International Journal of Trend in Scientific Research and Development (IJTSRD)
Volume 9 Issue 1, Jan-Feb 2025 Available Online: www.ijtsrd.com e-ISSN: 2456 – 6470

Emerging Technologies in the Power Industry

Matthew N. O. Sadiku[1], Paul A. Adekunte[2], Janet O. Sadiku[3]

[1]Roy G. Perry College of Engineering, Prairie View A&M University, Prairie View, TX, USA
[2]International Institute of Professional Security, Lagos, Nigeria
[3]Juliana King University, Houston, TX, USA

ABSTRACT

The power industry is the sector of the economy that generates, transmits, and distributes electricity and heat. It covers the generation, transmission, distribution, and sale of electric power to the general public and industry. The electric power sector has changed significantly over the past several decades, and significant changes are likely to continue.

The electrification of transportation, heating, and industrial processes is driving up electricity demand and creating new opportunities for businesses. This paper discusses how emerging technologies are transforming the power industry.

KEYWORDS: *technology, emerging technologies, power, power industry, utility industry*

How to cite this paper: Matthew N. O. Sadiku | Paul A. Adekunte | Janet O. Sadiku " Emerging Technologies in the Power Industry" Published in International Journal of Trend in Scientific Research and Development (ijtsrd), ISSN: 2456-6470, Volume-9 | Issue-1, February 2025, pp.484-493, URL: www.ijtsrd.com/papers/ijtsrd74888.pdf

Copyright © 2025 by author (s) and International Journal of Trend in Scientific Research and Development Journal. This is an Open Access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0) (http://creativecommons.org/licenses/by/4.0)

INTRODUCTION

The electric power industry is the fundamental sector of the economy responsible for generating, transmitting, and distributing electricity to meet the energy needs of a nation's population and economy. The industry is a vital part of the economy, providing electricity to homes, businesses, and industries. It serves as a measure of a country's strength and modernization.

The power industry has been through a remarkable shift in recent times, as a result of modern creative technologies. Businesses and industries are embracing innovative trends and technologies that promise to reshape the way we generate and consume power. There is a growing transition of these technology-based innovations into the power industry. The key drivers driving this transformation and the commercial opportunities they present include emerging technologies. These emerging technologies show an encouraging application into the power sector. Power engineers and technicians use these technology to design and maintain power system. Figure 1 shows some power engineers [1], while Figure 2 displays some power technicians [2].

WHAT ARE EMERGING TECHNOLOGIES?

Technology may be regarded as a collection of systems designed to perform some function. It can help alleviate some of the challenges facing business today. Emerging technology is a term generally used to describe new technology. The term often refers to technologies currently developing or expected to be available within the next five to ten years. Any imminent, but not fully realized, technological innovations will have some impact on the status quo.

Emerging technologies are shaping our societies. They continue to affect the way we live, work, and interact with one another. Emerging technology (ET) lacks a consensus on what classifies them as "emergent." It is a relative term because one may see a technology as emerging and others may not see it the same way. It is a term that is often used to describe a new technology. A technology is still emerging if it is not yet a "must-have" [3]. An emerging technology is the one that holds the promise of creating a new economic engine and is trans-industrial. ET is used in different areas such as media, healthcare, business, science, education, or defense.

The characteristics of emerging technologies include the following [4]:

- *Novelty:* Emerging technologies are typically new or novel, meaning they have yet to be widely adopted or used. They often represent a significant departure from existing technologies or processes.
- *Potential for Disruption:* Emerging technologies have the potential to disrupt existing markets, industries, or ways of doing things. They may also displace existing businesses or industries.
- *Uncertainty:* Because emerging technologies are still in the early stages of development, there is often a high uncertainty surrounding their future potential and impact. It can be challenging to predict how they will evolve.
- *Rapid Change:* Emerging technologies often evolve rapidly, with new developments and innovations emerging frequently. It can make keeping up with the latest trends and advancements challenging.
- *Interdisciplinary*: Emerging technologies often involve multiple disciplines or fields of study, such as computer science, engineering, and biology. They may require collaboration across different fields and industries to develop their potential fully.

