**Green Technology and Sustainable Development: Advancement and Strategies**

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**Abstract**

Traditional energy sources are responsible for releasing harmful pollutants and hazardous gases in the atmosphere. One of the most promising strategies to save the environment is to replace conventional energy with renewable energy sources that are obtained from the sun, wind, water, tides, and geothermal. The main impediment to renewable energy systems is uninterruptible energy generation especially electrical energy. The latest trend in research is also focused on developing novel methods to generate electrical energy from renewable sources. Lot of funding from government agencies is also available to promote research in these areas to tackle energy security issues and climate change. Such innovative routes have the potential to save about 30% of energy with 80% lower prices thereby reducing global warming. This is also viable and cost-effective way to achieve long-term growth and environment sustainability.

**Introduction**

The demand for energy has witnessed a rapid increase in recent time. According to United Nations, the industrial countries have 28% world's population but utilise 77% global energy. The current population worldwide is anticipated to grow 1.26 times by 2050 to 9.7 billion. The emerging countries account for nearly 90% of population growth. Although developed countries have implemented effective energy conservation policies to be achieved by 2050, yet their energy consumption has remained constant. Researchers in underdeveloped countries, are struggling to build their own energy-generating facilities (Salvarli and Salvarli, 2020).

It is projected that fossil fuel stocks will deplete naturally. As a result, alternative viable renewable energies are need of the hour in near future. This condition will provide an impetus to creating new jobs and building future industries. Rising industry, technological advancement and human labour have increasingly contaminated the environment causing global climate change. Inorder to attain sustainable development, renewable energy sources should be wisely harnessed with focus on its pricing, policies, applications and technology transfer (Salvarli and Salvarli, 2020).

Green renewable energy sources (RGEs) offer chances for Sustainable Development such as energy security,social and economic development,and climate change mitigation.The popular three-pillar model, which includes economy, ecology, and society, has been used to theorize the concept of sustainability. RGEs preserve natural capital as long as resource consumption does not reduce the prospect of a sustainable future.There should be a perfect harmony between the three-pillar model and RGE technologies for evaluating renewable green energy technologies and to frame appropriate economic, social, and environmental policies. This will definitely contribute significantly to the economies of countries rich in renewable green energy sources (Androniceanu and Sabie, 2022).Governments and other authorities should also encourage generous investment in sustainable green energy production to assure a more environment friendly and sustainable future.In 2019, India ranked fourth in world for the most appealing renewable energy market. By 2030, India is aspiring to achieve world's largest renewable energy expansion target of 450 GW (Kumar and Majid, 2020).

The present chapter includes an overview of Global energy consumption, current achievements, and types of green energy.The study also summarises potential trends over the next decade.

**Global Primary Energy Consumption**

Primary energy consumption has increased constantly in the world. Primary energy is the energy available in raw form before its actual conversion into either heat or electricity or any other type of fuels viz. fossil energy sources obtained from coal, oil, and gas, energy from uranium and bio-mass, energy from physical phenomenon like wind, solar radiation, and hydraulic power. The available primary energy sources have witnessed a visible transformation over last few centuries. Almost all new sources of energy have been explored to date beginning from fossil fuels to the use of nuclear and hydropower energy. The quantity produced and subsequently consumed has also increased manifold since the Industrial Revolution. Although Global energy consumption growth slowed down in 2022 (+2.1%) it is growing at the rate of around 1% to 2% per year with a aggregate increase of around 15.10% in 10 years.

The largest energy consumers in the world are Norway, Iceland, USA, Canada, Oman, Qatar, and Saudi Arabia. India holds third position in the world in primary energy consumption in 2017, with 5.6% of the growth rate as compared to the world average. Statistics reveal that energy consumption growth in 2022 slowed down in the two largest consuming countries China and USA. On the contrary, primary energy consumption declined in Europe due to fears of recession after Russia’s invasion of Ukraine and surging energy prices.

Activities related to power generation from primary energy sectors, deforestation, transportation, and industrial and technological advancements are responsible for CO2 emissions. Hence high energy consumption is coupled with an increase in global CO2 emission. It is a serious agenda that needs immediate solution to meet ambitious climate mitigation goals. Hence recently, at international level rigorous changes and adjustments are happening (Nfah et al., 2007).

