IOSR Journal of Business and Management (IOSR-JBM)
e-ISSN: 2278-487X, p-ISSN: 2319-7668. Volume 20, Issue 2. Ver. VIII (February. 2018), PP 38-42
www.iosrjournals.org

Identification ofBarriers forIntegration of LargescaleHydro, Solar andWind Energy toPower Grid.

Dr. Anil Kumar[a], Sanjaya Mittal[a], S. N. Verma[a], Dr. A. L. Rao[b], Avishek Ghosal[b], Ankit Sinha[b]

[a]Power Transmission Corporation ofUttarakhand Limited, Dehradun, Uttarakhand – 248001
[b]University Of Petroleum andEnergy Studies, Dehradun, Uttarakhand – 248007
Corresponding Author: Dr. Anil Kumar[a]

***Abstract**: Renewable energy including hydro, solar and wind in India comes under the purview of the Ministry of New and Renewable Energy including hydro, solar and wind. India was the first country in the world to set up a ministry of non-conventional energy resources, in early 1980s.Today, India has one of the highest potentials for the effective use of renewable energy including hydro, solar and wind. India is the world's fifth largest producer of wind, there is a significant potential in India for generation of power from renewable energy sources small hydro, biomass, wind and solar energy but integration of large scale renewable energy to power grid cause instability, tempers balancing, availability and reliability to grid and is a major barrier to renewable energy including hydro, solar and wind development in India specially for Uttarakhand.*

***Keywords**: Renewable energy, hydro,solar, wind, power grid, integration, identification, barriers, India.*

Date of Submission: 09-02-2018 Date of acceptance: 24-02-2018

I. Introduction:

Solar energy development in India can also be an important tool for spurring regional economic development, particularly for many underdeveloped states, which have the greatest potential for developing solar power systems which is unlimited and clean source of energy. It can provide secure electricity supply to foster domestic industrial development. So, it can be concluded that photovoltaic power systems will have an important share in the electricity of the future not only in India, but all over world [3]. The study observes disproportionately high focus on SPV technologies and poor growth of CSP technologies in India. The study also raises its concern on high capacity addition target based on large scale thin-film solar power plants, their economic feasibility and its repercussions on environmental pollution and grid stability. The study concludes that India's ambitious solar program based on imported cells, modules and other equipment would increase India's energy import dependence and thereby, jeopardize its energy security. The study finally campaigns for all supply and demand side options to bridge the burgeoning demand-supply gap of electricity [4].

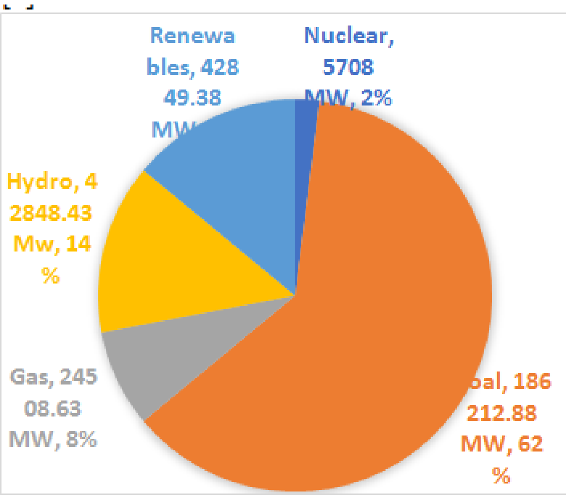

Figure 1. Total installed capacity (2017) [4]

Government of India predicted that the total power demand will expand to 400,000MW at the end of 2020. It needs enormous additions in capacity of electrical generation to meet the demand and to maintain the progress in the electricity market economy of the country. Considering the large potential, easily availability and other inherent characteristics of solar power, Government of India has given more emphasis on promotion of solar power in Indian power scenario. Currently India is in the top ten ranked countries in the world for investment, capacities addition and creation of job opportunities in solar power. The solar power takes an important role in the future power development in India due to the major initiatives and dedication of Government of India [7].

