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ABSTRACT

In this world of modernization every country tries to increase their domestic production in order to increase GDP. India is one of them, in order to improve their economy with the help of make in India and similar schemes. In this development process, India is committed to sustainable development and minimal use of conventional energy resources. In order to reduce CO₂ and CFC emission India started to reduce fossil fuel dependency. It tries to convert their fossil fuel system into regenerative and renewable sources. India begins to install Solar and Wind power plants of huge capacity instead of their conventional thermal and nuclear power plants. With the emergence of new technologies such as Wireless charging systems, Electric Vehicles, Smart systems such as Smart Grid and Wireless Communication systems such as Internet of things (IoT). But here one thing is notable that due to these systems power consumption also increases, due to their heavy power ratings and lower efficiencies in case of Wireless systems (Charging and Communication). In 2018 India is closest to power demand and its supply but not greater or equal to the power demanded. India has announced that power production is surplus in current scenario. But due to introduction of these above systems lead to immense increase in power demand. If India has not taken any effective steps to increase their power production then it will suffer power crisis in upcoming decades. The new power plants have higher efficiencies, high durability and produces almost no emissions. India has considered 8% growth till 2020, but this consideration must have reviewed as soon as possible. In 2018-19 data says that India is 0.9% power deficit which is very good progress in power sector as in past data. But this percentage is going to increase in future. There is also increasing market for Electric Vehicles. Automobile manufacturing companies are trying to shift their production towards Electric Vehicles. Due to their high cost efficiencies, low vibrations as compared to engines, no emissions, less maintenance, Electric Vehicle is becoming popular these days. This ultimately results in tremendous increase in power demand. Mobile manufacturer companies always try to increase power capacity of Mobile Batteries in order to increase its backup and introduce the wireless charging feature. This also results in increase in power consumption. Intelligent home appliances are also introduced, these also consumes more power due to integration of remote control and advanced User Interfaces such as facial recognition. Voice control and Artificial Intelligence (AI) systems are also integrated to these devices. These systems are designed for higher capacities i.e. parallel processing and high speed processing to enable multitasking features. These systems require more power than conventional systems.

Keywords: GDP (Gross Domestic Product), Electricity, Emissions, Smart Grid, Electric Vehicles, Smart Systems, CFC (Chlorofluorocarbon), Wireless Systems, Communication, IoT (Internet of Things), Efficiency, Equipment.

I. INTRODUCTION

Industrial, Service and agriculture sectors are the basis of economy in India. These sectors are majorly driven by electrical power. For a developing country like India the need of electricity is increasing. This development includes development of these sectors internally. The various product and services industries are improving their technology to ensure better performance and features. But development is must be sustainable and non emissive. In product industry the automobile sector plays vital role in economy. The automobile industry includes three types of vehicle production are diesel/gasoline engine Vehicle, Electric Vehicle and Hybrid Vehicle (integration of engine and electric motor) [1]. In automobile sector India officially committed to replace all the fuel engine car into Electric Vehicles till 2030. At present we can see that E-Rickshaws are replacing the conventional auto rickshaws very rapidly. The mobile manufacturer companies are trying to implement wireless charging technologies to their upcoming phones, which will need more power to operate. Various Home appliance manufacturers integrating Artificial Intelligence (AI) technologies in devices like Air Conditioners, Refrigerators, Washing Machines and Smart Homes. These systems demand more power for their functioning. In above advancements in technology there will be huge increment of power demand. To meet them India will have to install new power plants as planning commission forecast. But the plant type to be installed is thermal i.e. Coal or Gasoline Based. This is due to coal availability in India is very large. Mining of coal results in biodiversity and vegetation loss and burning of coal leads to emission of life threatening CO, CO₂, SO_x and NO_x gases also results in problems like acid rain and Global Warming. So this method of increasing supply of electricity results in atmospheric pollution and is not a sustainable or persistent. India have to choose alternative methods i.e. renewable energy resources can take place of conventional for long time span. So India must have to re-evaluate their planning to meet the upcoming power demand in an effective way [2]. International agencies and unions also warned India for limitation of pollution caused by burning of coal can also be noticed from space in form of white clouds. On August 2018 India has a total installed capacity of **3, 44,689MW**[3].

