Europe's Renewable Race– Keys to National Renewable Energy Use in the European Union

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A - Introduction and Research Statement

Europe is currently in a state of political experimentation, attempting to slowly unify and federate historically different and often combative nations. To this end, European nations have enacted policy, often through higher bodies such as the European Union, which binds them to a European standard. However, one area which is far from unified is energy policy. Many European nations have disparate energy policies, particularly with regard to nuclear and renewable energy. France, for instance, is a paragon of nuclear energy support, with 75 percent of the electricity produced in France coming from nuclear power (World-nuclear.org). Juxtaposing this impressive production is France's neighbor, Germany. Germany has always been sluggish in developing nuclear power when compared to France, (World-nuclear.org). The Fukushima Daiichi disaster of 2011 convinced the German public that nuclear energy was not the way forward, and Germany began to shut down its reactors with the ultimate goal of having no nuclear power by 2022 (Knight 2011). Germany plans on making up the energy deficit created by this policy by replacing nuclear power, and even some fossil fuel, with clean and renewable energy sources, such as solar and wind energy (Scientific American). Other nations often lie somewhere in between, creating an atomic spectrum in Europe, one that continues to grow even wider and more colorful with the inclusion of Eastern European countries in 1997 and the Lisbon Treaty in 2009, which imbued the European Union with fundamentally more power over its constituent states.

Recently, the European Union created a target for renewable energy, declaring that by 2020, 20 percent of the European Union's energy would be generated by renewables. It also pledged to cut its CO_2 emissions 20 percent by 2020 (European Commission). This binding policy has drawn attention to the energy sector in Europe, both on the differences already present between nations and the differences in their responses to this directive. My goal is to investigate and uncover what factors, institutionally, culturally, or otherwise, lead to the variation exhibited in Europe regarding energy policy and their response to this directive, specifically regarding the growth rate of renewable energy produced in each country. Ideally, this research will lead to applicable strategies for encouraging renewable energy usage in other countries such as the United States or possibly even developing countries.

Because the EU resolution is a relatively recent development, most writings are extremely recent, while somewhat rarer or older research doesn't specifically address the growth of renewable energy. A significant amount of previous research does investigate the institutional causes behind nuclear energy and fossil fuel use, which can help to explain each nation's current response to the goals set by the EU. There is also a dearth of research which compares Western European energy policy with Eastern European energy policy, particularly with renewable sources, in the context of the European Union.

This project will draw from the research done on public opinion in Europe, comparative research within the European Union, as well as investigation into the individual countries and their renewable energy use. This work will reinforce why these countries have different policies by examining factors, which were previously not carefully considered. Comparing public opinion data between countries will provide the basic differences between their perception of the European Union and consider it as a factor when many other works have omitted it. Further comparison of relevant institutions and cultural phenomena will then provide the logic behind the correlation of the opinion data and that nations' energy policy. A weakness of this strategy is the complexity of determining policy outcomes. Public opinion would only be a part of why energy policy is determined as it is. Ideally, the explanation through cultural and institutional factors will help cover more explanatory area and create a fuller, broader picture of why renewable energy usage differs. Another weakness is that there may not be significant differentiation in renewable energy usage and the differences between Eastern Europe and Western Europe may be predictable and uninteresting. The strength of this project is the reliable data already collected for public opinion in Europe combined established institutional and national history. The availability of data should make comparison simpler and more effective. This research could then confirm previously held opinions by providing new supporting evidence and bring in a relatively new perspective on the issues to the field while explain the modern differences in renewable energy usage.

B - Review of Current and Past Research

European energy policy and the policy differences of European nations have been a historical driver for many events throughout the past, and thusly, they have been researched, discussed and analyzed. This comes in many forms, from papers investigating causal factors in nuclear energy policy raw data about energy usage, development and growth. Much of the research looks into institutional reasons for the various policy outcomes within Europe or comparisons between Eastern and Western Europe. There has been limited recent research into renewable energy within the EU since the European Union set a goal for reduced carbon emissions and increased renewable energy use by 2020. Literature discussing the causes of different energy policies will be examined as well as data collected over the energy sectors within the European nations and public opinion data from the European Union. My study will be looking at the causes, some original and some repeated, of different trends in European energy policy since this policy change and the economic recession Europe is experiencing. This is a relatively untouched area of analysis in the field and I hope to add to the consensus over European energy policy and shed light on why current trends are established and how they may proceed in the future.

Many studies focus on what institutions can do to affect policy outcomes with regards to energy in Europe. Studies by Gordon Walker and Noel Cass as well as Tooraj Jamasb and Michael Pollit examine how policy interventions such as liberalization can affect energy sector growth. The Walker-Cass study also examines how policy affects public perception, which is key to understanding how a policy is created. This research bridges the historical and inner machinations of the energy policy world in Europe and what combination of events and structures has produced the current environment. How those factors will continue to affect policy may also be extrapolated or deduced from this valuable research.

Further studies by Colin Robinson, George Hoffman and William Diebold Jr., compare Western European energy plans, and institutional influences that shaped their energy approaches and encouraged or deterred changes in new technology and attitudes. Western Europe is the site of a considerable variation between national policies, which makes the in-depth analyses of their policy history very valuable. The problem here is they are mainly dated sources, and a product of their time-date is their focus on nuclear energy. Nuclear is an interesting variable to study here, because it is not renewable and can't help countries meet their goal of renewable energy use, but it can significantly reduce carbon emissions, which is another directive from the EU, one which may potentially override the renewable energy movement. This factor requires these studies to be examined and considered for how historical trends could be affecting current decision making. Hoffman's book, *The European Energy Challenge,* written in 1985, discusses differences between Eastern Europe and Western Europe regarding energy. Hoffman examines differences in energy supply, production, consumption and security focusing exclusively on fossil fuels. While not particularly useful for this paper, he does touch on two important and relevant subjects: Europe's energy supply from Russia and the natural endowment of European countries (Hoffman, 1985 p. 1-27). Background on these subjects will be helpful for this study and provides a grounding for understanding the current state of natural resource endowment and reliance on Russia for energy supply in modern Europe.

Books by David Buchan and Ute Collier discuss how the European Union and further integration have, and will, affect Europe with regard to energy policy. David Buchan's book *Energy and Climate Change: Europe at the Crossroads*, is an in-depth examination of the European Union's current situation and the direction it has decided to take in the future. Buchan discusses the EU's recent energy policy renovations and the goals set for 2020 in the energy arena (Buchan 2009 p.11). The book covers multiple areas of EU energy policy and the corresponding factors which influence policy in those areas, including nuclear energy, energy diversity and liberalization as well as energy security (Buchan 2009 p. 5-11). Renewable Energy and its newly-minted mandated status in European energy policy garners its own section, in which Buchan explains the current situation of renewable energy in European nations and how the shift towards renewable energy might be handled (Buchan 2009 p. 137-151). He does address the differences in national policy regarding renewable energy. Specifically, each nation's current renewable energy capabilities and their projected growth (Buchan 2009 p.143) and how a trading scheme has been put into place allowing certain countries to trade for renewable energy and therefore compensating for their lower-than-desired renewable energy production. Buchan asserts that a "feed-in tariff (a guaranteed full price)" is incredibly important to renewable energy growth in the European Union (Buchan 2009 p. 144). The book touches on the causes behind differences in renewable energy growth, but does not delve deeper or probe further explanations.

