

Audit Course Report  
On  
**“Green And Unconventional Energy”**  
*Submitted to*  
Savitribai Phule Pune University, Pune  
*in*  
*partial fulfillment of the requirements for the award of the degree*  
*of*  
*Bachelor of Engineering in*  
**Department of Information Technology**  
**TE [Div B] Semester VI**

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AY 2023-24

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**CERTIFICATE**

This is to certify that the audit course entitled “**Green and Unconventional Energy**” is a bonafied work done under my guidance by TE semester VI

students of this institute and is submitted to **Savitribai Phule Pune University, Pune** for the partial fulfillment of the requirements for the award of degree of Bachelor of Engineering in **Information Technology**.

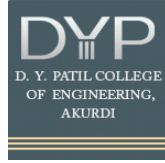
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# 1. Introduction

The imperative to shift from fossil fuels to sustainable energy sources has never been more pressing. Green and unconventional energy technologies offer a pathway to address climate change and environmental degradation while meeting our energy needs.

Solar, wind, and hydropower are among the prominent green energy sources, leveraging renewable resources to generate electricity with minimal environmental impact. These technologies have witnessed significant advancements in recent years, driven by declining costs, improved efficiency, and supportive policies.

Additionally, unconventional sources like geothermal, tidal, and wave energy hold promise for further diversifying our renewable energy portfolio. While still in the early stages of development, these technologies offer unique advantages, such as predictability and high energy density, making them valuable contributors to a sustainable energy mix.

Despite challenges, including technological barriers and regulatory constraints, investing in these technologies is critical for building a resilient and sustainable energy future. By embracing innovation and collaboration, we can unlock the full potential of green and unconventional energy sources, driving the transition towards a cleaner, more equitable, and prosperous world.

In this report, we will delve into the various aspects of green and unconventional energy, examining their technological, economic, and environmental implications, as well as the challenges and opportunities associated with their widespread adoption. Through case studies, analyses, and discussions, we aim to provide a comprehensive overview of the role of renewable energy in shaping the future of global energy systems and driving the transition towards a more sustainable and equitable world.

## **2. Course Objectives**

- To acquire knowledge to adopt green computing practices to minimize negative impacts on the environment.
- To examine technology tools that can reduce paper waste and carbon footprint by user.
- To understand how to minimize equipment disposal requirements.
- To gain skill in energy saving practices in their use of hardware
- Understand the concept of green IT and relate it to sustainable development.
- Apply the green computing practices to save energy.
- Discuss how the choice of hardware and software can facilitate a more sustainable operation
- Use methods and tools to measure energy consumption

### **3.Traditional Energy Sources and Their Limitations**

Traditional energy sources, such as coal, oil, and natural gas, have long served as the cornerstone of global energy production. These fossil fuels, formed over millions of years from organic matter, have been essential for powering industrialization, transportation, and modern society. However, their widespread use comes with significant environmental and social costs.

Coal, the most abundant and widely used fossil fuel, is a major contributor to air and water pollution, emitting large quantities of greenhouse gases, particulate matter, and other harmful pollutants when burned for electricity generation or industrial processes. The mining and extraction of coal also result in habitat destruction, landscape alteration, and health risks for nearby communities, particularly in regions with extensive coal mining operations.

Oil, primarily used for transportation and heating, poses similar environmental challenges, with its extraction, refining, and combustion processes releasing pollutants into the air, soil, and water. Oil spills, leaks, and accidents further exacerbate environmental degradation and ecosystem disruption, posing risks to human health, wildlife, and marine ecosystems.

Natural gas, often touted as a cleaner alternative to coal and oil, is not without its drawbacks. While natural gas combustion emits fewer greenhouse gases and air pollutants than coal or oil, its extraction via hydraulic fracturing (fracking) can contaminate groundwater, release methane—a potent greenhouse gas—into the atmosphere, and disrupt local communities and ecosystems.

Moreover, the combustion of fossil fuels is a leading cause of climate change, with carbon dioxide (CO<sub>2</sub>) emissions from human activities contributing to the warming of the planet and associated impacts such as sea-level rise, extreme weather events, and shifts in ecosystems and agricultural productivity.

