"Analysis of factors affecting Electricity Generation from Renewable Energy for "Asia and Europe"

A Dissertation Report submitted in the fulfillment of the

Requirements for the award of Master of Arts (M.A.)

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Under the Guidance of

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CERTIFICATE

TO WHOMSOEVER IT MAY CONCERN

This is to certify that the dissertation report on "**Analysis of factors affecting Electricity Generation from Renewable Energy for "Asia and Europe**" completed and submitted to University of Petroleum and Energy Studies, Dehradun by Mr. Upananda Pani in partial fulfillment of the provisions and requirements for the award of degree of MASTER OF ARTS (ENERGY ECONOMICS), 20014-16 is a bonafide work carried by the scholar under my supervision and guidance.

To the best of my knowledge and belief the work has been based on investigation made, data collected and analyzed by the scholar, and this work has not been submitted anywhere else to any other university or institution for the award of any degree/diploma.

Dated…….

( )

(UPES, Dehradun)

ACKNOWLEDGEMENT

First and foremost, I would like to thank my mentor “Mr. Upananada Pani” ( ) for his valuable guidance and encouragement throughout my research project on “Importance of Smart grid in India”. His expertise, enthusiasm, and dedication for work have been constant source of motivation for me.

I would like to express my deep gratitude to “University of Petroleum and Energy Studies” for extending the opportunity of undergoing the project and providing with all necessary resources and expertise needed for completion of the project.

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M.A (ENERGY ECONOMICS)

TABLE OF CONTENT:

Literature Review:

1. **RENEWABLES 2015 GLOBAL STATUS REPORT-**The paper focuses on the renewable energy trends with global view in background of renewable energy consumption and its Government support policies that have increased cost-competitiveness, particularly for electricity generated from wind and solar photovoltaic's (PV) have driven recent renewable energy development, resulting in changing market conditions for deployment. It has explained the importance of grid management, and integrated renewable energy-based power systems with the transport, buildings, industry, and heating and cooling sectors, demand side management. The paper also focuses on the financing of renewable energy projects in the developing nations and elaborating the industries which are the major consumers of energy mainly industries, transport industry.

2. **Impact of Fossil Fuels Subsidies on Renewable Electricity Generation: GSI Report-** The paper reflects how the subsidies gifted to fossil fuel production give a back gear to renewable energy generation. The IEA quotes that the fossil fuel subsidy globally in thrice to the renewable energy subsidy which does not give incentives to the designated consumers to produce electricity through renewable energy.

3. **Factors and Initiatives affecting Renewable Energy use in the Hotel Industry: Hotel Energy Solutions –**The paper focuses on the role of Hotel Industry in reducing the energy intensity through various energy efficient tools. In EU many hotels are using the energy efficient appliances and are also following energy building codes. The one concern is the cost and expertise required for the installation of renewable energy technologies as the costing is high with low technical experts available.

4. **What is the impact of renewable electricity generation on economic growth and carbon emissions in the UK:** Eteng Ibiang -In This paper the author has developed an economic model to analyze the renewable energy generation on GDP and Co2 emissions. The results shows that although the carbon emission levels have fallen which is a good sign but the economic growth is also showing a negative sign that is with incentives and subsidies for renewable energy generation it has a negative impact on the economic growth.

5. **Energy Efficiency Market Report 2015:** The major highlight of the report is the reduction in energy intensity by OECD nations. The energy consumption is OECD nations have reduced to the level of year 2000.The nations are focusing immensely on energy efficiency realizing the importance of energy security. The report gives a snapshot of countries in terms of efficiency market such as Brazil, Mexico, United States, Japan and more.

6. **Factors affecting the adoption of wind and solar Generating systems on U.S farms: Experiences at the state level –**The adoption of renewable energy is based on certain economic factors such as energy prices and resource potential. A country with high amount of non-renewable sources such as oil or coal may be reluctant to adopt renewable energy. The technical growth in RE can reduce the cost of installation a s well as the operating cost bringing it to the level of conventional sources would be highly advantageous.

7. **Uttarakhand Solar Power Policy-2013(MNRE)-**The Uttarakhand solar policy,2013 has major objective is to encourage green energy development in the state with aim of installed 500MW of solar capacity by 2017.It has also focused on creating a cohesive environment for investors and creating job opportunities in the sector. It has laid down various incentives and subsidies in case of R.E installation by the developers. The paper can help in finding the state of Uttarakhand in solar energy installation.

8. **Uttarakhand R.E Power Policy-2013(MNRE)-**Uttarakhand is high small and large hydro energy potential with more than 20,000MW capacity yet to be tapped. Hydro energy can bridge gap in demand supply energy deficit in Uttarakhand. The prime objective is to meet and supplement rural energy demand needs with sustainable R.E projects. Also, to enhance the use of resources this can reduce carbon emissions. This can help me find the policy initiated by the state government for hydro energy and help me in accessing data for actual hydro generation in the state. It also gives a detail report on wind and Geothermal energy potential in the state. It also lays down various eligibility criteria for setting up of renewable energy projects in Uttarakhand such as in case of self identified hydro project the individual should be of Uttarakhand, it explains the allotment procedure and the bidding mechanism which is a great help to my dissertation.

9. **Frankfurt School for Climate and Sustainable Energy Centre-** Global Energy trends in renewable energy Investments, 2015.This paper focuses on the global investment in the renewable energy sector. Global investment in renewable power and fuels (excluding large hydro-electric projects) was $270.2 billion in 2014, nearly 17% higher than the previous year. The key finding is the high investment in solar energy as installed capacity has touched 95 GW as compared to 74 GW in 2013.Investment in developing nations has risen to a large extent that is $ 131.3 billion, which is very close to the investment of $139 billion by developed nations. Also, Altogether, wind, solar, biomass and waste-to-power, geothermal, small hydro and marine power are estimated to have contributed 9.1% of world electricity generation in 2014, compared to 8.5% in 2013. This would be equivalent to a saving of 1.3 gigatonnes of CO2 taking place as a result of the installed capacity of those renewable sources.

10. **The Effect of Renewable Energy Development on Carbon Emission Reduction: An Empirical Analysis for the EU-15 Countries**-The study depicts the relationship between carbon emissions and the income in China and Turkey. The use of EKC to depict the relationship between carbon emissions and trade openness. The Paper investigates effectiveness of power generated by renewable energy sources, technological

innovation, and market regulations on the mitigation of climate change. Also, calculates the elasticity of carbon emissions per capita for each parameter. Finally, the report has given various ways through which the carbon emissions can be reduced such as energy efficiency, environmental tax, and technological shift to a better and efficient energy system. The analysis of the ecometrix model will be a guiding element in analysis of my model.

11. **Hydro Power Potential in Uttarakhand:** M.C. Joshi Department of Energy, Govt. of Uttarakhand, Dehradun.-The paper has described in detail the various Hydro projects working in Uttarakhand and the potential of the state in Hydro Energy in Micro,Mini and major Hydro plants in the state. It has listed various challenges faced in setting up of small hydro power projects. The main issue of environmental clearances and difficulty in setting plant due to geographical challenges.

12. **Schemes for Grid Interacted Rooftop and small SPV Power Plants in Uttarakhand:** The paper focuses on the need for off grid and decentralized system in Uttarakhand, for this JNNSM schemes are working to encourage solar rooftop and solar SPV power plants in the state. The last phase of my project requires the detail government initiatives to encourage various types of solar installation such as solar installations owned by consumer. Secondly, solar installations owned, operated and maintained by 3rd Party. Thirdly, Solar Installations Owned by the Utility Ownership of and its various sub parts.

13. **(ICLEI South Asia, May 2007)** -.Local government can be used as a driver to implement renewable energy as the required technologies are mature, available targets and policies exist at national level only for this clear target and proper framework can be set at the city level to achieve national target of energy efficiency. This paper has identified some important instruments that already exist with the local governments and can be used in achieving the goal, the following are the instruments. **Legal instruments**, this basically mean amending existing bylaws or making new policies. MNRE and Ministry of Urban Development have been working to get the building bylaws in all the municipalities across India for Installation of solar assisted water heating, eg. Rajkot Municipal Corporation.

14. For promotion of RE & EE at local level **financial instrument** plays an important role as these are kind of incentives which could be financial or fiscal. Example, Thane Municipal Corporation. **Persuasive and information instruments** to accelerate development and deployment of RE & EE Programs in local communities by organizing awareness and training programs. Example, Bhubaneswar and Nagpur have established RE & EE resource centers to create a focal point to generate awareness among citizens.

15. **Demonstration projects** at local level are implemented to demonstrate RE & EE option with that work in available climate, geography and in the general context.

16. **ADB sustainable development paper-Transport and carbon Emissions: Forecasts, Options Analysis, and Evaluation:** The transport sector contributes highly on carbon emissions. The road transport, automobiles and light trucks contribute majorly on the carbon emissions; the steady increase in GDP in the developing country has lead to high carbon emission. The increase in the numbers of trucks, cars on roads has increased greatly. The ADB has advice Asian countries to reduce carbon emissions using energy efficiency techniques.

17. **Linking Renewable Energy to Rural Deployment: OECD**
    The paper focuses on the importance of R.E to drive growth in the rural areas which can provide job opportunities in R.E market, work as a supporting system for enrgy access in the rural areas such as standalone system, Hybrid system and finally a measure to reduce C02 emissions in the country. It is also important to not to focus only on a single source of R.E, hybrid method such as solar, biomass and geothermal at the same platform can be used.

18. **Energy Efficiency Trends and Policies in Norway: Institute of Energy Technology**
    The paper has discussed the energy efficient market of Norway through the detail analysis of energy intensive industries such as transport, residential and commercial buildings and industries like aluminum and cement industry. The paper lays down the policies adopted by the government to reduce energy intensity and the carbon emission in the country**.**

Topic:

Renewable Energy as a concept is selling like hot buns across globe. India has also set up an optimistic target of 175GW of installed renewable energy capacity by 2022 under Jawaharlal Nehru National Solar Mission. Renewable Energy is the energy derived from natural resources that can be rejuvenated over a period of time and do not have the threat of depletion. Energy from sun, hydro, geothermal and wind are abundant in nature with less or no carbon dioxide emissions. The use of fossil fuels has led to the emissions of green house gases which have affected the climate conditions, infrastructure, health of individual and society as a whole. The drawbacks of conventional resources shifted the interest of economies to renewable resources of energy. India's first Hydro project was Sidrapong Hydel power station near Darjeeling which was commissioned in 1986.Many of the wind farms were also set up near Ratnagiri in Maharashtra and Gujarat at the same time and got momentum thereafter. The statistics also show the same tale, the 10 ten data depicts 25% growth rate in R.E installation in India as of January 2014 with exponential rate in installation of wind power that is 30000 MW, Solar energy has also risen from 0 to around 5000 MW recently. The growth in renewable has changed the business prospects also, more and more companies are willing to invest in renewable energy due to impulsive policy support from the government in terms of subsidies in setting solar plant at solar parks, incentives for solar rooftop and decentralized system or stand alone systems which are solar cookers, solar lanterns, solar lighting system and Micro-hydel to name a few are triggered through various rebates and subsidies.

Thus the Introduction briefs us regarding the renewable energy trend and policies initiated by government to increase the installed capacity. But it is also important to analyze the actual month wise generation trends across various regions in India. This will help us to build a model with Renewable Energy Generation say wind in first case as dependent variable and other parameters such as seasonality, electricity consumption from other renewable resources(solar, hydro),Carbon dioxide emission and per capita income of the state to be the independent variables.

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Thus collaborating my area of interest with industrial demand I have decided to chose this topic and herby provide the necessary research gap and objective through my synopsis.

Research Gap:

The main research area will be to find the impact of various factors such as Gross capital formation (constant 2005 US$), Carbon dioxide emission, Renewable energy consumption (% of total final energy consumption), Imports of oil (1000 tons), Energy use (kt of oil equivalent), and imports of LPG on Electricity production from renewable energy for three nations which are India, Japan and Singapore. Also, my key target is to find whether the government initiative through policy making has impacted the production of renewable energy and energy efficiency mechanisms in various countries and cities across globe and recommending to the Indian renewable system.

