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AIUB Journal of Business and Economics

The article is an extended version of the paper presented in the 1st AIUB International Conference on Business and Management.

Volume: 16 Issue Number: 1 ISSN (Online): 2706-7076

December 2019

Citation

Khan, T., and Khanam, S.N. (2019). Exploring the Renewable Energy Interventions Across the Globe: The Prospect & Progress of Solar Energy Ventures. *AIUB Journal of Business and Economics*, 16 (1), 57-69.

AIUB Journal of Business and Economics

Volume 16, Issue 1

ISSN (PRINT) 1683-8742

ISSN (ONLINE) 2706-7076

December 2019 pp. 57-69

Exploring the Renewable Energy Interventions Across the Globe: The Prospect & Progress of Solar Energy Ventures

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Abstract

This qualitative study aims to explore the emergent renewable energy interventions across the globe from the perspective of recent solar energy applications to improve electrification scenario. Due to an ever-increasing demand for clean energy, rapid growth in the utilization of naturally available solar energy has been evident. Realizing the environmental implications and socio-economic development opportunities brought in by the growing adoption of renewables to meet the escalating electricity demand around the world, this study reviews and analyze the prevailing literature on solar electrification projects in selected developed and developing nations. To support this proposition, this article essentially consolidates the scholarly works and pertinent insights highlighting the progress and scope of solar energy programs in American, African, Asian and European nations to improve the electrification status and upgrade energy security. With this backdrop, this paper further highlights the current global trend on solar technology adoption to address energy efficiency and access to electricity for all, particularly to the underserved and underprivileged population.

Keywords: Renewable Energy, Solar Energy, Solar Electrification, Renewable Energy Investments.

1. Introduction

1.1. Background

Energy is the building block of modern civilization and a prerequisite for sustainable development. Yet, at present, 1.317 billion people across the globe do not get access to electricity and majority of them live in the rural areas of Asia and Africa (Azimoh et al., 2016). To meet the electricity requirements across the globe, Renewable Energy (RE) sources such as solar energy technology have received major importance due to their social acceptance as well as an ability to provide sustainable energy generation (Khan and Arsalan, 2016). Renewable energy is generally defined as those that are abundant in nature and derived from a natural process with no depletion in the course of utilization, such as sunlight, wind, rain, tides, waves, and geothermal heat (IEA, 2017).

The importance of renewable energy technologies (RET), particularly the solar photovoltaics (PV) applications in bringing about both direct and indirect socio-economic and environmental benefits for the people across the globe, have been well documented (Onasanya, 2017; Hossain et al., 2017; Mishra and Behera, 2016; Fahmi et al., 2014; Kawep, 2013). More than 170 countries have renewable energy targets, and an estimated 150 countries have policies that support renewable energy (IRENA, 2018). According to the United Nations Environment Programme, in 2018, investment in Renewable Energy (RE) reached the amount of 288.9 billion, far exceeding the fossil fuel investment. In the last decade, there has been a major uptake in various forms of renewable energy, beyond the proof of concept stage, to mainstream use as a commercial alternative to fossil-fuel based energy generation (UNEP, 2016). During this period:

- New investments in renewable energy with an 18% increase between 2004 and 2015; with a higher share for developing countries
- Total transaction value related to renewable energy assets grew by
- Renewable energy provided an estimated 19.2% of global electricity consumption

The significant development opportunities offered by solar energy, however, have only become apparent in recent decades as the deployment of renewable energy technologies has become more widespread. Analyzing the

RE at the individual country and regional level, no recent study exists at the global level for cross-learning by the countries. This paper aims to make an appraisal on available literature on the status of solar energy interventions in the selected nations from Africa, America, Europe and Asian regions where RE has been relatively significant.

2. Methodology

This descriptive study aimed to make an appraisal on the prevailing literature on RE interventions, particularly solar PV technology in various nations from Africa, America, Asia and Europe. The study reviews current solar energy programs in relation to prior scholarship by finding, evaluating, and synthesizing the contents of many empirical and conceptual papers. The pertinent studies were analyzed based on the research concentration and subsequent findings. Both qualitative and quantitative shreds of evidence, scrutinized from these works of literature, had been reviewed in this study to encapsulate the progress and prospect of solar energy ventures in developed and developing nations.

3. Solar Energy Interventions Across the Globe

3.1. American Nations

As a developed nation, America has a greater potential in solar energy and there has been a rising trend in adopting RET across the country. Based on renewable energy technical potential reported by the National Renewable Energy Laboratory (NREL, 2017), in the last couple of years, the amount of solar photovoltaic (PV) capacity in the United States has experienced rapid growth that can power more than 3.2 million homes. From November 2012 to November 2014, the solar industry has experienced growth that was 10 times faster than the national average for employment, and around 140,000 Americans have been working in the solar energy industry in the recent years and this number is continuing to rise every year.

