International Journal of Research Studies in Electrical and Electronics Engineering (IJRSEEE)
Volume 9, Issue 1, 2024, PP 1-16
ISSN 2454-9436 (Online)
DOI: http://dx.doi.org/10.20431/2454-9436.0801001
www.arcjournals.org

A LitteratureReview :Electric Distribution Network

BouabbadiSoufiane, Guennoun Karim, Tazi Said, Wahbi Mohammed

Laboratory of information systems and sensors network, Hassania School of public works, Casablanca, Morocco

Corresponding Author:** ***BouabbadiSoufiane., *Laboratory of information systems and sensors network, Hassania School of public works, Casablanca, Morocco*

Abstract:*Smart grids are the next generation of electric power grids that use digital technologies to monitor and control the distribution and consumption of electricity. In this article, the author will discuss the steps of production, transmission and consumption of electrical energy. First, the article advances the sources of energy that are two types conventional and non-conventional. After, the aspects of electricity transportation will be discussed such as carbon emissions, air quality, costs, energy security, sourcing, sustainability. Finally, the distribution grid system will be discussed in terms of architecture, structure, outage, duties, planning process, demand forecasting and solutions for demand forecasting.*

Keywords:*Electrical distribution network, demand forecasts, loading forecasting, planning process, planning objectives, structure of distribution networks.*

1. INTRODUCTION

The Electric Distribution System is the final stage of electric power system where the generated power is converted into useful work through distribution lines and feeders. It deals with lower voltage magnitude as reverse of transmission system high voltage.

In a traditional power grid, electricity is generated at central power plants and then transmitted to homes and businesses through a network of power lines. However, this system is often inefficient and wasteful, as electricity is lost in transmission and there is little control over how much energy is consumed.

Smart grids address these issues by using advanced technology to monitor and control the flow of electricity. For example, smart meters are installed in homes and businesses to measure the amount of electricity being used in real-time. This information can then be used by utilities to better manage the electricity supply, reducing waste, and improving efficiency.

In this review, first, the article advances the sources of energy that are two types conventional and non-conventional. After, the aspects of electricity transportation will be discussed such as carbon emissions, air quality, costs, energy security, sourcing, sustainability. Finally, the distribution grid system will be discussed in terms of architecture, structure, outage, duties, planning process, demand forecasting and solutions for demand forecasting.

2. METHODS

2.1. The sources of energy

2.1.1. *Conventional Sources*

Fossil Fuels

Fossil fuels are fuels formed inside the earth from the remains of plants and animals after millions of years. The fossil fuels are coal, petroleum and natural gas. Fossil fuels are non renewable sources of energy so they should be conserved and used judiciously.

Figure1.*Fossil fuels energy*

Disadvantages of fossil fuels:

1. Burning of fossil fuels release gases and harmful particles which causes air pollution.
2. Burning of fossil fuels release acidic oxides of sulphur and nitrogen which causes acid rain which is harmful for living organisms, affects soil and water, causes damage to buildings, corrosion of metals etc.
3. Burning of fossil fuels release a large amount of carbon dioxide gas which increases the temperature of the atmosphere and causes global warming (green house effect).

Thermal Power Plants

In thermal power plants the heat energy produced by burning fossil fuels like coal, petroleum or natural gas is used to heat water and change it into steam which rotates the turbines of generators to produce electricity.

Figure2.*Thermal power plant*

Hydro Power Plants

In hydro power plants water from rivers are stored by constructing dams. The water from the dam flows down through pipes and rotates the turbines of generators to produce electricity.

Figure3.*Hydro power plants*

Advantages:

1. Flowing water is a renewable source of energy.
2. The electricity produced does not cause pollution.
3. The water stored in dams can also be used to control floods and for irrigation.

Disadvantages:

1. The initial cost is high.
2. Large areas of land gets submerged and the decomposition of vegetation produces methane gas which is a green house gas.
3. It causes displacement of people from large areas of land.

Biomass Energy

The waste materials and dead parts of living things are called biomass. Eg : wood, animal dung, vegetable waste, agricultural waste, sewage etc. Biomass is decomposed by anaerobic microorganisms to produce biogas. Biogas is a mixture of gases containing methane, carbon dioxide, hydrogen and hydrogen sulphide.

Figure4. *Biomass energy*

Wind Energy

Wind energy is used in wind mills which converts the kinetic energy of the wind into mechanical or electrical energy.

The kinetic energy of wind can be used to do mechanical work like lifting water from wells or grinding grains in flour mills.

It can also be used to rotate the turbines of generators to produce electricity. A single wind mill produces only a small amount of electricity.

So a large number of wind mills in a large area are coupled together to produce more electricity in wind energy farms.

