



A Study on Smart Grid to Minimize the Green House Gas Emission

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ABSTRACT: This is a broad consensus that global warming has already begun to cause a serious, wide spread and everlasting damage to the planet, Earth. Most of the electricity is generating by the burning of fossil fuels to drive the power turbines. By burning of fossil fuels heat trapping “Green House Gases” emits mainly CO₂.our traditional grid is less efficient in emission of CO₂. So, a modern technology of smart grid introduced which is more intelligent, Eco-friendly & user friendly. A grid comprises of three components generation, transmission and distribution. Generation is the main part which emits co₂ smart grid generates smartly including the use of renewal resources. Transmission and distribution relies on optimising the existing assets of Overhead Transmission Lines, Underground Cables, Transformers and Substations to minimize losses & maximize the generation capacity in future & reduce Green House gas emission. Earth adapters around the world both govt. And co-corporation have begun to take steps to reduce the emission of gases in the favour of human community. The paper presents a brief description of different methods of reduction of emission of Green House gases by the application of smart grid concepts.

KEYWORDS: What is Smart Grid? Why Smart Grid is smart? Building blocks of smart grid, Mechanism, Methodology & Summary, Conclusion

I. INTRODUCTION

With the development of smart technology, modernisation and energy need, mankind has developed the sources which are harmful for the whole civilization of the earth. The most severe problem around which is global warming which is the result of emission of Green House gases. The global emission is on course of over 35.9gt tonnes in 2014 in about 9.795gt is due to the burning of fossil fuels like coal, oil& natural gas to run the steam driven power turbine [1]. Electricity sector is the major source of Green House gas emission followed by transportation, industry, irrigation. Most of the thermal power plant uses coal to make steam. Coal emits a large proportion of total emission of CO₂ with 42% .CO₂ is the leading Green House gas which is responsible for heat trapping & global warming. Annual carbon dioxide emission showed a rise of 2.5%”Persist growth of CO₂ emission is& implication for reaching climate is a collaboration of research around the world [2]. The concentration of Green House gases are increasing continuously and reached 440ppm,since 1958 increased by 24%[3]which is an alarming rate of emission. If we continuous to emit without control or any reducing effort, it will be a threat to life on earth. The average global temp is increased by .8 degree Celsius since 1880 wit.15 to .20% per year as shown in figure 1. Climate change is responsible for endangering of some Habitats, Floods, Cardio respiratory Diseases and Ocean Temp. Rise, Oxygen Depletion which can destroy the life on earth

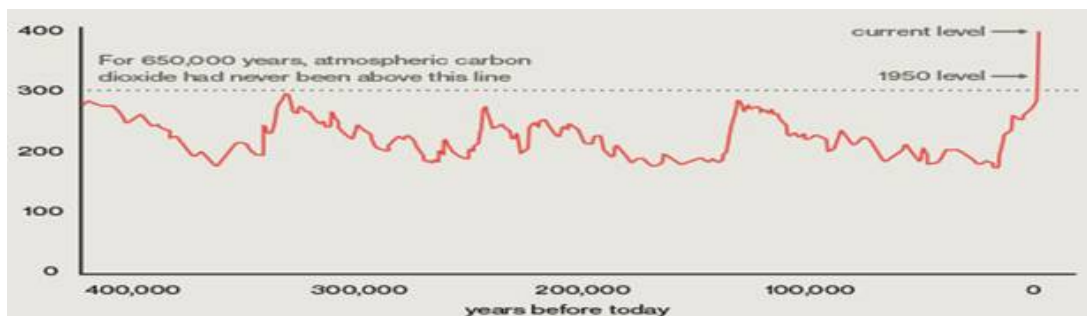


Fig.1 Concentration of CO₂ in ppm



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II. WHAT IS SMART GRID?