Research Question:

1. What is the impact of independent factors (Gross capital formation (constant 2005 US$), Carbon dioxide emission, Renewable energy consumption (% of total final energy consumption), Imports of oil (1000 tons), Energy use (kt of oil equivalent), and imports of LPG on the electricity generation from renewable sources (excluding hydro)?
2. Which model (Fixed Effects or Random effect model) should be used for the panel data regression in the comparative analysis of European and Asia's Renewable Energy Market?
3. What are the recommendations that can be given to policy makers to improve renewable energy market in India from the learning from European Renewable Energy Market?

Research Objective:

1. To Find the Impact of independent factors (Gross capital formation (constant 2005 US$), Carbon dioxide emission, Renewable energy consumption (% of total final energy consumption), Imports of oil (1000 tons), Energy use (kt of oil equivalent), and imports of LPG on the electricity generation from renewable sources (excluding hydro.

2. To find the best Model (Fixed Effects or Random effect model) for the comparative analysis of European and Asia's Renewable Energy Market?

3. To study the various policies and initiatives taken by European countries that can be implemented in Indian Renewable Energy Market to achieve the target of 175Gw by 2022.

4. To study the various Energy Efficiency techniques adopted by the European nations(Norway, Germany, Sweden) countries that can be implemented in Indian Renewable Energy Market

Research Methodology:

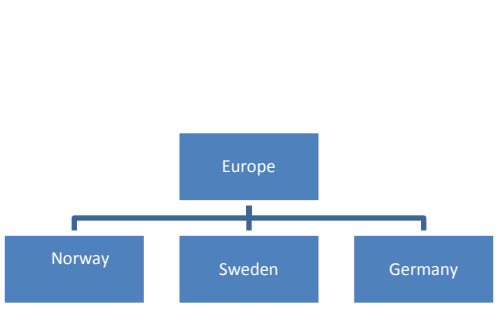
1. The study done through the Exploratory Research as it helps to start the research from starting point, and move to the future, either on the basis of exploratory past trends or casual dynamics of India, Japan and Singapore.

2. The data acquired for different countries which are Singapore, Japan and India will be used to run regression model and the panel data analysis will be done using software such as **STATA** and **GRETL** to find the impact of various parameters such as Gross capital formation (constant 2005 US$), Carbon dioxide emission, Renewable energy consumption (% of total final energy consumption), Imports of oil (1000 tons), Energy use (kt of oil equivalent), and imports of LPG on Electricity production from renewable energy. The entire research will be based on secondary research. The data acquired mainly from IEA and World Bank site.

Mathematically:

$$C = f(G.C.F, R.C, C02, \text{Imports of Oil}, \text{Imports of LPG}, \text{Energy Use})$$

For my analysis I have selected 6 countries, 3 for each region:



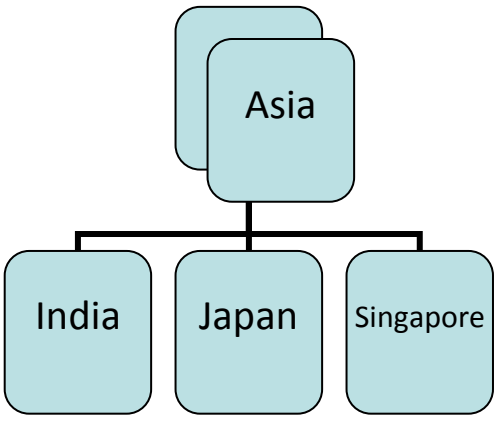


Figure1:

CHAPTER1

Introduction:

1.1 Panel Data Analysis for Electricity Production from Renewable Energy for "Asia and Europe countries"

The renewable energy is the energy derived from various sources such as sunlight which is called as solar energy, water which we refer as hydro energy and then the steam which is geothermal energy. The renewable energy can generally be replenished over a period of time and has low or no carbon emissions which is there in case of conventional sources like coal and oil. The renewable energy report states that, renewable contributed 19 percent to humans' energy consumption, 2 percent to their generation of electricity in 2012 and 2013, respectively. This energy consumption is divided as 9% coming from traditional biomass, 4.2% as heat energy (non-biomass), 3.8% hydro electricity and 2% is electricity from wind, solar, geothermal, and biomass. The investments in renewable energy production has increased enormously worldwide with India betting high on the target of 175 GW of energy generation from renewable which requires cores of capital investments.

India with the population of 128 billion people, growing at the GDP of around 7.2 % per annum is liable to have immense energy demand .The dependence on fossils fuels such as coal and oil has raised the need to bridge the demand-supply gap to resolve energy security and harmful environmental concerns, directing India to set the target of generating 40% of electricity from renewable sources by 2022.Talking about renewable energy mix in India, which comprises of Solar installed capacity of "", Hydro with the installed capacity of "" , Wind with installed capacity of ""and biomass with"'. India is the only country with exclusive ministry for non-conventional sources of Energy which then is named as Ministry of New and Renewable Energy in "".India is a tropical country with solar radiation of 4-6KWh/m^2/day and 3000 hours of sunshine per year, contributing approximately 5000 trillion kWh of energy. Thus, solar energy can play a vital role in achieving the target of 40% share of renewable energy in the total energy mix of India by 2030.Also, India ranks third in the wind energy and has high offshore wind energy potential as per Wind Energy association. To utilize the renewable potential to its maximum government has initiated various programs and policies such as Jawaharlal Nehru National Solar Mission which started in 2010 to achieve the highly optimistic target of 110 GW of solar electricity as a part of total target of renewable generation of 175 GW from Renewable Energy by 2022.With the availability of energy, the affordability of energy from renewable is also the prime objective. The grid connected price of solar power has reduced to very low level of Rs.4.34 per unit in a recent bid in Rajasthan due to technical growth, policies initiatives; the subsidy support by government has acted as the pioneer for the same .Similarly the investment in Hydroelectricity, wind has also increased at an impeccable rate due to the following reasons: Firstly, the social concerns has driven government to incentivize private players to invest in renewable, Secondly, to fight the demand-supply gap of energy, secondly, there is huge untapped renewable energy potential in India which has high economic value, thirdly, the Rajeev Gandhi Grameen Vidyutikaran Yojana to electrify rural areas which can be supported

majorly through renewable off grid solution. The Renewable Energy Market in India is worth "" and is expected to increase even more being the third most attractive investment country for renewable in 2016.It is thus vital for India to capture the optimism for renewable energy investment among developers and attract as many domestic private developers and Foreign direct Investment in renewable energy sector in India.

1.2 BACKGROUND:

Asian Region

The renewable energy production is also bounded with geographical location that is the equator regions have high solar energy capacity whereas the coastal region has high wind speed so the wind energy can have very good potential in such areas. Talking about India Karnataka, Andhra Pradesh has good wind energy potential, whereas Rajasthan is enriched with solar energy. Renewable energy is also the need of an hour due to the concerns of energy security Climate change and its economic benefits. Renewable energy not reduces the carbon emission level in the environment but always gives an alternative for conventional sources of energy which are exhaustible in the near future. In international public opinion surveys there is strong support for promoting renewable sources such as solar power and wind power. At the national level, at least 30 nations around the world already have renewable energy contributing more than 20 percent of energy supply. National renewable energy markets are projected to continue to grow strongly in the coming decade and beyond. Some places and at least two countries, Iceland and Norway generate all their electricity using renewable energy already, and many other countries have the set a goal to reach 100% renewable energy in the future. For example, in Denmark the government decided to switch the total energy supply (electricity, mobility and heating/cooling) to 100% renewable energy by 2050.

The second country for the analysis is Singapore which is a major hub for solar technology in Asian belt. It has a very strong research and development sector for new buildings codes, energy and water. It has invested huge capital for the energy efficient projects such as $550 million "Factory of the Future" initiative where major focus is on the adoption of green technologies and sustainable process. It does not only initiate new technology but also provide innovative financing mechanism such as project bonds and green business trusts are also being developed. Due to its limited land area it has come up with new technologies such as photovoltaic projects on Singapore reservoirs.

The Third country taken into account is Japan whose renewable energy source is majorly Hydro. Although the share of Renewable Energy has fallen sharply in Japan to just merely 10 % from 25% in 1970 in the generation mix of the nation. Government has laid various incentives such as Feed in tariff; Generation based incentives and many more to raise the electricity generation from renewable sources. The focus of Japan is more on the Nuclear Energy but it has been criticized among various nations due to the hazardous nation of nuclear energy to the environment.

1.3 Background

European Regions:

Norway is a country with high hydroelectricity installed capacity of 122Twh; 1283Gwh. In compared to EU average in 2008, the electricity consumption in Norway was three times more. Also, the main usage was for heating houses and in the energy intensive industries like aluminum industry. The Renewable energy share increased because of energy tax, tradable renewable energy certificates in the market. As per the Norweigner government report, Norway has excess supply of electricity than demand and has great export potential. Talking about sources highly prevalent in Norway such as Wind with the capacity of 650Mw in 2011 and has reached now to 838Mw in 2015.The solar potential of the country is also very high with already massive hydroelectricity capacity.

Sweden is one country which has invested impeccable amount on renewable energy, making it the world leader in renewable energy and energy efficiency. 75% of the energy demand was met by oil in 1970s but after oil crisis in 1970s Sweden looked for alternative sources of energy such as hydro, wind and solar. It brought down the level the dependence on oil to 20% now and has the target to be having fully renewable supply by 2050.Due to higher renewable use the carbon emissions have also fallen to commendable level. Sweden is the only country with 3 nuclear reactors per million citizens. It has world class energy market, giving the customers the choice to choose their supplier with the market driven price mechanism. It also has encouraged energy consulting services where citizens are guided to conserve energy through small changes in day to day activities, following Energy Building codes, the more usage of electric cars and the installation of solar Panels on roof top. Thus, it has highly renewable driven market and is a benchmark for various nations around the globe.

Germany has the most innovative and unique renewable energy market. The renewable energy share has increased from 6.3% in 2000 to 30% in 2015.It was called the first world renewable country, with the major biomass, wind and solar installed capacity. The investment on off share wind farms has also increased to a major extent. The renewable as a percentage of the primary energy consumption of Germany has increased from 1.3 % to 11.1 % in 2014.Germany is innovating on alternative technologies such as solar photovoltaic, Geothermal Energy, off shore wind farms, renewable energy certificates and electricity from biomass generation is encouraged to reduce carbon emission. Even the government incentives have boosted the R.E market. The scheme like selling R.E at the fixed rate for certain period of time which has surged R.E market. Secondly, the Renewable Energy sources Act also guides renewable energy through stipulating Feed-in-tariffs. Thus, it has a very developed renewable energy market and act as a pioneer for the most emerging nations of the globe.

Now, with the above background on national and global scenario of renewable energy, I would like to explain my project which analyzes the various factors that may affect the renewable energy production. I have selected three countries, firstly India, Japan and Singapore. The factors for the purpose of analysis are:

1. Gross capital formation
2. Renewable Energy consumption (% of total final energy consumption)
3. co2emission
4. Imports of oil

5. Energy use (kt)
6. Imports of LPG

The above are the six independent factors that might affect the dependent factor which is "Electricity production from Renewable Energy".

1. **Gross capital Formation**: It (formerly **gross** domestic investment) consists of outlays on additions to the fixed assets of the economy plus net changes in the level of inventories. It is expected to have negative relationship with Electricity generation of renewable sources (excluding Hydroelectricity).
2. **Renewable Energy Consumption**: It means the amount of renewable energy that is being consumed by the nation or the global renewable energy consumption. It is expected to have a positive relationship with Electricity generation of renewable sources(excluding Hydroelectricity)
3. **Co2 Emission**: Carbon dioxide emissions into the atmosphere, and the emissions of other GHGs, are often associated with the burning of fossil fuels, like natural gas, crude oil and coal. While this is harmful to the environment, carbon offsets can be purchased in an attempt to make up for these harmful effects. It is expected to have a positive relationship with Electricity generation of renewable sources (excluding Hydroelectricity).
4. **Imports of Oil**: It is the amount of oil that is being imported by India, Japan and Singapore. It is expected to have negative relationship with Electricity generation of renewable sources (excluding Hydroelectricity).
5. **Energy Use (KT):** It is amount of energy use in the unit KT. It is expected to have a positive relationship with Electricity generation of renewable sources (excluding Hydroelectricity
6. **Imports of LPG**: It is an important factor for the analysis. It is the amount of Liquefied Petroleum Gas imported by the different nations. In our case it is Japan, Singapore and India. . It is expected to have negative relationship with Electricity generation of renewable sources (excluding Hydroelectricity).