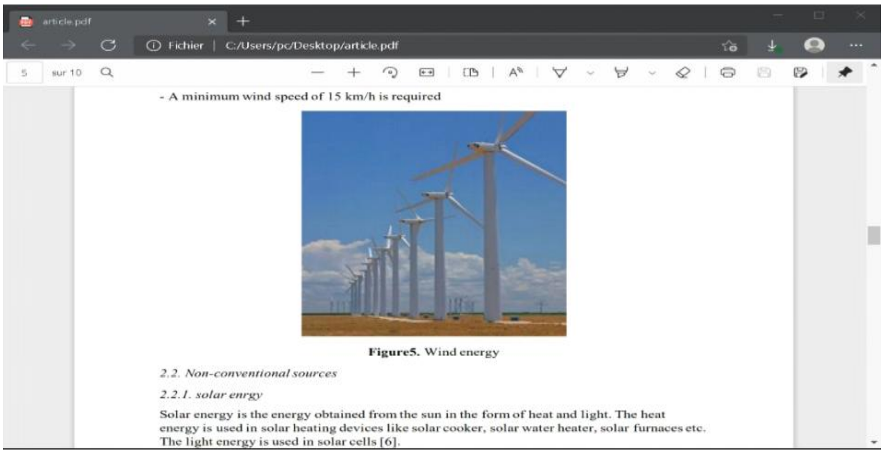


Figure5. *Wind energy*

Advantages:

1. It is a renewable source of energy.
2. It does not cause pollution.
3. The recurring cost is less.

Disadvantages:

4. Wind is not available at all times.

a. It requires a large area of land.
b. A minimum wind speed of 15 km/h is required

2.1.2.*Non-Conventional Sources*

Solar Energy

Solar cooker: The box type solar cooker has an insulated box painted black inside. It is covered by a glass plate which allows heat to enter inside but does not allow heat to escape out. It has a mirror to reflect more sunlight into the box. The food to be cooked is kept in containers inside the box It can produce a temperature of 100° to 140°.

Solar water heater: A solar water heater has an insulated box painted black inside with a system of copper tubes. It is covered with a glass plate which allows heat to enter inside but does not allow heat to escape out. When water flows through the copper tube it absorbs heat and becomes hot.

Solar cells: Solar cell is a device which converts solar energy into electrical energy. Solar cells are made from semi-conductors like silicon, germanium, gallium etc. A single solar cell produces a voltage of about 0.5 to 1 V and produces about 0.7 W electricity. So several solar cells are arranged in a solar panel to produce more electricity.

Figure6.*Solar energy*

Advantages:

a. It uses renewable source of energy.
b. It produces electricity which does not cause pollution.
c. It can be used in remote areas where there is no power supply.

Disadvantages:

a. It uses a special grade of silicon which is expensive.
b. Since silver is used for connecting the cells together it is more expensive.
c. The current produced is DC and to convert it to AC increases the cost.

Energy from the Sea

Energy from the sea is obtained in three different forms. They are Tidal energy, Sea wave energy and Ocean thermal energy.

Tidal energy: The periodic rise and fall of sea level due to gravitational attraction of the moon causes tides.

Sea Wave Energy**:** When strong wind blows over the sea it produces huge waves.

Ocean Thermal Energy:There is a temperature difference between the warm surface water and the cold water at the bottom of the oceans.

Geothermal Energy

The deeper regions of the earth's crust is very hot. This heat melts rocks and forms magma. The magma moves up and collects below at some places called Hot spots.

The underground water in contact with hot spot gets heated into steam at high pressure.

By drilling holes into hot spots the steam coming out can be used to rotate turbines of generators to produce electricity.

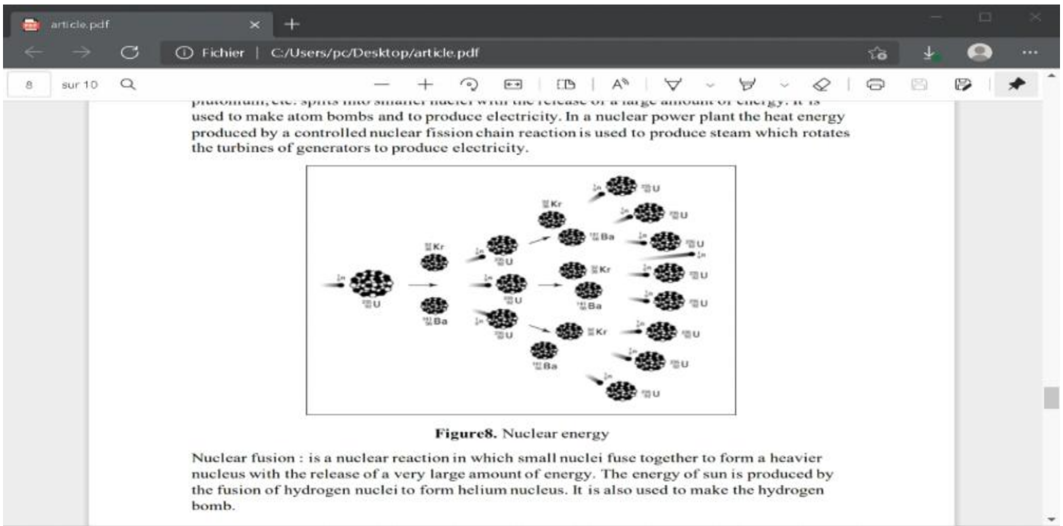
Figure7.*Geothermal energy*

Nuclear Energy

Nuclear energy is the energy is the energy released during nuclear reactions. During nuclear reactions some mass is converted into energy and so a very large amount of energy is produced during nuclear reactions.

Nuclear reactions types are: Nuclear fission and nuclear fusion.

Nuclear fission: Nuclear fission is a nuclear reaction in which the nucleus of a heavy atom like uranium, plutonium, etc. splits into smaller nuclei with the release of a large amount of energy. It is used to make atom bombs and to produce electricity. In a nuclear power plant the heat energy produced by a controlled nuclear fission chain reaction is used to produce steam which rotates the turbines of generators to produce electricity.



used to make atom bombs and to produce electricity. In a nuclear power plant the heat energy produced by a controlled nuclear fission chain reaction is used to produce steam which rotates the turbines of generators to produce electricity.