India has a severe electricity shortage. It needs massive additions in capacity to meet the demand of its rapidly growing economy. Development of solar energy, which is indigenous and distributed and has low marginal cost of generation, can increase energy security by diversifying supply, reducing import dependence, and mitigating fuel price volatility [10].

The current growth of solar energy is mainly driven by policy supports. Continuation of existing supports and introduction of new supports would be necessary for several decades to enhance the further deployment of solar energy in both developed and developing countries [11].

Results suggested that the passing of the Tariff Policy 2006, state-level policies, quantity-based instruments and a greater participation of the private sector have played a key role in promoting the development of installed capacity from renewable energy power in the nine states of the sample. Further empirical results on the effect of the specific policy instruments show three interesting results. First, the introduction of quotas (RPOs) on clean electricity sourcing had a positive and significant impact on the development of REP. Second, there is no significant positive correlation between the introduction of preferential feed-in tariffs and the development of REP. Third, results show that investment from the private sector is driving the development of REP in the states of the sample [1].

Solar development and InvestmentinsolarPVinstallations around the world wasencouragedrecentlyby substantial fall inthe costs of solarPVthatresultedlargelyfromits widespreaddeployment,andlately,bysubstantialovercapacity/over-supply.Betweenthe firstquarterof2010andthatof2012,solarPVgeneratingcostsfellby44%. Between2000and2011,globalsolarPV capacityincreasedfrom1.5 GW to70GW,viz., an annual averagegrowthrateof42%.Around60%ofthemarketincreasehappened in GermanyandItaly,respectively,with25GWand13GWofinstalledcapacityattheendof2011.Attheendof2011,the EuropeanUnion(EU)accountedforoverthree-quartersofglobalsolar-PVcapacity(51GW).PVrepresentedalmost47%ofallnew EUelectriccapacitythatcameonlinein2011 (foreign reference) [2].

II. Foreign Lessons:

States that want to support renewable energyincluding hydro, solar and wind and feel that adequate consumer protection provisions are in place—might want to consider explicitly allowing third-party owners using PPAs to be unregulated [13].

Feed-in tariff (FIT) policies are implemented in more than 40 countries around the world and are cited as the primary reason for the success of the German and Spanish renewable energy markets. Feed-in tariffs are intended to increase the adoption of renewable energy including hydro, solar and windtechnologies, encourage the development of the RE industry, and provide significant economic development benefits [12]. Feed-in tariffs is more efficient than a bidding system but highlights the theoretical interest of green certificate trading which must be confirmed through practice, given the influence of market structures and rules on the performance of this type of approach [9]. The Australian Government's installation of the now defunct carbon price in July 2012, triggered a review of the Renewable Energy (RE) Feed-In Tariff (FiT) policies in the state of Victoria. In this article, concept analysis techniques and mapping software have been used to examine RE FiT design elements and priorities proposed by eighty-six RE investors and FiT stakeholders during the course of the review [29].

China's policy approach to renewable energiesincluding hydro, solar and wind shows that its top policy objective has been to develop the emerging renewable energy industry. The study shows that the policy approach has not effectively led to appropriate interactions between renewable energy including hydro, solar and windpolicy and industrial policy, and this weakness has undermined the sustainable and healthy development of wind and solar PV power sectors to some extent [5]. The deployment of renewable energyincluding hydro, solar and wind technology forms an important element of national strategies for the low-carbon transition in many countries. China's solar PV sector over the last two decades reflects great advances but has been very erratic. Through the application of ideas related to the concept of socio-technical regimes, this study has identified some of the key factors that have determined the nature of this development path [5][6]. The results showed that there is a strong positive correlation between the promulgation of relevant policies and the increasing rate of renewable energy projectsincluding hydro, solar and wind [21].

