distribute daylight. Active solar techniques use PV panels, pumps, and fans to transform daylight into beneficial outputs. Passive solar techniques consist of choosing substances with favorable thermal properties, designing spaces that naturally circulate air, and referencing the location of a building to the sun. Active sun technology increases the delivery of energy and are taken into consideration to deliver side technology, whilst passive solar technology reduces the need for alternate resources and are usually taken into consideration demand side technology.

### 2.2 Waves

When calculating revenues from investments in solar energy, the primary parameter to not forget is latitude [5]. Let us assume that the Earth is round (a sphere). This causes the rays from the sun to hit the Earth's surface at different angles, starting from zero° (whilst the sun is above the horizon) to 90° (whilst the sun is perpendicular to the Earth). The prevalence of sunlight depends on geographic location, the time of year, and the time of day. The power of the rays from the sun describes such quantities as sun radiation, Global Horizontal Irradiance (GHI), Direct Normal Irradiance (DNI), Diffuse Horizontal Irradiance (DIF), and insolation. Solar radiation, frequently known as the solar resource, is a well known time period for energy emitted from the sun in the form of electromagnetic waves. There is likewise described GHI that's the ratio of the overall quantity of shortwave radiation falling horizontally on ground from outer space. This is the value that nicely describes the parameters for solar installations and consists of both DNI and DIF parameters. Most energy radiated from the sun hits the Earth's surface when the sun is perpendicular to it. The smaller the angle, the greater the rays from the sun dissipate, offering much less energy. Therefore, the amount of energy received from the Sun is typically decided by means of DNI parameter, because of this that the quantity of sun radiation obtained in line with unit area by means of a given surface measured on a flat aircraft perpendicular (or normal) to the rays from the sun. This is one of the maximum essential parameters that have to be taken into consideration in order to maximize the efficiency of photovoltaic panels. The DHI means a quantity of energy received in line with an area unit by means of a surface (which isn't always subjected to any shade) that doesn't arrive in an immediate path from the sun but is scattered by molecules and particles in the atmosphere and comes potentially from all directions.

The Sun emits a large amount of energy, only a tiny part of that's intercepted by means of Earth [2]. The power propagates via area within the form of electromagnetic waves, that are periodic versions within the depth of electrical and magnetic

energy. These periodic versions may be visualized as sinusoidal, water-like waves, in which case the wavelength of an electromagnetic wave would be the distance from the crest of one wave to the crest of an adjacent wave. Light waves and radio waves are probably the most familiar examples of electromagnetic waves. Electromagnetic waves are outstanding basically by means of their wavelengths. Radio waves have wavelengths which are fairly long; they vary from meters to millimeters in length. Infrared radiation, that's perceived as heat, is characterised by means of electromagnetic wavelengths that fluctuate from approximately one-tenth of a millimeter to approximately 700 nm, where the abbreviation nm stands for nanometer, or one-billionth of a meter. Visible light consists of electromagnetic radiation with wavelengths within the variety 700-400 nm. Different wavelengths inside this interval are perceived as different colors, and the complete spectrum of visible electromagnetic radiation may be visible in a rainbow, wherein the longer wavelengths appear toward the outer rim of the rainbow. Red is the color with the longest wavelengths. The shorter wavelengths appear close to the inside rim of the rainbow. Violet is the color with the shortest wavelengths. Electromagnetic waves with wavelengths much shorter than approximately 400 nm or a great deal longer than 700 nm can't be perceived by means of human eyes. Ultraviolet waves, that are responsible for sunburns, have wavelengths which are shorter than violet's.

The Sun's energy radiates out in all directions, and because it spreads out, it will become weaker. But even after crossing the splendid expanse of empty area that separates the Sun from Earth, a flat plate placed above the atmosphere and oriented perpendicularly to the Sun's rays might receive the Sun's electromagnetic energy at a rate of approximately 1,368 watts in line with square meter, a quantity known as the solar constant. (The solar constant is usually defined in phrases of watts in line with square meter—never in imperial units.) Despite its name, the solar constant isn't always constant. The fundamental source of variant within the solar constant—its simplest quantities to approximately three percent of its price—is because of small changes in the Earth-Sun distance, and this modification is because of the marginally elliptical path about which Earth orbits the Sun.

