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Impact of renewable energy sources integration with power grid systems through several methodology's

Omar A. AlKawak[a,*], Ali R. Ramul[b]

[a]Department of Air Conditioning and Refrigeration Technical Engineering, Al-Mustaqbal University College, Hilla, Babil, Iraq
[b]Computer Techniques Engineering Department, Al-Mustaqbal University College, Hilla, Babil, Iraq

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Abstract

This paper is primarily committed to three primary angles concerning photovoltaic based DG. The fundamental perspective being the reduction of influence changes in daylight based photovoltaic and the Reduction of influence distribution in the framework of the system. According to the unpredictable changes credited to the wide range of sun situated radiations. Further, the sizing related issues and region of a SPV based DG may cause a ton of influence concerns effecting the overall DG system operation and its efficiency. The second region of concern is the method used in the control of the DG and its feasibility to diminish framework influence issues. Another area of concern is network interconnection, through the appropriate introduction of RES into the ordinary grid for supportable and stable activity. This has been managed through an extensive contextual analysis of an operational system.

Keywords: Renewable energy, power grid system, energy management, Energy efficiency.

1. Introduction

The overall view on Renewable Energy Resources (RES) has changed fundamentally longer than 10 years or something like that, generally contributed through its socio-political and ecological effect on a nation. India, specifically, due to the accessibility of renewable energy resources in plenitude and having various expound projects to bridle renewable energy, is considered among the leaders in the renewable energy area. It gets up and coming for a quick creating economy like India to pace

*Corresponding author
Email addresses: o0maar@yahoo.com (Omar A. AlKawak), ali.rashid@mustaqbal-college.edu.iq (Ali R. Ramul)

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its energy development alongside mechanical development so the overwhelming difficulties of energy prerequisites can be met in a solid and feasible way. Simultaneously while investigating different energy resources to satisfy one's energy needs it has gotten similarly imperative to mull over natural elements, without causing any grave worldwide atmosphere danger. Because of the modest idea of the customary energy sources and different constraints related with it, for example, a danger to worldwide energy security, negative regular effects and declining prosperity and social conditions, the sincerity to move the fixation towards more achievable and atmosphere genial environmentally friendly power are moreover disturbed in the current force circumstance in India [16]. India has shown a for all intents and purposes consistent typical improvement movement rated as 5.65 % from the past. Efficient Energy usage is one of the most important factors describing the advancement of a nation's economy. Still nowadays continuous country advancements in energy usage shows a reacted extensive development [19]. Figures shows that almost a ten times higher increase ratio about a 302.5 GW taken into place in India at the end of 2016 April from 31 GW previously taken in the 1981[14]. In spite of this phenomenal improvement in the district of power, India truly neglects to crush any issues revealed among age altogether interest.

For that further development at the current age limit are required, revealing this outcome through government similarly as different excluded zones, with a more noticeable advancements on renewable energy based sources, to broaden its level of obligation and to motivate clean energy methodology's

There are several environmentally friendly power supplies available in different headways, such as sun arranged power age utilizing daylight based photovoltaic (SPV) advancement is seen as commonly sensible for appropriated age purposes. The most reliable improvement have been seen in India and around the globe to meet the power fundamentals of the provincial zones having no induction to the main network was the (SPV) advancements. Huge extension (SPV) sending should provide help in creation useful monetary sway by conceding the improvement of standard main power supplying stations. Greater highlighting the SPV based environmentally friendly power framework is the direct result of the way that its most noteworthy age agrees with top interest during mid-year. Various characteristics identified with SPV frameworks are their capacity to grow the reliability of the main network that is related to, neglecting many factors such as transmission and distribution related issues because of their proximity to the loads implementation. A large portion of the land region gets sun-based energy In India of around 4-5 kWh/m2 consistently for approximately at least about 300 sunny mornings annually. In the event that 1 % of such land territory is used for creating power using SPV at a general proficiency of 10 %, 429 $\times$ 109 kWh of electrical energy can be produced each year [19].

In the wake of having procured satisfactory age utilizing SPV, the accompanying test goes compromising little amount of energy supplied by generators according to the guideline lattice ranging from low to medium voltage levels. Such challenges should sufficiently be decided to intensify the benefits of the method of connection. SPV has expanded endless affirmation, especially in India, DG units on account of the progressive ways of their integration its assets improving several aspects such as wealth and perceptible constructive atmosphere outcome.

