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ANALYSIS OF RENEWABLE RESOURCES FOR HYBRID INTERCONNECT WITH SMART GRID SYSTEM

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ABSTRACT

Smart grid is based on changing the way of operation and control of smart equipment in an intelligent networking with advanced power line communication to optimize energy consumption in generation, transmission, distribution and loads. Problems in present electricals, such as transmission and copper loss, inefficient distribution and transmission system because of old infrastructure and power theft, can be addressed better in smart grid integrated system with renewable energy resource. Among all available renewable energy resource the combination of wind, solar provides the most reliable solution to the utility as both of them are complimentary to each other. This paper reveals an approach for growing towards the scope available in smart grid and renewable energy system.

Keywords – Smart Meter, Power Line Communication (PLC), Intelligent Networking using Fiber optics, Renewable Energy Resource such as Solar, Wind

I. INTRODUCTION

Since past two hundred years, coal and petroleum have been dominating in the electrical power input to various engineering applications. Based on technological inventions such as wireless communication and networking harness traditional with modern system development for present and future needs. Renewable, pollution free and non-fossil resources are influences, for encouraging better engineering and it can drive for next eco friendly revolution. New Entrepreneur and Employments will be generated due to the introduction of non-fossil engineering. Smart meters and power line optimization establish better reliable power delivered to the end users.

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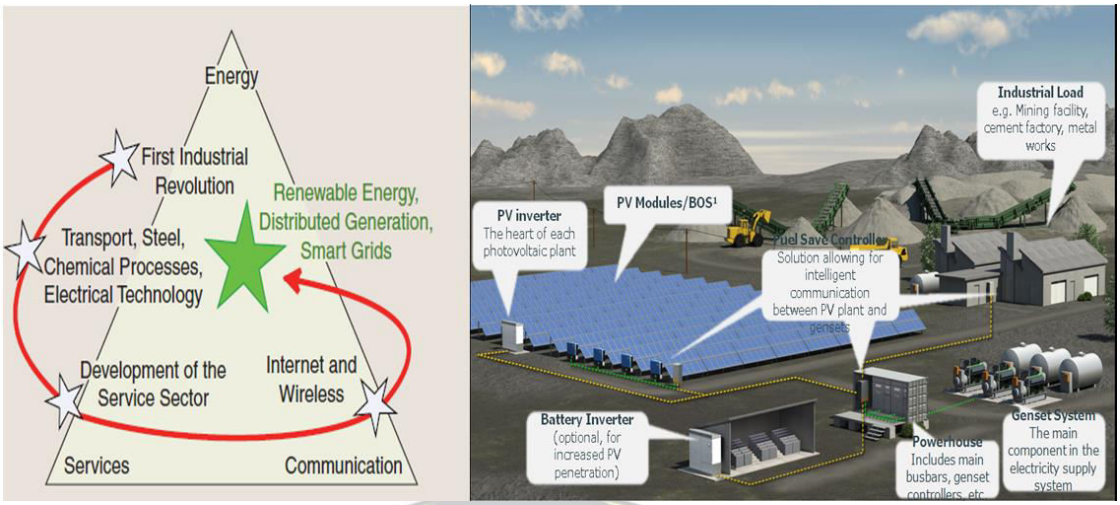

Figure.1. Visual History of Industrial Revolutions

Toxic and Hazardous are the problems in the fossil fuel to energy production. Toxic gases such as Carbon-di-oxide create more disturbances to the nature. Hazardous conditions are existing even in highly optimized modern engineering also. Renewable resources using in modern electrical engineering will be exploitable and it provide more energy in one hour.

II. RENEWABLE RESOURCES AND THEIR STATISTICS

Region	THERMAL				Nuclear	Hydro	RES	Grand Total
	Coal	Gas	Diesel	Total				
Northern	39143.50	5331.26	12.99	44487.75	1620.00	16598.11	5935.77	68641.63
Western	57464.51	10915.41	17.48	68397.40	1840.00	7447.50	11271.07	88955.97
Southern	26582.50	4962.78	939.32	32484.60	1320.00	11398.03	13784.67	58987.30
Eastern	25927.88	190.00	17.20	26135.08	0.00	4113.12	432.86	30681.06
North-East	60.00	1208.50	142.74	1411.24	0.00	1242.00	256.67	2909.91
Islands	0.00	0.00	70.02	70.02	0.00	0.00	11.10	81.12
ALL INDIA	149178.39	22607.95	1199.75	172986.09	4780.00	40798.76	31692.14	250256.99

Table.1 Indian Electricity Scenario. Source: CEA.

