

The Impact of Renewable Energy on Fossil Fuels

Xinyuan Zhang^{1,a,*}

¹*Northeastern University, 75 Saint Alphonsus Street, Boston, USA*

^a*zhang.xinyuan2@husky.neu.edu*

^{*}*zhang.xinyuan2@husky.neu.edu*

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Abstract: Sustainable energy goals centers around supporting renewable energy development through economies of scale, learning, and technological developments. It is believed that, once cost equality with fossil fuel is accomplished, a change towards renewable energy will effectively proceed without the need for further subsidies on renewable source. Notwithstanding, the thinking is based on the fact that the cost of fossil fuel will not response to the increase in renewable energy sources (BP, 2015). In this paper we construct a standard model to test the legitimacy of this supposition, especially with coal and gas source of energy. The paper determines that fossil fuel costs will respond to the renewable energy actions and neutralize the efforts, to the extent rendering the efforts futile (Hamilton, 2008). A lot of research is still needed to determine plausible ways of promoting renewable energy sources against the stiff price competition from the fossil fuels (IEA, 2014). The need to promote sustainable energy sources is guided by the global sustainable demands and the increase carbon tax in some nations.

1. Introduction

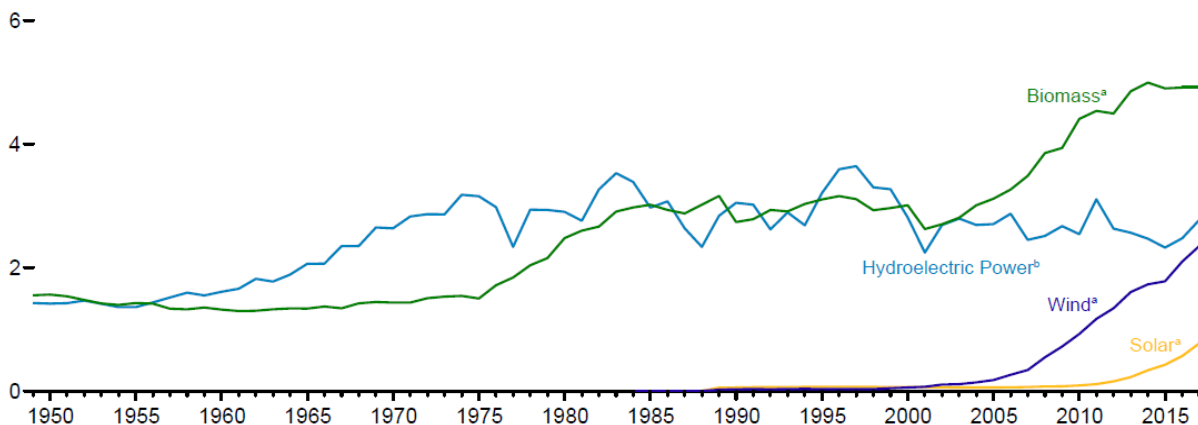
The 21st century is fighting two critical environmental challenges. Increasing sustainable energy consumption and decarbonization of the energy sector. The two problems are closely linked solution can only be achieved by examining the behaviors side by side. While energy consumption growth is by approximately 2% annually, the growth is mainly attributed to the fossil fuel (BP, 2015). Therefore, there is need to expand clean energy production and put in place cost measures that will render fossil fuels unattractive with the additional policy and educational programs in place. Currently policies are being implemented towards sustainable development =, but barriers of the influx of fossil fuels, quantity of clean energy, and prices still give away the much awaited 2030 goal.

In 2012, renewable energy in the United States was 13.2% of the domestic electricity produced. This was 11.2% of the total energy generated in U.S. The highest production of green energy was recorded in 2011, when it marked 11.7% of the total national production. It was this year that renewable energy production superseded national nuclear energy production after 1997.

Hydroelectric power is the largest renewable energy source in the United States. In 2010, hydroelectric power output was 6.2% of the national energy output and 60.2% of the total renewable energy production (IEA, 2014). The U.S. is the fourth largest hydroelectric power source after China, Canada, and Brazil. Its Grand Coulee Dam is the fifth largest hydroelectric power source worldwide. The United States wind power supplies 4% of the national electricity. Wind power has been effectively produced and utilized in Texas, Iowa, and California.

