# THE SUCCESS BEHIND RENEWABLE ENERGY: A COMPARATIVE ANALYSIS OF GERMANY, THE UNITED KINGDOM, BRAZIL AND TURKEY

**by**

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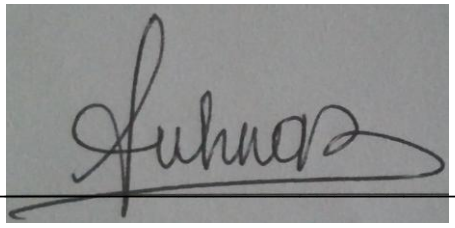

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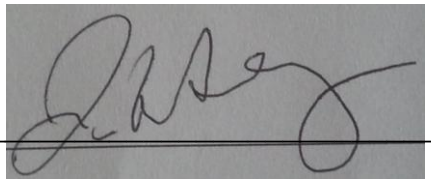

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**ABSTRACT**

This study is an attempt to investigate the reasons behind the renewable energy performance of two developed and two developing nations: Germany, the United Kingdom, Brazil and Turkey. Employing a most similar systems design, the analysis compares the developing and developed cases on a pair-wise basis in the 1990-2010 period. The renewable energy success is evaluated as the share of renewable energy within total primary energy supply and the factors leading to the success are sought in five different perspectives that form the groups of hypotheses: economics and welfare, environmental protection, security, state prestige and globalization, and civic virtue. The subject matter of the comparison is situated at the intersection of three theoretical frameworks: the literature on the environment, security studies and globalization. This literature is conducive to underlining the increasing importance of energy, especially in an age characterized by accelerating environmental degradation, climate change, and decreasing conventional energy resources; hence, it enables renewable energy to offer a possible remedy. Bringing a critical approach to realism, the analysis stresses the significance of energy security as part of national security and human security that complements the state security. The research presents the development of environmental protectionism and renewable energy at the crossroad of state and society in individual cases and aims to contribute to the literature through its comparative nature. The findings indicate that similar reasons affect the renewable energy success of developed and developing cases; economic means to invest in renewable energy along with the importance attached to welfare and national security emerge as the strongest explanations.

**Keywords:** Renewable energy, developed countries, developing countries, environmentalism, energy security, economic power, welfare

## ÖZET

Bu çalışma iki gelişmiş ve iki gelişmekte olan ülkeyi ele almakta, Almanya, Büyük Britanya, Brezilya ve Türkiye örneklerini kullanarak bu ülkelerin yenilenebilir enerji performanslarının arkasındaki nedenleri belirlemeye çalışmaktadır. "En benzer sistem tasarımı" yöntemini örneklere uygulayan analiz, gelişmiş ve gelişmekte olan ülkeleri 1990-2010 yılları arasında kendi aralarında farklı çift olarak karşılaştırmaktadır. Yenilenebilir enerjideki başarı, yenilenebilir enerjinin toplam birincil enerjideki payı olarak değerlendirilmekte ve bu başarıya yol açan etkenler farklı hipotez gruplarını oluşturan beş farklı perspektifte aranmaktadır: ekonomi ve refah, çevrenin korunması, güvenlik, devletin saygınlığı ve küreselleşme ile sivil erdem. Bu karşılaştırmanın ana konusu, çevre ile ilgili literatür, güvenlik bilimleri ve küreselleşme olmak üzere üç teorik çerçevenin kesişim noktasında yer almaktadır. Bu literatür, özellikle çevreye verilen zararın hızlanarak artması, iklim değişikliği ve konvansiyonel enerji kaynaklarının azalması ile karakterize edilen bir çağda enerjinin artan öneminin altını çizmeye yardımcı olmaktadır; bu nedenle, bu literatür yenilenebilir enerjiye olası bir çare sunması açısından yetki vermektedir. Realizme kritik bir bakış açısıyla yaklaşan bu analiz, enerji güvenliğinin milli güvenliğin bir parçası ve insan güvenliğinin devlet güvenliğinin tamamlayıcısı olmasının önemini vurgulamaktadır. Araştırma, farklı örnekleri ele alarak çevrenin korunmasına ilişkin bilinç ile yenilenebilir enerjinin nasıl geliştiğini devlet ve toplumun kavşak noktasında anlatmakta ve karşılaştırmalı doğasıyla literatüre katkı sağlamayı hedeflemektedir. Bulgular gelişmiş ve gelişmekte olan örneklerdeki yenilenebilir enerji başarısını benzer nedenlerin belirlediğini bildirirken, yatırım yapmaya izin veren ekonomik güç ile refah ve güvenliğe verilen önem bu başarıyı en güçlü biçimde açıklayan hususlar olarak ön plana çıkmaktadır.



**Anahtar kelimeler:** Yenilenebilir enerji, gelişmiş ülkeler, gelişmekte olan ülkeler, çevrecilik, enerji güvenliği, ekonomik güç, refah

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# CHAPTER ONE

## INTRODUCTION

Energy, national and human security, and a healthy environment are essential components for the continuity of our lives, in which case the use and extraction of energy is strongly related to the latter components because of its character. To secure our chances of survival, a particular amount of all of these elements are needed. All three elements are interconnected in the sense that having insufficient energy and living in a degraded environment undermines security on the personal level and vice versa. The usage of energy is required for survival. Continuing to employ conventional energy may ultimately result in environmental degradation. Lacking energy sources leads directly to concerns about security, as energy is required for producing food, manufacturing, transportation and defense. In this regard, renewable energy (RE) emerges as an almost perfect remedy: a clean technology that could satisfy the energy needs of nations which lack sufficient conventional energy.

This study focuses on two developed and two developing countries that invest in RE: Germany, the United Kingdom (UK), Brazil and Turkey. The developed countries, Germany and the UK have significantly similar backgrounds; both are located in Europe and have similar levels of income along with a similar path of development. In contrast, Brazil and Turkey are geographically apart; however, both countries have experienced an accelerated economic liberalization process in the 1980s, have similar income levels and currently attract global attention due to their rapid economic growth. The developed and developing cases share similar characteristics in terms of the RE potential per capita; thus, particularly solar, wind and hydroelectric potential are comparable within the groups. Germany and Brazil constitute the successful examples in RE development. They satisfy a considerable portion of their energy needs using RE, whereas the UK and Turkey need to take more steps before they climb up the ladders of RE.

The selection of the cases comes from three major reasons. First, the countries form four of the highly suitable examples in terms of their background and RE performance, when it comes to case study analysis. The within-group comparison is done on a most similar systems basis by taking developing and developed countries separately into consideration. The inter-group comparison is done on a most different systems basis, and a comparison between Germany and Brazil along with the UK and Turkey is provided. In this case, the study uses a more cautious tone due to the significantly different backgrounds of developed and developing cases. Second, the RE literature within political science is on the process of development and there are extremely few comparative studies. In the same regard, developing countries are often neglected in comparative energy studies and this study is an attempt to contribute to the literature by incorporating cases of different levels of development. Third, European countries are at the forefront of RE technologies and implementation; Brazil and Turkey, on the other hand, have started to receive greater interest in the international arena because of their admirable levels of economic growth and integration into the world economy. Thus, a comparative analysis involving these parties is believed to stimulate scholarly excitement regarding RE and offer insightful results for policymakers.

Countries with higher levels of RE deployment are taken as more successful cases controlling for their RE potential and level of development. The RE performance of a country is measured by the percentage of RE in the primary energy supply. To understand the reasons behind different levels of RE development in the cases, five sets of hypotheses are employed: economics and welfare, environmental protection, security, state prestige and globalization, and civic virtue. The multifaceted analysis is constructed by bringing developed and developing countries together in the same study as well as incorporating both state-related hypotheses, such as state prestige and security, and societal characteristics, as in the case of civic virtue. In this regard, this study is constructed on two main principles. First, it argues

that developing and developed countries do not need to be regarded differently; hence, income difference is not the only factor influencing the levels of RE implementation. Second, it maintains that, in contrast to state-centric studies on RE, the investment in energy should not be solely analyzed from a hard power perspective; in fact, in countries with advanced democracies or in those where the energy lobby is relatively weak, the attention to the security of the citizens is believed to be the single most decisive factor when the investment in RE is analyzed. In this regard, this study aims to fill a gap in the literature.

Security emerges as an important point of departure for decision making for states and people before they begin to make more investments in RE, as energy security constitutes one of the key elements of national and personal security and a sustainable environment is one of the strong contributors to human security. Environmental degradation is viewed as a long-term threat to security and sustainable development is sought for, as long as it serves to the security of states or their citizens. Moreover, globalization is a process that puts pressure on the environment, but, on the other hand, provides the necessary foundation for the development of RE because of the opportunities it offers in terms of exchanging technological know-how and higher income, and lowering the barriers of trade. Relying on security studies along with environment and globalization literature, this study employs a non-traditionalist perspective. Realist and neorealist perspectives are approached critically and viewed as rather narrow-minded because of their state-centric nature. In addition, they do not pay adequate attention to human security and occasionally even attempt to disregard security needs related to energy as intellectually void.

Taking the previous literature on RE into consideration, this study attempts to offer an innovative outlook in four ways. First, politics of energy and environmental politics is still viewed as a marginal subject in political science and it is difficult to find studies with comparable methodology that employ a particular theoretical framework in the literature.

Second, studies undertaken by policy analysts and researchers in hard sciences are either too technical and concentrate on the RE technology, too state-centric or they do not offer a clear path of measurement. Many previous works, most importantly those related to Brazil and Turkey act purely as academic justifications of the need to invest more in RE. Third, a great extent of the previous literature consists of short pieces, and therefore it is almost impossible to find a multidimensional analysis that employs different groups of hypotheses and cases that significantly differ from each other. Fourth, some of the cases in this study, most importantly Brazil, Turkey, and the UK, have not been adequately analyzed in terms of RE. In this way, this study is an effort to provide a new approach.

The analysis of the developed and developing cases provides two main results. First, economics and welfare, and security emerge as the strongest explanations behind more investment in RE; thus, countries that have higher income and value welfare more than their counterparts invest more in RE. Arguably, economically powerful nations invest in RE as they have enough financial sources to satisfy their other welfare requirements, including education, health services and military power. Also, countries that appreciate citizen-centered politics more than others prefer to invest more in RE, as green technology is one of the key elements protecting the nature and thus providing human security. In the case of security, RE increases the energy security by making a country less dependent on foreign sources, and therefore improving national security. Second, the incentives for developed and developing cases to invest in RE appear to differ mildly from each other; the results from the developed cases reveal that economics, welfare politics and concerns for security constitute almost the only factors that affect Germany and the UK's RE performance. In contrast, the reasons affecting the RE performance of Brazil and Turkey are more diverse: in addition to previously indicated factors, environmental protection and globalization have a moderate affect on the RE performance. The civic virtue supporting the investment in RE appears to have no

significant effect, which emphasizes the importance of policies initiated by politicians. The results are engaging in the sense that developed and developing countries share a similar set of causes that determine their RE policies, yet also provide a minor but stimulating difference between them.

The text is constructed in the following way: Chapter Two starts with an overview of the definition of energy and RE in particular by explaining how to measure it. In the following subsections, the theoretical framework that focuses on security, environment and globalization is provided. Chapter Three focuses on the previous literature on RE by taking the RE literature in general and the previous studies on different cases separately into consideration. Chapter Four introduces the cases, explains the hypotheses and attempts to justify why these particular cases and hypotheses were selected. Chapter Five constitutes the core of the analysis; it looks at each case separately and emphasizes the development of environmental consciousness in the case, the current situation of RE and conventional energy, policies and regulations, targets for RE, manufacturers of RE equipment and inspiring RE campaigns. The success of the particular case in RE is evaluated along with testing possible paths of explanation, hypotheses, and providing a verdict for the case. The conclusion provides an overview and a comparison, evaluates the value of the findings for the literature in general and offers possible paths of development.

## CHAPTER TWO

## ENERGY: AN INDISPENSABLE COMPONENT OF LIFE

Politics of energy constitutes a marginal field within political science and is not given a desirable level of attention; it is important to understand the meaning of energy to have a better grasp of the analysis on RE and to remember that energy is an essential building block of human survival. Energy is a required component for the survival of living organisms: it produces motion or heat; from the perspective of people, having or producing energy is

rational, if it contributes to the survival of humans by producing work and thus enabling people to produce things by providing light or the fuel to run manufacturing tools, to go from one place to another, to cook food and to defend themselves. International Energy Agency (IEA) defines energy as the ability to do work or to produce heat and energy manifests itself in many forms: heat, light, motive force, chemical transformation etc. (IEA 2013). The term primary energy is used to designate an energy source that is extracted from a stock of natural resources or captured from a flow of resources and that has not undergone any transformation or conversion other than separation and cleaning (ibid.), such as coal, crude oil, natural gas, solar power, nuclear power etc. On the other hand, secondary energy refers to any energy that is obtained from a primary energy source employing a transformation or conversion process. Thus, oil products or electricity are secondary energies, as these require refining or electric generators to produce them (ibid.). In this case, types of energy that do not require a transformation or conversion process, such as electricity produced by solar and wind energy, are more desirable by their nature, as they do not have to undergo any treatment—which could result in higher financial costs and environmental degradation.

RE constitutes a subsection within the concept of energy; the fact that is renewable comes from three aspects. First, RE cannot deplete, unless it is used beyond the limit of natural rate of renewability. Second, RE creates almost no carbon emissions. Third, using RE leads to a much lower extent of environmental degradation or none at all. In a similar manner, the US Energy Information Agency (EIA) uses the following definition of RE: "Energy sources that are naturally replenishing but flow limited. They are virtually inexhaustible in duration but limited in the amount of energy that is available per unit of time. RE sources include: biomass, hydro, geothermal, solar, wind, ocean thermal, wave action and tidal action" (EIA 2006). IEA indicates that the distinguishing factor between renewable and non-renewable sources is the issue of finiteness (IEA 2013). As indicated by EIA, IEA says that

some stocks could be renewed and used like a renewable energy, if its consumption (or extraction) does not exceed a certain limit. For example, firewood comes from a stock that could be replenished naturally if the extraction is less than the natural growth of the forest. If however, the extraction is above the natural forest growth, the stock depletes and the resource turns into a non-renewable one. In a more simplistic attempt, European policy circles usually employ the following definition: "All natural energy flows that are inexhaustible (i.e., renewable) from an anthropogenic point of view: solar radiation, hydropower, wind, geothermal, wave, and tidal energy, and biomass" (Criekemans 2007, p. 6). Erkan Erdoğdu, an energy expert from University of Cambridge indicates that an energy source is regarded as renewable if it is carbon neutral—has zero carbon emissions—and is derived from natural, mechanical, thermal and growth processes that repeat themselves within our lifetime (Erdoğdu 2009). This study regards renewable energies to be infinite sources with limitation of flows; as will be underlined, some sources have a stronger "renewable" character than others, such as solar and wind power, as they are flow limited, but so widely available that it is almost impossible to fully exploit their potential. Some forms of RE, such as wood and some types of biomass, have to be used very cautiously, as dependence on these sources may ultimately lead to a great scale of environmental harm. For example, Haiti satisfies around 60% of its energy from charcoal and its dependence on charcoal led to the destruction of 98% of the forests on the island. Thus, as previously explained, RE is green to the extent that it is used in a sustainable manner.

Experts classify types of energy in two groups: conventional and non-conventional energies; conventional energies are those which are obtained through commonly used technologies, whereas non-conventional energies are obtained using new and novel technologies or sources. Similarly, it is distinguished between non-modern and modern types of energy, as well. To calculate an energy account, following factors are employed:

production, imports, exports, bunkers (consumption by ships and planes in international territories), stock change (used as cushions to cover fluctuations in supply and demand), primary energy requirement, statistical difference, transformation input (energy spent on transforming a type of energy), energy sector's own use, transmission and distribution losses, net supply available, net domestic consumption, final energy consumption, agriculture, industry, transport, residential, commercial and non-energy uses (Codoni et al. 1985; IEA 2013). Supply, conversion and demand are the main flows considered in energy accounting. Countries often use their own assumptions and accounting conventions, which makes international comparison of energy statistics difficult; however, organizations like EIA, IEA and Eurostat publish standardized statistics.

Scientific units that are used to measure energy include calorie (cal), joule (J), British thermal unit (Btu) and kilowatt-hour (kWh). The energy produced using RE technologies is usually provided in kWh, as in the case of wind or solar energy, and cal or J, as in the case of biomass or firewood. However, the energy that conventional sources, such as oil, natural gas and coal, provide is given using ton of oil equivalent (toe) or ton of coal equivalent (tce). A calorie is equal to the amount of heat required to raise the temperature of one gram of water at 14.5ºC by one degree Celsius. A joule is a measure of work done and is approximately one-fourth of a calorie. A kilowatt-hour is the work equivalent of 1000J/s over a one-hour period. Thus, one kilowatt-hour equals 3.6 million joules. A table (IEA 2013) showing the conversion between units is provided below:

**Table 1: Energy Units**

| | |
|---|---|
| 1 Mtoe | $10^7$ Gcal |
| 1 Mtoe | $3.968 \times 10^7$ MBtu |
| 1 GWh | 860 Gcal |
| 1 GWh | 3412 MBtu |
| 1 TJ | 238.8 Gcal |
| 1 TJ | 947.8 MBtu |
| 1 MBtu | 0.252 Gcal |
| 1 MBtu | $2.52 \times 10^{-8}$ Mtoe |
| 1 Gcal | $10^7$ Mtoe |
| 1 Gcal | 3.968 MBtu |
| Source: IEA (2004) | |

From the perspective of the definitions, three points are important in reporting on RE: the conversion between toe and Wh (as an example, 1 toe = 11,628 kWh, thus around 9 toe energy can give necessary power to 1,000,000 bulbs of 100 W to illuminate for an hour), the fact that less conversion and transformation is better because of higher efficiency achieved and that some renewable sources have a stronger renewable character than others as they are more abundant.

## SECURITY, ENVIRONMENT AND GLOBALIZATION

The theoretical foundation of this study is grounded on three main directions of political thought. Security and environmental studies emerge as the most suitable frameworks to analyze the factors that have influence on decision makers who consider investing in RE, whereas the globalization literature illuminate the path that made the RE investments economically and technologically feasible. States and individuals put great emphasis on sustaining security to guarantee their survival and energy constitutes a vital component of this effort; thus, in contrast to traditional neo-realist views, an agenda that primarily focuses on the humane aspects of security is followed. In addition, the concentration of conventional energy sources in particular regions and the lack of it in other parts of the world, and the reckless usage of natural resources are considered to cause strife in the affected countries and tension in relations between nations. There is significant evidence showing that RE may contribute significantly to the increase in energy supplies, and it is also expected to greatly reduce conflicts by preserving crucial earth minerals and protecting the environmental standards.

### Security and Energy: A Non-Traditionalist Framework

The definition of and the approaches to security has evolved over the 20$^{th}$ century from a realist focus to an alternative agenda with fewer neorealist thinkers, described as traditionalist and non-traditionalist schools. This study employs a non-traditional agenda in analyzing the politics of energy. The traditionalist agenda differs from its counterpart in three

aspects: it employs the state as the level of analysis, perceives external threats and the use of military to be greatly important for survival, and assumes that anarchy is prevalent. Neorealist tools do not provide the desired accuracy to analyze energy politics. In contrast, the non-traditionalist conceptual frameworks argue that energy security constitutes a non-separable component of state security and the humane dimension of security is as important as the state aspect. In fact, recent developments, such as the reduction in greenhouse gases through Kyoto Protocol or the increase in the share of RE in total energy supply through EU membership are examples for the latter case. Although underestimated by the realist logic, energy can be used as a coercive mechanism, as energy-rich states can threaten others to cut their energy supply so that they pursue their political interests, whereas energy importers can look for other sellers of energy in defense. This section aims to highlight this transformation in security studies by providing examples from the academic and political world, to compare the traditionalist and non-traditionalist schools with a focus on the latter one and to highlight the importance of energy within security studies. In the second part, key themes in the energy and security literature will be discussed.

Security studies can largely be classified as pre-Cold War and post-Cold War literature; in the post-Cold War era, the approach to security underwent a necessary transformation to include non-military aspects of security, which is the most striking deficiency of the realist school. Nevertheless, the pre-Cold War realist agenda has characterized the 20$^{th}$ century and is still vibrant today. In 1943, Walter Lippman—an American journalist—defined security in terms of war saying that "a nation has security when it does not have to sacrifice its legitimate interests to avoid war, and is able if challenged, to maintain them war" (Romm 1993, p. 122) and thus evaluated security from the aspect of external coercion. In 1950, Harold Lasswell, a political scientist, indicated that "the distinctive meaning of national security means freedom from foreign dictation" (ibid.). Many

realist thinkers define as the study of threat, use and control of military force (Nye and Lynn-Jones 1988). Kenneth Waltz believes that anarchy and war strongly constrain the state behavior (Waltz 1979). In a similar fashion, Robert Jervis and George Quester focus on the effects of offensive and defensive advantages (Jervis 1978; Quester 2003).

Similarly, contemporary neorealist thinkers criticize alternative approaches as providing little explanation or intellectually void. One such intellectual is John Mearsheimer who believes that alternative approaches have provided neither a clear explanatory framework for analyzing security nor demonstrated benefits in concrete research (Mearsheimer 1995, p. 92). Mearsheimer also proposes that approaches that focus on alternative aspects of security are "idealistic" and "realists maintain that there is an objective and knowable world, which is separate from the observing individual" (Mearsheimer 1994, p. 37, 41). Other neorealists argue that employing alternative conceptions both leads to analytical mistakes and do not find any responses in political circles (Walt 1991, p. 213). In a similar manner, some experts reemphasize the state's so-called vital position by saying that security is about "survival and physical safety" and can only be achieved through the "deliberate use of force by states" (Morgan 1999, p. 40). Even more surprisingly, for some members of the traditionalist school, ethnocentrism is on the agenda as they believe that security is about the use, threat and control of force to ensure (Western) state survival in the face of objective external threats (Walt 1991, p. 212; Kolodziej 2005, p. 22; Buzan and Hansen 2009, p. 12), which do not correspond to the activities of non-Western states concentrated on improving energy security.

Realism and neorealism strongly correlate the extent of military power with the level of state security and identify external coercive threats to be main problems of security. However, as energy is a good with highly inelastic demand, energy security appears as an issue that is both significant for the state and its citizens; in fact, being energy-dependent on other states weakens the bargaining power of a state, whereas an energy exporter can force

others to take the political decisions it desires by limiting the quantity of exports or increasing their prices. Compared to alternative schools of political thought, realism and neo-realism provide relatively less adequate tools to analyze RE with their state-centric focus and tendency to underestimate the effects of globalization on economics, environment and global governance. Neorealist framework favors globalization as long as it serves to the interests of the states; thus, globalization is a tool to project power on other states and it is good to pursue hegemony, if there is opportunity to do so (Mearsheimer 2007). Hence, many neorelist thinkers would doubt the fact that the increased implementation of RE with the help of globalization enhances the national security of states that do not have a hegemonic stance. They could explain the rise of RE in Europe and China as a move of the hegemon to increase its own interests. Realist academics also argue that international organizations are not powerful enough to overcome the state behavior and frequently fail in achieving their goals. For the case of RE, the latter argument is insufficient, as well. For instance, as an effective institution in energy matters, the EU has been able to increase the relative supply of RE in its new members.

Neorealist thinkers are significantly concerned about the balance of power, which constitutes the strongest part of the realist theory related to energy. As energy is an important component defining the national power, it is important to consider whether decreasing dependencies of energy will lead to a multipolar world order through a geopolitical framework. David Criekemans, a specialist on geopolitics, argues that the location factor, where the energy resources are, and via which routes can they can brought to (potentially rival) consumer countries constitutes an important area of study within the field of geopolitics; thus, countries and areas which have energy at their disposal potentially have better cards compared to other countries and the geopolitics of RE can potentially be different than the geopolitics of conventional energy (Criekemans 2007). The conventional energy

emerges as a decisive factor in determining the national power, as the US built much its military power in the first half of the twentieth century—when it was the 'Saudi Arabia' of its time—and the Russian Federation used the period of depletion in the 2000s to restore a portion of its former international stature (ibid.). The development in the RE sector would lead to increases in the national powers of countries, not only in that of the hegemon, thereby creating multipolarity. Countries which geopolitically enjoy pivotal positions in the conventional energy world will not necessarily enjoy the same position in a world in which renewables grow in importance. However, due to the need of large investment and know-how, it is more likely that bigger RE projects will be controlled by more powerful states.