Emerging technologies are worth investigating. They are responsible for developing new products or devices. As emerging technologies continue to evolve, engineering is poised for a transformative future. Emerging technologies have driven innovation and progress in today's rapidly evolving digital landscape. The collective impact of emerging technologies such as artificial intelligence, machine learning, big data, and the Internet of things is undeniably transformative. Some emerging technologies are shown in Figure 3 [5].

POWER INDUSTRY

Electric power is an important basic industry for the country's economy and social development. The industry is a key part of the economy, supplying electricity to the manufacturing, processing, commercial, and residential sectors. In essence, the power industry does three things [6]:

- *Generates Electricity*: The power industry uses technology to generate electricity from various sources, such as fossil fuels, hydropower, and renewable energy. Generation is the conversion of some primary energy source into electric power suitable for commercial and domestic use on an electrical grid. A power plant is shown in Figure 4 [7].
- *Transmits Electricity*: The power industry uses transmission lines to move electricity from generation sites to distribution points. Electric power transmission is the bulk movement of electrical energy from a generating site, such as a power plant, to an electrical substation. Electric power is transmitted on overhead lines like those shown in Figure 5 [7].
- *Distributes Electricity:* The power industry uses distribution systems to move electricity from distribution points to homes, businesses, and industries. This is the final stage in the delivery of electric power. Electric power distribution carries electricity from the transmission system to individual consumers. Figure 6 displays a 50 kVA pole-mounted distribution transformer [6].

Generation, transmission and distribution may be offered by a single company, or different organizations may provide each of these portions of the system. They may be provided by a government controlled organization.

The commercial distribution of electric power started in 1882 when electricity was produced for electric lighting. By the middle of the 20th century, electricity was seen as a "natural monopoly." Since the 1990s, many regions have broken up the generation and distribution of electric power. In early 1882, Edison opened the world's first steam-powered electricity generating station at Holborn Viaduct in London. Later in the year, Edison opened the Pearl Street Power Station in New York City and it was a DC supply. Edison's system required power stations to be within a mile of the consumers. The mid to late 1880s saw the introduction of alternating current (AC) systems in Europe and the US. AC power had an advantage in that transformers, installed at power stations, could be used to step up or step down the voltage. AC and DC systems competed for a while, during a period called the war of the currents. AC eventually won due to its enormous technical and economic advantages. In the 1990s, several nations liberalized the regulation of the electricity market in ways that have led to the separation of the electricity transmission business from the distribution business [6]. In the United States, how electricity is bought and sold varies by region.

EMERGING TECHNOLOGIES IN POWER INDUSTRY

Tech-evangelists are optimistic, on how smart grids, advanced metering infrastructures, virtual power

plants, smart homes, intelligent transportation, and smart cities will enable the power industry of tomorrow. Emerging technologies in the power industry include the following [8]:

1. *Artificial Intelligence:* Artificial Intelligence (AI) is a game-changing technology that has the potential to revolutionize the power industry. It can also detect outages in milliseconds and restore electricity faster than ever before, guaranteeing improved grid reliability with minimal downtime. A prime example of AI in action within the power sector is its application in wind turbine optimization through machine learning algorithms. The integration of digital technologies and artificial intelligence (AI) is driving efficiency and optimization across the power generation sector. AI-driven predictive analytics, remote monitoring systems, and autonomous control algorithms enable more efficient power plant operation and maintenance. As AI technology advances, its applications will become more widespread, making it an integral part of everyday life.
2. *Drones:* Drones, or remotely piloted aerial systems (RPAS), are now becoming a mainstream tool in utility industry, and are expected to have an increased use for grid monitoring. Drones can track the health of the transmission and distribution systems, cutting down expenditure on the use of aerial surveys or manual visits. Figure 7 shows the use of a drone in power system [8].
3. *Smart Grid*: A smart grid is an advanced power grid that uses digital technology to monitor and manage the flow of electricity to improve the efficiency and reliability of the electricity supply. The grid is an electrical grid with automation, communication, and IT systems that can monitor power flows from points of generation to points of consumption. Smart grid is a platform that enables functioning of different technologies and systems. It monitors energy supply and usage in real time to reduce waste, prevent outages, and lower greenhouse gas emissions. From energy efficiency perspective, the "smart" way of energy use implies energy resource optimization. Smart grids comprise a variety of operational and energy measures including smart meters, smart appliances, renewable, and energy efficient resources. They deal with important aspects such as electronic power conditioning, production control, electricity distribution and reduction of carbon emissions. Smart grids bring the power of networked, interactive technologies into an electricity system, giving utilities and consumers alike a new level of control over energy use. In the concept of smart grid, energy storage and charging stations play an important role. Microgrids are self-contained energy systems that have the capability to work autonomously or in conjunction with a main power grid. Figure 8 shows the smart grid [9].
4. *Internet of Things* (IoT): This is a giant network of connected devices, electronics and sensors such as smart homes, smart phones, smart cars, and smart cities which enables data exchange in real time. IoT connects everyday devices to the internet, enhancing efficiency and convenience in homes and industries. It is a network of connected devices that can communicate with each other and with other devices. These devices can be anything from phones and computers to sensors, actuators, and other electronic components. The Internet of things is in large part the enabler of smart gird as its technological and infrastructural components are mostly IoT-based. The convergence of smart grid technologies and the Internet of things (IoT) is revolutionizing power distribution and management. The integration of smart grid technologies and the Internet of things (IoT) offers potential solutions to the challenges posed by the intermittent of renewable energy sources.
5. *Energy Storage:* This is an exciting technology that is revolutionizing the power industry. By storing excess energy from renewable sources and releasing it when needed, these systems reduce dependency on fossil fuels while increasing grid stability. Energy storage technologies like pumped hydroelectric storage and battery storage help to integrate variable renewable generation and energy demand peaks by storing energy for times when it is most needed. Battery storage typically charges during periods when power prices are low and discharges during periods when power prices are high. Starting in 2021, battery storage established itself as a rapidly emerging energy technology in the US power sector.
6. *Advanced Metering Infrastructure* (AMI): The introduction of AMI has been incredibly beneficial for utilities and consumers alike. This is an integrated system of smart meters, communications networks, meter data acquisition, and meter data management systems that enable two-way communication between utility service providers and customers. This cutting-edge technology provides utility companies with real-time data on electricity consumption. AMI is considered as a cornerstone of the smart grid by potentially providing a communication backbone for low-latency data aimed at improving

distribution asset utilization failure detection. It is revolutionizing the power industry, with estimates projecting that over half of American households will have a smart meter by 2025. It expands the range of time-based rate programs that can be offered to consumers. AMI offers many benefits to power companies at operational, security, and financial front such as faster return of investment (ROI) by reducing equipment and maintenance costs.

7. *Renewable Energy:* One of the main reasons for the changes introduced in the power sector is the strong affirmation of electricity generation from renewable energy sources. The shift towards renewable energy sources like solar, wind, and hydropower is gaining momentum worldwide. As concerns about climate change escalate, nations and businesses are increasingly investing in clean energy solutions. By the year 2030, renewable energy sources are anticipated to contribute to around 45 to 50 percent of global generation. Advances in renewables technology, smart meters, and grids which enable optimization of consumption usage, have opened a new chapter in the markets development of electric energy. Wind power, which comes from wind turbines, is super important for getting energy from renewable sources. The future development of wind power presents a significant opportunity in terms of providing low carbon energy. Figure 9 shows a multi-rotor wind turbine [10].
8. *Wireless Power Transfer*: Wireless power transfer (WPT), also known as wireless energy transfer, is the transmission of electrical energy from a power source to a receiver without the use of interconnecting wires. Though still in its early stages of development and production, wireless power transfer is a promising innovation for the future of electronics and power systems. WPT systems use time-varying electromagnetic fields for energy transmission. A receiver in a device picks up the power, which allows for contactless charging, powering, and data communication. WPT eliminates the need for chasing chargers. This technology transfers power to devices wirelessly through air, plastic, granite, wood, or any dielectric medium. It could be used to power and charge wearables such as fitness trackers, smartwatches, and medical devices.
9. *Wearable Tech:* Wearable devices, virtual reality (VR) and augmented reality (AR), are now becoming the next computing platform, followed by personal computers and smartphones. Wearable devices like smart glasses can both collect and deliver data in the field. Other devices include smart watches and other smart wrist and armbands, smart helmets. Engineers could use augmented reality to quickly target a problem with a piece of equipment; or a virtual reality model could enable someone to remotely predict catastrophic failures to distribution equipment.