Figure 10.1 Renewable Energy Consumption
(Quadrillion Btu)

Major Sources, 1949–2017



By Source, 2017

By Sector, 2017

Figure 1: Trends in Renewable Energy Consumption

After the launch of Solar One, the U.S. has also invested heavily in solar thermal power. Currently the SEGS group of plants situated in Mojave Desert produces 354 MW and is the largest solar power source in the world. There are increasing numbers of photovoltaic power plants across the nation with the Agua Caliente Solar Project, as the largest photovoltaic power source in North America. U.S. also has the largest geothermal powers station in the world, the Geysers.

Whereas there is a significance focus on climatic concern demands are increasing, the constant fluctuation in fossil fuel cost is a matter of concern and development of renewable energy is considered the best alternative. Findings from International Energy Agency, by 2020 the demand for electric energy alone is estimated at 30%, evidently, a renewable energy will be the only solution for the growing energy needs amid the condemnation of carbon emission. Wind power, hydro, bio, and other forms of green will become the best replacement of for the carbon compounds. Statistics have shown a constant increase in wind and hydro energy, but their successful penetration of the market partly depend on fossil fuel stability in the market and their demand and supply behaviors. Therefore, for effective penetration of alternative green energy, market behaviors must be analyzed side to side with the behaviors of fossil fuel.

The president of the United States has been fighting for the reduction of oil ports. The national goal is to reduce oil imports by a third by 2025. However, the United States energy use is expanding every year. Petroleum account for 35%, natural gas 23%, coal 20% while nuclear, and other renewable sources account for 8% (BP, 2016). With the growing of confluence economic global crisis and environmental issues, the need for green energy sources has become a U.S. priority. The

degree to which renewable energy can successfully replace the fossil fuels depends on three key factors: the extend fossil fuel generators are important backup to electricity grids and the level of penetration and storage currently in place; the profitability of the already deployed renewable energy against the fossil fuels to inform decision for the latter; and the cost competitiveness of the renewable energy against the fossil fuels (Long, 2015).

Coal production and Consumption (1949-2017)

