

## Energy and Environment and the Case for Renewables as an Alternate

Abida Firdous\*, Abid Rashid Gill †, Asif Naveed Ranjha‡

### Abstract

*Energy is the backbone of the modern global economy. It is one of the crucial ingredients of nearly all goods and services of modern life however, it is also a predominant source of pollution and environment changes. Millions of deaths are attributed to pollution every year. Moreover, environmental changes resulting from energy production and usage are also threatening to the sustainability of the planet. It is, therefore, becomes imperative to examine how energy is being produced and used to gear economic activities. This paper examines the sources of energy generation and environmental impacts. It also assesses the potential of renewable energy sources to tackle the threat of hazardous changes to the environment. Further, the constraints to the development of renewable energy also have been highlighted.*

**Keywords:** fossil fuel; renewable energy; pollution; sustainability; environmental losses.

### Introduction

Economy lies at the heart of a modern society that is driven by energy use. Energy is the lifeblood of the global economy and basic input to almost all goods and services. According to Voser (2012) "without heat, light, and power you cannot build or run the factories and cities that provide goods, jobs and homes, nor enjoy the amenities that make life more comfortable and enjoyable." Hence, sustainable supply of energy is central to upgrade the living standards of the billions of people of this planet.

Particularly, in the present time, the world economy needs more energy to support social and economic activities. Energy has become vital to enhance the quality of life in both developing and developed countries. Reliable and sustainable energy supply enables gadgets like computer, laptops, modern gadgets and services such as transport, education, entertainment and medical to enrich the lives of people. A reliable supply of energy supports the expansion and modernization of industrial, agricultural and trade activities.

Hence, it can be asserted that energy growth is directly associated with the prosperity and well-being of people across the globe. As Stern (2011) stated that scarcity of the energy poses a series constraint on the economic growth and people's welfare. It is a global challenge to meet the energy demand to sustain economic and social activities. Although momentous strides in technological growth and energy efficiencies have reduced the energy demand, yet worldwide energy demand is expected to rise by 25 % by the end of next decade (IEA, 2018b).

However, the provision of energy around the globe also comes with some crucial responsibilities and commitments for the utilization of natural resources. The environmental degradation due to energy production has been connected to many environmental challenges such as climate changes, air pollution and global warming (Dobrokhotov, 1995). It is, therefore, a challenge of the present time to maximize the benefits gained from energy consumption while minimizing environmental losses.

Currently, 80% of energy is being produced through the burning of fossil fuel (coal, oil and gas) that is considered to have the most pollution-intensive process (IEA, 2018a). Consequently, the energy sector has become one of the largest contributors to climate changes and global warming (Roser, 2019). According to Agarwal, Narain, and Sharma (2017), the current global path of economic growth propelled by fossil fuel is not sustainable in its three pillars: economic, social and environmental. Decisive actions and strict policies, therefore, should take place to reverse the negative environmental consequences of economic growth. To do so, many countries have turned their efforts

\*Abida Firdous, Economics Department, The Islamia University of Bahawalpur(Pakistan).

[abida.shanzay@iub.edu.pk](mailto:abida.shanzay@iub.edu.pk)

†Dr. Abid Rashid Gill, Economics Department, The Islamia University of Bahawalpur (Pakistan).

‡ Asif Naveed Ranjha, Social Work Department, The Islamia University of Bahawalpur (Pakistan).

towards substituting fossil fuel energy generation to renewable cleaner alternatives, as well as improving the efficiency of energy usage.

The Paris Summit (2015) aims to address the issues of climate changes and global warming. The global economies pledged to make a considerable reduction in CO<sub>2</sub> emission that is the major cause of these calamities, to curtail world temperature below than pre-industrial era. However, despite the summit, the worldwide CO<sub>2</sub> emissions have increased by 1.7 % in 2017 and 2.7 % further in 2018 and the year 2019 is expected to observe more highest increase. Moreover, the last five years have been the hottest years of history (Mulvaney, 2019).