A review of the literature shows that the traditional and neo-traditional school of realism has three deficiencies. First, they do not attach a desirable importance to significant aspects of security and thus may lead policy makers to improperly evaluate non-coercive threats. Second, they are not constructively influenced by the ideological transformation in security studies and thus do still attach greater importance to state security than human security, and lastly they do not adequately appreciate the global nature of security. In fact, the departure from the realist, state-centered concept of security has led policy makers to realize new vulnerabilities, such as oppression, physical violence and poverty, and global interconnectedness, as in the case of financial crises and terrorist networks.

**A Vital Approach to Security: Energy**

Despite its crucial importance for states, energy security finds shelter only under the umbrella of the non-traditional school of security studies (for examples see Mathews 1989; Weiner 1992). Energy security does not only mean that there is sufficient energy available to satisfy economic needs; an appropriate transfer of this source to all levels of the society is also necessary. According to Daniel Yergin, an American author, "the objective of energy security is to assure adequate, reliable supplies of energy at reasonable prices and in ways that do not

jeopardize national values and objectives" (Yergin 1988, p. 11). Others define energy security as "reliable supplies at a reasonable price" (Baumann 2008, p. 4; Kuik et al. 2011, p. 627). Furthermore, energy entails additional aspects related to the survival of a society. According to Baumann, energy security is a multidimensional concept including internal policy, economic, geopolitical and security policy dimensions (ibid.). Energy security is believed to consist of four R's: review (availability of energy sources), reduce and restrict (energy efficiency), and replace (capacity to shift to other sources) (Hughes 2009). Thus, although the realist ideology that underestimates the value of energy security, it emerges as an important concept within security studies and also much more complex to be classified as intellectually void.

The changing agenda of the political circles over the last decades in an attempt to incorporate non-military aspects within security policy more strongly is a sign that the realist approaches to security are situated on a weak ground. The realist ideology has been weakening since the 1970s, as evidenced by Harold Brown, the US Secretary of Defense from 1977 to 1981 in the Carter administration who enlarged the definition of national security by incorporating elements such as economic and environmental security (Watson 2008, p. 281). Similarly, energy security has become a prominent issue in international politics due to the oil embargoes of the 1970s. In the following decades, rising global energy prices, China's economic growth, conflicts in Africa and the Middle East and natural disasters further enhanced the importance of security in the context of energy. As a further example, starting from the Carter administration, all of the American presidents have indicated that America should be energy independent to secure its future, yet the American dependence on imported oil has steadily increased. These worries have been concretized by the former president George W. Bush's "America is addicted to oil" speech (New York Times, February 1st 2006).

For the purpose of sustaining its energy security, the US is currently buying oil from more than 60 different countries (Correlje and Linde 2006, p. 537).

Types of external threats have diversified over time, and threats against energy routes and supplies have risen in significance. To illustrate, the US Energy Secretary Steven Chu has indicated that "terrorists are looking for opportunities to impact the world economy" by targeting energy infrastructure. In recent years, terrorists have targeted pipelines refineries, and tankers in the world's most important energy reservoirs, such as Iraq, Nigeria, Saudi Arabia, and Yemen (Atlantic Community 2011). The "US National Security Strategy" (2002 and 2006 editions) is concentrated on the energy resources, the emergence of new rising powers, and population's growth trends and NATO is considering to start "An Energy Security and Intelligence Analysis Cell" (Ercolani 2011). Illustratively, just few days before the inaugural ceremony for the opening of Baku-Tbilisi-Ceyhan (BTC) pipeline, Condoleezza Rice signed a security agreement with Turkey (ibid.). In this regard, RE is expected to increase energy security by providing states and societies an energy source that is directly under their control and that does not need to be transported across borders. These changes show that a non-traditional framework for creating policies has been increasingly used by today's politicians.

**A More Humane Perspective on Energy Security**

Energy security is also achieved through a more democratic distribution of the energy supplies, which will be achieved through implementation of higher amounts of RE; in fact, the geographic concentration of petroleum and gas deposits in a relatively small number of locations worldwide, and the need to ship petroleum through constrained corridors together with the concentration of technological know-how in a few countries leads to great centralization in oil business. In contrast, RE is expected to provide more flexibility in terms of demand and supply, as the regions with vast potential are spread around the world, the

technological know-how being possessed by a greater number of countries--as evidenced by the cases of developing countries, such as India and China, having their own wind turbine companies—and the lack of need to transport energy through certain routes. In a society where the energy is controlled by a small group, it is more likely for the majority of the population to unite for the purpose of resource capture.[1] Nils Petter Gleditsch argues that in a world with high resource constraints, there will be more interstate conflict, countries with high resource constraints are more likely to be involved in conflicts with other countries and countries with high resource constraints are likely to be involved in conflict with countries with an ample supply of the same resource (Gleditsch 1998, p.396), as in the case of the 2003 Iraq War. Nevertheless, the issue of poverty and underdevelopment is highly significant in such conflicts (ibid.), which results in the fact that analyzing developed and developing countries separately might be beneficial.

The fact that energy security should also include the fair distribution of energy supplies within the society is stressed by the members of the "Copenhagen School."[2] To illustrate, Barry Buzan and Ole Wæver emphasize the duality of the security of perspective stating that state security is concerned with sovereignty and societal security takes into account identities and interests (Buzan et al. 1998). Mahbub ul Haq brings human security as

[1] In this regard, Marxist and Gramscianist frameworks are helpful in the sense that they support collective ownership and are against the transnational elite respectively. The transnational elite do not pay attention to the distribution of well-being, but the concentration of wealth. In fact, Jeremy Rifkin, an American economist, believes that different sources of RE can complement one another in an efficient way via smart grids. According to Rifkin, these technological developments could give power to the people and he calls this process a "re-globalization from the bottom up" (Euronews 2012). In fact, if individuals and societies take the chances to organize themselves and their energy needs, the energy regime of renewable will be from bottom up, a development that would not please conventional energy suppliers, as it threatens the power structures upon which they base their activities.

[2] A more democratic distribution of energy provides a higher level of energy security on the personal level, as energy is needed for survival and therefore can be used by its owners to manipulate others. The usage and implementation of RE requires strong action by the state, but is also well-connected to the will of the society, as producing energy using RE sources brings significantly more financial costs than building a plant that produces energy using conventional sources and therefore requires public approval. As a result, this public approval provides people an increase of security both because of the choice towards RE and also the fact that there is democratically collected will for its implementation and the elite interests are not represented. David Criekemans argues that a societal revolution which brings energy closer to the people, in the end also offers chances to strengthen one's own democracy and the possibility to decrease the dependence on foreign energy companies thus ultimately redefining the geopolitics of a country (Criekemans 2007, p. 12).

a new paradigm in security studies into attention saying that societies are in a new era where the security of all the people everywhere—in their homes, jobs, streets etc.—will be a key issue (Ul Haq 1995, p. 115). In fact, the transformation in security studies has placed human beings at the core of security and the state is no longer privileged over the individual.

Taking human security into consideration, energy is viewed as a good with highly inelastic demand especially in the short run and is expected to remain relatively inelastic in the long run; thus, customers will indispensably buy it. For instance, Bernstein and Griffin argue that the relationship between demand for electricity and natural gas and price is relatively inelastic and the same relationship has been tested to be in existence since the 1980s (Bernstein and Griffin 2005, p. xii). Previous studies indicate that there is a difference between short run and the long run for the price of energy; in a scale of -1 to 0 (-1 means perfect elasticity, whereas 0 stands for perfect inelasticity), Bohi and Zimmermann (1984) found out that the price elasticity for electricity is -0.2 in the short run and -0.7 in the long run, whereas Dahl and Sterner (1991) obtained -0.24 and -0.80 for gasoline. In this respect, energy has become an inseparable part of human security.

MacFarlane and Khong indicate that the innovations in security studies has provided a language for understanding the effects of violent conflicts on humans and some states and international organizations have incorporated human security concerns into their foreign policy (MacFarlane and Khong 2006, p. 228). Prabahakaran Paleri, an Indian academic, listed a large number of elements counted within national security, including but not limited to energy, environmental and resource security (Paleri 2008). Thus, the weakening of the realist ideology is most strongly characterized by the types of insecurities that cannot be circumscribed in a region; the threats are still in place, but they do not project military offenses directed to a state anymore and they do not necessarily need to come from states. An

illustrating example is the global terrorist networks such as Al Qaeda, which can be resisted almost only through global cooperation.

**Renewable Energy: A Multidimensional Cure to Pessimism in Environmental Politics**

Security literature argues that increasing the share of RE in the total energy supply is desirable for improving national security, whereas the literature on environment implicitly maintains that RE will be a cure to ongoing environmental problems. The environmental security literature primarily relates to climate change and degradation of environmental resources. As a result of the ongoing and potential harm done to the environment, millions of people might be forced to migrate and this might lead to potential conflict over resources. In this regard, RE emerges as a cure to decrease this pessimism, as it may substantially reduce greenhouse gases by producing energy in an environmentally friendly manner. Thomas Homer-Dixon, a Canadian social scientist, confirms that RE may be used as a remedy to decrease environmental degradation; however, the per-capita availability of it as well as the distribution of resources within a society is also important (Homer-Dixon 1994, p. 8), as a fairer distribution will also improve energy security by preventing the energy from being controlled by few people.

This analysis argues that RE offers three cures to ills related to environmental degradation. First, it views RE as a remedy to lessen, and in the case of complete transition to RE, to stop the damage to environment and thus offer an option to secure the chances of survival for future generations. Second, as the sources to generate RE are infinite, a gradual transition will dramatically change the availability of resources and prevent possible scarcities. In fact, the 20$^{th}$ and 21$^{st}$ centuries have experienced the greatest relative increase in air pollution, which is strongly connected to the boom in oil consumption. Thus, both the demand for energy and environmental degradation has reached unprecedented levels. Third,

RE is also viewed as a cure to stop possible conflicts between societies by improving the energy supplies.

The connection between environmental scarcities and the relative abundance or the lack of certain minerals—such as oil—and conflicts between or within societies has been repeatedly proven by various academics. This fact emerges as a strong contribution to the implementation of RE as a considerable energy supply in different countries. Many scholars agree that "wars are often over resources" (Galtung 1982) and "where there is environmental degradation or acute scarcity of vital resources, war may follow" (Lodgaard 1992). Scholars found out that environmental scarcities are contributing to violent conflicts in many parts of the developing world, as in the case of water issues resulting in the intifada on the West Bank and in Gaza and the conflict between South Africa and Lesotho (Homer-Dixon 1994, p. 6, 14, 19). Interestingly, Homer-Dixon suggests that environmental pressures in China may cause the country's fragmentation (Homer-Dixon 1994, p. 37), which emerges as a potential explanation of China's passion to develop RE. Michael Ross examined thirteen recent civil wars and found out that oil, nonfuel minerals and drugs are causally linked to conflict and resource wealth makes the conflict more likely to occur, last longer and produce more casualties (Ross 2004, p. 35). RE is expected to greatly lessen the conflicts between the states by creating a more "just" distribution of energy sources between all countries and also providing states that do not have sources to produce energy with adequate supplies for sustainable growth.

On the personal level, climate change dramatically affects the human security, as well, by reducing access to, and the quality of, natural resources that are important to sustain livelihoods. Environmental degradation may also indirectly affect the level of poverty, the degree of the availability of public institutions, government revenue and state capacities to provide the opportunities and services that help people to sustain their livelihoods, and the

types of relations between vulnerable groups. As a tool that can decrease the speed of, if not eliminate these processes, RE proves to be a promising remedy. In certain situations, the forced migration through environmental conflicts emerges as a great threat to the personal security (Peluso and Harwell 2001). Diamond and Dijk analyzed many cases of catastrophic social change and found out that environmental change was an underlying factor in all of them, and particularly climate change was a cause of many conflicts (Diamond and Dijk 2008). In the case of research on energy, a focus on developing countries has particular importance, as marginalized people are more vulnerable to environmental and climate change, as indicated by studies in Northern Pakistan, South Asia, the Niger Delta, the Pacific Islands and Ethiopia (Barnett and Adger 2007, p. 641). In this regard, the comparative nature of this study aims to support the increase of RE also in the developing world.

In terms of energy, potential energy insecurity most frequently emerges when conventional types of energy are employed, such as the threat of an attack on centralized power production structures, transmission and distribution grids or pipelines or global oil supply restrictions resulting from political actions which lead to extreme price volatility in energy markets. RE systems have the capacity to reduce the risk of energy supply disruptions by reducing the reliance on imported fuels. International Energy Agency (IEA) argues that RE technologies present three opportunities to mitigate risks to energy supply: market stabilization, chance to avoid technical system threats including terrorism and taking precaution against extreme weather events (Ölz et al. 2007, p. 7). Additionally, RE sources are widely distributed, available in many regions and also lead to extra benefits such as greenhouse gas reductions (Ölz et al. 2007, p. 64). RE sources offer great complementary flexibility and are widely available. Investing more in RE is a significantly feasible path that can lead to efficiency in benefitting from renewable sources and a future of sustainable

development. Thus, increasing the implementation of RE systems is believed to provide benefits geared to increase national security and the standards of living.

A review of security studies from the perspective of energy provides different insights both into the security literature at large and also approaches to energy security. In the case of the former one, findings show that the traditionalist school, which strongly relies on neorealism, offers a theoretical perspective that is highly unhelpful in analyzing the energy politics, as the national dimension and policy aspect of energy politics is as equally important as its international aspect. Governments, including the US, Russia and China have taken more "realistic" steps than the realist and neorealist scholars in this issue by incorporating energy policy as an indispensable factor into their security agenda. However, as the traditionalist school would agree, conflicts and problems related to energy most frequently emerge when there is relative inequality between states and absolute differences between people, a situation that reinforces the importance of human security as the level of analysis. Additionally, conflicts are usually associated with countries of low or middle development level, which makes a comparison between developing and developed countries potentially academically more fruitful.

**Environment in a Globalizing World: The Development of Renewable Energy**

The inclusion of environment in the process of globalization is a recently new phenomenon. This study is based on the argument that globalization is an underlying factor in the development of RE because of three factors. First, it created additional demand for energy resulting from trade liberalization. Second, it led to economic growth and the transfer of know-how between nations. Third, the strains that globalization has placed on the global environment which may result in the rise of conflicts between societies can partly be overcome by implementing RE. If the increasing connection between states was limited to certain parts of the world, RE would not have developed to the current extent.

A survey of the literature shows that there has been a strong divide between the developed and developing countries in terms of the global environmental governance in the second half of the 20th century. The South argued that the costs of environmental measures were too high, making development prohibitive—which they objected, as the North also took advantage of world's resources to industrialize. Contrastingly, North countries stressed the importance of aggregate scarcity (Stevis 2005). These lines are much more blurred today with both developing and developed countries paying different levels of attention to RE independent from their level of development. In fact, by the late 1970s, the scarcity arguments started to lose their appeal and there has been a rise in the number of environmental organizations with a globalist rhetoric, the most important of which are Greenpeace and Friends of the Earth (ibid.). In this vein, it is important to mention once more that realist approaches to environmental politics have lost their steam in the past. Both developed and developing countries are paying considerable attention to their relationship with the environment and view it as a central component of their security.

**Globalization: A Curse or a Cure?**

Taking the economic and environmental effects of globalization into consideration, globalization affects the development of RE in a complex manner. Globalization may lead to increases in the level of income thereby raising the levels of consumption worldwide. More consumption may result in higher levels of environmental degradation; however, higher income, exchange of green technological know-how between nations and global environmental governance—the development of which is facilitated through the international platforms—also cultivate the rise of environmentally friendly energy. Nevertheless, globalization is conducive to the increase of the RE's share in total energy supply both through its undesirable and favorable outcomes.

One of the major anchors of the literature on the economics of environment is the Environmental Kuznets Curve which takes its name from Simon Kuznets' article published in the 1950s. Kuznets Curve indicates that as income grows, the pollution level grows by a certain extent. If the income continues to increase, the level of pollution ultimately decreases, thereby producing an inverted U-relationship between income and pollution. Kuznets Curve presents a seemingly insightful theory for studying RE, as developed countries tend to be better equipped with RE technology and also employ RE to satisfy a greater portion of their energy needs compared to developing countries. However, when the countries are classified according to their development levels, the Kuznets Curve loses its credibility, as evidenced by the cases including but not limited to European countries versus other developed nations, and China and Brazil in contrast to other developing countries. Therefore, it is more logical to assume that countries of different levels of development also have other reasons to support RE and therefore should be analyzed comparatively.

The economic growth that is achieved through trade liberalization is believed to result in more RE investment. Experts indicate that wealthier citizens will have preferences towards environmentally friendly products and technological changes (Van Veen-Groot et al. 1999, p. 337; Kwong 2005, p. 21). The proponents of ecological modernization believe that continued industrial development provides the best option for escaping from the ecological crises of the developed world (Fisher and Freudenburg 2001, p. 702). The scholars of this group understand environmental protection not as burden on the economy, but as a precondition for future sustainable growth.

As previously indicated, taking the transformation of environmental politics within the agenda of globalization and the development of RE into consideration, the reality lies between the two camps. It is true that globalization has increased the pace of environmental degradation, as in the case of high income countries buying a great extent of imported goods

from developing countries. However, globalization also fostered the development of global environmental governance which—at least partly—succeeded in fighting against the rise of pollutants, as evidenced by the partial success of Kyoto Protocol. Avoiding too contrasting images in the interpretation of globalization's relationship with the environment, James K. Boyce believes that globalization does not necessarily mean a greening of the North and browning of the South; in fact, it can bring a substantial convergence in terms of environmentally conscious production (Boyce 2004). Nevertheless, RE is an environmentally favorable product of this duality; in other words, globalization has been a contributing factor to the development of RE by supporting economic growth and allowing room for green R&D, and also by creating winners of energy trade resulting in the search for alternative energies.

## RENEWABLE ENERGY: A HUMANE DEVELOPMENTAL APPROACH TO ENERGY

Literature on renewable energy (RE) offers a fertile ground to compare the cases—Brazil, Turkey, Germany and the UK—from the perspectives of support schemes for RE, the public perception of RE, policy mechanisms to mitigate the problems associated with climate change and other economic aspects of RE development. Under the umbrella of international relations and comparative politics, it is almost impossible to find comparative RE research or research on RE at all. Public policy and environmental economics literature dominate the field with articles concentrating on the technical aspects of the issue forming the second largest branch of academic research.

Past comparative research is mainly focused on the developed countries. Germany is frequently studied with moderate attention given to the UK; in contrast, comparative studies in the case of Brazil and Turkey are relatively few. Comparative analyses on different types of RE and motivations behind the transition to RE offer an exciting field and are still in the phase of development. The review of the literature aims to accomplish several tasks: first, the

review looks at how the RE success is evaluated in other research, what the motivations for and against RE are and how RE changes the host country. In the same section, a comparative analysis of support schemes is given, as well.

This study is an attempt to complement the past literature on several aspects regarding RE. Previous studies on RE are predominantly policy-centric; thus, they do not employ theoretical frameworks. Hence, the connection between people and the RE projects is significantly weak in the past literature; in fact, in countries where the energy lobby is not as strong as in others and where the democracy is fully developed, there should be a close connection between society's will and government's response to the implementation of RE projects. The country cases in this study—Brazil, Turkey, Germany and the UK—emerge as fruitful examples to analyze the connection between society, state and RE projects. The energy lobby in Turkey and Germany are considerably weak compared to that of Brazil and the UK. The UK is a strong democracy, which comes together with the fact that the society has the option to intervene in energy policies. Brazil, on the other hand, is a country that heavily invests in RE and also has strong democratic features, which proves its adequacy for a case study.

The energy literature in the fields of public policy, business, economics, and geology give significant emphasis to RE and form a highly great fraction of previous research. These works are highly successful at providing an overview of the situation in terms of the potential of RE and the implementation of projects; nevertheless, they are insufficient in analyzing the motivations behind it. Hence, they do not include any theoretical framework or a case study design. In fact, as countries with highly similar backgrounds follow different RE policies, an increase in the number of case studies is more than necessary for the literature. In this vein, in a period of depleting resources and accelerating climate change, the significance of RE within

the political science literature is expected to increase and thus an analysis in this direction offers potentially fruitful results for understanding the politics of future.

**Renewable Energy: Motivation, Support and Success**

A great extent of the literature on RE measures the success in RE as the percentage of RE in total primary energy supply; thus, countries set their goals according to this value to meet certain requirements, as in the case of the EU's RE share obligation of 20% by 2020 for EU members. In addition, other studies weight the development in certain sectors of RE differently to assess success; for instance, in the RE reports published by Ernst and Young, the wind index has a 55% share, whereas solar index and biomass and other resources indices have 32% and 13% shares respectively (Ernst and Young 2012, p. 2). In fact, the availability of the RE potential differs from one country to another with wind and solar power as well as the biomass potential being available to almost every country in a comparable manner, which justifies the Ernst and Young's position. In contrast, hydropower, tidal power, ocean energy and geothermal energy may only be developed if certain geographical and geological conditions exist in a particular country. Thus, some types of RE, especially solar and wind energy have a more "renewable" character than others.

In the RE field, there is often a difference of opinion in categorization; hydroelectric and geothermal electricity generation are frequently listed separately from solar, wind and tidal energy, as these forms of RE can both be destructive for the environment and be only provided if particular sources such as rivers and geothermal energy is available; for instance large-scale hydroelectric dams can be a significant source of $CH_4$ emissions when they cause deforestation and alter natural river flow (Kaygusuz 2010, p. 1075). Taking the environmental impacts into consideration, all types of RE expectedly perform better than fossil fuels; Erdoğdu indicates that fossil fuels contribute into emissions air pollution and climate change, contribute to water pollution, create waste, have bad visual impacts on the society, make

disturbing noise and generally affect the habitat badly. On the other hand, except geothermal energy, RE does not create any pollution, but some RE systems might still have a disturbing appearance, make noise and thus have a negative impact on the nature and the society (Erdoğdu 2009, p. 2542). Therefore particular types of RE, solar and wind, should be paid greater attention.

From the energy perspective, privatization is beneficial for the society, as long as its results lead to the satisfaction of consumer demands, provision of high quality service by the private company and the increase in competition between firms, which ultimately leads to a reduction in prices. Thus, as illuminated in the security framework, privatization enables the consumer to buy reliable products at reliable prices, thereby increasing the human security and welfare in a society. Tamer Çetin believes that the privatization within the energy sector can cause a problem only if the privatized company used to constitute a monopoly and had great significance for national security (Çetin 2009). Thus, privatizations within the RE sector, such as hydropower plants, do not have this downside, as they produce a small share of the national energy supply and are also not part of a monopoly due to the large share of conventional resources in energy production. Similarly, Çetin proposes that if the privatization of a particular sector, in this case energy, creates competition, this leads to more efficiency and thus more welfare for the society than imposing regulations on state-owned enterprises (ibid.). Taking a similar stance for Brazil, Steven Lewis argues that Brazil should continue to privatize its energy sector in order to have more reliable energy supplies, reduced costs to the Brazilian consumer and a decreased dependency on energy imports (Lewis 2004).