Figure8. Nuclear energy

Nuclear fusion : is a nuclear reaction in which small nuclei fuse together to form a heavier nucleus with the release of a very large amount of energy. The energy of sun is produced by the fusion of hydrogen nuclei to form helium nucleus. It is also used to make the hydrogen bomb.

Figure8.*Nuclear fission*

Nuclear fusion: Nuclear fusion is a nuclear reaction in which small nuclei fuse together to form a heavier nucleus with the release of a very large amount of energy. The energy of sun is produced by the fusion of hydrogen nuclei to form helium nucleus. It is also used to make the hydrogen bomb.

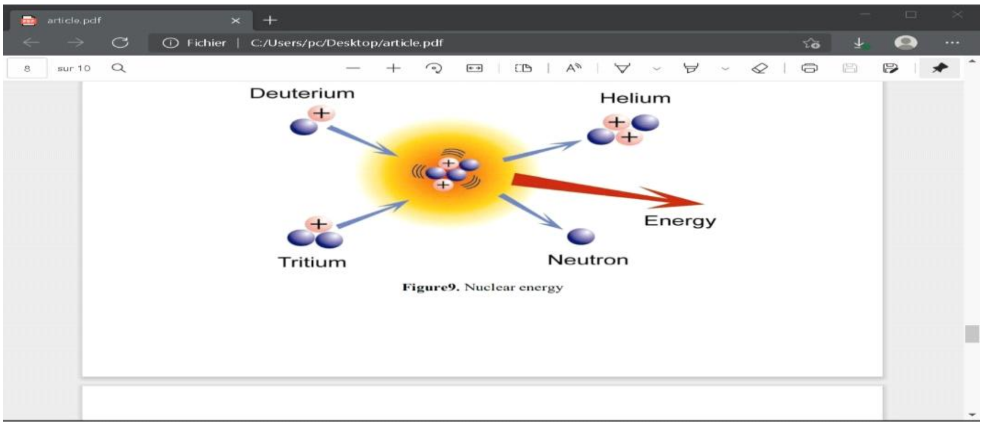


Figure9.*Nuclear fusion*

Advantages of nuclear energy:

a. It produces a very large amount of energy per unit mass than any other source of energy.
b. If safety measures are taken, it is more environment friendly than fossil fuels.

Disadvantages of nuclear energy:

a. The cost of a nuclear reactor is very high.
b. The availability of nuclear fuel is limited.
c. Nuclear reactors produce harmful nuclear wastes which is difficult to dispose.

2.2. Electric Transportation System

2.2.1. Definition

Transportation electrification refers to the use of electricity from external sources of electrical power. It is considered to be a potential quadruple win for the electric utilities and the society as it enables companies to support environmental goals while building customer satisfaction, reduce operating costs and assure the future value of existing assets. Utilities can define multiple value streams that will drive the regulatory policy and align staff around a holistic approach through transportation electrification.

2.2.2. *Benefits of Transportation Electrification*

Reduced Carbon Emissions

Transportation emissions are responsible for around 28% of all GHG emissions in the United States. Although the manufacturing of EVs is environmentally taxing, any emissions released during the production process are neutralized when the vehicles are driven.

Table1.*Carbon Emissions*

CO2 emissions	Raw materials/materials	Raw materials/ material procurement
	Production	Production
	Distribution	Transport to a warehouse/user
	Usage	Usage by the user
	Disposal/Recycling	Reclamation, incineration, recycling

Improved Air Quality

The electrification of transportation will improve the air quality in towns and cities because these vehicles do not have a tailpipethat produces carbon dioxide emissions.

Table2.*Air pollutants*

Common indoor air polluants				
Airborne particles	Indoor formaldehyde	Household & gases	Ozone	Carbon dioxide
diesel, exhaust, dust, smoke..	building materials, furniture, cooking, smoking..	activities, painting, cooking, smoking..	outdoor air, ground level ozone..	people exhaling, cooking..

Lower Operating Costs

Nationally, EVs are between three and five times cheaper to drive per mile than their gas-powered counterparts. In certain parts of the United States, including Arizona, Florida, and Tennessee, certain models are up to six times cheaper to drive.

Table3.*Low operating costs*

Solar thermal	Solar PV system	Dual flush toilet	Hot water	
High efficiency water geating system	Energy star applications	Energy efficient heating and cooling system	Energy Efficiency lighting	Grey water recycling system

Increased Energy Security

The governments has long been dependent on fossil fuels, including oil, coal, and natural gas, for its energy production. But these materials, though proven to be highly efficient and effective, are finite resources, which means they will one day run out.

Table4.*Energy security*

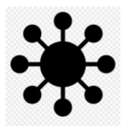
Availability	Access	Stability	Utility
Grid infrastructure Existence of sources	Economic cost Connection to grid	National policies Enviromental impact	Reliability Efficiency Social acceptability

2.2.3. Trends in Transportation Electrification

Reshoring and Nearshoring

Both ongoing supply chain disruptions and new government legislation are triggering a rise in reshoring and nearshoring efforts.

Table5.*Reshoring and Nearshoring*

Inverto/Near-shoring/Re-shoring Approach						
Opportunity & Risk analysis	Market research & Selection	Assesment& Audit	Sourcing	Ramp-up & Enablement	Continuous supplier management	Expansion to other categories
						

Sourcing Alternative Materials

Because many of the raw materials required to produce lithium-ion batteries are in increasingly short supply, automakers in the U.S. are considering cheaper and more readily available alternatives.