TABLE 1 CASE STUDY OF ENERGY FROM VARIOUS SOURCES

Fuel	MW	% of Total
Total Thermal	2,21,803	64.3%
Coal	1,96,098	56.9%
Gas	24,867	7.2%
Oil	838	0.2%
Hydro (Renewable)	45,457	13.2%
Nuclear	6,780	2.0%
RES* (MNRE)	70,649	20.5%
Total	3,44,689	

Source: Central Electricity Authority (CEA).

*Installed capacity in respect of RES as on 30.06.2018.

*RES (Renewable Energy Sources) include Small Hydro Project, Biomass Power, Urban & Industrial Waste Power, Solar and Wind Energy.

From the above table we can conclude that the major of the portion of power is produced by Thermal i.e. Coal which leads to more emission. But this source is non renewable i.e. it will end after few years. According to a research oil will run out in 53 years, natural gas in 54 years, and coal in 110 years.

TABLE 2 CASE STUDY OF PERFORMANCE OF CONVENTIONAL GENERATION

GENERATION AND GROWTH IN CONVENTIONAL GENERATION IN COUNTY DURING 2009-10 TO 2018-19:

Year	Energy Generation from Conventional Sources (Billion Units)	% of growth
2010-11	811.143	5.56
2011-12	876.887	8.11
2012-13	912.056	4.01
2013-14	967.150	6.04
2014-15	1048.673	8.43
2015-16	1107.822	5.64
2016-17	1160.141	4.72
2017-18	1205.921	3.95
2018-19*	527.388	3.66

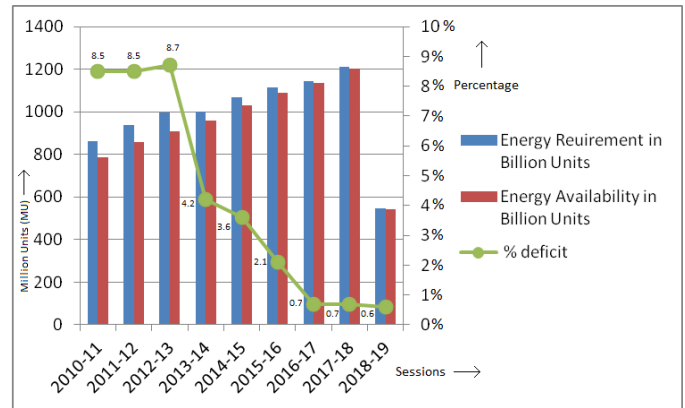
*Till August 2018 (Provisional), Source: CEA

The above Table shows a gradual increase in growth rate of conventional power generation from 2010-11 to 2014-15 and after it growth rate decreases by taking pollution in

consideration. In present session 2018-19 the percentage growth is 3.66%. This signs good but not actually good. India has committed to shut down all of their thermal power plants but in current scenario Power Demand increases drastically. If we do not choose other eco friendly alternative energy source, we should not stop use of thermal power plants completely.

CASE STUDY OF ENERGY DEMAND AND SUPPLY

Data analysis of Energy demand and supply in India



* Till August 2018 (Provisional), Source : CEA

**Graphical representation of energy demand, supply and energy deficit from year 2010-11 till now

The above data clearly shows the Energy demand and supply per year. From table we can see that India is Energy deficit Country from past years till now. But in session 2018-19 Energy deficit is only 0.6% but still not zero or generating surplus energy [4].

After analysis of data in above tables we can predict three main conclusions:

- India’s power sector is totally based on Coal (Fossil Fuels).
- India is still growing its thermal (Conventional) power plants.
- India is trying to be a power surplus country.

At present India is nearest to meet the power demand. If we neglect various losses i.e. generation, transmission, distribution and User end losses (losses in various equipments) India is producing surplus power. Most of the power loss is in agricultural and industrial sectors in terms of power theft. Due to vast geographical area and distributed (scattered) consumers power theft is difficult to detect and rectify. But due to recent advancements in power industry i.e. with the introduction of smart grid technology, we are now able to rectify these problems. Above statement will contradict the power saving systems sometimes and requires more power.

This paper presents the analysis of increasing power demand in India, factors affecting it and suggests the methods to reduce i.e. Limits power demand. This paper also recommends the ways to increase power capacity. It is also helpful for review of

future power planning that will meet the upcoming power demand.

II. COMPARATIVE ANALYSIS OF VARIOUS SYSTEMS IN TERMS OF POWER USAGE

For comparative analysis we have to know all of the factors affecting the power demand.