To popularize sustainable green energy among the masses, the prime agenda of the international global energy policies now is to focus on the transition of the fossil energy-based system to low-carbon energy-based system (Dizdaroglu, 2017). In order to achieve a breakthrough from the high-carbon energy-based system to the low-carbon one, national and international policies, market mechanisms, and legal systems should be synchronous with each other and should actively acknowledge the energy issues to establish the best consumption model and renewable energy production.

**Current Achievements in Green Energy in India**

The Government of India have initiated ample national programs in different areas of the renewable energy sector to deploy and popularize renewable energy systems among the general public. Government and private institutes such as the Ministry of New and Renewable Energy, The Energy Resource Institute, Centre for Wind Energy Technology, Indian Oil Corporation Ltd., IITs, NITs, Universities are involved in Research & Development of renewable sources of energy. For smooth implementation, delivery, and outreach of renewable energy projects, the government has constituted District Advisory Committees , and developed Akshay Urja Shops, Renewable Energy Clubs, and Energy parks (Purohit and Michaelowa, 2008; Maithani, 2008;Chaturvedi and Garg, 2007).

The major achievements of India in the field of renewable energy is as follows.

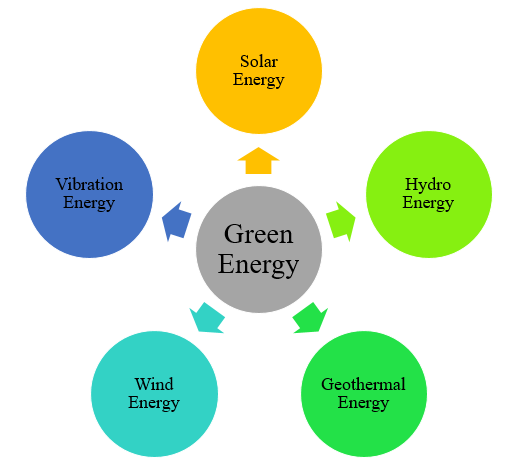
1. Wind Energy Technology Centre at Chennai has created a scientific and industrial research cell for assessment of wind resources, equipment certification, and R&D.
2. Solar Energy Centre at Gurgaon, Haryana is specialized for solar energy systems development.
3. Integrated Rural Energy initiative has been administered in 860 blocks.
4. Sixteen hundred renewable energy projects has funded by Indian Renewable Energy Development Agency Limited.
5. Solar Photovoltaic products of 30 MW capacity has been exported to countries all over the world.
6. 280 Energy Parks has been established for illustration of renewable energy devices in various educational institutions
7. Heating systems powered by solar energy has been equipped in 7 lakhs m2 collector domain.
8. Over 4200 MW grid power is successfully generated from wind, small hydro, biomass and solar energy.
9. Largest solar–steam cooking system is installed at Tirumala Devasthanam, Tirupati for fifteen thousand persons per day.
10. Biogas plants worth 3.5 million for cooking and lighting applications and wood stoves worth 35 million has been improved in rural abodes.
11. 3600 remote villages/hamlets including those in Ladakh and the North East are electrified through solar energy.

**Types of Green Energy**

Renewable Energy sources are distributed over a wide geographical area and available throughout the year. These resources do not exhaust and can be easily revived by a natural phenomenon. It does not cause contamination of environment. The advantage of availing renewable resources is that by one-time investment one can take benefit without affecting the environment for many decades.

There are five main types of green energy:

1. Solar energy
2. Hydro energy
3. Geothermal energy
4. Wind energy
5. Vibration energy

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**Fig 1: Types of Green Energy**

1. **Solar Energy**

Sun is an abundant solar energy source providing vital energy to the living organisms, flora, and fauna on earth. It is a sustainable, clean, and direct energy with minute impact on the surrounding. It does not produce harmful gases like carbon dioxide as a co-product and therefore do not contribute to global warming. It can be successfully harnessed into useful energy using Parabolic Trough Systems and Solar Photovoltaic cells. Many everyday low-power absorbing devices like calculators can be efficiently powered by solar energy. It’s also a longer lasting energy source for future generations because it lasts forever.

**Hydro Energy**

Hydro energy is electricity generated from the water cycle by continuous process of falling and fast-running water. Hydroelectric power is major reliable, affordable, domestic and well established renewable energy that meets approximately 19% of the world’s electricity requirements (Maithani, 2008). Large-scale schemes and projects are undertaken by the government to harness hydroelectric power in the world. It is also specific clean energy sources as it does not lead to any by-products during conversion.