### 2.3 PV

Photovoltaic (PV) technology converts daylight directly into electricity [2]. Improving the efficiency of photovoltaic technology and lowering its prices are most important studies targets at many laboratories, each public and private, around the world. The reason is simple: PV technology has the capacity to convert more of the Sun's light into electricity than different competing technology together with, for example, the more common parabolic trough structures. And PV technology is already not an unusual place in some areas of interest. Some calculators depend upon PV cells for their power, for example, and PV cells offer electricity in conditions wherein get entry to to the grid is not possible. Other specialised programs exist. But despite many years of research, PV technology nevertheless makes a negligible contribution to the supply of electricity for the grid. Nor have many house owners turned to arrays of PV panels as an opportunity to the grid. To appreciate PV technology, it's miles essential to recognize each its successes and its failure thus far to compete with greater traditional power generation technologies.

Solar energy is a renewable resource, and increased use of the resource does now no longer have an effect on its availability [6]. Solar photovoltaics launch electrons which generate electricity after the rays from the sun strike the surface of the photovoltaic cells. Photovoltaic structures can be installed on rooftops, included into constructing designs and vehicles, or scaled as much as megawatt scale power plants. Photovoltaic structures also can be used at the side of concentrating mirrors or lenses for large-scale centralized power.

There are types of photovoltaic technology: (a) crystalline silicon-based photovoltaic cells and (b) thin film technology made from different semiconductor materials which includes amorphous silicon, cadmium telluride, and copper indium gallium diselenide. Solar thermal technology makes use of sun warmth for heating and electricity generation. Solar thermal technology can either be (a) sun thermal nonelectric and (b) sun thermal electric powered. Solar thermal nonelectric is used for agricultural drying, water heaters, air heaters, cooling systems, and solar cookers, whereas solar thermal electric powered entails the usage of sun warmth to provide steam for electricity generation.

Energy within the shape of warmth is one of the fundamental power necessities in home, agricultural, business and business areas of our economy [7]. From an induce point of view, sun thermal power finds its application in these regions. Solar thermal energy devices convert radiant energy of the solar into thermal energy for different productive works. In fact, sun energy includes infrared radiation. It is characteristic of infrared radiation that on every occasion it falls on any object, it converts into thermal heat energy.

The conversion of sunlight into thermal energy is without problems or readily completed through a steel or plastic cover, painted black with ordinary black board paint or having selected coating over it and protected with one- or double-glazing cover for transmitting sun radiation inside it. This steel cover is known as an absorber, below it either channels or pipes or passages for permitting access of water or air are provided, via which heat energy is transferred to operating medium both air or water. The absorber plate is protected with suitable thickness of insulating material on its back or sides for preventing loss of heat from the absorber plate. This whole system is enclosed in an airtight box. When exposed to sun radiations, the blackened steel surface absorbs sun energy and converts into heat. This heat can be used for cooking meals, heating of water and air, evaporation of moisture from the grains etc. In fact, the absorber works on the principle of black body, which absorbs maximum and a good absorber is a good emitter. Hence generated heat can be utilized for distinct programs.

Solar radiations, this is, electromagnetic radiations emitted by means of the sun, represent the maximum abundant natural, easily exploitable, clean, and reliable resource on Earth, and it could be exploited to provide solar power through solar photovoltaics (PV) and concentrating solar power (CSP) technology [8].

Solar CSP plants have garnered increased interest within the sun energy area because of its better performance and decrease prices. Generally, CSP plants are composed of numerous additives: sun concentrators, receiver, steam turbine and electric generator, and thermal storage. Mirrors are used to pay attention to sun rays and convert them into high-temperature heat; the heat is then channeled via a traditional generator to provide power. CSP may be labeled into four fundamental technologies. Among them, the parabolic trough collectors display the maximum superior operational level, yielding up to 354 MW and operating at temperatures up to 500°C with excessive modularity and the best land use factor. They are used to pay attention to daylight into receiver tubes positioned within the trough's focal line. A thermal transfer fluid together with a synthetic thermal oil is added alongside those tubes. After being heated to about 400°C by means of the sun radiation, the oil is pumped via heat exchangers to supply heat for vapor generation or different thermal applications. By installing the sun parabolic trough plant at offshore regions, the requirements for the concentrator structures may be simplified because of the solar's monitoring alongside a vertical axis, and thermodynamic efficiency can increase due to the availability of huge quantities of cooling seawater.