Smart grids is a complex network of electric generation sources, transmission & distribution networks, a combination of both communication and information technology. SG use sensors throughout, digital instrumentation & two way communication which makes it different from the existing, more accurate and less human dependent. I.C.T. is the back bone of smart grid concept .it is more safe, reliable, self-healing ,efficient & sustainable .it is a self-decision making and intelligent system, all the efforts are done automatically by the program that run in relays. SG tech. could contribute to greenhouse gas emission control by making the improvements in the existing grid. The existing grid works on SCADA a supervisory control and data acquisition system which works with limited bandwidths and relatively slow data transmission rates that often require several seconds or more to respond to an alarm or system change, limited or no visibility in the distribution network below the substation The immediate in developments SCADA Technology for utilities are to increase Bandwidth and begin to measure and control Assets below the substation level, at which Time the system will begin to become part Of a distributed control system (Boyer 2007)—and a key part of the smart grid. Thus a Smart grid cannot characterised by Single technology but a vision.

“The smart grid isn’t a thing but rather a vision.... It must be more reliable...more secure...more economic...more efficient...more environmentally friendly... (And) It must be safer. A “smart grid” can be (characterized as) a “trans-active” agent... (That) will: Enable active participation by consumers... Accommodate all generation and storage options... Enable new products, services, and markets... Provide power quality for the digital economy...

Optimize asset utilization and operate efficiently... Anticipate and respond to system disturbances (self-heal).

Operate resiliently against attack and natural disaster. Achieving the vision is dependent upon participant circumstances and involves: Empowering consumers by giving them the information and education they need to effectively utilize the new options provided by the smart grid... Improved reliability and “self-healing” of the distribution system... Integration of the transmission and distribution systems to enable improved overall grid operations and reduced transmission congestion... Integration of the grid intelligence acquired to achieving with new and existing asset management applications.

III. WHY SMART GRID IS “SMART”?

The notion given to it smart is true because it is digitally instrumented, two way communicated, self-monitoring, self-healing, active consumer, pervasive control and the following qualities makes it smarter:-

Fast demand response: - The Federal Energy Regulatory Commission (FERC) definition of DR is “changes in electric usage by end-use customers from their normal consumption patterns in response to changes in the price of electricity over time, or to incentive payments designed to induce lower electricity use at times of high wholesale market prices or when system reliability is jeopardized.” (FERC, 2010). Smart responds to the energy demand change very fastly & changes the quantity of generation and transmission according to it.

Distributed Generation\micro grid:-Smart Grid uses distributed generation at different geographical locations by both conventional & non-conventional energy resources at distribution level which makes it eco-friendly.

Distributed storage Batteries: - Flywheel, Super conducting magnetic storage and thermal storage technology devices are connected at distribution level which are used to make it more reliable.

Feeder automation:-distribution & feeder automation expand SCADA communication in substations, into feeders for the control networks advanced protective circuits at different levels.

Sensors:-Smart grid uses the latest technically fast and modified sensors which gives its reading directly to the computer programs that anise and synthesise the reading carefully to operate the grid efficiently.

IV. BUILDING BLOCKS OF SMART GRID AT DISTRIBUTION LEVEL

- i. **Advanced Metering System**
- ii. **Demand State Integration**
- iii. **Electricity Storage Devices**
- iv. **Peak Load Management**

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- V. Distributed Generation \Micro Grid
- vi. Electric Vehicles (E.V.s) & Plug In Hybrid Electric Vehicles (P.H.E.V.s)
- vii. Smart Homes & Buildings

I. **Advance Metering Infrastructure (AMI)**:-It is a system that measures, collects & transmits the readings with metering devices on schedule or request as shown if figure 2. This system have smart meters, communication system, and consumer energy display & controlling devices, meter data acquiescing system (MDAS), Meter data management (MDAM), Software and supply business systems. It is the most important and significant part of the smart grid in rendering to the load, Quality Management etc.