1. **Geothermal Energy**

Geothermal energy is produced inside the earth in the form of heat from the radioactive decay of radioactive materials like uranium. The pioneering geothermal power plant was constructed in Larderello. The US National Renewable Energy Laboratory reported that hot dry rocks have potential to supply around 4 million MW capacity electricity, which is higher than that used by the United States today. Due to negligible emissions, it is considered to be an exceptional alternative over traditional fossil fuel energy sources for mitigation of global warming. It is the cost-effective, reliable, affordable, renewable, and sustainable source of energy used for household purposes.

1. **Wind Energy**

The energy produced using wind turbines by the flowing wind is called wind energy. Wind is actually type of solar energy. It is created by heating of the earth atmosphere by the sun and by the rotation of the earth. Wind turbines used for energy production are usually installed in huge open-land farms. Empty land around wind turbines can be effectively used for agriculture and horticulture. Wind turbines do not contribute to acid rain or greenhouse gases. It is a clean and renewable energy source and requires less cost.

1. **Vibration energy**

This mechanical phenomenon in which the vibration occurs at equilibrium is known as vibration energy. The study on vibration energy came into focus in recent years. The vibration produced in the surrounding by a large traffic on the road or a large crowd or by vibrations of skyscrapers, vehicle systems, bridges, railways, and ocean waves can also be harnessed efficiently. These vibrational energies can be transformed into electric energy that can be stored. This energy can be used to power electronic appliances required low-power. Usually, harvesting of vibrational energy from large sources produces about 1W to 100 kW energy (Chaturvedi and Garg, 2007). Vibration energy has been successfully used to replace the batteries in medical implants as traditional batteries loaded with toxic heavy metals. Vibration energy can be used to control the noise in the environment generated by industries, air craft’s etc by vibration damping and isolation.

**Strategies for a green sustainable energy future**

In 2019, India ranked fourth in the world for the most appealing renewable energy market. India has set an ambitious renewable energy target of 450 GW by 2030.This is the world's largest renewable energy expansion plan. India has three of the top Five largest solarparks in the world. It also includes the second-largest solarpark in the world at Kurnool, Andhra Pradesh, with acapacity of 1000 MW. In Rajasthan the world's largest solarpower plant, Bhadla Solar Park exist with a capacity of2255 MW.

Denmark, the greenest of the five countries, is regarded as one of the most energy secure and sustainable country in the OECD (Sovacool and Brown, 2007) and EU27 (Eurostat, 2013). Denmark has rapidly reduced its reliance on foreign energy supplies, from more than 90% in the 1970s to nearly nil now, and has become a net exporter of fuels and power (Sovacool and Tambo, 2016). A commitment to energy efficiency; extended taxes on energy fuels, electricity, and carbon dioxide; and incentives and subsidies for Combined Heat and Power (CHP) and wind turbines are at the heart of Denmark's effective approach (Sovacool, 2013). Denmark's goal is to achieve 100% renewable energy by 2050 (Sovacool, 2013; Danish Government. Energy Strategy, 2011).

Germany, one of the EU's top energy importers, is in the midst of a bold energy revolution (Proskuryakova, 2018). Germany is regarded as the most successful country in terms of renewable energy promotion (Liu, 2018). Germans had the greatest energy security performance among EU countries in 2014, owing to lower oil and coal shares and increased diversification of energy imports (Matsumoto et al., 2018). The German energy transition (Energiewende) is widely acknowledged as the most well-known renewable-based national energy policy (Harjanne and Korhonen, 2018). The Energiewende seeks to cut greenhouse gas emissions by 80-95% by 2050 (relative to 1990), raise the renewable part of final energy to at least 60%, and raise the renewable share of power demand to 80% (Hansen et al., 2019). Germany likewise wants to finish its nuclear phase-out by 2022 (Energiewende, 2019), a controversial move in the authors' opinion. Hansen et al. (2019) provided a strategy for reaching 100% renewable energy for the whole German energy system, arguing that such a scenario is achievable with the implementation of crucial regulations.

China is the world's greatest energy user (British Petroleum, 2019), the largest emitter of greenhouse gases (Yang et al., 2050), the world's fifth largest producer of oil, the world's seventh largest producer of natural gas, and the world's largest producer of coal (Zhang et al., 2017; Wang et al., 2018). China intends to reduce the share of coal in its power mix, but coal use is increasing, and more coal-fired power projects are being planned. Indeed, the proportion of fossil fuels in total primary energy consumption in China is predicted to approach 90%, with coal serving as the dominant fuel source (Matsumoto and Andriosopoulos, 2016). At the same time, China has the most hydropower resources in the world, with a total theoretical hydropower potential of 694 GW (Zhang et al., 2017). By the end of 2015, China's hydropower capacity has surpassed 25% of the world's nonhydro renewable capacity, accounting for 63.1 and 117.0% more than the US and Germany, respectively (Yang et al., 2016). Until the end of 2017, China's installed renewable energy generation capacity was 635 million kW, accounting for 35.7% of total installed electric power capacity (Liu, 2019).