Solar PV plants include more than one cell and mechanical and electric connections, which permit the direct conversion of sun rays into electricity without any heat engine. Solar cells are the primary components of the system, and that they may be outstanding into three different generations based on materials (crystalline silicon wafer-based cells, thin-film cells, organic materials based cells).

## 2.4 Water

Approximately 50% of the world's population lives in rural regions [9]. Another truth additionally brings approximately the facts that the rural population exceeds 70% of the country's population, specifically in low- and middle-income countries. In many countries, the percentage of rural GDP is much more than that of urban GDP; however, in terms of quality of life, the rural population is a long way behind that of the urban population and lacks access to fundamental services such as electricity, water supply, transport, sanitation. Water is a fundamental necessity of life, and the availability of potable consuming water is a high priority for improving health of rural and poor sectors. As in line with the report of UNICEF in 2001, nonavailability to potable consuming water ended in almost 1.5 million losses of lives of children with 37.7 million yet affected. In rural regions, the groundwater or earmarked surface water has been taken into consideration to be secure for public water supplies. But recent instances, sufficient evidence have delivered the fact that present groundwater is turning into increasingly infected with elevated concentrations of heavy metals. Also, it's a recognized fact that globally, almost 1.0 billion human beings remain without access to electricity and 2.9 billion are nevertheless cooking on dangerous and inefficient stoves. Easy control and disposal of domestic wastewater is every other key issue for rural citizens. Many rural citizens nevertheless stay within the far off rural locations, and till they've got entry to to power services, little development may be made to broaden and improve their lives.

There exists a huge range of available solutions for above-mentioned consuming water and sanitation issues, however with their very own set of limitations at the the front of long-term sustainability. For instance, like water remedy strategies implemented nowadays for the motive of consuming water elements conventionally require power-extensive technology together with coagulation, filtration and flocculation. The treatment technology consists of ion exchange, electro dialysis, ultra-filtration, which aren't simplest depending on a dependable delivery of grid electricity supply however also are high-priced and require professional operators. But such technology isn't economically feasible in rural regions and is discovered to be deficit in terms of reliable power delivery in addition to in line with capital profits. Another health effect is the usage of the traditional cook stoves. Many rural household females nevertheless depend upon traditional cook stoves for cooking, which risks their health in many forms.

Therefore, an innovative approach for sustainable control of water, sanitation and different essential troubles like alternative secure and healthy cooking practices is needed in rural regions. The innovative approach has to additionally not forget the neighborhood custom and environmental situations so that it will offer a long-time period and reliable solution. One such method is harnessing sun energy for this motive. For a country like India, that's blessed with ample amounts of sunshine, i.e. approximately 5000 trillion kWh of sun energy annually, counting on sun energy is an upcoming frontline of research as new initiatives. Not only does it make use of the certainly gift sun flux, however additionally promotes the independence of neighborhood villagers to smarter inexperienced technology. These technologies and structures which are greater cost-effective, natural, grid free, sustainable, bear less operation and maintenance cost and may be utilized by each ladies and men of the family. The sun energy on the planet is most efficiently tapped in forms which include sun energy as heat (thermal capturing) and sun capturing via biomass manufacturing (photon or radiation capturing).

## 3. Characteristics

Sunlight has always been crucial to survival on this planet [10]. The vast majority of the earth's living organisms depend upon light and warmth from the solar for his or her sustained subsistence. Plants that save sun energy via photosynthesis form the basis for food chains that sustain and nourish billions of human beings and different creatures throughout the globe. Even the energy within the fossil fuels that heat our homes, propel our automobiles, and illuminate our computer monitors originates from the sun.

On the other hand, concerns about global warming are a reminder of the capacity troubles of getting an excessive amount of sun radiation. Most scientists now agree that fossil fuel emissions are trapping extra sun warmth within the earth's atmosphere and that this greenhouse impact ought to motivate common temperatures to rise significantly and hazardously impact

communities and ecosystems throughout the world.

