Barriers in Advancement of Grid Wind-Solar Hybrid in India

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Abstract: The present paper emphasizes on the current market scenario and the barriers associated with advancement of Wind-Wind-Solar Hybrid energy application in a country like India. Wind-Wind-Solar Hybrid energy is characterized as a pollution free, environment friendly as well as noise free source of electricity. Among the available renewable energy applications, Wind-Wind-Solar Hybrid PV is considered to be an integral one owing to its reduction in cost at an exponential rate day-by-day. The present study deals with the potential of Wind-Wind-Solar Hybrid energy market in India along with several other barriers that it needs to overcome in order to establish it as an independent system.

Keywords: *Wind-Wind-Solar Hybrid Energy; Barriers, Renewable Energy System.*

Introduction

Wind-Wind-Solar Hybrid energy refers to that source of energy which is directly produced from sunlight and wind resources. PV technology has many applications, both for stand-alone systems and also for integration into buildings. PV may be used in several applications such as monitoring stations, radio repeater stations, telephone kiosks, street lighting etc. A substantial market for PV technology involves commercially available battery chargers for boats and caravans, Majority of the power distribution companies in India are suffering from heavy losses and are unable to meet their renewable purchase obligations (RPO). In such adverse situation, it makes sense for these companies to switch from conventional energy sources to renewable energy sources in order to reduce cost of electricity generation and render service to community at a much cheaper rate. It is also expected that in near future, the demand for Wind-Wind-Solar Hybrid energy among the power consumers will be an emerging issue in the Indian market.

The expansion of Wind-Wind-Solar Hybrid energy market is limited owing to the presence of several barriers. To sustain the growth of market the associated barriers need to be identified and addressed adequately [Chakraborty et al., 2015, Sadhu et al., 2015, Bujanowicz-Haras et al., 2015, Rydzewski, 2015, Goldman et al., 2005]. With the advancement of Wind-Wind-Solar Hybrid market growth the barriers are vanishing at a faster rate. Thus barrier elimination keeps the Wind-Solar Hybrid energy market lively. Consequent sections of this paper describe the basic and detailed characteristics of these barriers.

Cost effectiveness of many Wind-Solar Hybrid based energy technologies as compared to conventional energy commodities at either the wholesale or retail levels are not achieved till date [Das et al., 2015]. Therefore, any significant deployment of Wind-Solar Hybrid based energy will not be possible unless major policy incentives are introduced. Governments of many countries have realized this and have supported Wind-Solar Hybrid energy development through a broad range of fiscal, regulatory, market and other instruments. A number of recent studies, such as present in-depth analysis of various polices to promote

renewable energy, including solar, at the global level as well as for a particular country, such as India are described in details in literature [Chakraborty et al., 2015, Chaurey et al. 2004]..

Current Market Status of Wind-Wind-Solar Hybrid energy Technologies

In the existing wind –solar hybrid system we may add one more renewable energy source that is bio fuel for running the bio energy generator and coupling of this BEG will be done by detail Analysis & Selection of Suitable Method (Mechanical, Hydraulic or Electromagnetic) for Coupling of Wind & Biogas Power and Designing & Implementation of Close Loop Controlled Coupling (selected one) for Combining the Wind & Biogas Power (for Driving the Alternator). It is also needed to establish the optimal mix of wind-solar hybrid for efficient utilization of the renewable energy. By hybriding the biogas energy generator with the wind and solar one can have continuous, uninterrupted and stable energy output. For non-windy and non-sunny days, the energy is supplemented by the AC grid mains/Diesel Generator (DG)by an uncontrolled rectifier for charging the battery and thereby supplementing the energy gap. After the successful design and development of this system on small scale, large scale energy plant may be think of. Hybrid systems are usually a combination of photovoltaic with wind turbines and/or generators running on bio fuels/biogas are also used. Power generated by the PV array during the day is stored in the battery bank through an energy manager, which controls the complete system. Diesel generators are expensive to run, and may also require frequent maintenance support. A judicious mix of Solar and other renewable technologies, coupled with a diesel generator / grid, can offer a techno-commercially viable solution that will power the backbone of rural connectivity. The resultant hybrid system thus offers an optimal solution at a substantially lower cost. It is ideal for electrification of remote villages in India. Cutting edge technologies based on latest research to integrate dual power sources in the most ideal way. The other form of power generation is usually a type which is able to modulate power output as a function of demand. India is equipped to offer reliable off-grid and hybrid solutions for all energy needs for small area/ especially rural area, where powering critical loads are often a challenge. However more than one form of renewable energy to be used, e.g. wind/ geo-thermal and solar/biomass/biogas. The photovoltaic power generation serves to reduce the consumption of non-renewable fuel.