Russia has one of the world's largest fossil fuel reserves and is the world's fourth largest emitter (after China, the United States, and India). Russia has the world's second largest natural gas reserves and production (behind the United States) (British Petroleum, 2019), allowing it to play a significant geopolitical role, such as being the primary supplier of natural gas to most European countries. At the same time, Russia is a large country with a diverse topography and climate, providing it the opportunity to generate nearly every type of renewable energy (International Energy Agency, 2003Russia is expediting the implementation of solar and wind energy through auctions in order to help isolated populations in terms of employment, research, technology, and energy security (Gielen et al., 2019). Despite being an early leader in renewables technology, Russia's strategy relies around the expansion of fossil fuels and nuclear energy (Lanshina et al., 2018). The Russian government introduced the Capacity-Based Renewable Energy Support Scheme (CRESS) in 2013 (Smeets, 2017). Each year, a maximum installed capacity of solar, wind, and small hydro projects might acquire financial guarantees on Russia's wholesale power market under CRESS implementation (Boute, 2012). Russia's energy security will continue to be connected to its natural gas supplies, and its capacity to supply it to European and other markets will decide its position as an energy hegemon.

Renewable energy is better adapted to distributed production than the fossil fuel paradigm, making it more secure. Renewable energy will contribute to the emergence of an era of energy democracy, in which a network of decentralised prosumer systems will replace large-scale power generation.

**Energy security, sustainability challenge and expectations**

Recently, there has been a surge of support for incorporating renewable energy into the energy mix as a priority measure for tackling energy security and climate change (Hache, 2018). Energy security planning is becoming increasingly focused on developing a low-carbon economy and meeting climate mitigation targets (Hamed and Bressler, 2019).

Article 2 of the Paris Agreement (United Nations, 2015) mandates countries to implement their nationally defined contributions and gradually increase their goals in order to keep global mean temperature rise below 2°C (Rogelj et al., 2016). Renewable energy naturally takes front stage as new energy options must be less polluting than the sources they replace. Goldthau and Sovacool (2012) discussed three major energy challenges: energy security, energy justice, and a low-carbon transition. They emphasised the importance of considering energy security as a democratic issue, equity as a key part of accessibility, and global climate change as an important aspect of acceptability.

Sovacool and Rafey (2011) proposed a similar set of four dimensions of energy security: (1) availability, that is, diversifying fuels, preparing for disruption recovery, and minimising reliance on foreign supplies; (2) affordability, that is, providing affordable energy services and minimising price volatility; and(3) efficiency and development, which includes increasing energy efficiency, changing consumer attitudes, and building energy infrastructure; and (4) environmental and social stewardship, which includes safeguarding the natural environment, communities, and future generations.

Energy security, according to Sovacool and Brown (2009) is defined by the following criteria (i.e., dimensions), which can be measured with corresponding metrics: availability, affordability, energy and economic efficiency and environmental stewardship. Availability is measured by oil and natural gas import dependence as well as availability of alternative fuels; affordability, measured by retail electricity, gasoline and petrol prices, whereas energy and economic efficiency is measured by energy intensity, electricity use per capita, and average fuel economy of passenger vehicles. Environmental stewardship, measured by sulfurdioxide (SO2) and carbon dioxide (CO2) emissions.

The global move to renewable energy demonstrates a more powerful global response to climate change. Most European countries have enacted policies that will have substantial social, political, and economic ramifications. This shift to low-carbon energy is likely to change the geopolitical landscape, altering the dynamics between producer and consumer countries (International Renewable Energy Agency, 2009) and establishing new energy norms for exporting countries (Overland, 2019). The renewable energy revolution will be one of the major characteristics and pillars of the low-carbon transition. Transitions from coal to natural gas as well as transitions from fossil fuels to renewable (and nuclear) will be important energy (Matsumoto and Andriosopoulos, 2016).