Main factors affecting the power demand are: (i). Automobile Sector. (ii). Electronic Sectors. (iii). Home appliance sectors.

(i). Automobile Sectors: Globally automobile companies started to manufacture electric vehicles rapidly. The total number of electric car reached 3 million units globally. Approximately one million new electric cars were sold in 2017. The electric vehicle market is also expanding in India. There are 25,000 units of electric vehicle were sold at the end of 2016-17. Various automobile companies are going to launch their electric vehicles in 2019-20 [5]. Besides these preparation of launches firstly we have to analyze their impact on Utility Grid. Many charging points were made up for charging of batteries of electric vehicles. So these charging points also draw electricity from Electricity Grid. They will result in extra burden over the grid. Finally we have to review our planning for such a huge change.

TABLE3 COMPARISON OF INTERNAL COMBUSTION (IC) ENGINE CAR WITH ELECTRIC VEHICLES

PARAMETERS	IC ENGINE CAR	ELECTRIC CAR
Vehicle Cost	Moderate	High
Size	Engine and Fuel assemblies acquires most of car space	Motor and Battery Requires less space
Emissions	CO ₂ ,SO _x and NO _x	Almost no emissions
Durability	Moderate	High
Maintenance	High	Low
Riding Cost	Low	High
Riding Range	Moderate	Lower than IC engine car
Refueling Time	Lowest	Very High
Energy efficiency	17-21%	85-90%

From the above table it shows the advantage of electric vehicle over conventional IC engine vehicles. So in few years people

will likely prefer electric vehicles. We have also analyze its impact on grid. Averagely an electric car consumes 4.5-5.5 km/kwh energy which is equivalent to adding an additional house load burden on the grid [6]. It's charging assembly also introduces power loss in terms of ac-dc conversions in conventional chargers and ac-dc-ac-dc in modern advance semiconductor charging equipment. In that condition national grid may able to deliver such additional energy demand but local infrastructure is not capable to support such huge power transmission and delivery. In hybrid and dc microgrid systems such devices offers more losses due to use of cycloconverters and chopper controlled dc converters. Chargers like SMPS (Switched mode power supply) performs well i.e. also in load and variable voltage outputs but they also suffers ac-dc-ac-dc losses we will discuss more about them in second factor.

There are various types of losses in different types of electric drive application in electric vehicles: (a).Series PHEV, (b). Parallel PHEV, (c). Blended PHEV

*PHEV (Plug-in Hybrid Electric Vehicle).

In case of hybrid electric vehicles there will be electric motor drive is only for no fuel and emergency conditions. This will not be responsible for huge increment of burden on grid [7]. But those vehicles which are only of electrical type can be responsible on greater impact on load increment on the grid. Because in this case the motor battery system are only present which will draw more amperes from the main grid [8].

On the basis of motor and its supply technology the losses results in additional load as follows:

- (a). AC Supply Based Induction or Synchronous motor.
- (b). DC supply based stepper or BLDC (Brushless DC) motor.

In the case of AC supply based motors, Induction motors are generally used for more convenient operation than Synchronous motor. So in Induction motors losses are generally due to its slip and losses due to nature of input supply. This will increase the apparent power intake of the motor from supply due to its low power factor [9]. But in case of DC supply based motors, BLDC motors are generally used due to its smooth, simpler and reliable operation. BLDC motor runs at synchronous speed i.e. almost zero slip and at a better power factor [10]. But DC systems and transient losses also comes into play. This also results in a huge ohmic loss due to voltage drop across at least value of resistances also. Hence resulting output mechanical power is reduced as per electrical input power. As we know that a small quadcopter BLDC motor must draw 5-10 amperes initially so for BLDC motors having higher current drawing capacities i.e. almost 5 to 8 times greater than the smaller one. This will result in fast battery drainage which is connected as a source. Again charging of this battery at lesser time intervals increased energy demand from the grid.

Finally we have to analyze which type of electric drive system offers greater efficiency at various desired conditions for drive operation. We should have also analyze the efficiencies of different converters (controllers) which are based on different technologies. Which will helps in planning of power system operation and control [11]. We have to accept the fact this time that no any electrical machine can give as much efficiency as

static electrical machines hence always results in power loss and draw more input power to operate under rated parameters.