Thusly, the execution of SPV based DG frameworks with network the board can manage the energy issue in agrarian countries like India sufficiently by giving earth heartfelt, viable, and strong energy effortlessly. Considering the tendency given by the DG frameworks, there is a certain possibility that more development is to be made in several parts of intensity age of DG frameworks in both network and installation modes generally similarly as in India. According to this assessment, SPV-based passed on delivering framework, their matrix the board and issues with network affiliation are discussed.

As indicated by the orchestrating commission, India's circumstance in overall power age placed as

fifth at 33.45 % made through state governments, 25.191 % delivered through the central territory, and the rest 41.362 % is created through the private region, with an all out constraint of 302833.20 MWs (302.8 GWs). The warm bit of it is 69.81% with essentially 14.14% comes from the hydro sources, 1.91% comes from nuclear and the rest is about 14.16 % is from environmentally friendly power resources [14].

There are a dissemination model which The Indian power area is managed by in a various levels. It is included 5 Territorial Power Sheets, for example, the eastern local power board (EREB), western provincial power board (WREB), northern local power board (NREB), southern local power board (SREB), and northeastern local power board [18]. The greater part of the conditions of the area is under the provincial sheets of power starting on 30 April 2016.

As per the twelfth arrangement time frame, the expansion of the 15,000 MW limit was focused on, which would venture up the REpower age to around 40,000 MW through 2017 yet this imprint was accomplished much before the focused on schedule and REpower age crossed the imprint in April 2016. On the off chance that the speeding up of the RE area continues, it will cross the 1, 75,000 MW mark through 2022 [15].

There are two significant reasons that influence the renewable energy needs of India when contrasted with the needs of different countries. Initially, RE supplies energy to that country populace that is distant through customary transmission grid, for example, slopes, islands, distant away from age focus maybe the far off regions can get power just from renewable energy resources [31]. Furthermore, RE being a viable method of power age which is available to 1.25 billion being supplied by their own territories.

India is as of now seeing an occasion to take the economical energy future to extraordinary statures through fortifying inventive and business person aptitudes into it [5]. Most nations have embraced market changes to give admittance to the transmission grid for free power makers, including little scope renewable energy makers. India has likewise taken such drives to advance the renewable energy power age. Numerous monetary sponsorships are made accessible to advance renewable energy creation everywhere and little levels. First among these methodologies is the Power Demonstration of 2003 that disposed of the essential of grants for autonomous age and transport systems in nation areas. The Public Rustic Charge Strategy, 2005 and Public Provincial Zap Strategy, 2006 are set down for lively shock of nation regions [6]. JLNSM is likewise focused on decrease of generally cost of intensity age through sun oriented. It has set down long haul strategy alongside enormous scope organization objectives and condition of craftsmanship R&D offices to tame the per unit power age through sun based around network equality. An exhaustive RE Policy for thorough advancement of area has been defined through MNRES. The strategies focusing of 15% of extra matrix power Generation ability to come from RE through 2017 [2].

The vitality of The Power Demonstration 2003 in boundless power can be seen through the way that it considers RE in the Public Power Strategy in grid-related and in free structures. One of the huge courses of action is that, as indicated by Segment 3 (1) of the Power Demonstration 2003, the central government will set up the Public Power Strategy and duty technique according to the time changes and situations, participating with the governments of that state in several conversations. Electricity Demonstration 2003' has designated a basic part to state power managerial commissions (SERCs) to diagram practical power approaches at the state level. In Segment (86-1) from the Power Demonstration, it is crucial for the SERCs to propel and co–age a lot in the inclusion of RE sources. The Demonstration in like manner allows the trading of power as a product between RE generators and people [25]. Paper organized as in section 2 presented a literature review on deferent studies, Section 3 presents a research methodology, in section 4 described results and conversation and end and future work introduced in area 5.

2. Literature Review

Following reviews are listed based on available studies on various technique Impact of Renewable Energy Sources Integration with Power Grid Systems.

