Solar power - Whether it is economically possible substitute for natural gas in the near future

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According to estimations by Goldemberg, the fossil fuels that powers our world today – coal, natural gas and oil will soon run out of stock. Though the origination of fossil fuel is still in debate, most evidences show that fossil fuels are formed from the remains of ancient creatures, meaning it is not renewable within the time frame of human history. Once the fossil fuels run out, the power cost for products that use fossil fuel as energy source will skyrocket and most families will not be able to afford them anymore. This will severely damage the human society and economics, because most of human’s vital devices and facilities, such as gasoline vehicles, public transportation, electricity and residential heating system are powered by fossil fuels. A world without those things is unimaginable. The urge needs of finding a suitable substitute for fossil fuels drives us to think about the economical efficiencies of neon-power sources, especially the renewable ones. This essay will try to analysis the possibility if solar power can take over natural gas as main power source for electricity generation in the near future (~1-10 years). The economical issues will be addressed.

1. Usage

According to EIA, the United States used about 27.49 trillion cubic feet (Tcf) of natural gas in 2016, the equivalent of 28.4 quadrillion British thermal units (Btu), and 29% of total U.S. energy consumption (EIA, Use of Natural Gas, Oct. 26, 2017). In contrast, only 54866 MWh of solar power is spent in 2016, U.S. 28.4 quadrillion Btu equals 8.32e9 MWh, which is ~5 orders of magnitude larger then the latter. From here we can see that natural gas is still a major power source and the use of solar power can hardly make up the consumption of natural gas.

However, the usage of solar power is increasing every year in an astonishing rate. In the year of 2014, the total usage is still about 29GWh then in 2015, it becomes 39GWh. In the year of 2017, it grows to 77GWh. This is about 35% in increase every year, and the growing rate itself is also increasing yearly (EIA, “Net Generation from Renewable Sources: Total (All Sectors), 2008-June 2018”, Aug.24, 2018). If this trend continues, the use of solar power will be on the same level as natural gas in 30-40 years, and evidences are the current gas reserve is more then enough to support the use till that time.

This is good news, but can things be even better? There are 3 major issues with solar power. First and the most important issue is the price. Solar power is more expensive then natural gas. Industry and residence always choose the most economically efficient way of energy supply, and that is why they are still using gas. Secondly, solar energy is not a chemical energy, this limits its power. A solar panel can only generate a fixed power, unlike a natural gas-powered generator. So, whether the power from solar panels can be enough for residential/industrial use determines to what extent solar power can substitute for gas. Thirdly, the solar power is not a stable power source. The power of a solar panel changes due to the difference in the angle of the sun, and the climate. In the contrary, the need of power is all-day and all-week, thus to fulfill the needs we need a method to save the energy generated for future use. The rest of this article will try to analyze the cost basis.

1. Price and cost

*If someday the price of solar power can be cheaper then, or nearly as cheap as natural gas, then the use of solar power will probably surpass natural gas in a sudden.*

According to EIA, the construction cost for a natural gas power plant is 696$/kW in 2015. For solar power plant however, it’s 2921$/kW in the same year, and it should be noted that just 2 years earlier, in 2013, it was on an astonishing value of ~4000$/kW (Owen Comstock, [Construction costs for most power plant types have fallen in recent years](https://www.eia.gov/todayinenergy/detail.php?id=31912), EIA-Today in Energy, July.5, 2017). Few people were using solar power instead of power-grid electricity in the past years, simply because it’s too expensive. Merchants need to cut their utility cost to make revenue, and residents need to balance their sheets, so solar power is not their choice.

Over these years however, solar power is expanding rapidly. Still in 2015, more then 3000 MW of solar power is newly installed, almost half of the capacity of the newly installed natural gas power. The reason why solar power is becoming more and more popular is still behind the numbers on the balance sheets.

We already seen that the installation cost of solar power has been decreased greatly over the years. Though it is still more than 3 times higher than gas power, there are other factors that make the reality not so bad.

There are at least 3 other things that affects the final cost of power plants. First, the cost of the power source itself obviously should be considered. Second, the cost of the land that is used to construct the plant, it should be noted that some kinds of power plant, like wind, solar and geothermal, request a significantly larger area then other plants. Lastly, the policy bonus for renewable energy.

First let’s add the cost basis of power source itself into the table. The price of natural gas is currently 2.98$/MMBtu, or 0.01$/kWh (Natural Gas Price, markets.businessinsider.com, Sept.17, 2018). The price of natural gas is affected by a lot of factors which will not be covered in this paper, and for the past 20 years the average natural gas price is around 4$/MMBtu, or 0.015$/kWh, which will be applied in this paper. The cost of solar power, for now, is free, so 0$/kWh. If we take the life span of a power plant to be 40 years, which is not guaranteed but very possible, and use an average annual inflation of 2% (data taken from year 1989-2018) (Tim Mcmahon, Annual Inflation, inflationdata.com, Aug.10, 2018), the life time cost of natural gas for a power plant would be equivalent to 0.015$/kWh\*8h/day\*365days/year\*(1+1/1.02+1/1.02^2+…+1/1.02^39)=1222$/kW. Here we are using 8h/day because the solar panel can work only with proper sunlight. The hour and intensity of sunlight differs from place to place, but we are taking a reasonable average. Now the total cost of natural gas plant becomes ~1900$/kW, but the cost of solar plant is still ~3000$/kW.

Then consider the cost of land. As we all know solar plant is large in area, which implicitly increases the cost of solar power. But recently solar power corporations are extending the traditional roof-top installation of solar panel to a new level. Roof-top solar panels are becoming more beautiful, robust and affordable then ever. This is a very important reason to count for the rapid growth of solar power. With roof-top installation, the land issue of solar plant is avoided. Also consider the fact that most industrial solar plants are placed at the center of deserts, the average land cost of solar power plant should not be too much higher than natural gas plants.

Adopting solar power also grants the user a tax benefit according to policy, but the extend is different across the US, so this paper will not go into depth of this factor.

1. Conclusion

The price of solar power is becoming a lot cheaper these days. Corporations like Tesla are offering financial assistance for their solar panel products, which further reduces the financial threshold for those families who want to switch to solar power. These facts result in a rapid growth of solar power in the recent years. However solar power is still a lot (~60%) more expensive then natural gas, which makes it a minor source of electrical energy. Given about one or two decades though, with the price of solar panel continues to go down and the price of natural gas keep rising due to its limited amount of reserves, solar power will take the place of natural gas with no doubt.

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