Table6.*Electricity sources*

				
Solar energy	Hydropower	Bio energy	Wind power	Geothermal power

Sustainability Efforts

Several entities within the transportation sector are already expanding their facilities to accommodate large-scale battery recycling operations. For example, recently launched a research center on lithium-ion battery recycling.

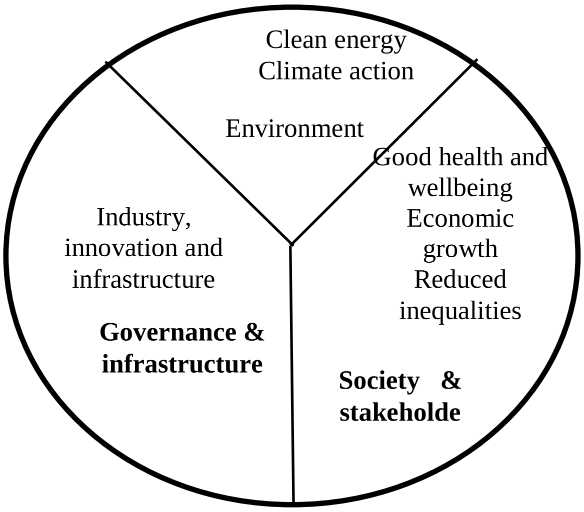


Figure10.*Sustainability efforts*

2.3. Electric Distribution System

2.3.1. Architecture of smart grids

The architecture of a smart grid refers to the design and structure of the electricity system, including the components and technologies used to generate, transmit, distribute, and consume electricity.

A well-designed smart grid architecture is essential for improving energy efficiency, increasing reliability, and reducing costs.

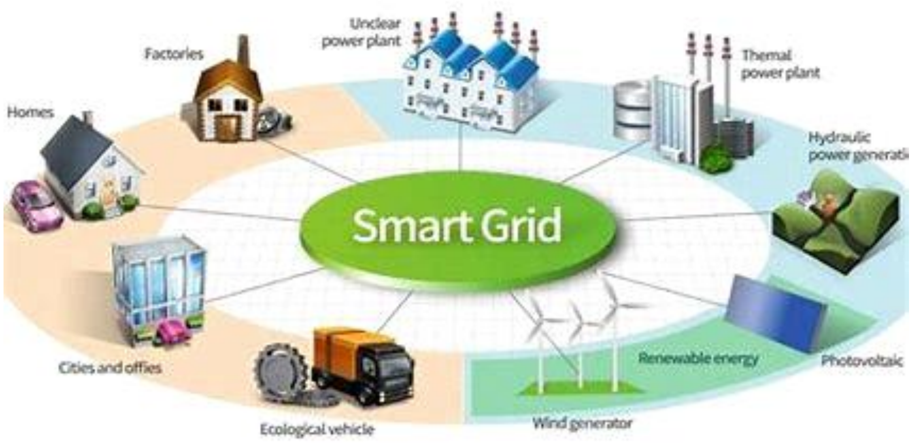


Figure11.*Smart grids architecture*

2.3.2. Structure of Distribution Networks

Generation: This includes all sources of electricity generation, such as traditional power plants, renewable energy sources, and distributed generation.

Transmission: This includes the high-voltage power lines and substations used to transmit electricity from the point of generation to the point of consumption.

Distribution: This includes the low-voltage power lines and transformers used to distribute electricity to homes and businesses.

Metering and Monitoring: This includes smart meters and other technologies used to monitor and control energy consumption in real-time.

Energy Management: This includes the systems and software used to manage energy use, such as load management programs and dynamic pricing systems.

Customer Engagement: This includes the technologies and programs used to engage and educate consumers, such as energy conservation programs and consumer portals.

Data Analytics: This includes the advanced analytics systems used to analyse the vast amounts of data generated by smart grids, providing valuable insights into energy.

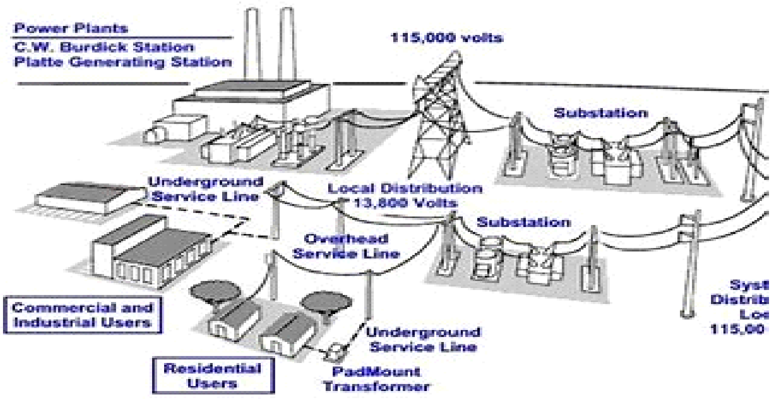


Figure12.*Structure of distribution network*

2.3.3. Smart Grids Outage

Supervisory Control and Data Acquisition (SCADA) systems: SCADA systems are used to monitor the grid in real-time, providing information about the location, severity, and duration of outages.

Geographic Information Systems (GIS): GIS systems are used to map out the locations of power outages, allowing utilities to quickly dispatch crews and resources to affected areas.