If we analyze the real relationship : We take the assumption that government is pro towards conventional sources that is with the increase in Gross capital Formation there will be no or less impact on electricity production from renewable sources.

Variable	Obs	Mean	Std. Dev.	Min	Max
Electricity Generation from Renewable Sources	66	1.23E+10	2.25E+10	2.09E+08	1.06E+11
Gross capital Formation	66	2.38E+11	2.43E+11	3.74E+10	6.44E+11
Renewable Energy Consumption	66	33.83643	22.53194	1.974577	61.37897
Imports of Oil	66	40781.86	44493.41	384	112314
co2emission	65	298326.1	369811.6	29655.03	929973.2

1.3 Graphical Description of descriptive analysis:

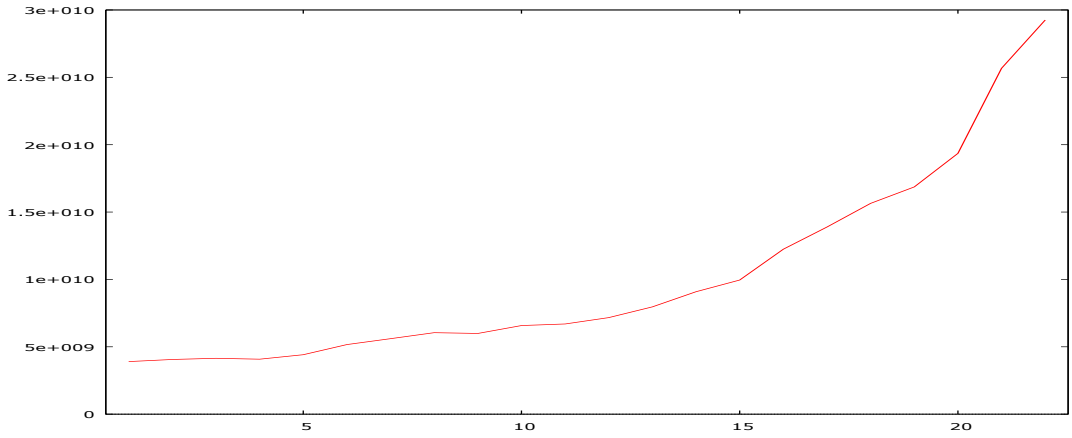


Figure1: Electricity production from renewable sources

The mean of Electricity production from renewable sources has an increasing trend with S.D of. 1.21E+10 and min 3.20E+07 and max of 4.47E+10.

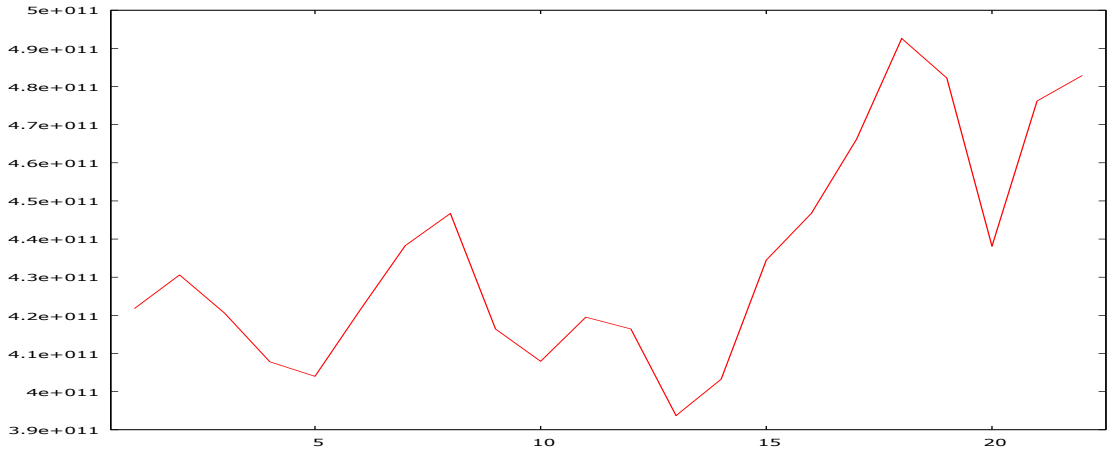


Figure2: Gross Capital Formation

The trend in gross capital has various trends. It has decreased and increased and this cycle is maintained. This has increased lately.

1.

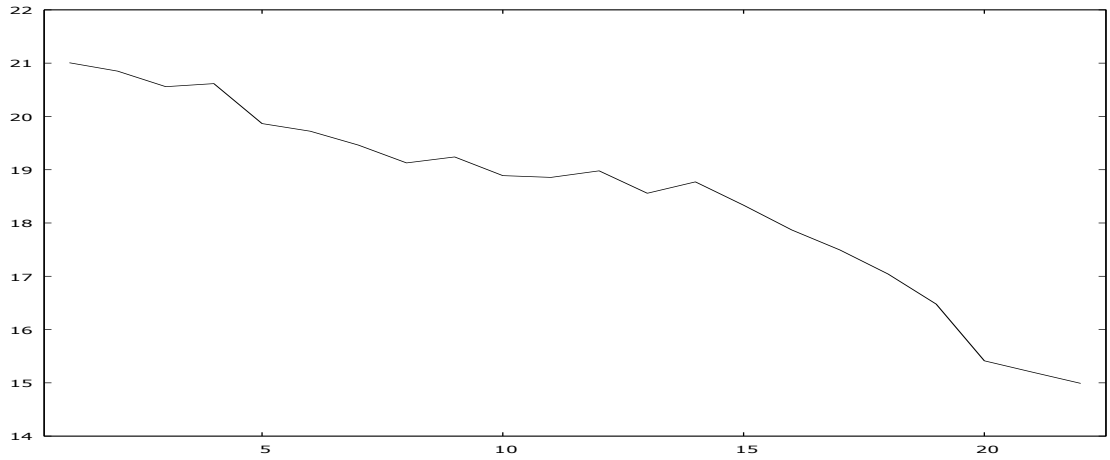


Figure3: Renewable Energy Consumption

The mean of the renewable energy consumption is showing a sharp decline.With an average mean of 18.51478.

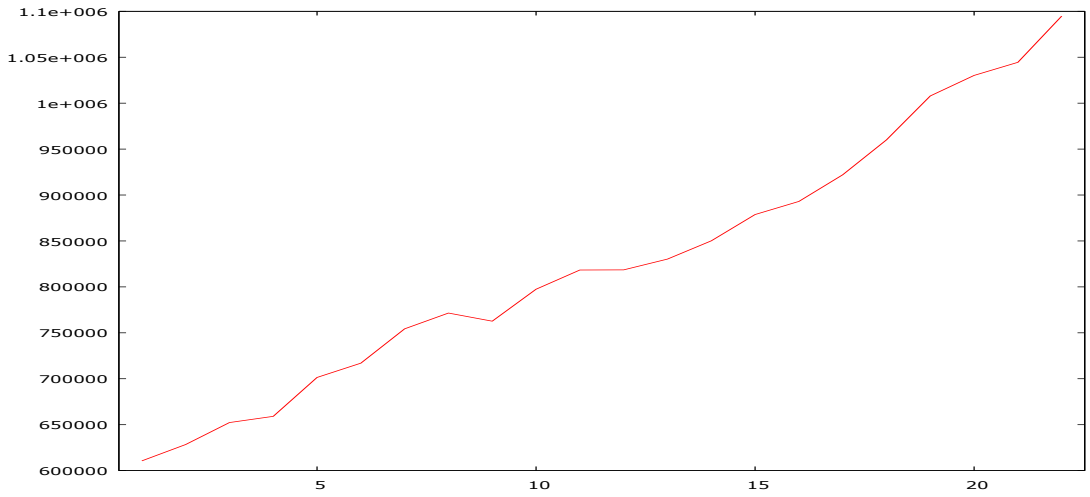


Figure4: C02 Emission

The trend in the mean of the carbon emission has increased over the period of time.

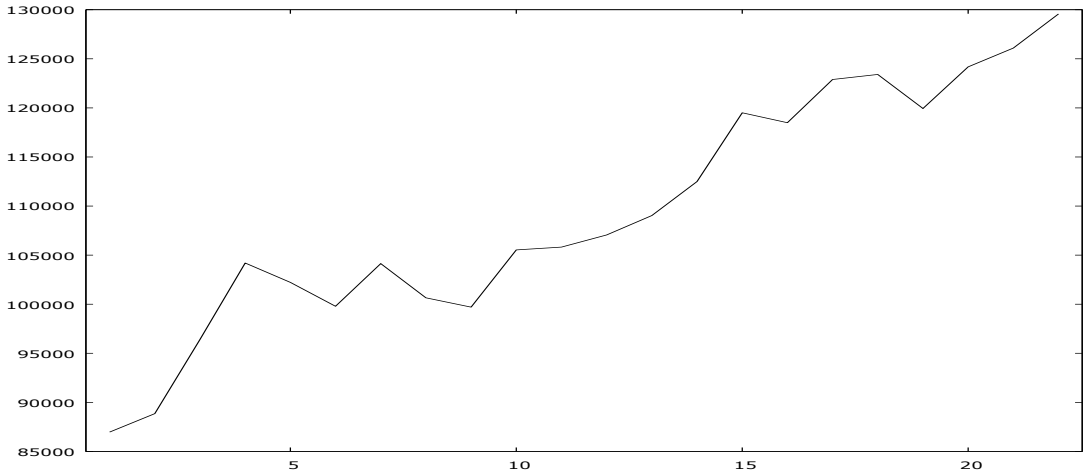


Figure5: Imports of Oil

The mean for imports of oil has increased then fallen and then risen sharply.

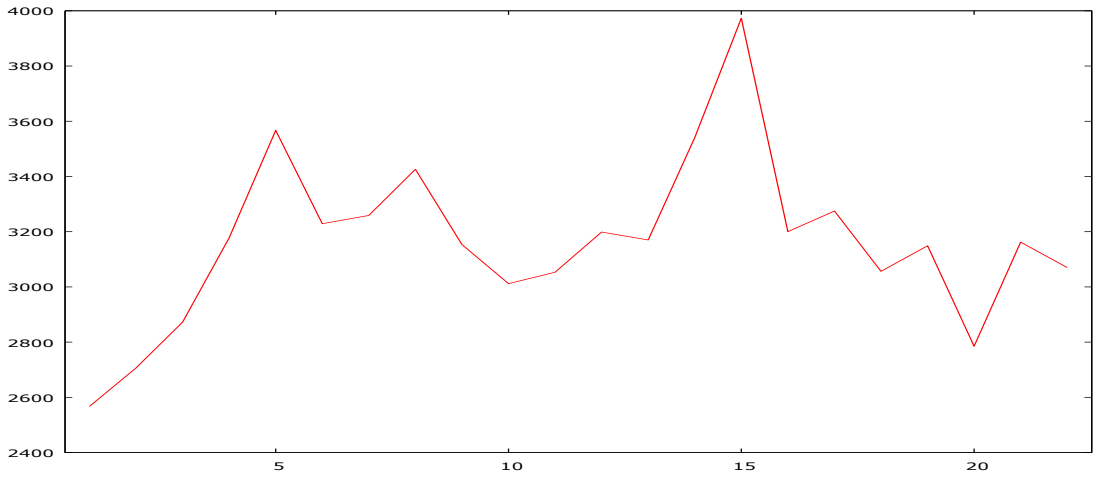


Figure6: Energy Use

The graph of mean for the energy use has very ups and downs. It reached the peak and then has fallen.