Energy and The Environment in the European Union by Ute Collier attempts to create a full representation of the issues, policies and future of energy in the European Union. Written in 1994, it does include discussion of Eastern Europe and its potential integration into the Union. A large portion of the book is centered on energy issues facing Europe and how integrated policies will take shape in Europe and affect the energy climate (Collier 1994, pg. 1-12). A decent portion of this discussion is outdated and irrelevant to today's European Union and its integrated policy. However, Collier does provide case studies of a unified Germany, the Netherlands and Great Britain, which provides some institutional and historical insight into their energy cultures and polices, much of which is still applicable. Of particular interest, he describes the renewable energy potential in these nations and discusses the prospect of their growth (Collier 1994, p. 59). Collier also provides a good report on what political factors have influenced energy policy decision-making for the UK, the Netherlands and Germany in 1994 (Collier 1994 p. 224), much of which remains influential on current energy policy. The author also takes an interesting and special interest in the Research and Development budgets and processes of these countries and how they affect energy policy (Collier 1994 p. 73). Research and development had not been discussed often in previous literature and could have a bearing on renewable energy's status at present. These sources are more current, and in that respect, more relevant. They do not, however, discuss the motivations behind current policies or explain the differences in national response the European Union directive.

Most of the published research deals with institutions and their effect on nuclear, fossil or renewable energy policy, production and consumption. This is useful to understand what forces can affect public opinion about energy, as well as forces that filter public opinion before policy is enacted. *Politics and Nuclear Power* by Michael Hatch is an example of such work. Published in 1986, the book details the national energy policy, specifically focusing on nuclear energy, of several Western European states. Namely, West Germany, France and the Netherlands are case studies. This work is valuable because it also provides a history of not only energy politics in Europe, but nuclear energy, which is potentially the biggest competitor to renewable energy in Europe. Understanding nuclear energy's positives and negatives is important to understand how the current debate came about and the viewpoints in said debate. Hatch analyzes how nuclear, and more broadly, energy policy is created in these states and identifies the institutions responsible for their energy policy Hoffman 1986 pg. 1-9). These institutions also effect current renewable energy policy, though the degree to which they do is debatable. Much has changed since 1985 as well, prompting renewed investigation into this subject and a fresh focus on the energy source of the day, which has shifted from nuclear to renewable. However, many of these sources are before the Maastricht and Lisbon treaties and before a bigger more unified European Union. The somewhat old publication date of these studies is unfortunate and further information must be gathered to supplement and compensate for recent events. Luckily though, institutions within the nation-states have not changed too drastically, so their findings are still relevant to my study. The recent inquiries into European energy schemes in the larger context of the European Union are extremely useful and relevant. They address the differences moving forward in Europe, however, they also mainly focus on what can and will happen in the future and what consequences that will have.

There is also some research on how broad EU policy affects individual states decision making capacity and outcomes. This literature deals with many areas, such as human rights and border security. Laura Cram has a book which dissects how policy is formed, passed and enacted in the European Union; it is aptly titled *Policy-making in the European Union*. Written in 1997, the book discusses the historical processes of policy-creation in the European Community and European Union and evolution of said processes, conceptualizes current integration's effects and theorizes how future integration will affect EU policy (Cram 1997 pg 1-5). Because this book was written in 1997, it doesn't account for the changes, such as more power given to the EU government over member-states, affected by the Lisbon treaty. However, its analysis of historical and, at that time, current methods of policy-making are useful and effective at fostering an understanding of the European Union whereas some of the speculation on future integration is relevant and interesting, but most is now rendered derelict. *The Politics of Sustainable Development*, edited by Susan Baker, Maria Kousis, Dick Richardson and Stephen Young, also delves into this subject, but with a focus on environmentally sustainable economic growth. Also written in 1997, parts of the book are no longer relevant and even the relevant parts deserve updating. It does however bring up some very good points. For one, it mentions the Brundtland Report, which argues,

> "that there is no single blueprint of sustainable development, given that economic and social systems and ecological conditions differ widely among countries. Thus, despite seeing sustainable development as a global objective, *Our Common Future* pointed out that each nation would have to work out the concrete policy implications for itself." (Baker, Kousis, Richardson, Young 1997, p. 4).

This statement lays out the significance and importance of each country's individual policy in reaction to an EU directive and the necessity of studying each nation's policy in order to understand how and why that policy arose. This book also does some important work regarding local, state and national governments, a variable which will also be studied in this paper (Baker, Kousis, Richardson, Young 1997, p. 18). The significance of local control and power over sustainable development is discussed, however not statistically linked to renewable energy and the discussion refers to local control before further EU expansion and the Lisbon Treaty.

A chapter on the issues facing sustainable energy in Mediterranean Europe, written by Pridam and Konstadakopulos, covers many important factors for both sustainable development and renewable energy. This section is very relevant to my own paper and discusses many of the same issues facing Europe. The date of its publication does establish the further need for research into this subject however, as shown by this excerpt, "Despite having been granted a stronger legal role in the environmental field, the Union still has weak powers of co-ordination at the levels of incorporation, implementation and enforcement" (Pridham, Konstadakopulos 1997 p. 138). The Lisbon Treaty as well as the creation of the Eurozone are two major events amongst many others which have changed the political climate drastically enough from the time of this study to warrant another investigation which includes the new forces created by these historical events.

In the arena of energy policy, Europe has granted nations a large amount of autonomy, which is unusual for binding goals such as their renewable energy goal (Lisbon Treaty). Europe has also taken a leadership role in fighting climate change, putting policies such as their energy ones, in the limelight. This global focus on Europe increases the importance of their success for maintaining this leadership role.

I will consider what has already caused these differences within the nations and attempt to identify the relative causal weight of different factors regarding renewable energy usage. The comparisons between Western and Eastern Europe are very interesting as well, showing that the stark differences between these two blocs have also caused energy differences. The recent expansions of the European Union and economic growth in Eastern Europe may have mitigated many of the factoral differences, so it will be interesting to see if there are new causes for differentiation or the same ones as previously determined hold true. This research is reflective of the field in that it has institutional analysis from the past as well as speculation towards the future, but not very much substance regarding what motivates current attitudes toward energy in Europe. Public perception of the EU and a nation's membership to it fits in here and there is a noted lack of acknowledgement for this factor. Further research into public perception of EU membership and the EU's place in energy policy seems to be a rich place for findings. This is where I would like to begin further inquiry, in order to find how the policies of the past intersect the prospects of the future presently in each individual country and why it differs between them.