Overview, 1949–2017

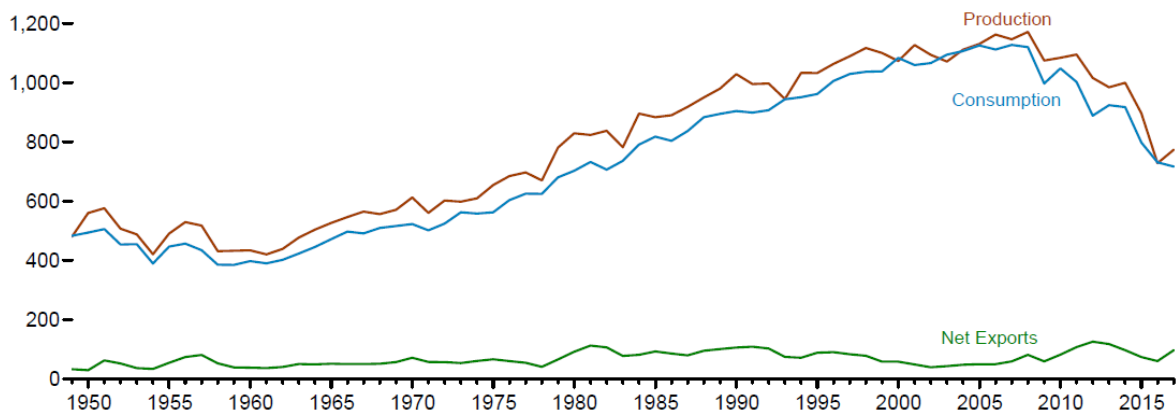


Figure 2: The Coal Production and Consumption

Total Wells Drilled by Type, 1949–2010

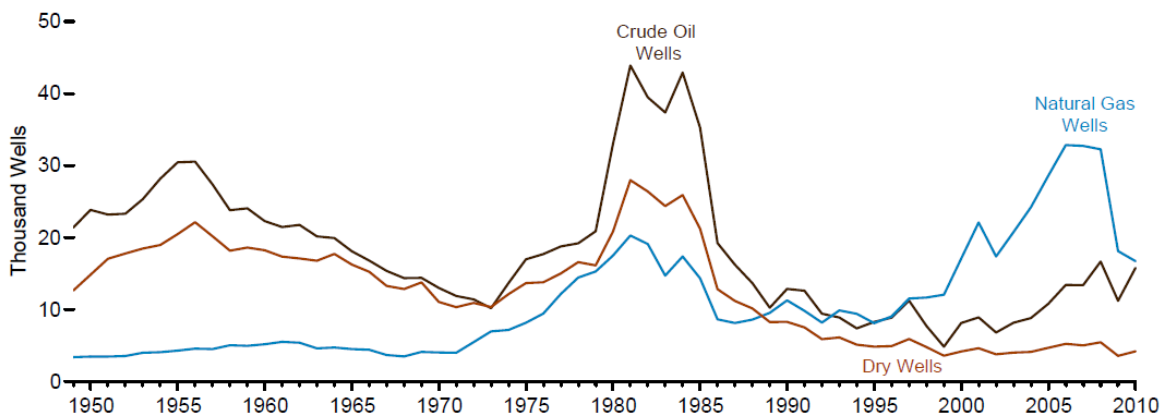


Figure 3: Price Response of the Deployment of Renewable Energy against Fossil Fuels

Since there is no data on the price response of deployment of fossil fuel against renewable energy, a hypothetical approach is taken to analyze the scenario. A standard economic theory is adopted and tested against the currently available evidence. The hypothetical test is based on supply and demand as postulated by Hamilton (2008). Based on economic model, price and quantity are the regulators of supply and demand, hence, it is expected that an introduction of renewable energy in the market will create a shift in supply in demand. Additionally, quantity and price factors will influence the market behavior towards or away from the renewable energy.

In case the annual demand for energy is constant and renewable energy engages the fossil fuel with at equal price response, renewable energy will replace equal amount fossil fuel market and

reduce the fossil market. However, the capacity power assumption is inaccurate since power demand is a price function (IEA, 2014). If the introduction of renewable energy creates reduction price, the demand for power would increase. Based on the low margins of renewable energy costs, the price sensitivity of fossil fuel used in power generation will result in decrease in prices due to displacements by renewable energy, but the decrease is believably will be smaller than the corresponding amount by the renewable energy (Long, 2015).

According to BP (2015), global power generation has shown an annually increase of 3.1% for the past 20 years, and the trend is expected to continue. BP document that no significant replacement of BP oil has occurred and fossil fuel is showing significant gain in momentum. A well coordinated policy must be put in place to offset the trend. Based on the Carbon Leakage theory, unless strategic policies are put in place cheaper carbon fuels will always offset the struggle of the renewable energies.