Distribution Management Systems (DMS): DMS systems are used to manage the distribution of electricity from the grid to individual customers.

Work Management Systems: Work management systems are used to manage and track the progress of repair and maintenance activities, helping to ensure that power is restored as quickly as possible.

Customer Communication Systems: Customer communication systems are used to keep customers informed about power outages and estimated restoration times.

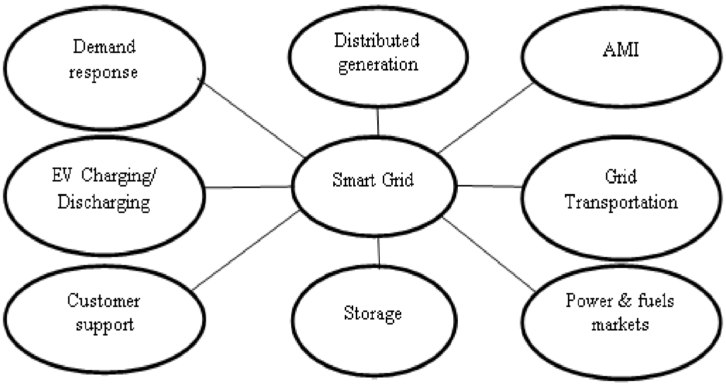


Figure13.*Smart grids outage*

2.3.4. Duties of Distribution System Planners

This duties necessitates gathering the following information:

a. The history, demand forecasts, and capacity of each zone substation
b. Evaluation of probable loss of load (LOL) for each subtransmission line and zone substation. This requires an accurate reliability analysis including the expected economic and technical impact of the load loss
c. Determination of standards applied to the distributors planning
d. Studying the available solutions to meet forecast demand including demand management and the interaction between power system components and embedded generation
e. The choice and description of the best solution to meet forecast demand including estimated costs and evaluation of reliability improvement programs undertaken in the preceding year

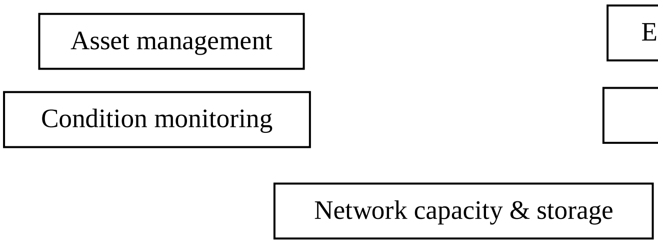


Figure14.*Smart grids duties*

2.3.5. Factors Affecting the Planning Process

Demand Forecasts

For distribution systems, the study of demand forecasts concerns mainly with the estimation of expected peak load in the short term.

The peak load is affected by several factors such as social behavior, customer activity, and customer installations connected to the network and weather conditions.

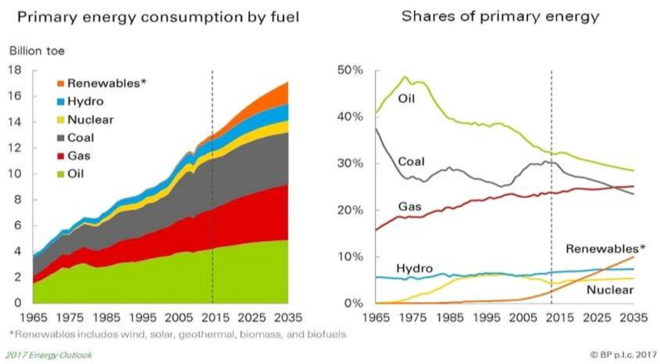


Figure15.*Demand forecasts*

Planning Policy

The plan may include the replacement of some parts of the network and/or adding new assets in addition to increasing the lifetime of present system components in accordance with an asset management model.

Table7.*Planning policy*

Asset manager tasks		
Decision making	Development	Monitoring
Lifetime cycle Replacement Assets	Maintenance Plant capital Investment	Execution Providers

Command Monitoring

CM is a system of regular scheduled measurements of distribution plant health. It uses various tools to quantify plant health, so that a change in condition can be measured and compared.

CM can also be an effective part of both a plant maintenance program, including condition-based maintenance (CBM) and performance optimization programs.

Figure16.*Command monitoring*

						
Monitor		Data acquisition		Data analysis		Fault prescription

Reliability Planning Standards

a. Automatic circuit reclosers (ACRs) that result in a significant reduction of customer interruptions and customer minutes off supply (the probability of secondary damage to assets, thereby increasing the chances of successful recloser attempts for transient faults).
b. Fault locators to provide system control and network operators with the approximate location of faults enabling operators to locate the faults faster, thereby reducing supply restoration times
c. Ultrasound leakage detectors to detect leakage current on assets enabling corrective action to be carried out before pole fi res develop
d. Thermovisions to detect hot spots on assets to enable corrective actions to be carried out before they develop into faults due to thermal break-down of components

			
Reliable Not valid	Low Reliable Low validity	Not Reliable Not valid	Reliable Valid

Figure17.*Reliability types*

Categories of Customer Reliability Level

The distribution system is reliable when the interruption periods are as small as possible, that is, less LOL.

Therefore, the distribution system structure must be designed in such a way that the continuity of supply at a desired level of quality is satisfied.

2.3.6. Planning Objectives

Load Forecasting

Load forecast study is one of the most important aspects in planning because the loads represent the final target of the power system.

Generation and transmission systems planning depends on long-term load forecast, while the distribution system planning depends on the short-term load forecast.