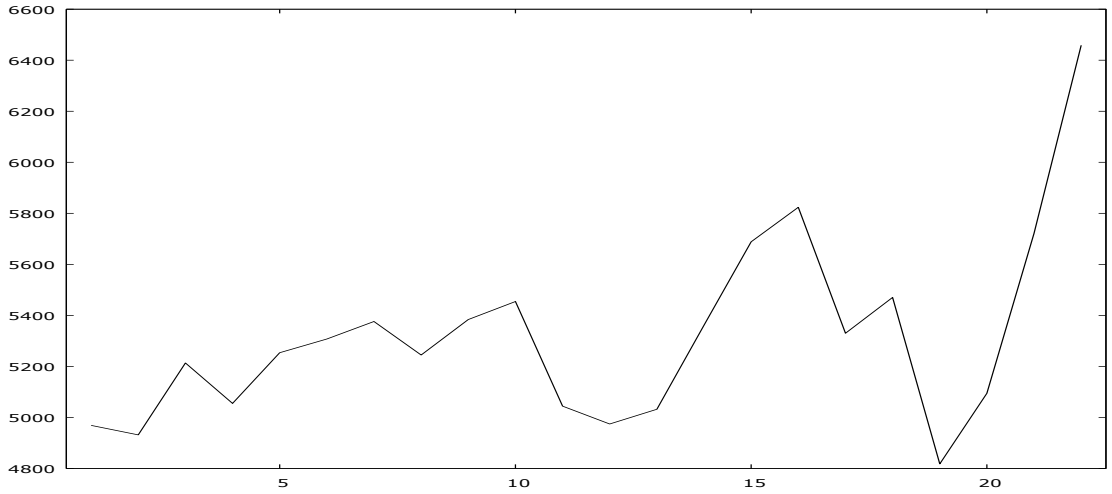


Figure 7: Imports of LPG

The mean of imports of LPG has fallen the sharply in the mid year and then from the average it rose to higher level.

CHAPTER 2:

2.1 Comparative Analysis of Individual Parameters for Countries

1. Electricity Production From Renewable Sources

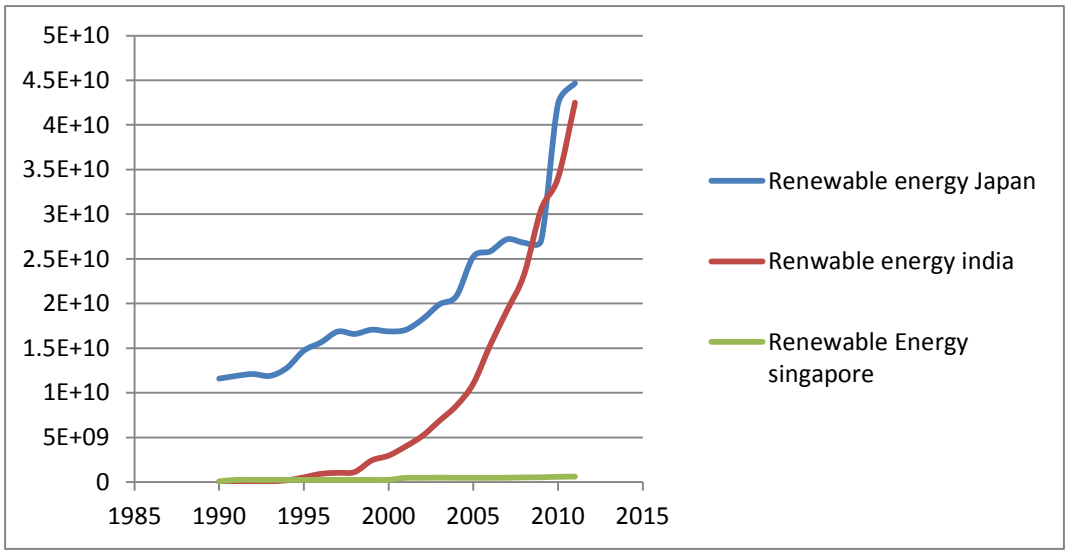


Figure8:

The dependent variable in my model is Electricity Production from Renewable Sources except Hydro. The graphs above show that in Japan the curve is increasing although has seen some downfall in year 2010 when electricity production fell from renewable sources as there was more focus nuclear energy although due to energy security concerns the production has sharply increased again from 2011.Qouting the facts the generation from non-hydro resources has not increased much in Japan as still there is ample reliability on Fossils and nuclear energy.

For India the trend shows a steep increase in Electricity Generation from Renewable sources due to the carbon emission concerns, energy security and also a developing country like India where people do not have access to energy, renewable energy can act as standalone system for energy access to its citizens.

Now The trend of renewable generation in Singapore in disheartening as per graph. There is low or no growth rate in electricity production from renewable sources. Due to the geographical issues, Singapore faces challenges in solar energy generation as it is usually cloudy, the wind speed in Singapore in also comparatively low to act as a potential state of wind energy.

2. Gross Capital Formation

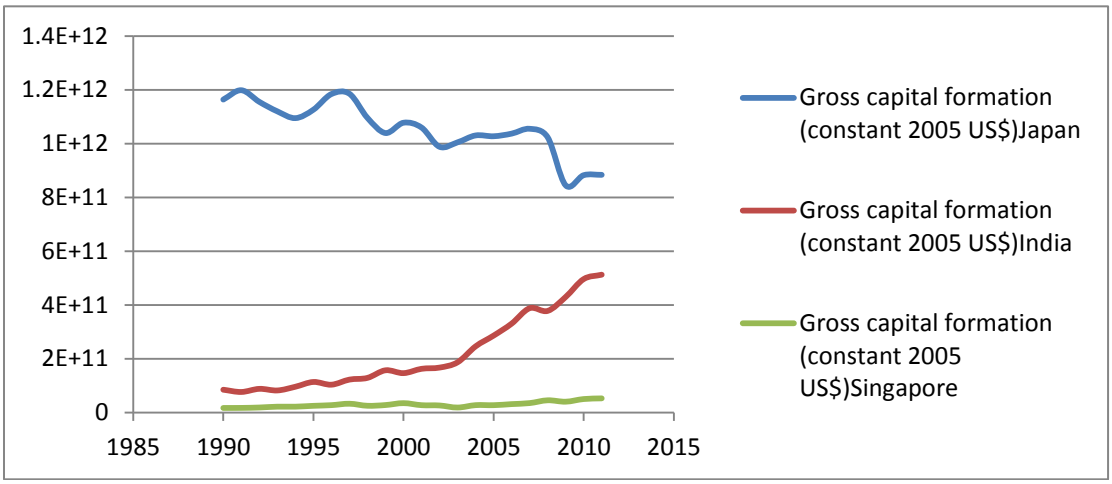


Figure9:

The gross capital formation for Japan was high in 1990 but has shown increase and decrease from 1995 to 2005 and has reduced in 2011.For the case of India the gross capital formation has shown an upward trend since 2005-2010.The development in infrastructure, energy sector, policies stablity, improvement in trade balance as led to the upward trend in gross capital formation.The singapore gross capital has not increase to a greater extent since 1990. The increase is very narrow.

3. Renewable Energy Consumption

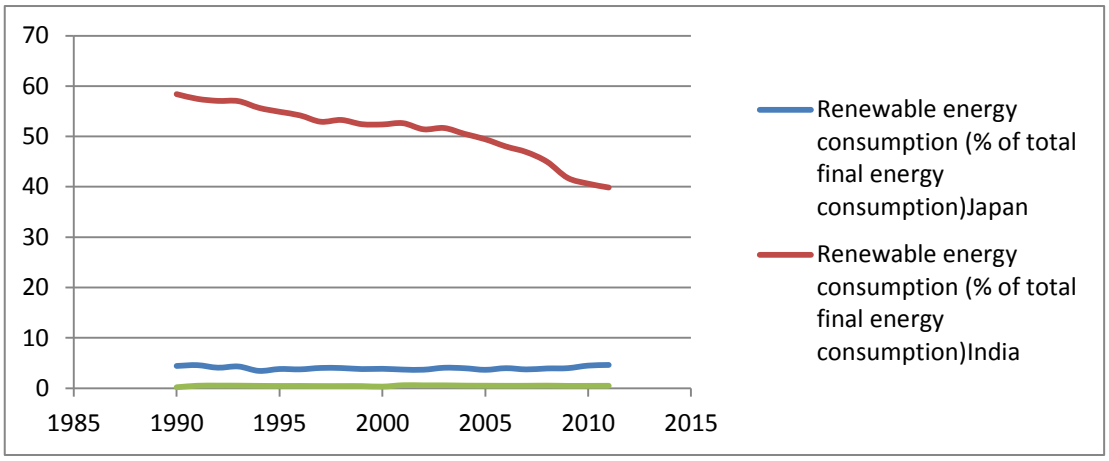


Figure10:

The renewable energy consumption in Japan is showing a downward trend from 2000 to 2011. The dependence on nuclear energy is high in Japan.Although after 2011 due to the Fikushima crisis, many of the plants were shut down due to environmental concerns.The energy policy of Japan has again focussed more on the nuclear energy than alternative energy from cleaner fuels.

The renewable energy consumption for India is showing somewhat the same path.India has high potential for renewable energy generation and policies initiatives by Government to improve energy security and reduction in the carbon emission will a guidess for the same.
The trend for renewable energy consumption in singapore is very low. It has hardly shown an growth improvenment since 1990 to 2011.It has high dependence on oil and other fossils as geographical condition do not favour the renewable energy generation.

4. C02 Emissions

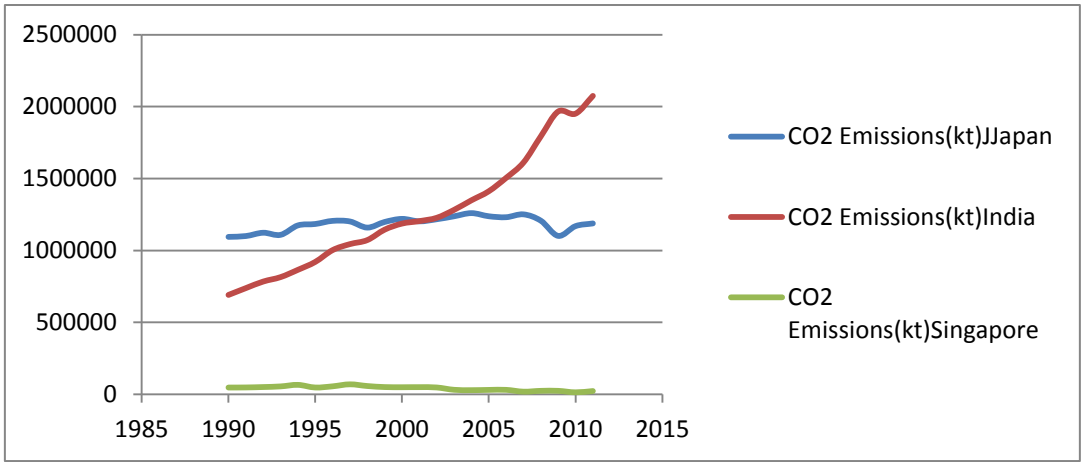


Figure11:

The carbon emissions in Japan has been steady and very high due to high imports of fossil fuels such as coal and oil.Wheres in carbon emissions in India are extremely heavy. The main reasons for this could be the growth of manufacturing sector in India.With the increase in economic growth the carbon emissions also increased because India is still 60-70% dependent on coal for power generation and oil for transport and other requirements.

5. Imports of Oil

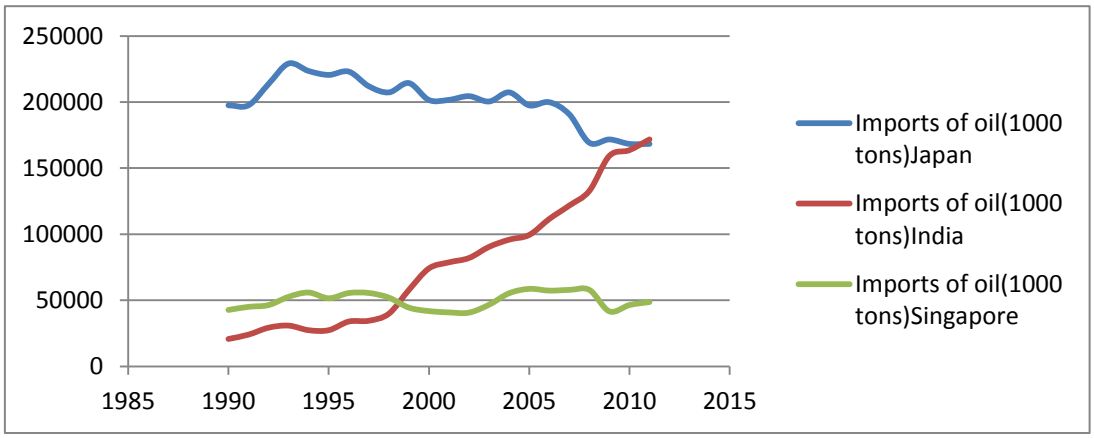


Figure12:

The Imports of oil in Japan has reached its peak during 1990-1995 where the dependence on imported oil increased heavily.But as per the above trend it shows the fall in imports of oil from 2008 onwards.