In Latin America, Chile has grown into the region's leading solar market. It has constructed 400 megawatts (MW) of solar PV generation, more than any other nation in the region. To further accelerate the solar projects forward, comparing to most of the Latin American nations, the country offered a higher degree of financial security for solar electrification projects along with a flexible regulatory environment (Escobar et al., 2014). As a potential

poverty eradication and climate change strategy, Yadoo and Cruickshank (2012) studied the merits and demerits of using RET for rural electrification Peru. The authors opined that given a reliable fuel source, renewable energy mini-grids considered to be the preferred option due to their less operational costs, potential to provide stable service and ability to host larger capacity systems that permits a wide range of electricity uses. Given a reliable fuel source, renewable energy mini-grids considered to be the preferred option due to their less operational costs, potential to provide stable service and ability to host larger capacity systems that permits a wide range of electricity uses. These studies suggested necessary initiatives to raise awareness about renewable energy, improve institutional, technical and regulatory frameworks and develop innovative financing mechanisms to encourage private sector involvements in RE.

3.2. African Nations

About 90% of the rural population in Sub-Saharan Africa has no access to electricity (IRENA, 2017). Nevertheless, with enriched renewable resources, Africa has the potential to benefit from the growing use of renewable energy. Based on research findings from remote off-grid rural communities in Cameroon and in other nations (Kenya, Tanzania, Ethiopia,) the authors, summarized that, to improve the living condition, the rural communities prefers solar mini-grids that provide needed electricity supply and make such solar energy ventures commercially viable (Kawep, 2013; Myers, 2013). Various African countries have undertaken appropriate initiatives to expand the usage of renewable energy sources. In this context, the governments of South Africa, Egypt, Ghana and Madagascar, respectively set targets of 13%, 20%, 10%, 75%, as the share of electricity generated from renewable sources by 2020 (IRENA, 2017). Policymakers, as well as researchers in this part of the world, opined that utilizing off-grid renewable energy sources in rural areas will contribute in improving access to basic energy services, enabling water pumping and irrigation activities (Azimoh et al., 2016).

The research study of Onasanya (2017) in rural Nigeria revealed that motivated by the need for a regular power supply, residential adopters install solar PVs to avail the household benefits from the system. The potential of solar electrification was also addressed by Myers (2013) to highlight the solar community initiatives in West African nations, Liberia and Ghana to solve the crisis of electrifying rural areas. Although the study focused on the

Nigerian situation, some of the findings can be drawn-out to other developing countries with similar challenges in the provision of energy services to the underserved communities.

3.3. European Union

In Europe, the considerable growth in solar PV electricity has been driven by rapid technological progress, reductions in cost and the comparatively shorter project development times (Klessmann, 2011). Sweden has the highest share of renewables at a considerable 53.9% of total power generation capacity. Next are the nations of Finland (39.3%), Latvia (37.6%), Austria (33.0%) and Denmark (30.8%) to adopt RET. The countries with the smallest share of renewables are Luxembourg and Malta (both 5%), the Netherlands (5.8%), Belgium (7.9%) and the United Kingdom (8.2%) as the former member of the region. To expedite the adoption of RET, the EU Member States have agreed on a new EU renewable energy target of at least 27% by 2030 (IRENA, 2017).

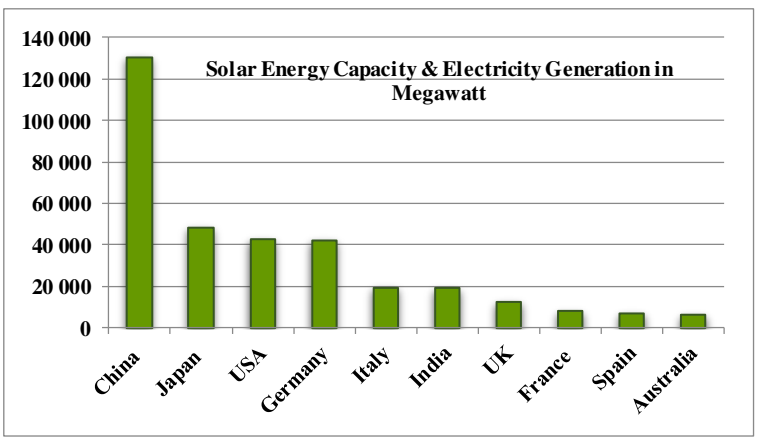

Figure 1: Top 10 nations in terms of RE capacity development (IRENA, 2018)