Given this backdrop, this paper aims to highlight the serious problem faced by world communities in moving away from fossil fuel-based energy to sustainable energies from renewable sources. The current study highlights the links between pollution and energy generation that are considered one of the main determining factors of the environmental issues faced by global communities. Also, the current study explains the potential of renewable energy to contain the problem of environmental degradation. Further, the constraints in the development of renewable energies are highlighted.

### **Energy and Pollution**

Energy does not create pollution, rather the energy generation process produces pollution. As mentioned above most of the energy in the world is generated through fossil fuels (coal, oil, and gas) that generate harmful toxins. Consequently, energy generation has become the leading contributor to environmental changes and global warming. The air pollutants generated by human activities are mainly derived from the production and usage of the energy generation from fossil fuel. The 85% of global dangerous pollutants such as Sulphur Dioxide (SO<sub>2</sub>), Nitrogen Oxides (NO<sub>x</sub>) and Carbon Dioxide (CO<sub>2</sub>) related to energy production from fossil fuels (IEA, 2018b).

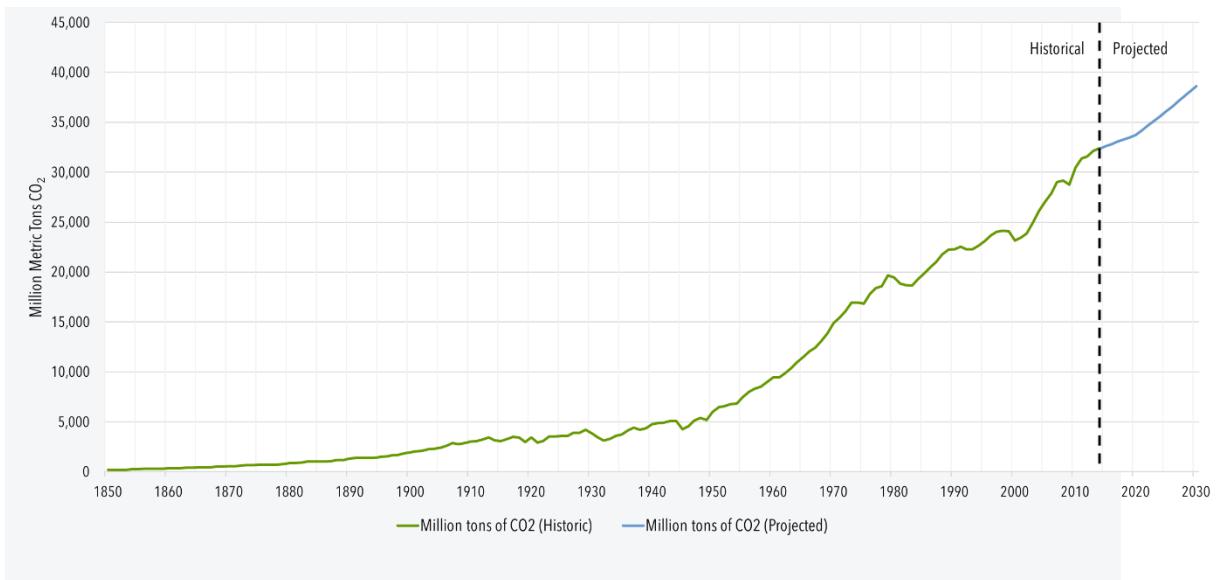
The two landmark studies on the environment namely the Intergovernmental Panel Report on Climate Change (IPCC, 2007) and N. Stern (2006) created awareness and concerns about the critical consequences of global warming. Though these studies had different details of the analysis, both concluded the same that economic growth driven by fossil fuels is the main cause of environmental changes and global warming. If proper measures are not taken, the continuous release of CO<sub>2</sub> emission into the atmosphere will lead to catastrophic climatic impacts such as changing rainfall patterns, rising of the ocean levels and increased intensity of hurricanes and storms.