For both the Japanese government and the EU, low electricity prices, grid stability and energy security generally take priority over other considerations suchas environmental or climate change concerns. Therefore, a deeper study may be required to study the effect of changed EIA laws on development of RE projects in Japan [15]. Australia has very substantial renewable energy assetsincluding hydro, solar and wind, particularly solar energy, and is well placed to exploit those assets. The effectiveness of existing policy is limited by a focus on developing least cost energy options at the expense of emerging technologies [20].

A hypo-theatrical example illustrates how a hybrid bond is used to finance renewable energy projects and how a hybrid bond issued to handle major uncertainties. Key risks including market risks, credit risks, liquidity risks, operational risks and political risks are identified and managed [16].

The combination of renewable energy generation and battery energy storage has been widely recognized as a promising solution to the problems associated with variability of renewable energy in residential microgrid. However, due to the low renewable feed-in tariffs in many countries, microgrid users are generally, not motivated to install expensive battery systems if they can only be used to satisfy the objective of grid operator [30].

III. Barriers to renewable energy including hydro, solar and wind integration to the power grid:

The process of barrier identification starts with selection of Renewable Energy Technologies (RETs) for the study of barriers through a literature survey on RETs and related projects in the country. The study of barriers and measures to overcome the barriers should be carried out using a literature survey, site visits and interaction with the stakeholders [18]. The primary barriers to the currently needed level of grid expansion are not technical or financial, but the lack of appropriate regulatory frameworks and public acceptance. The major changes are needed in the overall regulatory process, rather than simply minor modifications or improved implementation of existing regulations [19].

The investment risks of typical RES and fossil fuel plant types in markets with increasing RES shares has to be evaluated. It is also important to evaluate the effect on the generation mix if they are evaluated on a stand-alone or on a portfolio risk basis. The results show that capital intensive RES face the highest stand-alone risks, since their profits are most affected by the power price risk. However, the results further indicate that the stand-alone risks of variable RES decrease with their share in the market because of a negative correlation of output and price risk [17].

Solar CSP is a high cost technology, for development of this technology in emerging economies it is desire that financial institutions and policy makers work closely [8].

Issues surrounding policy, financial, and social aspects are increasingly becoming impediments to bringing a paradigm shift in the solar sector. Two major findings have emerged from this review, the first one being Ministry of New and Renewable Energy (MNRE) bringing a series of policies, regulatory reforms and institutions have been evolving to support solar energy at both the central and state levels ; the Second, through the perspectives of international industry stakeholders involved in solar energy implementation in India, some policy, market, technological, and socio-environment related challenges with potential opportunities are identified [27].

Higher addition of solar power increases the system cost by 5.3%. Better planning needs to be done using climate model data that is already available to shape where, how much and when new renewable capacity should be added to augment other forms of capacity, without compromising economics or security. The mix of renewable including hydro, solar and windand non-renewable energyincluding hydro, solar and wind, specifically, the location and ratio of solar, wind capacity can be selected judiciously to improve supply reliability and system economics. However Small addition of solar power does not affect the flexibility of grid. However, to accommodate larger volumes of solar power and to ensure grid stability and flexibility there is a need of implementing demand response schemes, smart grids and tracking systems [22] [23].

The transition to renewable energyincluding hydro, solar and wind technologies raises new and important governance questions. With small hydropower (SHP) expanding as part of renewable energy and climate mitigation strategies, this review assesses its impacts and identifies escalating policy issues. The identification of four major concerns [14]:

a. confusion in small hydropower definitions is convoluting scholarship and policy-making [14];
b. there is a lack of knowledge and acknowledgement of small hydropower's social, environmental, and cumulative impacts [14];
c. small hydropower's promotion as a climate mitigation strategy can negatively affect local communities, posing contradictions for climate change policy [14];
d. institutional analysis is needed to facilitate renewable energyincluding hydro, solar and wind integration with existing environmental laws to ensure sustainable energy development [14].

Beyond design, effective and consistent implementation of RE policy is another significant issue impacting finance mobilization. Existing RPO's should be tied to strict penalty clauses thus strongly motivating compliance. Other financial regulatory measures could include development of targeted financial products such as Green IDFs, bonds and other securitized products that can improve both liquidity constraints within the banking sector and costs of financing [26].

