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Abstract of Diploma Thesis

Optimization of energy production using renewables in Sweden

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Abstract

This paper deals with the Optimization of energy production using renewables in Sweden. It examines from 1995 to 2015, and this period has been chosen because on this period the development of renewable energy sources is very significant. The core objective of the research is to prove that, CO2e emissions and GDP has significant opposite relationship. Energy is vital to economic progress, but the modern universal population increase that demands more energy produced from predictable exhaustible resources, an energy price expansion, and environmental fears, risks sustainable economic growth. However, switching to renewable energy twisted from naturally restocked resources encourages energy security, similarly addressing matters such as global warming and climate change. This paper aims at discovering the influence and fundamental relation among renewable energy. Also, this paper tells about CO2e emissions and GDP growths with the help of different renewable energy resources. The simplex method has been used to find out the cost minimization problem which tells us to figure out the optimal solution. The results provide support for a positive influence of renewable energy overall, as well as by type, specifically hydropower, Nuclear energy, wind power, solar energy, and others on gross domestic product per capita in Sweden. Even so, Hydroelectricity shows the highest influence on economic growth among the rest of renewable energy types in Sweden. Last but not in the least, the diploma thesis optimizes the current renewable energy mix by using linear programming and recommends the optimal ratio of the carefully chosen energy sources both from an economic perspective and an environmental perspective.

Keywords: Sweden, Renewable energy resources, Energy Production Sweden, Optimization, Hydroelectricity, Nuclear energy, Wind energy generation, Solar power generation, Linear programming , Simplex method, Kaya Identity, CO2 emissions, GDP growth.

Objectives

Main objective of my research is to learn the different form of alternative energy sources accessible for future and to figure out the potential energy sources in the Sweden. And, I am focusing to understand important factors for contribution in influential if alternative energy should be used on beside. Sweden is one of the good examples to follow for the future sustainable development in energy sector, so I am more interested to understand vital role for the country economy by renewable energy sources. Furthermore, to analyse and predict future affect in the environment by non-renewable sources and role played by renewable energy sources. Sweden has high strategic plan and the target is 100 percent renewable electricity production by 2040 so one of main objectives is to understand how it will work effectively and it can be a good motivation for other developing countries to follow -up. Last but not least is to understand the main circumstances of CO2e emissions using kaya identity. In the last three-four decades the amount of CO2e is increasing all over the world which affect daily human life and environment, so my research will help to understand the how bad effect of non-renewable energy in the daily life of human beings and to the environment. And adding the main aims of the study is,

a. To analyse the potential energy economics in Sweden by renewable sources.
b. To know performance and prospects of renewable energy sources and their position on Swedish economy.
c. To review the main factors and to find the ideal energy mix for the Sweden.
d. To analyse future situation of renewable energy sources and impact on the economy.
e. To figure out the ideal renewable energy mix.

Methodology

I have been used several ways to clarify and understand my research. Some of the major are as follows:

Comparison method: with Norway and Germany

This method will help to understand how neighbours are growing up and what is the future role of Sweden to compete in the market by renewable energy sources. I have been compared with the production of renewable energy, consumption of renewable energy, kaya identity which told us about CO2 emissions in the certain criteria. Also, in comparison method, there has been compared the latest development and energy policy and strategic plan in each country. In comparative analysis data will be analyse among Norway with Sweden and Germany with Sweden. Production of renewable energy will be comparing in between these two countries. Mainly comparison will be done in the production, consumption and installed capacity of each country in last two decades. Data will be taken from 1995-2015, since this is the most appropriate period to analysis for future prediction as well.

Statistical data analysis:

If we are satisfied of estimation of our hypothesis, it as well necessary to evaluate the model efficiency and quality. We always interested in an economic variable, what really affects to the acknowledgements that's why we can get good result. Statistical analysis will be done via application excel, where CO2 emissions will be dependent variable and four different independent variables. Independent variables are GDP, however is also connected with different factors, population of the country, Energy intensity and carbon intensity. In statistical analysis data will be taken from 1995-2015 so analysis could be very effective, and it could talk about past procedure and it makes easier to estimate the future prediction. In statistical analysis, the production mix of renewable energy and cost efficiency will be calculated which will help to figure out which sources more productive and less costs efficient.

Kaya identity (Greenhouse gas emissions)

Last method will be kaya identity. The Kaya identity tells the greenhouse gas (GHG) emissions to energy use, economic progress and population growth. Consequently, it can be functional to crumble GHG emissions with respect to the latter relations. In kaya identity will focus on the three different state which are obviously Sweden and Sweden will be compared with complex progressive Nordic countries Norway and West European country Germany. I have been chosen those countries because both of them are huge country and the strategic plan of those countries are similar to Sweden and Germany has huge impact on EU and is the leading country in the EU. While, Norway has huge resources of renewable energy sources for example hydro, solar and wind energy. So, the kaya identity will discover and figure out the relation of country economy and CO2 emissions.

Hypothesis

H1: More energy consumption per capita supports economic growth of Sweden

H2: Renewable sources of energy such as Hydro power, nuclear power plant is less harmful to the life of human being compared to a non-renewable source of energy such as coal (in point of view from CO2 emission)

H3: Increase in share of renewable energy impact on greenhouse gas emissions and climate change.

Results

My research found that decrease in carbon emission has indirect relation with the GDP growth of the nation. To reduce the carbon emissions, we must use renewable energy sources. Furthermore, if we have more manufacturing companies and factories or so on means we need more energy. Such as consuming more energy demands more production. And consumption has a direct relationship with the GDP of the nation. So more renewable energy consumption increases the GDP of the states. In the other hand, we are using the energy from non-renewable sources definitely decrease the amount of fossils fuels and mainly decreases the amount of carbon emissions. It is true that renewable energy resources also produce carbon while manufacturing and construction of the power plant, however, this amount is comparatively low with the non-renewable energy sources. In another part of my research about cost minimization, the optimal solution shows that there is needed some modification and it recommend that Sweden should more focus on Biogas energy since it is less cost efficient and more eco-friendly .Progressively less energy will be accounted to produce solar modules, due to technological advancement and a modification on the road to less energy concentrated technology alternatives. At the same time, the global environment variation, the determination will diminish the CO2 emissions per unit of electricity.

Conclusion

The core aims of the thesis was to examine the current renewable energy mix from the economic and environmental standpoint, to understand the development strategy of Sweden in comparison with Germany and Norway and to figure out how the CO2 emissions affect GDP of the nation. Based on the examination, it was acknowledged that the current energy mix in Sweden might be improved as of the economic aspect, and positively should be more optimized from the environmental standpoint. Overall research also hints that Sweden could be the example to follow about electricity from renewable energy sources because Germany and Norway are considered to be a very strong country in point of view from the development of renewable energy, however, Sweden has more consumption of renewable energy in last two decades and also Sweden seems very effective on their strategic policy. On the Other hand, after using of linear programming for the cost minimization solution prefer Biomass energy and correspondingly hint that there should be considerable changes in the future of energy mix.

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