International Conference on Applied Energy 2019
Aug 12-15, 2019, Västerås, Sweden
Paper ID: xxxx

Reasons for shifting and barriers to renewable energy; A literature review

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Abstract

Consumption of fossil fuel resources leads to serious economic and environmental issues such as (high fossil fuel subsidies, high carbon emissions, and high energy demand). This current economic situation needs new methods, which should generate sustainable solutions that are mostly independent of the use of fossil fuels. However, there are many barriers to the development of renewable energy. Based on the literature the major barriers to renewable energy are economic, Policy and legal, and technical. A literature review was performed in this paper to determine the reasons for shifting from conventional energy to renewable energy and identifies the barriers to the development of renewable power generation.

Keywords: renewable energy, fossil fuels, energy subsidies, CO_2 emissions, capital cost.

1. Introduction

In recent years, the world has been facing an energy crisis because of the increased demand for fossil fuels to meet the growing demand for energy. Studies have shown that the world is facing a challenge in providing adequate resources for energy generation. The shortage is expected to be particularly in oil and natural gas, which the world has relied on for 55% of the global energy consumption [1]. Perera [2] argues that the burning of fuels is considered the main human source of air pollution and greenhouse gases that cause global warming. According to IEA [3], global carbon emissions grew by 1.4 percent in 2017, reaching32.5 gigatonnes which are the highest indication in its history.

At the same time**,** fossil-fuel subsidies have been one of the reasons for the continued use and slow shift from fossil fuels to renewable energy. According to IEA [3], global fossil-fuel consumption subsidies reached US$ 260 billion in 2016. Electricity subsidies were US$ 107 billion, followed by oil subsidies accounted for 40 percent of total consumption subsidies (i.e. about $105 billion). Natural gas subsidies and coal subsidies were $50 billion and $2 billion respectively over the same year.G20 spent four times more on fuel subsidies than it spent on renewable energy between 2013 and 2015 [4].The expansion in using renewable energy technologies is facing barriers. Despite the significant decline in the costs in recent years, some studies argue that the costs are still one of the essential barriers to the development of renewable energy.

We aim to determine the reasons for shifting from conventional energy to renewable energy and identifies the barriers to the development of renewable energy. This paper reviewed numerous studies published between 2009 to 2018. These studies were concentrated in developed countries, some developing countries, and emerging countries, while there were a limited number of studies in the MENA region.

2. Reasons for shifting from fossil fuels to renewable energy

2.1 High fossil fuel subsidies

The economic theory suggests that fossil fuel subsidies fail in meeting their objectives in supporting the most unfortunate of society. Subsidies of fuel proved to be poorly aimed because of high-income household, who are capable of affording a higher consumption level, catch most of the benefit. IMF [5] reports that 10% of the wealthiest households in India consumed fossil-fuel subsidies seven times greater than the poorest 10%. In Sudan, the poorest twenty percent of the population

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absorbs only three percent of fuel subsidies, while more than 50 percent goes to the richest 20 percent [5].

Bridle and Kitson [6] emphasised that subsidies of fossil fuel have effects and repercussions on investment decisions making it a harder competition for energy efficiency and renewable energy. In spite of the fact that many countries have reduced fuel subsidies throughout time, fuel subsidies remain high in developing nations [7]. IEA [8] estimates that $260 billion was spent on fossil fuel subsidies globally in 2016, from almost $310 billion in 2015. IEA [8] attributed this drop as the result of the fall in oil prices and a subsidy reform process in dozens of countries such as Egypt, Indonesia, and Mexico. A study by Coady, Parry, Sears, & Shang [9] found that Post-tax subsidies of fossil fuel went from $4.9 trillion worldwide in 2013 to $5.3 trillion in 2015, this equals 6.5 percent of GDP in both years. This study reveals that the top five subsidisers of energy are China, USA, Russia, the European Union, and India.

2.2 High energy demand

Adams et al. [10] estimate that total global energy consumption will witness a raise by 28 percent from the period of 2015 to 2040, raising from 575 quadrillion British thermal units (Btu) in 2015 to 663 quadrillion Btu by 2030 and reaching 736 quadrillions Btu by 2040. Due to rapid population increase and high economic growth, energy demand is increased mainly in Non-OECD countries. While comparing the energy consumption in both non-OECD countries and OECD countries from 2015 to 2040, a 41 percent rise is noticed in non- OECD countries in comparison to a much smaller rise, a 9 percent rise, in OECD countries. In developing countries, there is an expected and anticipated increase of energy use by 90 percent rather than a 17 percent increase in industrialized countries by the year 2040. Also, China's energy demand is predicted to be twice as much that of the United States.