Incase of India import of oil the trend is upward sloping.Since 1990 to 2011 it has imported heavily from Iraq and other oil producing nations.
Singapore depenedence on oil is also large but in terms of quantity it is comparatively low than India and Japan.

6. Energy Use(kt of oil Equivalent)

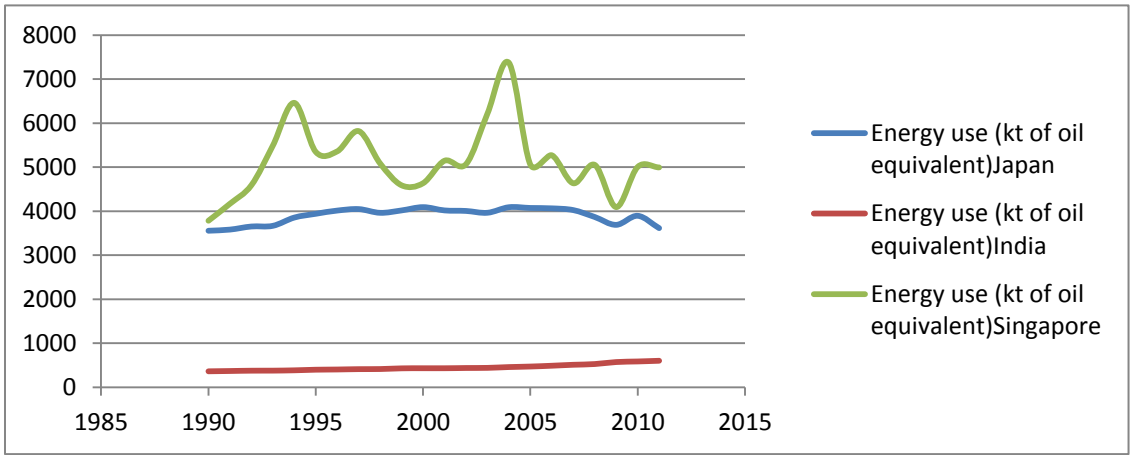


Figure13:

The Energy Use for Japan from 1990 showed and increasing slope but faced ups and down between 2001 ti 2005.Where for India it is more or less a STRAIGHT line with less change in overall. Similarly was the case with Singapore as well .

7. Imports of LPG

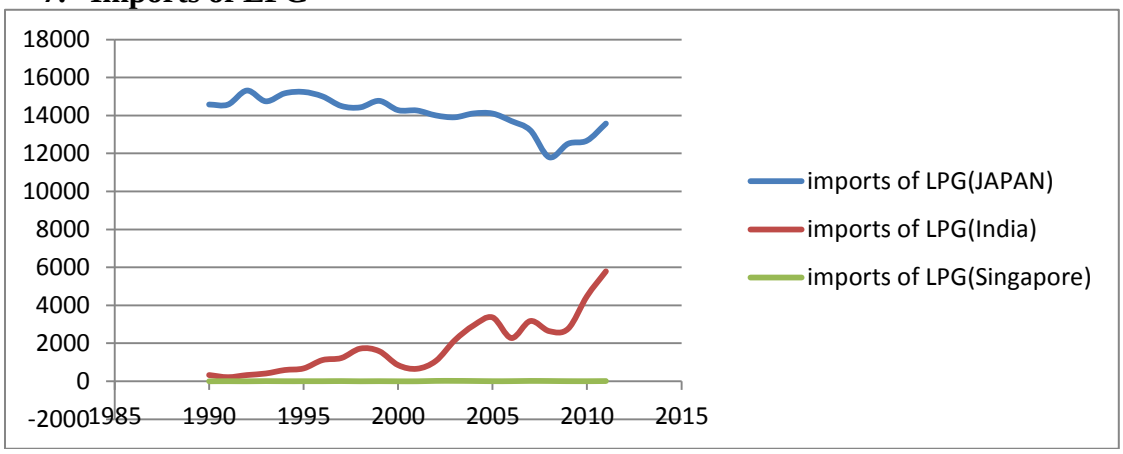


Figure14:

Imports of LNG are high in Japan. The graph shows a bit downfall in 2008 but then it increased again in 2010 onwards. Similarly with rising population and increase dependence of citizens on LPG for cooking and industrial activities the imports has risen sharply since 1995. In Singapore, the imports of LPG are very low and not even increased to a greater extent since 1990.

CHAPTER 3: Panel Root Test

3.1 Panel Root for Asia Region

Electricity Production from renewable Sources:

ADF regressions:	1 lag	
	Statistic	p-value
Unadjusted t	4.6179	
Adjusted t*	6.42	1

The p value shows that dependent parameter that is Electricity Production from renewable sources except hydro has high chance of being non-stationary but after first differentiation it turned out to be stationary.

Gross Capital Formation:

ADF regressions:	1 lag	
	Statistic	p-value
Unadjusted t	-1.9461	
Adjusted t*	-0.067	0.4733

This variable is found to be non-stationary. But after conducting first difference it is stationary at 10% significance level.

Renewable Energy Consumption

ADF regressions:	1 lag	
	Statistic	p-value
Unadjusted t	-2.2951	
Adjusted t*	1.1598	0.8769

This variable is found to be non-stationary. But after conducting first difference it is stationary at 10% significance level.

CO2 Emissions

ADF regressions:	1 lag	
	Statistic	p-value
Unadjusted t	-2.816	
Adjusted t*	-0.4548	0.3246

The p value shows that the variable is non-stationary (it is greater than 0.1) thus after conducting the first differentiation the unit root problem was solved.

Imports of oil (1000tons)

ADF regressions:	1 lag	
	Statistic	p-value
Unadjusted t	-4.7744	
Adjusted t*	-2.8005	0.0026

The p-value of the variable shows being stationary (The value is less than 0.

Energy Use:

ADF regressions:	1 lag	
	Statistic	p-value
Unadjusted t	-1.3883	
Adjusted t*	0.5826	0.7199

The p value shows that the variable is non-stationary (it is greater than 0.1) thus after conducting the first differentiation the unit root problem was solved.

Imports of LPG:

ADF regressions:	1 lag	
	Statistic	p-value
Unadjusted t	-5.8399	
Adjusted t*	-1.7578	0.0394

The p-value of the variable shows being stationary (The value is less than 0.1)

3.2 Panel Root Test: (Europe Region)

Electricity Production from Renewable Sources

ADF regressions:	1 lag	
	Statistic	p-value
Unadjusted t	0.2271	
Adjusted t*	1.3724	0.915

The p value shows that dependent parameter that is Electricity Production from renewable sources except hydro has high chance of being non-stationary but after first differentiation it turned out to be stationary.

Gross Capital Formation:

ADF regressions:	1 lag	
	Statistic	p-value
Unadjusted t	-6.6958	
Adjusted t*	-3.177	0.0007

The p value for shows the value does not have the problem of unit root as it is stationary with p value of 0.0007**.**

Renewable Energy Consumption:

ADF regressions: 1 lag	
Statistic	p-value
Unadjusted t -2.8831	
Adjusted t* -1.2420	0.1071

The p value is stationary at 10% level of significance. It does not have panel root issue.

Imports of oil:

ADF regressions:	1 lag	
	Statistic	p-value
Unadjusted t	-2.4808	
Adjusted t*	0.2092	0.5828

This variable is found to be non-stationary. But after conducting first difference it is stationary at 10% significance level.

Energy use (kt of oil equivalent):

ADF regressions:	1 lag	
	Statistic	p-value
Unadjusted t	-4.1214	
Adjusted t*	-0.0453	0.4819

The value of the variable is non-stationary. But after conducting first difference it is stationary at 10% significance level.

Imports of LPG:

ADF regressions:	1 lag	
	Statistic	p-value
Unadjusted t	-4.4457	
Adjusted t*	-0.4643	0.3212

The value of the variable is non-stationary. But after conducting first difference it is stationary at 10% significance level.

Analysis:

The Panel Unit Root for the Europe and Asia shows a diverse nature. For Europe the only variable which was stationary was Electricity Production from the Renewable sources (Accept Hydroelectricity), whereas all the other dependent variables such as Gross capital formation, Energy Use, Renewable Energy Consumption, Imports of Oil, Imports of LPG are non-stationary. But after conducting first differentiation it turned out to be stationary at 10% significance level. In case of Europe, the only independent variable that is Imports of Oil is stationary rest is non-stationary. The panel root problem was solved after first differentiation

3.3 The parameters wise graph for European nations (Norway, Germany, Sweden)

1. **Electricity production from renewable sources, excluding hydroelectric (kWh):**

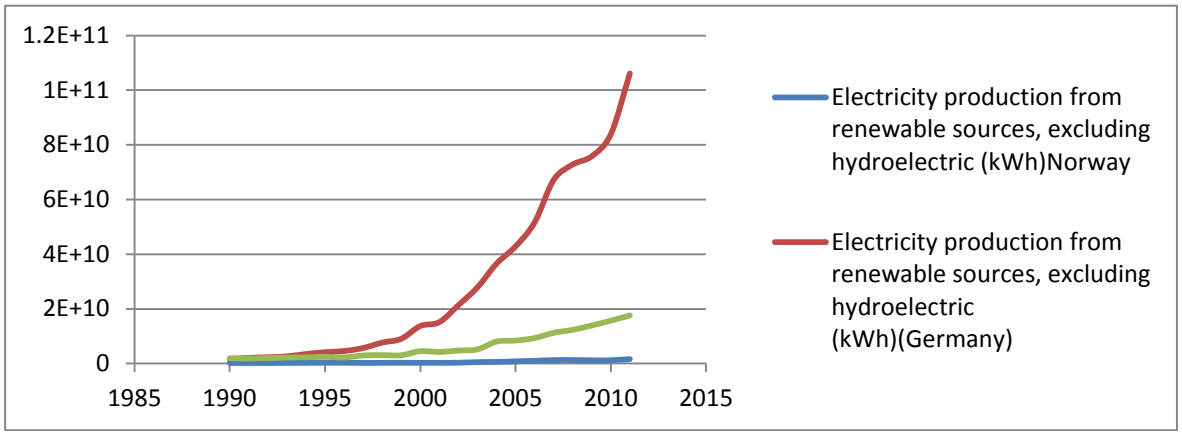


Figure15:

The Dependent variable in the model for Europe region in Electrcity Production from renewable sources,excluding hydro for Norway shows an upward trend since 2000 with huge potential in solar sector. The norwiegn government has invested huge capital in solar from 2003 which increased the electricity production from reneawbles.Although the potential wind energy is comparatively very low in Norway.Although the investment in offshore wind energy has increased from 2008 onwards and further investment may add on to the electricity production.

In the case of Germany, which is the most important country to use renewable energy sources for electricity production.It has adopted energy efficient technology to reduce energy intensity in the industrial as well as residential level.Germany set the target of 30% renewable electricity by 2020 which it already has achieved in 2016. The most of the growth is from wind energy .Thus show an upward growth in electricty through renewable sources.

In case of Sweden,the renewable energy ahs nearly contributed 30% by 2011 and has reached 49% by 2015. The main reneawble source being solar, wind and Hydro. The promotion of renewable through green energy certificates was majorly important . Although the graph shows a flat curve but the renewable energy generation has reached heights in Sweden.