In summary, while traditional energy sources have played a crucial role in powering human progress and economic development, their reliance on finite and polluting resources poses significant challenges for environmental sustainability, public health, and climate resilience. As we confront the realities of a changing climate and finite fossil fuel reserves, the need to transition to cleaner, more sustainable energy sources become increasingly urgent.



## 4.Green Energy Sources

### 4.1 Solar Energy:

Solar energy, a cornerstone of the renewable energy revolution, harnesses the abundant and inexhaustible power of the sun to generate electricity and heat. This technology operates through photovoltaic (PV) cells, which directly convert sunlight into electricity, or solar thermal systems, which use sunlight to heat water or other fluids to produce steam, driving turbines to generate electricity. Its versatility and scalability make it an attractive option for both large-scale utility projects and decentralized residential installations

The advantages of solar energy are manifold. It offers a clean, renewable, and abundant energy source, reducing greenhouse gas emissions and mitigating climate change. Its decentralized nature enhances energy security and resilience by diversifying energy sources and reducing reliance on centralized power grids. Furthermore, solar energy systems require minimal water usage and have low operating and maintenance costs, making them economically viable in the long term. However, challenges such as intermittency (dependent on weather and daylight hours), high upfront costs, and land use requirements remain barriers to widespread adoption.



*Figure 1 Solar Energy*

In summary, solar energy stands as a beacon of hope in the quest for clean, sustainable, and affordable energy solutions. As technology continues to improve and costs decline, solar energy is poised to play an increasingly prominent role in shaping the future of global energy systems, driving us towards a greener and more sustainable world.

## 4.2 Wind Energy:

Wind energy, a leading player in the renewable energy landscape, capitalizes on the kinetic energy of wind to generate electricity through the rotation of wind turbine blades connected to a generator. This clean and abundant energy source has witnessed remarkable growth in recent years, driven by technological advancements, declining costs, and supportive government policies. Wind turbines, ranging from small-scale turbines for residential use to massive offshore installations, offer a scalable and environmentally friendly alternative to conventional fossil fuel-based power generation.

One of the key advantages of wind energy is its renewable and emissions-free nature, helping to reduce greenhouse gas emissions and combat climate change. Its decentralized deployment enhances energy security by diversifying energy sources and reducing dependence on centralized power grids. Moreover, wind energy projects often create local jobs, stimulate economic growth, and provide additional income for landowners hosting wind turbines.