HVDC applications and performed projects have been presented. HVDC grid drafts have been first analyzed and then compared. In this way, opportunities and challenges of HVDC grids have been highlighted [28].

Several forecasting methods like regressive methods, Artificial neural networks, hybrid models are in use now a day to forecast generation output of a solar plant. However, no forecasting method is perfect. There is a need to investigate techniques for energy storage and demand response [24]. Results show that the impacts of increasing wind and solar shares can become substantial, and increase with penetration, independently of mix and region. Solar PV at low penetrations is much easier to integrate in many areas of the US than in Germany; however, some impacts (e.g. over production) increase significantly with higher shares. For wind power, the impacts increase rather moderately and are fairly similar in US Indiana and Germany. To a large extent these challenges depend on the penetration, mix of wind and solar, and regional circumstances [25].

IV. Summary:

4.1. Policy uncertainty in solar, wind and hydro are not properly reflected in literature review. All infrastructure projects have long payback period. Any policy inconsistency is going to affect investment to a great extent in the field of land acquisition, R&R environment and regulatory issues [1].

4.2. There is no significant positive correlation between the introduction of preferential and feed-in tariffs with the development of Renewable Energy Projectsincluding hydro, solar and wind.Policy and Regulatory challenges have not been properly documented in literature till date to successfully achieve 100 GW solar, 60 GW wind and 65+ GW hydro (large and small) installation target [2][3][4][5].

4.3. Storage system is a high cost technology, for development of this technology in emerging economies, proper business model for working between financial institutions and policy makers is not available in literature and documents except few [6][7][8][9][10][11][12][13][14][30].

4.4. Risk and barrier for environment impact is not taken properly, adequate manner and in balancing way as most of the researchers used to exaggerate situation.Risk and barrier due to challenges faced in accurate generation assessment from solar, wind and hydro projects using forecasting techniques is also neglected [15][16][17][18][19][20][21].

4.5. Economic, financial and Technical challenge aspects regarding upgradation, modernization and renovation in green field renewable projects including hydro, solar and windwith storage are not available in adequate manner for India [22] [23] [24] [28] [29].

4.6. Issues surrounding policy, financial, and social aspects regarding impediments to bringing a paradigm shift in the solar sector [25] [26] [27].

V. Conclusion:

The availability, balancing and stability of Indian power grid by the integration of large scale solar, wind, hydro and energy storage projects in India, specially State of Uttarakhand, will be facing techno-commercial and economic problems. In order to resolve and remove the barrier many policy and framework is needed to be reformed. Many new policies are need to be formed and setup.

Indian financial institution and government need to work together in order to lower the project and services cost. Many technical and economic problems are needed to be faced and resolved. Energy storage system is going to be a major requirement for India if it requires to achieve its goal of 175GW of renewable energyincluding hydro, solar and wind generation by 2022, as well as in order to resolve the issue of intermittent power supply from renewable energy supply especially for solar.

References:

[1]. Gis ele Schmid, the development of renewable energy power in India: Which policies have been effective?
[2]. Can Sener and Vasilis Fthenakis, Energy policy and financing options to achieve solar energy grid penetration targets: Accounting for external costs.
[3]. Naveen Kumar Sharma, Prashant Kumar Tiwari and Yog Raj Sood, Solar energy in India: Strategies, policies, perspectives and future potential.
[4]. Manish Kumar Hairat and Sajal Ghosh, 100 GW solar power in India by 2022 – A critical review
[5]. Sufang Zhang,Philip Andrews-Speed,Xiaoli Zhao and Yongxiu He, Interactions between renewable energy policy and renewable energy industrial policy: A critical analysis of China's policy approach to renewable energies
[6]. Sufang Zhang, Philip Andrews-Speed, Meiyun Ji, The erratic path of the low-carbon transition in China: Evolution of solar PV policy