APPLICATIONS OF EMERGING TECHNOLOGIES

Technological advancements and innovations driven by rapid electrification of segments like transport, expansion of renewables, and digitalization of the grid are transforming the power sector. Electrification continues to expand across transportation, industrial processes, and buildings and homes. Common applications of emerging technologies in the power industry include the following [11,12]:

- *Electric Vehicles:* Electric vehicles (EVs), electric heating systems, and electrified industrial equipment are becoming increasingly common, opening avenues for companies involved in electric vehicle manufacturing, charging infrastructure deployment, and electric appliance production. Thanks to the growing uptake of EVs, the development of robust charging infrastructure has boomed with it, with fast-charging stations, wireless charging technology, and vehicle-to-grid (V2G) integration. With this, time-of-use (TOU) tariffs are becoming more prevalent as EV owners look to improve their electricity affordability by charging their vehicles during off-peak hours. This system promotes more efficient use of the power grid. With electric vehicle manufacturer Tesla continuing to break records for production and market value, it is clear the future of electronics is in cars. Figure 10 shows an electric car that is being charged [13].
- *Microgrids:* These are self-contained energy systems that can work independently or with a main power grid. A monogrid can use multiple renewable energy sources, like wind turbines, solar panels, and natural gas generators. This grid can operate in two modes, island or connected, depending on need and a community's power usage. Not only do microgrids and smart grids improve communication between power supply companies and technology, but they also put the power in the hands of the customer. The increasing availability of battery electric storage systems has strengthened the case for microgrids to enhance grid resilience and reliability.

- *Renewable Energy Storage:* Advancements in energy storage technologies, such as grid-scale batteries, flow batteries, and hydrogen storage, are one of the most crucial and effective ways of integrating renewable energy sources efficiently and reliably to the grid. Renewable energy storage has the ability to overcome intermittency challenges as well, as it is able to efficiently store surplus energy generated during peak production periods (like sunny or windy days) and release during times of high demand or low renewable energy generation. As a result, these technologies ensure a more reliable and stable energy supply.
- *Data Centers:* Data centers, fueled by the rise of generative AI, machine learning (ML), and cryptocurrency-mining activities, are becoming major electricity consumers. These energy-intensive facilities currently consume 6% to 8% of total annual electricity generation. Power demand estimates vary widely. How to meet this escalating demand while simultaneously transitioning to a cleaner energy mix presents some challenges. As data centers continue to demand reliable power to meet a share of their anticipated demand, some are seeking to power their operations with clean energy by supporting the buildout of renewable energy. Data centers are water-intensive, and their proliferation, especially in water-stressed regions, could exacerbate existing shortages.
- *Smart Cities*: Smart cities are all about using technology to make our cities better places to live. They bring together things like the Internet, smart gadgets, and big data to make city life smoother and greener. The goal of smart cities is to solve big city problems, like traffic jams, saving energy, keeping people safe, and taking care of the environment. It is like giving our cities a high-tech upgrade to make life easier and nicer for everyone who lives there. By connecting up all the city's services and stuff, like traffic lights and energy systems, smart cities can make things work better and use up fewer resources. Using smart algorithms powered by artificial intelligence (AI) and machine learning, we can figure out smart ways to use the data generated.