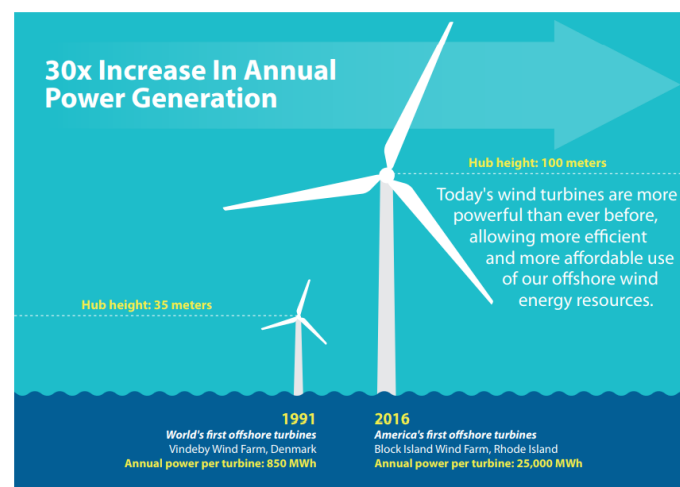


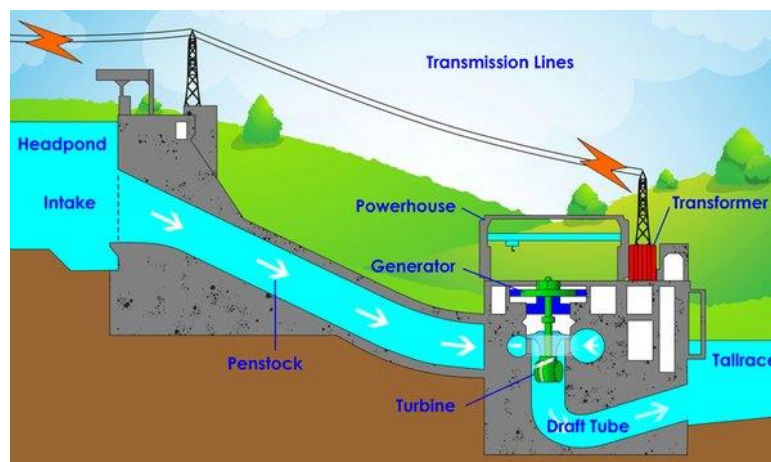
Figure 2 Wind Energy

In conclusion, wind energy represents a vital component of the transition to a sustainable energy future, offering clean, renewable, and economically viable solutions to meet our growing energy needs. Its ability to harness the power of the wind offers promise in reducing carbon emissions, enhancing energy security, and fostering economic development. As technology continues to advance and costs decline, wind energy is poised to play a pivotal role in reshaping global energy systems, paving the way towards a cleaner and more sustainable world.

### 4.3 Hydro-Power:

Hydropower, a longstanding contributor to global energy production, harnesses the gravitational force of flowing or falling water to generate electricity through dams, turbines, and other infrastructure. This renewable energy source has played a significant role in providing reliable and low-carbon electricity generation, particularly in regions with abundant water resources. Large-scale hydropower projects, such as dams and reservoirs, offer the advantage of scalability and flexibility, providing baseload power and essential services such as flood control and irrigation.

One of the primary advantages of hydropower is its reliability and consistency, as water flow can be controlled and adjusted to meet demand, making it a stable source of renewable energy. Additionally, hydropower produces minimal greenhouse gas emissions during operation, contributing to efforts to mitigate climate change and reduce reliance on fossil fuels. However, large-scale hydropower projects can have significant environmental and social impacts, including habitat disruption, altered river flows, and displacement of communities, which must be carefully managed and mitigated.



*Figure 3 Hydropower*

In summary, hydropower remains a crucial component of the global energy mix, offering reliable, renewable, and low-carbon electricity generation. Its ability to provide baseload power and essential services makes it a valuable asset in the transition towards a sustainable energy future. As efforts to mitigate environmental and social impacts continue, hydropower will continue to play a significant role in reshaping global energy systems and driving us towards a cleaner and more sustainable world.

## 5.Unconventional Energy Sources

### 5.1 Geothermal Energy:

Geothermal energy taps into the Earth's natural heat reservoirs to generate electricity and provide heating and cooling for various applications. This renewable energy source harnesses the thermal energy stored beneath the Earth's surface in rocks and fluids, offering a reliable and consistent source of energy with minimal environmental impact. Geothermal power plants typically utilize steam or hot water from underground reservoirs to drive turbines connected to generators, converting geothermal energy into electricity.

One of the primary advantages of geothermal energy is its reliability and availability, as the Earth's heat is a virtually limitless resource that remains constant over time. Unlike solar and wind energy, which are subject to weather fluctuations, geothermal energy provides a stable and predictable source of electricity, making it particularly suitable for baseload power generation. Additionally, geothermal power plants produce minimal greenhouse gas emissions during operation, contributing to efforts to mitigate climate change and reduce reliance on fossil fuels.

Despite its advantages, geothermal energy also presents some challenges. While geothermal resources are abundant in certain regions with tectonic activity and volcanic hotspots, they are geographically constrained, limiting widespread deployment. Furthermore, the development of geothermal projects requires significant upfront investment and technical expertise, particularly in drilling and reservoir management.