Ironically, humankind is increasingly looking to sunlight for methods to combat global warming. Technologies that convert sun resources directly into electric power can offset a number of the arena's consumption of coal, oil, and natural gas and thereby help to reduce global emissions of greenhouse gases. As the demand for sun energy structures rises, economies of scale are enabling manufacturers to make those structures ever more efficient and cost-effective. Consequently, for the primary time in history, sun power is starting to have a noticeable impact in energy markets throughout the world.

Although the pace of utility-scale sun energy is developing, maximum sun energy development is "distributed" in nature, which include endless rooftop solar PV arrays spread throughout cities and towns. Distributed sun energy improvement is advantageous in that it no longer requires the set up of costly transmission superhighways via remote rural regions. On the other hand, the boom of disbursed sun energy additionally means that landowners are increasingly putting in sun energy structures near houses and different forms of improvement, thereby increasing the potential for conflicts.

Solar energy is created by means of the heat and light of the sun [11]. Solar power is produced whilst this power is transformed into power or used to heat air, water, or different substances. Solar power is clean green electricity that is either created from sunlight or from heat from the sun. Having sun electricity in a domestic typically manner setting up a solar photovoltaic system at the roof. Solar energy is a renewable free source of energy that is sustainable and definitely infinite, not like fossil fuels which are finite. It is also a nonpolluting source of energy, and it does not emit any greenhouse gases when producing electricity. The sun electricity that is produced can supply the entire or partial energy consumption.

Approximately 1.3 billion human beings, or almost 20% of the world's citizens, are deprived of electricity and living a miserable off-grid life. However, these growing nations' mass dependence on expensive, unhealthy, and high carbon footprint kerosene lanterns and candles for light is possible to stop at an even lower cost alternative and this is solar renewable energy. Various devised technology, commercial enterprise models, and tactics to bring solar photovoltaic power and community-sized micro grids to off-grid communities are to be had round by means of dint of the IEEE Smart Village Initiative and its collaborators round the world. Only required issue is the innovative questioning in step with marketplace demand and intention to implement the plan.

Solar energy offers many benefits that make it one of the most promising energy forms. Renewable, non polluting, and to be planet-huge, it contributes to sustainable development and job creation where it is installed. Likewise, the simplicity of this technology makes it best for the usage of in rural or difficulty accessed regions remoted from the network. Solar power is likewise beneficial for producing power on a big scale and injecting it into the network, specifically in areas wherein the meteorology presents for lots of hours of sun per year. Solar power, as soon as a niche application for a restricted marketplace, has grow to be the most inexpensive and fastest-developing electricity source at the earth. The fundamental barrier to significant implementation has been the fairly excessive preliminary funding; however, prices had been lowering in recent years. Federal tax credits are available, and plenty of states provide incentives as well. Countries such as Germany have effectively used policy mechanisms together with feed-in tariffs to become the world leaders in sun energy production.

Nonrenewable energy, this is, fossil fuels, is a precious source of energy. They are relatively less expensive to extract, and that they also can be stored, piped, or shipped, everywhere in this world. Yet, burning fossil fuels is negative for the atmosphere. The particles that are released from burning fossil fuels pollute the air, water, and land.

Solar energetic particles (SEPs) come as bursts of high-energy particles from the path of the Sun lasting for hours or sometimes days [12]. The particle energies vary from approximately 10 keV (kilo electron volts) to relativistic energies of numerous GeV, particle speeds 90% of the speed of light. In addition to the dominant protons and electrons, all the different chemical elements from He via Au and Pb have now been measured. The relative abundances of those elements and their isotopes had been an effective new resource in our quest for knowledge of the bodily tactics of acceleration and interplanetary transport of SEPs which alter those abundances in distinctive ways.