Rank	Country	All Renewables	Wind Index	Onshore Wind	Offshore Wind	Solar Index	Solar PV	Solar CSP	Biomass / Other	Geo-thermal	Infra structure
1	China	70	76	79	69	61	66	46	58	51	74
2	USA	68	67	71	57	74	74	75	63	69	65
3	Germany	66	70	67	80	51	70	0	67	58	74
4	India	63	64	71	43	65	69	54	60	45	67
5	UK	59	66	61	80	34	48	0	58	36	66

Rank	Country	Solar Index	Solar PV	Solar Thermal
1	USA	74	74	75
2	India	65	69	54
3	China	61	66	46
4	Italy	57	63	42
5	Spain	55	53	60

Table.2 Renewable and Solar Index

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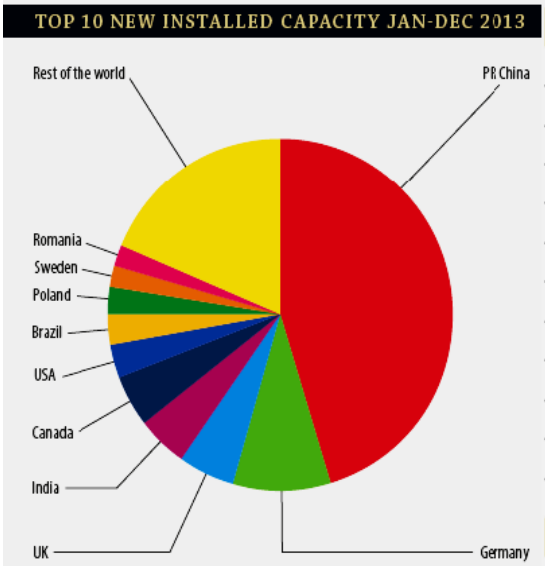

Country	MW	% SHARE
**PR China	16,100	45.4
Germany	3,238	9.1
UK	1,883	5.3
India	1,729	4.9
Canada	1,599	4.5
USA	1,084	3.1
*Brazil	948	2.7
Poland	894	2.5
Sweden	724	2.0
Romania	695	2.0
Rest of the world	6,573	18.5
Total TOP 10	**28,894**	**81**
World Total	**35,467**	**100.0**

Figure.2 Global Wind Energy Statistics, GWE Council

III. SMART GRID SYSTEM

Interdisciplinary functions are more in Smart Grid approach. Communication and Information technologies are needed in smart meter and power management in smart grid operation. Existing grid reliability has to be maintained and wants to integrate various smart grid resources such as renewable energy, demand response, electric storage and electric transportation. Automation establishes the opportunities in intermittent power resources, better monitoring and bulk transmission over wide distance and distributed power generation, empowering more efficient outage management and energy conservation. Now due to opportunities extended, attention came to factors like policies, regulation and efficiency. Benefits and services create balanced market strategies through restructuring of power scenario with extended energetic approach. Smart grid encourages learning and implementing secured communication with standard protocols. It provides advanced data base management, power management and efficient architecture with ethical data exchange.