In [26] India needs to grow in the power sector without any compromise in climate change using renewable sources harnessed to its maximum potential. The objective of mitigating increased energy demand with eradicating poverty & social development poses a formidable challenge, but at the same time provides an opportunity to increase the overall energy mix for a sustainable eco-friendly market for renewable sources.

In [30] have focussed on the problems faced through renewable energy sources & technologies for the developing countries. The authors are promoting solar energy as secure, environment friendly & viable option for increase in generation capacity. The restructuring of power system improves the electricity market but, at the same time, increases the complexity.

In [7] author insisted that the power prices can be lowered down following deregulation & restructuring of the power sector. The deregulation is directly affecting the pricing mechanism & plays an essential role in power planning essential for economic growth of India making it financially & commercially sound.

In [32] author India is among the few countries which have a fully functional ministry dedicated for promoting renewable energy sources. The Ministry of New & Renewable Energy provides a holistic approach & complete roadmap for successful deployment & promotion of renewable energy for the mass & present & future growth of India.

In [11] author incorporates the indicators of economic growth of the country on the basis of per capita energy consumption & projected the economic growth to 8%. It further reports that even after huge capacity growth is planned for energy sector, the net demand will continuity to increase at a faster rate.

In [17] author initiated the power reforms with an objective to mitigate the gap between demand & availability of electricity, improving the performance of State Electricity Boards (SEBs) & mobilising Central & State Governments for expansion of generation capacity.

The Tariff Policy through the Ministry of Power published on 6th January 2006 [2] in compliance with Electricity Act 2003 & NEP 2005 provide the complete legal & policy frame work with structure of tariff regulations which has to be followed through different type of energy producers & consumers.

In [10] author The already established electricity feed laws & feed-in tariff structure of the wind energy sector is used for preparing the complete roadmap for making decision to develop advanced renewable tariff for other sectors like solar & biomass for isolated as well grid interactive systems.

In [20] author has enumerated the changes influenced through the restructuring of power system which causes mandates on power utilities & has large impact in complex ways. The new regulatory structures for reducing environmental impacts having large penetration of renewable energy sources after restructuring have been studied.

In [9] author has elaborated the renewable energy technologies as sustainable & clean energy sources. The renewable energy sources ensure environment friendly economic growth. The restructuring & deregulations provide complex but viable options for promoting renewable energy in wider perspective of energy solution.

The policies for biomass energy utilization in India developed through Ministry of New & Renewable Energy Sources are well documented & sufficient for making adequate policy for renewable energy sources.

In [13] author has proposed a study for tremendous growth in the power sector on India post independence. Also give a comparative study for developing countries for electricity demand, shortage

of supply & focus on options to be implemented for improvement.

Ministry of New & Renewable Energy Sources has issued policy, regulation & mandates for large scale renewable energy power generation for standalone as well as grid interactive systems. The state electricity regulatory commissions have demarcated the operations of small grids based on renewable energy sources for rural as well as urban landscapes.

In [12] author elaborates a comprehensive knowledge about the issues in grid integration of power from renewable energy sources. The factors influencing the power quality are mainly related to the issue of variability in the solar & wind patterns. It addresses the possible solution for grid stability problem caused through voltage & frequency changes.

In [23] creator introduced a diagnostic articulation to compute the ideal size and a compelling philosophy to recognize the relating ideal area for DG situation for limiting the all out force misfortunes in essential appropriation frameworks dependent on accurate misfortune recipe. The impact of area and size has been examined with expounded load stream examination utilizing misfortune affectability technique.

In [24] proposes a novel methodology for incorporating a twofold taken care of enlistment generator (DFIG) based breeze ranch with miniature lattices. In spite of the fact that this paper focuses on the miniature framework application, the strategy can likewise be utilized in an air conditioner network and with high voltage direct current (HVDC) interface associations. The control approach includes expanding the DFIGs with hang attributes to share the breeze ranch matrix voltage and recurrence control.

In[1, 22] papers the discussion was all about enhancing the integration between the DG based on solar farms and wind turbines with the main grid power using an proposed inverter control methodology implementing FLC controller which proven to be solving several integrations issues as the results showed.

In [29, 27] introduced a force the board creates for power hardware based low voltage minimal cross-segment in islanding activity. The proposed authentic and responsive force control depends upon the activity range control technique for use with the virtual $\omega - E$ plot wrap framework for power-sharing and control among the DG units in obliged hardware interfaced low voltage downsized lattice during islanding development.