**Recent advancements in green energy**

Renewable energy (RE) sources include biofuels, geothermal, hydro, solar, tidal, waste, and wind. The main impediment to RE systems is uninterruptible energy generation. The most unpredictable are solar and wind and as compared to other RE sources, their variability is substantial (Ghosh, 2022). Among the technologies that have aided the expansion of renewables, power electronics has been a key enabler. The electronic converters enabled the coupling of renewable energy producers to legacy power systems, as shown schematically in Fig. 1, and enhanced energy harvesting efficiency through customised controls. Furthermore, power electronics is widely used on the consumer side and is a key component of the future smart grid. Wind turbine systems have undergone significant evolution over the years. A 50kW wind turbine was regarded enormous in the 1980s, although today's standard wind turbine is rated at 2 to 3 MW. The necessity for lower energy costs drove much of the development for larger units, while performance improvements, particularly in terms of grid connection, imposed some of the electric technology upgrades.

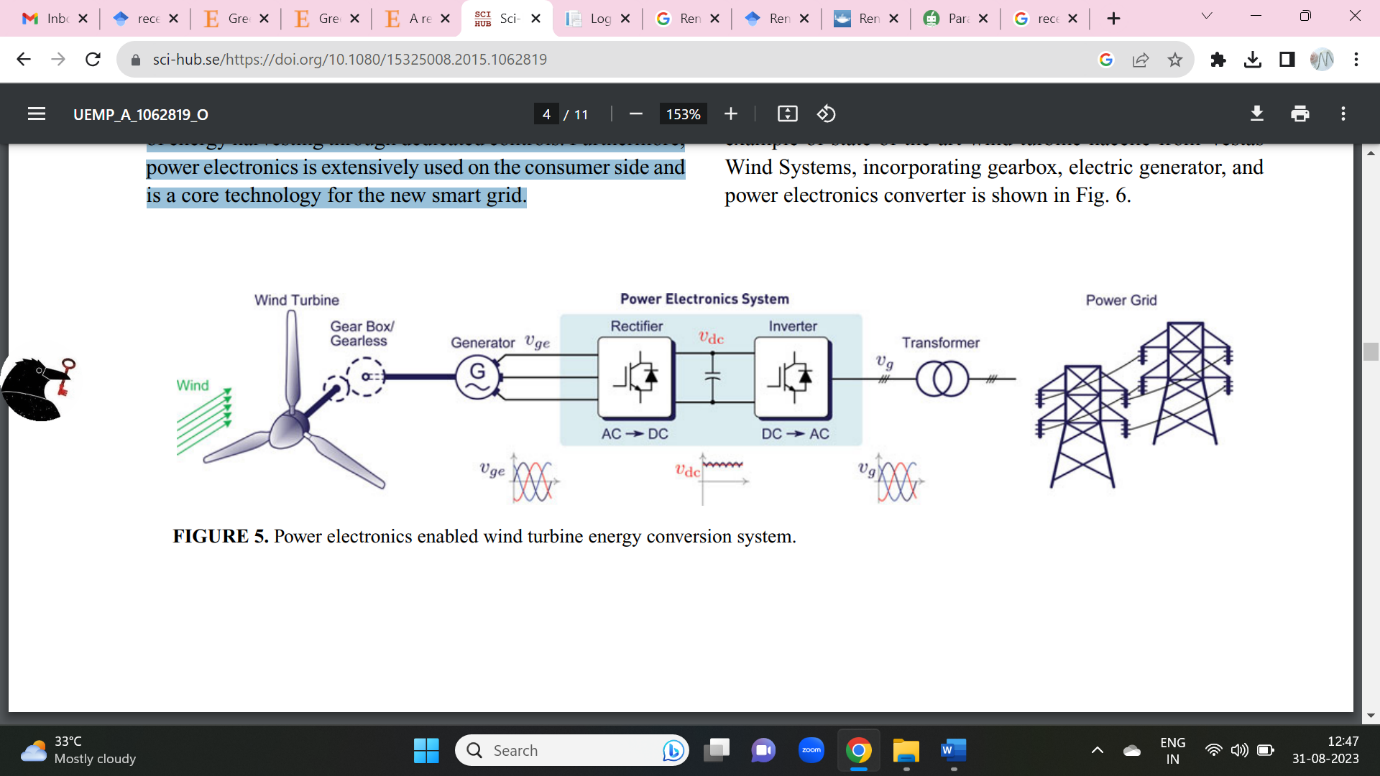


Figure 1: Power electronics enabled wind turbine energy conversion system (Source: Blaabjerg and Ionel, 2015)

Grid-connected photovoltaic (PV) systems, such as the one shown schematically in Fig. 2, include a power electronics DC/DC converter that assures maximum sun energy harvesting via maximum power point tracking (MPPT) regulation and a DC/AC converter for grid hookup. PV systems have grown in popularity not just for multi-MW utility scale power plants/farms, but also for roof top installations on business and residential buildings with ratings as low as hundreds of watts.