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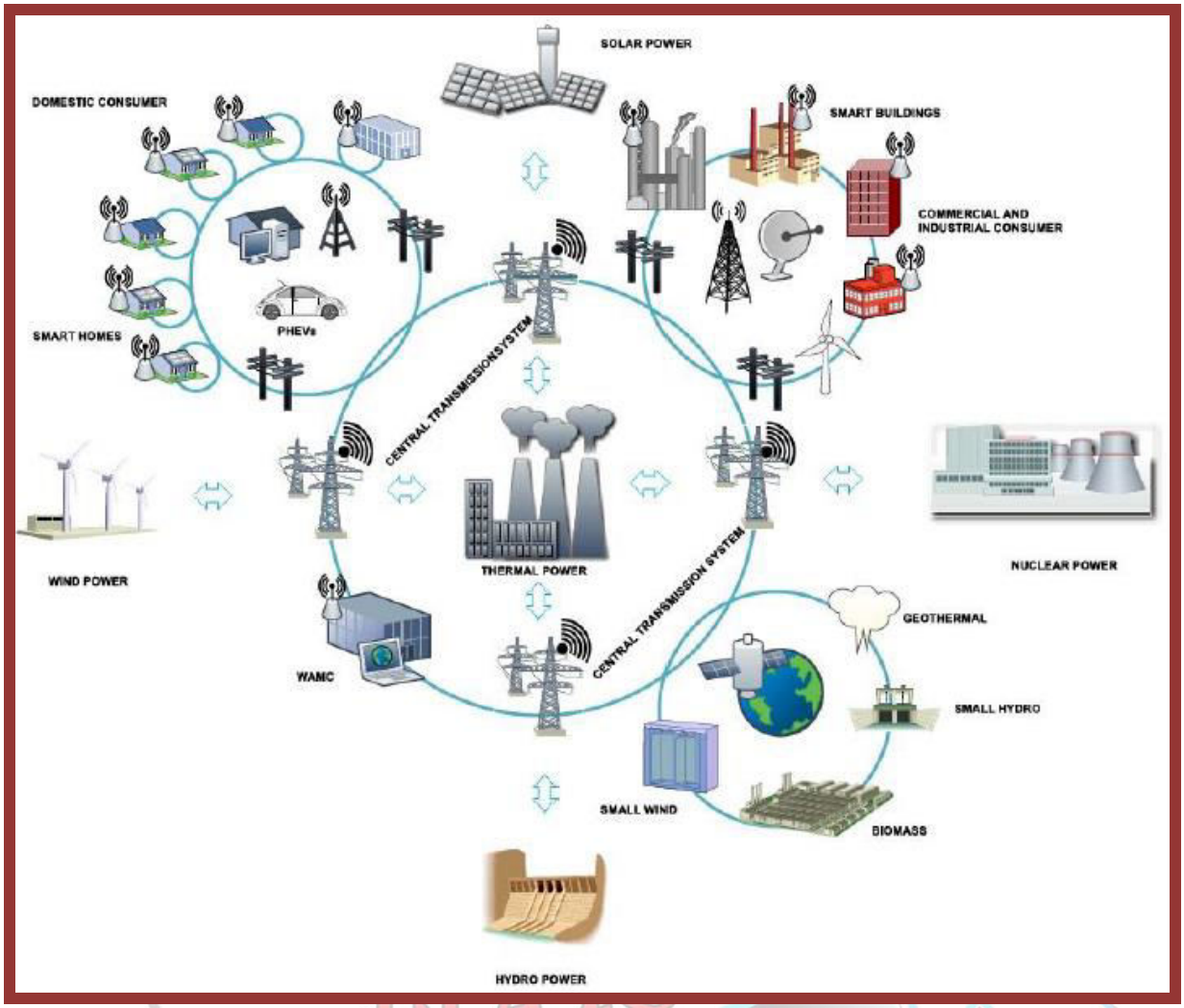

Figure.3 Diagram of Smart Electricity Grid

The technology has been updated through Information and communication technology (ICT). ICT supports dynamic real time in two ways energies and information flow which also facilitates the integration of renewable energy sources into the grid. Introduction to advanced metering infrastructure (AMI) and virtual power plant (VPP) empower the consumer tools for optimizing their energy consumption. Monitoring, healing and regulating to all kinds of problems associated with power transportation, redeployment and intensification of accident is made with different intelligent meters and network communication topologies.

Social reformers and incredible engineers with their engineering curiosity in decarbonizing the electrical power and minimizing the dependency of fossil fuels, developing fortified renewable integration in the power grids. Hybrid renewable integration, smart grid efficiency and added equipments, such as energy storage devices are the concerns. Hybrid renewable integration includes Fuel cells, Photovoltaic cells, Wind turbine and Micro hydro generators etc. smart grid efficiency includes with hardware and software associations. Hardware such as AMI, PLC, VPP make distribution and management of energy efficiently. Software associated with cloud computing with fiber optics technology.