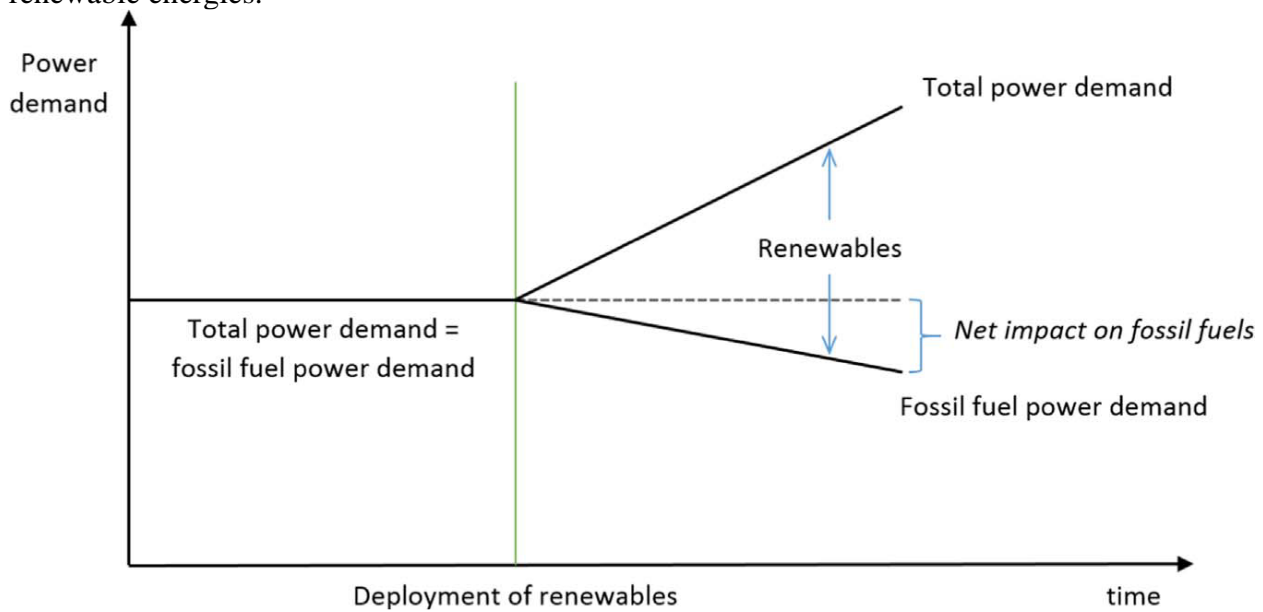


Figure 4: The Net impact of Renewable Energy on Fossil Fuels

While the quantity of fossil fuel being displaced by the renewable energy is small, the fuel price impact might be high-based demand and supply elasticity as shown below. (Figure 5)