Among the hypotheses in previous studies that analyze the development of RE in different countries, there are those that relate demographic indicators and others focusing on the state. The development of RE is based on a number of factors including technology, costs, accessibility, environment, politics, demographic conditions, safety, economic development

and rural electrification (Atabi 2004, p. 76). Especially for the case of developed countries, the green collar jobs agenda, climate protection, and an innovative democracy that bring all actors into the decision making process might have a significant impact on driving the industry forward, whereas public opposition and insufficient financial support can hold it back (Mendonça et al. 2009, p. 1). Other experts believe that some developing countries invest in RE to reduce emissions and green house gases. Having an innovative industry is regarded as one of the most significant factors for sustaining life standards while overcoming severe environmental concerns—especially important for the case of RE; in fact, countries have developed areas of specialization in specific types of RE sources with Denmark having a long established strong technological advantage in wind technologies, Sweden and Germany having been specialized in bioenergy, Germany and Spain in solar, Norway and Austria in hydropower systems (Vona et al. 2012, p. 3). Thus, countries that do not give particular importance to some of those factors or countries that lack them or have them in excessive amount might be reluctant to develop their RE sectors.

Other policy-centric studies argue that policy stability, the reduction of project risks, a stable financing source independent of the state budget and a regular adjustment of support conditions to market progress are the key factors behind successful RE development (Klessmann et al. 2011, p. 7656; Lewis and Wiser 2007; Gan et al. 2007, p. 154). The experiences in developing countries indicate that state subsidies to develop RE can undermine private investments and business in new markets and should be applied with attention to private sector conditions. They are more effective when tied to operating performance rather than investment and continuing subsidies may always be needed for poorer segments of the population (Martinot et al. 2002, p. 332). Similarly, weak labor markets encourage policymakers to shift incentives in favor of jobs in the RE sector and GDP per capita seems to slightly increase the probability of RE support (Jenner et al. 2012, p. 10). Additionally, states

learn from each other and having a state that strongly supports RE is conducive for the neighboring state to adopt similar policies (Chandler 2009). In the case of innovation, lowering market regulations fosters development in RE technologies, more in cases when the initial level of R&D is sufficiently high; in comparison, a more ambitious environmental regulation is also more effective when combined with lower entry barriers for new RE investors (Vona et al. 2012, p. 25). These studies provide insightful results on the relationship between state behavior and RE. However, they fall short of analyzing the causal mechanism between the characteristics of state and society versus RE.

Few works that focus on the connection between society and the willingness to develop more RE indicate that not-in-my-backyard (NIMBY) attitude is the most frequently encountered motivation against the development of RE, which comes from a broad range of social and personal factors affecting human interactions (West et al. 2010, p. 5740). Thus, experts in the field categorize people in three ways: individualist, hierarchist and egalitarian. Individualist people believe that climate change does not form a concern and it is a propaganda measure by government to create revenue through taxes, whereas hierarchists view that the government is the main responsible body for RE development. Contrastingly, egalitarians follow a moral obligation to think of others and future generations (West et al. 2010, p. 5744). Thus, there are studies in the literature that employ more concrete measures to investigate the causal mechanism between society's choices the RE success. This study aims to bring a more comparative approach by both incorporating the societal characteristics as well as the state policies.

**Renewable Energy: Investment Schemes and Costs**

Countries that have implemented RE throughout the world use around ten different types of support schemes: feed-in tariffs, renewable portfolio standards, capital subsidies/grants or rebates, investment excise or tax credits, state tax/energy tax or VAT

reduction, tradable RE certificates, energy production payments or tax credit, net metering, public investment/loans or financing and public competitive bidding; the majority of countries employ feed-in tariffs, capital subsidies and tax credits, followed by renewable portfolio standards, tax reduction and tradable RE (Saygın and Çetin 2011, p. 116). Some researchers indicate that the basic concepts of both the renewable portfolio standards and feed-in tariffs have been refined in such a way that the two systems are gradually moving towards each other, as seen in the examples of the introduction of technology bands, promotion of the establishment of long term agreements between RE producers and electricity suppliers, increased effectiveness of the market to stimulate technology cost reductions in the renewable standard portfolio system and the setting of a budget ceiling in the feed-in system—possibly due to achievement of policy targets (Van der Linden et al. 2005, p. 61).

For the purposes of this study, the costs of RE relative to the cost of conventional energy have a highly significant importance, as states require public support to carry the financial burden of RE. If not regulated, energy firms owned by powerful minorities would seek to maximize profit by investing in a less costly option, conventional energy. The costs of different types of RE differ significantly from each other. A comparison between the electricity generation costs reveals that hydropower generation costs 3.85 $c – 18 $c/kWh, wind 6 $c – 9.24 $c/kWh, geothermal 6 $c – 10 $c/kWh, solar thermal 7.7 $c – 10 €c/kWh, energy crops 12.8 $c – 25.7 €c/kWh and solar PV 36.8 $c – 39.8 €c/kWh. Contrastingly, among the conventional types of energy electricity production from natural gas is the cheapest (5.5 $c – 6.9 $c/kWh) followed by coal (5.8 $c – 9 $c/kWh) and nuclear power (6.8 $c – 11.9 $c/kWh) (Erdoğdu 2009, p. 2540). 2010 was the first year in which the overall global investment in solar energy came close to catching up that in wind; in fact, no other technology has gained more from falling costs than solar in the second half of the 2000s (Ringel 2006, p.12). This is surprising, as solar PV currently constitutes the most expensive RE form.

The RE literature primarily encompasses five areas: the classification of the types of RE, support schemes and their effects of the RE sector of countries, country-specific economic, social and developmental indicators that are decisive in the development of RE, cost comparisons between different types of RE and public sentiment towards it.

## CHAPTER THREE

## COUNTRIES IN FOCUS: GERMANY, THE UNITED KINGDOM, BRAZIL AND TURKEY

This analysis compares four countries with different levels of success in RE. The review of the literature on countries has two goals. First, it aims to show that some countries are more successful than others with similar backgrounds. Second, it demonstrates that previous literature is too policy-centric, offers too little comparative analysis and can hardly find shelter in the realm of political science. In the case of developed countries, Germany emerges as a country that has achieved to implement a considerable amount of RE and is rapidly increasing its RE sources, whereas the UK has fallen much behind the average of developed countries in employing RE as a major energy supply. Among the developing countries, Brazil has been strongly working towards increasing its RE supplies starting from the 1990s, whereas Turkey joined the game in the 1990s with a slower growth rate.

The comparative studies on RE are few in number and small in scope with Germany being the most widely discussed country in the literature. There are extremely few pieces that compare developed countries with developing ones. As previously indicated, taking the cases in this study into consideration, studies largely focus on public policy; for instance, there are many works praising the successful German feed-in rate policy and there are some blaming the slow increase in RE in the UK on the lack of sound policies or the presence of renewable portfolio standards. However, except very few examples, studies on Germany and the UK do not take different hypotheses to analyze the current state of RE into consideration. In the case

of Brazil, the literature is highly weak with only a few descriptive studies. In regard to Turkey, there are few more studies; however, they are either descriptive (for instance, the calculations of RE potential) or criticize the current level of RE implementation without providing any credible arguments.

**A Comparative Look at the Developing and Developed Countries**

Investing in RE is not a rare phenomenon and many countries have special policies for RE, which provides cultivable ground for a comparative study. In at least 66 countries worldwide, policy targets for RE have been implemented; included among these countries are all 27 European Union countries, 29 U.S. states (and D.C.), and 9 Canadian provinces; most countries have set high goals for the utilization of RE by the middle of the century, but present day usage of renewable sources of energy is dominated by developed nations such as the United States, Germany, Spain and Denmark as well as the developing nations Brazil and China (Saygın and Çetin 2010, p. 108).

The comparisons between developing and developed countries frequently employ income or related measures, such as welfare and research and development (R&D) budget, to build hypotheses. However, as the cases chosen for this study show, countries with similar levels of economic development may have very different results regarding RE; therefore, this approach is highly critical. As an example, the findings focusing on different types of RE provide mixed results. In the case of biofuels, a comparison between Ireland, Nicaragua and the Netherlands indicates that country context, such as the population density, land and labor costs, income and investment risks can have large impacts that produce energy crops. Nicaragua produces crops much more cheaply; however, the resulting cost of electricity is similar to that of Ireland and the Netherlands mainly because of the risks involved (Van den Broek et al. 2002, p.95). In the second half of the 2000s, developing countries have made great steps in investing RE with RE figures doubling or tripling in important cases; for

instance, R&D in developing countries rose from $4 billion to $70.5 billion, Latin American investments tripled to $6.2 billion, Africa jumped five-fold to $3.6 billion and Asia rose by 31% to $4 billion (Ringel 2006, p. 20). Contrastingly, some developed countries including the UK experienced sharp falls in financial investment for RE: the British investments in RE fell from $10.8 billion to $2.9 billion (Ringel 2006, p. 22). These figures are only important to understand that the interest in RE is not region or income-specific; countries with different backgrounds, levels of economic development, size and culture may have a comparable interest in RE and also manage to achieve a similar performance

As this study also claims, a comparison between Europe, Japan, United States and a group of developing countries indicates that each of them have a different motivation to invest in RE. Europe, Japan and the United States develop RE mainly to fight against the climate change, to protect the environment and to have higher energy security with Europe attaching more importance to climate change and environmental issues than other parties. Contrastingly, developing countries use RE to satisfy consumer demand and to pursue local economic development (Bourdeau 1999, p. 8). The financial motivation of the developing nations also reveals itself with the support schemes: except the most powerful emerging nations, other economies may not be able to afford the same level of subsidy support for clean energy technologies as Europe or North America (Ringel 2006, p. 12).

The previous studies prove that very few, if no study at all that uses a framework for comparison that is similar to the one employed in the current analysis. Past studies prove that the differences between developing and developed nations in financial resources and levels of economic growth, generation costs, policy mechanisms and priorities, technological know-how as well as population and geography provides an exciting ground and a fertile platform to analyze developed and developing cases in the field of RE.

**Renewable Energy in Developing Countries and the BRICs**

The RE literature on developing is considerably weak; even more strikingly, comparative studies that employ developing countries are almost non-existent. The literature on RE largely connects the lack of RE success in the developing countries with lack of resources and low income. Investments in RE have been gaining increasing significance in developing countries, as many developing countries with RE potential are in a position to alleviate poverty, improve the health and education of its citizens, create opportunities for employment and urbanize their population more efficiently (Boccaletti et al. 2008, p. 1). Developing countries including oil-rich countries and oil-poor countries surrounded with oil-rich countries are reluctant to do so because of the poor infrastructure or the lack of interest due to financial reasons (Alzoubi 2010, p. 45; Jalilvand 2012, p. 1). Understandably, due to their level of economic development, these countries are primarily interested in providing energy to their citizens in a sustainable way, as seen in examples of South Africa and Malaysia (Bourdeau 1999, p. 8).

The need to provide welfare for the citizens is seen as a major cause for developing countries to invest more in RE. For the growing economies that have low to middle income level, providing electricity to all of their citizens emerge as an important problem, as in the case of 30 million Chinese and around 400 million Indian people having no access to modern energy; for this case, experts approve of the recognition of local people to use small rather than big power stations which can provide energy through RE (Liming 2009, p. 1097). Regardless of the categorization, interestingly, the countries that employ RE for more than 80% of their electricity are both from the developed and developing world: Iceland, Lesotho, Albania, Paraguay, Bhutan, Mozambique and Norway.

Some developing countries are characterized by the lack of interest for more RE and this strongly correlates with the lack of policy motivating the implementation of RE systems.

For instance, MENA countries possess 45% of the world's potential for RE and can achieve more exports and jobs through the development of RE; however, they only show marginal interest due to their rich underground sources (Jalilvand 2012, p. 2; Jablonski et al. 2012, p. 291). As a further example, Gulf countries have limitless solar capital, but almost no projects for RE, as the cost of RE based electricity is still very high compared to the cost of conventional electricity. Other countries with considerable potential including Turkey lean towards using non-renewable but more environmentally friendly sources as a substitute for RE, such as natural gas. The lack of sound environmental policy and the associated implementation strategies for stimulating RE constitute large barriers against RE development in developing countries (Atabi 2004, p. 69).

The literature on developing countries suggests that a comparative study might be a helpful contribution to the literature on RE, as different countries have different needs and tendencies. Of all developing regions that had implemented energy market reforms by the late 1990s, Latin American countries experienced the greatest privatization of power distribution assets (44%). In this case, there is no one-size-fits-all policy; however, at least eight countries in Latin America have introduced feed-in tariffs, two employ quotas and one (Brazil) employs a tradable green certificate system. Other specialists accordingly argue that developing countries have different learning stages of industrial development; to illustrate, most inducement mechanisms that are required and necessary in energy transitions towards RE are weak in South Africa compared to India, whereas India performs fairly well in terms of development of positive externalities, degree of legitimacy and entrepreneurial activities (Doranova and Miedzinski 2013).

Among the BRIC countries, Brazil has a more environmentally sound approach to climate change, which implies the importance of RE for Brazil. China and India are particularly less likely to adopt a voluntary commitment to an emissions cap on the national

economy in the near future than Mexico, which has the highest mitigation capability among all five. BRICs propose to cut the carbon emissions intensity by 20-50% by 2020 with China and Mexico expecting to reduce them by around 50% (Rong 2010, p. 4582). As of the mid-2000s, the carbon intensity is the lowest in Brazil among BRICs, followed by Mexico, India, China and South Africa consecutively with ecological vulnerability being highest in China and India (ibid.).

As in other cases, policy studies constitute the major portion of the literature on developing countries. In this case, Brazil and China have certain significance, and they are considered as two of the most successful examples in RE usage among developing nations. Some researchers in the field found out that renewable policies in Brazil and China are more conducive to long-term growth in RE consumption and production (Zhang et al. 2011, p. 4904). In contrast to the rest of the world, BRIC countries attached greater importance to policies that stimulate the development of RE as proven by the examples of the Brazil's early Pro-Alcohol Program that started in the 1970s to spark the usage of bio-ethanol and China's economic and social development plants considerably focusing on the implementation of RE starting from the 1980s. Contrastingly, Russia and India enacted laws in the same direction starting from the 2000s (ibid.). In a comparative manner, Brazil is the leading country in terms of fostering RE, whereas China, India and Russia follow it accordingly.

Relatively limited literature on developing and the BRIC countries suggests that developing countries need to engage more in RE, as they have the potential to do so. Nevertheless, it is relatively difficult to expect an environmentally sound agenda or policies strongly focusing on energy security from them, as they are currently more interested in investing their sources primarily in economic growth occasionally at the expense of other measures.

**Renewable Energy in Developed Countries, OECD and the EU**

In contrast to developing countries, policy-centric studies constitute a greater portion of literature on developed countries. The existing studies both help to identify the winners and losers in RE and also provide room for further research that also takes societal characteristics into consideration. A comparison between developed countries argues that the institutional structure of regulatory agencies in the energy sector and the degree of autonomy from elected political institutions affect the level of regulatory risk; similarly, the nature of policy-making processes through which RE policies are formulated and implemented have an additional effect; thus, policies that have become solidified in legislation are more difficult to modify than policies set by agency or ministerial orders (Holburn 2012, p. 654). As an example, a comparative analysis on Germany, the Netherlands, Sweden and the US argues that the long term nature of policy goals on energy security, mitigation of climate change, and environmental protection may undermine the long term development of new green electricity technologies (Gan et al. 2007, p. 144). The lessons from Denmark and the US prove that a long-term, stable support scheme that allows a multiplicity of actors to invest in the sectors provides a secure basis for development of the industry in a decentralized way (Mendonça et al. 2009, p. 17). European countries mainly employ two forms of support schemes: feed-in tariffs (majority of the countries including Germany, France and Spain) and a quota system, also known as the green certificate (as in the case of UK and Italy).

As will be tested in the case study section, variables related to the state prestige constitute an important part of the literature on developed countries. Equally important, a low level of installed capacity represents development potential and higher likelihood to promote the development of RE in those countries, as leading countries in RE such as Germany and Spain are becoming less attractive due to geographical constraints (Julien and Lamla 2011, p. 20). Regulatory framework and the stability of the support scheme are also similar in both

countries; however, Germany leads the race with its feed-in tariffs (Julien and Lamla 2011, p. 25). Support schemes need to provide sufficient financial incentives, have to be adjusted according to the regularly decreasing construction and maintenance costs and offer financial stability to the investors.

The market growth in all the sectors of RE has been mainly driven by the effective policies in a small or medium number of top runner countries (Klessmann et al. 2011, p. 7655). GDP, RE and bioenergy market deployment policies that provide support for the market introduction of new and improved technologies and encourage the development of an industry have significant impacts on the per capita supply of RE and bioenergy, whereas R&D expenditures, energy prices, $CO_2$ emissions and other energy policies such as research and innovation as well as the policies directed towards creating a competitive market are statistically insignificant (Gan and Smith 2011, p. 4497). In fact, until the 1990s, many European countries have focused on R&D to stimulate their RE production, a policy that was replaced with support policies or obligations for RE delivery by countries including Denmark, Germany and the UK in this period (Klessmann et al. 2011, p. 7637).

It is also evident from the European perspective that there is strong correlation between energy efficiency and RE. Researchers have stressed that the EU plays a leading role in improving energy efficiency and has the lowest energy intensity among all world regions; to illustrate, the average power plant efficiency of the world is 34%, whereas this figure is 40% for the EU (Ceylan and Günay 2013, p. 2). A Europe-wide comparison shows that energy efficiency in the European countries has increased slowly over the years, but environmentally aware energy efficiency performance and improvement is much lower in all countries (Ceylan and Günay 2013, p. 1).

As with the developing countries, level of income and financial resources devoted towards RE constitute an important measure for RE growth. European states are by a wide

margin the leader in rankings when it comes to research spending. The European Commission indicates that more than half of the RE research is done by the public sector and one quarter of the public spending comes directly from the EU budget. IEA designed several scenarios for a future with RE; a "TECHplus" scenario envisions high technology progress for renewable, nuclear, hydrogen fuel cells, and advanced biofuels with renewables' share of primary energy reaching 30% by 2050 (Martinot et al. 2007, p. 216).

The fact that there is strong correlation between income, welfare, research and development, energy efficiency and the implementation of RE among the developed countries matches with the expectations of this study. Past studies confirm that the developed countries are situated at the forefront of RE technologies and deployment in the world. The successful policy programs, the lack of alternative sources that emerged during the oil crisis in the 1970s which gave these countries an early start in RE and the high level of public support towards RE strongly suggest that the developed countries will remain as the leading nations in the field of green technologies.

**Germany: A Policy Miracle**

The previous RE literature on Germany strongly confirms that Germany is a highly successful country in terms of the RE implementation. In fact, excluding the hydropower, Germany, Denmark and Austria also have the best scores for RE technology in Europe (Klessmann et al. 2011, p. 7639). Countries using quota obligations such as Italy and Sweden have been able to develop significant amounts of RE only later than Germany, and therefore lag behind in the process (Klessmann et al. 2011, p. 7643). The German model comprises of three elements: the guaranteed grid access for RE producers, including the extension of the grid to this where needed; the preferred feed-in of RE into the power grid; a long-term (commonly 20 years) support, fixed, economically viable price for RE, the additional costs of which are shared among all producers and consumers (Jalilvand 2012, p. 17). Experts of RE

believe that the German FIT-system provides higher security for investors than the British Renewables Obligation and "promotion strategies with low policy risks—as in the case of German 1000 roofs and 100,000 roof-top photovoltaic promotion campaigns (Haas et al. 2011, p. 1024)—have lower profit requirements for investors and, hence, cause lower costs to society" (Haas et al. 2011, p. 1005). Other RE specialists underline that Germany started to develop RE much earlier than other countries, such as Czech Republic, and therefore has a much larger RE share in total energy consumption.

The feed-in tariff system is easy to implement and can be revised to account for new capacities in a very short time, administration costs are usually lower than implementing a national trading scheme, and a technology-specific feed-in tariff helps to diminish the producer surplus (Haas et al. 2011, p. 7). A comparison between Spain, Germany and Slovenia reveals that the guaranteed duration of tariff level is one year in Spain and Slovenia, whereas it is generally for 20 years in Germany; similarly, reduction of tariffs for new installations are predefined (2-6.5%) in Germany, in which case Spain implements digression in a flexible way and Slovenia offers no digression (Held et al. 2007, p.30). This situation points at another aspect of successful German RE policies. In fact, four of the five countries with the highest level of policy effectiveness in deploying wind power from 2000 to 2005 were Germany, Spain, Denmark and Portugal which primarily used feed-in systems to encourage that development. In contrast, countries with renewable standard portfolio policies—Italy, Belgium and the UK—were not able to score high levels of deployment effectiveness (Fischer and Preonas 2010, p. 8). Another example comparing the US with Germany indicates that both countries started on remarkably similar paths of developing RE; however, at a crucial historical juncture Germany adopted the feed-in tariff system earlier than the US and German policy entrepreneurs pushed the country toward a more successful path. In fact, neither German nor the American politicians have been continuously interested

in developing RE starting from the 1970s; thus, for instance, Chancellor Helmut Kohl and President Ronald Reagan were completely opposed to furthering RE (Laird and Stefes 2009).

Germany has taken the problems associated with climate change very seriously and constantly invests in renewable energies, having become the European embodiment of excellence for the development of wind and solar electricity and aims to develop at least 30% of its electricity from renewable sources by 2020 (Julien and Lamla 2011, p. 5). Contrastingly, the UK depends strongly on fossil and nuclear electricity and is in fact one of the European countries with the strongest dependence on conventional energies (Julien and Lamla 2011, p. 17). In terms of the share of RE in total energy consumption, Germany expects to produce 18% of its energy from RE by 2020, whereas the same figure is 15% for the UK. Emerging economies such as China and South Korea have relatively modest goals with 15% and 11% (Shokria and Heob 2012, p. 2). The reluctance to invest in RE is evidenced by the fact that the UK has the best wind resources in Europe; however, it ranks far behind Spain and Germany in wind power production (ibid.).

The fact that a more democratic ownership of energy leads to more RE development has also been discussed by experts in the past in three aspects. First, as seen in the German case, participation of a wide range of stakeholders provides a good basis for renewable electricity policy development (Gan et al. 2007, p. 154). Second, to guarantee success in RE, a state has to be highly interventionist in the energy sector, which is only possible if it has democratic approval. Thus, in comparison to Brazil, Germany is in a much more interventionist position in wind power: the German electricity sector is completely privatized, which necessitates the state to intervene in the market by regulating in favor of RE, as private companies are only interested in investing in cheap technologies with rapid returns (Wachsmann and Tolmasquim 2003, p. 1029). Third, success in RE comes from cooperation within the country and forming coalitions, the establishment of which requires a democratic culture. A comparison on the

evolution of the PV industry in Australia, Germany and Japan reveals that various national players have specialized in different activities, with the institutions' building block being a key determinant for success; thus, in the case of Australia the main actors in PV policy coalitions have been research groups in universities, small industry associations representing a very limited number of manufacturing companies involved in PV and some utilities with interest in renewable and weak community groups, whereas in Germany the influence of coalitions supporting renewable has been more effective in provoking changes in the existing institutional framework (Marinova and Balaguer 2009, p. 462).

The past literature on Germany underlines five aspects of Germany's success in RE: the early start in the RE race, the interventionist feed-in tariff system that creates a low risk environment for RE investors, the decentralized political system that gives the German state a flexible mechanism to create RE policies, public support and involvement in the system, and other particular characteristics of the country, the most important of which is the level of economic development. There is a significant consensus by experts on RE that Germany is one of the most successful countries in the world in terms of the implementation of RE. However, as previously indicated, policy-centric studies that do not analyze the situation from a comparative perspective and emphasize the causality from a single direction (for instance income) are numerous in the German case.

**The United Kingdom: Questionable Support Schemes and Public Awareness**

As in the German case, policy studies dominate the literature on the UK and comparisons with other countries almost solely focus on Germany. Many experts believe that, in contrast to Germany that employs feed-in tariffs, the UK's quota policy is relatively weaker and has been unable to stimulate many new large scale developments (Do Valle Costa et al. 2008, p. 68); scholarly views about the UK are complex, as although competitive policies are assumed to have driven down the price for RE including wind energy, the risk associated with

them has increased capital cost, while paying a uniform subsidy for different renewable types and locations creates significant "infra-marginal rents" and financial weakness for the investors (Butler and Neuhoff 2008, p. 1854). Taking the policy mechanisms for RE deployment into consideration, it is striking that Italy, the UK, Poland and Belgium, countries which have transformed their markets into quota systems as the main support instrument have high levels of profits but low growth rates (Haas et al. 2011, p. 1028; Do Valle Costa et al. 2008, p. 87). Nevertheless, in general, as the magnitude of absolute support level increases, the RE quantity deployed grows (ibid.). The UK's Non-Fossil Fuel Obligation (NFFO) which provided periodic tenders for RE generation during the 1990s was not sufficiently profitable to draw much manufacturing interest to the country (Lewis and Wiser 2007). Despite being methodologically different, previous research confirms that the UK constitutes a relative failure for RE, although it has had the opportunity and the background to become as successful as Germany in RE. Other significant factors behind the slow growth of RE in the UK are technological constraints, an over-reliance on a market-based approach to stimulate RE and a planning system that has historically been unsupportive of RE projects (West et al. 2010, p. 5739).