3.4. Asian Nations

The research by Fahmi et al. (2014) highlights the potential of a non-grid connected solar cabin to replace the current use of diesel generators and generate sufficient power supply to the farming villages in Malaysia. The study by Macabebe et al. (2016) stressed that SHS is convenient to be

distributed in the islands and in remote communities in the Philippines where the establishment of grid connectivity necessitates heavy financial involvement. Currently, Thailand has been recognized as a national leader in renewable energy development in ASEAN. Related studies (Iemsomboon and Tangtham, 2014) identified the need for policy development to educate the potential users on the fundamentals of RET and thus enhance long term growth of SHS ventures.

Currently, China is referred to as the world's leading investor in renewables. The study of Bo et al. (2015) in rural China analyzed the prospects in renewable energy usage. The author opined that solar thermal utilization is the primary way of solar energy applications, such as solar water heaters, solar houses and solar cookers. On the other hand, with 1.3 billion people, India is the world's third-largest consumer of electricity. By analyzing the renewable energy experiences in Odisha state of rural India, Mishra and Behera (2016) found that households' adoption of solar energy depends on a set of socio-economic, demographic and institutional dynamics. Ghosh (2015) opined that in order to cater the electricity demand of the poor and encourage rural entrepreneurship; India's energy policies should be revised to develop a portfolio of grid-connected and decentralized sources of renewable energy.

The dissemination process and use of Solar Home Systems (SHS) in Sri Lanka as a power generation and poverty reduction strategy have also received attention in academia. Laufer and Schafer (2011) affirmed that the introduction of solar energy technology in remote rural areas of Sri Lanka with the provision of microloans permits potential users to finance the installation of these systems. In Nepal, currently 40% of the population has access to electricity, and the rural electrification accounts for only 29% (Nepal, 2012). The residential sector has been the driving force behind the increasing adoption of PV technology in the country. However, the empirical evidence in the study by Surendra et al. (2011) suggested that despite a huge potential in harnessing various renewable energy resources such as hydropower, solar power, wind energy and biofuels/bioenergy, these resources have not been appropriately utilized due to geographical, technical, political and economic limitations.

From the context of solar energy programs in Bangladesh, there has been a growing local market penetration by the participating organizations supported by government interventions. With 4.13 million Solar Home Systems (SHS) installed under the national RE program, at present around

18 million people are getting solar electricity for domestic and commercial purposes (IDCOL, 2018). However, to sustain the benefits of solar electrification for the underprivileged communities in the upcoming years, SHS program in Bangladesh necessitate the government to address policy challenges and lift barriers to deployment (Hossain et al., 2017). This will contribute to a reliable electricity supply in the face of escalating energy demand and limited generation capacity from the conventional grid connectivity.

4. The Global Trend of Renewable Energy Adoptions: Emerging Utilization of Solar Energy

Globally renewable energy sector had experienced a momentous growth in the year 2016, mainly driven by thriving solar PV distribution in Asia, particularly in People's Republic of China and as well as in the other nations around the world. According to the "Renewables Analysis and Forecasts to 2022" report published by the International Energy Agency (IEA), around two-thirds of new net electricity capacity generations in 2016 has been derived from the renewable sources (IEA, 2017). This growth has been aided by a significant decline in cost and revising policy support in the renewables, increasing the employment opportunity in the sector.

About 115 million people worldwide currently rely on the basic energy services provided by solar lights, while another 25 million obtain a higher level of renewable energy services through solar home systems or connection to a solar mini-grid. In 2016, worldwide new solar PV capacity development had 50% growth, resulting in more than 74 GW. In this regard, China accounts for almost half of this development (IEA, 2017).

This progressive utilization of renewables is primarily driven by the ascending amendments for solar energy in Asia, specifically in China and India (Bo et al., 2015; Mishra and Behera, 2016). China plays an important role in developing the global market and pricing strategies for solar technology. At present, 60% of yearly global solar cell manufacturing capacity is retained by Chinese companies (IRENA, 2017). Thereby, renewables production and policy interventions in China have global consequences for the demand, supply and prices of solar energy technologies.