In [27, 28, 21] courses of action with the stream status of circled age (DG) in Greece and the presentation of a 60 kWp photovoltaic (PV) power station, made under Law 3468/06 Creation of Power from Renewable Energy Sources, High-Effectiveness Cogeneration of Warmth and Power and Other Demises‖. This application is the essential DG foundation with fixed PV modules realized in the country after the support of Law 3468/06. Pay money related assessment of the made DG foundation is performed and the experiences related to the ability of DG in the Greek power market are presented and discussed.

In [4, 8, 3] creator The primary target of this paper is to explore a few strategies that can be utilized to diminish the vacillations in the force produced from an enormous client claimed photovoltaic (PV) framework, in the request for megawatts. This paper centres around three strategies: 1) the utilization of battery stockpiling frameworks; 2) the utilization of dump loads and 3) abridgement of the created power through working the force melding unit of the PV framework beneath the most extreme force point.

3. Research Methodology

3.1. Research and development (R &D) initiatives

- Engaging of the (MNRE) Ministry of New and Renewable Energy through building encouraged sun masterminded by photovoltaic framework to support the focal conditions to light based energy usage in times especially during the course of action and keep improving it. Non-Traditional Energy Sources Ministry has been always in supporting innovative work in order for more improvement and work movement in RE. Present supplement goal is in reducing the expense comes from the current advancement deficiency. Achieving more advancement progress, and improvement framework in research would contain five classes, viz.

- Basic research having a drawn-out perspective for the improvement of creative and new materials, measures, and applications.

- Applied research zeroed in on the advancement of the ebb and flow cycles, materials, and the development for improved execution, toughness, and cost power of the systems/devices.

- Technology approval and showing ventures focused on field assessment of various setups, incorporating crossovers with customary force frameworks for getting criticism on execution, operability and expenses.

- Development of Research and development establishment in private open association (PPP) mode, and Sponsorship for incubating and new organizations, a 3-level Research and development institutional system, including a critical level assessment chamber, Public Focal point of Greatness, and an association of focal points of significance.

3.2. Distributed power generation

A Circulated Age (DG) is a generally little power age system that is working in segregation from the focal producing station and is put in nearness with the heap place. The limit of a DG, for the most part, goes from a couple of kW to thousand of kW contributed from an assortment of little traditional energy sources like little gas motors, diesel generators, and non-customary sources, for example, sun oriented photovoltaic, wind, biogas, and so on The ages got from these appropriated sources, which are generally found near the heap community and are added to the dissemination system. In any case, the measures of the system to which they are associated are generally huge when contrasted with these DG systems. The force got from the scattered sources is utilized using a comparative game plan of allocation conductors which are used to move the force from the standard utility framework to the stack place. DGs are considered to cause a basic impact on the dissemination framework through changing limits, for instance, voltage, current, and force stream. Starting at now, several important factors, for instance, security, overall normal issues, adaptability safety, and the efficiency of the energy are going forward to an extending design implementing sources of DG. The advancements of SPV, explicitly, provided more benefits the usage of such sources, with respect to the end-customer usefulness and region close by. Generally some client additions like changing sizes are provided depending on the loads reliant are made. Not at all like the framework transmission framework which incorporates gigantic capital endeavours and has and offers enough long brooding period, sun-based energy DG diminishes the overall cost and time of the network based framework. Furthermore, the appropriated sun situated DG framework excludes complex control orchestrating and working supports.

Implementing SPV power has the versatility in the levelling setups such as medium, or large can be arranged depending on the customer needs. it enhances the upsides of voltage profile and

disaster influence got mitigated and diminished, providing steady-working framework for higher network levels, distribution level improved power quality as well as in the transmission level of the framework, DGs installing at the best ideal zones it is key that is to be set properly in order to get best results outcomes.

In the Past usage of small dg units at the extent of few kilowatts to 10,000 kilowatts might be through the associations with the network framework. This can happens either from active interconnection or power fed to the distribution level zones. The dg power can be exchanged with the dispersed generation with a size range of one to a hundred kilowatts, which are ordinarily used to fulfil the need of a household appliances or organizational small units power requirements.