Similarly, Earth Policy Institute (EPI, 2017) indicates that "increasing global emission of CO<sub>2</sub> is pushing the world into dangerous territory, closing the window of time to avert the worst consequences of higher temperatures such as melting ice and rising sea levels. Since the dawn of the industrial revolution, carbon emissions from the burning of fossil fuels have grown exponentially. Despite wide agreement by governments on the need to limit emissions, the rate of increase ratcheted up from less than one per cent each year in the 1990s to almost three per cent annually in the first decade of this century". The exponential increase in CO<sub>2</sub> can be seen in Figure-1 below.

The conventional fossil fuel energy resources like oil, coal and gas, therefore, have become under intense pressure due to the host of environmental problems. In the 70s and 80s fossil fuel was considered a blessing, nevertheless, it has a damaging impact on the future productivity of the earth. Energy generated from coal, oil and gas produce dangerous toxins and emit millions of tons of carbon dioxide into space annually. Carbon dioxide hangs onto heat, which builds up in the atmosphere and contributes to climate changes. Rizwan Nawaz and Sharif (2019) highlighted that there is a consensus among the scientists that burning of fossil fuel is the major cause of climate changes and global warming. The world has become one centigrade warmer than it was in pre-industrial stage. They further explained that burning of fossil fuel not only produce GHG but also release a lot of heat to the atmosphere.

Followings are the sources of energy generations and their respective share in energy production and pollution. Moreover, the comparative environmental impacts of renewables energies also have been discussed in the following section.

**Figure-1: The Worldwide CO<sub>2</sub> emissions1850-2030**



### Coal

Coal is considered the most polluting way of producing energy and pose a serious threat to the environment of the world. Burning of the coal is the biggest source of toxin emission from human activities. Coal mining also generates methane that is also a potent greenhouse. Coal is mainly made up of carbon and is the most carbon-intensive source of energy generation. Its burning generates almost double greenhouse gases than from the natural gas to generate the same amount of energy. According to IEA (2018b), coal generates almost 30 per cent of the world's energy supply and produces 46 per cent of global CO<sub>2</sub> emissions.

Moreover, it also produces wastes like sludges, toxic chemicals, and heat. The electricity generation from coal produces pollution during all stages of energy production such as mining, transporting and burning. There is an urgent need to transit from dirty and polluting coal to alternative sources in electricity production. The Paris agreement 2015 indicates that fossil fuel era must come to an end especially coal mining. The evidence around the globe also grows about the steep decline of the coal industry.

### Oil

After coal, oil is the second most polluting source of energy generation. The electricity generation from oil burning produces significant air pollution in the forms of SO<sub>2</sub>, NOx and heavy metals such as mercury, and volatile organic compounds. Besides, it also generates a significant amount of CO<sub>2</sub> and other greenhouse gases. According to Birol (2017), oil produces 41% of world electricity and contributes 34.6% in global emissions of greenhouse gases (GHG). Moreover, the oil field powerplants harm to water, underground water, and land usage. The oil field plants require a huge amount of water for cooling and steam, therefore, harm local water resources and habitats. Furthermore, the oil residuals turn into solid waste that contain very dangerous toxic materials. Drilling of the oil also generates various air pollutants and hazardous materials.

### Natural Gas

Natural gas is the third most important fossil fuel that also contributes to environmental changes. It is relatively less toxic as compared to coal and oil. However, it does pollute the atmosphere by producing CO<sub>2</sub>. Birol (2017) revealed that gas produces 22.9 % of world energy and contributes 19.9% of global emissions of GHG. Most importantly it releases very dangerous and more potent methane gas. This gas is 35 times more dangerous than CO<sub>2</sub> and SO<sub>2</sub> for humane health (ScienceDaily, 2016). The extracting of gas also requires a huge amount of water that harms local water resources.

By releasing methane gas and dumping CO<sub>2</sub> in the atmosphere, natural gas also poses a serious risk for life on the earth.

### **Renewable Energies**

The renewable energies such as solar, wind, hydroelectric and geothermal have come into the spotlight as a true solution to the environmental problem of the day. Unlike fossil fuels, renewable energies do not produce gas or any harmful toxic solids as a by-product of the energy generation. However, these forms of energies also affect the environment in other ways.