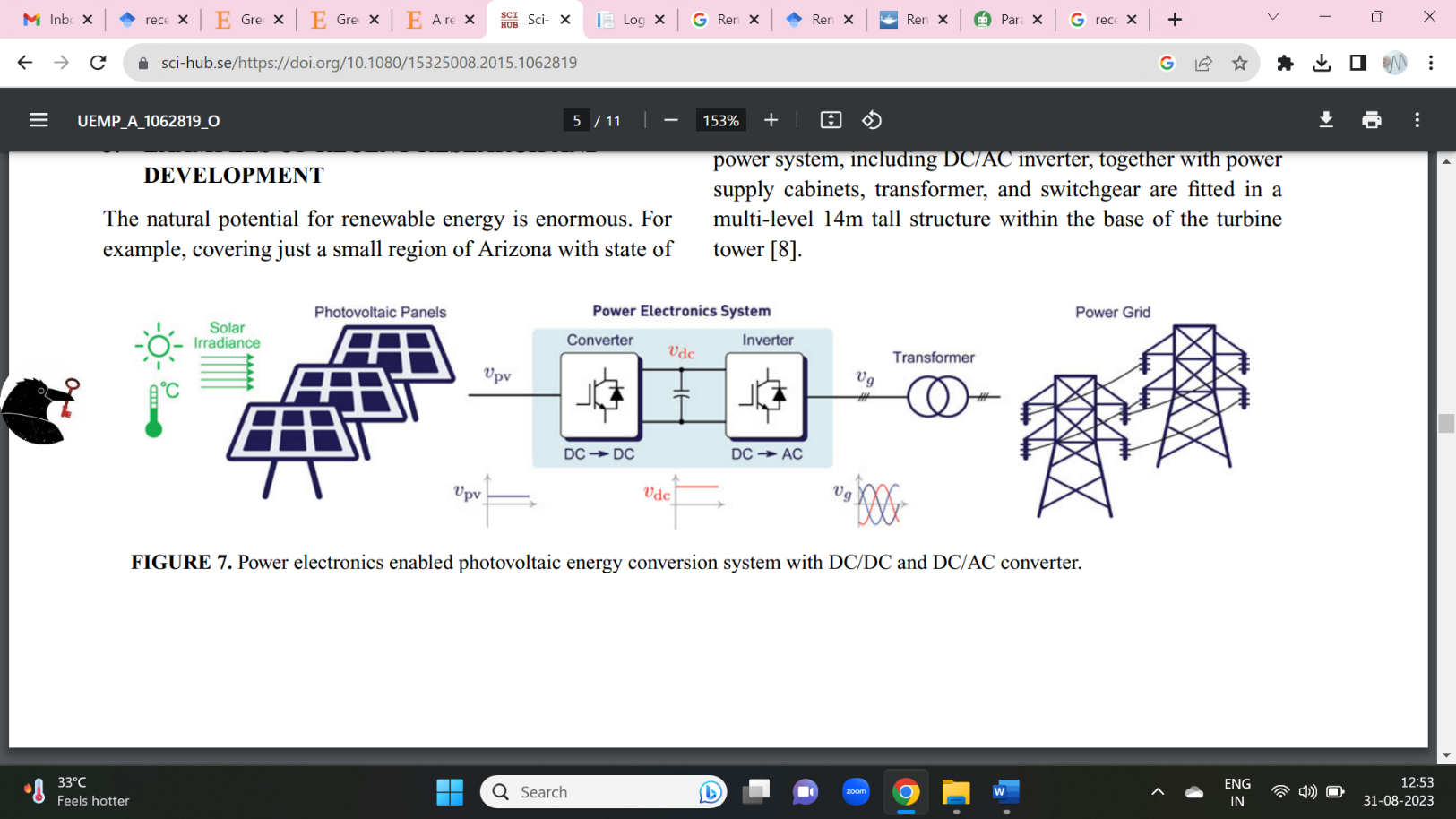


Figure 2: Power electronics enabled photovoltaic energy conversion system with DC/DC and DC/AC converter (Source: Blaabjerg and Ionel, 2015)