A. **Smart Transmission Grid**

The spine to conveying the electric power from the age station to the heaps and purchasers' side, the transmission arrange has skipped essential part and has been profoundly perceived element of energy framework designing. Beginning of the transmission of electric energy to be an immediate current (DC) transmission, the extent of the transmission has been broadened to HVAC, HVDC transmission at different voltage levels alongside plentiful complex system topologies. Up-degree of transmission organize by expanding high limit multi-circuit/package conductor lines, High Surge Impedance Loading (HSIL) Line, high limit HVDC framework, High Temperature Low Sag (HTLS) Line, and so forth encourages the nature of energy

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transmission with the core of unwavering quality and economy of the framework. Yet at the same time flourishing difficulties and issues which are being gone head to head by today's' transmission system, for example, natural difficulties, showcase/client needs, framework challenges and imaginative advancements. With the condition of craftsmanship innovation progresses in the zones of detecting, correspondence, control, registering and data innovation, it has quarried an exceptional vision without bounds keen transmission frameworks by recognizing the significant shrewd attributes and execution highlights to deal with the difficulties. Figure.4. portrays the highlights and their qualities of a Smart Transmission Grid. An itemized investigation on the savvy transmission matrix improvement is being depicted under three fundamental intuitive and shrewd segments; brilliant control focuses, keen transmission systems and savvy substations.