For instance, all form of renewable energies requires land for the installation and local habitats are often destroyed for this purpose. This is true in case of hydro-electric that is commonly generated through the construction of dams. The dams not only drastically change the natural habitat, but also reduce the water availability to downstream areas. Moreover, hydroelectric dams also have drastic consequences for the natural environment. Similarly, wind turbines change the air pressure that increases the risk of collision of birds and bats with these structures. According to the report of (Bryce, 2016), 140000 to 328000 birds are killed by wind turbines each year in North America. The solar forms are mostly installed in deserts because the sunlight is highly accessible there. The installation of these solar forms also threatens the desert environment and important living habitats. Moreover, the desert birds may also collide with solar forms and sometimes be burned by concentrated solar rays. Furthermore, geothermal energy also produces some greenhouse gases that are trapped into the earth.

Given the fact that clean energies are also not perfect, it can be stated that the energy needs of the world cannot be met without any negative impact on the environment. However, with continued advances in technology and with careful planning, the negative impacts the renewables are manageable as compared to the damages of fossil fuels.

### **Renewable Energies and Environmental Problem of the Day**

Historically, renewable energies have been the primary source of energy for human beings as wood has been used for cooking and heating water. However, during the last 200 years, fossil fuel has replaced renewables, especially in industrialized countries due to its much higher energetic value. Nevertheless, renewable energies have minimum environmental impacts and produce minimum secondary wastes, therefore, are considered sustainable to meet current and future societal needs as renewable , sustainable modern energy sources will open a new and modified world of opportunities for all through economic opportunities and sources of jobs for billioniers (Nations, 2015).

The renewable energy is composed of renewable resources that are naturally replenishable such as wind, sunlight, rain, waves, tides and geothermal heat. REN21's (2016) revealed that 19.2 % of global energy consumption comes from renewable sources. Among renewables, 8.9% energy comes from biomass, 3.9% from hydro and 2.2% from wind, solar and geothermal. IEA (2017) predicts that by 2040, the share of the renewable energy in total energy generation will reach to 40% in the European Union, 30% in Japan and China and around 23% in India and USA. While coal share will drop by 11% in the global electricity mix. The UNEP (2017) also revealed that renewable energy added 138.5 gigawatts to global power capacity in 2016. This addition is eight per cent higher than the previous year production of renewable energy.

The rapid development of renewables is considered to generate a better distribution of wealth, energy security and to mitigate the environmental problems. Prior literature also provides empirical support to the stance that a shift from traditional fossil to renewable energies can significantly curtail the environmental damages of economic growth. For instance, Nakicenovic (1992) claimed that renewable technologies can improve the environmental status quo by mitigating greenhouse gases (GHG) emission without hurting economic activities. Boudri et al. (2002) assessed the comparative environmental impacts of renewable and non-renewable energy resources in India and China for time span of 1990 to 2020. It is also analyzed that renewable energies could reduce SO<sub>2</sub> pollution by 17 to 35 per cent in China and 35 per cent in India.

Iwata, Okada, and Samreth (2010) investigated the role of nuclear energy to control CO<sub>2</sub> emission in France. They found a significant role of nuclear energy in controlling the CO<sub>2</sub> emission. The same authors in 2011 found a significant negative impact of nuclear energy on CO<sub>2</sub> emission in 28 OECD countries. Marrero (2010), explained the link between energy consumption and pollution

after examining the data of twenty four EU economies for the time span of 16 years such as 1990-2016 & resulted that pollution is reliant on energy and the final use of the energy.

Panwar, Kaushik, and Kothari (2011) endorsed that renewable energies can provide opportunities to mitigate the emission of greenhouse gases (GHG). Saber and Venayagamoorthy (2011) reiterated the same that renewable energy, mainly wind and solar, can reduce emissions from the electricity industry (mainly from power plants). Another important study on this topic was carried out by Burke (2012). He inspected the significance of transitions from fossil to renewable sources in 170 countries to tackle CO<sub>2</sub> emissions for the period 1960-2006. He claimed that a one per cent increase in the share of renewable sources energy in total energy generation augments the probability of CO<sub>2</sub> reduction by 1.4 percent.

