A Study on Household Solar Systems in the United States

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Abstract: Nowadays, the household solar system has become a popular topic in the United States, and the U.S government has been encouraging residents to install the system in their houses in the last decade. In this research, we would discuss the factors that drive an increase in the numbers of the U.S household solar system. Furthermore, we would learn the positive relationships between the increasing household solar system installed capacity and the U.S economic growth, based on capital investment, productivity, and the Gross Domestic Product (GDP). Last but not least, we would discuss the future trend of household solar systems in the United States.

1. Introduction

Nowadays, solar power technologies are well developed and practiced in many aspects of modern societies, such as industrial purposes, transportation projects, and other important parts of countries' developments. Along with big projects from the government, solar power technologies also have been introduced to individual households. The most common usage of solar power technology in the household is installing solar panels system on the house's roof to generate daily sunlight. This method would convert solar power into electricity, which supplies the household daily electricity demand. The solar panel system would achieve the most energy efficiency when the panels collect as much solar power as possible. Hence, as a country with the richest solar resources around the world, the United States is a perfect location for the household solar power system. Indeed, there are dramatically increasing numbers of U.S households that decide to have solar systems in their houses in the past few years. Household solar system has become a trendy topic and extremely popular industry in the U.S. In the study, we want to discuss what are the factors that drive American households going forward with home solar systems. Moreover, we would study the relationship between the increasing household solar system installed capacity and the U.S economic growth. Furthermore, we would discuss the future trend of household solar systems in the United States.[1]

2. Household Solar System

According to the Solar Energy Industries Association (SEIA), solar power technologies are technologies that generate energy from the sun and converted into thermal or electrical energy. The

three major solar power technologies are solar photovoltaic (PV), solar thermal electricity, and solar heating and cooling. The Household solar panel system is one of the most common usages of solar PV technologies. Based on government data, 88 percent of U.S households live in single-family houses, which are qualified for installing residential solar systems. [2]In the last decade, the number of U.S households that choose home solar systems has been progressively increased every year. According to SEIA, the installed solar capacity was 421.82 Megawatt in 2009 and 15850.09 Megawatt in 2019, which indicated an approximately 3758 percent increase in just ten years[1]. We are going to discuss the reasons behind this dramatically increasing in this part of the study.

2.1. Government Incentive

The United States and all the State governments are playing important roles during the processes of promoting household solar system. During the last decade, the governments established many incentives and attractive polices on residential solar systems to draw more residents' attentions. Those incentives and policies are one of the main reasons that leading the progressively increase in the U.S household solar system installed capacity in the last decade. There are three major government incentives and policies that apply to most of U.S households, which are a federal investment tax credit for solar, State solar programs, and solar renewable energy certificates (SRECs).[3]

First of all, the U.S federal government provides solar tax credit incentives, which also knows as the investment tax credit (ITC), to encourage house owners to make decisions on solar panel systems. The ITC allows households to deduct 26 percent of the cost of the solar panel system from their year-end income taxes in 2020. The incentive was even stronger in a few years before, in which tax credit remains at 30 percent of the cost of the solar system. For example, the average cost of a household solar system in America is around 15,674.5 dollars. With tax credit incentives, households would save about 4,100 dollars on the year-end tax return. Secondly, along with the federal government incentives, each state government also announces its in-state solar programs to support promoting household solar systems, such as state tax credit, cash rebates, and other financial support policies. For instance, the Arizona state government offers additional solar tax credit, which is 25 percent of the cost of the solar panel system, on residents' income tax in the year of installation. Also, besides the federal government's ITC, the state of Texas provides homeowners 2,500 dollars cash rebate after they install solar panel systems in their house. Furthermore, other than the federal government and the state governments' incentives, the SRECs program also plays an important role in promoting solar panels to households. Some states require utility companies to generate a certain percentage of electricity from solar power. Thus, with SRECs solar panel systems, homeowners could sell certificates for solar energy to their utility companies, which some state could worth to 300 dollars. Therefore, with all the incentives from governments, many households are going forward with solar panel systems, because they could gain many benefits and save lots of money from installing the system.

2.2. Personal Savings

Other than the money saved from government incentives, the household solar system also helps families bringing down the electricity bills significantly. To illustrate the saving amount more specifically, I would use my current California residential house as an example. As a medium-size single-family house in Southern California, my current electricity bills are ranging from 140 dollars per month during wintertime to 290 dollars per month during summertime, which average around 200 dollars per month year-round.[4] Depending on the estimation quote from Project Sunroof, a

residential solar system estimation organization, the up-front cost of solar system installation for my house is 25,994 dollars before the tax credit and incentives and the remaining electricity cost for 20-year is 6,549 dollars. After calculation, the total 20-year cost without solar is 59,932 dollars and the total 20-year cost with solar is 24,745 dollars. Comparing both costs, we would save around 35,000 dollars from my electricity bill along in 20 years with a household solar system. Similar to my example, most U.S households would expect a great amount of saving on electricity with solar systems.

With this great amount of saving from electricity bills, people could deposit the additional fund into their bank account for emergency or retirement purposes. On the other hand, homeowners could also allocate this amount of capital into other goods and services, which would increase their level of utility, such as traveling, luxury goods, or other objects that people feel more satisfied with. Therefore, personal saving increasing from installing the solar panels system is a strong attractiveness to the majority of the U.S households, thus leading the solar installed capacity increase in the last decade.