2. Gross Capital Formation

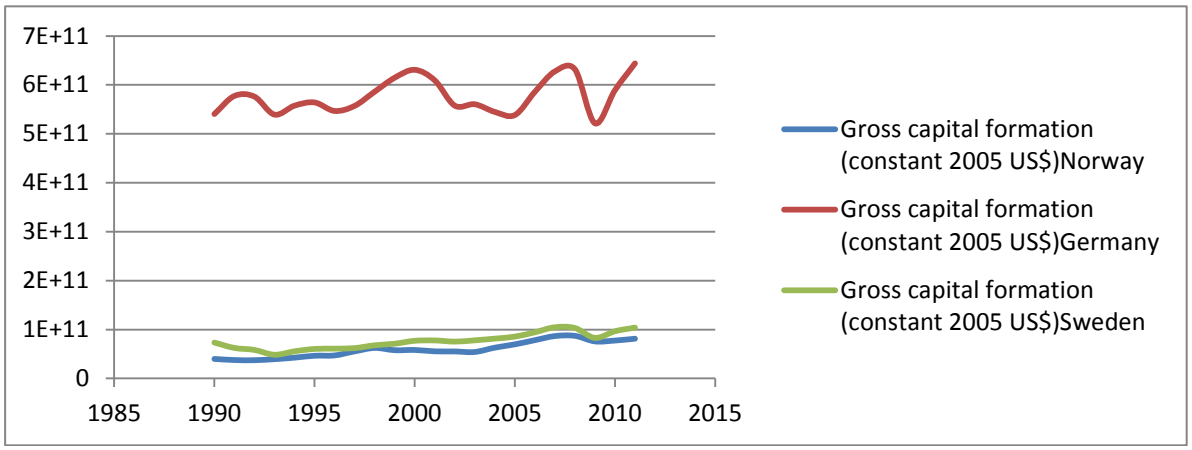
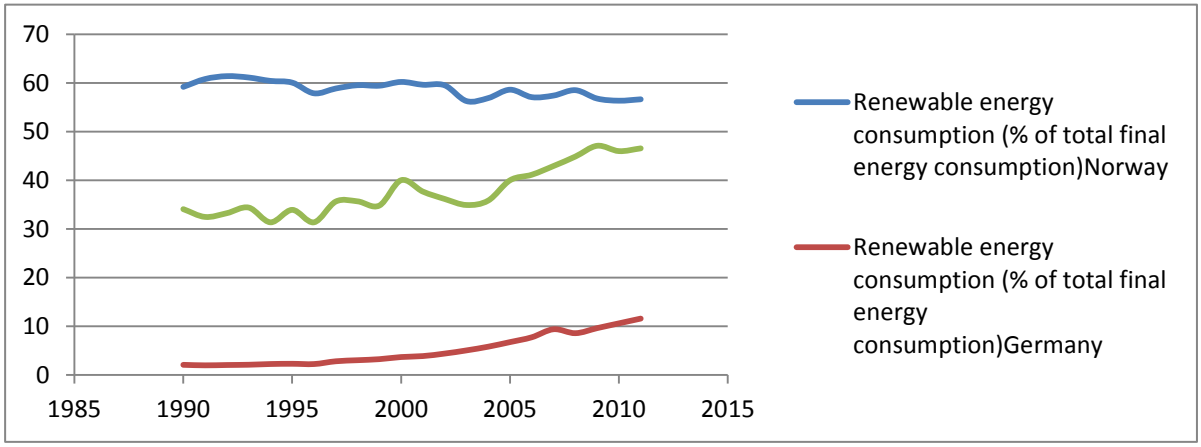


Figure16:

The Gross Capital Formation in Norway is high since 1990 to 2011. It is only showing a continuous increasing path. It has also been increasing for Germany and Sweden although in low absolute term than Norway.

3. Renewable Energy Consumption:

Figure17:



The Independent factor, Renewable Energy consumption(% of the total final energy consumotion) for Norway is showing a steady growth since 1995. Although some slight fall in 2003 but then again rose as investment in solar was done during that time leading to higher renewable energy consumption.For Germany it is showing a increasing % growth from 2003 onwards.In case of Sweden earlier in year 1990-1995it was almost at same growth level but this increase electricity production from renewable sources , the consumption % of total energy has also increased.

4. C02 Emissions:

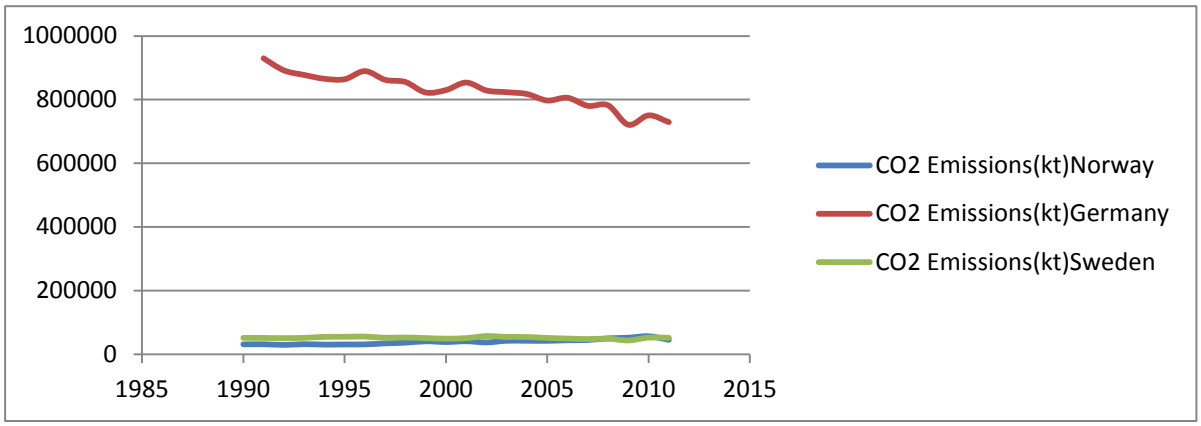


Figure18:

The carbon emissions in Norway were very high in 1990s due to the industrial GHG. With the Kyoto call it reduced its carbon emission by 16% since 1990s.It has constantly worked for reduction in carbon emission and has set the target of 40% reduction by 2022.
The carbon emissions in Germany and Sweden is comparatively low than Norway. Germany is the top amongst the countries using energy efficient technologies to reduce energy intensity and carbon emissions from the conventional sources of energy.

5. Imports of Oil:

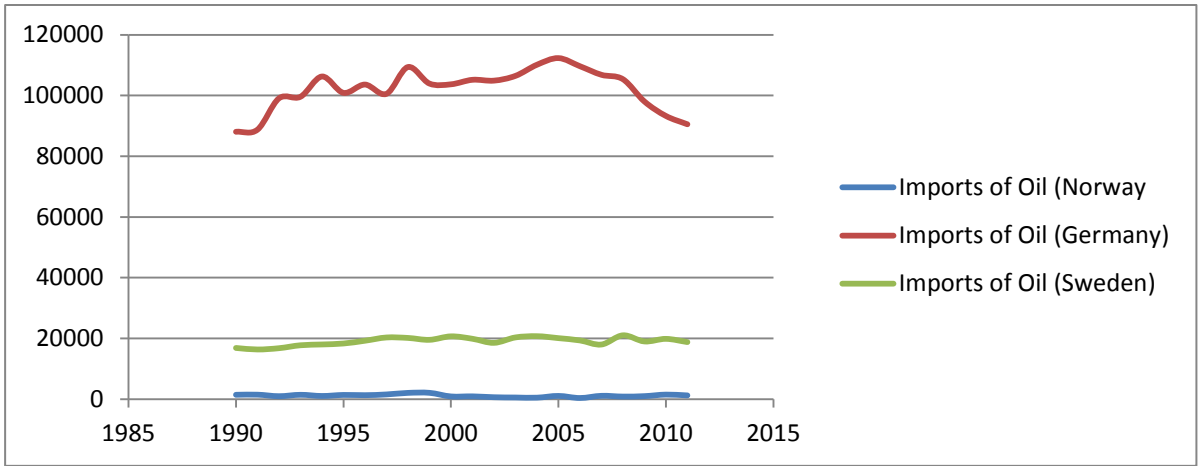


Figure19:

The imports of oil for Norway is high although is showing a declining trend due to dependence on renewable energy has increased. Imports of oil in Germany and Sweden are comparatively low in absolute terms though are rising at a stagnant rate from 1990 to 2011.Germany and Norway has increased the generation of Electricity through Renewable such as wind, Solar thus resulting in lower or stagnant oil imports.

Energy Use:

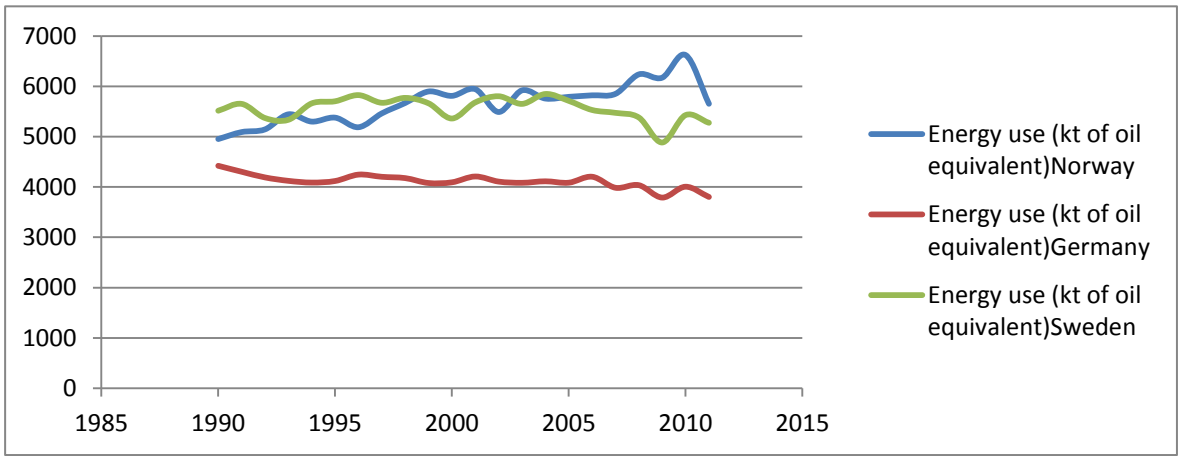


Figure20:

The Energy use(which is use of primary energy without transformation to secondary energy) for the three of the countries is high and is showing a straight line path for Sweden since 2000-2010.For Norway and Germany it is showing an increasing trend. In 2005 it was increasing than fell in 2011 for Germany.

Imports of LPG:

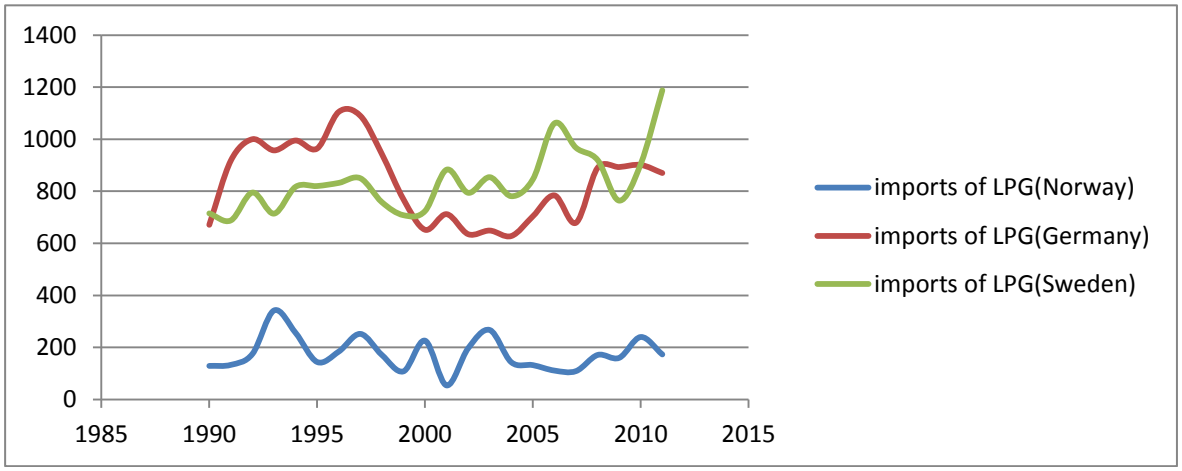


Figure21

The import of oil for all the three nations is showing huge ups and down. For the year 1990 the imports of LPG in Germany increased but it had a steep fall after 1995, it then increased to some amount after 2008.
The Sweden graph for LPG is also bit haphazard in nature. It has many swirls and turns since 2000-2005.Incase, of Norway it has lower absolute imports than the other two countries and is bit stagnant after 2005 to 2011.