BENEFITS

The proportion of electric energy in the total energy and the speed of development of the electric power industry are taken to measure a nation's comprehensive strength and modernization degree. By embracing new and cutting-edge technologies, we can vastly improve efficiency, reliability, and sustainability. Businesses and consumers alike are benefitting from unprecedented efficiency levels, more reliable outcomes, increased environmental awareness, more sustainable practices, and less dependence on nonrenewable sources of fuel. Other benefits include the following [14]:

- *Impact on Businesses*: The adoption of cutting-edge technologies in the power industry has wide-reaching implications for businesses and consumers alike. Companies can benefit from these developments with cost savings, improved reliability, and reduced environmental impact.
- *Impact on Consumers:* For individuals, taking advantage of new technologies can mean lower electricity bills, more dependable service delivery, and increased control over energy consumption. Smart Meters Interface (AMI), for example, gives customers real-time updates on their usage, which enables customers to make informed decisions about how they use energy resources.
- *Cost Reduction:* The cost of renewable electricity generated by wind and solar technology has decreased significantly over the past two decades, becoming competitive with existing coal and gas generation. In addition to decreased construction costs, the total operation and maintenance costs of renewable sources are low compared to fossil fuel sources, particularly coal-fired sources.
- *Power System Automation:* This enables rapid diagnosis of and precise solutions to specific grid disruptions or outages. Three technology categories for advanced control methods are distributed intelligent agents (control systems), analytical tools (software algorithms and high-speed computers), and operational applications (SCADA, substation automation, demand response, etc.).

CHALLENGES

The management of the current transmission and distribution networks, along with their electricity sources, requires a complex array of utilities, merchant transmission companies, industry parties, and regulatory authorities. The electrification of transportation, heating, and industrial processes is increasing the demand for electricity. Other challenges include the following [15]:

- *Intermittency of Renewable Energy Sources*: One of the primary challenges facing the future of power generation is the intermittent of renewable energy sources such as solar and wind. Unlike traditional fossil fuels, renewable sources are

dependent on weather conditions and may not always be available when energy demand is high.

- *Energy Storage Capacity and Efficiency:* Renewable energy sources offer clean and sustainable alternatives, their intermittent nature necessitates effective energy storage solutions to store excess energy generated during peak production periods and release it when demand is high. However, existing energy storage technologies face limitations in terms of capacity, efficiency, and cost-effectiveness, hindering their widespread adoption and scalability.
- *Pollution:* Electricity demand levels are a significant driver of emissions. The power industry is a significant source of greenhouse gas emissions. Coal-fired electricity is an emissions-intensive energy technology in the power sector. The addition of pollution control technologies to comply with various Clean Air Act regulations together with market forces and advances in cleaner generation technologies have resulted in reduced air emissions from the power sector over the last several decades. Any emissions corresponding to increased demand will depend on the type of sources generating the electricity, the pollution controls used across the transmission system, and the rate at which the demand growth occurs. The development of natural gas-fired electricity sources over the past two decades has played a key role in emission reductions in the US. Natural gas generation surpassed coal-fired generation in 2016 and has continued to grow.
- *Complexity:* The complexity of the process of planning, development, and management of the electric power system has influenced the choice of centralized business management. The structure of the organization of electricity market is largely conditioned by certain physical and economic characteristics that limit the extent to which market mechanisms can replace the traditional form.
- *Regulation:* Until the early 1980s, the electric power industry has been treated as a natural monopoly. Utilities in traditionally regulated regions operate as a monopoly in their territories, which means that customers only have the option to buy power from them. To keep electricity rates reasonable for customers, state regulators oversee how these electric utilities set electricity prices. In deregulated areas, electricity customers have the option of selecting an electric supplier (known as customer choice) rather than being required to purchase electricity from their local electric utility. Since many regional transmission organizations (RTOs) operate wholesale markets that encompass multiple states, they are regulated by FERC (with the exception of the Texas RTO).