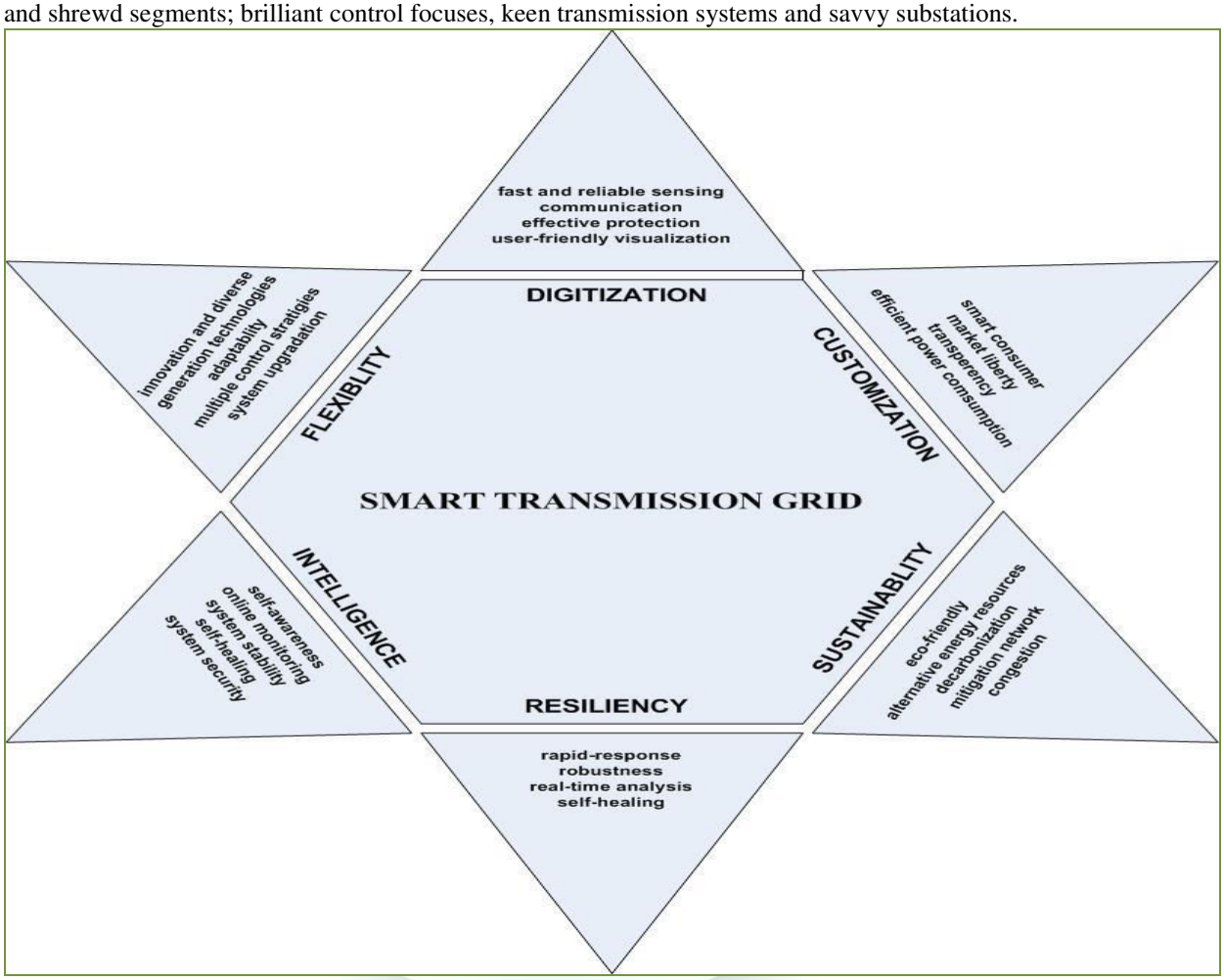

Figure.4 Features and characteristics of Smart Transmission Grid

B. **Hybrid Energy**

By and large, a crossover vitality framework could be incorporated as Figure appears. This sort of vitality frameworks are called "half breed" since they incorporate in excess of one vitality source so as to cover a decided electrical load, usually an AC stack; be that as it may, it might likewise supply a DC stack or both in the meantime. Vitality sources might be elective (i.e. sustainable) and in addition traditional (i.e. electrical matrix or diesel generator), or vitality stockpiling parts (i.e. battery bank or power devices); along these lines, shortcoming of some vitality sources is supplemented by qualities of alternate sources in a characteristic or controlled way. At the point when a half and half vitality framework incorporates sun oriented or wind vitality, the greater part of times is required a helper wellspring of vitality (e.g. originating from battery banks, energy components, or utility lattice), the previously mentioned is with a specific end goal to defeat the stochastic accessibility of those energies.

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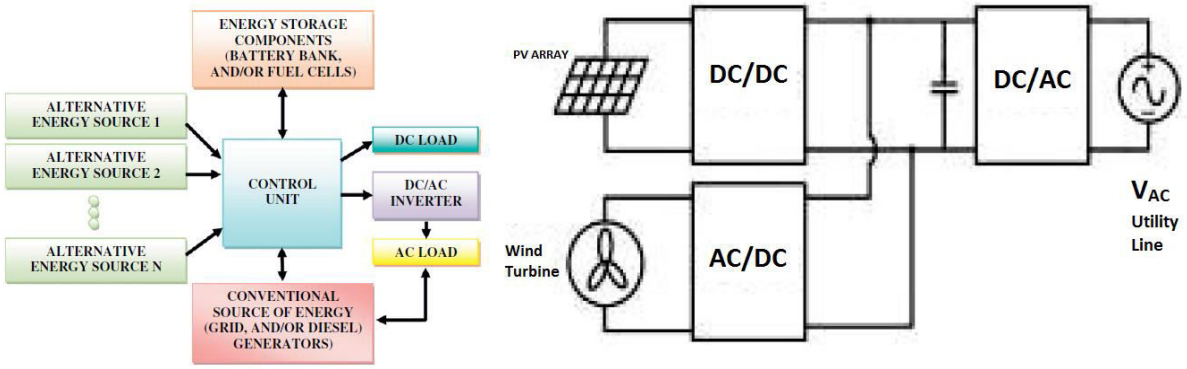

Figure.5 Hybrid energy system and DC-shunted grid-connected hybrid PV/wind energy system

The PV framework produces DC yield though WT creates AC yield voltage. For lattice association of these two sources diverse power electronic interfaces are required. The DC-shunted lattice associated cross breed PV/wind control framework appeared in figure is picked in this work. In DC-shunted framework associated mixture PV/wind control framework, the yield of PV cluster is associated with DC/DC help converter and the dc interface voltage is managed. Air conditioning yield voltage of wind vitality framework is amended utilizing uncontrolled rectifier in the main stage and afterward a DC/DC support converter is utilized to control DC connect voltage. The VSI joined with shunt dynamic power channel usefulness is additionally used to interface the DC shunted wind-sunlight based half breed model to the matrix. The framework being considered is appeared in figure. It comprises of adjusted three stage four wire network which speaks to perfect conveyance framework. Set of three stage and single stage non-direct loads are considered to infuse music into the framework. Wind-Solar crossover demonstrates is considered to emulate RES. Four leg VSI is considered to reap genuine power provided by RES to the framework and in addition to execute the obligations of shunt dynamic power channel. Id-Iq technique for control procedure is utilized to consolidate shunt dynamic power channel usefulness to the interfacing inverter. PI controller is utilized as a voltage controller to balance out the voltage over the DC interface.