C - Hypotheses

The frontier laid out by the literature in this area presents several paths, but this study will focus on covering the consumption of renewable energy as a share of total energy consumption in European nations. It will map the spectrum of that growth and determine causal factors of those differences. To accomplish this objective and uncover the desired answers, several hypotheses from 5 main organizational categories will be tested and their results analyzed. They are as follows:

1. European Union Hypotheses

1.1. If a country does not use the Euro as currency, then they will be less likely to pursue renewable energy.

1.2. The higher a nation's public opinion of EU membership, the higher their use of renewable energy.

Perhaps most importantly, this section deals with a nation's dedication to the EU and its goals.. The two hypotheses here are meant to demonstrate the commitment a member state has to the European Union, its future and its ideals. Using the Euro as currency reflects a strong commitment to the concept of a unified Europe, as well as a deference to European directives. The support, or lack of support, for EU membership can reflect the public's acceptance and zeal for EU initiatives and goals, such as the Europe 20-20-20 and will reflect how effectively a nation pursues those goals. In these ways, these two variables can measure the commitment to the European Union of the states being studied and, by proxy, their commitment to the renewable energy goal.

2. Natural Endowment and Current Consumption Hypotheses

2.1. As a country's level of natural resources, i.e. oil, natural gas, uranium, increases, renewable energy usage will decrease.

2.2. As a countries solid fuel consumption increases, its renewable energy usage will decrease.

The logic behind these hypotheses is derived simply from the fact that each of the nations in the EU have different natural resources and renewable capabilities. The resources available to a country will inform their energy policy decisions heavily because it determines how easy it is to acquire different types of energy. The current state of consumption can also be hard to change and often is, so measuring how much solid fuel is consumed shows how much a nation depends on it, and could reflect a hesitance to switch away from solid fuels.

3. Political Institutions Hypotheses

3.1. The more decentralized a government is, the less likely they will be to pursue renewable energy. The thinking here is that a decentralized government will be less able to encourage and enforce larger initiatives, such as renewable energy increases.

3.2. The more nuclear power generated, the less renewable energy will be consumed.

3.3. The more protected area for biodiversity, the more renewable energy will be consumed.

3.4. The higher the implicit energy tax, the more renewable energy will be consumed.

By the same token as the previous hypotheses, the political institutions of a nation shape not only if a policy can in fact, become law, but how likely that is to occur. Decentralized government has been identified as a factor in determining energy policy outcomes by previous literature and continues to have relevance today. It is also a variable which varies somewhat dramatically amongst nations in Europe. Countries such as Sweden and France have very powerful central governments, whereas Germany and the United Kingdom have more decentralized structures (Reuters). Decentralization poses several issues for energy policy, primary amongst them are implementation and consensus. A consensus on energy policy may be harder to build with a more decentralized government and effective implementation of a policy, once it is decided, may also be less effective than it would be under a more centralized system. Also, due to the previous EU goals of lowering carbon emissions (European Commission), nuclear energy was considered a viable energy option. If a nation has a substantial nuclear energy sector already, they would have lower carbon emissions than a more fossil-fuel based energy sector. The same motivation lies behind energy tax because implicit tax rate also includes carbon emission tax. The lower carbon emissions would then lead to a less pressing need for renewable energy in order to meet the EU goal, and therefore, lower renewable energy growth.

4. Economic Hypotheses

4.1. The larger a nations PPP (Purchasing Power Parity), the more renewable energy they will consume

4.2. The larger a nation GDP growth rate, the more renewable energy they will consume

4.3. The more fuel imported from Russia, the higher renewable energy consumption will be

This section is somewhat related to the first hypothesis, in that it looks into what resources a particular nation has at its disposal. The more financial capital and strength a nation has, the more capable it is of committing to renewable energy and the more political agency it has to foster this commitment. Most of Europe is also dependent on Russia for fuel (citation) and the more dependent a nation is, the larger the energy supply is a security risk. Therefore, increasing renewable energy usage would be a step towards energy independence.

These hypotheses are rather broad, but ideally analyzing all the European Union member states will show broader trends amongst the member states and any shared motivation they may or may not have for increasing their use of renewable energy.

D - Methodology

Data will be compiled into a conglomerate dataset with the variables stated in the hypotheses, or proxy variable substitutes as well as variables which may be related to, or have an effect on, the primary independent variables and deemed pertinent to include in the analysis. Once this data set has been assembled, the independent variables will be statistically analyzed for significance using STATA as the analytical program. Simple bivariate regressions will be run for every independent variable alone against the dependent variables to search for significant correlation results amongst the data. After the initial tests and once significant and relevant variables have been identified, a multiple variable linear regression will be run to determine the relationship of each independent variable with the dependent variable when the other variables are measured at the same time. This regression will show just how statistically correlated and significant each variable is in the spectrum of potential causes outlined by the hypotheses. Only one public opinion variable was included in this larger regression to eliminate problems of colineraity experienced when all were run together. A beta value will also be calculated in the multivariate regression allowing us to see a common scale of correlation foe all the independent variables. A combination of the results from bivariate regression and multivariate regression creates a comprehensive assessment of correlation between the independent variable and dependent variables.

E - Data Summary

This data was compiled from across several sources for the purpose of quantitatively analyzing the questions posed in this paper. The data came from Eurostat, the Eurobarometer, the European Environmental Agency, the Energy Information Administration and a previous work by Hooghe, Marks and Schakel (2008). Data relevant to the stated hypotheses was appropriated and assembled into a single dataset in order to conduct regression analysis on the chosen variables. Countries were the unit of analysis in this project, so country data over time was sought out. There are missing values for some countries, often those who are newer to the European Union, or for some variables, which only have recent data. There are, however, enough values for those variables to extrapolate a trend and the missing data by country is usually for countries such as Serbia, who are not in the European Union, but included in many European Datasets. A summary table of the variables with their name in the dataset, number of observations, range and a short description can be found in the appendix as Table 1.

European Union Public Opinion Data

To measure the European Union hypotheses, public opinion data from the Eurobarometer was selected, as well as a count of which countries use the Euro as currency. The two main datasets that the Eurobarometer provided dealt with the role of the European Union and the benefits of being a member of the European Union. The Eurobarometer has a very extensive database of public opinion data relating specifically to Europe and the issues facing it, making it a an ideal source for public opinion data about European Union policies.

The main issue encountered collecting this data was finding a good measure of public opinion that was also collected over an acceptable range of years. Most of the questions posed by the Eurobarometer relating to the EU and its specific role in energy have only been asked in recent years, creating a dearth of data to compare with the other variables. That is why these two questions were chosen. The best measure of public opinion towards the European Union was determined to be whether or not respondents thought that energy policy should be exclusively decided by the national governments or jointly with the European Union (national_gov, jointy_EU). It directly measures respondents' opinions on the EU's role related to energy policy, and therefore is the most likely to be an accurate proxy measure for support of the European Union's goal of 20% of energy usage being renewable energy. However, the problem of its recent collection and short span of years made a second public opinion measure necessary.