CONCLUSION

The power industry is in the midst of an unprecedented transformation, with a bright future ahead. As the demand for energy continues to rise, the power industry must adjust and accept new strategies. The future of electric power influences several industries, such as automotive, healthcare, manufacturing, telecommunications, banking and finance, retail, education, energy, aerospace, and security. The future of power generation presents a wealth of commercial opportunities for businesses across various sectors. By embracing innovative technologies, staying ahead of market trends, and addressing the evolving needs of customers and regulators, companies can position themselves for success in the dynamic and transformative energy landscape of tomorrow. Businesses specializing in smart grid infrastructure, IoT devices, and energy management software stand to benefit from the increasing adoption of intelligent grid solutions. More information about emerging technologies in the power industry can be found in the books [16,17] and the following related journals:

- *IEEE Smart Grid.*
- *The Electricity Journal*
- *Energy Policyz*

CONCLUSION

The architecture industry rapidly adopts new technologies to make smart buildings. New architecture technologies help design the buildings of tomorrow, today. They empower architects to spend more time exploring, creating, and pushing the boundaries of design.

They are going to reshape the future state of application architecture and will help build faster, more secure, scalable, highly available, and innovative products for different business domains. The power of these tools has only begun to be harnessed.

Whether it is more affordable housing or ultra-modern vertical cities, architects are turning to new technologies to help them design the structures of the future. Today's developing technologies will no doubt reshape architecture and design, freeing up mental capacity to solve more complex challenges and create truly human-centered solutions. Emerging technologies increasingly influence architects' work,

acting as catalysts for creativity, productivity, and communication. The integration of AI, AR, VR, BIM, robotics, blockchain, and global collaboration platforms will usher in an era where creativity meets efficiency. Exploring these emerging technologies provides valuable insights into the future direction of digital technologies in the AEC sector. More information about emerging technologies in architecture can be found in the books [12-15] and a related journal: *Automation in Construction.*

REFERENCES

[1] "Trends and technologies in power generation," March 2024, https://prismecs.com/blog/trends-and-technologies-in-power-generation

[2] "State & future of the power industry," https://guidehouse.com/insights/energy/2024/state-and-future-of-the-power-industry

[3] M. Halaweh, "Emerging technology: What is it?" *Journal of Technology Management & Innovation*, vol. 8, no. 3, 2013, pp. 108-115.

[4] N. Duggal, "Top 18 new technology trends for 2023," July 2023, https://www.simplilearn.com/top-technology-trends-and-jobs-article

[5] "How enterprise architects integrate emerging technologies to enhance architecture," https://www.linkedin.com/pulse/how-enterprise-architects-integrate-emerging-technologies-qdgfe/

[6] "Electric power industry," *Wikipedia,* the free encyclopedia, https://en.wikipedia.org/wiki/Electric_power_industry

[7] "US electricity markets 101," March 17, 2022, https://www.rff.org/publications/explainers/us-electricity-markets-101/

[8] R. K. Pandey, "Emerging technologies in the utility industry," February 2018, https://www.rmsi.com/blog/2018/02/emerging-technologies-in-the-utility-industry/

[9] "The role of internet of things (IoT) in smart grid technology and applications," August 2021, https://hashstudioz.medium.com/the-role-of-internet-of-things-iot-in-smart-grid-technology-and-applications-86061ad17f53

[10] S. Watson et al., "Future emerging technologies in the wind power sector: A European perspective," *Renewable and Sustainable Energy Reviews,* vol. 113, October 2019.

[11] "20 Emerging technologies that will change our world," June 2024, https://blog.emb.global/emerging-technologies-that-will-change-our-world/

[12] "Top 10: Emerging technologies," Unknown Source

[13] "Five power and electric trends that will shape the future,"

https://www.mtu.edu/globalcampus/5-power-electrical-engineering-trends/

[14] M. R. Rizvi, "Empowering tomorrow: The 4 game-changing technologies shaping the power industry," November 2023

https://smartgrid.ieee.org/bulletins/november-2023/empowering-tomorrow-the-4-game-changing-technologies-shaping-the-power-industry

[15] "Power sector evolution,"

https://www.epa.gov/power-sector/power-sector-evolution

[16] P. Breeze, *Power Generation Technologies.* Newnes, 2005.