Similarly, Ben Jebli, Ben Youssef, and Ozturk (2013) claimed a one-way causality from renewable energy and income to CO<sub>2</sub> emission in 25 OECD countries during 1980-2009. Farhani and Shahbaz (2014) also indicated a unidirectional causality from renewable energy to CO<sub>2</sub> emission and income growth in MENA countries over the period 1980 -2009. These causality results also imply that the development of renewable energies reduces the GHG emissions.

Equally, Shafiei and Salim (2014) found that traditional fossil fuels increase pollution while renewable energy decreases pollution. They, therefore, suggested that policymakers should focus on renewable energies to curtail global warming and climate changes.

Mert, Böltük, and Büyükyilmaz (2015) analyzed the connection between GDP per capita, GHG, renewable and non-renewable energy consumption of 16 European countries for the period 1990 to 2008. They confirmed that renewable energy had significantly reduced the GHG emission in European countries. Similarly, Bölkü and Mert (2015) admitted the potential and importance of renewable energy sources to tackle the problem of environmental degradation. Al-Mulali, Ozturk, and Lean (2015) also found a negative impact of renewable energy production on CO<sub>2</sub> emission during 1990-2013 from twenty three economies of Europe.

Bilgili, Koçak, and Bulut (2016) aimed at investigating the impact of renewable energy on CO<sub>2</sub> emissions in 17 OECD countries for the period 1977-2010. They found that renewable energy consumption could yield negative impact on CO<sub>2</sub> emissions. They eventually concluded that countries through fair and easy access to renewable energy can significantly combat global warming. Dogan and Seker (2016) also recommended the same that the European Union's countries should keep on increasing the share of renewable energies to decrease CO<sub>2</sub> emission.

Zoundi (2017) examined the role of renewable energy to mitigate CO<sub>2</sub> emissions in 25 selected African countries for the period 1980 to2012. The results indicated a strong negative impact of renewables on CO<sub>2</sub> emissions. Similarly, X. Liu, Zhang, and Bae (2017) concluded that renewable energies should be promoted to curtail the emission of GHG.

Inglesi-Lotz and Dogan (2018) evaluated the impact of renewable energies on pollution in the eight biggest electricity user of Sub-Saharan countries for the period 1980-2011. They claimed that the use of non-renewable energies was intensifying the environmental issues while the use of renewable energies was curtailing environmental degradation. Similarly, from the empirical investigation of China for the period, 1993- 2016 Dong, Sun, Jiang, and Zeng (2018) claimed that fossil fuels had been the main culprit of environmental degradation while renewable energies could play an important role to mitigate global environmental issues. Balsalobre-Lorente, Shahbaz, Roubaud, and Farhani (2018) also drew a similar conclusion from the empirical investigation conducted on France, Germany, Italy, United Kingdom and Spain over the period 1985–2016. Finally, Bekun, Alola, and Sarkodie (2019) confirmed that fossil fuel consumption increases while renewable energy consumption decreases GHG emissions. They, therefore, recommended the use of environmentally friendly energy resources to attain the goals of sustainable development.

Hence, there is compelling evidence around the globe that renewable energy has the potential to curtail global environmental issues. Due to concerns about environmental changes, pollution, global warming and energy securities, renewable energy has become a fast-growing segment of the energy industry especially in developed countries and in fast-growing economies of the developing countries.

The new technologies and rising environmental considerations also have contributed to this development.

### **Barriers to Renewable Energy Technologies**

Although renewable energies have enormous potential to curtail the environmental problem of the day, however, there are significant market barriers and market failures that can limit its development. These barriers and failures are as follows.