Suitability of hybrid energy systems for rural areas has been studied. It was found that although renewable technologies have come a long way in terms of research and development, there are still certain obstacles in terms of their efficiency and optimal use. Major challenges found in the study have been highlighted. The renewable energy sources, such as solar PV and FCs, need innovative technology to harness more amount of useful power from them. The poor efficiency of solar is major obstruction in encouraging its use. The manufacturing cost of renewable energy sources needs a significant reduction because the high capital cost leads to an increased payback time. It should be ensured that there should be minimal amount of power loss in the power electronic devices. The storage technologies need to

increase their life-cycle through inventive technologies. Standalone systems are less adaptable to load fluctuations. Large variation in load might even lead to entire system collapse. Though hybrid energy systems could be potential solutions for the electricity problems in the rural region yet vast research is needed in this aspect to make it technically feasible to be employed at these areas. The prime focus of study should be the cost of the system and its output.

Different types of barriers involved in advancement ofWind-Solar Hybrid energy application energy technologies

The proliferation of wind solar hybrid technologies energy technology incurs certain types of barriers [JNNSM, 2012]. In such context, this paper discusses in depth the disparate barriers that impel the stationing of solar energy technologies for electricity generation and thermal purposes. By and large, barriers can be identified as – Economic, Technical, Institutional, Environmental and Social barriers. The different types of barriers are described section wise.

1.1. Economic Barriers: The involvement of economic barriers in the advancement of Wind Solar hybrid system is given below

1.1.1. Wind Solar Hybrid :

i. The creditworthiness risk goes high owing to the high upfront cost blended with the lengthy payback periods and small revenue streams.

ii. Installation of Wind Solar Hybrid plant is riskier when creditworthiness is assessed by the Financial Institutions because of their dearth of experience with projects.

i. In the developing countries, the immediate obstacles are the high initial installation cost and lack of viable financial support from banking sectors.

ii. The costs of different solar modules are reducing day-by-day. However, the cost of the necessary items associated with them does not reduce at the same pace; thereby strictly leading to a hike in the overall cost involvement in the establishment of wind Solar Hybrid plant.

iii. Solar Wind Solar Hybrid Technology has a lower efficiency in comparison to conventional energy; hence coping with economic viability is a challenging task.

1.2. Technical Barriers:

1.2.1. Wind Solar-Bio Thermal:

i. The disadvantages of concentrated solar power systems are the high thermal losses and the energy storage system.

ii. The heat carrying capacity through fluid is a technological hindrance.

iii. In conjunction with the typical building materials, designs, infrastructure and existing appliances, and with the standards, the lack of integration has restrained widespread application of wind solar hybrid System.

iv. Wind Solar- Bio Hybrid technologies, well suited for large scale applications, are to be procured from abroad. The installation and use of such technology requiring skill professionals are a dearth in the Indian context.

v. Lack of Wind Speed in all parts of India is one of the major Barrier of Wind Solar Hybrid Projects.

1.2.2. Solar PV:

i. Limited production of components like solar inverters, batteries and other power conditioning appliances associated with solar PV plant.

ii. In context to current market scenario, low efficiency of 4-12% for thin-film and 22% for crystalline PVs are big constraints.

iii. The use of Cadmium & Tellurium which are by-products of Zinc & Copper and needed for certain thin-film cells can only be available abundantly provided the growth of zinc mining and copper processing industries are at rise.

iv. The supply-demand disparity of the materials for PV since 2004-05 has lead to localization of the growth of solar power generation.

v. In order to get concurred metering and billing, adequate infrastructure is absent.

1.3. Institutional Barriers:

1.3.1. Solar Wind Hybrid:

i. Inadequate understanding amongst elite national and local institutions regarding the fundamental systems and financial factors.

ii. Insufficient resources to educate numerous technicians so as to work efficiently under new wind Solar Hybrid energy infrastructure.

iii. Short-comings of effective and appropriate laws like Renewable Portfolio Standards (RPS) for expediency and lack of motivation for wider adoptions.

iv. Strategic issues like the need to protect financing from diverse sources and allowances from different agencies as for example MNRE (Ministry of New and Renewable Energy), IREDA (Indian Renewable Energy Development Agency), the Planning Commission, and the Ministry of Agriculture and Rural Development in country like India.