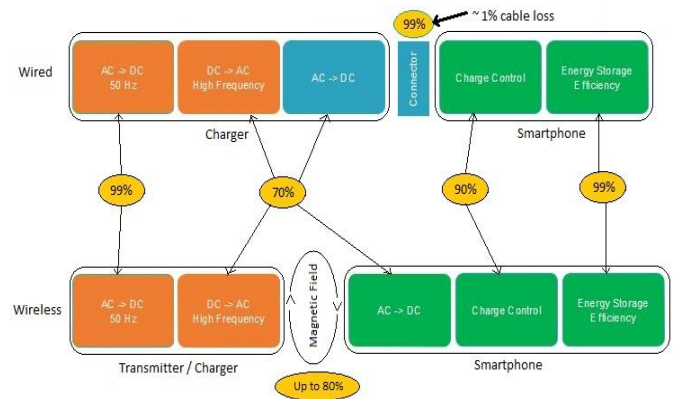
(ii).Electronic Sectors (Wireless Power Transmission and Battery charging): Electronic sectors here refers to semiconductor devices which converts the one form to another i.e. alternating current to direct current and vice versa. Many of the companies involved in this sector they usually made wireless chargers for smart phones, laptops, electric cars and buses. Instead of wired charging methods wireless chargers are less efficient i.e. for same power output wire charging draws more power from input. It also requires a certain distance limit for working it efficiently and possess primary winding and core losses when charging device is kept far from distance limit. For improving this we have to introduce Tx and Rx i.e. Transmitter and receiver coils in which we increase the frequency of A.C. (Alternating current) to reduce transmission losses [12]. But unfortunately while achieving this it results in increased harmonics and distortions. This affects both input and output side of the power transmission system i.e. supply as well as phone end receiver's converter. This will lead to increased total harmonic distortion and decreases supply power quality [13]. This may be considered as extra burden on grid. In current scenario of electronics sector manly in mobile products like smart phones they are continuously trying to give more and more features like latest telecommunication technology like 4G and 5G. Every generation is trying to reduce power consumption but due to competitive market and user demand for more bit rate which is also as a result of HD voice, video calling and real time gaming applications. This indirectly demands more power for such high speed communication system. Smart phone manufacturing companies are trying to improve and add the new features to their products. By doing a simple comparison we can analyze the power difference among batteries which were used in past i.e. 850 mAh were sufficient for one week use for mobile phones. But if we take example of present smartphones, by improving battery technologies we are able to install capacities of 5000-1000 mAh batteries but they not run a day completely after charging. This also makes a huge difference in power demand. These advancements are done to add on more features to smart phones like camera pixels and various sensors for enabling artificial intelligence features. Commonly used sensors like proximity, gyroscope, accelerometer, gravity, barometer, temperature sensor, orientation, Rotational vectors, Magnetic compass and Light sensor consumes on average of 2-5 mA of current results in huge power loss when are continuously used [14].

Latest coming smart phones are equipped with AI (Artificial Intelligence) microprocessors and they are capable of multitasking and multithreading operations. These microprocessors consumes less power in small scale applications but in large scale like industries they will demand extreme energies and were implemented by industries to reduce human hence regarding cost. These companies are also influenced by high production quality and accuracy. Now a days electronic manufacturing companies producing smartphone, tablet are introducing wireless charging in their devices and also introduced reverse wireless charging. Like reverse wired charging, reverse wireless charging can either get charged and can also charge other devices wirelessly. In this

feature the device consists of high frequency coil facilitates both receiving aswell as transmission coil. User can select mode of operation or automatically chosen by device.

But this will results in more power loss due to wireless technology will used consecutively two or more times hence power loss and consumption will increased.

Comparison between Wired and Wireless Charging Technologies Process chart:



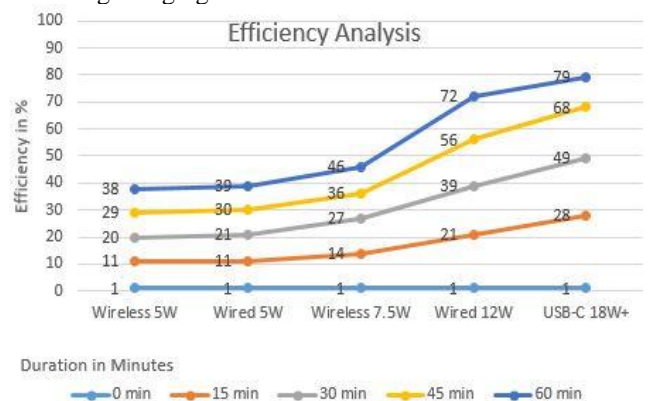
*Wireless Charging of smartphone

**Source: MT5009 - Analyzing Hi-Technology Opportunities - Group Project

From above chart we can observe that overall charging efficiency of wired charging after calculation is 42.79% after using same conversion technology as wireless charging. But wireless charging have calculated overall efficiency of 34.57%. These both efficiencies are calculated by keeping other parameters same i.e. conversion and energy storage efficiency. Energy storage efficiency 99% by considering Lithium ion battery in both wired and wireless charging technologies [15].

The calculated efficiency difference is 8.22% i.e. wired charging efficiency is still greater than wireless charging. This 8.22% more power is drawn by wireless charging to keep the output power same as wired charging.

Efficiency Analysis for various charging techniques considering charging durations:



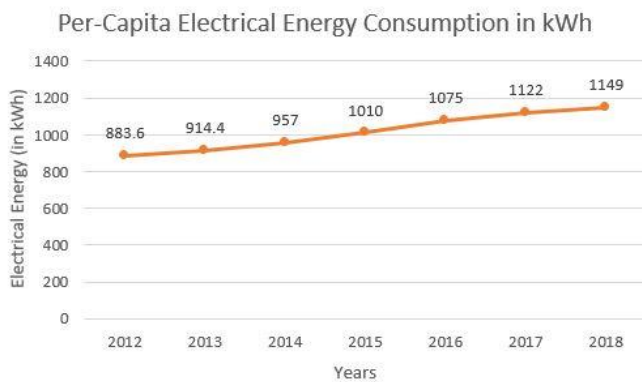
*Analysis of wired/wireless USB-C (15 min intervals),

**Source: MacRumors

From above graph we can observe the in real time operation for same charging power and duration i.e. 5W wireless and wired charger have no efficiency difference at starting. But at 15 minutes and onwards we can measure an efficiency difference of 1%. USB (Universal Serial Bus) Type C have greater charging efficiencies when it is used with wired and wireless charging technologies [16]. But overall efficiencies are always differ by 1%. Due to this difference, individually they negligibly affect power demand. But when huge wireless chargers are connected on the grid they will make a huge incremental power demand on the grid.

(iii). Changing Lifestyle of People: In last two decades technological revolution takes place in which human are not untouched. Technologies have greater impact on human living and their survival. Today we are surrounded by technologies and their associated equipment. These equipments are found from life support systems to entertainment for humans. Many equipments like air purifier, water purifier, Smart Air Conditioning systems, Bio-medical diagnostics and treatment, Smartphones, Tablets, Laptops, Smart Televisions, Refrigerators, Kitchen appliances like Air fryer, Electric Chimneys, Microwaves, Induction cookware, and other smart appliances are making our life easier but making us more electrical energy dependent. These technologies are seems to easier and flexible to use but they demands more electrical power. Our per-capita energy demand is increasing tremendously from recent few decades [17]. With the emergence of new technologies our non-energy consuming portion of lifestyles turned into energy consuming portion. Technologies like smart grid are energy efficient but consumes energy from main grid under no operating conditions like non-operating durations of renewable energy sources. Smart wireless communication system are getting integrated with conventional equipments which are beneficial to enhanced remote operation and control, but may draw more power than conventional in communication units.

Analysis of Per-Capita Electrical energy consumption:



*Analysis of per-capita energy consumption in past years.
 **Source: Wikipedia.

From above chart, the per-capita energy consumption is increased 265 kWh from year 2012 to 2018 shows tremendous increase in energy demand. This will results in future energy crisis when not compensated by renewable energy resources. Reason for this energy crisis is increased demand of facility and services which are usually for ease of human efforts.

III. CONCLUSION

This paper concludes that energy demand per person is huge increased in past decades and increasing till now. By collecting and analyzing the previous data we have to increase the electricity production much more than forecasted. To make India power surplus country we have to produce more electricity in eco-friendly way. We have to search new technologies to extract electrical energy more efficiently. India have to install more solar, wind, tidal, geothermal power plant than expected. India have to discover new and clean energy resources to overcome upcoming power crisis. We have also improve transmission efficiency and reduce the power theft.

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