The data reflected? whether or not respondents of the Eurobarometer survey thought that being a member of the European Community was good, bad or neither (ECgood, ECbad, ECneither). While this variable is less precise at measuring public opinion towards the EU's role in energy policy, it does reflect a nation's general attitude towards the EU and covers a longer timespan. These traits make it a useful variable for gauging how likely a country is to view the European community as positive, which could affect how willing they are to accept policy from the European Union. The Euro counter is an even more blunt measure of this, but does also reflect an investment and trust in the EU's power and role in a nation's policies. These three variables are therefore used to measure how important views on the European Union are to a country's renewable energy policy.

Economic Variables

Statistics that directly measure the economic variables hypothesized earlier to affect renewable energy usage, were easy to access and very available from several sources. The GDP growth rate, which was chosen over GDP because it would reflect the countries immediate economic situation and confidence more accurately, was taken from Eurostat, as was PPP (Purchasing Power Parity). PPP was also used to reflect the nation's wealth outside of GDP growth rate.

Political Institutional Variables

Several, somewhat eclectic, variables were also included in order to look at possible political or institutional causes of renewable energy usage.

These variables are usually structural institutions already in place to reduce carbon emissions or protect the environment, such as how much total area in a country is protected for biodiversity and how much nuclear energy is already generated. These factors affect carbon emissions, energy production, and public perception of energy policy and environmental protection. Both of these statistics came from Eurostat.

Implicit Energy Tax, also pulled from Eurostat, measures how much energy consumption is taxed, a method employed by countries to reduce emissions and reach their environmental goals. This national instrument will help determine how much a country already punishes consumption and may affect how fervently they pursue renewable energy. These economic variables are used to help provide the financial aspect of the energy spectrum.

The amount of gas imported from Russia is also included in this category, despite being an economic variable and relating to natural resource endowment. This categorization is due to the political implication of importing gas from Russia. Russia is the largest supplier of natural gas and fuel to Europe and has many points of contention with European nations. Europe's energy dependence is a very large part of any diplomacy that may occur between the EU, it's member nations, and Russia. This variable also came from the US Energy Information Administration.

The Regional Authority Index is from the study by Hooghe, Marks and Schakel (2008). In this work, they create a regional authority index that reflects how much power regional governments, as opposed to the national government, hold. This measurement is for how decentralized a nation's government is.

Natural Endowment Variables

These variables are meant to reflect the natural resource endowment of the nations being investigated. Simply, these are the present fuel reserves and present level of fuel consumption, represented by those variables. The fuel reserves, natural gas and oil, are from the US Energy Information Administration. The fuel consumption is from Eurostat. Greenhouse gas emissions, statistics from Eurostat, are also included here because a large motivation behind using renewable energy is to lower the amount of emissions and is closely related with fuel consumption.

One difficulty encountered here was a nation's potential for renewable energy. I attempted to find data for this and the only available data I found was private. The data on renewable potential is often subject to change as well and the depth at which it is studied has increased only recently. While this data is likely to impact renewable use, the member states of the EU all have the feasible potential to reach 20% renewable consumption, and so data on how much potential renewable energy a nation can generate was deemed superfluous because every nation has enough natural potential in renewable sources such as wind, solar, and hydropower to accomplish the EU objective (World Nuclear Association). These variables provide a grasp on the existing state of energy in a country due to its natural resources and levels of consumption.

Variable Name	Observations	Range	Description
ccode	661	1-52	A unique code given to each country
cyear	661	12000-522011	A combination of a country's code and the year of the observation to create a unique identifier for every observation
russiagas_imports	379	0-5107614	Amount of natural gas imported from Russia in terajoules
ECgood	274	.24-.81	The percentage of respondents from that nation who think belonging to the European Community is good
ECbad	274	.03-.44	The percentage of respondents from that nation who think belonging to the European Community is bad
ECdontknow	274	0-.22	The percentage of respondents from

			that nation who don't know if belonging to the European Community is good
ECneither	274	.12-.52	The percentage of respondents from that nation who think belonging to the European Community is neither good nor bad
protected_area	208	316-3205980	The total protected area for biodiversity in km^2
PPP	402	4563-1.38e +07	Real expenditures in Purchasing Power Parity, an alternative to GDP for measuring wealth
nuclearheat	310	0-260286.1	The gross inland consumption of nuclear heat in thousand tonnes of oil equivalent. It measures how much nuclear energy a country produces
tax	373	31.3-316.44	This indicator is defined as the ratio between energy tax revenues and final energy consumption calculated for a calendar year. Energy tax revenues are measured in euro (deflated) and the final energy consumption as toe (tonnes of oil equivalent). Implicit Energy Tax also includes Carbon Emissions Tax (Eurostat)
GDPgrowth	428	-17.7-11	Gross domestic product (GDP) is a measure of the economic activity, defined as the value of all goods and services produced less the value of any goods or services used in their creation. The calculation of the annual growth rate of GDP volume is intended to allow comparisons of the dynamics of economic development both over time and between economies of different sizes. For measuring the growth rate of GDP in terms of volumes, the GDP at current prices are valued in the prices of the previous year and the

			thus computed volume changes are imposed on the level of a reference year; this is called a chain-linked series. Accordingly, price movements will not inflate the growth rate. (Eurostat)
Fuel	300	.1-330310.7	The gross inland consumption of solid fuel in thousand tonnes of oil
crudeoil	364	0-9.22665	The proven crude oil reserves a nation has in billions of barrels, EIA
renew_energy	248	0-65.2	The percent of a nation's energy consumption that comes from renewable energy sources
greenhousegas	414	38.21-203.16	This indicator shows trends in total man-made emissions of the Kyoto basket of greenhouse gases. It presents annual total emissions. These gases are aggregated into a single unit using gas-specific global warming potential (GWP) factors. The aggregated greenhouse gas emissions are expressed in units of CO2 equivalents. Data Source: European Environment Agency
naturalgas	364	0-136.945	Proved reserves of natural gas in trillion cubic feet
Euro	661	0-1	A binary scale in which 0 denotes not using the Euro as currency and 1 denotes using the Euro
RAI	217	0-29.47	"Regional authority index, which is the sum of self_rule and shared_rule" according to the codebook provided by Hooghe, Marks and Schakel
national_gov	175	.08-.6	Respondents think that decisions about energy policy should be made by the national government, not the EU
jointly_EU	175	.26-.9	Respondents think that decisions about energy policy should be made

			jointly between the national governments of member states and the EU government
DkDontKnow	175	0-.15	Respondents don't know whether or not decisions should be made at the national level or jointly with the EU government
country	661	--	Simply the country the data describes
year	661	2000-2013	The year that the data describes