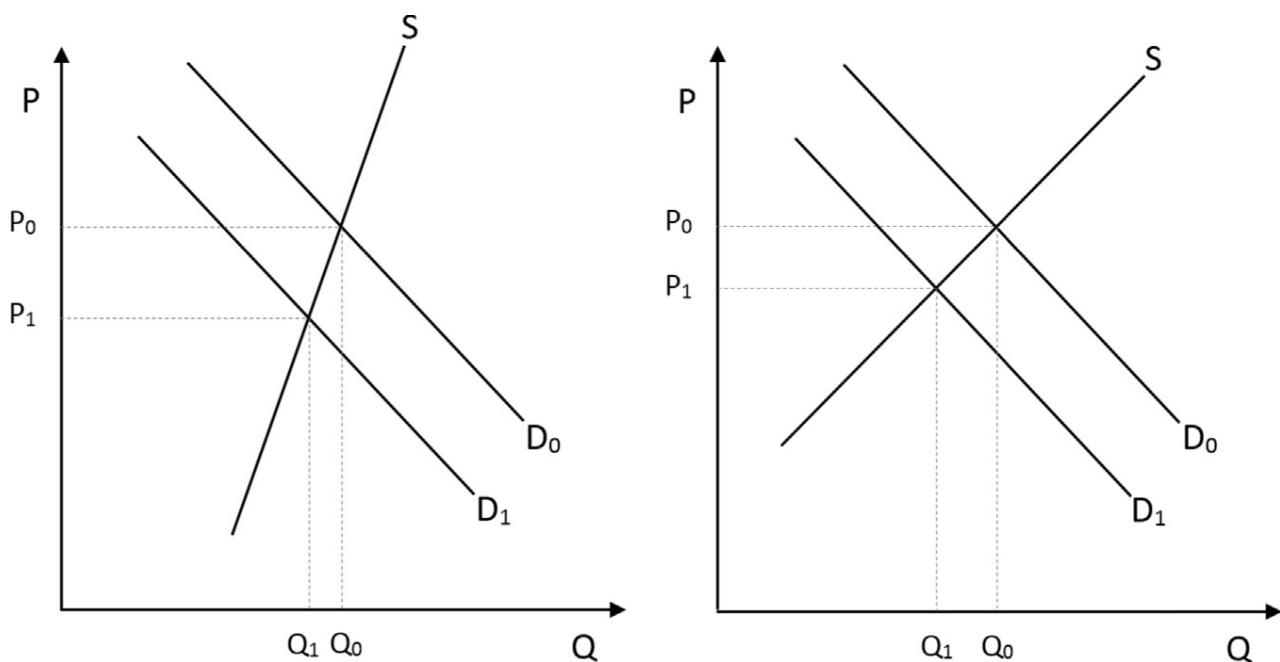


Figure 5: The effect of Demand and Supply elasticity on Fuels Price Change

A leftward shift in demand curve result to result to a significant price drop in an inelastic supply curve. An inelastic demand curve will result to another large price drop. In case the demand and supply curve for fossil fuels are inelastic, a small displacement of fossil fuel will attract a large drop in prices (IEA, 2013). Analysis of the behavior is however not easy because of the scarcity of data.

In an inelastic demand and supply, there can be a small shift to the left, which can lead to significant price response. In the short run, demand will be inelastic, hence price movement will depend on supply elasticity, which a market function (BP, 2015). If the producers start to compete against the renewable energy sources, a further drop in fossil fuel price may result, which will then push the supply curve downwards as shown below. (Figure 6)