DG implementation has several concerns which depends on the loads of users and households which should be takin into account in connecting it with the grid framework. Over loading costumers it wold be more economical to use it rather than the main grid, illustrated below features associated of DG installations.

Estimated quality: main power generators produce power at very high level, still try to mitigate several issues such as overall cost, increase the efficiency etc. dg based on renewables will be perfect solution through the mitigation of production cost, to do that several investments in the RES must be made leading in lowering the manufacturing, production and transmission cost leading power market to involve around the RES based dg ,nowadays the integration process has more stability and efficient loading and growthing by the second which will ultimately replace old methods of power generation.

Proficiency: Co-operation has been done in power generations such as combining thermal with natural gas cycles, still reliability amount required is huge to maintain normal operation with the cost of coal, gas and other which are not suited for small dg based units, but with the technology advancements in the renewable energy sector made them locally implementable whereas non-renewable transport its fuel use easily unlike natural gas based ones.so energy efficiency, per unit cost ,can be increased through the reduction of the greenhouse emissions and their dg based units.

Emission's mitigation: Typically renewable based dg are free of emissions, this also can be done in nowadays with fossil based dg generators, thanks to technology advancements in this area, like CO reform seq, gas production and fuel cell.

Security: instantaneous reserve power can still be suppled if one of the dg generates encountered a failure for any kind of reasons through a spare units. Also mitigating several problems in the system and the lines before even get detected be the sensors at the customer leading a power quality huge enhancements.

Load managing: load profile can be adjusted by using clipping at load peaks through injection or load reduction, full building and load shifting also capable by using renewable energy based dg instalments, and conservation is possible which means the reuse of production waste by reducing the entire loads.

3.3. Grid management

Providing stable and uninterruptable power to the user end from the main generation is the responsibility of main grid management. Power balance between the grid and its interconnected dg must be ensured at all-time basis and grid managements has several operation instructions through engineers tasked with in order for making it possible. Moreover the optimal operation of the power system features including its economic, secure and efficient reliability mostly managed by the grid management some tims the loads reaches its peak led by very high demand as compared with other times. The cost of the power supplied from the power generators at these peaks times can be reduced by changing, reshaping the peaks or even if possible restructuring it by the management team of

the grid. This can be done by splitting the high peaks into small ones and distribute them among renewables based dgs resources in order to supply particular profile or category managed by the grid managements.

4. Results and Discussion

According to the planning commission, India's situation comes in the fifth in worldwide power age with 33.44 % produced through state governments, 25.19 % by the central sector, and the rest created through the private sector 41.36 %, with a (303 GWs) 302833.21 MWs as a total limitation. With 69.81% portion shared by thermal of the all-out 303GWs with 14.14 % simply comes from hydro, atomic shares 1.909 % and the rest comes from renewable energy sources which is about 14.16%.

Power sector in India has a hierarchical shaped distribution method. Which contains five regionally distributed boards through the (SREB) southern nearby force, (NEREB) north-eastern nearby force, (NREB) northern neighbourhood power,(WREB) western nearby force and (EREB) eastern common force. All these territory's states is mentioned in the Figure 1 below. From late April 2016 under the regional board of power. Table 1 showed up as a bit of the RES related to Indian network. It is noted to observe that.

Table 1: RES Share and Indian Grid total installed capacity at several different operational plans

Plan #	*Period of the plan*	*RES Share (MW)*	*Overall Installed Capacity (MW)*
Plan#6	*(1980 - 1985)*	*0*	*42584.71*
Plan#7	*(1985 - 1990)*	*18.15*	*63636.33*
two Annual Plan	*(1990 - 1992)*	*31.89*	*69065.18*
Plan#8	*(1992 - 1997)*	*902.02*	*85797.38*
Plan#9	*(1997 - 2002)*	*1628.4*	*103410.05*
Plan#9	*(2002 - 2007)*	*7760.7*	*132329.22*
Plan#11	*(2007 - 2012)*	*24503.46*	*199877.04*
Plan#12	*(2012 - till 30 April 2016)*	*43086.83*	*302833.1*

Between local force trade has developed commonly after the foundation of different between provincial connections. These force trades help in gathering overflow interest in energy deficiency locales alongside boosting the economy of India. Figure 2 shows the Local Power driving collection of India and the degree of area canny presented limit.