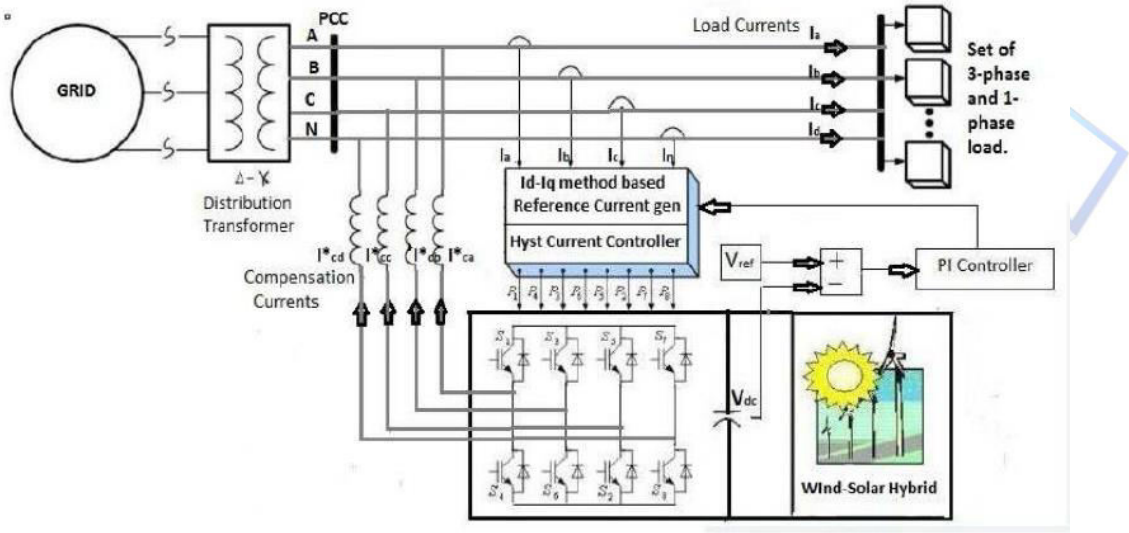

Figure.6 Hybrid energy System

IV. PROPOSED TECHNOLOGY

A. Smart Metering Technology:

Savvy metering framework has been considered as a viable technique for enhancing the example in control utilization and effectiveness of vitality customers along these lines decreasing the money related weight of power. It is the blend of energy framework, media transmission and a few different advancements.

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Undeniably, with the improvement of science and bleeding edge innovation, more offices have been added to this region. Savvy meter is a propel vitality meter that measures the vitality utilization of a customer and gives added data to the service organization contrasted with a standard vitality meter. The bidirectional correspondence of information empowers the capacity to gather data planned with correspondence framework and control gadgets. Also, the meter is utilized to screen and control home machines and gadgets, gather diagnostics data about the utility lattice, bolster decentralized age sources, vitality stockpiling gadgets, and solidify the metering units.

Progressed metering Infrastructure (AMI), a label of savvy metering innovation which comprises of set of keen meters, correspondence modules, LAN, information gatherers, WAN, arrange administration framework (NMS), Outage Management System (OMS), Meter Data Management Systems (MDMS), and different subsystems. With a propel highlight of information accumulation, the framework gets a protected, secure, quick and self-upgradable with created vision of dependable and adaptable access to power utilization of the supporters utilizing force and appropriation network. A proposed design of open savvy metering framework has been outlined in Figure.5. which likewise gives and brief perspective of utilization of AMI and different subsystems. The model arranged outcomes and bound together framework for procurement and control of energy conveyance frameworks. The Data Model demonstrated contains Virtual Meters which is a piece of a more extensive idea called Virtual Power Plant (VPP).