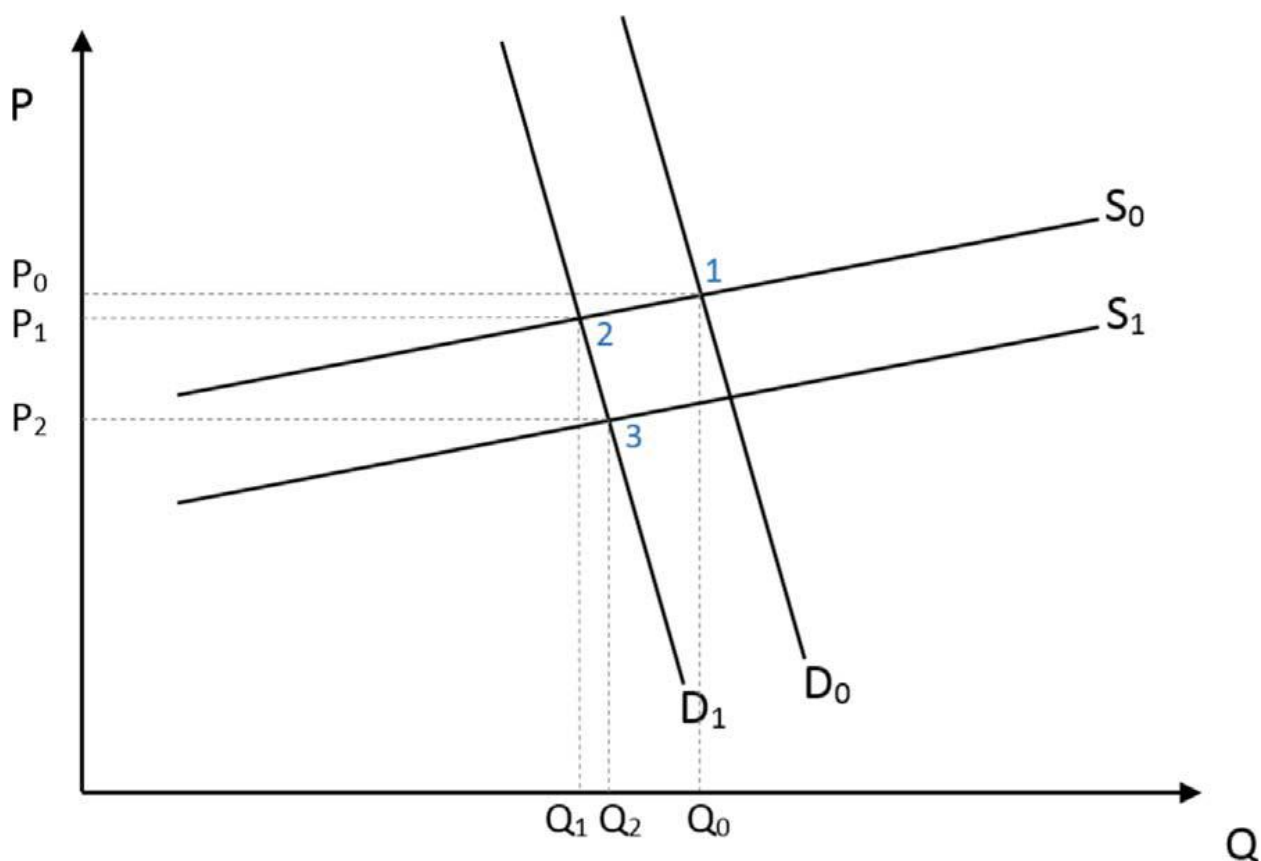


Figure 6: The Change in Price Shift the Supply and Demand Curve

Demand shift from D_0 to D_1 over elastic S_0 , this is followed by supply shift S_0 to S_1 that causes price drop P_0 to P_2 , a larger shift compared to demand shift along.

In a perfect completion with price equal to marginal cost, firms focus on technological advantages and cost reduction measures. However, the presence of large players in the fossil industry renders the market as imperfect. Some players will be ready to sell below the market price to gain competitive advantage. This is a threat for entrance of renewable energy.

Supply response of fossil fuel depend on the particular fossil, ownership, the field of mining, pricing mechanism, and the value chain. Coal basin costs vary with a factor determined as 3, and those to Europe by 4 (BP, 2015). The variations are considered techno-economic and geological disparities, labor, finance, and capital structure. Extraction in the basins also present financial variation since some basins proves more expensive than others. Based on ownership, private sectors will always fight completion with whichever mechanism available. State owned corporations as well enjoy economy of power and use price tool to control the market. The reactions suggest that without stronger policy approached, renewable energy will still face a challenge in the market.

Coal market on the other hand is considered a more stable market with strong pricing strategies. Coal dominates the global market as is often subjected to international pricing policies. However, the even coal distribution means only 15% is traded at the international market, the rest is traded regional and is influence by domestic market decisions (IEA, 2014). Such decisions can include price response incase in a competitive environment.

Price response after introduction of renewable energies is expected to occur. Price response will affect cost competitiveness of renewable energy, making introduction of the green energy take longer time and more expensive. The figure below demonstrates the effect of fossil price response.