Considering the energy needs of India, level of petroleum derivative import, and emerging economy; earth agreeable power is certainly not a decision anyway a dedication for the Indian power region. Seeing this reality, India was the chief nation to set up an alternate help concerning economical power for instance Administration of New and Renewable Energy (MNRE) during the 1980s. Since its set up legitimate force share in India's done power limit is dependably on the ascending as it was only 4% in 2005 and has made to get 14% of preeminent force age for example 42000 MW in 2015. The centrality of normally very much arranged force sources in the progression to a reasonable energy base was seen during the 1970s. Official assessments show the need for an extra introduced limit of 100,000 MW in the following decade. Indian undertakings for progressing practical force

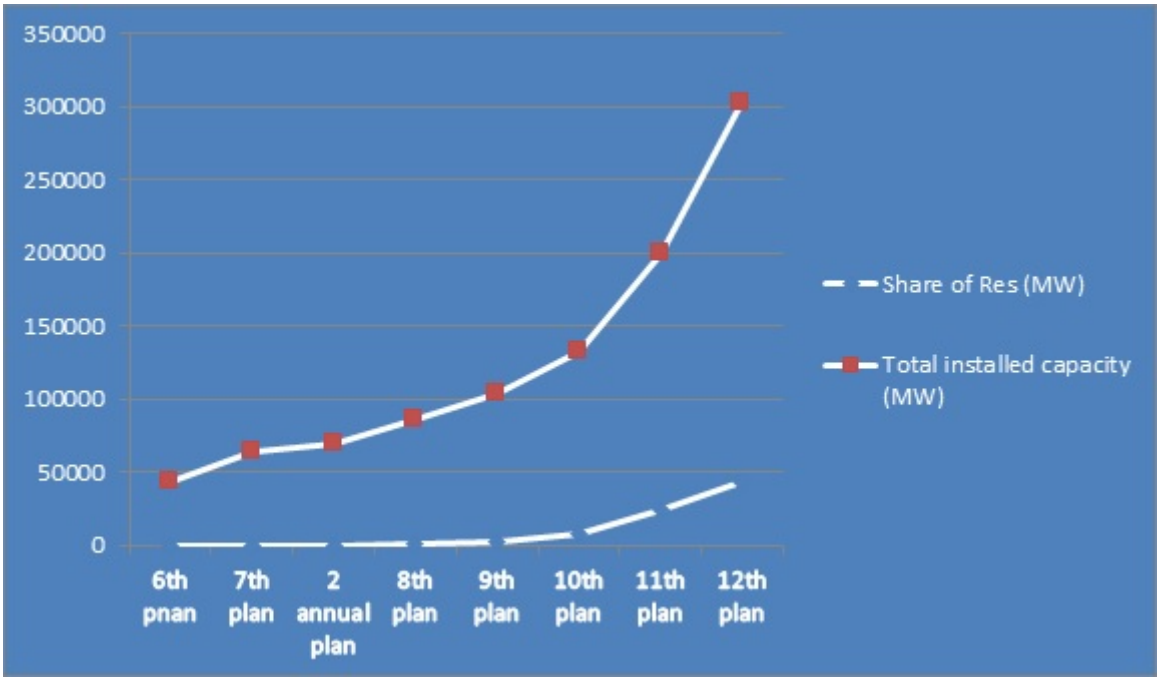

Figure 1: RES Share and Indian Grid total installed capacity at several different operational plans

are in concurrence with overall concerns in orientation of pursuing cutting down the general expense of boundless power headways through a constant assessment and improvement effort and various systems.