The function of the power system is to feed the loads. So, load forecasting is the main base for estimating the investment.

The difficulty in load forecasting results from its dependence on uncertain parameters. For instance, the load growth varies from time to time and from one location to another.

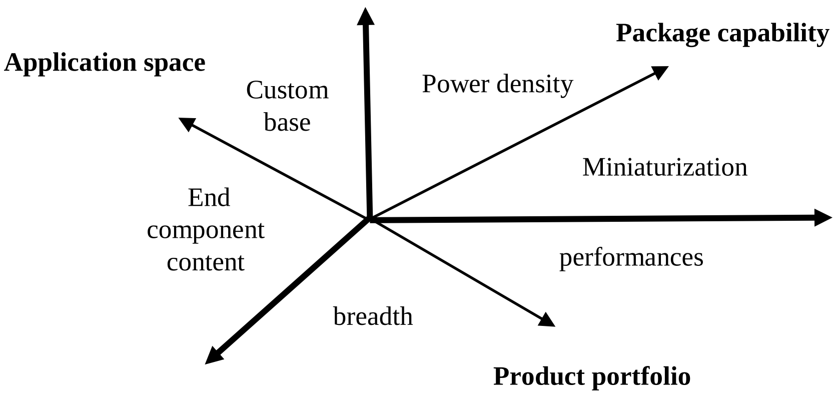


Figure18.*Load forecasting*

Power Quality

Meeting the demand forecasts by distribution system planning is necessary but not a sufficient condition to achieve a good plan.

The power quality is a complementary part. It must be at a desired level to be able to supply customers with electricity.

The power quality is determined by the electric parameters: voltage, power factor, harmonics and frequency.

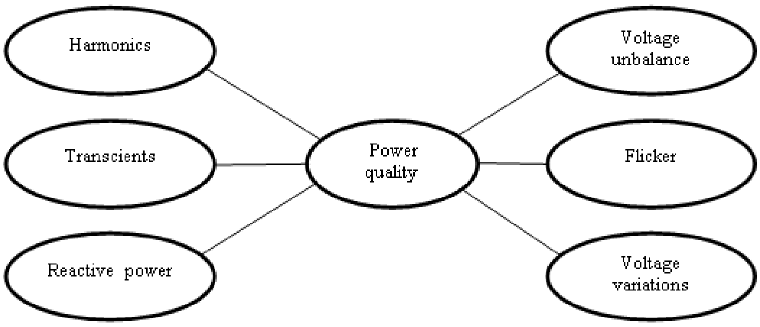


Figure19.*Factors influencing power quality*

Compliance with Standards

The distribution system planner takes into account the rules and standards that must be applied to system design. The system infrastructure, such as lines, cables, circuit breakers, and transformers; system performance; and system reliability, must all be in compliance with the international codes.

Supervisory control and data acquisition (SCADA) systems have been employed for distribution automation (DA) and distribution management systems (DMS) in order to achieve high operational reliability, to reduce maintenance costs, and to improve quality of service in distribution systems.

Moreover, once reliable and secure data communication for the SCADA system is available, the next step is to add intelligent application operation at remote sites as well as at the DA/DMS control centers.

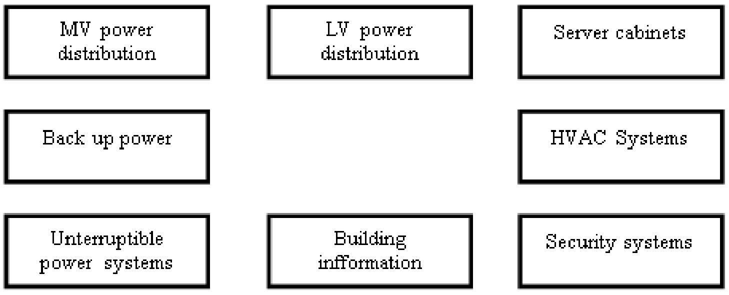


Figure20.*Electric distribution standards*

Investments

Investments required to establish the system infrastructure must be estimated before implementing the plan. It is associated with financial analysis.

Financial analysis, including life cycle costs, should be performed for the solutions that satisfy the required technical and performance criteria.