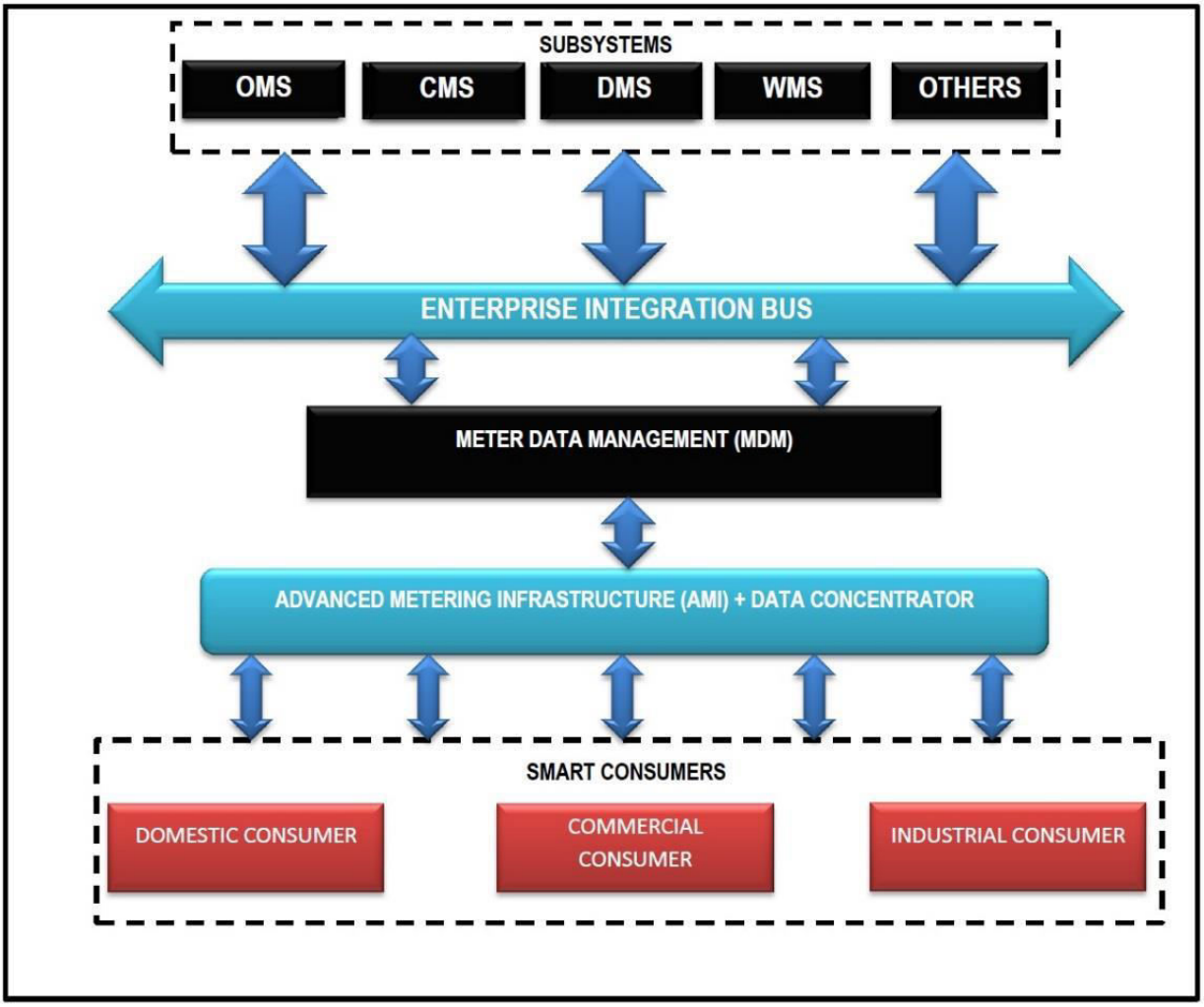

Figure.7 Advanced Metering Infrastructure (AMI)

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A vital innovative gadget called the In-Home Display (IHD) is a basic improvement for the progression and execution of brilliant metering framework. A preparation has been uncovered in table.1. The proposed design was actualized inside a Meter Data Management framework, along these lines demonstrating it worth.

Table.3 Smart Metering System using In-Home Display (IHD) units.