F - Results and Analysis

The series of regression tests produced some interesting results, particularly the multivariate regression. Each of the variables will be discussed as they relate to the hypotheses. The multiple linear regression has a R-squared value of .8467, which is high enough to consider this model fairly effective at judging which variables would correlate and possibly affect renewable energy as shown in Table 2.1 below.

renew_energy	Coefficient	St. Err.	t	P>|t|	Beta
ECbad	**1.035**	**.1575**	**6.57**	**0.000**	**.6486171**
russiagas_imports	**-6.95e-06**	**6.22e-06**	**-1.12**	**0.270**	**-.225751**
Protected_area	**.0000343**	**9.89e-06**	**3.47**	**0.001**	**.5306008**
PPP	**-4.40e-07**	**6.15e-06**	**-0.07**	**0.943**	**-.027073**
Nuclearheat	**-.0001948**	**.0000578**	**-3.37**	**0.002**	**-.467389**
Tax	**.06395**	**.0158279**	**4.04**	**0.000**	**.3517774**
GDPgrowth	**-.178**	**647676**	**-0.27**	**0.785**	**-.038926**
Fuel	**3.81e-07**	**.0000636**	**0.01**	**0.995**	**.0007173**
Crudeoil	**-7.039**	**2.335789**	**-3.01**	**0.004**	**-.663952**
Greenhousegas	**-.1921**	**.0604477**	**-3.18**	**0.003**	**-.463124**
Naturlgas	**-.1503**	**.0635744**	**-2.36**	**0.023**	**-.192799**
Euro	**4.332**	**2.410052**	**1.80**	**0.079**	**.1786714**
RAI	**-.2026**	**.1366161**	**-1.48**	**0.146**	**-.158168**
_cons	**9.17**	**8.995271**	**1.02**	**0.314**	**-**

European Union Results

The series of regressions yielded somewhat unexpected results for this group of hypotheses, particularly the public opinion related theories. Both variables that supported the European Union (ECgood and jointly_EU) had negative coefficient values when bivariate regressions with the renewable energy percentage share of total energy (renew_energy), as shown in Table 3.2 . A negative coefficient indicates an inverse relationship in which an increase in the independent variable leads to a decrease in the independent variable. Naturally, the counterpart variables that reflect more nationalistic and negative EU views (national_gov and ECbad) have a positive coefficient, indicating that as negative views on the European Union increase, so does renewable energy's share of the total energy. An inverse relationship is shown by the bivariate regressions, in which a negative view of the EU, or a nationalistic view, result in higher levels of renewable energy.

The magnitude of the coefficient is not too large in the bivariate regression however, especially compared to the coefficient in the multivariate regression table, which has a much larger coefficient of 1.035 for the variable ECbad. A coefficient greater than one indicates a very strong statistical relationship. The t-value is 5.67 in the multi-variate regression as well, indicating statistical significance. This is a sizeable increase over the 0.44 coefficient in the bivariate model. The difference between the two and overall correlation in the multi-variate regression leads to the conclusion that believing your country's' membership to the EU has a positive relationship with renewable energy usage.

Table 3.3 Positive Perception of EU Membership

renew_energy	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]	
ECgood	-23.98241	5.574994	-4.30	0.000	-34.97572	-12.9891
_cons	25.73328	3.005359	8.56	0.000	19.80702	31.65954

Table 3.3 – Without Nordic Nations

renew_energy	Coefficient	St. Err.	t	P>|t|	95% Conf. Interval
ECgood	-.2219032	.0431486	-5.14	0.000	-.3070584 - .136748
_cons	22.40555	2.331765	9.61	0.000	17.80373 27.00737
Number of obs = 178	F(1, 176) = 26.45	Prob > F = 0.0000	R-squared = 0.1306	Adj R-squared = 0.1257	Root MSE = 7.8983

However, when you look at the data, the Nordic countries are seemingly obvious outliers because while they have a more negative perception of EU membership, they have very high levels of renewable energy. Removing these countries form the regression does lower the coefficient and relationship, but the magnitude of the coefficient is still large and statistically significant, as shown in Table 3.3. These results reject the hypotheses bout public perception of EU membership. Whether this relationship is causal or spurious is debatable. It's possible that a negative view of the EU comes from confidence in the respondent's home country and therefore, its ability to use renewable energy, but this would require other public opinion data to test. Logically connecting the two here seems counter-intuitive, given the EU's commitment to environmental protection and renewable energy. While the model run in this study has an r-squared of 0.85, justifying its use, there are still factors which could affect renewable energy.

The Ramsey RESET test yielded a $p < .05$, meaning that the null hypothesis of no omitted variables can be rejected. Therefore, it is likely that the model is missing at least one variable that would significantly contribute to prediction of renewable energy use. The missing factor or factors could either explain this correlation between negative perception of the EU and renewable energy or mitigate it. Further investigation of this relationship, perhaps when more data is available, is necessary to truly get to the root of this relationship.

When examining the bivariate of the Euro currency variable, it initially has a negative coefficient and is statistically significant, indicating that not having the Euro would lead to higher renewable energy, which is also unexpected because one would think that investment in the Euro would result in following the objectives set by the EU. When you run a regression excluding the Nordic countries, the coefficient becomes positive and the t-value drops below 2.0, rendering the regression statistically insignificant. A similar result occurs in the large multi-variate regression: the coefficient reverses and becomes positive as well as statistically insignificant. These two examples suggest that using the Euro as currency actually has little effect on renewable energy usage in the European Union.

Economic Results

The bivariate regressions for all 3 variables in this category yielded scant results. The regression for Purchasing Power Parity showed a small coefficient,, and a t-value of 1.78, relegating it as non-significant. The same test for GDP growth rate yielded a similar result; both a low coefficient and a low t-value, but this time, the P value was fairly high, meaning the correlation is more likely to be random, cementing the lack of relationship between GDP growth rate and renewable energy. Russian gas imports showed slightly more of a relationship with renewable energy, the coefficient was somewhat larger, and the absolute value of t was slightly greater than 2.0, meaning it is statistically significant. The multivariate regression reduces this t-value to below 1.0, rendering natural gas imports from Russia statistically insignificant along with the other economic factors included in the model. However, Russian gas imports are only a part of the energy relationship between European nation and Russia. The complexity of the relationship along with the bivariate regression warrant a larger investigation into how Russian energy can affect renewable energy use. The multivariate regression table clearly shows that there is no significant statistical relationship between these variables and renewable energy.

Table 4.1 – Amount of Natural Gas Imports from Russia

renew_energy	Coefficient	St. Err.	t	P>|t|	95% Conf. Interval
Russiagas_imports	**-2.08e-06**	**9.87e-07**	**-2.11**	**0.036**	**-4.03e-06 - 1.38e-07**
_cons	**16.14061**	**.9291989**	**17.37**	**0.000**	**14.30973 17.97148**
Number of obs= 231	**F (1,229)**	**PROB > F = 0.0359**	**R-Squared = 0.0191**	**Adj R-Squared = 0.0148**	**Root MSE = 13.24**

Political Institution Results

The bivariate regressions for the political variables show very little statistical significance. Nuclear heat and Implicit tax rate did not show significance but Protected Area for biodiversity did.