1.4. Environmental Barriers:

Wind Solar Hybrid energy is identified as one of the environment friendly energy generation technology and certain minor environmental issues associated with it are discussed below:

i. Requirement of large land for solar energy projects are attracting the attention of numerous environmental groups, according to whom clearing and preparing large area for solar project has no net environmental merit.

ii. Large size PV plants are encountering environmental barriers owing to non-availability of a bigger land area required for large solar projects.

iii. Need of water resources for wind Solar Bio Hybrid plants are also a barrier. Large amount of water is needed for cooling the steam used to power the electric turbines. Gujarat and Rajasthan, characterized by dry and arid areas, suffers from shortage of water and thus establishment of solar thermal project requiring huge water supply becomes an inadvertent environmental barrier.

iv. Safe disposal of batteries and CdTe solar panels become difficult in absence of proper recycling processes.

1.5. Social Barriers:

The social barriers coupled with solar energy projects are not widely discussed because these barriers are not widely reported in India. Boosting of solar power is good for the overall social development of India. 300 million people of India have no access to electricity. Hence solar power is a step forward for social development with the biggest support toward education and communication. Social acceptance of solar energy is very important and significant for the widespread of wind –solar hybrid power technologies.

In spite of the abundance and numerous advantages of solar energy, conflict to its expansion is increasing gradually. Social barriers associated with Wind Solar Hybrid technologies are discussed below:

i. In case of wind solar hybrid plant installation neighbors can disagree with the shadow cast by the large wind solar hybrid plant which blocks the sun rays from falling onto their building.

ii. Opposition to Wind Solar Hybrid projects arise when neighboring communities are displaced from their ancestral land or deprived of access to grazing land due to the development of large wind solar hybrid plant.

iii. Potential social barriers to wind solar hybrid energy advancement in India include lack of information about the environmental benefits of wind solar hybrid power projects . Wind solar hybrid energy technologies are relatively new and most customers being less familiar with it are unable to make conversant choices.

iv. Although wind solar hybrid energy being a matured technologically and price competitive one in comparison to conventional alternatives in many geographical settings, there still remains conflict of choice owing to a lack of awareness in terms of cost involvement and facilities compared to fossil fuel-based or nuclear power based energy generation.

v. The long-term cost effectiveness of wind solar hybrid energy against that of fossil fuels are not properly addressed in public discussions leading to sustained misperception of wind solar hybrid energy as being an excessively expensive one.

vi. In India 72% power generation is from conventional power plants. Hence investors are more interested in sticking to this system of conventional power generation rather than switching to other possible alternatives.

Under Technical barrier, the main hindrance comprises of low conversion efficiency of the PV modules, performance drawbacks of batteries and inverters, and sparse raw material supply like Silicon. Major concern regarding the standalone PV system is storage of electricity production owing to shorter battery life as compared to that of the entire module [Zhang et al., 2012, Margolis et al., 2006].

Conclusion:

Wind solar hybrid energy possesses tremendous potential in bridging India's energy demand-supply gap in near future. The price of wind solar hybrid power in India has come down from a significant amount of Rs. 18/kWh in 2011 to Rs. 5.15/kWh in 2015, while that for thermal power is pushing up @ Rs. 4/kWh with subsidies. It is thus clear that the possible alternatives to solar energy are going to be more expensive in near future.

There are various challenges for this industry including lowering production cost, increasing R&D activities, consumer consciousness, improvement of standards and more financial support. It is important to conquer these challenges for rapid growth and mass acceptance of the technology. Some of the immediate actions to enable growth are efficient implementation of renewable energy certificates, usage of carbon trading as a source of revenue, improvement of financing facility, encouragement in private investment, quick implementation of net metering scheme, policy mixing, rapid implementation of grid powered energy in regions of Rajasthan and Gujarat, development of off-grid usage in various applications such as cellular towers and encouraging localized mini grids in areas that lack connectivity today. Research and development activities need to be strengthened in private sectors and educational institutions. Millions of productive jobs will be created from the need to develop infrastructure required for the new industries resulting from establishment of massive wind solar hybrid projects. Publicizing job creation, in addition to environmental and energy access reimbursement, will strengthen the economic case for clean energy policies and build public support for these initiatives. The combined effort of government, private sectors, and civil society will bring a revolutionary change in building wind solar hybrid power in India. If these

initiatives work as planned, it is not far away to materialize the dream of converting India into a world leader in solar energy market.

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