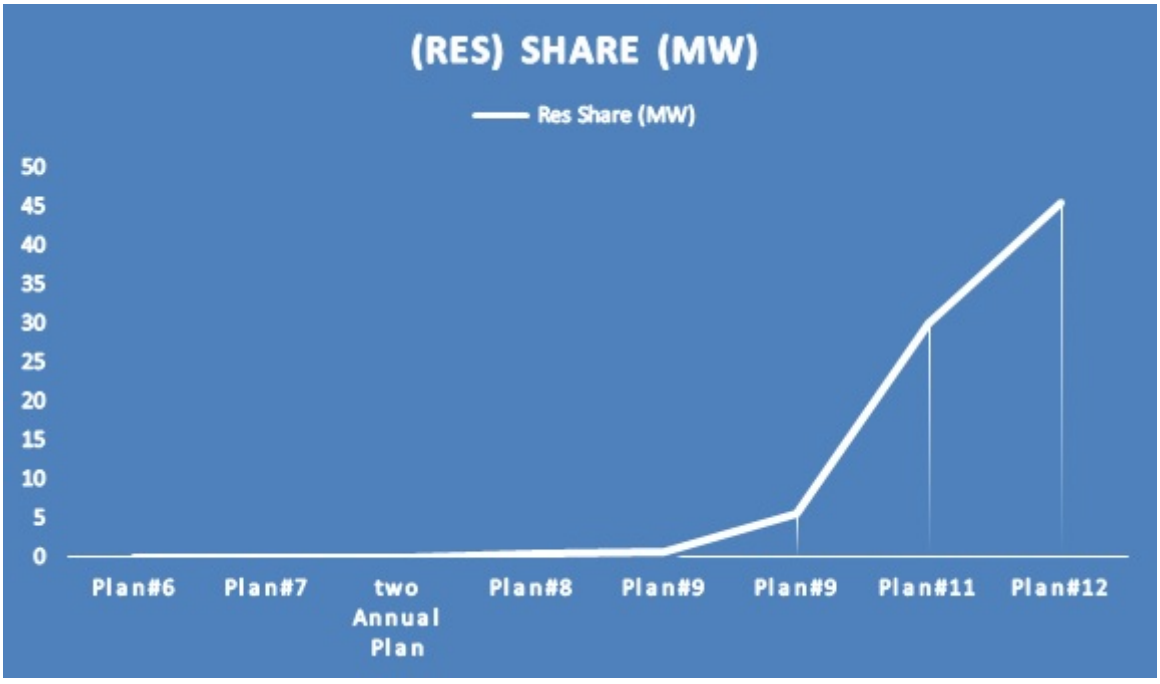

Figure 2: Growth of RES during various plans

The assessed complete capability of renewable in India is 84777 MW where the significant offer is from wind energy. Figure 4 gives the installed capacity of various renewable energy sources as in April, 2016.