Table 5.1 - Total Protected Area for Biodiversity

renew_energy	Coefficient	St. Err.	t	P>|t|	95% Conf. Interval
Protected_area	**.0000147**	**. 5.01e-06**	**2.93**	**0.004**	**.2275816 .6441805**
_cons	**10.34907**	**1.13804**	**9.09**	**0.000**	**3.309209 10.14715**
Number of obs= 175	**F (1,173) = 8.58**	**PROB > F = 0.0039**	**R-Squared = 0.0472**	**Adj R-Squared = 0.0417**	**Root MSE = 10.829**

Protected area has a respectable coefficient and Beta value, showing a correlation in the multiple regression. A possible causal explanation of this relationship is that the more protected area a nation has, the less opportunity there is for that nation to explore for resources such as fossil fuels. Restricting where resources can be found and extracted would make renewable energy a more attractive alternative to generate energy. A problem with this theory is that renewable energy sources, while often smaller, less intrusive and destructive, do still, to a lesser extent than fossil fuels, use land. While this protected area might lead to more renewable energy in this way, it is likely that it is a spurious correlation exists and there is third variable which causes both renewable energy and the amount of protected area to increase. This variable may be how much the citizens of a nation value and prioritize environmental protection, as that could be logically connected to more renewable energy and protected area for biodiversity.

In the full multivariate however, two variables stand out. The Regional Authority Index remains statistically insignificant and a non-factor. Nuclear heat, on the other hand, which is representative of nuclear energy production, and Implicit energy tax become statistically significant with t-values over 2.0 and respective coefficients of -.000192 and .064, which are worth noting when their units of measurement are taken into account, as shown by their beta value (See Table). These coefficients show that a higher implicit tax correlates to more renewable energy as well as nuclear energy decreasing correlates to renewable energy increasing when other non-political variables are included in the regression model. Both of these results confirm the hypotheses and can be logically linked as a cause of renewable energy use. Nuclear energy dissuades the use, or a least growth, of renewable energy because it also has lower carbon emissions. Cutting carbon emissions is one of the main motivations behind using renewable energy and the European Union's 20-20-20 initiative and therefore, nuclear energy reduces motivation for renewable energy. The energy tax is meant to reduce energy use as well as carbon emissions. Carbon emission taxes are included in the tax measure in this model as well. This means that the higher the tax, the more a country punishes carbon emissions and the more likely they consider renewable energy, reducing carbon emissions and the European Union's 20-20-20 initiative to be a priority.

Natural Endowment and Resource Use Results

The remaining variables deal with natural resources and current energy use in the member states, including proven reserves of crude oil and natural gas as well as inland fuel consumption and greenhouse gas emissions. Fuel consumption was shown to be statistically significant, but also to have a minor correlation with renewable energy, not enough to justify causation. The multiple regression model marginalizes inland fuel consumption further, showing that it has a small coefficient value, a small t-value, and a P value which is too high and doesn't reject the null hypothesis. The other three variables all appear as statistically significant and have negative coefficient values indicating correlation with renewable energy. The correlation only seems stronger when the variables are examined in the multiple linear regression. All three variables remain statistically significant, crude oil reserves and greenhouse gas emissions actually grow in this respect.

Crude oil reserves and greenhouse gas emissions also demonstrate a strong negative correlation with renewable energy, as reflected in their coefficients and Beta values, meaning that as renewable energy increases, these variables decrease. Reducing greenhouse gas emissions is one of the main reasons renewable energy is used, however lower levels of greenhouse gas emissions seems highly unlikely to cause high levels of renewable energy. High emissions spur the increase of renewable energy, but the subsequent decrease in emissions is just the product, not an active factor in increasing renewable energy, other than reinforcing it's effectiveness in reducing emissions, of course.

Table 12.1 – Greenhouse Gas Emissions

renew_energy	Coefficient	St. Err.	t	P>|t|	95% Conf. Interval
Greenhousegas	-.0763965	.0285404	-2.68	0.008	-.1326135 - .0201794
_cons	21.60215	2.821351	7.66	0.000	16.04483 27.15946
Number of obs = 246	F(1, 244) = 7.17	Prob > F = 0.0079	R-squared = 0.0285	Adj R-squared = 0.0245	Root MSE = 12.806

Table 11.1 – Proven Crude Oil Reserves

renew_energy	Coefficient	St. Err.	t	P>|t|	95% Conf. Interval
Crudeoil	**-.8909266**	**.4506021**	**-1.98**	**0.049**	**-1.778931 - .0029217**
_cons	**13.54263**	**.7468828**	**18.13**	**0.000**	**12.07075 15.01452**
Number of obs = 224	**F(1, 222) = 3.91**	**Prob > F = 0.0493**	**R-squared = 0.0173**	**Adj R-squared = 0.0129**	**Root MSE = 10.57**

Crude oil has a remarkably strong negative correlation with renewable energy. This result also comes as no surprise, confirming the hypothesis. Countries with large oil reserves not only have less of a need for the domestic energy generated from renewable sources that might substitute foreign fossil fuel imports; these nations have an economic interest in selling this oil and so renewable energy could be construed as competition. The lack of pressure and incentive to switch due to large oil reserves naturally leads to lower renewable energy. This finding has interesting implications for future EU projects. Nations who don't feel as much pressure to comply, due to their unique status, are less likely to, and while that seems like common sense, it is important to note that they seemingly will lag behind, and EU policy should account for that.

Results and Analysis Conclusion

The multi-linear model and the bivariate regressions, for the most part, have yielded noteworthy, if not expected, results. Surprisingly, the economic factors measured were not significant and had little correlation and relation to renewable energy. Other, more nuanced, economic measures could be used in future studies that may garner more conclusive results, but the economic factors in this model did not impact the dependent variable.

The political factors showed much stronger correlations with renewable energy consumption. Protected area may be spuriously correlated with renewable energy consumption. Other factors such as nuclear energy production and implicit tax rate have a causal relationship with renewable energy.

Natural endowment and resource use variables also produced findings. Fuel consumption proved to be insignificant and have no relationship with renewable energy. Natural gas, reserves, crude oil reserves, and greenhouse gas emissions all proved to be correlated with renewable energy and statistically significant. High greenhouse gas emissions can be seen as a reason to increase renewable energy, however low greenhouse gas emissions do not cause high renewable energy but are more likely to be a product of renewable energy. Crude oil, and to a lesser extent, natural gas, have a negative correlation. As crude oil reserves decrease, it causes an increase in renewable energy, confirming that hypothesis.

The European Union public opinion results are the most intriguing. While the Euro proved to be relatively unimportant, the perception of membership to EU as bad had a strong correlation to renewable energy. This result is most likely spurious and caused by a variable not included in this study. Finding that variable or one that may mitigate the relationship would lead to conclusive result on how perception of EU membership affects the EU's renewable energy objective.