#### **Price Distortions**

The market price of the energy does not take full account of the various social costs associated with the use of fossil fuels. The energy generation from fossil fuel produces a variety of negative environmental externalities. Due to these unpriced externalities, more energy is being used than the socially optimal level. The overuse of fossil fuel has led to environmental changes and global warming to a dangerous level. Most of the leading ecologists such as Kolbert (2015) and N. Stern (2008) believe that further exploitation and use of the fossil will be catastrophic for humankind. A strong case emerges for the internalization of these externalities into the price of fossil fuels. Moreover, economic theory also supports the internalization of positive as well as negative externalities in the price of a commodity. The social cost of every source of energy must be reflected in its price. Various studies such as D. Coady, Parry, Sears, and Shang (2017) suggests that if externalities are included in the price of all source of energy generation, renewable energies would be a more viable option for producers and consumers.

Hence, the biggest factor that prevents a transition from fossil fuel to renewable is the failure to internalize the negative externalities of fossil fuel in its price. The true price of fossil fuel that includes its environmental externalities will send a clear message to consumers and producers that fossil fuels are an economic bad.

#### **Market Failure to Value Public Benefits of Renewables**

Renewable energies contribute to contain environmental changes, reduce pollution, and eventually curtail the threat of global warming in addition to fulfilling the global energy needs. These benefits of the renewable energies are accrued to every individual on the earth. Besides, employment, price stability, and fuel diversity are other indirect benefits of renewable energy. The renewable energies are, therefore, can be termed as a public good like other public goods such as streetlights, education, training, and health facilities.

The public good or service has two basic characteristics: inexhaustibility and non-exclusiveness. The inexhaustibility implies that consumption of one person does not reduce its availability to others. While non-exclusiveness means it is not possible to exclude others from the use of this commodity. Due to these characteristics, public goods like renewable energies are underpriced and the market tends to under-produce them despite its widespread environmental and macroeconomic benefits. These obstacles hinder the adoption of renewable technologies and effective investment in energy efficiencies even if economies appear to be favourable.

#### **Imperfect Information**

Free, perfect and symmetrical information are key determinants of the functioning of an efficient market. Nevertheless, markets do not have as perfect information as is assumed under competitive market especially energy markets. They are also plagued with imperfect and incomplete information. Moreover, information is more expensive and more difficult to obtain in energy markets as compared to other markets. Insufficient and incorrect information leads to suboptimal investment in clean energy and energy efficiencies.

Due to technical difficulties and high cost of obtaining the information, consumers are not aware of features and economies of energy products. Usually, consumers do not have many choices for energy products. Most of the utility companies do not provide information about the environmental impact of their energy products. Consequently, consumers remain unaware of the complete social cost and benefits of energy products.

Moreover, renewable technologies are new, and consumers are not well informed about it. The industrial and commercial consumers are also unaware of the renewable energies and its environmental benefits to society. They are mostly trained to find low-cost energies for their industries. Even the

industrial managers who look for ways to reduce the in-house pollution do not consider the pollution attached to their electricity purchased. Moreover, they do not evaluate how renewable technologies can fit into their industrial structure.

### **Unequal Government Subsidies**

The fossil fuel energy companies also enjoy significant advantages in tax and subsidies as compared to their counterpart companies. As D. Coady et al. (2017) estimated that global subsidies available to fossil fuel were \$5.3 trillion in 2015, This amount was 6.5% of total world GDP. They measured these subsidies as the difference between what consumer should pay for fossil energy to cover supply cost as well as its environmental cost and what they pay. These subsidies are pervasive across the developed and developing world, from oil-producing to oil-importing countries. The authors also detailed the results according to fossil fuel usage and types. According to the results, coal and oil enjoy larger subsidies as compared to other counterpart fuels. Moreover, the USA, China, and Russia were placed on top of the list of subsidizers of fossil fuel in the world. While the European Union subsidizes fossil fuels to about half of the USA.