An analysis of Denmark, Germany and the UK compares these countries from the perspectives of energy security and environmental protection. It appears that all three countries are motivated to reduce their dependence on fossil fuels with Germany being the least and Denmark the most self-sufficient country. All three nations consider RE development as a major part of strategy for meeting the Kyoto objectives and opposition to nuclear power has been a motivation for RE development especially in Germany and Denmark (Lipp 2007). When the policies implemented in these countries are compared, the UK is found to have paid more than other countries for RE development despite generation

costs being comparable in all three countries—this is explained by the higher risks involved for developers (price risk, volume risk, market risk) and the high ROC price (ibid.).

Experts in RE that have analyzed the UK provide four results about the country: the UK pays lower attention to efficiency and RE technologies than Germany, it has a much weaker policy mechanism to encourage investments in RE, a more centralized government with less flexibility and relatively unfavorable public opinion about RE that might create a further barrier in the deployment of green technologies. The findings prove that the UK is not one of the model countries in terms of successfully taking advantage of RE. However, there are deficiencies in previous research; there are no studies taking both the society and the state simultaneously into consideration and comparative studies are almost always based on the comparison between Germany and the UK.

**Brazil: A Promising Future with a Tradition**

Brazil emerges as one of the few success cases in the developing world; however, the RE literature has been highly reluctant to confess it. As in the German case, the RE investment has been continuously intervened by the state. Brazil has a centralized system of government concerning energy power production and use; states and municipalities do not have autonomy to legislate in energy power policies and their potential for action in this area is limited to a few projects, usually in partnership with energy companies and with the financial support of multilateral bodies (Do Valle Costa et al. 2008, p. 81).

Although few pieces in literature underline Brazil's success in environmental politics, these works strongly stress this fact. A comparison between India, Brazil, Mexico and China on Clean Development Mechanisms (CDM) indicates that Brazil is the second in ranking with 99 projects, whereas India has already implemented 225 projects; in comparison, Brazil is the third country in terms of technology transfer with 40% of its technology transferred from other countries, which proves that cooperation is one of the foremost important factors in

developing RE. The same figure is 13%, 68% and 59% for India, Mexico and China respectively. Additionally, China has the largest sizes for projects with Brazil ranking the second, but five times behind China for project size on average (Dechezleprêtre et al. 2009, p. 705).

Past research on Brazil in the field of RE is limited, yet offers three interesting conclusions: Brazil's success in RE comes from its early start in the game and interventionist policy making, widely available potential especially in the case of hydropower, its willingness to implement clean energy technologies and the increasing levels of energy consumption. In the case of Brazil, this study also aims to reaffirm that Brazil is a successful implementor of RE and brings a comparative aspect to the RE literature regarding Brazil. As previous literature frequently revolves around developed countries, having a developing country such as Brazil is believed to make contribution to the RE literature.

**Turkey: A Thorny Path to a Future with Renewable Energy**

Turkey does not pay the desired level of attention to the development of RE and the current level of energy imports point at this reality. Turkey has the natural resources to invest further in RE; in fact, Turkey has average amount of wind potential, but competitive potential in hydropower, solar energy and geothermal energy, the latter one giving Turkey the seventh richest position among other countries in the world (Kaygusuz 2002; Kaygusuz 2003, p. 1681; Kaygusuz and Sarı 2003, p. 464; Erdoğdu 2009, p. 2535). To illustrate, Turkey's hydropower and wind potential ranks first in Europe; however, the developed hydropower and wind power potentials are 20,5% and 0,1% respectively with economically more developed European countries such as Germany and Spain having levels of development more than 70% (Barış and Küçükali 2012, p. 383; Öztürk et al. 2009, p. 614).

The relatively high public approval to invest more in RE and rising pollution levels imply that public policies constitute the main barrier that prevents the country from investing

more in RE. A comparative survey among university students in Canada, Romania and Turkey reveals that Turkish students have more favorable opinion of RE and water conservation than their Canadian and Romanian counterparts with 80% of them supporting it. Turkish students believe that more RE should be implemented as an alternative for nuclear energy and a way to boost economy, whereas Romanian and Canadian students indicate that RE is good for the environment and enhancing energy security (Özil et al. 2008). There are only few studies that investigate the society and state relationship. Therefore, there is considerable room for expansion in the RE literature regarding Turkey.

Experts frequently stress the need to increase the RE supplies to enhance national security. Barış and Küçükali indicate that the most appropriate RE alternative for Turkey is biomass because of its extremely high social benefits followed by wind and geothermal energy, which rank higher than PV and hydropower (Barış and Küçükali 2012, p. 388). Additionally, conventional energy in Turkey is highly expensive with natural gas and electricity prices for residential and industrial use having been increased by almost eight and seven times between 1999 and 2010 (Barış and Küçükali 2012, p. 378). Turkey should aim to meet its energy requirements from national sources and policies that provide supply security should be put into practice because of Turkey's characteristic location and geopolitical conditions (Erdal et al. 2008, p. 3841; Tükenmez and Demireli 2012, p. 8).

Policy studies indicate that Turkey's late arrival in the RE game and its inadequate financial strategies in motivating more investment in RE constitute two main reasons behind the current situation. As in the case of many other newly industrializing countries in Europe including the post-Soviet states, Turkey implemented feed-in tariff only in the second half of the 2000s with environmental funds and tax relief programs being the major support schemes before. In fact, the regulation conditions for RE are more favorable in member countries than the conditions in candidate countries (Reiche 2006, p. 372). However, Turkey ranks poorly in

the case of feed-in tariffs among developed European countries, as its tariffs are not particularly high enough to attract new investors. For instance, the minimum price of renewable electricity is around 5.0-5.5 €c/kWh in Turkey, whereas Portugal, Spain and Germany offers 7.5-7.9 €c/kWh, 6.3-7.5 €c/kWh and 6.2-8.5 €c/kWh respectively (Erdoğdu 2009, p. 2538). Experts in the field believe that when the price paid to producers of RE is higher, new RE technologies become competitive earlier as happened in the case of Germany versus the US in solar PV systems (EIA 2013). In the event that Turkey pursuing the same policy, it is more likely that renewable shares will continue to decrease; for instance, the total share of RE in total primary energy supply has declined depending on the decreasing biomass use and increasing usage of natural gas (Saygın and Çetin 2011, p. 112).

The review of literature on Turkey confirms that Turkey is an unsuccessful case in RE. Having started to invest in RE relatively late in the game—in the 1990s—along with low feed-in rates provided by the government form the two major reasons behind undesirable RE performance. In contrast, there is a significant amount of public awareness on the importance of RE, high levels of potential to increase the RE share in energy supply and a growing economy in dare need of energy security for economic growth; thus, a quick and effective response from the state emerges as a requirement for the field of RE. As in the previous cases, the RE literature on Turkey suffers from three major issues: lack of comparative studies that analyze Turkey, relatively policy-centric approaches and the scarcity of multifaceted studies.

## CHAPTER FOUR

## THE SELECTION OF THE CASES

The countries in developed and developing case groups were selected to especially satisfy the two conditions required for most similar systems design in case studies: having a highly similar developmental background and country characteristics, yet a significantly different performance in RE. Contrastingly, the brief comparison between developing and

developed countries will use a more cautious tone. Developed and developing countries that are analyzed have very different backgrounds, but they have comparable success in RE, as in the case of Brazil and Germany along with the UK and Turkey. In addition to the levels of development, the characteristics that decide on the similarity and differences between cases are the following: availability of RE potentials, availability of conventional energy sources, economic and populational differences as well as the geographic size of the countries, economic development policies and growth levels, and distribution of sectors in their economies. In this regard, this study will not be able to disprove the existence of any other candidate that may potentially be suitable for comparison; however, careful attention was paid to determine the optimum cases that would fit in a case study, have credible data, and also appeal to the reader.

**Brazil and Turkey: A Multifaceted Similarity**

Brazil and Turkey emerge as two of the most suitable and favorable cases for comparison among the developing countries. They share strong similarities in economic, sociological and socioeconomic, domestic and international political aspects. The development and economic indicators show that two cases are delightfully similar, when numbers are taken into consideration:

**Table 2: Development Indicators, Brazil and Turkey**

| **Brazil** | | | | | |
|---|---|---|---|---|---|
| **Indicator Name** | **1990** | **1995** | **2000** | **2005** | **2010** |
| Population, total | 149650206 | 161848162 | 174425387 | 185986964 | 194946470 |
| GDP per capita (current US$) | 3086.88 | 4751.07 | 3696.15 | 4743.27 | 10992.94 |
| GDP per capita, PPP (current international $) | 5181.90 | 6277.87 | 7016.62 | 8509.43 | 11180.29 |
| Literacy rate (% of people ages 15 and above) | | | 86.37 | | |
| Mean years of schooling | 3.80 | | 5.60 | 6.60 | 7.20 |
| Share of women employed in the nonagricult. sector | 35.10 | 38.50 | 40.30 | 41.50 | |
| Seats held by women in national parliaments (%) | 5.30 | | 5.70 | 8.60 | 8.60 |
| Unemployment, total (% of total labor force) | 3.70 | 6.00 | | 9.30 | |
| GINI index | 61.04 | 60.24 | | 57.42 | |
| Human Development Index | 0.59 | | 0.67 | 0.70 | 0.73 |
| Internet users (per 100 people) | 0.00 | 0.11 | 2.87 | 21.02 | 40.65 |
| Mobile cellular subscriptions (per 100 people) | 0.00 | 0.79 | 13.29 | 46.35 | 104.10 |

| | | | | | |
|---|---|---|---|---|---|
| Life expectancy at birth, total (years) | 66.34 | 68.34 | 70.14 | 71.53 | 73.10 |
| CO2 emissions (metric tons per capita) | 1.40 | 1.60 | 1.88 | 1.87 | |
| **Turkey** | | | | | |
| **Indicator Name** | **1990** | **1995** | **2000** | **2005** | **2010** |
| Population, total | 54130268 | 58864649 | 63627862 | 68143186 | 72752325 |
| GDP per capita (current US$) | 2783.59 | 2879.25 | 4189.48 | 7087.72 | 10049.77 |
| GDP per capita, PPP (current international $) | 4418.04 | 5371.66 | 9262.02 | 11464.73 | 15829.77 |
| Literacy rate (% of people ages 15 and above) | 79.23 | | | 88.23 | |
| Mean years of schooling | 4.50 | | 5.50 | 6.10 | 6.50 |
| Share of women employed in the nonagricult. Sector | | 17.90 | 19.50 | 20.90 | 23.00 |
| Seats held by women in national parliaments (%) | 1.30 | | 4.20 | 4.40 | 9.10 |
| Unemployment, total (% of total labor force) | 8.00 | 7.60 | 6.50 | 10.60 | 11.90 |
| GINI index | | | | 42.56 | |
| Human Development Index | 0.57 | | 0.65 | 0.68 | 0.72 |
| Internet users (per 100 people) | 0.00 | 0.08 | 3.76 | 15.46 | 39.82 |
| Mobile cellular subscriptions (per 100 people) | 0.06 | 0.74 | 25.36 | 64.00 | 84.90 |
| Life expectancy at birth, total (years) | 63.06 | 66.07 | 69.45 | 72.08 | 73.70 |
| CO2 emissions (metric tons per capita) | 2.69 | 2.92 | 3.40 | 3.48 | |
| Source: World Bank (2013), UNDP (2013) | | | | | |

Figures above indicate that Brazil and Turkey are closely comparable in per capita terms, especially in education, communications, health and Human Development Index (HDI). Brazil performs slightly better in the cases of gender equality, employment and pollution levels, whereas Turkey has higher scores in income and income equality; nevertheless, the differences in development indicators of two countries share strongly similar characteristics, a level of similarity that is higher than that between many other developing countries.

An economic overview of both countries reveals that both countries have been struggling with crises until recently. After the 1980s, both countries suffered from debt and fragile economic structure and until the 2000s, privatization of public enterprises and other economic policies were designed to attract foreign direct investment. Brazil's pattern of development in the last decades has been characterized by urbanization and economic liberalization and Turkey shares a similar character, as well. Both countries have had an ongoing income inequality problem, as stated by the former Brazilian President Medici in

1974: “The economy is doing well, but the poor are doing poorly” (Sloan 1983, p. 66). Brazil and Turkey also have a comparable problem, when the inequality between regions is taken into consideration; thus, the northeastern part of Brazil has a relatively poor population, as the eastern Anatolia economically underperforms the western regions of Turkey. As Esra Ünal indicates, the transformation of Brazilian and Turkish economies in the second half of the 20th century led to mass migration within countries with people traditionally employed in the agricultural sector coming to industrial cities searching for jobs. This situation led to a divide between the traditional elite and poor people, as evidenced by the increase in the number of shanty towns, *favelas* and *gecekondus* in both countries (Ünal 2013). Thus, both countries have fairly large populations and both suffer from problems such as poverty, illiteracy, lower standards of living and corruption.

The recent political history of Brazil and Turkey has experienced conflict between civil administrations and military; thus, a consolidated democracy has not been present for a fairly long time. Brazilian military played a major role in the redemocratization process, but it has progressively given up power to elected civilians. The Turkish General Staff intervened several times in the civil administration on the claims of protecting territorial integrity and secularism. Additionally, poor people have been manipulated for the elite’s interests and thus distributive policies have been followed in both countries (Sloan 1983, p. 53); for instance, in Turkey, municipalities perform charity work by collecting funds from the rich and distributing them to the needy. In addition, the unequal access to political resources in two countries has diminished over the last thirty years, with “organic intellectuals”, for instance, Lula and Erdoğan, having emerged as strong political leaders.

Foreign powers and actors have also been influential on Brazil and Turkey; to illustrate, Carter’s administration made significant pressure for democratization in Latin America, whereas the Copenhagen Criteria was an incentive for political opening in Turkey.

In Brazil, international financial markets and poor economic performance in the beginning of the 2000s forced the country to make policy reforms and follow economic orthodoxy, whereas the Turkish government took advantage of the Copenhagen Criteria to carry out the reforms required for the EU accession as well as to constrain the political influence of the secularist establishment, military, state institutions, and the traditional political movements (Jenkins 2006, p. 186).

Brazil and Turkey share a common denominator in terms of their conventional energy reserves and RE potential. Both countries have considerably little reserves of oil, gas and coal, especially when their relatively large populations are taken into consideration. Contrastingly, both of them offer high RE potentials, the highlights of which are solar and hydroelectric potential. Nevertheless, Brazil emerges as a more successful investor of RE: it has relatively more conventional resources, yet invests more in RE with Turkey importing most of its needs from other countries. Tables regarding the situation of energy reserves and potential are provided below:

**Table 3: Conventional Energy Reserves, Brazil and Turkey**

| **Brazil** | | | | | |
|---|---|---|---|---|---|
| **Years** | **1990** | **1995** | **2000** | **2005** | **2010** |
| Population | 149650206 | 161848162 | 174425387 | 185986964 | 194946470 |
| Oil, total | 2.82 | 3.8 | 7.36 | 10.6 | 12.8 |
| Oil, per capita | 18.84 | 23.48 | 42.2 | 56.99 | 65.66 |
| Gas, total | 108.99 | 137.39 | 225.94 | 250.01 | 364.21 |
| Gas, per capita | 728.3 | 848.88 | 1295.34 | 1344.23 | 1868.26 |
| Coal, total | | | | | 4559 |
| Coal, per capita | | | | | 23.39 |
| **Turkey** | **1990** | **1995** | **2000** | **2005** | **2010** |
| Population | 54130268 | 58864649 | 63627862 | 68143186 | 72752325 |
| Oil, total | 0.52 | 0.49 | 0.3 | 0.3 | 0.26 |
| Oil, per capita | 9.61 | 8.32 | 4.71 | 4.4 | 3.57 |
| Gas, total | 19.96 | 10.51 | 8.89 | 8.5 | 6.09 |
| Gas, per capita | 368.74 | 178.55 | 140.51 | 124.74 | 83.71 |
| Coal, total | | | | | 2343 |
| Coal, per capita | | | | | 32.21 |

*Oil, natural gas and coal reserves are given in billion barrels, billion cubic meters and million tons respectively. Per capita terms are provided in barrels, cubic meters and tons respectively.

Source: World Bank (2013), BP (2012) and U.S. Energy Information Administration (2013)

**Table 4: Renewable Energy Potential, Brazil and Turkey**

| | Brazil | | Turkey | |
|---|---|---|---|---|
| | **Technical** | **Per capita** | **Technical** | **Per capita** |
| Solar photovoltaic | 2592000 TWh | 13296 GWh | 977000 TWh | 13429 GWh |
| Solar thermal | 70 TWh | 0.359 GWh | | |
| Wind | 443900 GWh | 0.0023 GWh | 400 TWh | 5.50 GWh |
| Geothermal | 7.8 TWh | 0.04 GWh | 24.192 TWh | 0.33 GWh |
| Hydro (small and large) | 851 TWh | 4.37 GWh | 433 TWh | 5.95 GWh |
| Biomass, biowaste and biofuels | 27633353 TWh | 142000 GWh | 120580 TWh | 1657 GWh |
| Total Renewable Energy | 30226282 TWh | 155300 GWh | 1098437 TWh | 15098 GWh |

Source: DR Country Report, Brazil (2005), Evrendilek and Ertekin (2003), Özgür (2008)

The figures above lead to two conclusions. First, Brazil has much higher reserves of conventional energy; it has much larger amounts of oil and gas, whereas Turkey has slightly more resources of coal. Thus, although RE alone does not compensate the energy needs of both countries, Turkey appears to have more reasons in invest in RE, when its large population is taken into consideration. Second, Brazil offers a much larger potential of RE; however, the theoretical RE potential of both countries is virtually inexhaustible; for instance, a household of four people consumes only around 10000 KWh, in which case Brazil and Turkey has enough theoretical potential to meet the energy needs of extremely many people; however, in the case of economically viable options, such as hydraulic energy, both countries have similar capacities. The lack of conventional resources and large potential of RE bring two countries on a comparable basis.

Brazil and Turkey are relatively large countries, as their populations, area of country and the government expenditures indicate. Thus, they have comparable resources to devote to military capabilities, health services and education. Similarly, the distribution of sectors in the economy is highly similar with services sector having a large share in both economies despite their classification as developing nations:

| Table 5: Country Size, Government Expenditures, Brazil and Turkey | | | | | |
|---|---|---|---|---|---|
| **Brazil** | **1990** | **1995** | **2000** | **2005** | **2010** |
| Population, total | 149650206 | 161848162 | 174425387 | 185986964 | 194946470 |
| Land area (sq. km) | 8459420 | 8459420 | 8459420 | 8459420 | 8459420 |
| Health expenditure, public (% of GDP) | | 8.36 | 4.08 | 4.70 | 7.08 |
| Military expenditure (% of GDP) | 6.3 | 1.9 | 1,8 | 1.5 | 1.6 |
| Public spending on education, total (% of GDP) | | 4.57 | 4.01 | 4.53 | |
| Services, etc., value added (% of GDP) | 53.21 | 66.70 | 66.67 | 65.02 | 66.63 |
| Industry, value added (% of GDP) | 38.69 | 27.53 | 27.73 | 29.27 | 28.07 |
| Agriculture, value added (% of GDP) | 8.10 | 5.77 | 5.60 | 5.71 | 5.30 |
| GDP (current US$, trillions) | 0.46 | 0.77 | 0.64 | 0.88 | 2.14 |
| **Turkey** | **1990** | **1995** | **2000** | **2005** | **2010** |
| Population, total | 54130268 | 58864649 | 63627862 | 68143186 | 72752325 |
| Land area (sq. km) | 769630 | 769630 | 769630 | 769630 | 769630 |
| Health expenditure, public (% of GDP) | | 10,66 | 9.76 | 11.28 | 12.79 |
| Military expenditure (% of GDP) | 3.5 | 3.9 | 3.7 | 2.5 | 2.4 |
| Public spending on education, total (% of GDP) | | 2.08 | 2.25 | 2.59 | |
| Services, etc., value added (% of GDP) | 49.75 | 50.47 | 57.21 | 60.69 | 63.40 |
| Industry, value added (% of GDP) | 32.16 | 33.24 | 31.48 | 28.51 | 26.95 |
| Agriculture, value added (% of GDP) | 18.09 | 16.29 | 11.31 | 10.80 | 9.65 |
| GDP (current US$, trillions) | 0.15 | 0.17 | 0.27 | 0.48 | 0.73 |
| Source: World Bank (2013) | | | | | |

Brazil and Turkey's economic situation implies that the officials in neither of the cases have enough time and resources to achieve better RE performance. In the case of Brazil, the overarching problems are productivity, high level of government expenditures, the ill-functioning judicial system, poor infrastructure, and the lack of long term economic vision—especially for decreasing the size of informal economy (Elstrodt et al. 2007). To increase productivity, large amount of energy is needed in short time, which is not possible with RE. In the case of Turkey, the government desires to achieve stable economic growth and increased global competitiveness through the creation of employment opportunities in the private sector. Although the importance of security has been emphasized in the last development plan, as in the Brazilian case, the large size of informal economy and the barriers to entry constitute considerable challenges for the economy in general. The R&D levels are still in the low end of emerging economies and the low quality in secondary and tertiary education remain as big hurdles to be overcome. Thus, both countries have significant policy issues to be tackled.