G - Conclusion

The European Union was formed to make Europe more secure and successful and allow Europe to accept challenges facing the continent as a concert of nations. Climate change is just such a challenge, and the European Union is the global paragon in the fight against global warming. Its goal-setting approach has left the nations with the freedom to achieve this renewable energy goal in the manner they choose. This approach has led to differentiation in renewable energy usage across nations, which this study has tried to explain. The results of the model used in this paper bring up some broader considerations for energy and its future in the European Union.

First and foremost is the effect of public opinion on national energy policy, specifically renewables. A correlation between negative views of the European Union and renewable energy usage was shown. This rejected the hypothesis set forth earlier in the paper and the model has provided no salient causal theory linking the two variables. If one is found, such a causal relationship could prove that the EU has little power over the population of Europe and it policy regarding energy. It may also show which policy tools nations are using to increase renewable energy and maybe other 20-20-20 goals, despite negative public sentiment. This finding is particularly interesting considering the lack of recent literature linking public opinion to energy policy, specifically renewables. This study has exposed a weakness in the current research and another question to answer, which will strengthen our understanding. Further investigation with more precise public opinion variables both regarding energy policy and related topics should be used in order to create a more complete and encompassing picture of public opinion in these nations. Then public opinion about the EU and its relation to energy policy and renewable energy can be determined.

H - Appendix

Table 1.1

Variable Name	Observations	Range	Description
ccode	661	1-52	A unique code given to each country
cyear	661	12000-522011	A combination of a country's code and the year of the observation to create a unique identifier for every observation
russiagas_imports	379	0-5107614	Amount of natural gas imported from Russia in terajoules (EIA)
ECgood	274	.24-.81	The percentage of respondents from that nation who think belonging to the European Community is good (Eurobarometer)
ECbad	274	.03-.44	The percentage of respondents from that nation who think belonging to the European Community is bad
ECdontknow	274	0-.22	The percentage of respondents from that nation who don't know if belonging to the European Community is good
ECneither	274	.12-.52	The percentage of respondents from that nation who think belonging to the European Community is neither good nor bad
protected_area	208	316-3205980	The total protected area for biodiversity in km^2 (Eurostat)
PPP	402	4563-1.38e +07	Real expenditures in Purchasing Power Parity, an alternative to GDP for measuring wealth (Eurostat)
nuclearheat	310	0-260286.1	The gross inland consumption of nuclear heat in thousand tonnes of oil equivalent. It measures how much nuclear energy a country produces (Eurostat)
tax	373	31.3-316.44	This indicator is defined as the ratio between energy tax revenues and final energy consumption calculated

			for a calendar year. Energy tax revenues are measured in euro (deflated) and the final energy consumption as toe (tonnes of oil equivalent). Implicit Energy Tax also includes Carbon Emissions Tax (Eurostat)
GDPgrowth	428	-17.7-11	Gross domestic product (GDP) is a measure of the economic activity, defined as the value of all goods and services produced less the value of any goods or services used in their creation. The calculation of the annual growth rate of GDP volume is intended to allow comparisons of the dynamics of economic development both over time and between economies of different sizes. For measuring the growth rate of GDP in terms of volumes, the GDP at current prices are valued in the prices of the previous year and the thus computed volume changes are imposed on the level of a reference year; this is called a chain-linked series. Accordingly, price movements will not inflate the growth rate. (Eurostat)
Fuel	300	.1-330310.7	The gross inland consumption of solid fuel in thousand tonnes of oil
crudeoil	364	0-9.22665	The proven crude oil reserves a nation has in billions of barrels, (EIA)
renew_energy	248	0-65.2	The percent of a nation's energy consumption that comes from renewable energy sources(Eurostat)
greenhousegas	414	38.21-203.16	This indicator shows trends in total man-made emissions of the Kyoto basket of greenhouse gases. It presents annual total emissions. These gases are aggregated into a single unit using gas-specific global

			warming potential (GWP) factors. The aggregated greenhouse gas emissions are expressed in units of CO2 equivalents. Data Source: European Environment Agency
naturalgas	364	0-136.945	Proved reserves of natural gas in trillion cubic feet (EIA)
Euro	661	0-1	A binary scale in which 0 denotes not using the Euro as currency and 1 denotes using the Euro
RAI	217	0-29.47	"Regional authority index, which is the sum of self_rule and shared_rule" according to the codebook provided by Hooghe, Marks and Schakel
national_gov	175	.08-.6	Respondents think that decisions about energy policy should be made by the national government, not the EU (Eurobarometer)
jointly_EU	175	.26-.9	Respondents think that decisions about energy policy should be made jointly between the national governments of member states and the EU government
DkDontKnow	175	0-.15	Respondents don't know whether or not decisions should be made at the national level or jointly with the EU government
country	661	--	Simply the country the data describes, see table 1.2 for list
year	661	2000-2013	The year that the data describes

Table 2.1 – Regression with multiple Independent Variables

renew_energy	Coefficient	St. Err.	t	P>|t|	Beta
ECbad	1.035	.1575	6.57	0.000	.6486171
russiagas_imports	-6.95e-06	6.22e-06	-1.12	0.270	-.225751
Protected_area	.0000343	9.89e-06	3.47	0.001	.5306008
PPP	-4.40e-07	6.15e-06	-0.07	0.943	-.027073
Nuclearheat	-.0001948	.0000578	-3.37	0.002	-.467389
Tax	.06395	.0158279	4.04	0.000	.3517774
GDPgrowth	-.178	647676	-0.27	0.785	-.038926
Fuel	3.81e-07	.0000636	0.01	0.995	.0007173
Crudeoil	-7.039	2.335789	-3.01	0.004	-.663952
Greenhousegas	-.1921	.0604477	-3.18	0.003	-.463124
Naturlgas	-.1503	.0635744	-2.36	0.023	-.192799
Euro	4.332	2.410052	1.80	0.079	.1786714
RAI	-.2026	.1366161	-1.48	0.146	-.158168
_cons	9.17	8.995271	1.02	0.314	-
Number of obs= 56	F (13,42) = 17.84	PROB > F = 0.00	R-Squared = 0.8467	Adj R-Squared = 0.7992	Root MSE = 5.04

Table 3.1 – Negative Perception of EU Membership

renew_energy	Coefficient	St. Err.	t	P>|t|	95% Conf. Interval
ECbad	.4358811	.1056341	4.13	0.000	.2275816 .6441805
_cons	6.728182	1.73385	3.88	0.000	3.309209 10.14715
Number of obs= 202	F (1,200) = 17.03	PROB > F = 0.00	R-Squared = 0.0785	Adj R-Squared = 0.0738	Root MSE = 10.508

Table 3.2 – Positive Perception

renew_energy	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]	
ECgood	-23.98241	5.574994	-4.30	0.000	-34.97572	-12.9891
_cons	25.73328	3.005359	8.56	0.000	19.80702	31.65954