#### 4. Incentives

As they arrive to grips with the urgency of weather change mitigation and the crucial imperative to decarbonize the energy industry, country wide, regional, and network establishments create sun incentives [13]. Many authorities' sun incentives are centered on business and business sun operations. In international locations that require utilities to fulfill a threshold in their portfolio with renewable energy, the state establishes markets for tradable renewable power credit. In the USA, it's rare for portfolio standards to specify what sort of renewable energy, leaving markets saturated with wind power. When a sun goal is set, the marketplace for sun power credit incentivizes large-scale technology facilities. This top-down incentive does little to increase sun era possession to maximum ratepayers. Other incentives are greater available by means of small-scale sun development, but require a certain ownership: land, a sunny rooftop, or the capital for an up-front funding. A federal sun funding tax credit score simplest enables the ones whose tax liability exceeds the credit score. Though those incentives have inspired the solar industry, they by and large make sun greater possible for folks who already have enough money to take part. Rebates and subsidies can also additionally incentivize disbursed sun installations, however come at a value to the authorities and may be politically unpopular. Instead, complicated incentives for the sun may be condensed into policies that guarantee compensation for sun generation, i.e., internet metering without a cap or a feed-in tariff. Programs can then be designed to permit local proposals for community solar, distributing incentives to a much wider audience and organising a greater equitable "bottom-up" path to fulfill climate targets.

#### **4.1 Renewable Energy**

The term 'renewable energy' covers energy from a wide spectrum of more or less self-renewing energy assets together with daylight, wind, flowing water, the Earth's internal heat, and biomass (together with power crops and agricultural and industrial waste) [14].

Similar to fossil fuels, renewable energy resources aren't uniformly distributed at some stage in the arena, however each location has a few renewable energy resources. And whilst we do not forget that renewable energy structures generate very little waste or pollution that make contributions to acid rain, city smog or extra carbon dioxide and different gases in the atmosphere, renewable energy technology provide the promise of clean, abundant energy from self-renewing assets together with the sun, wind, Earth and plants. The biomass, however, does launch carbon dioxide whilst it's miles transformed to energy, however due to the fact the biomass absorbs carbon dioxide because it grows, the complete process of growing, using, and regrowing the biomass outcomes in very low to zero carbon-dioxide emissions.

Renewable energy resources could make a decisive contribution to the monetary, social, and sustainable improvement of rural areas in developing countries, but the intake of fossil fuels is dramatically increasing at the side of upgrades withinside the exceptional of life, the industrialization of developing international locations, and the boom of the world's population [7]. It has been identified that immoderate intake of fossil fuel leads no longer simplest to a diminishing fossil fuel reserves more quickly, however additionally has a considerable damaging effect on the environment. Such affects bring about increased health dangers and the chance of global climate change. Changes to enhance environmental situations have become more politically acceptable globally, specifically in advanced nations. Society is slowly moving in the direction of looking for greater sustainable manufacturing strategies, minimizing waste, reducing air pollutants from vehicles, generating distributed energy, conserving local forests, and reducing greenhouse gas emissions. Increasing consumption of fossil fuel to meet our current energy demands, however, has sounded alarms regarding potential energy crises. This has generated a resurgence of interest in selling renewable options to fulfill the growing international's developing energy needs. Excessive use of fossil fuels has caused global warming from carbon dioxide emissions, therefore, promoting renewable forms of clean energy is eagerly required. To monitor the level of these greenhouse gas emissions, an agreement that has fulfilled the objectives of the Kyoto Protocol was created with overall pollution prevention targets.

#### **4.2 Energy Efficiency**

Energy has an important function. It is the crucial force at the back of productivity, leisure, and the environment [4]. There is a sturdy correlation among energy use in line with person and standard of living in every country. Higher per capita energy consumption means a higher per capita gross country wide product. Energy is a crucial issue of business products, employment, monetary growth, environment, and comfort. Low-cost energy changed into plentiful withinside the past. Energy value changed into simplest a totally small fraction of the value of completed product. Use of low-cost energy for domestic comfort became very predominant. The subsequent increase in oil charges increased the energy cost in each sector, domestic, business, industrial, etc.

It is important to be conscious that international energy resources are rapidly depleting. This energy saving or conservation is important in advance in addition to growing nations. Energy conservation manners the usage of power greater successfully or reducing wastage of energy, mainly withinside the technology of electricity. It is important that any energy conservation plan has to simplest try and get rid of wastage of power with no manner affecting productivity and growth rate. Energy conservation typically requires new funding in more efficient equipment to replace old inefficient ones. Thus, energy conservation can bring about greater process possibilities, decrease prices, less expensive and higher products, etc.