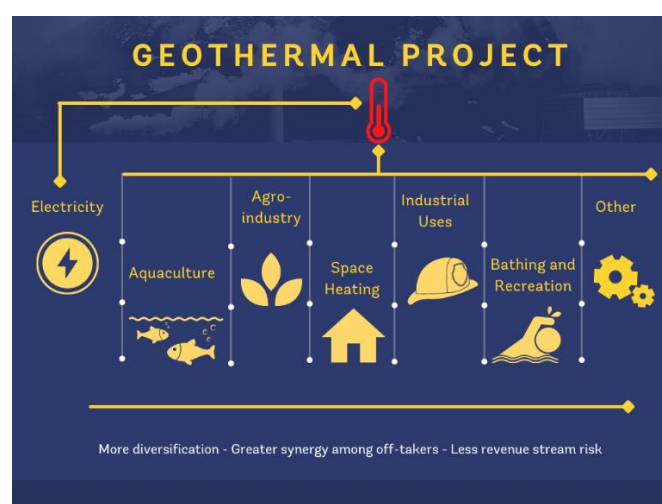


Figure 4 Geothermal Energy

## 5.2 Tidal Energy:

Tidal energy harnesses the rhythmic rise and fall of ocean tides to generate electricity, offering a predictable and renewable source of energy with minimal environmental impact. This renewable energy source captures the kinetic energy of tidal currents using specialized turbines or barrages, converting it into electricity through mechanical or hydraulic systems. Tidal energy is particularly abundant in coastal regions with strong tidal currents, making it a promising option for countries with access to oceans and estuaries.

One of the primary advantages of tidal energy is its predictability, as tidal patterns are influenced by gravitational forces from the moon and sun, providing a reliable and consistent source of electricity. Unlike solar and wind energy, which are subject to daily and seasonal variations, tidal energy production follows predictable tidal cycles, making it suitable for baseload power generation. Additionally, tidal energy generation produces minimal greenhouse gas emissions and environmental impact, as it does not require fuel combustion or large-scale infrastructure.

Despite its advantages, tidal energy also presents challenges and limitations. The development of tidal energy projects requires careful site selection and assessment of tidal currents, seabed conditions, and environmental impacts. High upfront costs, technical complexities, and regulatory challenges can also hinder the widespread deployment of tidal energy technologies. Furthermore, the potential impacts on marine ecosystems and wildlife, such as changes in water flow patterns and underwater noise pollution, require thorough environmental monitoring and mitigation measures.

In summary, tidal energy offers a promising solution for meeting our energy needs while reducing carbon emissions and dependence on fossil fuels. Its predictability, sustainability, and low environmental impact make it an attractive option for countries seeking to diversify their energy sources and transition towards a cleaner and more sustainable energy future. As technology continues to advance and costs decline, tidal energy is poised to play an increasingly significant role in reshaping global energy systems and driving us towards a greener and more sustainable world.

### 5.3 Wave Energy:

Wave energy harnesses the kinetic energy of ocean waves to generate electricity, offering a renewable and predictable source of energy with minimal environmental impact. This innovative renewable energy source utilizes specialized devices, such as wave energy converters (WECs) or oscillating water columns (OWCs), to capture the motion of waves and convert it into electricity through mechanical or hydraulic systems. Wave energy is particularly abundant in coastal regions with strong wave climates, making it a promising option for countries with access to oceans and coastlines.

One of the primary advantages of wave energy is its predictability and consistency, as ocean waves are influenced by wind patterns and ocean currents, providing a reliable source of electricity. Unlike solar and wind energy, which are subject to daily and seasonal variations, wave energy production follows predictable wave patterns, making it suitable for baseload power generation. Additionally, wave energy generation produces minimal greenhouse gas emissions and environmental impact, as it does not require fuel combustion or large-scale infrastructure.

Despite its advantages, wave energy also presents challenges and limitations. The development of wave energy projects requires careful site selection and assessment of wave climates, seabed conditions, and environmental impacts. High upfront costs, technical complexities, and regulatory challenges can also hinder the widespread deployment of wave energy technologies. Furthermore, the potential impacts on marine ecosystems and wildlife, such as changes in water flow patterns and underwater noise pollution, require thorough environmental monitoring and mitigation measures.