The SASDAC system is made up of four major parts: (1) a desiccant dehumidifier, (2) a sensible heat exchanger, (3) a cooling unit, and (4) a solar regeneration heat source. The essential functioning concept of the main component of a solid desiccant system is discussed below and illustrated in Figure 2. During stage (1-2), hot and humid air from the outside enters the system and passes through the desiccant wheel, becoming hot and dry as the desiccant wheel absorbs moisture. This hot and dry air flows through the heat recovery wheel (2-3) where heat exchange occurs between the return and primary air. The air then flows via a humidifier at stage (3-5), where moisture is added to achieve the desired cooling effect, before entering the conditioned environment. At step 6-7, air returns from the room and is fed through a humidifier, which adds moisture to lower the temperature. At step (7-8), the wet air flows through a heat recovery wheel and gets heated. At stage (8-10) the heated air goes through heating coils and desiccant material that has been regenerated by increasing the temperature with solar energy.

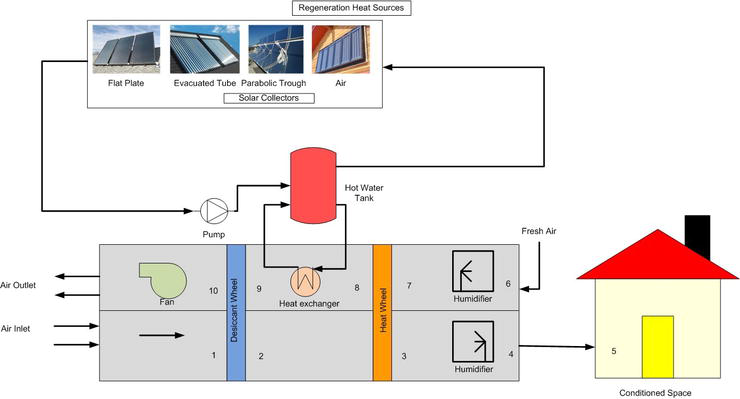


Figure: Working principle of solar-assisted solid desiccant cooling system [20].

Beside from the previously described technologies, methods, and devices, a special mention should be made of the significant ongoing efforts for integrating renewables into the power and energy system, where a correct balance between production and consumption occurs. Controlling the complete energy system as a whole, comprising not just the electrical power system, but also thermal energy and water flow, is an ongoing problem for science and society. Smart-grid functions and facilities, such as communications and energy storage, are considered as solution enablers in this context, but there is still a long way to go.

**Conclusion**

Fossil fuels continue to account for the majority of energy usage and are on the rise around the world. Environmental pollution is unavoidable in this situation, and renewable energy plants make no direct contribution.Longer term, if investments in renewable technology continue, renewables have the potential to contribute significantly to energy needs.

Furthermore, various technologies include biofuels, and fuel cells can contribute to the heat, transportation, and energy markets.In 2023, the share of fossil fuels in total primary energy supply is predicted to be around 81%. Renewable energy will account for approximately 30% of global energy structure by 2050.

Many energy-efficient enabling technologies are used in power plants, buildings, industrial facilities, and transportation systems to consume less and cleaner energy. These technologies have the potential to reduce prices by up to 80%, save energy by up to 30%, and assist to halt global warming in the future. As a result, the countries may remain cost-effective while making long-term growth. Marketing renewable energy can also be characterised as the skill of comprehending consumers' wants and needs.