Undoubtedly, all countries should try and use all their energy sources for the formation of their energy mix. This consists of the usage of wind, sun, hydro, nuclear, and tidal and recycling sources together with biogas and municipal solid waste. It additionally consists of fossil fuels, coal, oil, and natural gas—but in as easy a style as possible. However, it is important to recognize the characteristics of every energy source to make the best feasible election. For example, wind and sun are intermittent sources and for that reason require a backup delivery and a bigger electrical grid (with more transmission lines and towers) than some other supply. Also, it needs to be taken into consideration whether or not any specific fuel is, in fact, a net saver of fossil or different energy source.

#### **4.3 Environmental Justice**

Sustainability and environmental rules are complicated and multidimensional troubles, requiring political, economic, business, scientific, legal, and philosophical approaches [15]. Most nations, in the position of policymakers, and different stakeholders, apprehend the significance and urgency of climate change mitigation and adaptation, in addition to the need for dynamic energy policies advancement and environment oriented route of principle and immediate climate action. The quality of the environment depends on all stakeholders, and this quality can be additionally interpreted as a public good consumed by means of all members of society. At local and worldwide levels, country Parties develop and adopt new best-practice climate policies looking for new answers in significant and positive climate change dialogue and promotion of environmental justice standards.

The worldwide environmental justice movement presupposes the development, evolution, and advancement of worldwide environmental law. The EU's goal is to be climate-neutral by 2050; the development of the legal energy policy framework of

the EU is a manner in an effort to permit the changes in environmental markets. The flagship initiative "A resource-efficient Europe" has lately been delivered as a part of the European Commission strategy. This initiative outlines the structural changes and technological innovations by 2050, such as objectives that define all important goals and objectives set by the EU and aimed to be achieved by 2020. The Member States aim at reducing greenhouse gases (GHGs), to reach a 20% share of renewable energy sources (RES), and to get a 20% increase in energy efficiency.

The energy justice idea is likewise carefully associated with eight core standards as affordability, availability, transparency, accountability, sustainability, due-process, intragenerational equity, and responsibility. These eight standards ought to offer realistic guidance to policymakers. The worldwide transition to renewable energy sources as one of the means of climate change mitigation requires effective energy policy development and advancement, allowing nations to take advantage of emerging economic opportunities and facilitating new sorts of energy growth, energy distribution as well as governance. Renewables are anticipated to be the future competitive source for energy technology; sun energy continues getting more affordable. Solar energy is getting cheaper than coal, for example, and the cost of sun power continues to decrease rapidly. Coal use in the U.S. and Europe has decreased. However, growing international locations continue to use coal that "imposes very large externalities in addition to its contribution to climate change."

#### **4.4 Bureaucracy**

During energy sector transitions, solar developers may discover themselves confronted with the want to stable some of distinct licences: to lease land for up to three decades, to behavior fundamental environmental effect assessments, to get entry to grid infrastructure, to import solar modules and to advantage the proper to offer a positive quantum of strong supply to the electrical grid over a stated period or to enter into bilateral contracts with customers, to mention some examples [16]. These represent practices of bureaucratic legitimation, and actors who're not able to navigate such needs may discover themselves close out from having the ability to take part as solar developers. A suitable quantity of bureaucratic manners is essential to stable considered necessary oversight over some of interlocked features in a technical sector like energy; a well-conceived bureaucratic system can function in-built corrective measures that are characteristic as responsibility mechanisms, internalised checks and balances. But what complicates topics is while bureaucratic requirements show overly zealous reach or are really biased toward or against a specific technology or set of actors—specifically emerging ones who tend to have less social capital—to an extent that interferes with the efficient functioning of the sector.

Sometimes such bureaucratic interference is expressly permitted and justified on normative grounds—renewable energy can be permitted to head beforehand as much as a positive aspect of the entire energy supply, with the intention to meet clean energy targets as a percent of the grid mix, consequently loosening up bureaucratic requirements for renewable manufacturers as much as this target. Yet, normative commitments aren't usually truely articulated—fossil fuels are accorded numerous subsidies, each traditionally in phrases of present energy infrastructure and without delay at present, to a quantity that different assets might discover it not possible to stable through any quantity of bureaucratic processes. Bureaucratic alternatives aren't usually easy to discern. Wholesale energy trading markets, for instance, follow bureaucratic sets of rules which have advanced traditionally in energy sectors with relatively small components of renewable energy, and as the proportion of renewable energy increases, the policies governing these markets may not necessarily adapt in ways that optimize grid performance or ensure fairness among various stakeholders. This includes the citizens and customers who rely on the energy sector to meet their changing needs in a responsive manner. As a part of energy transitions, those ought to encompass regulatory frameworks for people and groups to prosume and receive appropriate compensation for power sold to the grid from rooftop solar panels.