It will be difficult and challenging to estimate the energy amount demanded globally by using fossil fuels solely, with the present increase in energy demand. Shafiee & Topal [11] used three econometrics models to demonstrate the relationship between fossil fuel reserves, their consumption and respective prices from 1980 to 2006. The study assumes that if world consumption continues to consume fossil fuels at 2006 rates, oil will run out in 40 years, natural gas in 70 years, and coal in 200 years. According to RES4MED [12], Egypt will encounter a challenge to accommodate the growing energy demand in time to come as a result of rapid utilization and rise of extraction costs for non-renewable resources.

2.3 High CO_2 emissions

Based on a literature review, a major source of CO_2 emissions is fossil fuel energy. According to IRENA [13], Burning fossil fuels releases about 80 percent of human-caused CO_2 emissions. This portion of emissions originates from coal by 44 percent, 36 percent from oil and 20 percent from natural gas. Fossil fuels burning marked to be the main source of US greenhouse gas emissions from human activities [14]. Rafindadi, Yusof, Zaman, Kyophilavong, & Akhmat [15] used panel least square technique for the individual countries of Asia-Pacific over a period from 1975 to 2012, asserted that there is a significant relationship between air pollution, energy consumption, and water productivity. The study showed that fossil fuel energy consumption plays a great role and impact on the air pollution variation in the area.

China and India's emissions have risen dramatically since 1990 and developing nations now produce more greenhouse gases than developed nations. Much of that rise was due to the burning of coal. China is held responsible for nearly half of global coal trade [16]. Goods and services exports from developing countries to developed countries are the primary cause of a growing share of CO_2 emissions from fossil fuel combustion [17].

Multiple Studies have tried to assess and evaluate economic costs associated with fossil fuel-related CO_2 emissions. For example, Watson, McCarthy, & Hisas [18] found that air pollution from burning fossil fuels currently costs the United States $240 billion a year, which is 40% of the current growth of the United States economy and 1.2% of the GDP. The study estimates that this number will grow within the next decade to $360 billion per year, which is about 50% of the estimated growth of the economy. A recent study by Stefanski [19] examined the relationship between a country's emissions intensities and its GDP, by using the calibrated model for 170 countries during 1980- 2010. The model found that over the last thirty years subsidy-like wedges have been a major cause of a quarter of global carbon emissions. The direct cost of fossil-fuel price-distortions reached US$ 983 billion in 2010 only that equates to 3.8% of total global GDP in the same year.

3. Barriers to the development of Renewable Energy

Several barriers to the market deployment of renewables have been listed in the literature. Barriers discussed in this section are economic, Policy and legal, and technical.

3.1 Economic barriers

3.1.1 Cost of technologies

Historically, high cost has been cited as one of the essential barriers to shifting from traditional energy sources to renewable energy sources. Dufey [20] highlights that the expense per installed megawatt of renewable energy remains more expensive compared to traditional energy production which makes the use of the traditional energy more wide spread, even though the renewable energy has positive impacts and its great future prospects are recognised. Renewable energy projects requires a high investment, many aspects contribute to their high cost. Starting from the technology used cost, hiring experts and specialists for project development, to the cost of the studies themselves and ensuring the feasibility of project and resources needed. Chodkowska-miszczuk [21] states that the rising and high cost of renewable energy are considered an obstacle to the evolution of the renewable energy system compared to conventional electricity.

Timmons, Harris, & Roach [22] found that renewable electricity costs are sensitive and responsive to interest rates as a result of high capital costs of nearly all renewable energy resources. They also found that higher interest rates make traditional energy more attractive when compared to renewable sources, while low-interest rates make renewables more attractive. The construction of large-scale renewable power plants is highly costly because of the high capital costs of renewable energy technologies [23]. For instance, in Western Europe, the cost of wind plants are 4.6 more than the cost of gas plants and large-scale PV plants are 14.1 more than the cost of gas plants [24].

Recent studies argue that renewable energy has become cheaper than traditional energy. A review by U.S. Department of Energy [25] reported that since 2010, the price of installed solar energy has fallen by as much as half. At that time, the average price per photovoltaic unit decreased from 2.08 dollars/ watt to 0.66 dollars/ watt. The report shows that cost for solar energy has dropped by about 40% compared to 2015, which makes it economically competitive with traditional energy sources across the United States.