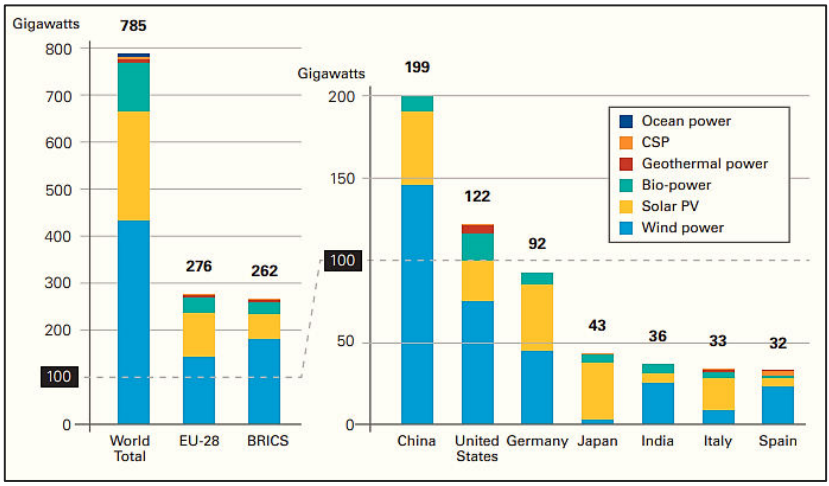

Figure 2: Renewable Power Capacities in World, EU 28, BRICS and Top 7 Countries

Source: 'Renewable 2016 Global Status Report'

5. Findings and Discussion

Almost all of the growth in the use of off-grid power has occurred in the last five years — has been largely driven by the increased availability and affordability of small solar devices, such as solar lights and lighting kits. These devices only provide lighting and low-power charging (e.g. for mobile phones) and do not provide a comprehensive range of energy services. However, only about 10% of the population served in Africa obtains the higher level of services associated with solar home systems and mini-grids, whereas in Asia the share is over 30%. Technical and strategic measures including the progressive transformations in the power sector, expansion of power generation capacity and establishments of transmission lines are required to expedite the utilization of solar energy to upgrade electricity and power generation.

New sources of investment are increasingly available from sources such as the Green Climate Fund and the Asian Infrastructure Investment Bank. The Asian Development Bank has also launched several programs to support renewable energy deployment in Asia including framework development initiatives and funding programs for project development. As a result, the affordability cost of electricity to grid off-takers and availability improved

significantly. Hence, this study calls for stakeholder collaboration and a holistic approach of sustainable RE generation to address the shortcomings in prevailing practices and to form harmony among the national and international regulatory bodies, participating organizations and global research communities.

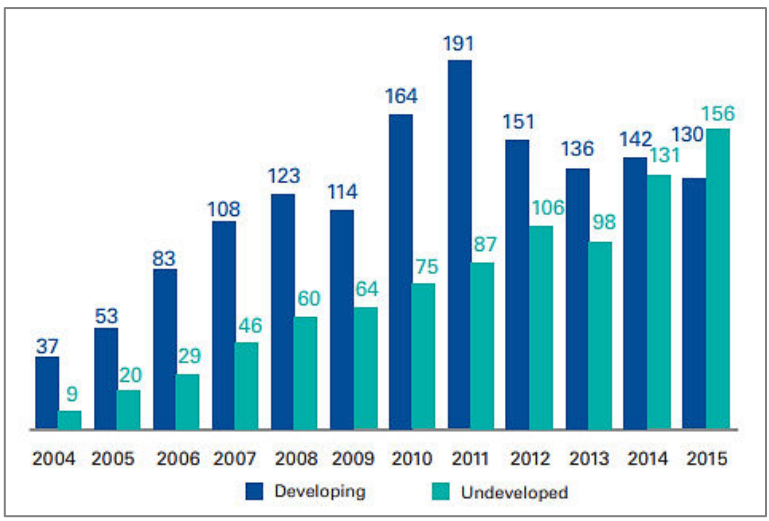

Figure 3: Global Investment Trends in Renewable Energy (in USD billions)

(Source: UNEP, Bloomberg New Energy Finance)

6. Conclusion

The deployment of renewable energy is distributed very unevenly around the world. The distribution of research and development initiatives in renewables is similarly uneven. Such efforts are dominated by a small number of industrialized nations (Japan, USA, Germany), though developing countries such as China, India, and Brazil are playing an increasingly important role. Fostering competences in the deployment and development of renewable energy technologies across a wide range of countries is a prerequisite if ambitious visions for future sustainable energy systems are to be realized. Thus, all countries can share the economic benefits associated with a transition to a sustainable energy system.

Based on the discussions through facts and figures collected from international RE statistics and research studies, the growth in solar PV

energy can be further accelerated by working on the policy constraints, uncertainties in funding and other dissemination barriers. Technical and strategic measures including the progressive transformations in the power sector, expansion of power generation capacity and establishments of transmission lines are required to expedite the utilization of solar energy.

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