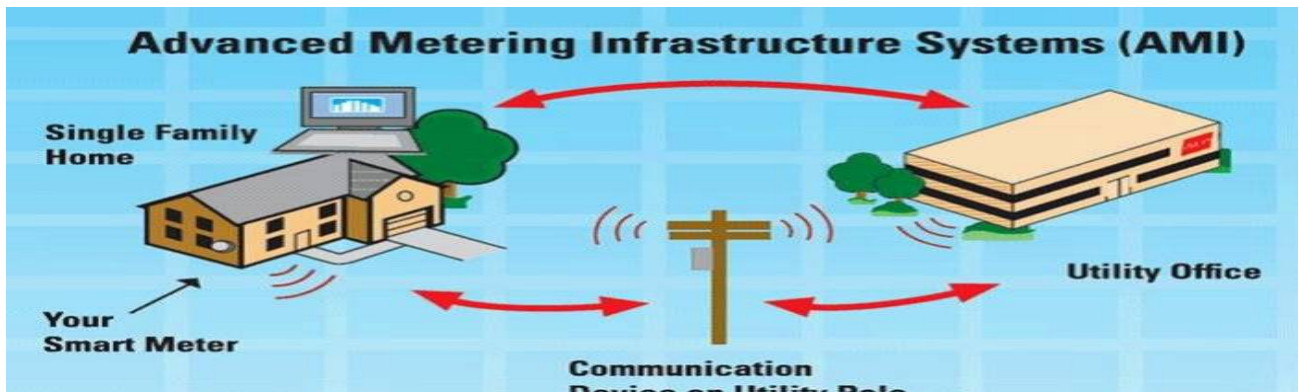


Fig.2 AMI

II. **Electric Vehicles & Plug in hybrid electric vehicles**:. An EV has only an electric motor that receives its energy from a battery that must be plugged into an outlet to recharge. A PHEV has both an electric motor that receives its energy from a battery and an internal combustion engine, and the battery can be charged by either plugging it into an outlet or internal combustion engine and/or braking. In each, the battery is sized such that the electric energy is sufficient to cover an about 40 miles in one time charging. It reduces less greenhouse gases & helps in reduction of consumption of fuel and cost of the journey. There is a synergetic relationship between electrifying the vehicular transportation sector and the ability of the grid to generate and deliver the “electric” fuel to millions of electric vehicles (EVs) and plug -in hybrid electric vehicles (PHEVs) The new load resulting from the PHEV is acyclic to the existing load served, meaning that with load management strategies (discussed below) the new vehicle load can be served during the off-peak load night-hour period. The resulting benefit would be improved utilization of the electric infrastructure (generation, transmission, and distribution assets) from the increased sale of electricity with no additional investment in infrastructure.

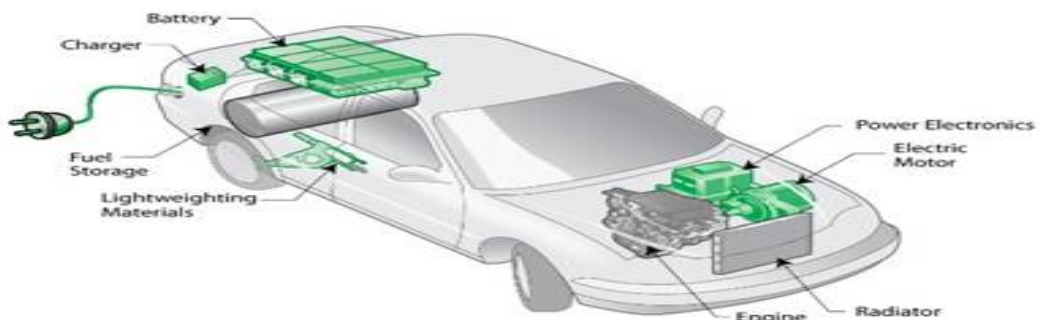


Fig3. PHEV

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III. **Smart homes And buildings:-**Smart homes are those the homes which are equipped with the smart power using elements as the automatic electric system, L.E.D lights, Smart Meters & less electricity consuming equipment & roof top solar power generation plants for its own use shown in figure.