**Germany and the United Kingdom: A Comparative Look**

Germany and the United Kingdom are two European nations with striking similarities in terms of their development indicators. The figures below show that economic, social and educational characteristics of both countries only marginally differ from each other, the most important difference being the higher level of economic inequality in the UK:

**Table 6: Development Indicators, Germany and the United Kingdom**

| **Germany** | | | | | |
|---|---|---|---|---|---|
| **Indicator Name** | **1990** | **1995** | **2000** | **2005** | **2010** |
| Population, total | 79433029 | 81678051 | 82211508 | 82469422 | 81776930 |
| GDP per capita (current US$) | 21583.84 | 30887.87 | 22945.71 | 33542.78 | 40163.82 |
| GDP per capita, PPP (current international $) | 18504.46 | 22446.38 | 25756.73 | 31114.53 | 37651.59 |
| Literacy rate, adult total (% of people ages 15 and above) | | | | | 99.00 |
| Mean years of schooling | 8.00 | | 10.50 | 12.20 | 12.20 |
| Share of women employed in the nonagricult. sector | | 43.00 | 45.10 | 46.60 | 47.80 |
| Seats held by women in national parliaments (%) | | | 30.90 | 31.80 | 32.80 |
| Unemployment, total (% of total labor force) | | 8.10 | 7.70 | 11.10 | 7.10 |
| GINI index | | | 28.31 | | |
| Human Development Index | 0.80 | | 0.87 | 0.90 | 0.92 |
| Internet users (per 100 people) | 0.13 | 1.84 | 30.22 | 68.71 | 82.00 |
| Mobile cellular subscriptions (per 100 people) | 0.34 | 4.55 | 58.53 | 96.04 | 127.04 |
| Life expectancy at birth, total (years) | 75.32 | 76.42 | 77.93 | 78.93 | 79.99 |
| CO2 emissions (metric tons per capita) | | 10.60 | 10.12 | 9.82 | |
| **United Kingdom** | | | | | |
| **Indicator Name** | **1990** | **1995** | **2000** | **2005** | **2010** |
| Population, total | 57247586 | 58019030 | 58892514 | 60224307 | 62262786 |
| GDP per capita (current US$) | 17687.67 | 19943.78 | 25057.61 | 38121.56 | 36237.70 |
| GDP per capita, PPP (current international $) | 16288.95 | 19681.14 | 26039.14 | 32957.67 | 35298.43 |
| Literacy rate, adult total (% of people ages 15 and above) | | | | | 99.00 |
| Mean years of schooling | 7.90 | | 8.60 | 9.00 | 9.40 |
| Share of women employed in the nonagricult. sector | 44.00 | 46.90 | 46.00 | 46.30 | |
| Seats held by women in national parliaments (%) | 6.30 | | 18.40 | 19.70 | 22.00 |
| Unemployment, total (% of total labor force) | 6.80 | 8.60 | 5.50 | 4.70 | 7.80 |
| GINI index | | | 34.00 | | |
| Human Development Index | 0.78 | | 0.84 | 0.87 | 0.87 |
| Internet users (per 100 people) | 0.09 | 1.90 | 26.82 | 70.00 | 78.00 |
| Mobile cellular subscriptions (per 100 people) | 1.95 | 9.89 | 73.80 | 108.75 | 130.76 |
| Life expectancy at birth, total (years) | 75.88 | 76.84 | 77.74 | 79.05 | 80.40 |
| CO2 emissions (metric tons per capita) | 9.96 | 9.73 | 9.23 | 9.00 | |
| Source: World Bank (2013), UNDP (2013) | | | | | |

One of the biggest differences between Germany and the UK is their structure of the economy, as both countries historically represent two different varieties of capitalism. Germany is characterized by its coordinated market economy (CME), whereas the UK has a liberal market economy (LME) (Hall and Soskice 2001); however over the last two decades, both countries have started adopting economic policies from each other and thus created mixed economies. For instance, in addition to LME elements such as deregulation, low unionization level, and the empowerment of employers individually, the UK also took advantage of Keynesian macroeconomic policies to increase economic growth. In the same manner, German institutions continued to monitor firms more closely, encourage cooperation between firms and protect the rights of the employees more adequately; however, Germany also began to coordinate wages more loosely, reduce social benefits to employees and foster the development of a part-time labor market over the last two decades. In this sense, both countries adopted an economic system that is more similar to each other than it used to be.

Both nations are role models of democracy and parliamentary democracies thus having governments elected by the majority of the constituency and a parliament elected for a legislative period. The parliament can be dissolved, if a clear majority cannot be established. Germany has a federalist structure and coalition governments may come to power, whereas the UK model includes single-party government along with a weak court to check and balance the ruling party; thus Germany has a more decentralized system. For the purpose of this study, this difference is not important, as it would only matter if it impeded the development of democracy.

Germany and the UK emerge as two most suitable examples to test the RE performance of developing countries; the conventional energy reserves of the UK is fairly larger than those of Germany as the UK has access to the oil in the North Sea, yet the UK's reserves are not sufficient to satisfy the UK's energy demand. In contrast, they have more

comparable potentials of RE with the UK having lots of wind power potential that comes from being an island, whereas Germany's hydro- and solar power potential is greater. Information on energy reserves is provided in the tables below:

**Table 7: Conventional Energy Reserves, Germany and the United Kingdom**

| **Germany** | | | | | |
|---|---|---|---|---|---|
| **Years** | **1990** | **1995** | **2000** | **2005** | **2010** |
| Population | 79433029 | 81678051 | 82211508 | 82469422 | 81776930 |
| Oil, total | 0.40 | 0.37 | 0.36 | 0.39 | 0.28 |
| Oil, per capita | 5.04 | 4.51 | 4.34 | 4.78 | 3.38 |
| Gas, total | 188.02 | 302.99 | 339.49 | 279.09 | 175.56 |
| Gas, per capita | 2367.07 | 3709.57 | 4129.48 | 3384.17 | 2146.87 |
| Coal, total | | | | | 40699 |
| Coal, per capita | | | | | 497.68 |
| **United Kingdom** | **1990** | **1995** | **2000** | **2005** | **2010** |
| Population | 57247586 | 58019030 | 58892514 | 60224307 | 62262786 |
| Oil, total | 4.26 | 4.52 | 5.15 | 4.49 | 3.08 |
| Oil, per capita | 74.34 | 77.85 | 87.50 | 74.50 | 49.53 |
| Gas, total | 590.01 | 629.99 | 755.01 | 588.99 | 292.00 |
| Gas, per capita | 10306.28 | 10858.39 | 12820.17 | 9779.94 | 4689.85 |
| Coal, total | | | | | 228 |
| Coal, per capita | | | | | 3.66 |

*Oil, natural gas and coal reserves are given in billion barrels, billion cubic meters and million tons respectively. Per capita terms are provided in barrels, cubic meters and tons respectively.

Source: World Bank (2013), BP (2012) and U.S. Energy Information Administration (2013)

**Table 8: Renewable Energy Potential, Germany and the United Kingdom**

| | **Germany** | | **United Kingdom** | |
|---|---|---|---|---|
| | **Technical** | **Per capita** | **Technical** | **Per capita** |
| Solar photovoltaic | 112 TWh | 1370 KWh | 140 TWh | 2248 KWh |
| Solar thermal | - | | - | |
| Wind | 408 GWh | 4989 KWh | 480 TWh | 7709 KWh |
| Geothermal | 147 TWh | 1798 KWh | 1,09 TWh | 17 KWh |
| Hydro (small and large) | 27 TWh | 330 KWh | 2,45 TWh | 39 KWh |
| Biomass, biowaste and biofuels | 72 TWh | 880 KWh | 96,2 TWh | 1545 KWh |
| Total Renewable Energy | 766TWh | 9367 KWh | 720 TWh | 11564 KWh |

Source: Defra (2007), GENI (2011)

The tables above indicate that the UK and Germany has comparable reserves of conventional energy; however the UK is in a more advantageous position, as it has much higher amount of gas—a source that is relatively more environmentally friendly, whereas

Germany has a great amount of coal. In fact, the British Petroleum Company indicates that it will take 216 years for Germany to use all of its reserves at the current rate of extraction. Thus, as both countries have similar reserves, conventional energy should not greatly affect their RE investment decisions. Contrastingly, although not a precise result due to possible methodological differences, the UK has slightly more potential of RE per capita, yet it is much less successful in taking advantage of it. This leads to the conclusion that the availability of RE potential does not determine the RE performance in Germany and the UK.

In addition to the development indicators, Germany and the UK show highly similar characteristics in terms of their area, population and the government expenditures. The distribution of sectors and public spending indicate that both countries have comparable economic structure and priorities of policy in the case of spending:

**Table 9: Country Size, Government Expenditures, Germany and the United Kingdom**

| **Germany** | **1990** | **1995** | **2000** | **2005** | **2010** |
|---|---|---|---|---|---|
| Population, total | 79433029 | 81678051 | 82211508 | 82469422 | 81776930 |
| Land area (sq. km) | 349130 | 349100 | 348950 | 348760 | 348570 |
| Health expenditure, public (% of GDP) | | 8 | 8 | 8 | 9 |
| Military expenditure (% of GDP) | 2.5 | 1.6 | 1.5 | 1.4 | 1.4 |
| Public spending on education, total (% of GDP) | | 4.54 | | | |
| Services, etc., value added (% of GDP) | 61.17 | 66.58 | 68.23 | 69.73 | 71.21 |
| Industry, value added (% of GDP) | 37.34 | 32.14 | 30.49 | 29.40 | 27.92 |
| Agriculture, value added (% of GDP) | 1.49 | 1.27 | 1.27 | 0.87 | 0.87 |
| GDP (current US$, trillions) | 1.71 | 2.52 | 1.89 | 2.77 | 3.28 |
| **United Kingdom** | **1990** | **1995** | **2000** | **2005** | **2010** |
| Population, total | 57247586 | 58019030 | 58892514 | 60224307 | 62262786 |
| Land area (sq. km) | 241930 | 241930 | 241930 | 241930 | 241930 |
| Health expenditure, public (% of GDP) | | 6 | 6 | 7 | 8 |
| Military expenditure (% of GDP) | 3.8 | 3 | 2.4 | 2.4 | 2.6 |
| Public spending on education, total (% of GDP) | 4.37 | 5.2 | 4.51 | 5.43 | |
| Services, etc., value added (% of GDP) | 64.12 | 67.16 | 71.67 | 76.04 | 77.66 |
| Industry, value added (% of GDP) | 34.07 | 31.00 | 27.34 | 23.29 | 21.62 |
| Agriculture, value added (% of GDP) | 1.82 | 1.84 | 0.99 | 0.67 | 0.72 |
| GDP (current US$, trillions) | 1.01 | 1.16 | 1.48 | 2.3 | 2.26 |
| Source: World Bank (2013), UNDP (2013) | | | | | |

Germany and the UK are economically highly developed countries and therefore have the sources to cope with the financial burdens of RE investment, and Germany proves this availability by being one of the pioneers among developed countries in terms of setting full transition to RE as a long-term policy goal. As will be closely explained in the case analysis section, the difference between two countries comes more from the policy and reflections of societal differences on the culture of governance.

## HYPOTHESES

### Economics and Welfare

Income per capita (real and PPP), R&D expenditure on RE and general R&D expenditure, and Human Development Index will be considered in this group of hypotheses. An increase in income is believed to increase the share of RE because of four reasons. First, a richer society invests more in RE, as it perceives environment and air quality as an indispensible good; thus, the demand for environment and clean air is more inelastic in richer nations. Second, as RE is more expensive than conventional energy, only societies that have reached a certain level of wealth have the chance to strongly invest in RE. Relatively poorer countries have other priorities, such as military security and other types of public service. Third, as a country becomes richer, the demand for energy grows simultaneously. If there is not adequate supply of conventional energy or the cost of importing is too high, this situation may lead rich countries to look for alternative energy to sustain their level of economic development. Fourthly, in a similar way, as the income grows, people's need towards preserving this amount of wealth grows, as well. Thus, they have to allocate some portion of their wealth towards preserving it. In this sense, RE emerges as a security measure.

Past literature confirms a positive correlation between RE and the level of income. As previously mentioned, the Environmental Kuznets Curve indicates that as income grows by a certain extent, the pollution levels increase, as well. However, after a particular threshold, the

pollution levels starts declining with income continuing to rise. Perry Sadorsky indicates that growth in real per capita income leads to proportionally greater changes in the consumption of RE (Sadorsky 2009, p. 4027). Other experts believe that environmental concern is a luxury (Hökby and Söderqvist, 2003). Thus, higher levels of income are very frequently portrayed as a cause of more environmental protection.

The increase in R&D for RE projects is expected to lead to an increase in the share of RE in total energy supply by both increasing the quantity of RE projects and also boosting the RE technology, thus leading to more efficiency. In fact, previous literature suggests that such causality is extremely probable; Schilling and Esmundo argue that plotting the performance of a technology against the money or effort invested in it most often yields an S-shaped curve: slow initial improvement, then accelerated improvement, followed by diminishing improvement. In the case of R&D investment and technological improvement, both wind energy and geothermal energy are expected to become more economical than fossil fuels within a relatively short time frame (Schilling and Esmundo 2009). Other experts indicate that renewable technologies are "learnt by doing" (Neij 2008) and "learnt by searching" (Kobos et al. 2006), both of which require R&D investment. Evidence shows that a higher level of R&D corresponds to higher levels of investment in RE.

RE is also expected to increase the welfare of the society, as clean air and protected environment increases the standards of living by positively affecting health through clean air, water, and soil. In this regard, a country that pays close attention to increasing the welfare of its population is expected to invest in RE, as well. The willingness of a country to increase the welfare of its citizens will be measured by the HDI. Jacobs and Šlaus indicate that $100 of renewable energy is not equal in value to $100 of non-renewable fossil fuel and that GDP is not a correct way to measure welfare. In fact, human welfare related government expenditure as a percentage of GDP is much higher in some European states, such as Germany (14%), the

UK (12%) and Sweden (16%) compared to developing countries—Turkey (3%), Brazil (5%) and China (4%)—and the US (6%) (Šlaus and Jacobs 2011), and RE is given higher importance in European countries, as well. Forgach et al. proved using regression analysis that there is a strong correspondence between ecological footprint and human development index and elevated social welfare is a factor, which enhances the use of renewables (Forgach et al. 2008). RE constitutes a measure of welfare and an indispensable part of human development, a perspective that constitutes the foundation of this study, as well.

**Environmental Protection**

For the case of environment, there are several indicators that would potentially correlate with the investment in RE: $CO_2$ emissions per capita, GDP per unit of energy use and forest area as a portion of the country's area. Similarly, the evolution of environmental politics in cases, particularly the approaches of governments to environmental programs and NGOs, such as Greenpeace, will provide insight into the consciousness about the environment in a particular population.

A decrease in $CO_2$ emissions per capita over the years, especially for the case of industrial production, would mean that a country is either willing to become more efficient and thus has been increasingly consuming less conventional energy or has been able to develop green technologies that allow it to produce at a lower energy cost. Aviral Kumar Tiwari indicates that a positive shock on the consumption of RE source increases GDP and decreases $CO_2$ emissions (Tiwari 2011). Guerrero-Lemus and Martinez-Duart indicate that rapid decreases in $CO_2$ levels will be achieved by a combination of energy efficiency, replacement of conventional by RE technologies, as well as the capture and storage of $CO_2$ emitted (Guerrero-Lemus and Martinez-Duart 2013). In a similar manner, Mantzos and Capros argue that, if Europe becomes acceleratingly energy efficient, the slower growth of electricity requirements, combined with the shift towards carbon free energy forms and the

more efficient production of electricity and steam, will lead to much lower $CO_2$ emissions from the power generation sector in Europe. The evidence shows that $CO_2$ emissions, RE development and energy efficiency are closely interrelated. This study acknowledges that economic recessions have an impact on the reduction of the $CO_2$ levels, yet this variation has been ignored under the consideration that it does not have a substantial effect to change the dynamics of the comparison. In that sense, a look at the cases of Turkey and Brazil shows that the reduction in $CO_2$ levels due to economic recession, as in the 2001 and 2008 recessions in Turkey, has not changed the emission performance of Turkey to an extent that it would rank lower than Brazil. In the case of Germany and the UK, there have been no major variations too.

In the same vein, GDP per unit of energy will be used to measure the efficiency in a country, arguing that a more efficient country will more likely invest in RE; in fact, GDP-energy ratio is a frequently used concept in the 1980s and frequently employed to measure energy intensity. For the purposes of this study and in terms of the availability of data, it appears to be a useful concept. Ang argues that it is hard to conceptualize energy efficiency; however, it generally means using less energy to produce the same amount of services or useful output (Ang 2006, p. 575). In comparison, Wei et al. indicate that by investing in energy efficiency measures, money otherwise spent on energy costs can be redirected to stimulate the economy, most importantly through job creation in the green technology sector (Wei et al. 2010). Dinçer believes that energy efficiency, effective utilization of energy sources, using RE and sustainable development are closely interrelated (Dinçer 2000).

Policies oriented towards having a sustainable environment lead to specific environmentally related behaviors. Qualitative findings, such as the approval of environmental programs and NGOs shed light on the possible approaches of a state and society to RE. For instance, the environmentally concerned states of the USA with more

"green" policies are those that invest in measures leading to better air quality, water quality, hazardous waste management, energy efficiency, and at the same time a smaller carbon footprint through RE. Among these states, there are Rhode Island, California, Maryland and Vermont (Forbes 2007). The proximity between energy efficiency and consciousness about the environment makes the environmental protection group of hypotheses one of the most significant factors in analyzing the RE success.

**Security**

Based on the foundation of this study, security emerges as one of the most promising groups of hypotheses. In this regard, RE may appear at first as a tool to improve energy security in a questionable manner; in fact, some renewable sources, such as wind and solar, are only available seasonally and therefore alternative sources of energy, such as nuclear power, may be advertised as more convincing. However, it should be regarded that investing in nuclear energy is a problematic decision; it may prove difficult because of the international political climate—most importantly because of the possibility of producing nuclear weapons by enriching uranium in nuclear power plants, the lack of required technology and reserves and the lack of adequate financial resources. In comparison, the domestic opposition against nuclear energy might be considerably high especially because of environmental concerns and risks, which turns RE into the best alternative for improving energy security for a country that lacks conventional energy sources. For the security case, four hypotheses are taken into consideration: the percentage of energy imports in GDP, hard power, the amount of remaining non-renewable energy sources in a country and qualitative findings. As in the previous cases, if data is not available for the period of study, qualitative sources will be paid more attention.

The hypothesis focusing on the ratio of energy imports in GDP argues that an increase in the energy imports will make a country less energy secure over time and therefore more willing to invest in RE; hence, bigger values will correspond to more RE. For instance, energy

poor countries, such as Japan and European countries have made considerable investments in RE both in the past and the present. Being a resource poor country that relies for 96% of its energy supply on other countries, Japan was only surpassed by Germany in photovoltaic solar energy in the 2000s. The fact that Europe is dependent on Russia and the Middle East paves the way for Europe to invest more in RE. Similarly, Jordan, an energy poor country surrounded by energy rich nations, plans to invest 15 billion dollars in RE to prevent a big portion of its GDP from being spent on oil and also in as a reaction to the attacks on the Arab Gas Pipeline (Natural Gas Asia 2013). As evidence indicates, less energy-secure countries were driven by this characteristic in their decisions to invest in RE.

The hard power is expected to have a positive causal relationship with energy security, as a country might usually choose to increase its hard power, military security, and energy security simultaneously. To measure the hard power of case countries, National Material Capabilities Index from the Correlates of War project will be employed. This index is calculated yearly and gives a composite score based on the total population, urban population, iron and steel production, primary energy consumption, military expenditure and military personnel figures. A simultaneous increase of hard power with the increasing shares of RE in total energy supply will attempt solidify the study's contrasting position to realism. Florian Baumann views hard power as a complementary asset for sustaining energy; for instance, NATO is involved in maritime security with its naval patrols in the Mediterranean Sea and the EU needs to project hard power to secure energy according to the Petersberg tasks (Baumann 2008, p. 10).

The RE investment is expected to increase as the discovered amount of conventional energy sources, gas and oil, declines and sources near depletion. Experts point at the fact that depletion of conventional resources may result in agricultural catastrophes and economic recession and only be fought by investing more in RE. István Lakatos emphasizes that

conventional hydrocarbons are dwindling and antiquated power networks and obsolete or even new environmental regulations may threaten the Western world into a new energy crisis. Lakatos proposes to accelerate the research and to develop a more efficient application of the new scientific results for the sake of better utilization of the available natural resources (Lakatos 2003). For instance, Saudi Arabia, the world's largest exporter of oil, decided to invest 100 billion dollars in solar, nuclear and other renewable energy sources, as the oil supply dwindles (Schwartz 2011). In this regard, many countries that have very little or no conventional resources may choose to make dramatic RE investments, as in the case of China and many European countries, such as Denmark and Germany. Contrastingly, countries that have vast RE potential, but also significant sources of oil—for instance the countries in the MENA region—usually take advantage of the conventional energy, as it is less costly to produce it.

**State Prestige and Globalization**

Investing in RE requires essential know-how in green technology, as the equipment rapidly evolves to meet the demands for enhanced energy production and storage, in which case a globalizing world fosters RE. The development of a RE-oriented policy requires vision projected by the state, as many states are tempted to rely on conventional energy due to its low costs and the expertise that has already been gathered in extraction, processing and marketing of it. Thus, certain states offer a more fertile ground to invest in clean technologies and are more attractive for RE. For this case, the following factors will be used: Freedom in the World Index published by the Freedom House, the Index of Economic Freedom by The Wall Street Journal and Heritage Foundation and foreign direct investment (FDI) per capita data published by the World Bank.

An increase in all of those measures—except the Freedom House scores, in which case it is a decrease—means that a country is more likely to attract RE investment and is more

willing to increase the state prestige through RE. Thus, if a country is more strongly connected to other countries via forces of globalization, has a more open economy, and offers better conditions and prospects for doing business, it is more likely to experience investment in RE. If a country offers fruitful investment returns, FDI per capita is expected to correlate well with its RE performance. Similarly, a stronger democracy would mean more participation of the society in policy making; as people will be more inclined to protect the environment and fight against climate change than profit-oriented energy firms controlled by smaller groups, a more democratic state is likely to invest more in RE.

The index of economic freedom has great importance in the global realm. A study on North Africa—a region with limited economic freedom—indicates that the RE pricing mechanism in North Africa has a politicized nature, which makes investors dependent on governments or regulations once investments have been done (Komendantova et al. 2012). Polls undertaken by the United Nations show that the possible reason behind the low inflows of FDI in Africa is firstly conflict and stability, and secondly personal and business safety (United Nations 2008). Additionally, Georgiou et al. argue that political stability, control of corruption and ease of doing business are three major factors that affect the level of RE investment in a country (Georgiou et al. 2008). Among the EU countries, experts indicate that a sound and secure investment climate which also guarantees sufficient profitability is vital for a significant development of RE (Haas et al. 2011, p.1004). Thus, the culture of democracy and the ease of doing business usually have a strong relationship; in fact, the index of economic freedom and the Freedom House indices show that African countries have the worst scores on democracy and the ease of doing business. Surprisingly, some rapidly growing economies such as Russia, China and Turkey are classified as "partly free" by Freedom House and have 112$^{th}$, 91$^{st}$, and 71$^{st}$ positions in the world in terms of the difficulty

of doing business respectively. Similarly, the more globalized countries perform better in RE, as in the case of European countries, for instance Ireland.

Additionally, the individual technology indices for RE and the fact that whether the cases have their own RE firms which invest domestically is a contributing factor to the RE success of a country and might give the case country a significant advantage in starting early. Previous studies on wind industry prove that there is a strong relationship between a manufacturer's success in its home country market and its eventual success in the global wind power market and the dominance of the Danish wind companies Vestas and NEG Micon stems in large part from their first-mover advantage (Lewis and Wiser 2007, p. 1844). Countries with lower wage rates such as India and China are able to realize cost savings through domestic manufacturing of wind turbines compared to their European and American counterparts. Thus, having technology available at the domestic level paves the way for a future dominated by modern energy.

**Civic Virtue**

An environmentally more conscious society—a society that gives up its income for environmental protection, support government's favorable policies for the environment, chooses protecting the environment over more economic growth and views environmental problems as urgent—would be more inclined towards investing in RE. Thus, people with civic responsibility do not only have a tendency to pursue their personal interests, but also place a great emphasis on the social, economic, and ecological well-being of their immediate surroundings (Petrzelka and Bell 2000). People do so because they share a common interest in the "locality" where they interact and meet their daily needs (Bridger and Luloff 1999). Portney indicates that among the 41 sustainable cities in the US, 34 cities take advantage of participatory processes in their environmental programs (Portney 2005, p. 586). For the purpose of the civic virtue hypotheses group, a selection of "Environment" variables from

World Values Survey and other complementary polls will be employed. The data on civic virtue is relatively limited; however, it fulfills the expectations related to determining the factors behind the RE performance to a considerable extent, as there are large differences in RE performance between cases, but only minor differences in polls.

Researchers in the field indicate that there is a positive correlation between a society's level of concern about the environmental problems and the percentage of RE; thus, a society that is sensitive on environmental issues is more likely to approve of RE. Sebastian Bamberg, a German psychologist, indicates that environmental concerns are indirect determinants of environmentally related behaviors (Bamberg 2003, p. 21). Jay Zarnikau found out in a study done in Texas, USA that intensive exposure to information about energy source issues lead to an increase among people interested in paying a modest premium to support investments in alternative energy (Zarnikau 2003, p. 1661). Similarly, Ekins argues that there are many factors that determine the successful implementation of RE technologies, one of which is public acceptance (Ekins 2004). Civic responsibility has a complementary function to laws for providing an environmentally sustainable development and it hinges on the ability of people to come together and act collectively towards developing initiatives aimed at complementing, rather than replacing, existing federal, state, and local regulations.