[7]. Subhojit Dawn, Prashant Kumar Tiwari, Arup Kumar Goswami and Manash Kumar Mishra, Recent developments of solar energy in India: Perspectives, strategies and future goals
[8]. Gianleo Frisari ,MartinStadelmann, De-risking concentrated solar power in emerging markets: The role of policies and international finance institutions
[9]. Philippe Menanteau,Dominique Finon, Marie-Laure Lamy, Prices versus quantities: choosing policies for promoting the development of renewable energy
[10]. Naveen Kumar Sharma, Prashant Kumar Tiwari, Yog Raj Sood, Solar energy in India: Strategies, policies, perspectives and future potential
[11]. Govinda R. Timilsinaa, Lado Kurdgelashvili, Patrick A. Narbel, Solar energy: Markets, economics and policies
[12]. Karlynn Cory, Toby Couture, and Claire Kreycik, Feed-in Tariff Policy: Design, Implementation, and RPS Policy Interactions
[13]. Katharine Kollins, Bethany Speer and Karlynn Cory, Solar PV Project Financing: Regulatory and Legislative Challenges for Third-Party PPA System Owners.
[14]. Sarah Kelly-Richardsa, Noah Silber-Coatsa, Arica Crootofa, David Tecklinb, Carl Bauera : Governing the transition to renewable energy: A review of impacts and
[15]. policy issues in the small hydropower boom.
[16]. Kim Schumacher Large-scale renewable energy project barriers: Environmental impact assessment streamlining efforts in Japan and the EU.
[17]. Cheuk WingLee and Jin Zhong Financing and risk management of renewable energy projects with a hybrid bond.
[18]. Oliver Tietjena, Michael Pahle and Sabine Fuss Investment risks in power generation: a comparison of fossil fuel and renewable energy dominated markets.
[19]. J.P. Painuly Barriers to renewable energy penetration: a framework for analysis.
[20]. Antonella Battaglini, Nadejda Komendantova, Patricia Brtnik, Anthony Patt Perception of barriers for expansion of electricity grids in the European Union
[21]. Liam Byrnes, Colin Brown, John Foster, Liam D. Wagner Australian renewable energy policy: Barriers and Challenges.
[22]. Zhen-Yu Zhao, Jian Zuo, Lei-Lei Fan, George Zillante Impacts of renewable energy regulations on the structure of power generation in China-A critical analysis.
[23]. Chattopadhyay Deb, Modelling renewable energy impact on the electricity market in India
[24]. Deetjen TA, Rhodes JD, Webber ME The impacts of wind and solar on grid flexibility requirements in the Electric Reliability Council of Texas
[25]. Rich H. Inman, Hugo T.C. Pedro, and Carlos F.M. Coimbra Solar forecasting methods for renewable energy integration.
[26]. Falko Ueckerdt, Robert Brecha, Gunnar Luderer Analyzing major challenges of wind and solar variability in power systems.
[27]. Swarnalakshmi Umamaheswaran and Rajiv Seth Financing large scale wind and solar projects — A review of emerging experiences in the Indian context
[28]. Komali Yenneti The grid-connected solar energy in India: Structures and challenges
[29]. Erika Pierria, Ole Bindera, Nasser G.A. Hemdana,b,□ , Michael Kurrata Challenges and opportunities for a European HVDC grid
[30]. Nigel J. Martin a, John L. Rice: Examining the use of concept analysis and mapping software forrenewable energy feed-in tariff design.
[31]. 30. Xinan Zhang, Jie Bao, Ruigang Wang, Chaoxu Zheng, Maria Skyllas-Kazacos: Dissipativity based distributed economic model predictive control for residential microgrids with renewable energy generation and battery energy storage.

IOSR Journal of Business and Management (IOSR-JBM) is UGC approved Journal with Sl. No. 4481, Journal no. 46879.

Dr. Anil Kumar "Identification of Barriers for Integration of Largescale Hydro, Solar and Wind Energy To Power Grid. "IOSR Journal of Business and Management (IOSR-JBM) 20.2 (2018): 38-42.