Fig 4. Smart Home

V. MECHANISM METHODOLOGY AND SUMMARIES

There are the two methods by which we can analyse the impact of Smart Grid on the greenhouse gas emission.

Direct Reduction

Indirect Reduction

- i. **Direct Reduction:-**In this method we analyze the direct impact of the functions of Smart Grid which reduces the energy consumption\emission at the end use by reducing the generation requirement.
- ii. **Indirect Reduction:-**In this method we analyses those the functions of smart grid which are cost saving subsequently the saved capital is used to establish the renewable source emery generation plants
Table 1& Table 2 shows an impact overview of different functions

Table No.1 Shows an impact analysis of smart grid mechanisms with the function of energy efficiency

Mechanism	Direct Reduction in CO ₂ Emission	Indirect Reduction in CO ₂ Emission
Conservation effect-of consumer information& feedback response	Conservation effect of consumer feedback based on AMI & DR control	--
Joint Marketing of Energy efficiency & DR program	--	Energy efficiency program cost saving from-shared marketing &outreach expenses
Development of Diagnostic in HAN	Energy saving from Equipment performance diagnostics for household use	--



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Measurement & verification for energy efficiency program	Efficiency from marginal energy effective measure that are cost effective based on accurate M&V	Reduced cost for M&V Of saving from energy efficiency program
Shifting load to more efficient generation	Reduced fuel emission resulting from load shifting using DR	--
Support additional EV & PHEV	Reduced fuel & emission from addition electric powered LDV enabled shift charging	--
Conservation voltage & advanced voltage control	Reduced distribution losses & end use consumption from optimizing distribute energy	--
Support penetration of solar generation (Renewable Portfolio Standard RPS>20%)	Distribution level voltage control enables using advance voltage control & automation control to manage reverse power flow	--
Support penetration of Renewable Wind Generation(20%RPS)	Reduced energy consumption By using demand response and Distributed storage instead of Power plants to supply regulation Services	Reduced costs for additional generation capacity by using demand response and distributed storage instead of power plants to meet reserve requirements

Table.2 shows an impact analysis of Smart Grid mechanisms with the function of energy integration.

Reduction Mechanism For Direct Reduction	Energy		Carbon Emissions	
	% of U.S.	10 ⁹ kwh\yr.	%of U.S.	M.M.T/Yr
Conservation Effect Of Consumer Information & Feedback System	3	135	3	92
Enabling Mass Development Of Diagnostics In Residential&HAN	3	p152	3	90
Measurement & verification for Efficiency program	1	59	1	35
Shifting load to more efficient generation	.04	2	.03	1
Support additional EV & PEHV	3	139	3	82
Support penetration of solargeneration. <i>Reduced energy for regulation (25%)</i>	2	99	2	59
Support penetration of solargeneration. <i>Reduced energy for regulation (25%)</i>	.02	1	.02	1
Total reduction without including additional EVs & PHEVs	9	467	9	277
Including support for additional EVs & PHEVS	13	606	12	359

Reduction MechanismFor Indirect Reduction	Energy		Carbon Emissions	
	Of % U.S	10 ⁹ kwh\yr	% U.S	M.M.T/Yr
Joint marketing of efficiency & demand response program	0	0	0	0
M&V	.5	278	.5	15
Support Penetration of wind generation (RPS20%)	5	253	5	150
Total Indirect reduction	6	278	6	165



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VI. CONCLUSION

We can conclude from the above study that Smart Grid concept is sustainable, effective & helpful in the reduction of Green House gas emission. It can change the current status of the earth in gas proportion, which will be very helpful for the human community. From the last few decades Smart grid continues to prove its working in the field of reduced emission. We should appreciate its use and help the organization in its establishment in favour of our future generation. With the help of Smart Grid we can utilize our both conventional & non-conventional source of energy in different manners. It has an ability to reduce the cost also which is indirectly helping in the reduction of emission. It is a technology of present for future generation. It is an emerging electrical technology which is helpful in reducing the CO₂ by electrical sector.

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