Table 3.3 – Without Nordic Nations

renew_energy	Coefficient	St. Err.	t	P>|t|	95% Conf. Interval
ECgood	-.2219032	.0431486	-5.14	0.000	-.3070584 - .136748
_cons	22.40555	2.331765	9.61	0.000	17.80373 27.00737
Number of obs = 178	F(1, 176) = 26.45	Prob > F = 0.0000	R-squared = 0.1306	Adj R-squared = 0.1257	Root MSE = 7.8983

Table 3.4 – Euro without Nordic Nations

renew_energy	Coefficient	St. Err.	t	P>|t|	95% Conf. Interval
Euro	1.437642	1.11536	1.29	0.199	-.7608572 3.636141
_cons	10.15455	.8586048	11.83	0.000	8.46214 11.84695
Number of obs = 216	F(1, 214) = 1.66	Prob > F = 0.1988	R-squared = 0.0077	Adj R-squared = 0.0031	Root MSE = 8.0544

Table 4.1 – Amount of Natural Gas Imports

renew_energy	Coefficient	St. Err.	t	P>|t|	95% Conf. Interval
Russiagas_imports	-2.08e-06	9.87e-07	-2.11	0.036	-4.03e-06 - 1.38e-07
_cons	16.14061	.9291989	17.37	0.000	14.30973 17.97148
Number of obs= 231	F (1,229)	PROB > F = 0.0359	R-Squared = 0.0191	Adj R-Squared = 0.0148	Root MSE = 13.24

Table 5.1 - Total Protected Area for Biodiversity

renew_energy	Coefficient	St. Err.	t	P>|t|	95% Conf. Interval
Protected_area	.0000147	. 5.01e-06	2.93	0.004	.2275816 .6441805
_cons	10.34907	1.13804	9.09	0.000	3.309209 10.14715
Number of obs= 175	F (1,173) = 8.58	PROB > F = 0.0039	R-Squared = 0.0472	Adj R-Squared = 0.0417	Root MSE = 10.829

Table 6.1 –Purchasing Power Parity

renew_energy	Coefficient	St. Err.	t	P>|t|	95% Conf. Interval
PPP	-6.71e-07	3.78e-07	-1.78	0.077	-1.41e-06 7.31e-08
_cons	15.12692	.897582	16.85	0.000	13.35899 16.89484
Number of obs = 248	F(1, 246) = 3.15	Prob > F = 0.0769	R-squared = 0.0127	Adj R-squared = 0.0086	Root MSE = 13.251

Table 7.1 – Amount of Nuclear Heat Generated

renew_energy	Coefficient	St. Err.	t	P>|t|	95% Conf. Interval
Nuclearheat	-.0000208	.0000327	-0.64	0.526	-.0000851 .0000436
_cons	13.37122	.7659844	17.46	0.000	11.86169 14.88075
Number of obs = 224	F(1, 222) = 0.40	Prob > F = 0.5257	R-squared = 0.0018	Adj R-squared = -0.0027	Root MSE = 10.638

Table 8.1 – Implicit Energy Tax Rate

renew_energy	Coefficient	St. Err.	t	P>|t|	95% Conf. Interval
tax	-.0035075	.0114664	-0.31	0.760	-.0261045 .0190894
_cons	13.65716	1.685495	8.10	0.000	10.33554 16.97878
Number of obs = 224	F(1, 222) = 0.09	Prob > F = 0.7600	R-squared = 0.0004	Adj R-squared = -0.0041	Root MSE = 10.645

Table 9.1 – Gross Domestic Growth Rate

renew_energy	Coefficient	St. Err.	t	P>|t|	95% Conf. Interval
GDPgrowth	-.1696889	.2064864	-0.82	0.412	-.5763956 .2370179
_cons	14.92579	.9490334	15.73	0.000	13.05653 16.79506
Number of obs = 248	F(1, 246) = 0.68	Prob > F = 0.4120	R-squared = 0.0027	Adj R-squared = -0.0013	Root MSE = 13.317

Table 10.1 – Inland Solid Fuel Consumption

renew_energy	Coefficient	St. Err.	t	P>|t|	95% Conf. Interval
Fuel	-.0001547	.0000381	-4.06	0.000	-.0002299 - .0000795
_cons	15.42968	.8148259	18.94	0.000	13.82357 17.0358
Number of obs = 216	F(1, 214) = 16.46	Prob > F = 0.0001	R-squared = 0.0714	Adj R-squared = 0.0671	Root MSE = 10.15

Table 11.1 – Proven Crude Oil Reserves

renew_energy	Coefficient	St. Err.	t	P>|t|	95% Conf. Interval
Crudeoil	-.8909266	.4506021	-1.98	0.049	-1.778931 - .0029217
_cons	13.54263	.7468828	18.13	0.000	12.07075 15.01452
Number of obs = 224	F(1, 222) = 3.91	Prob > F = 0.0493	R-squared = 0.0173	Adj R-squared = 0.0129	Root MSE = 10.57

Table 12.1 – Greenhouse Gas Emissions

renew_energy	Coefficient	St. Err.	t	P>|t|	95% Conf. Interval
Greenhousegas	-.0763965	.0285404	-2.68	0.008	-.1326135 - .0201794
_cons	21.60215	2.821351	7.66	0.000	16.04483 27.15946
Number of obs = 246	F(1, 244) = 7.17	Prob > F = 0.0079	R-squared = 0.0285	Adj R-squared = 0.0245	Root MSE = 12.806

Table 13.1 – Proven Natural Gas Reserves

renew_energy	Coefficient	St. Err.	t	P>|t|	95% Conf. Interval
naturalgas	-.0926695	.0341549	-2.71	0.007	-.1599788 - .0253602
_cons	13.70703	.740106	18.52	0.000	12.2485 15.16556
Number of obs = 224	F(1, 222) = 7.36	Prob > F = 0.0072	R-squared = 0.0321	Adj R-squared = 0.0277	Root MSE = 10.49

Table 14.1 – Euro as Currency

renew_energy	Coefficient	St. Err.	t	P>|t|	95% Conf. Interval
Euro	-4.18209	1.680537	-2.49	0.013	-7.492168 - .8720127
_cons	16.86518	1.244491	13.55	0.013	14.41396 19.3164
Number of obs = 248	F(1, 246) = 6.19	Prob > F = 0.0135	R-squared = 0.0246	Adj R-squared = 0.0206	Root MSE = 13.17

Table 15.1 – Regional Authority Index

renew_energy	Coefficient	St. Err.	t	P>|t|	95% Conf. Interval
RAI	-.1947856	.1676592	-1.16	0.248	-.527973 .1384017
_cons	15.04843	2.136138	7.04	0.000	10.8033 19.29356
Number of obs = 90	F(1, 88) = 1.35	Prob > F = 0.2485	R-squared = 0.0151	Adj R-squared = 0.0039	Root MSE = 13.095

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