In summary, wave energy offers a promising solution for meeting our energy needs while reducing carbon emissions and dependence on fossil fuels. Its predictability, sustainability, and low environmental impact make it an attractive option for countries seeking to diversify their energy sources and transition towards a cleaner and more sustainable energy future. As technology continues to advance and costs decline, wave energy is poised to play an increasingly significant role in reshaping global energy systems and driving us towards a greener and more sustainable world.

## 6. Technologies and Innovations

1. **Energy Storage Systems:** Technologies like lithium-ion batteries and pumped hydro storage enable the integration of renewable energy sources into the grid, enhancing reliability and flexibility.
2. **Smart Grid Technologies:** Digital communication and automation optimize grid operation, facilitating the integration of distributed energy resources and improving efficiency.
3. **Energy Efficiency Solutions:** Innovations in appliances, lighting, and building systems reduce energy consumption and waste across sectors, enhancing energy productivity.
4. **Advanced Materials:** Lightweight and durable materials improve the performance and lifespan of renewable energy technologies, reducing costs and environmental impact.
5. **Artificial Intelligence (AI) and Machine Learning:** AI algorithms optimize renewable energy system operation, maintenance, and energy management, increasing efficiency and reliability.
6. **Ocean Energy Technologies:** Wave energy converters, tidal turbines, and OTEC systems tap into the vast energy potential of oceans, with ongoing efforts to improve efficiency and address environmental challenges.
7. **Carbon Capture and Storage (CCS):** CCS technologies capture and store carbon emissions from power plants and industrial processes, mitigating climate change impacts.
8. **Biogas and Biofuels Production:** Conversion technologies turn organic waste and biomass into renewable fuels, offering sustainable alternatives to fossil fuels for transportation and power generation.

## 7. Economic and Environmental Impacts

### 7.1 Economic Impacts:

1. **Job Creation:** The renewable energy sector creates jobs across various stages of the supply chain, including manufacturing, installation, operation, and maintenance. This stimulates economic growth and provides employment opportunities in local communities.
2. **Investment Opportunities:** The transition to green and unconventional energy sources attracts investment in renewable energy infrastructure, technology development, and research and development. This drives innovation, fosters entrepreneurship, and spurs economic development.
3. **Energy Independence:** Investing in domestic renewable energy resources reduces reliance on imported fossil fuels, enhancing energy security and reducing vulnerability to geopolitical risks and price fluctuations in global energy markets.
4. **Cost Savings:** Over time, renewable energy technologies like solar and wind become increasingly cost-competitive with conventional fossil fuels, leading to lower electricity costs for consumers and businesses. Additionally, renewable energy projects often benefit from long-term price stability, reducing financial risks associated with volatile fuel prices.
5. **Revenue Generation:** Renewable energy projects, such as wind farms and solar parks, generate revenue for landowners through lease agreements and royalties. This provides additional income for rural communities and landowners, contributing to local economies.



## 7.2 Environmental Impacts:

1. **Reduced Greenhouse Gas Emissions:** Green and unconventional energy sources produce minimal or zero greenhouse gas emissions during operation, helping to mitigate climate change and reduce air pollution. By displacing fossil fuel-based energy generation, renewables contribute to lower carbon emissions and cleaner air.
2. **Protection of Natural Resources:** Renewable energy technologies utilize natural resources such as sunlight, wind, and water, without depleting finite resources or causing environmental degradation. This helps preserve ecosystems, biodiversity, and water resources, reducing habitat destruction and land degradation associated with fossil fuel extraction.
3. **Improved Air and Water Quality:** By replacing coal-fired power plants and other polluting sources of energy, renewable energy technologies reduce emissions of harmful pollutants such as sulfur dioxide, nitrogen oxides, and particulate matter. This improves air quality and reduces respiratory illnesses and other health impacts associated with air pollution.
4. **Mitigation of Environmental Risks:** Green and unconventional energy sources reduce the risk of environmental disasters associated with fossil fuel extraction and transportation, such as oil spills, groundwater contamination, and habitat destruction. This enhances environmental resilience and protects ecosystems and communities from the impacts of industrial accidents and disasters.
5. **Water Conservation:** Renewable energy technologies require minimal water usage compared to conventional fossil fuel-based power generation, reducing pressure on freshwater resources and mitigating water scarcity in regions facing water stress. This is particularly relevant for hydropower, which can have significant water consumption and ecosystem impacts.