[17] E. Muljadi, H. Jiang, and Y. Zhang (eds.), *New Technologies for Power System Operation and Analysis.* Elsevier Science, 2020.

ABOUT THE AUTHORS

Matthew N.O. Sadiku is a professor emeritus in the Department of Electrical and Computer Engineering at Prairie View A&M University, Prairie View, Texas. He is the author of several books and papers. His areas of research interest include computational electromagnetics, computer networks, engineering education, and marriage counseling. He is a Life Fellow of IEEE.

Paul A. Adekunte holds Masters degree in crime management and prevention from Bayero University, Kano, and a bachelor degree in Zoology from Ahmadu Bello University, Zaria, Nigeria. He is a seasoned lecturer, trainer, and consultant in security matters, human and management/public relations.

Janet O. Sadiku holds bachelor degree in Nursing Science in 1980 at the University of Ife, now known as Obafemi Awolowo University, Nigeria and doctoral degree from Juliana King University, Houston, TX in December 2023. She has worked as a nurse, educator, and church minister in Nigeria, United Kingdom, Canada, and United States. She is a co-author of some papers and books.

Figure 1: Some power engineers [1].

Figure 2: Some power technicians [2].

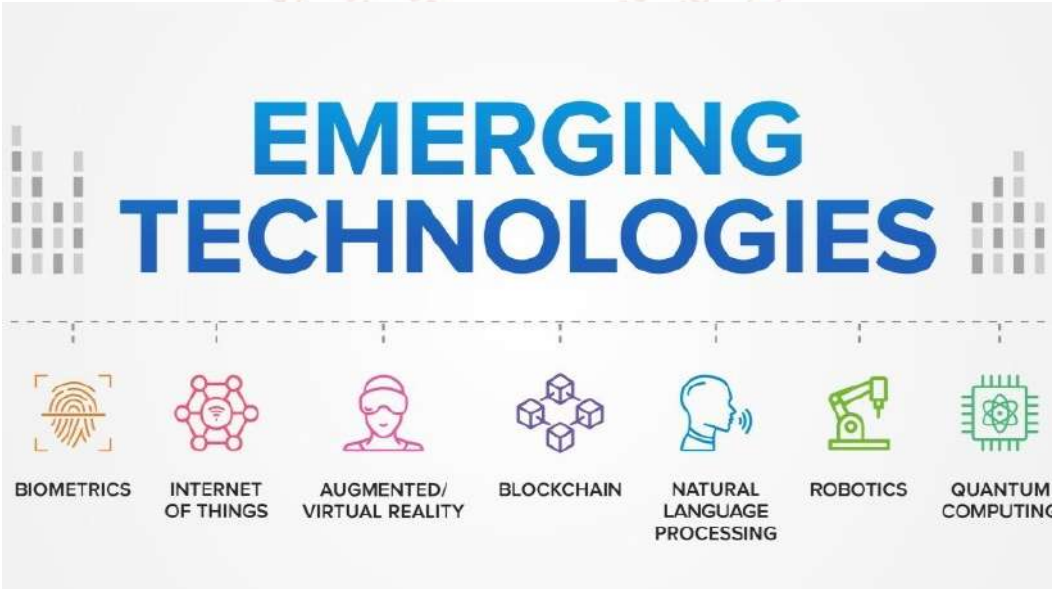

Figure 3: Some emerging technologies [5].

Figure 4: A power plant [7].

Figure 5: Electric power is transmitted on overhead lines [7].

Figure 6: A pole-mounted distribution transformer [6].

Figure 7: Use of a drone in power system [8].

Figure 8: Smart grid [9].

Figure 9: A multi-rotor wind turbine [10].

Figure 10: An electric car that is being charged [13].