SMART METERING SYSTEM	PRINCIPLE OR NORM	OBJECTIVES	FACILITIES	LOCATIONS/REGIONS
AMI-Related System	Induces power savings by time-varying tariff	Improvement in efficiency of power distribution network by control of power peak and demand response	Information of power consumption and price rate change in a simple form	Australia and United States
EMS-type System	Induces self-power savings by offering detailed information of energy consumption w.r.t time	Improvement in efficiency of power distribution network by control of consumption level of power by the consumers	Information of power consumption, higher resolution colour display, multiple information of other utilities	Japan

B. Smart Control and Monitoring System:

With the attack of extremely complex versatile arrangement of keen power lattice; a dynamic, stochastic, computational and adaptable (DSCS) with inventive control advancements can be a promising quality for a dependable, secure and productive power organize. This unpredictability and interconnectivity of the electric power matrix is accumulating with conveyed coordination of sustainable wellsprings of vitality and vitality stockpiling of various types. In opposite, various ways to deal with customary demonstrating, control and improvement can be increased or eased within the lattices for quick adjustment, dynamic foreknowledge, self-recuperating, control framework islanding, adaptation to non-critical failure, and vigor to unsettling influences and irregularity. Worldwide Dynamic Optimization (GDO) is an essential angle to accomplish for a DSCS technique for brilliant control of the lattice, where Computational Intelligence (CI) and Adaptive Critic Designs (ADCs) are alluded as the promising and potential methodologies. These are a versatile system propelled from regular marvels and AI worldview which encourages astute and savvy conduct amid mind boggling, questionable and evolving conditions. These ideal models of CI between join to shape half and halves viz. neuro-fluffy frameworks, neuro swarm frameworks, fluffy PSO frameworks, fluffy GA frameworks, neuro-hereditary frameworks and so forth., and following unrivaled than a particular worldview. What's more, the ADCs depend on the consolidated idea of fortification learning and surmised dynamic programming utilizing neural system based outlines for improvement. Table. embodies the control innovations utilizing the GDO.

Table.4 Innovative technologies using the GDO

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CONTROL TECHNOLOGIES (CI and ADCs based)	OUTCOMES
Neural Networks and Fuzzy System	Captures non-linearity in power systems and smart grids
Neural Networks	Behavioral modelling, fast, dynamic decision in smart grids
Fuzzy and Neuro-Fuzzy	Fast and accurate decision making during uncertainty and invariability in the system
Artificial Immune Systems	Immunizes against transients that results from disturbances and fault in smart grids, thus provides fault-tolerance
Swarm Intelligence and Evolutionary Computation	Allows offline, large scale optimization of smart grid operation
Adaptive Critic Designs (ACDs)	Allows design of robust, adaptive and optimal controllers in a dynamic, uncertain and variable smart grid environment, dynamic optimization and scheduling.
Computational Intelligence (CI)	Self-healing characteristics in power grids

C. Challenges in Implementation of Smart Grid

Table.5 Challenges in Implementation

TECHNOLOGY	CHANLLENGES	OBLIGATIONS
Self-Healing Action	Security	Exposed to internet attacks (spams, worms, virus etc.), question of National security
	Reliability	Failure during natural calamities, system outages and total blackout
Renewable Energy Integration	Wind/PV generation and forecasting	Long-term and un-predictable intermittent sources of energy, unscheduled power flow and dispatch
	Power Flow Optimization	Transmission line congestions and huge investments
	Power System Stability	Decoupling causes system stability issues causes reduced inertia due to high level of wind penetration
Energy Storage Systems	Cost	Expensive energy storage systems like Ultra capacitors, SMES, CAES etc.
	Complexity	Complex customary design module and networks
	Non-flexibility	Unique designs for all individual networks not ease adaptation.
Consumers' Motivation	Security	Malware, data intercepting, data corruption, illegal power handling and smuggling
	Privacy	Sharing of data cause privacy invasion, identity spoofing, eavesdropping etc.
	Consumer awareness	Corruption and system threats like security and privacy issues
Reliability	Grid Automation	Need of strong data routing system, with secure and private network for reliable protection, control and communication
	Grid Reconfiguration	Generation demand equilibrium and power system stability with grid complexity
Power Quality	Disturbance Identification	Grid disturbances due to local faults in grids, load centers or sources
	Harmonics Suppression	System instability during sags, dips or voltage variation such as over-voltages, under voltages, voltage flickers etc.

V. CONCLUSION

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Decreasing the vitality use and power administration with inexhaustible assets has now turned into an essential goal. Straightforwardness in the power utilization and normal input on vitality usage must be given to shoppers so they can roll out a few improvements in the power utilization example to spare vitality. In this paper, we have recommended an intelligent framework which gives normal input in regards to the vitality usage to the buyers. For this reason keen power meters that can be remotely observed and controlled are utilized with Hybrid interconnected inexhaustible asset.

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