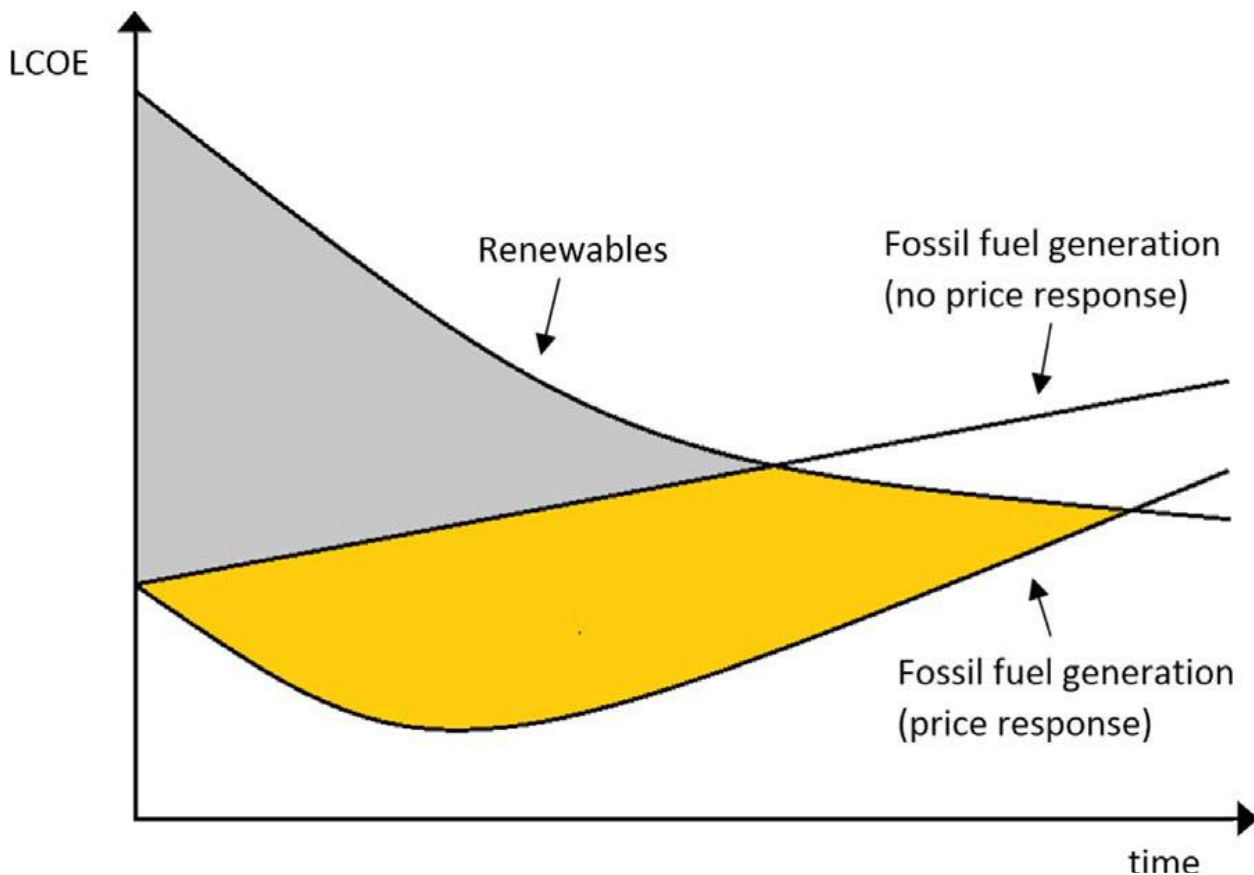


Figure 7: Price Response based on Levelized Cost of Energy

Based on the levelized cost of energy, fossil fuel generators will stay below the expected for a period longer than expected. Therefore, more financial investment should be pumped to ensure the realization of renewable energy competitiveness (yellow), below non-price response by fossil fuel (grey) (Long, 2015). Other market conditions will influence the magnitude of the scenario.

2. Conclusions

The paper analyzes possible market barriers to green energy and low carbon fuels. The paper identifies price responses that can make it hard for green energy to replace carbon compounds or make it expensive to execute than thought before. The theories that underscore the fossil fuel challenge include the Carbon Leakage and Green Paradox. The theories analyze the time and geographical effect of replacing fossil fuels, and has informed policies based on the need for sustainable development. However, market forces cannot realize the necessity of climate change needs. In response, the fossil fuel market players will adopt any possible to stay competitive. The paper, in detail has documented the impact of price responses to displacement of fossil fuel by the renewable energy forms (Long, 2015). The paper has adopted a framework and hypothetically tested the quantity and price factors against demand and supply, and tested possible completion behaviors that might impede green energy penetration of the market. Several factors have been determined to have impact on the renewable fuel successful displacement of the fossil energy sources.

Factors that can influence green energy penetration may include:

- Reduction in fossil fuel demand due to huge penetration of renewable energy alternatives. However, since price is a function of power the reduction can be influenced by price responses. In addition, the fact that fossil fuels have other functions outside power uses, they can take advantage of the environment.

- The demand for coal and gas for power is inelastic hence small reduction in fossil fuel demand can create a big price response

- Coal and gas price elasticity is uncertain. Price change due to fossil fuel supply reduction is insignificant, but additional price can be expected among the producers in response to competition needs.

- The imperfect nature of the market and the monopolistic behavior of fossil fuel producers have effect on competition control behaviors.

- There is a possibility of supply shift, but the extent is determined by the market structure and fossil fuel market segment.

The research concludes that more research is necessary to bring forth data for analyzing the market behavior and responses to determine the best approaches renewable energy can penetrate the market with ease.

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