Equation of My Model:

$$R.Gi_{ut} = \beta_1 + \beta_2 G.R.C_{it} + \beta_3 R.Ci_{it} + \beta_4 C02_{it} + + \beta_5 IMoil_{it} + \beta_6 IMgas_{it+} \beta_7 E.U + u_{it}$$

R.G**:** Electricity Generation from Renewable Sources
G.R: Gross Capital Formation
R.C: Renewable Consumption
C02: Carbon Emission
IMoil: Imports of Oil
IMgas: Imports of Gas
E.U: Energy Use

$$R.Gi_{ut} = \alpha_1 + \beta_2 G.R.C_{it} + \beta_3 R.C_{it} + \beta_4 C02i_{it} + \beta_5 IMoil_{it} ++ \beta_6 IMgas_{it+} \beta_7 E.U + \alpha 2Indiai + \alpha_3 dSingapore_i + u_{it}$$

Where, Asia Region

dIndia: Country dummy for India

dSingapore: Country dummy for Japan

dSingapore: Country dummy for Norway

European Region

$$R.Gi_{ut} = \alpha_1 + \beta_2 G.R.C_{it} + \beta_3 R.C_{it} + \beta_4 C02i_{it} + \beta_5 IMoil_{it} ++ \beta_6 IMgas_{it+} \beta_7 E.U + \alpha 2Ger + \alpha_3 dSwe_i + u_{it}$$

Where,

dNor: Country dummy for Norway

dGer: Country dummy for Germany

dSwe: Country dummy for Sweden

CHAPTER 4: Pooled, Fixed and Random Effect Model

4.1 Fixed-effects (within) regression (Asia Region)

Fixed-effects (within) regression	Number of observation = 66
Group variable: panel id	Number of groups = 3
R-sq: within = 0.7882	Obs per group: min = 22
between = 0.1452	avg = 22.0
overall = 0.0009	max = 22
	F(6,57) = 35.35
corr(u_i, Xb) = -0.9013	Prob > F = 0.0000

Source	SS	df MS		Number Of Obs=	66
				F(6, 59)	70.9
Model	8.41E+21	6 1.4024e+21		Prob > F	0
Residual	1.17E+21	59 1.9779e+19		R-squared	0.8782
				Adj R-squared	0.8658
Total	9.58E+21	65 1.4741e+20		Root MSE	4.4E+09
electricity production from renewable	Coef.	Std. Err. T	P>t	[95% Conf.	Interval]
Gross capital formation	-0.02316	.0128413 -1.80	0.076	-0.0488503	0.00254
Renewable consumption	-8.12E+08	1.20e+08 -6.79	0	-1.05E+09	-5.73E+08
co2emission	49853.96	4805.924 10.37	0	40237.33	59470.59
Imports of oil	-253270	56127.48 -4.51	0	-365581.2	-140960
Energy use	568610.2	1183494 0.48	0.633	-1799556	2936776
Imports of LPG	2027760	790461.5 2.57	0.013	446050	3609469
_cons	9.16E+09	6.31e+09 1.45	0.152	-3.46E+09	2.18E+10

Analysis: The true effect size for all the studies is identical in the case of Fixed Effect Model; the variation may be due to the sampling error in the study. The model shows that five variables are significant. They are Gross Capital Formation, Renewable Energy Consumption

(% of total Consumption), Carbon Emissions, Imports of Oil and Energy Use (Kt).Although analyzing the beta coefficients:

1. **Gross Capital Formation**: The sign of beta coefficient is negative implying that with 1 unit increase in gross capital formation the Electricity generation from renewable sources will fall by 0.02316.Although the fall is minimal.

2. **Renewable Consumption**: The variable is significant and with 1 unit decrease in renewable energy consumption, the Electricity generation from renewable sources will increase by 8.12 units.

3. **C02 Emissions**: The sign of beta coefficient is positive implying that with 1 unit increase in carbon emission there will 49853.96 increase in electricity generation from renewable resources. This can be elaborated that as carbon emission rise, the government being a pro-active in renewable investment, invest more in renewable sources thus increasing the electricity generation from the renewable sources.

4. **Imports of Oil**: The sign of beta coefficient is negative that is with one unit decrease in oil imports electricity from renewable sources will increase by 253270. The Asian countries are heavily dependent on oil, but with rising energy securities issues the increasing generation from renewable sources are now encouraged.

5. **Energy Use:** The sign of beta coefficient is positive implying that with 1 unit increase in Energy Use there will be 568610.2. Energy use is basically the consumption of primary energy before the conversion to secondary sources. Thus as renewable investment increase the electricity generation from it also increased.

6. **Imports of LPG:** The sign of beta coefficient is positive. Although the variable is insignificant.

Now Explaining the **constant term** which says that even when the value of dependent value is zero there will some generation of electricity production from the renewable sources (Excluding Hydro electricity).This could have many reasons like prices of the imports of oil, gas and coal has increased thus the government has decided to invest more on renewable thus lowering the burden of imports of fossils for the country. The Electricity from Renewable such as Wind, Biomass, and Solar will increase in the country.

4.3 Random Effects

Random-effects GLS regression	Number of obs =	66
Group variable: panelid	Number of groups =	3
R-sq: within = 0.7701	Obs per group: min =	22
between = 1.0000	avg =	22
overall = 0.8782	max =	22
Random effects u_i ~ Gaussian	Wald chi2(6) =	425.43
corr(u_i, X) = 0 (assumed)	Prob > chi2 =	0

electricit~b	Coef.	Std. Err.	z	p>t	[95% Conf.	Interval]
Gross capital formation	-0.023155	1.28E-02	-1.8	0.071	-0.0483234	0.002013
Renewable energy consumption	-8.12E+08	1.20E+08	-6.79	0	-1.05E+09	-5.78E+08
co2 emission	49853.96	4805.924	10.37	0	40434.52	59273.39
Imports of Oil	-253270.4	56127.48	-4.51	0	-363278.3	-143263
Energy use	568610.2	1183494	0.48	0.631	-1750995	2888216
Imports of LPG	2027760	7.90E+05	2.57	0.01	478483.7	3577036

sigma_u	0
sigma_e	4.340e+09
rho	0 (fraction of variance due to u_i)

The model shows that five variables are significant. They are Gross Capital Formation, Renewable Energy Consumption (% of total Consumption), Carbon Emissions, Imports of Oil, Energy Use and Import of LPG .**Although analyzing the beta coefficients gives us the following results**:

1. **Gross Capital Formation**: The sign of beta coefficient is negative implying that with 1 unit increase in gross capital formation the Electricity generation from renewable sources will fall by 0.023155.Although the fall is minimal.
2. **Renewable Consumption**: The variable is significant and with 1 unit decrease in renewable energy consumption, the Electricity generation from renewable sources will increase by 8.12 units.
3. **C02 Emissions**: The sign of beta coefficient is positive implying that with 1 unit increase in carbon emission there will 49853.96 increase in electricity generation from

renewable resources. This can be explained that as carbon emission rise, the government being a pro-active in renewable investment invests more in renewable sources thus increasing the electricity generation from the renewable sources.

4. **Imports of Oil**: The sign of beta coefficient is negative that is with one unit decrease in oil imports electricity from renewable sources will increase by 253270.4.TheEuropean countries are also dependent on oil, but with rising energy securities issues the increasing generation from renewable sources are now encouraged

5. **Energy Use:** The sign of beta coefficient is positive implying that with 1 unit increase in Energy Use there will be 568610.2. Energy use is basically the consumption of primary energy before the conversion to secondary sources. Thus as renewable investment increase the electricity generation from it also increased.

6. **Imports of LPG:** The sign of beta coefficient is positive.

4.4 Hausman Test :

	---- Coefficients ----		
	(b) (B)	(b-B)	sqrt(diag(V_b-V_B))
	fe re	Difference	S.E.
grosscap~200	-0.0551192	-0.0088092	0.0030511
renewablee~a	-2532000000	-9.07E+08	1.24E+09
co2emissio~t	38076.99 49853.96	-11776.97	15457.25
importsofo~s	-432402.5	74138.31	31034.15
energyusek~t	370698.3 568610.2	-197911.9	79591.28
Importsoflpg	-10052.1 2027760	-2037812	900312

b = consistent under Ho and Ha; obtained from xtreg

B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(3) = (b-B)'[(V_b-V_B)^(-1)](b-B)

= 5.13

Prob>chi2 = 0.1628

(V_b-V_B is not positive definite)

Analysis: The Hausman test checks a more efficient model against a less efficient but consistent model to make sure that the more efficient model also gives consistent results.

The null hypothesis: Both the estimation methods are correct and will yield similar coefficients.
The Alternative Hypothesis: It shows that Fixed Effect is correct and random effect is not.

In our model the Huasman Test is (insignificant P-value, Prob>chi2 larger than .05).It will be significant to use random effect model as random effect will give better p-values with better estimators. The random-effects estimator in STATA is the weighted average of fixed and between effects.

Conclusion: In the random effect model for European Region, three variables were significant. The significant variables are: Gross Capital Formation, Renewable Energy Consumption (% of total Consumption), and Carbon Emission.

4.5

Model 3: Pooled OLS, using 66 observations
Included 3 cross-sectional units
Time-series length = 22
Dependent variable: electricityproductionfromrenew1

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	5.08584e+010	2.95198e+010	1.7229	0.0903	*
grosscapitalformationconstant21	−0.0319642	0.0131988	−2.4218	0.0186	**
renewableenergyconsumptionofto1	−1.7194e+09	1.247e+09	−1.3788	0.1733	
co2emissionskt	38077	16187.1	2.3523	0.0221	**
importsofoil1000tons	−179132	64135.9	−2.7930	0.0071	***
Energy use kt of oil equivalent	370698	1.18617e+06	0.3125	0.7558	
Imports of LPG	−10052.1	1.19808e+06	−0.0084	0.9933	
D2	1.93612e+010	5.71154e+010	0.3390	0.7359	
D3	−4.32951e+010	2.93499e+010	−1.4751	0.1457	

5.

Mean dependent var	1.02e+10		S.D. dependent var	1.21e+10
Sum squared resid	1.07e+21		S.E. of regression	4.34e+09
R-squared	0.887945		Adjusted R-squared	0.872218
F(8, 57)	56.45987		P-value(F)	2.72e-24
Log-likelihood	−1553.428		Akaike criterion	3124.856
Schwarz criterion	3144.563		Hannan-Quinn	3132.643
rho	0.813362		Durbin-Watson	0.424774

The model shows that, the intercept varies over the individual but slope coefficients will be constant**. It shows that:**
The Intercept for country 2(India):5.08+1.936=7.016

The Intercept for Country3 (Singapore):5.08+ (-4.32) =0.76

This shows that the intercept for the country is different from the base country that is Japan.

4.5 Limitations:

1. The mode has some issues of multicollinearity. The imports of oil are showing high co linearity with dependent variable. But it is an important variable for my model as rejecting may create specification bias.

CHAPTER5: Fixed and Random Effect Model

5.1 Fixed-effects (within) regression (Europe Region)

Electricity generation from Renewable(excluding Hydro)	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]
Gross capital Formation	0.0565738	0.0384027	1.47	0.146	-.0203561	.1335038
Renewable energy consumption	1.27E+09	3.40E+08	3.72E+00	0.000	5.85e+08	1.95e+09
co2emission	492007	32752.02	-15.02	0.000	-557617.2	-426396.8
Imports of oil	-863122.6	229656.4	-3.76	0.000	-1323180	-403065.5
Energy use(kt)	1.19E+07	3551604	3.34	0.001	4753949	1.90e+07
Imports of LPG	1053183	7904431	0.13	0.894	-1.48e+07	1.69e+07
_cons 7.57e+1 2 .53e+10	9.11e+10		2.99	0.004	2.50e+10	1.26e+11
sigma_u 3.104e+11						
sigma_e 6.155e+09						
rho .99960709 (fraction				of variance due to u_i)		
F test that all u_i=0: F(2, 56) =				76.49	Prob > F = 0.0000	

Analysis: The true effect size for all the studies is identical in the case of Fixed Effect Model; the variation may be due to the sampling error in the study. The model shows that four variables are significant. They are Renewable Energy Consumption (% of total Consumption), Carbon Emissions, Imports of Oil and Energy Use (Kt).Although analyzing the beta coefficients:

1. **Gross Capital Formation**: The sign of beta coefficient is negative implying that with 1 unit increase in gross capital formation the Electricity generation from renewable sources will fall by 0.02316.Although the fall is minimal.