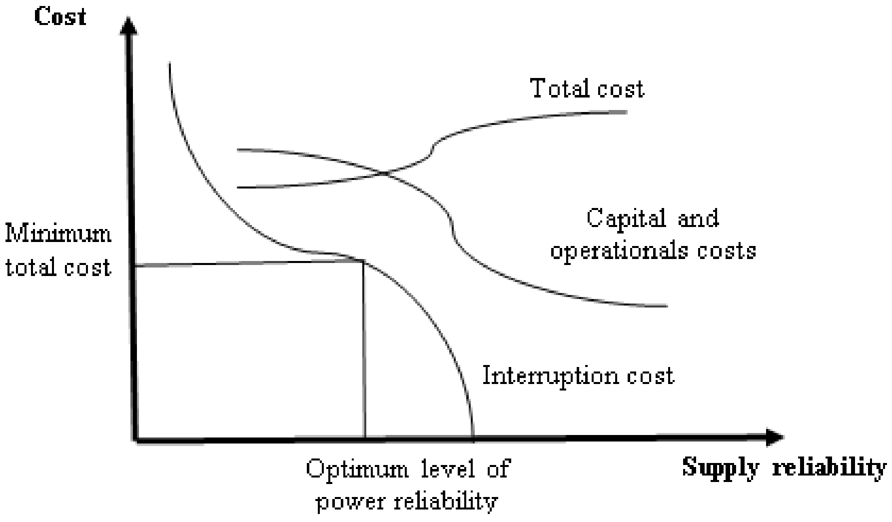


Figure21.*Investments in electrric distribution systems*

Distribution Losses

1. Distribution losses are inevitable consequences of distributing energy between the zone substations and consumers.
2. Losses do not provide revenues for the utilities and are often one of the controlling factors when evaluating alternative planning and operating strategies.
3. Variable losses can be reduced by :
    a. Increasing the cross-sectional area of lines and cables for a given load
    b. Reconfiguring the network, for example, by providing more direct and/or shorter lines to where demand is situated
    c. Managing the demand to reduce the peaks on the distribution network
    d. Balancing the loads on three-phase networks
    e. Encouraging the customers to improve their power factors
    f. Locating the embedded generating units as close as possible to demand

Table8. *Distribution losses*

Electric Network losses	
Technical losses (Heat)	Non-technical losses (Electricity theft)
Transformer Transmission line Distribution line	Non-payment Billing error Record keeping error Energy theft

Amount of LOL

The distribution system components are exposed to unexpected failure and thus being out of service. If the failed component is a major component in the system, a shortage of capacity will occur and the system will not be able to provide some customers with electricity.

The power demand of those customers is expressed as the amount of LOL.

Table9.*Amount of LOL*

Distribution losses	
Technical losses	Non-technical losses
Variable losses (load losses)	Metering types
Network, demand, power factor	Metering installation
Fixed losses (no-load losses)	Filling system
Quality of transformer	Unread meters

2.3.7. Solutions for Meeting Demand Forecasts

Network Solutions

According to the power system arrangement, the network solutions start from the load points to determine the adequacy of the size of the load.

If it is not the standard size for the expected loads, the feeders must be resized.

Also, the planner must look at the DP switchboard design because it may be necessary to add a panel with circuit breaker for a new feeder or rearrange the present load loops.

These are the network solutions:

- New subtransmission lines, New transformer to zone substation, New zone substation (capacitors, regulators to enhance the voltage profile).

Non - Network Solutions

Embedded Generation: It includes the following solutions

- Gas turbine power stations, Cogeneration from industrial processes, Generation using renewable energy.

Demand Management and Demand Response ;Demand management schemes could include

- Peak clipping, Valley filling, Load shifting, Strategic conservation, Load building, Flexible load shape.

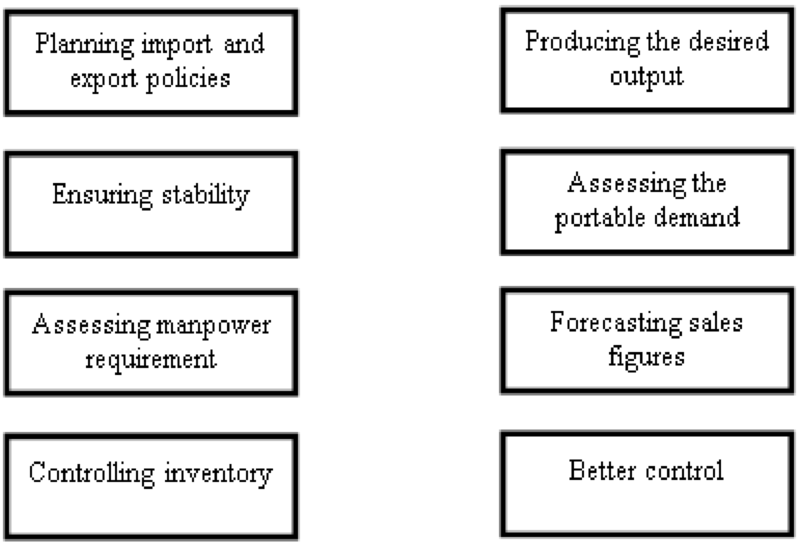


Figure22.*Solutions for meeting Demand Forecasts*

3. Discussion

Here are some data and descriptive statistics of energy and electricity sources.

Table10.*Quantity of energy by sources*

Secteur	Total capacity	Pourcentage
Coal	116333.38	56.64
Hydroelectricity	39291.40	19.12
Renewable energy source	24832.68	12.09
Gas	18903.05	9.20
Nuclear	4780	2.32
Oil	1199.75	0.58

Table11.*Quantity of energy by sectors*

Secteur	Total capacity	Pourcentage
state sector	86275.40	42.01
Central sector	62073.64	30.32
Private sector	56991.23	27.75

It is clear that there a multiple source of energies. And, we remark that the renewable energies has a majoritory part in the production of elctricity.

In addition, the alimentation differs by sectors (public, central and private).

So, every sector must choice the right source of energy to its uses.

Also, we do respect the rules of connecting our consumption to the electrical networks (distribution networks, distribution grids..)

There is many factors influencing the electrical disribution system.

Environmental specifications (location, position, temperature and humidity)

Distribution System Voltage and Frequency (Frequency is usually determined by standards in the region. Voltage selection tends to be a little more complicated.)