## 8.Challenges and Barrier

1. **Costs:** The initial investment for renewable energy infrastructure, such as solar panels or wind turbines, can be substantial, posing a barrier to widespread adoption.
2. **Integration:** Variable renewable energy sources like wind and solar require upgrades to the existing electricity grid to ensure reliable and stable integration, adding complexity and cost to the transition.
3. **Land Use:** Large-scale deployment of renewable energy infrastructure, such as solar farms or wind parks, may require significant land area, potentially leading to land use conflicts and environmental impacts on ecosystems.
4. **Regulation:** Inconsistent or inadequate regulatory frameworks and policies can create uncertainty for investors and developers, hindering the deployment of renewable energy projects and slowing progress.
5. **Innovation:** Continued research and development are necessary to improve the efficiency, reliability, and cost-effectiveness of renewable energy technologies, driving down costs and expanding deployment.
6. **Perception:** Public acceptance and support for renewable energy projects vary, influenced by factors such as aesthetics, noise, and perceived impacts on property values, requiring effective communication and community engagement.
7. **Competition:** Renewable energy faces competition from established fossil fuel-based energy sources, which benefit from longstanding infrastructure, subsidies, and market dominance, posing challenges to market penetration and investment.
8. **Skills:** Transitioning to renewable energy requires a skilled workforce with expertise in areas such as engineering, construction, and maintenance, highlighting the need for workforce training and development initiatives to meet growing demand.

## 9.Screenshots

### Renewable Energy: The Power of Nature

Harnessing the unlimited power of natural elements such as sunlight, wind, and water, renewable energy offers a clean and endless source of power for the future.



### Solar Energy: Lighting the Way

Solar energy, derived from the radiant energy of the sun, is a versatile and abundant source of renewable power. From rooftop panels to massive solar farms, the potential is limitless.



## Wind Power: Riding the Breeze

Wind power, harnessed by turbines, presents a clean and efficient energy solution. With advancements in technology, wind farms are becoming an increasingly prominent feature of the energy landscape.



## The Power of Innovation

From cutting-edge research to bold experimentation, the pursuit of new energy sources requires **creativity, ingenuity**, and a willingness to push the boundaries of what is possible. Let's embrace the power of innovation!



## 10. Conclusion

In conclusion, the exploration of green and unconventional energy sources reveals a landscape of promising solutions and transformative potential in the quest for a sustainable and resilient energy future. Through the examination of solar, wind, hydropower, biomass, geothermal, tidal, and wave energy technologies, it becomes evident that these renewable energy sources offer viable alternatives to traditional fossil fuels, with numerous economic, environmental, and social benefits.

On the environmental front, green and unconventional energy sources play a crucial role in mitigating climate change, reducing greenhouse gas emissions, protecting natural resources, improving air and water quality, and mitigating environmental risks. By displacing fossil fuel-based energy generation and promoting clean and renewable alternatives, these technologies help preserve ecosystems, biodiversity, and public health while mitigating the impacts of climate change.

However, the transition to green and unconventional energy sources is not without challenges. High upfront costs, grid integration issues, land use conflicts, regulatory barriers, technological limitations, public perception, market competition, and workforce development constraints present significant hurdles that must be addressed through coordinated efforts from governments, policymakers, industry stakeholders, and civil society.

Nevertheless, the case studies and examples presented throughout this project demonstrate the transformative power of renewable energy adoption in driving sustainable development, fostering economic growth, protecting the environment, and improving the quality of life for communities around the world. By embracing innovation, investing in infrastructure, and prioritizing sustainability, societies can accelerate the transition to a cleaner, more resilient, and equitable energy future.

In summary, green and unconventional energy sources offer a pathway towards a more sustainable, prosperous, and equitable world. By harnessing the power of renewable energy technologies and overcoming the challenges and barriers that lie ahead, we can build a future powered by clean, abundant, and affordable energy for generations to come.

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