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This study weights each group of sub-hypotheses equally and sub-hypotheses within a group are given the same weight. Thus, when a sub-hypothesis is confirmed, the score of the group with which it is affiliated increases. For a group of hypothesis to be confirmed, the group needs to reach a considerably higher percentage than others. In this regard, for a group of hypotheses to have credibility in explaining the RE performance, not all sub-hypotheses have to confirmed. The dependent variable, the groups of hypotheses, the relationship with the dependent variable, and the sources are provided in the table below:

| Table 10: Dependent Variable and Hypotheses | | | |
|---|---|---|---|
| **Index** | **Dependent Variable** | **Source** | |
| D | Share of RE in Primary Energy Supply | International Energy Agency, British Petroleum | |
| **Index** | **Hypothesis** | **Results in an increase in RE, when:** | **Source** |
| **Economics and Welfare (a)** | | | |
| H1a | Income per capita (real and PPP) | Increases | World Bank |
| H2a | R&D Budget for RE and general R&D Budget | Increases | International Energy Agency, World Bank |
| H3a | Human Development Index | Increases | United Nations |
| **Environmental Protection (b)** | | | |
| H1b | $CO_2$ emissions per capita | Decreases | World Bank |
| H2b | GDP per unit of energy use | Increases | International Energy Agency |
| H3b | Forest area | Increases | World Bank |
| H4b | Qualitative sources: environmental politics | | Primary and secondary sources |
| **Security (c)** | | | |
| H1c | The percentage of energy imports in GDP | Increases | World Bank |
| H2c | Hard power (Material Capabilities Index) | Increases | Correlates of War |
| H3c | The amount of remaining conventional energy sources | Decreases | International Energy Agency |
| H4c | Qualitative sources: security | | Primary and secondary sources |
| **State Prestige and Globalization (d)** | | | |
| H1d | Freedom in the World Index | Decreases | Freedom House |
| H2d | The Index of Economic Freedom | Increases | The Heritage Foundation |
| H3d | Foreign direct investment per capita | Increases | World Bank |
| **Civic Virtue (e)** | | | |
| **The following questions are taken from the "Environment" set of World Values Survey (WVS).** | | | |
| H1e | Would give part of my income for the environment | Increases | WVS 1981-2008 Integrated Data |
| H2e | Increase in taxes if used to prevent environmental pollution | Increases | ibid. |
| H3e | Government should reduce environmental pollution | Increases | ibid. |
| H4e | Would buy things at a 20% higher price if it helped to protect environment | Increases | ibid. |
| H5e | Protecting environment and fighting pollution is less urgent than suggested | Increases | ibid. |

## PERIOD OF STUDY AND DATA

This study will employ data from the 1990-2010 period. The selection of this timeframe comes from several reasons. First, the development of RE is a relatively new phenomenon with developments in Brazil dating back to the 1970s, Germany and the UK starting to increase their RE shares in the 1980s, and Turkey only having started to consider—especially non-hydro—RE only in the 1990s. Second, the data on RE becomes exponentially scarce in this 1990 period, as some of the RE technologies have only been increasingly adopted starting from the 1990s and different data sources provide more overlapping results starting from this period. Third, historical developments, such as the end of Cold War and the

signing of Kyoto Protocol emerge as natural starting points for this study. In the former case, the end of the hostility between two superpowers, the US and the Soviet Federation, enabled the creation of a global environmental governance, in which both the US and Russia actively participate. Kyoto Protocol that is signed in 1997 and became effective in 2005 enforces on its participants a certain reduction in the percentage of $CO_2$ from their initial $CO_2$ levels in 1990. Thus the availability of data, development of particular RE technologies and political events led to the selection of the 1990-2010 period.

The data employed in this study is collected from various sources. The majority of the data on RE comes from IEA, which has an extensive statistical database on the energy figures and provides significant quantitative detail on RE in different countries. As an intergovernmental organization established in the framework of OECD in the wake of 1973 crisis in 1974, IEA emerges as one of the most reliable sources on energy statistics, as it is a non-profit organization employing experts from the field who collect data based on national statistics of different countries, data from international organizations such as World Bank, and through correspondences with government officials. British Petroleum (BP) and World Bank provide extensive data on energy, which will be employed when necessary. World Bank and Correlates of War data are used for the economic and welfare, environmental and security hypotheses. To measure the RE potentials of countries, RE potentials that are related to different types of RE and calculated by various scholars are used.

## CHAPTER FIVE

## THE SUCCESS BEHIND RENEWABLE ENERGY

## TURKEY: AN INDOLENT PLAYER IN THE RENEWABLE ENERGY GAME

Turkey is an emerging market with an increasing hunger for energy so that it can pursue a development characterized by high economic growth. To satiate this urge, Turkey has the advantage to employ RE to a great extent, as it has considerable RE potential. The Turkish government and the society are in fact well aware of the need to invest more in

energy generation, as manifested by the strong will of the state to construct two nuclear power plants and several thermal power plants. Nevertheless, in an irrationally reluctant manner, this goal did not reveal itself in the RE arena and Turkey still remains as one of the poorly performing countries in the RE game.

Evidence shows that starting from the 1950s Turkish governments have not been paying enough attention to the environmental and energy components of human security and the effects of environmental degradation on local people, as revealed by three factors. First, the Turkish officials have only recently begun to pay desirable attention to environmental norms and the implementation of RE; thus, laws and regulations that fairly facilitate the investment in RE have only come into being in the 2000s. Second, governments' lack of support and occasional pressure on the environmental groups starting from the second half of the 20$^{th}$ century led to the creation of only a few number Turkish NGOs and political groups interested in raising environmental awareness and advocating for RE. Similarly, some of these formations have been passionate followers of the causes on environment, yet were not able to attract significant number of voices from the population; others were not well-versed to voice themselves in the Turkish public and international platforms. Third, the structure of the Turkish government is relatively centralized and does not provide local governors the room to decide on RE investment that is well suited to the needs of the local population.

The history of environmental charities in Turkey date back to the 1950s starting with the Charity for the Protection of Turkey’s Nature (1955), the Charity for the Protection of Natural Life (1975) and the Turkish Environmental Foundation (1978) (Paker 2013). The Green Party of Turkey was founded in 1988; however, its political power is negligible. Comparably, in the 1990s and the early 2000s, foundations including Turkish Foundation for Combating Soil Erosion (TEMA), Greenpeace Mediterranean and WWF-Turkey along with other organizations of smaller scale came into existence. The activities of the environmental

NGOs in Turkey are diverse. TEMA is engaged with large campaigns of afforesting the formerly green areas of Turkey to fight against erosion and the degradation of the soil (TEMA 2013), whereas ÇEKÜL, the Foundation for Protecting and Presenting the Cultural and Environmental Values, aims to raise awareness by making documentaries about the history and the environment of Turkey (ÇEKÜL 2013). In this way, new generations will have a better understanding of what cultural and environmental values have been hurt over time. Similarly, TURMEPA educates young children and teachers to reduce sea pollution (TURMEPA 2013). These organizations achieved success; however, those achievements were relatively small in scale. In the 2000s, there were and have been projects on preventing the building of dams that would dislocate the local population and harm cultural history—for instance, the campaign against the Ilısu Dam for the preservation of Hasankeyf—and limiting the consumption of genetically modified food. Despite their significant promise, these developments are not enough to categorize Turkey as a country with high levels of environmental awareness. On the contrary, they underline its shortcomings because of two reasons: the campaigns raised were against the government policies and protests against many dam projects have not been able to affect government policies in favor of local will.

Reaching an unprecedented level in the 2000s, the Turkish governments have almost always prioritized economic goals over environmental concerns. Hande Paker, a sociologist, indicates that the economic development policies of the Turkish state constitute its red lines; in fact, those policies are the major factors that result in environmental degradation and damage that cannot be repaired (Paker 2013). In fact, the web site of the Turkish Ministry of Environment confirms that Turkey is willing to contribute to solutions for environmental problems by taking into account its national interests, socio-economic position and priorities for development (Türkiye Cumhuriyeti Dışişleri Bakanlığı 2013).

The literature on the relationship between local governance and the implementation of RE or environmental projects in Turkey is limited; however, examples from other countries strongly indicate that more decentralized government structures or in cases where the central government is not powerful enough to control local policies, projects related to the preservation of the environment flourish more easily. Miranda Schreurs provide examples from California, Japan and Germany. In the California case, the state has been a critical agenda setter on a number of fronts by establishing and Air Pollution Control District and setting the first statewide air quality standards in the 1950s. In comparison, the Tokyo metropolitan government led the national government in the establishment of numerous pollution control policies, as evidenced by the controls imposed on factory pollution, smoke and noise (Schreurs 2008, p. 347). The German city of Freiburg, a stronghold of the Green Party is one of the most eco-friendly cities in the world, rejected the nuclear power in the 1970s, adopted energy efficiency measures and can easily be announced as the leader and role model of the extremely high level of commitment to environmental protection and RE in Germany today. Schreurs indicates that among these examples Germany is faced with the fewest restrictions (Schreurs 2008, p. 352), which may have resulted in an exemplary RE performance. With its highly centralized politics, China appears to be a counterexample at first sight; however, due to the size of the country the central government has little control on the RE policies at the local level, therefore it does not emerge as an exception.

**Regulations, Laws, and the Market: Weak Links in the Turkish Energy Sector**

The regulations and laws offered by Turkey along with the market structure for RE constructs a barrier for investors in the RE sector. There are three problems related to this issue. First, the Turkish energy sector has started to become competitive only in the beginning of the 2000s with private sector coming to the scene fairly recently. Second, the laws regarding the implementation of RE have been ratified in the 2000s; there is still no legal

framework for some sectors, such as solar energy. Third, the laws created for the benefit of the RE sector are in fact textbook reforms and do not offer as lucrative opportunities as they should.

Turkey has experienced decades of quasi-privatization—as in the cases of build-operate-transfer, build-own-operate and transfer of operating rights schemes—with guarantees from the Treasury. Although promising, this method was at times not conducive to improve the worsening fiscal situation of the Turkish economy. In addition, the Turkish economy has long suffered from a bureaucratic opposition from government owned utilities or labor unions to privatization so that they can maintain their privileged position in current public utilities. In parallel to the government, the Turkish society has frequently opposed privatization based on economic nationalism. To illustrate, the constitutional court of Turkey issued a series of rulings in 1994 and 1995 making the privatization almost impossible to implement in electricity industry (Erdoğdu 2007, p. 5). Erdoğdu indicates that the Electricity Market Law (EML, No. 4628) emerges as a milestone in the Turkish electricity sector, as it is aimed at establishing a financially strong, stable, transparent and competitive electricity market (Erdoğdu 2007, p. 9). In a similar regard, other experts believe that the actual beginning of the RE policy was the definition of RE sources in the decree of the Modification of the License Regulation in the Electricity Market in 2003; before then there was no national RE policy and few incentives existed to promote market deployment of RE (Koyun 2007, p. 36). The reason behind poor performance in wind and solar sectors is strongly connected to the state's long-lasted hegemony in the RE sector which did not let greener forms of RE flourish.

Turkey has joined the RE game significantly late in terms of the ratification of the appropriate laws. In fact, all the laws that are part of the Turkish energy sector legislation have been created and updated in the 2000s. In contrast, many developing and developed nations had already established their RE laws and facilities well before the indicated time. In

comparison, the Turkish government has passed laws to increase the share of RE in total energy supply (for an example see "Law on Usage of Renewable Energy Sources as Electricity Energy Production, 2005 and 2011, and “Geothermal Sources and Natural Mineral Water Law”). Nevertheless, the fact that Turkey does not have desirable performance in solar, wind and geothermal energy shows that these laws have not been conducive to more RE investment, at least until now. Erdoğdu confirms that Turkish RE laws have a "textbook" nature (Erdoğdu 2007, p. 1). The proportion of foreign RE companies in the Turkish market is extremely low, which proves that the energy reforms were not able to attract them despite the high potential of economic growth. In the case of environmental laws, however, there is an entirely different perspective. In fact, the 1983 Turkish Constitution is the first constitution to have announced environment as a right of the citizen and emphasized the aspects of the environment to be protected. In comparison to Europe, a region with the world’s most strict environmental regulations, Turkey’s environmental legislation is surprisingly well developed; however, Turkey lacks the administrative capacity to put these regulations into practice and also suffers from the dilemma between economic development and environmental protectionism (Adaman and Arsel 2008). This situation is also combined with the weak level of democratization in Turkey that has not yet envisioned mechanisms to improve the public participation in environmental policy making. All these factors undermine the potential success of the Turkish environmental law.

The Turkish government has announced relatively ambitious RE goals for the near future and 2023. As indicated, the Turkish government is primarily interested in the number of hydropower plants and hydropower may be regarded as the only type of RE actively supported by the Turkish state. In fact, the Ministry of Energy and Natural Resources indicates that taking benefit of all of Turkey’s hydroelectric potential is one of the goals that the government is willing to achieve until 2023 (Enerji ve Tabii Kaynaklar Bakanlığı 2013).

In a promising manner, the Ministry has recently announced a strategic plan for 2023, in which it indicates the goal of raising electricity produced by renewable sources to 25% by 2020 (ibid.). The percentage of biodiesel as an additive in fuel oil will be at least 3% until 2016 and the ratio of domestically produced bioethanol will be at least 3% by 2014. In comparison, Turkey's 2023 energy targets include the reduction of $CO_2$ and some energy efficiency measures with a vague explanation on RE: "usage of more renewable sources."

The Turkish government offers several incentives for the investors of RE; however, there are few types of them and the financial incentives are not enough to result in considerable attraction. Turkey only offers feed-in tariffs and biofuel obligations, whereas a successful country like Germany also offers fiscal incentives and public loans, including capital subsidies, tax credits for investment and reduction in sales.

**Renewable Energy Performance and Conventional Energy in Turkey**

Turkey has quite low amounts of oil and almost no natural gas reserves. Turkey's 270 million barrels of proven oil reserves are enough to satisfy only 8% of oil needs (EIA 2013). Thus, significant amount of oil and natural gas are imported from the Middle East, Iran, Russia and few other sources. Turkey is dependent on oil and natural production as primary energy supply and to produce electricity; therefore, it is considerably dependent on outside sources, which undermines the national security. In 1970, 77% of the total primary energy consumption was met by indigenous energy sources, this percentage decreased to 28% in 2003 (Geni 2011, p. 5). In comparison, the share of RE sources in primary energy consumption decreased steadily in the years from 1980-2006; RE could meet 35% of the energy need in 1970, whereas it covered only 10% in 2010 (Geni 2011, p. 8). Together with increasing energy consumption, air pollution gives a justifiable ground to develop more RE, especially for the cases of geothermal energy, solar energy and hydropower (Kaygusuz 2003, p. 1671; Kaygusuz and Sarı 2003, p. 459; Ocak et al. 2004, p. 845; Kaygusuz 2010, p. 1075;

Saygın and Çetin 2011, p. 26; Öztürk et al. p. 605). Despite being energy poor, Turkey has hitherto shown little interest in taking advantage of its domestic potential, both RE and other possible conventional sources through exploration. This contrast and reluctance makes the Turkish RE performance more dramatic.

Hydroelectric power plants constitute the main focus of RE investment in Turkey and the majority of the large business groups are interested in investing in hydropower. In fact, the first electric generator in Turkey was a 2 kW dynamo connected to the water mill installed in Tarsus in 1902 (Erdoğdu 2007, p. 5). A report by PricewaterhouseCoopers tells that as of 2012 there are 832 licenses entitled for the production of hydropower to private companies, in which case the largest power plants remain outside of the government's privatization portfolio. As of 2012, the operational total capacity of hydroelectric power plants is 15,275 MW, being a further 14,295 MW under construction (PwC 2012). The importance of hydroelectric power within RE cannot be disregarded. It may affect the environment significantly less than conventional sources in the long run, yet its promises are not as "green" as those of solar and wind energy. The government's strong support in this sector shows another deficiency in Turkish environmental governance.

Wind power emerges as a more favorable alternative. The first wind power facility in Turkey was commissioned in 1998 (Geni 2011, p. 5) and the regulational framework has only started to give considerable motivation to investors in the 2000s. Nevertheless, the feed-in tariffs and the spot market prices for electricity along with financing and running costs put great difficulty on the investors interested in the wind energy sector. In fact, many variables such as the wind speed and the location, the electricity produced in different times of the day (such as peak hours), different construction costs and the distance to the substation affect the price paid by the state for the electricity—all of which make the wind power investment highly risky. In the same regard, there are bureaucratic obstacles that investors are faced with

before they implement their investment goals, as in the case of the wind survey analysis that is jointly conducted by the Ministry of Energy and Environment and The Scientific and Technological Research Council of Turkey (TÜBİTAK) (PwC 2012). In addition to some foreign companies, large Turkish business groups, most importantly Zorlu Enerji, are interested in investing in wind energy. As a more miserable case, the solar PV sector suffers from the lack of regulatory framework (that has been absent until 2013), low feed-in tariffs, bureaucratic obstacles and the almost complete lack of local producers. However, in contrast, thermal solar systems are widely used in Turkey and Turkey ranks the 2$^{nd}$ in the world with a total capacity of 7.8 GWh in 2008 following China (ibid.).

Turkey is the richest country in terms of geothermal resources in Europe, yet it only takes advantage of geothermal energy to a limited extent. The geothermal power capacity projection is around 2,000 MW with 114 MW of this capacity being in operation and 255 MW being under construction (ibid.). Geothermal energy offers lucrative opportunities for investors; however, the available sources still remain rather limited. In parallel, biomass sector also offers less potential than hydro, solar and wind power and the investments are comparably low—80 MW in operation and 55 MW under construction. In addition, as solar energy, the biomass sector lacks adequate regulatory framework. Other types of RE, such as tidal and bioethanol are currently employed in a highly limited manner. An overview of the Turkish RE sector reveals three main problems. First, there is more financial and technological support for an RE sector, hydropower, which is environmentally less friendly. Second, an abundant and cheap source like geothermal energy is not employed to a desirable extent. Third, newly developing and the greenest types of RE, wind and power, are not paid adequate attention, both in terms of the regulations and the financial support.

The production of RE equipment is relatively limited in Turkey. There are limited number of firms solely focusing on manufacturing RE equipment and some of those

companies only produce small scale, noncommercial equipment. In parallel to the energy production front, the Turkish government endorsed The Turkish Electromechanic Industry Company—an affiliate of the Ministry of Energy and Environment that concentrate on the production of all kinds equipment necessary for hydropower plants. In contrast, wind energy sector suffers from a lack of local producers manufacturing high capacity turbines with two Turkish companies producing turbines with up to 1,650 kW capacity (ibid.). A short overview of the Turkish RE sector along with the feed-in tariff rates is provided below:

**Table 11: Short Overview of the Turkish Energy Sector**

| | |
|---|---|
| **Are there environmental NGOs?** | Yes, they are relatively weak. They are against the government policies and government does not pay much attention to them. |
| **Green parties** | Yes, miniscule in power. |
| **Are there RE goals?** | Yes, very modest. |
| **Is there a competitive RE market?** | Not really, there are laws for sustaining a competitive RE market. |
| **Renewable energy and private sector** | Many players in the hydropower sector, not many in others. |
| **Most developed RE sector** | Hydropower and solid biomass |
| **Are there RE equipment producers?** | Yes, few in number and production scale. |
| **Feed-in tariffs** | |
| Hydroelectric | $9.6 cents/kWh |
| Wind | $11 cents/kWh |
| Geothermal | $13.2 cents/kWh |
| Biomass | $18.9 cents/kWh |
| Solar PV | $20 cents/kWh |
| Concentrating Solar | $22.5 cents/kWh |
| Source: Renewables 2011 Global Status Report (2011) | |

## BRAZIL: A PASSIONATE INVESTOR IN RENEWABLE ENERGY

In strong parallel to Turkey, Brazil is a developing country with acceleratingly increasing demands for energy. To continue its economic development and to decrease its energy dependency on foreign nations, Brazil has significantly relied on domestic conventional and non-conventional sources starting from the 1970s. Both the Brazilian society and its governments, especially the democratically elected politicians, have been well aware of the country's need to invest in energy. Brazil has a strong tradition of RE and the political as well as the societal desire to expand the share of RE has been growing despite Brazil's huge conventional potential, especially in the case of off-shore oil.

Brazil's experience with RE in the second half of the 1970th century reveals that RE, especially biomass, was a source of attraction for the Brazilian governments. During the military rule from 1964 to 1985, RE investments emerged as a method of improving national security. In contrast, in the democratic period that came afterwards there have been a stronger emphasis on human security and an increase in the political strength of advocates for environmental protection, both within and outside of the government. In contrast to Turkey, the greater importance attached to RE by Brazilian politicians and society manifests itself in three ways. First, the Brazilian governments have been paying significantly higher attention to RE than most of the developing countries beginning from the 1970s; in parallel, there are laws that date back to the 1980s and regulate energy sector in a comprehensive manner. Second, incentives provided by the politicians for the formation of NGOs increased the power of environmental groups to an extent that almost does not anymore allow the governments to take any economic or environmental actions for the disadvantage of the security of its citizens. In fact, the increasing power of environmental organizations has been criticized as excessive by the private sector and other forces of the government (IAEA 2006, p. 12). Third, Brazil has a federal structure, which gives local governors ampler opportunities in making environment or energy related decisions at the local level.

Past experiences indicate that environmental NGOs have had a strong role in Brazilian politics in the 1970s. International Atomic Energy Agency (IAEA) states that Brazilian NGOs have been defending environmental assets since the 1970s and have an important role in environmental licensing (IAEA 2006, p. 186). Alonso and Clemençon indicate that the biggest environmental organizations in Brazil have become professional bureaucracies—which led to higher efficiency and to a focus on project implementation and management (Alonso and Clemençon 2010, p. 249). NGOs like Fundação SOS Mata Atlântica, Greenpeace Brasil, World Wide Fund for Nature (WWF) and Instituto do Homem e Meio Ambiente da

Amazônia have been influential in environmental politics. In comparison, NGOs have been highly successful in diagnosing the existing or potential sources of environmental degradation, raising awareness about them and forcing the government to change policies when needed. For example, Greenpeace had an important role during the licensing process for building Belo Monte Dam (a large hydropower plant project) by taking aerial photos related to the project. In the end, using the evidence provided by Greenpeace, the Federal Public Prosecutor filed several law suits against Belo Monte Dam and the project stopped (ibid.). In a similar regard, the basis of environmental groups in Brazil is much larger than those in Turkey; for instance, groups like grassroots rural unions and Catholic Church representatives also proved themselves as passionate activists, which shows that environmental protectionism finds more significant societal response. Thus, in contrast to the Turkish case, the campaigns in Brazil have been larger in scale and more frequently found positive response from state authorities.

Brazil is in strong need of energy due to its developmental concerns; nevertheless, high level Brazilian bureaucrats frequently show strong sympathy for environmental causes. Thus, economic development and environmental protectionism go hand in hand. To illustrate, the former Brazilian president Lula da Silva had an "environmentalist" Minister of Environment in his cabinet, Marina Silva. Lula da Silva indicated that Brazil has a RE target for 2020 and that Brazil has to make changes to improve its energy matrix that is already one of the cleanest energy matrices in the world and has also made the commitment to reduce the deforestation of the Amazon rainforest by 80% by the year 2010 (Johnson 2001, p. 199). In the same regard, Brazil is internationally recognized as a centre of major environmental events and hosted the UNCED in 1992 in Rio de Janeiro, which produced a set of strategies for sustainable development into the 21$^{st}$ century (IAEA 2006) and Brazil played a key role in the negotiation of the Kyoto Protocol (Johnson 2001).

The federal structure of the Brazilian state has allowed some states to take greater incentives in dealing with environmental or energy-related problems. The 26 states and the Federal District have broad authority to issue laws that are either complementary or more stringent than other states in Brazil. Some economically important states, such as Minas Gerais, Sao Paulo, Rio de Janeiro and Santa Catarina have well-developed environmental laws, which are notably progressive, as in the case of Sao Paulo (EIATrack 2013). Furthermore, Brazil has a large area; therefore, the cost of electricity is quite high in communities that are far from the populated regions and electricity plants. In this regard, Brazil has taken a number of steps to encourage solar PV adoption and has eliminated sales taxes on solar cells and modules (IAEA 2006, p. 234). This situation gives local communities a considerable authority in producing their energy.