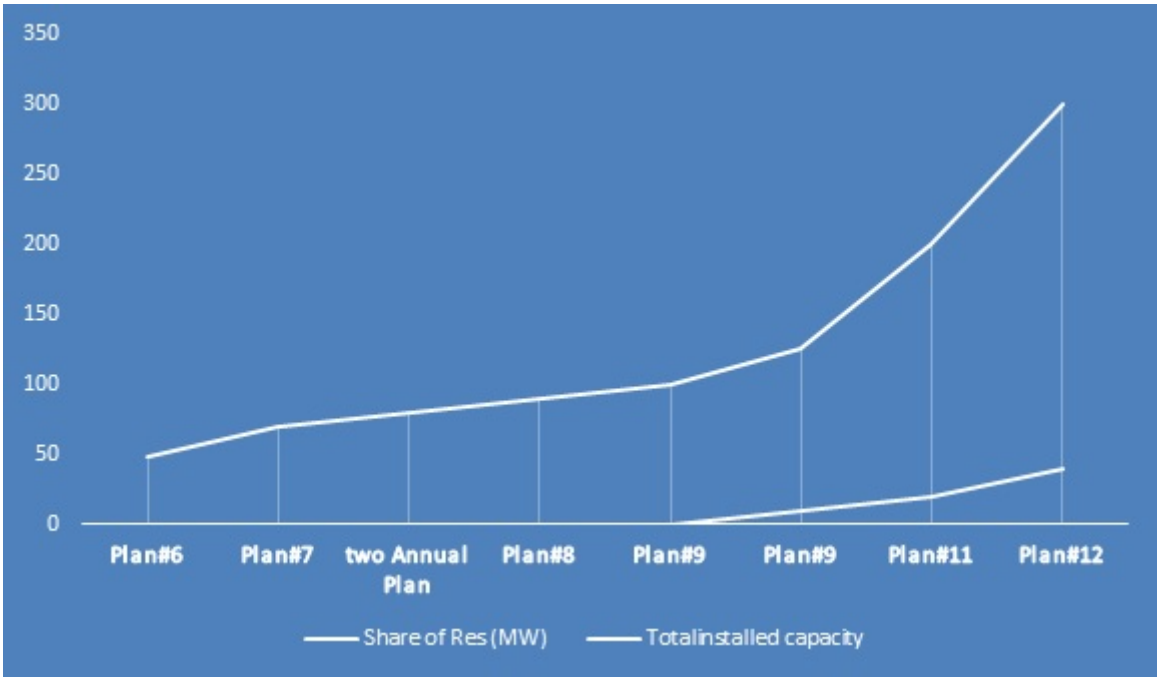

Figure 3: Total installed capacity growth & RES growth during different Plans

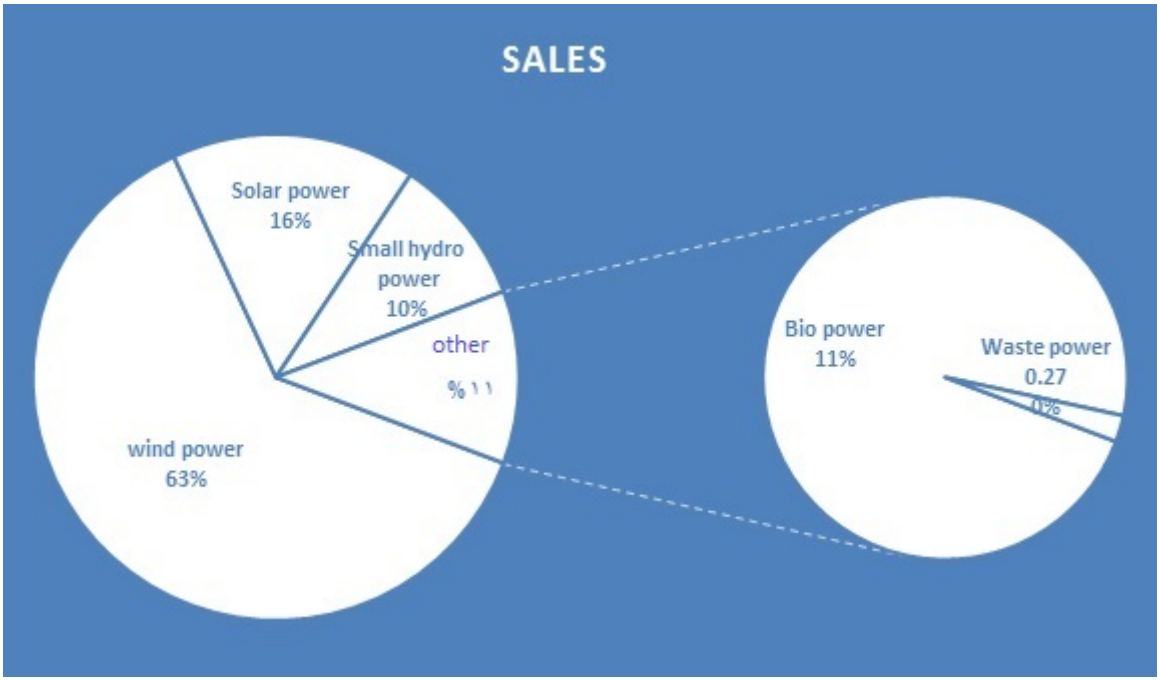

Figure 4: Pictorial representation of India's RES installed capacity

5. Conclusion and Future Work

Challenges of integration of SPV based distributed power generation to the main grid are analyzed & presented in this paper. Power loss reductions & voltage profile improvement are achieved during while integration of SPV based distributed power generation to the main grid. When clouds are passes over the SPV plants, power fluctuation occurs. A study of power fluctuation due to cloud passing over the SPV plant is also presented. In the proposed study, a comparison of single power

plant & differently geographically located SPV of the same capacity in total is presented. It is found that power fluctuation of the combined geographically distributed SPV plants is quite less as compared to the single located power plant. It is concluded that small size SPV plants at different location are much better than a large size power plant. In the future, transmission losses may also be considered for a more rigorous analysis. The analyses can also be included strengthening through considering the plants which are at extreme distance and at close proximity.

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