**References**

* Agora Energiewende (2019). European Energy Transition 2030: The Big Picture. Ten Priorities for the next European Commission to Meet the EU’s 2030 Targets and Accelerate Towards 2050.
* Agreement No.: CE 36/2000, Study on the PotentialApplications of Renewable Energy in Hong Kong, Stage 1 StudyReport, December 2002
* Boute A (2012). Promoting renewable energy through capacity markets: An analysis of the Russian support scheme. Energy Policy, 46:68-77.
* British Petroleum (2019). BP Statistical Review of World Energy. 68th ed.
* Chaturvedi P and Garg HP (2007). Financing renewables—emerging dimensions. IREDA NEWS; July–September 2007.
* Dizdaroglu D (2017). The role of indicator-based sustainability assessment in policy and the decision-making process: a review and outlook. Sustainability, 9(6): 1018.
* Eurostat. EU27 Energy Dependence Rate at 54% in 2011. 2013.
* Gielen D, Boshell F, Saygin D, Basilian MD and Wagner N (2019). The role of renewable energy in the global energy transformation. Energy Strategy Reviews, 24:38-50.
* Goldthau A and Sovacool BK (2012). The uniqueness of the energy security, justice, and governance problem. Energy Policy, 21:232-240.
* Hache E (2018). Do renewable energies improve energy security in the long run? International Economics, 156:127-135.
* Hamed TA and Bressler L (2019). Energy security in Israel and Jordan: The role of renewable energy sources. Renewable Energy, 135:378-389.
* Hansen K, Van Mathiesen B and Skov IR (2019). Full energy system transition towards 100% renewable energy in Germany in 2050. Renewable and Sustainable Energy Reviews, 102:1-13.
* Harjanne A and Korhonen JM (2019). Abandoning the concept of renewable energy. Energy Policy. 127:330-340.
* International Energy Agency (IEA). Renewables in Russia: From Opportunity to Reality. Paris: IEA/OECD; 2003.
* International Renewable Energy Agency (IRENA). A New World. The Geopolitics of the Energy Transformation. Global Commission on the Geopolitics of Energy Transformation. 2019.Available from:https://geopoliticsofrenewables.org/assets/geopolitics/Reports/wpontent/uploads/2019/01/Global\_commission\_renewable\_energy\_2019.pdf
* Kalyani VL, Piaus A and Vyas P (2015). Harvesting Electrical Energy via Vibration. Journal of Management Engineering and Information Technology, 2(4): 2394 – 8124
* Lanshina TA (2018). The slow expansion of renewable energy in Russia: Competitiveness and regulation issues. Energy Policy, 120:600-609.
* Liu J (2019). China's renewable energy law and policy: A critical review. Renewable and Sustainable Energy Reviews, 99:212-219.
* Maithani PC (2008). Renewable energy policy framework of India. India: Narosa Publication Delhi,pp. 41–54.
* Matsumoto K and Andriosopoulos K (2016). Energy security in East Asia under climate mitigation scenarios in the 21st century. Omega, 59: 60-71.
* Matsumoto K, Doumpos M and Andriosopoulos K (2018). Historical energy security performance in EUcountries. Renewable and Sustainable Energy Reviews, 82:1737-1748.
* Nfah E, Ngundam J and Tchinda R (2007). Modelling of solar/diesel/battery hybrid power systems for far-north Cameroon. Renew Energy, 32(5): 832–844.
* Overland I (2019). The geopolitics of renewable energy: Debunking four emerging myths. Energy Research and Social Science, 49:36-40.
* Proskuryakova L (2018). Updating energy security and environmental policy: Energy security theories revisited. Journal of Environmental Management, 223:203-214.
* Purohit P and Michaelowa A (2008). CDM potential of SPV pumps in India. Renewable and Sustainable Energy Reviews, 12:181–199.
* Rogelj J, Den Elzen M, Höhne N, Fransen T, Fekete H and Winkler H (2016). Paris agreement climate proposals need a boost to keep warming well below 2°C. Nature. 534:631-639.
* Smeets N (2017). Similar goals, divergent motives. The enabling and constraining factors of Russia’s capacity-based renewable energy support scheme. Energy Policy,101:138-149.
* Sovacool BK (2013). An international assessment of energy security performance. Ecological Economics, 88:148-158.
* Sovacool BK and Brown MA (2009). Competing Dimensions of Energy Security: An International Perspective. Working Paper #45, Working Paper Series. Atlanta, GA: Ivan Allen College, School of Public Policy, Georgia Tech.
* Sovacool BK and Rafey W (2011). Snakes in the grass: The energy security implications of Medupi. The Electricity Journal, 24:92-100.
* Sovacool BK and Tambo T (2016). Comparing consumer perceptions of energy security, policy, and low-carbon technology: Insights from Denmark. Energy Research and Social Science, 11:79-91.
* United Nations (UN). Paris Agreement. 2015. Available from: https://unfccc.int/sites/default/files/english\_paris\_agreement.pdf
* Wang B, Wang Q, Wei Y-M and Li Z-P (2018). Role of renewable energy in China’s energy security and climate change mitigation: An index decomposition analysis. Renewable and Sustainable Energy Reviews, 90:187-194.
* Yang XJ, Hu H, Tan T and Li J (2016). China’s renewable energy goals by 2050. Environmental Development, 20: 83-90.
* Zhang L, Sovacool BK, Ren J and Ely A (2017). The dragon awakens: Innovation, competition, and transition in the energy strategy of the People’s Republic of China, 1949–2017. Energy Policy, 108:634-644.