**Regulations, Laws, and the Market: A Long History of Success**

Brazil has considerably better regulations than Turkey, when it comes to the protection of the environment. Brazil adopted environmental laws in the beginning of the 1980s: a federal law issued in 1981 led to the creation of the National Environmental Policy (IAEA 2006, p. 145). In comparison, Brazilian governments issued additional laws that created the main framework for environmental protection in the 1980s. Thus, environmental awareness became an issue much earlier than it did in Turkey. Similarly, the way the laws are written put a much greater emphasis on the humane aspect of security. To illustrate, according to a law issued in 1988, all individuals have right to enjoy an ecologically balanced environment, considered as a common use asset and essential to a healthy quality of life (latinlawyer.com 2013). Another characteristic of the Brazilian environmental laws is that they encompass many different aspects of potential environmental degradation, such as oil pollution, gas emissions and biosafety of genetically modified products. Therefore, environment is protected

in a way that gives highly little room for possible environmental degradation to remain unpunished.

Brazil's current laws on RE production data back to the beginning of the 2000s; thus, they are slightly older than Turkish RE laws. More importantly, these laws offer stronger regulations and take environmental protection more seriously into consideration. As an example, considering that RE generates lower environmental impact, the monetary environmental compensation fee due to a federal law shall equally be lower. Second, Brazilian laws are aimed at providing incentives to investors who choose to invest in regions with low level of RE deployment and offer a variety financial incentives for potential RE investment (latinlawyer.com 2013). Moreover, the Brazilian political system created several environmental agencies at the federal level that have considerable autonomy in the regulation of environmental and energy politics. To illustrate, along with others, Brazilian Institute for Environment and Renewable Resources (IBAMA) is in charge of applying environmental statutes and regulations and executing the environmental permitting of activities in strategic locations and Chico Mendes Institute for Preservation of the Environment and Biodiversity (ICMBio) is in charge of management and enforcement of environmental policies in federal protected areas (ibid.).

The privatization of the energy sector in Brazil gained momentum in the 1990s under the government of Fernando Collor. By the end of the 1980s, polls indicated that the Brazilian society was dissatisfied with many aspects of public services and there was a fertile ground for privatization. Nevertheless, Collor was able to start the "National Privatization Plan" after overcoming substantial political opposition within congress, from labor unions, and from private firms that benefited from the state's role in the economy. The laws implemented starting from 1995 allowed the oil sector to privatize. In the case of electricity sector, most importantly hydropower, the Brazilian government recognized the need of reform in the early

1990s and starting in 1993 have altered the legal framework to facilitate privatization and private investment. Under President Cardoso, Brazil issued laws that allow private firms to provide public services through concessions and in 1996 created the energy regulator, ANEEL which monitors the sector, authorizes new concessions, establishes tariffs and conducts auctions. There are still concerns in Brazil because of electricity being produced to a large extent by the state and competition being highly limited; nevertheless, a comparison with Turkey reveals that Brazil was able to build a framework for privatization in the energy sector at least half a decade earlier than Turkey. In comparison, despite oppositions from labor unions and some state organs, economic nationalism against privatization appears to find a much lower attraction in Brazil.

Starting from the 1980s, Brazilian governments have set comprehensive goals for RE development and the protection of environment; thus, in contrast to Turkey, policies were not only limited to preservation and efficiency. Since the 1930s, Brazil has devoted significant public resources to developing a broad modern energy distribution system and nationwide commercial energy markets. Federal policies regarding energy efficiency have been in place since 1985 (IAEA 2006). In this regard, Brazil has set two main goals. First, after the UN conference on Climate Change, Brazil announced a national target for reducing greenhouse gas emissions to 1990 emissions levels—which Turkey did not. Similarly, Brazil aims to increase the share of renewables in electricity production to 70% by 2020 (Ernst and Young 2012). Thus, the goals are directed towards RE implementation and significantly more assertive than the Turkish goals. In addition, Brazil offers tax incentives, public investment and loans, and feed-in tariffs for RE investment. Similarly, it implemented mandatory contracting of RE (RE portfolio). On the whole, Brazil has an incentive system that is better-rounded than Turkey's incentive options.

**The Renewable Energy Performance and Conventional Energy in Brazil**

Brazil is a highly rich country on offshore oil sources and also possesses a significant amount of natural gas, yet it is one of the most successful countries in employing RE among developing nations. The emphasis on employing indigenous energy sources to improve national security started in the 1970s in parallel to the RE development. Brazil has oil reserves estimated at 12.6 billion barrels and is expected to become oil-sufficient in very near future (EIA 2013). Brazil is comparably rich in RE potential; however, following strongly rational security concerns, Brazil has hitherto chosen to invest in both conventional and non-conventional energy simultaneously (IAEA 2006).

Hydropower and biomass are the two most widely used types of RE in Brazil. Both large and small hydropower is used extensively; Brazil has one of the world's largest hydroelectric dams, such as the Itaipu facility on the Parana River and significant potential to put other large hydropower facilities into use (EIA 2013). In comparison, small hydropower sector is dominated by private actors. The first private small hydro project was completed in 1996 by Energisa and the sector also attracted attention by foreign investors. Some firms in Brazil, such as Lafarge, have chosen to invest in small hydro in order to satisfy their energy needs. Brazil has two problems regarding hydropower development; first, Brazil's hydropower potential is located far away from population centers and this causes problems with distribution. Second, there is opposition between the Brazilian environmental groups and the Brazilian state which has traditionally supported hydropower.

Brazil has world-wide reputation of producing bioethanol and bagasse (the residue left after extracting juice from sugar cane), a program that was first launched in 1975. In comparison, many rural parts of Brazil are still dependent on wood for energy. More than 10% of total energy supply comes from bioethanol and bagasse, and another 10% from wood (IAEA 2006, p. 11). Nevertheless, as in the case of hydropower, bioethanol does not

constitute one of the "greener" sources of RE, as it requires large areas and potentially forest land for cultivation of the sugarcane and is not emission-free—despite being the emission levels much lower compared to oil. Similarly, bioethanol may become subject to large fluctuation in supply, as its production is strongly dependent on the level of sugarcane production. In similar regard, wood consumption may be sustainable; nevertheless, it frequently leads to deforestation.

The first modern wind farm in Brazil was completed in 1996 and the sector took a major leap in 2006 with the completion of a 150 MW wind-farm in Palmares do Sul and Osorio, which was built by the Spanish RE company Elecnor. Brazil has significant wind energy potential and only around 0.05% is exploited so far, which is a source of foreign attraction. Nevertheless, government is highly passionate on developing it further and more than 400 firms are interested in joining the auctions held by the Brazilian government. In addition, due to Brazil's accelerating interest, Wobben Windpower—a German producer of wind turbines—has set up two manufacturing plants in Brazil (IAEA 2006). In comparison, solar power is deployed across the country, yet the applications are quite limited and private sector has not shown adequate interest so far. In contrast to Turkey, wave energy was able to achieve limited generation in Brazil with the construction of a 100 kW wave energy plant in Brazil's northeast coast.

An overview of the Brazilian RE sector reveals three major successes and relatively minor problems. First, Brazil has chosen to implement RE extensively in fairly distant past and the discovery of rich oil sources has not curbed the development of RE. Second, Brazil continues the implementation of RE in a much more environmentally concerned manner despite the wishes for economic growth. Third, more environmentally friendly RE sectors have fairly successful regulational frameworks. In contrast, less green energy, such as hydropower and thermal energy produced by biomass is still used widely.

Brazil has a high number of firms engaged in the production of RE equipment. To illustrate, there are more than twenty producers of solar power equipment, most of which undertake significant R&D, as in the case of PM Service producing photovoltaic cells. In comparison, there are around five players in the wind turbine manufacturing which produce systems for small turbines (energy.sourceguides.com 2013). As indicated above, foreign RE manufacturing firms have strong interests in expanding in and exporting to the Brazilian market. A short overview of the Brazilian RE sector along with the feed-in tariff rates is provided below:

**Table 12: Short Overview of the Brazilian Energy Sector**

| | |
|---|---|
| **Are there environmental NGOs?** | Yes, they are highly strong. They occasionally work with the government. Government pays great attention to them. |
| **Green parties** | Sustainability Party founded in February 2013. |
| **Are there RE goals?** | Yes, ambitious. |
| **Is there a competitive RE market?** | Yes, to some extent. State still has large control. |
| **Renewable energy and private sector** | Many players in the hydropower and wind sector. |
| **Most developed RE sector** | Hydropower and biomass |
| **Are there RE equipment producers?** | Yes, many in number, but small scale production. |
| **Feed-in tariffs (PROINFA Program, N/A since 2010)** | |
| Small hydro | $9.6 cents/kWh |
| Wind | $18.4 cents/kWh |
| Biomass | $7 cents/kWh |

Source: IAEA (2006)

## A COMPARATIVE EVALUATION OF BRAZIL AND TURKEY'S RENEWABLE ENERGY PERFORMANCE

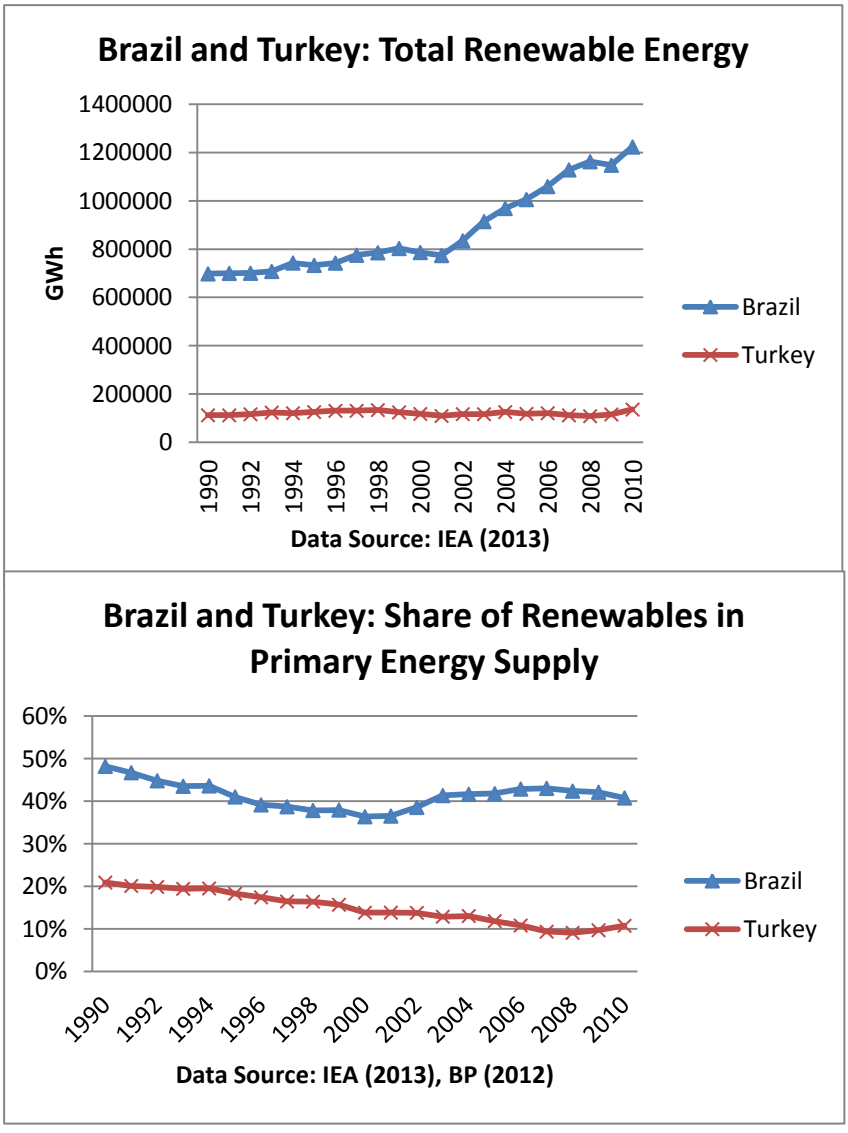
Brazil outperforms Turkey in terms of the share of RE in its primary energy supply. As told above, Brazil's superiority does not come from its RE potential and the appropriate methods to take advantage of them, but the favorable approach of the state, non-governmental bodies and the society in general to developing RE and advocating for the preservation of the environment. In the 1990-2010 period, the share of RE in primary energy supply decreased from 48% to 41% in Brazil and 21% to 11% in Turkey (IEA 2013). In the Brazilian case, the decrease in the share of RE did not result from a change in attention paid to RE, but the growth of energy needs, especially that of industrial sector which cannot be satiated through

non-conventional sources of energy. In the Turkish case, however, significant new investments were relatively few in number and the need of energy grew acceleratingly too. EIA forecasts that energy dependence on natural gas and renewable will grow as industrial production continues to rise, yet the pace of growth for natural will be far greater—with oil having the lowest level of growth in the predictions (EIA 2013). Brazil and Turkey employ a fairly share of renewables relative to other countries in the world.

A comparison between two states for the 1990-2010 period shows that solid biomass and hydropower evidently dominates the RE market surpassing all other RE sectors like wind and solar energy. In fact, in this period the share of hydropower increased from 30% to 33% in Brazil and 21% to 38% in Turkey (IEA 2013). On the other hand, the share of solid biomass changed from 70% to 66% in Brazil and from 75% to 38% in Turkey respectively. Taking other sectors into consideration, Brazil is one of the leaders in producing biofuels and biogases worldwide, whereas Turkey is a leading player in geothermal energy that constitutes 17% of its RE in 2010. The large share of biomass and hydropower in the 1990-2010 period is due to three factors. First, many different types of RE have only recently been equipped with technology that make them feasible for investment; for instance, the investments for energy started to become financially rational only in the late 1990s and solar photovoltaics is still too costly for many countries to pursue. Secondly, especially in the Brazilian case, renewables constitute a large of energy supply and therefore makes other sectors, such as wind energy disappear in the figures despite the promising advancements in this area. Third, solid biomass that includes components like firewood and animal dung are frequently employed in developing countries that have large rural areas with little to no access to energy networks. The indicators on energy and the share of RE is provided below:

| Table 13: Energy Figures and Share of Renewables, Brazil and Turkey | | | | | |
|---|---|---|---|---|---|
| **Years** | **1990** | **1995** | **2000** | **2005** | **2010** |
| **Brazil** | | | | | |
| **Consumption** | | | | | |
| Mtoe | 124.54 | 153.74 | 185.98 | 206.96 | 257.97 |
| Total (GWh) | 1448151.26 | 1787642.01 | 2162556.61 | 2406507.34 | 2999671.82 |
| Total Renewable (GWh) | 698086.92 | 733211.56 | 786429.99 | 1005602.67 | 1223363.00 |
| **Renewable Share** | 0.48 | 0.41 | 0.36 | 0.42 | 0.41 |
| **Turkey** | **1990** | **1995** | **2000** | **2005** | **2010** |
| **Consumption** | | | | | |
| Mtoe | 46.2 | 59.1 | 73.4 | 86.0 | 108.8 |
| Total (GWh) | 537788.66 | 686947.22 | 853033.34 | 999540.25 | 1265461.09 |
| Total Renewable (GWh) | 112370.10 | 125602.54 | 117873.80 | 118232.65 | 135866.38 |
| **Renewable Share** | 0.21 | 0.18 | 0.14 | 0.12 | 0.11 |
| Source: IEA (2013), BP (2012) | | | | | |

*Figure 1: Total Renewable Energy and Share of Renewables, Brazil and Turkey*

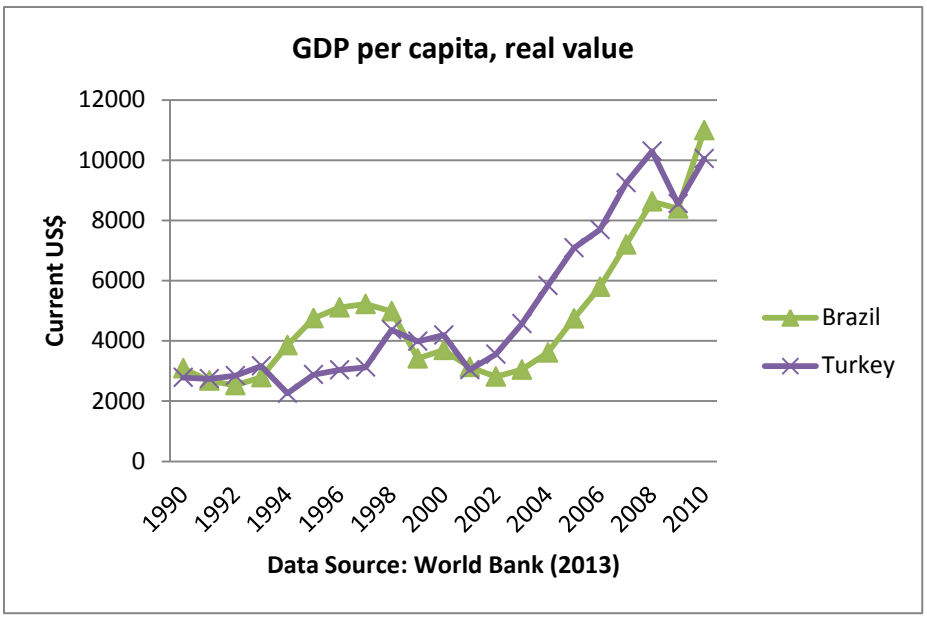


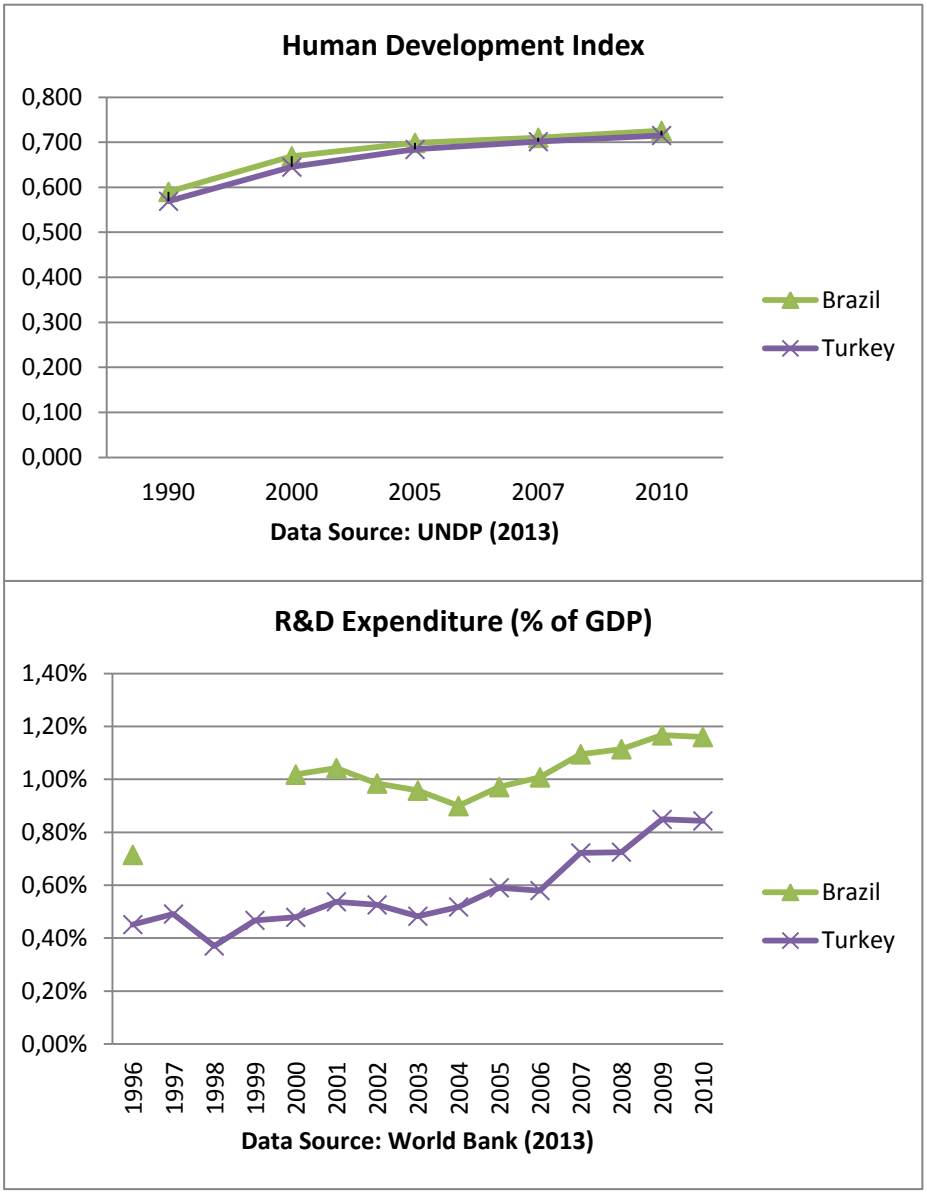
| Table 14: Different Types of Renewable Energy, Brazil and Turkey | | | | | |
|---|---|---|---|---|---|
| Years | **1990** | **1995** | **2000** | **2005** | **2010** |
| **Brazil** | | | | | |
| Hydro | 0.30 | 0.35 | 0.39 | 0.34 | 0.33 |
| Wind | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Solar photovoltaics | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Solar thermal | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Geothermal | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Solid Biomass | 0.70 | 0.65 | 0.61 | 0.66 | 0.66 |
| **Turkey** | **1990** | **1995** | **2000** | **2005** | **2010** |
| Hydro | 0.21 | 0.28 | 0.26 | 0.33 | 0.38 |
| Wind | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 |
| Solar photovoltaics | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Solar thermal | 0.01 | 0.05 | 0.09 | 0.14 | 0.13 |
| Geothermal | 0.05 | 0.05 | 0.07 | 0.10 | 0.17 |
| Solid biomass | 0.75 | 0.66 | 0.64 | 0.52 | 0.38 |
| Source: IEA (2013) | | | | | |

Economic power and welfare politics have significant influence on the development of RE technologies and boosts the RE sector of a country. Taking income per capita, HDI and R&D budget into consideration, the Brazilian and Turkish cases confirm this hypothesis to a considerable extent. In fact, for the 1990-2010 period, Brazil has consistently achieved higher HDI scores than Turkey and the results show that Brazil proves higher performance in education, communication, sustainability and gender inequality, whereas Turkey has recently realized improvements in health and income. Both countries are classified as countries of high development level and Brazil is constantly ahead of Turkey by five to ten countries. In comparison, the R&D budget of Brazil has traditionally been much higher than that of Turkey. To illustrate, Brazil has devoted more than 1% of its GDP to R&D throughout the 2000s, whereas Turkey has not achieved the 1% mark yet. In contrast, the income per capita experience of Turkey and Brazil has been highly similar in the last two decades with Brazil surpassing Turkey in a considerable portion of the 1990s and Turkey getting ahead of Brazil in the late 2000s. The comparison of the economic and welfare performances:

| Table 15: Economics and Welfare Indicators, Brazil and Turkey | | | | | | | |
|---|---|---|---|---|---|---|---|
| **GDP per capita, PPP (current international $)** | | | | | | | |
| Years | **1991** | **1995** | **2000** | **2005** | **2010** | | |
| Brazil | 5349.76 | 6277.87 | 7016.62 | 8509.43 | 11180.29 | | |
| Turkey | 4538.31 | 5371.66 | 9262.02 | 11464.73 | 15829.77 | | |
| **GDP per capita (current US$)** | | | | | | | |
| Brazil | 2677.27 | 4751.07 | 3696.15 | 4743.27 | 10992.94 | | |
| Turkey | 2742.77 | 2879.25 | 4189.48 | 7087.72 | 10049.77 | | |
| Source: World Bank | | | | | | | |
| **HDI** | | | | | | | |
| Years | **1990** | **2000** | **2005** | **2007** | **2010** | | |
| Brazil | 0.590 | 0.669 | 0.699 | 0.710 | 0.726 | | |
| Turkey | 0.569 | 0.645 | 0.684 | 0.702 | 0.715 | | |
| Source: United Nations Development Program | | | | | | | |
| **Research and Development (% of GDP)** | | | | | | | |
| Years | **1996** | **2000** | **2002** | **2004** | **2006** | **2008** | **2010** |
| Brazil | 0.72 | 1.02 | 0.98 | 0.90 | 1.01 | 1.11 | 1.16 |
| Turkey | 0.45 | 0.48 | 0.53 | 0.52 | 0.58 | 0.73 | 0.84 |
| Source: World Bank (2013) | | | | | | | |

*Figure 2: Economics and Welfare Indicators, Brazil and Turkey*






Experts in welfare regimes confirm the difference in welfare politics between Brazil and Turkey. Sonia Fleury from Brazilian School of Public Administration and Business indicates that Brazil has been building a welfare system based on the principle of extending social rights to all citizens through universal social policies, especially to benefit the poor through improvements in social assistance, social insurance and education (Fleury 2011). Similarly, Brazil is often criticized for being an expensive welfare state, a system that could ultimately undermine the Brazilian economy (Economist 2013). In contrast, Mine Eder from

Bosporus University indicates that Turkey's welfare state has long been limited and egalitarian; strong family ties coupled with indirect and informal channels of welfare, as in the cases of agricultural subsidies and informal housing, characterized the system's non-universality (Eder 2010). To achieve desired goals, Turkey should approach RE as a public good like health care or education and seek ways to develop viable RE options commercially (Kaygusuz and Sarı 2003, p. 475). Other experts strongly criticize the inequality of the welfare system in Turkey from the labor perspective with less that 30% of Turkish women participating in labor force. In comparison, as indicated in the security section, academics focusing on the security aspect of international relations frequently express the energy aspect of welfare and having a sustainable source of energy is an indispensable component of human security. Indicators and qualitative sources imply that the Brazilian success in RE is strongly connected to the economics and welfare hypotheses. In this case, income per capita does not lead to any significance, but HDI and R&D emerge as explanatory variables for the explanation. Thus, economics and welfare indicators provide strong explanation for success in RE for Brazil and Turkey.