2. **Renewable Consumption**: The Sign of beta coefficient is positive which shows that 1 unit increase in Renewable Energy Consumption the Electricity Generation of Renewable sources will increase by 1.27. It means that as renewable demand will increase and with the higher investment in renewable energy the electricity generation will also increase.

3. **C02 Emissions**: The sign of beta coefficient is positive implying that with 1 unit increase in carbon emission there will 492007 increase in electricity generation from renewable resources. This can be elaborated that as carbon emission rise, the

government being a pro-active in renewable investment, invest more in renewable sources thus increasing the electricity generation from the renewable sources**.**

4. **Imports of Oil**: The sign of beta coefficient is negative that is with one unit decrease in oil imports electricity from renewable sources will increase by 863122.6. The European countries are heavily dependent on oil, but with rising energy securities issues the increasing generation from renewable sources are now encouraged.

5. **Energy Use:** The sign of beta coefficient is positive implying that with 1 unit increase in Energy Use there will be 568610.2. Energy use is basically the consumption of primary energy before the conversion to secondary sources. Thus as renewable investment increase the electricity generation from it also increased.

6. **Imports of LPG:** The sign of beta coefficient is positive, But the p value shows that the variable is insignificant.

Now Explaining the **constant term** which says that even when the value of dependent value is zero there will some generation of electricity production from the renewable sources (Excluding Hydro electricity).This could have many reasons like prices of the imports of oil, gas and coal has increased thus the government has decided to invest more on renewable thus lowering the burden of imports of fossils for the country. The Electricity from Renewable such as Wind, Biomass, and Solar will increase in the country.

5.2 Random Effect:

Random-effects GLS regression	Number of obs = 65
Group variable: panel id	Number of group = 3
R-sq: within = 0.6342	Obs per group: min = 21
between = 0.9984	avg = 21.7
overall = 0.7595	max = 22
Random effects u_i ~ Gaussian	Wald chi2(6) = 183.13
corr(u_i, X) = 0 (assumed)	Prob > chi2 = 0.0000

Electricity Generation from Renewable sources	Coef	Std. Err.	z	P>z	[95% Conf.	Interval]
Gross capital formation	0.3796844	0.0505638	7.51	0.000	.2805812	0.478788
Renewable energy Consumption	2.61E+08	3.64E+08	0.72	0.472	-4.52e+08	9.74E+08
co2emission	-280103	32937.55	-8.5	0.000	-344659.5	-215547
Imports of oil	-494887.8	325503.9	1.52	0.128	-143088.1	1132864
Energy use	-1.17E+07	5422068	-2.15	0.031	-2.23e+07	-1055646
Imports of LPG	-1089583	8952488	-0.12	0.903	-1.86e+07	1.65E+07
_cons	3.92E+10	4.37E+10	0.9	0.370	-4.64e+10	1.25E+11

The model shows that three variables are significant. They are Gross Capital Formation, Energy Use, and Carbon Emissions. **Although analyzing the beta coefficients gives us the following results**:

1. **Gross Capital Formation**: The sign of the beta coefficient is positive shows that with a unit increase in the gross capital formation there will be a 0.3796844 unit increase in the Electricity generation from the renewable sources (excluding Hydroelectricity).This is quite reasonable as with energy security issues various the European countries have invested to increase Electricity Consumption from renewable sources.

2. **Renewable Consumption**: The Sign of beta coefficient is positive which shows that 1 unit increase in Renewable Energy Consumption the Electricity Generation of Renewable sources will increase by 2.6 units. It means that as renewable demand will increase and with the higher investment in renewable energy the electricity generation will also increase.

3. **C02 Emissions**: It means that with 1 unit decrease in the Carbon Emissions the Electricity Generation from renewable sources will increase by 280103 units. It means that use of R.E technology will reduce the carbon emissions and motivate the public and the private players to invest in the renewable technology

4. **Imports of Oil**: The sign of beta coefficient is negative that is with one unit decrease in oil imports electricity from renewable sources will increase by 494887.8 .The European countries are also dependent on oil, but with rising energy securities issues the increasing generation from renewable sources are now encouraged

5. **Energy Use:** The sign of the beta coefficient is negative that is with one unit decrease in oil increase electricity generation from renewable sources will increase by 1.17 units.23

6. **Imports of LPG:** The sign of beta coefficient is negative. It means 1 unit decrease in imports of LPG the Electricity Generation from the Renewable sources will increase by 1089583.

5.3 Huasman Test(European Region):

In our model the Huasman Test is (insignificant P-value, Prob>chi2 larger than .05).It will be significant to use random effect model as random effect will give better p-values with better estimators. The random-effects estimator in STATA is the weighted average of fixed and between effects.

Conclusion: In the random effect model for European Region, three variables were significant. The significant variables are: They are Gross Capital Formation, Energy Use, and Carbon Emissions

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5.4 Country Dummy (Europe Region):

Model 1: Pooled OLS, using 66 observations
Included 3 cross-sectional units
Time-series length = 22
Dependent variable: electricityproductionfromrenew1

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	−2.20828e+011	7.73783e+010	−2.8539	0.0060	***
grosscapitalformationconstant21	0.092871	0.0903906	1.0274	0.3086	
renewableenergyconsumptionofto1	3.50031e+09	7.33585e+08	4.7715	<0.0001	***
co2emissionskt	13269.8	22865.1	0.5804	0.5640	
importsofoil1000tons	−798706	541401	−1.4753	0.1456	
Energy use(kt) of oil equivalent	3.12318e+06	8.27607e+06	0.3774	0.7073	
Imports of LPG	−3.95761e+07	1.76681e+07	−2.2400	0.0290	**
D2	2.70775e+011	1.07651e+011	2.5153	0.0147	**
D3	1.18313e+011	2.86683e+010	4.1270	0.0001	***

Mean dependent var	1.23e+10	S.D. dependent var	2.25e+10
Sum squared resid	1.20e+22	S.E. of regression	1.45e+10
R-squared	0.636562	Adjusted R-squared	0.585553
F(8, 57)	12.47944	P-value(F)	3.83e-10
Log-likelihood	−1633.093	Akaike criterion	3284.186
Schwarz criterion	3303.893	Hannan-Quinn	3291.973
rho	0.888707	Durbin-Watson	0.292151

The model shows that, the intercept varies over the individual but slope coefficients will be constant**. It shows that:**
The Intercept for country 2(Germany): −2.20+2.70= -.5
The Intercept for Country3 (Sweden): −2.20+1.18= -1.02

This shows that the intercept for the country is different from the base country that is Norway.

CHAPTER 6: Conclusion and Recommendations:

This dissertation aimed at finding the factors that affect the Electricity generation from the Renewable Sources (Excluding Hydroelectricity) in the Asia and the Europe Region. As I collected the data from World Bank and IEA site and consolidated in the Excel Sheet. After checking for the panel root test, the stationary was checked and panel regression analysis was conducted. For Asian countries and European nations it was found that the Random effects model was the most suitable for analyzing the results for such category.

For the Asian and European, three variables in common were most significant. They are Renewable consumption at the % of total energy consumption, Carbon emissions and Imports of oil. The one variable which was not insignificant for both regions was Imports of LPG. After conducting intense literature review I could make out the reason for the insignificance In the European nation. Although Sweden is dependent on Denmark for its LPG import supply, it is in evidently increasing its investment in R.E and does not have any major impact even if the import price increase or decrease. All the European nations all are intensively using energy efficient techniques and reducing their carbon intensity. For the Asian region although the LPG is a key requirement in households but it has no direct impact on the Electricity Generation from the R.E sources.

Recommendations for Indian Energy Efficient Market:

1. Germany:

Germany is on the top of the list when it comes to setting up benchmark for energy efficient market. It can surely act as catalyst in improving productivity through less use of energy. The initiatives by Government are:

- It is providing **energy efficiency consultancy services** to its citizens. They have a toll free number and depending on the question the concern official solve the query in person or through phone. As a part of "National Action Plan for Efficiency" it is expanding the consulting services with already 630 consulting centre in function.
- Germany banks have decided to give loans for the renovation of the building that stipulated private investments of more than 34 billion Euros in 2013. It is also providing incentives to the houses implementing efficiency measures.
- Indian has small manufacturing enterprises who contribute highly in the manufacturing sector, in Germany government offers 30% subsidies to the SMES for improving efficiency in the production process.

Thus, these are the few steps that the Indian Government can adapt to improve energy efficiency in the Indian context.

2. **Norway**: It has worked massively on reducing energy intensity in the **transport sector.** This is also a key concern for India as major transport in India works on Diesel and petrol.

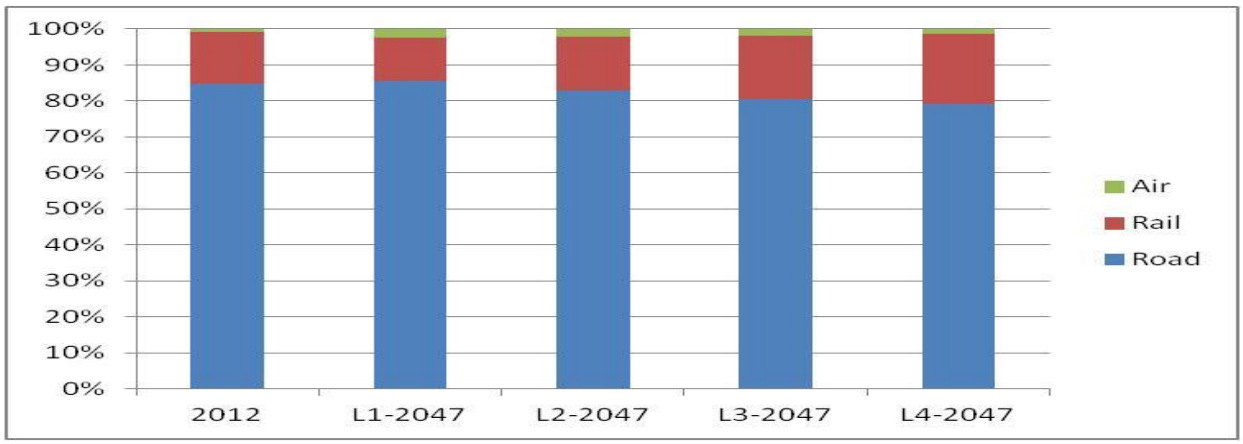

Figure22:

As in above Figure we can see the significant ratio of road transport in comparative to other modes. The road transport is highly energy intensive therefore it becomes essential to reduce it.

Learning from Norway:

- It has mandated the reduction in speed in some areas for environment purposes.
- It has levied taxes for using studded tyres in the city or elsewhere.
- The amount of tax levied was in correlation with C02 emission
- It has encouraged the use battery cars with several exemption such as free parking and no charge if parked on public place.
- It has exempted battery cars from road toll which is a big incentive for people to switch to battery cars

What is the Impact on C02 Emission?

- The Competition within the car makers to make more energy efficient cars increased in order to reduce the tax payment thus more energy efficient model were produced. Thus, lowering emissions
- In the year 2014, 13% of the new cars registered had zero emission levels.

Berlin:

- Berlin is a good example of using Solar PV panels into the roofs and buildings for meeting 20-30% of its residential electricity demand**.**
- In Berlin the cooling requirement in the urban areas is met of solar PV only. As, when the demand is high during summers, the output is also high. This has reduced the demand for fossils and brought grid discipline.
- It has also used Solar PV for the street lights, PV operated parking.
- It has used innovative advertisement Solar PV boards at bus stop which have battery storage behind the bus stand.

India has immense solar power potential and gets almost 300 days of solar power in a year. It can surely adopt such measures to reduce peak demand. The solar lamps can be used for lighting streets at night.

Barcelona City:

- The city of Barcelona passed an ordinance that the heating requirement for all the buildings, private and commercial places will supply their heating demand through solar thermal.
- The programme gained immense success due to the support by the general public. They celebrated **"Solar Day"** in their city. The meetings were organized with the stakeholders, government officials, and private players to implement the measures in day to day life to improve energy efficiency.

The target of 110GW of solar energy generation by 2020 can be achieved only such small measures are adopted in the cities of India. It is thus important to aware general public and start working at the regional and connecting local bodies to make the goal look achievable.

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