#### **5. Future**

Fossil or nuclear primary energy sources (PES) have been broadly utilized in energy structures globally [17]. The PES are finite and are forecasted to last only for the next 60 (natural gas) or 200 (hard coal) years at today's stage of consumption. However, the consumption of energy has been growing globally for many years. Furthermore, an increase of CO<sub>2</sub> emissions has been determined as a negative result of the increase in consumption, which has become evident from the global warming effect. It has become necessary to define global countermeasures to stabilize the increase in the Earth's temperature.

These countermeasures have been first proposed in the so-called Kyoto Protocol in 1995 and concretized in the climate agreement in Paris in 2015. This agreement was ratified in October 2016 with the aid of the European Union (EU), China, the USA, Japan and other countries, and mandates that members reduce their CO<sub>2</sub> emissions with the aid of using 40 % by 2035.

The first result of these countermeasures is that the growth of energy consumption in the industrial countries and, therefore, the growth of CO<sub>2</sub> emission, have been decoupled from the gross domestic product (GDP). Unfortunately, despite this decoupling, the energy consumption in the developing countries has continued to develop proportionally to the GDP.

As may be seen, the consumption growth in OECD countries has been near zero for many years. This resulted from the conversion to greater economic production and the set up of money-saving equipment in households in those countries. In different countries, consumption growth continues to be between 2 and 5 % in 12 months, that's a result of gathered desires over many years. The cutting-edge in keeping with- capita energy consumption in a few developing countries, specifically people with high populations (e.g., China and India), continues to be less than 50 % of the per-capita energy consumption in industrial countries.

The share of primary energy consumption changes globally each 12 months for two major reasons: the shortage of PES and the necessary reduction of CO<sub>2</sub> emissions. Independent of the current low fee for oil, this type of PES has been systematically

experiencing a decrease in its dominating role in the energy mix, and likewise, coal and nuclear energy consumption have also decreased. At the same time, there was a specifically dynamic increase in the use of renewable energy, and this trend is forecast to continue over the next 20 years. Natural gas may also be used in the future in more flexible power stations, resulting in lower CO<sub>2</sub> emissions than that produced with the aid of combusting other fossil fuels.

Solar energy technology has been growing at an increased rate over the last decade [18]. Solar energy has only a few environmental effects and produces no CO<sub>2</sub>. The lifespan of solar panels can be an environmental concern. Many manufacturers only offer guarantees for a maximum of 25 years and their overall performance after this period is an area for future research.

A problem with solar energy is that it's far presently expensive, despite the fact that the charges are set to lower. In many approaches the incentives to install solar energy are too low in many countries and that they need to obtain greater incentives especially to accelerate technological development. There are few objections with the aid of using local communities to solar energy or even within the case of solar farms. Solar energy advantages with the aid of using being greater localised, with individuals seeing the advantage without delay, and consequently they're much less in all likelihood to object to any solar energy developments. Solar farms are being developed increasingly in more unusual places such as old airports—and possibly in time on uninhabitable and over-polluted sites.

## 6. Conclusion

Solar energy is the radiation of light and heat from the Sun that people have used since ancient history. Solar radiation along with secondary solar sources such as wind and wave energy, hydropower and biomass together make up the majority of the renewable energy available on Earth. Only a small part of the available solar energy is used. Solar energy allows production using thermal machines or photovoltaics. Once produced its applications are limited only by the human imagination. Part of the list of solar applications includes space heating and cooling, drinking water by distillation and disinfection, lighting, solar hot water, solar cooking heat, high temperature industrial water. Solar technologies are broadly characterized as either passive or active, depending on how sunlight is collected, converted, and distributed. Active solar techniques include the application of photovoltaic panels and solar collector heat to convert sunlight into usable products. Passive solar techniques include orienting buildings toward the sun, selecting materials with favorable thermal mass properties or light scattering properties, and designing spaces in which air circulates naturally.

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