3. The Relationship Between Household Solar System and Economic Growth

As the U.S governments promoting household solar systems, the country is leading the solar panels developments around the world. The U.S also becomes more energy efficient in the last decade. Many statistics data and researches suggest that there is a positive correlation between household solar panels system capacity and the country's economic growth. Moreover, in terms of economics, many indicators could demonstrate economically growth and relationships. In this part of the study, we will explain the relationship between the household solar system and the U.S economic growth from capital investment, production, productivity, and the Gross Domestic Product (GDP) aspects.

3.1. Capital Investment, Production, and Productivity

As we learned in the previous study, with all the governments' incentives and reduced electricity bills, the U.S households could save significant amounts of money from installing solar panels system in their houses. This benefit from residential solar systems would increase households' personal savings in their banks. Therefore, with more savings in the bank, the U.S banks would have stronger capabilities to invest in new businesses and manufactories, which also know as capital investment. According to researches, capital investment usually defined as an amount of money provided to a company to further its business objectives, such as the acquisition of long-term assets. With the capital investment from banks, companies could expand their business more widely, such as investing in new manufactory plants or opening new branches in the U.S. Those new plants would create more job opportunity for the U.S workforce, which would help to decrease the local unemployment rate and also increase production power. Moreover, with capital investment from the bank, the company could invest in equipment improvements and advanced technologies for production lines. With an advanced working environment, the company could achieve a higher level of labor efficiency and productivity, which also increases the total production level of the firm. Therefore, with improvements in companies' production level and labor productivity, the United States' production power and productivity would develop into an alternative level, which would also increase the country's economic growth, the country's trade power, and the country's developments.

On the other hand, as the fastest-growing industry in the U.S, the numbers of household solar system companies have been raised in the last decade. In 2020, there are over 6000 household solar panels companies around the U.S, which created over 200,000 job opportunities around the country[5]. Moreover, according to government researches, the residential solar panels industry still

has lots of room to expand, which would create more job positions in the U.S in the next decade. Therefore, the growing solar panels industry would keep improving the country's unemployment rate and increasing the production power on energy in the next few years, which would bring positive effects on the U.S economic growth.

3.2. GDP

As we all know, the Gross Domestic Product (GDP) is one of the most commonly used indicators that determine the country's economic performance of the year. We usually could explain and understand a country's economic position by analyzing the country's current GDP. Therefore, we could study the relationship between household solar system installed capacity and the U.S economic growth by analyzing the variables of GDP. There are three approaches to calculate the GDP, which are income approach, output approach, and expenditure approach. We would study the correlation between installed capacities of household solar systems and GDP from the expenditure approach.

According to expenditure approach, Gross Domestic Product (GDP) = Consumption spending + Investment spending + Government spending + Net Exports.

First of all, under the current situation, the United States has imported more energy than exports every year since 1953. The U.S has depended on importing energy to satisfy domestic energy demand. With increasing installed capacities in household solar systems, the U.S could generate more solar energy domestically, which would decrease the amount of energy purchasing from foreign countries. Thus, as keeping other variables the same, reducing energy imports from other countries would lead to an increase in the U.S's net exports, which would cause an increase in the country's GDP. Moreover, as we mentioned before, installing household solar systems would encourage the country's investment activities. Therefore, along with an increase in net exports, higher solar panels installed capacities would drive an increase in the country's investment spending, which would boost the U.S GDP as well. Hence, we could explain the positive relationship between household solar systems and the U.S Gross Domestic Product (GDP), which also concludes the positive correlation between household solar systems and the U.S economic growth.

4. Conclusion

As a well-developed country, the United States is leading the household solar system developments in the world. With support from the U.S governments, many U.S companies devote entirely to solar power innovation technologies. The solar panel efficiency has been improved substantially in the last decade. Moreover, as a new method to encourage solar systems installed capacity, most of the U.S new construction houses start to have built-in solar panels systems in 2020. To further developments on household solar systems, the U.S solar power companies should keep researching in the solar panel technologies, which would optimize the solar panel working efficiency and extend solar panels' lifespan. Moreover, the U.S governments should continue establishing new incentives and policies to best fit the country's situation of the time. Therefore, with complete supports from the U.S governments and companies, the household solar system industry is expecting a greater expansion in the next decade. Eventually, the United States would achieve a higher level of energy efficiency and energy self-sufficient in the future.

References

[1]. Becker, B. S. (2019, April 14). Solar Energy Statistics: 44 Numbers That Define U.S. Solar. Retrieved May 26, 2020, from https://solstice.us/solstice-blog/solar-energy-statistics/

[2]. About Solar Energy. (2020). Retrieved May 26, 2020, from https://www.seia.org/initiatives/about-solar-energy

[3]. Household accounts - Household spending - OECD Data. (2020). Retrieved May 26, 2020, from https://data.oecd.org/hha/household-spending.htm
[4]. Database of State Incentives for Renewables & Efficiency®. (2020). Retrieved May 26, 2020, from https://www.dsireusa.org/
[5]. Stewart, C. (2020). Census of Population and Housing - Publications - U.S. Census Bureau. Retrieved May 26, 2020, from https://www.census.gov/prod/www/decennial.html