Because of these huge amounts of subsidies, fossil fuels are more viable than the renewables. We all pay this cost in one way or other. The global energy subsidies persist because policymakers have not fully valued the issue. The quantitative benefits of the energy reforms have emerged in academic debate very recently (D. P. Coady, Parry, & Shang, 2017; Lin & Jiang, 2011; W. Liu & Li, 2011; Tongsopit, Kittner, Chang, Aksornkij, & Wangjiraniran, 2016). Reforming the energy subsidies can accrue a lot of climate, health, fiscal and economic benefits. Removing energy subsidies are largely in the countries' interest as it is likely to address domestic as well as global environmental problems.

### **Renewable are in Small Size**

Renewables projects and companies are generally small as compared to their counterpart companies especially of fossil fuels. They have fewer resources and are not able to deal directly with large numbers of customers. They also have weak negotiating powers to get favourable terms from larger market players. Moreover, they are less likely to participate in regulatory or legislative proceedings, or in industry forums to define new electricity market rules. On the other hand, fossil fuel companies (coal, oil, and gas) are big giants. They have huge resources to manipulate markets. They are so powerful that they can manoeuvre the economic and political policies of the governments in their favour.

### **Conclusion and Recommendations**

The study demonstrates that energy generation all over the world largely depends on the burning of fossil fuel that is the main culprit of environment changes, global warming, and air pollution. The study concludes that renewable energies have the potential to reverse these trends. A shift from traditional fossil fuels to renewable energies can significantly reduce the local and global pollutants.

Nevertheless, it is also concluded that the renewables are unable to compete with traditional fossil fuels on prevailing market prices. Fossil fuels are the cheapest source of energy and developed and developing countries are heavily dependent on it. These are the cheapest because the governments all over the world provide heavy indirect subsidies. A huge transformation is, therefore, imperative to make renewable energies viable relative to fossil fuels.

The study also concludes that the speed of transition from traditional fossil fuels to renewable energies largely depends on public policies. The reforms in fossil fuel subsidies are critical to producing economically efficient energies. Public policies can also help to reduce the cost of production of renewable energies by providing capital to renewable projects at a subsidized rate.

It is also concluded that market imperfections and market failures inhibit the socially optimal level of investment in renewables and energy efficiencies. It is the primary cause of considering public intervention in energy markets. Without taxing fossil fuels, their market price would not reflect its true cost to society. Economists term it as a market failure where an external cost of a product "in this case damages incurred via climate change, toxic air and polluted water" is not captured by the market price. Rather it is paid by taxpayers that is a massive subsidy to the fossil fuels industry.

An effective public policy such as carbon tax can internalize the negative externalities attached to the use of fossil fuels. A carbon tax equal to the amount of the externalities creates a fossil fuel price that reflects the full direct and indirect cost of energy to the society. It would force consumers to minimize their use. Similarly, renewables should be subsidized equally to the positive externalities generated for society.

However, Clements, Jung, and Gupta (2007) warned that the reform process may face opposition from the general public and industry groups if reforms lead to an increase in energy prices. Similarly, Fofana, Chitiga, and Mabugu (2009) also highlighted that higher energy prices resulting from energy reforms may also negatively affect the competitiveness of the industry. Moreover, the reform process may be costly and may not be affordable for developing countries. A global mechanism is, therefore, imperative that pays the differences between fossil and renewable energies by taxing fossil and subsidizing the renewables.

The world is naturally endowed with solar and hydro sources of renewable energy, therefore, a shift towards these less polluted renewable technologies is viable and would contribute towards the goals of sustainable development. Moreover, some issues must have to be addressed relating to renewable energy sources. First, renewable sources must be competitive and economical as compared to fossil fuels. Second, it must be concentrated, stocked and transportable to meet the demand of distant areas. The fossil fuel is successful because it fulfills above mentioned three essential requirements.

A large portion of the transition to environmentally sustainable energies can also be accomplished by redesigning the energy infrastructure regarding the distribution and consumption of the energy. This task can also be spurred due to the prevailing higher cost of renewable energies. The conservation of costly energy is unavoidable. Both efficient energy conservation and renewable energy can eventually replace the polluting fossil fuel dominated energy systems.

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