3.1.2 Access to finance

Another essential barrier to renewable energy technologies is financing. IEE [26] shows that high financing costs influence the competitive position of renewables, as renewable energy requires higher initial investment than traditional energy, although their operating costs are lower. Renewable energy developers and customers may face difficulty in obtaining low-cost financing, as may be available for conventional energy facilities. Nelson et al. [27] estimated that about 90 percent of total project costs of photovoltaic, and hydropower are comprised of initial capital cost, while the initial investment of gas projects represents just one-third of the total cost of the discount life.

In the lack of such long-term financing, investment choices will be directed toward traditional technologies that may be financially practical [28] . In recent years, private investment has become the largest source of financing for renewable energy projects in different countries after the government played this role. This is due to two factors the costs of renewable energy technologies have declined, and renewable energy policies have encouraged private sector investment by creating new market opportunities [29].

3.1.3 Price distortion

Pelosse [30] argues that the comparison between renewable energy and traditional energy prices is unfair because of the financial and political support which traditional gained in the past and the benefits it still enjoys. Several studies argue that the market prices of fossil fuels don't reflect their actual costs. The study by Biebl [31] deduced the price of fossil fuels to be low in the United States because of government subsidies. Without these subsidies, renewable energy producers would be in a better state to compete in the energy market.

Studies have shown that ignoring environmental and health cost for conventional energy also create price distortion. Muthami [32] argues that renewable energy is costly in comparison to fossil fuels due to the pricing of fossil fuel not consisting of environmental externalities, such as health care costs. Wind and solar energy from new plants in Europe are cheaper than coal and nuclear power plants, given environmental and health risks [33].

3.2 Non-Economic Barriers

3.2.1 Policy and legal barriers:

In many countries, governments focus more on the traditional energy sector than on renewable energy. This includes the absence of national R&D programs and low domestic spending on R&D [34]. According to Elliott [35], Shifting policies and changing priorities was one of the main difficulties faced by the United States in supporting renewable energy.

The lack of a comprehensive legal and regulatory framework has been a main obstacle for investment in renewable energy technologies by independent power producers in Ghana [36]. Chang & Wang [37] show that there are a few laws and regulations related to renewable energy and utilisation in China, which affects energy development.

3.2.2 Technical barriers

Renewable Projects are confronted by technical and infrastructure barriers and challenges. Nasirov et al. [38] highlight the main technical barrier for the renewable industry regarding network integration is associated with the wide variety of requirements and standards, which differ from country to country. The study finds that RETs need a high level of the technical basis for their technological assessment. The absence of energy storage is becoming a main technical barrier to the electricity production from renewable energy resources.

REN21. [39] argues that major barriers to renewable energy expansion are therefore not related to cost but to the limitations of current infrastructure. Nasirov, Silva, & Agostini [40] show that one of the most significant barriers to increased current and future renewable energy generation is the limited grid infrastructure in areas where renewable resources are most abundant.

4. Conclusion

From the literature review, there are main reasons to shift from conventional energy to renewables. One of these reasons is that many countries are suffering from a gap between energy supply and the domestic energy demand for them. Several studies have shown that fossil fuel energy subsidies fail in meeting their intended objectives. In addition, the literature illustrated that the fossil fuels consumption is major source of carbon dioxide emissions. Fossil fuel energy is one of the main source of CO_2 emissions. This economic and environmental situation needs more feasible solutions that are self-sufficient and non-relying on the use of fossil fuels.

Barriers to renewable energy in the literature were classified into three categories economic, policy and legal, and technical. Although high cost has been cited in the literature as one of the major barriers to shifting to renewable energy sources, recent studies indicate that cost of renewable energy has decreased over the last decade. Some studies find that costs of renewable energy may be cheaper than fossil fuels in some cases and areas. In some countries, financial institutions are not quite acquainted with renewable energy and likely to recognise them as risky, and this is a main barrier to the deployment of renewable energy.

Within the literature, there are barriers other than economic that face renewable energy. In many countries, governments focus more on the traditional energy sector than on renewable energy. This leads to the lack of a comprehensive legal and regulatory framework that supports renewable energy. In addition, some authors found that major barriers to renewable energy generation are irrelevant to cost but to the limitations of current infrastructure, and the absence of skills and training.

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