Acceptable Variation in Distribution System Parameters (Control Variation Extent, Automated Interfaces to Limit Variations, Certain Equipment to Enhance Variation Levels)

Capacity to Withstand Faults (Equipment selection must have ratings that are higher than short circuit currents where this could occur)

Planning Distribution System Configuration (Overall Configuration, Number of Incoming Feeders, Incoming and Distribution Voltage Levels, Major Equipment Ratings, Type of Distribution, Integration of Emergency Standby Equipment and Protective System Earthing)

Rating/Sizing for Equipment (Rated Voltage, Current, and Frequency, Voltage and Frequency Variation, Fault Withstanding Current and Time, Fault Breaking Capacity, Clearance and Creepage)

Designing and Planning Summarized (modeling and documenting important aspects of the distribution system)

4. Conclusion

In this article, the author discusses the sources of energy. It can be classed into conventional energies and non conventional energies.

In addition, the use of type of source depends on the quantity of energy and the sector.

As a consequence, the electric network inserts source of energy into distribution grids or smart grids.

After that, the article discusses the structure of distribution networks, the duties of distribution systems, factors affecting the planning process, planning objectives and solutions for meeting demand forecasts.

Thus, these systems have a role to optimize the production, transport and distribution of electrical network.

So, if there any specific methods for optimizing the electric distribution system ?

References

[1] A. Lotfipour, H. Afrakhte. A discrete teaching–learning-based opti- mization algorithm to solve distribution system reconfiguration in presence of distributed generation. Int. J. Electr. Power Energy

Syst., vol. 82, pp. 264–273, Nov. 2016.
[2] Arul A. An Analysis of Opportunities and Barriers of Integrating Renewable Energy with Smart Grid. Technologies in India; 2015.
[3] Aydin, Dem R. Smart grid integrated with hybrid renewable energy systems. Eskehr Technical University journal of Science and Technology. 2019 ; 120-131.
[4] Blaifi SM. An enhanced dynamic model of battery using genetic algorithm suitable for photovoltaic applications. Journal of Applied Energy. 2016 ;888-898.
[5] BouabbadiSoufiane. Optimization of the electrical distribution using the profile of electrical consumption, ResearchGate (November 2023).
[6] BouabbadiSoufiane. A literature review: the sources of energy, ResearchGate (September 2023).
[7] BouabbadiSoufiane. A Survey on Hybrid SCADA/WAMS State Estimation Methodologies in Electric Power Transmission Systems, ResearchGate (September 2023).
[8] BouabbadiSoufiane. ML-Based Intermittent Fault Detection, Classification, and Branch Identification in a Distribution Network, ResearchGate (September 2023).
[9] Demir Z. Smart grid integrated with hybrid renewable energy systems. Eskehr Technical University Journal of Science and Technology. 2019 ;120-131.
[10] Ekneligoda N, Weaver W. N.C. Ekneligoda, W.W. Weaver, Game theoretic optimization of DC micro-grids without a communication infrastructure. Proceedings of the 2014 Clem- Son Univ. Power Syst. Conf ; 2014.
[11] F. Capitanescu, L. F. Ochoa, H. Margossian, and N. D. Hatziargyriou,"Assessing the potential of network reconfiguration to improve distributed generation hosting capacity in active distribution systems," IEEE Trans. Power Syst., vol. 30, no. 1, pp. 346–356, Jan. 2015.
[12] Gilani M.A., Kazemi, A., Ghasemi M. Distribution system resilience enhancement by microgrid formation considering distributedenergy resources. Energy 2020,191, 116442.
[13] Hossain E. Micro grid testbeds around the world : State of art. Energy Conversion and Management. 2014, 132-153.
[14] Kazerani M., Tehrani K. Grid of Hybrid AC/DC Microgrids: A New Paradigm for Smart City of Tomorrow. In Proceedings of the IEEE 15th International Conference of System of Systems Engineering (SoSE), Budapest, Hungary, 2–4 June 2020; pp. 175–180
[15] Li R.,Wang W., Chen Z., Jiang J., Zhang W. A Review of Optimal Planning Active Distribution System: Models, Methods, and Future Researches. Energies 2017,10, 1715.
[16] L. W. de Oliveira, E. J. de Oliveira, F. V. Gomes, I. C. Silva, A. L. M. Marcato, and P. V. C. Resende. Artificial immune systems applied to the reconfiguration of electrical power distribution networks for energy loss minimization. Int. J. Electr. Power Energy Syst., vol. 56, pp. 64–74, Mar. 2014.
[17] Maradin D. Advantages and Disadvantages of Renewable Energy Sources Utilization. International Journal of Energy Economics and Policy 2021.
[18] MS A. Viability of grid-connected solar PV energy system in Jos, Nigeria. Internal Journal for Electric Power. 2014 ;61-64.
[19] Shahidehpour, M. Ding, T. Ming, Q. Huang, C. Wang, Z. Du. Multi-Period Active Distribution Network Planning Using Multi-Stage Stochastic Programming and Nested Decomposition by SDDIP. IEEE Trans. Power Syst. 2020,99, 1.
[20] S. Naveen, K. S. Kumar, and K. Rajalakshmi. Distribution system reconfiguration for loss minimization using modified bacterial foraging optimization algorithm. Int. J. Elect. Power Energy Syst., vol. 69, pp. 90–97, Jul. 2015.
[21] Yesilbudak M. A novel intelligent approach for yaw position forecasting in wind energy systems. International Journal of Electrical Power & Energy Systems. 2015 ;406- 413.

Citation: *BouabbadiSoufiane et.al., (2024) "A LitteratureReview :Electric Distribution Network", International Journal of Research Studies in Electrical and Electronics Engineering (IJRSEEE), 9(1), pp.1-16, DOI: http://dx.doi.org/10.20431/2454-9436.0801001.*