The group of indicators that focus on the environment does not provide a highly clear divide between Brazil and Turkey in contrast to the first group. In this case, evidence show that the $CO_2$ emissions per capita have been traditionally lower in Brazil than in Turkey, which could point at the success of Brazil in RE; thus, in 1990, Brazil and Turkey emitted 1,4 and 2,7 metric tons per capita respectively, whereas the figures for 2010 were 1,9 and 3,9 metric tons respectively. In comparison, the GDP per unit of energy use has been higher in Brazil in the 1990s and higher in Turkey in the 2000s, which does not explain the larger share of RE in the 1990-2010 period. In a similar regard, forest area has always been larger in Brazil due to the Amazon forest, and, similar to the share of RE in primary energy supply, there was a small decrease in the share of forest over the 1990-2010 period. Nevertheless, the

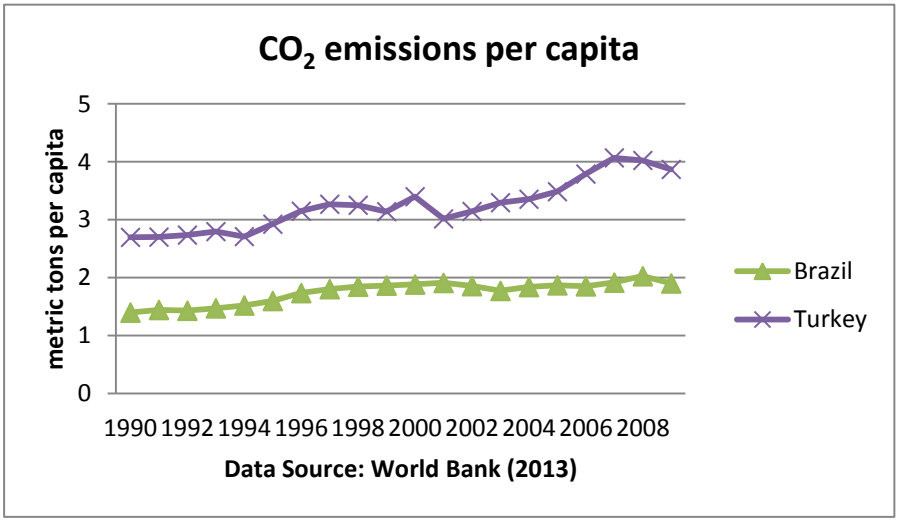
Turkish case witnessed a slight decrease in the share of RE over the last decrease along with a small increase in forest area.

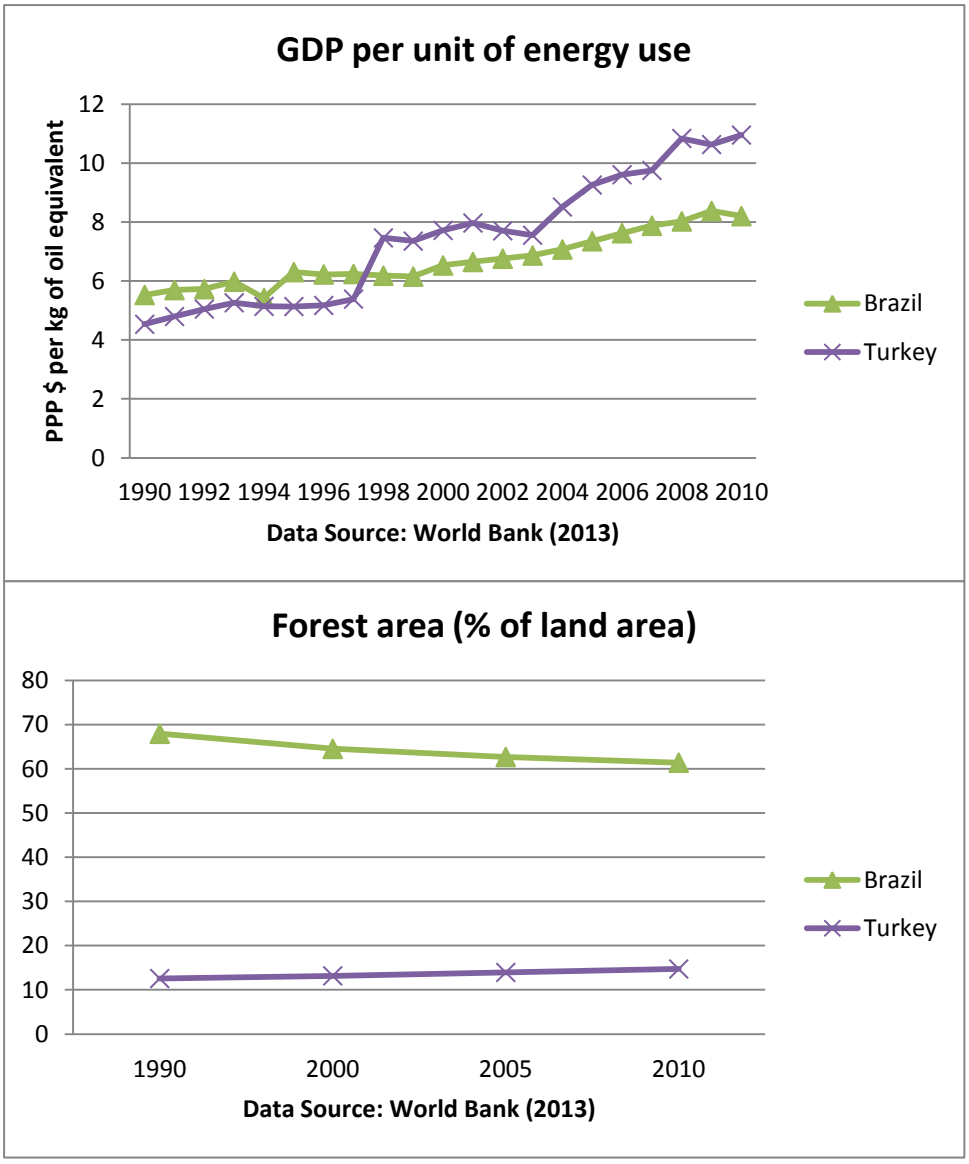
Brought forward in the introduction section, qualitative sources indicate that the Brazilian case is a much better example in terms of environmental awareness both in non-governmental and governmental circles. Similarly, preservation of the environment and nature is much more frequently debated in Brazil than in Turkey. On the whole, the hypotheses in this group provide a mixed result, with two hypotheses pointing at a possible confirmation of the Brazilian success in RE—$CO_2$ emissions and qualitative sources—and other two, GDP per unit of energy and forest area providing an unclear result, but not a clear rejection of the hypothesis. This result places the group of environmental indicators in a relatively weak position compared to the first group. An overview of the indicators is provided below:

**Table 16: Environmental Indicators, Brazil and Turkey**

| Years | 1990 | 1995 | 2000 | 2005 | 2009 | 2010 |
|---|---|---|---|---|---|---|
| **$CO_2$ emissions (metric tons per capita)** | | | | | | |
| Brazil | 1.40 | 1.60 | 1.88 | 1.87 | 1.90 | |
| Turkey | 2.69 | 2.92 | 3.40 | 3.48 | 3.87 | |
| **GDP per unit of energy use** | | | | | | |
| Brazil | 5.53 | 6.31 | 6.53 | 7.35 | | 8.21 |
| Turkey | 4.53 | 5.14 | 7.72 | 9.26 | | 10.95 |
| **Forest area (% of total land area)** | | | | | | |
| Brazil | 67.95 | | 64.54 | 62.71 | | 61.41 |
| Turkey | 12.58 | | 13.18 | 13.95 | | 14.73 |
| Source: World Bank (2013) | | | | | | |

*Figure 3: Environmental Indicators, Brazil and Turkey*






In the third group of hypotheses, security is taken into consideration. The possible effect of security concerns on the RE performance is evaluated using National Material Capabilities Index, energy imports (% of energy use), and remaining amount of conventional resources—oil, natural gas and coal. Despite the existence of qualitative sources arguing that Brazil has begun investing in RE to improve its national security by securing its energy supplies in the 1970s, the quantitative indicators from the 1990-2010 period do not show a highly strong trend in the same direction. In fact, high energy imports and lower levels

remaining conventional resources should cause an increase in the share of RE, as this would make a country less dependent on foreign powers.

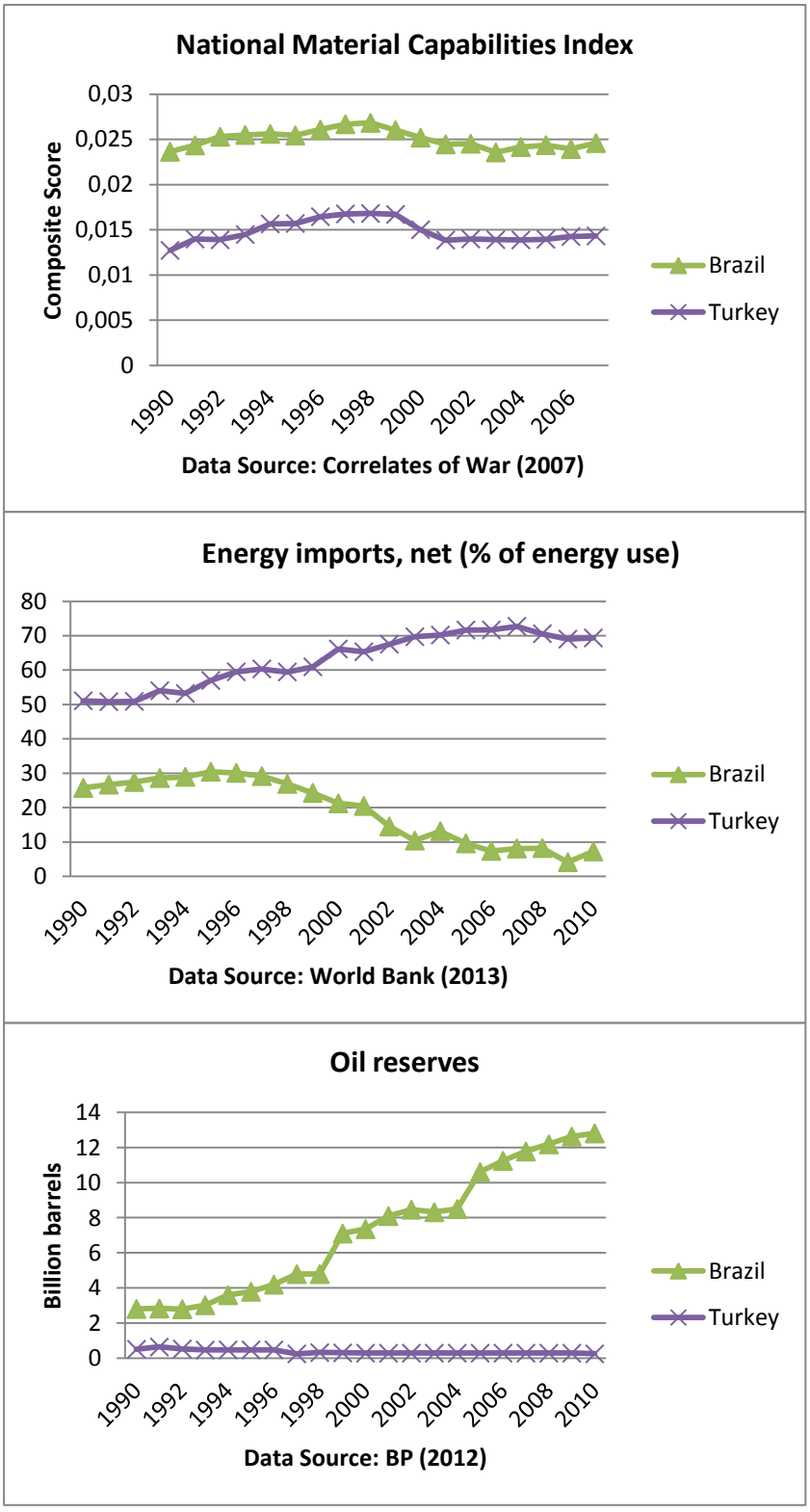
The Brazilian energy imports consistently decreased from around 26% to 7% over the last two decades and the Turkish energy imports increased from 51% to 69%. Although the share of RE decreased in both countries, Turkey has become more energy-dependent in the same period with Brazil becoming less energy-dependent as expected. In comparison, the Brazilian conventional energy reserves have constantly increased with new discoveries, yet the power of the Brazilian RE sector did not diminish as much; in the same vein, although not much present in the beginning, Turkish conventional reserves decreased slightly, but the dependence on foreign energy grew strongly. Coal proves to be a negligible source of conventional energy for both states. In contrast, National Material Capabilities Index proves more fruitful results with relatively lower levels of index levels corresponding to lower shares of RE and Brazil scoring higher than Turkey over the last two decades both in hard power and RE. Thus, weaker than the group of hypotheses focusing on the environment, two of the hypotheses confirm the success and failure of in Brazil and Turkey respectively, and the other two hypotheses do not establish any causality. An overview of the security indicators is provided in the table and the figure below:

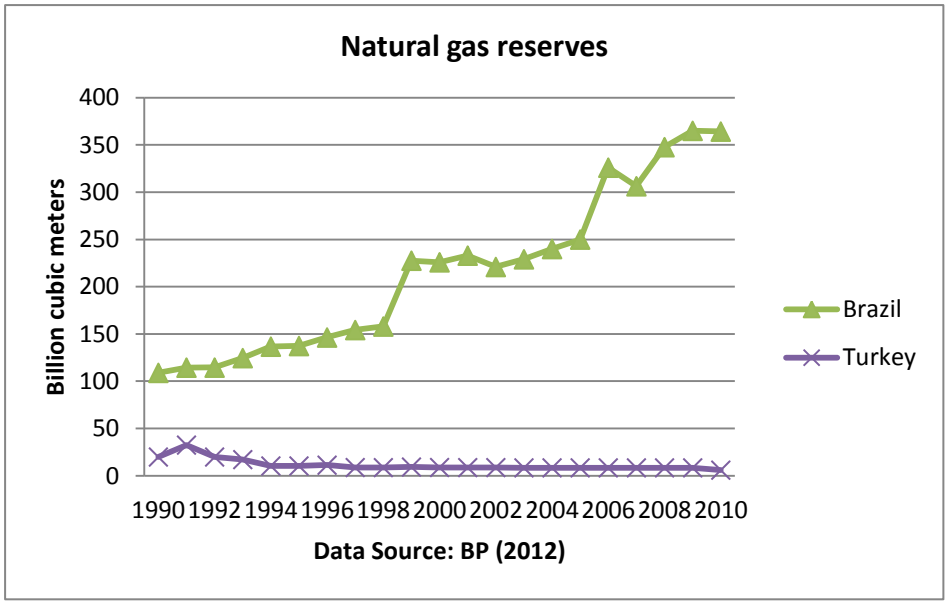
**Table 17: Security Indicators, Brazil and Turkey**

| **National Material Capabilities Composite Index Score** | | | | | | |
|---|---|---|---|---|---|---|
| Years | **1990** | **1995** | **2000** | **2005** | **2007** | **2010** |
| Brazil | 0.023635 | 0.025438 | 0.025197 | 0.024371 | 0.024597 | |
| Turkey | 0.012725 | 0.015700 | 0.015004 | 0.013953 | 0.014317 | |
| **Energy imports, net (% of energy use)** | | | | | | |
| Brazil | 25.72 | 30.44 | 21.24 | 9.58 | 8.09 | 7.25 |
| Turkey | 51.07 | 56.97 | 66.13 | 71.64 | 72.73 | 69.35 |
| **Remaining Resources** | | | | | | |
| **Oil (billion barrels)** | | | | | | |
| Brazil | 2.82 | 3.80 | 7.36 | 10.60 | 11.77 | 12.80 |
| Turkey | 0.52 | 0.49 | 0.30 | 0.30 | 0.30 | 0.26 |
| **Natural Gas (billion cubic meters)** | | | | | | |
| Brazil | 108.99 | 137.39 | 225.94 | 250.01 | 306.39 | 364.21 |
| Turkey | 19.96 | 10.51 | 8.89 | 8.50 | 8.50 | 6.09 |

| Coal (million tons) | 2011 |
|---|---|
| Brazil | 4559 |
| Turkey | 2343 |
| Source: Correlates of War (2007), World Bank (2013), BP (2012) | |

*Figure 4: Security Indicators, Brazil and Turkey*

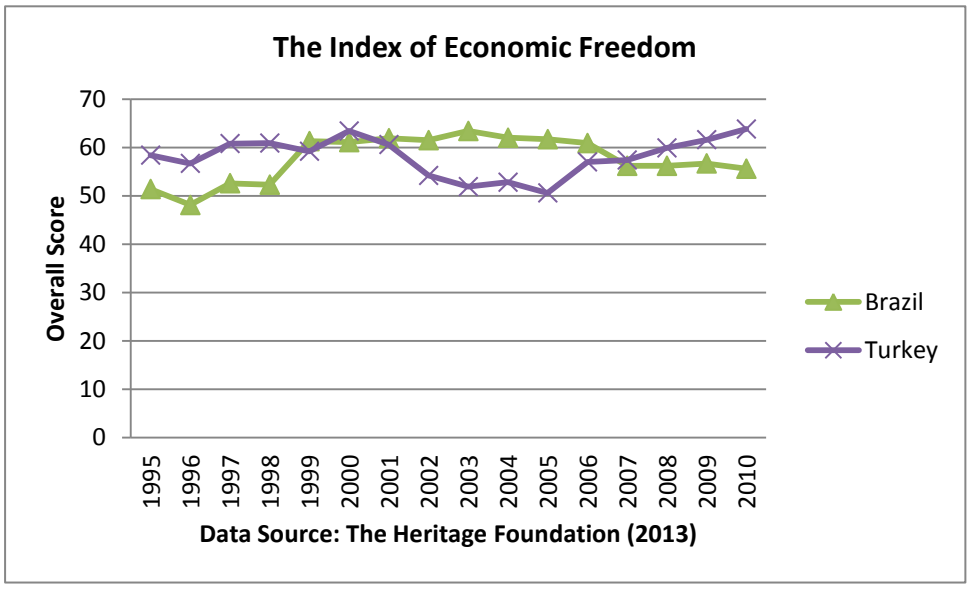


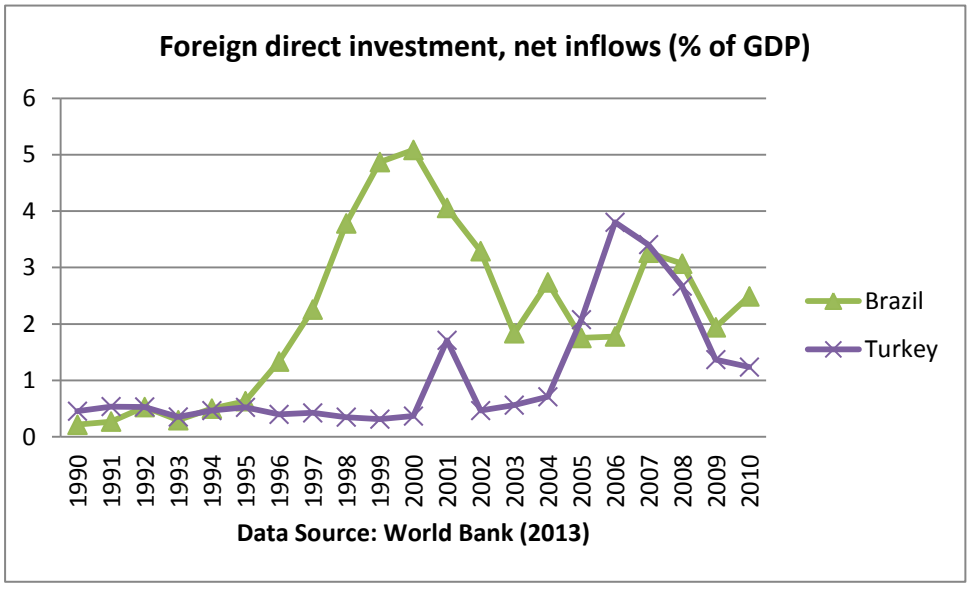


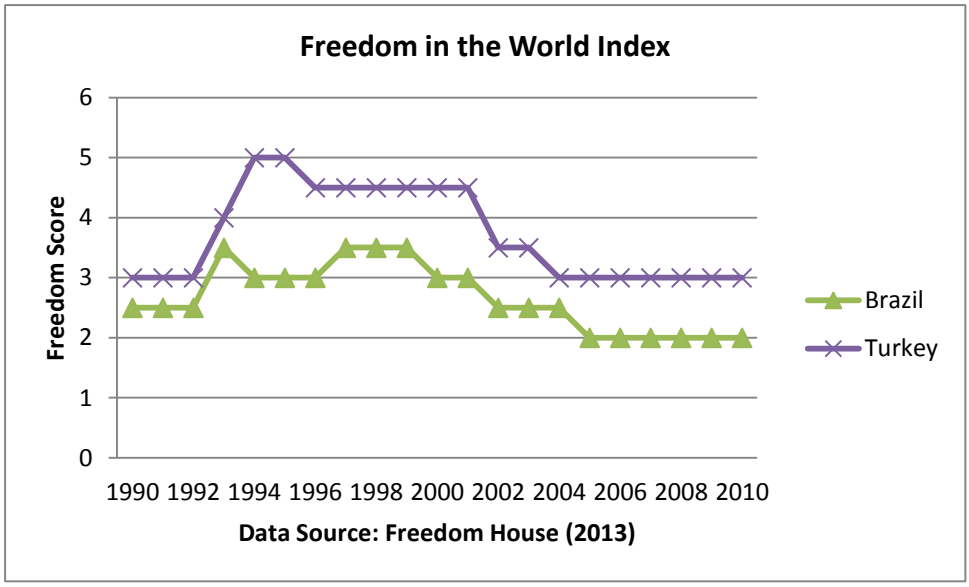

The proxies for a country's vision to invest in RE and its achievement in integrating with other countries are grouped under the "state prestige and globalization" hypotheses. In this case, indicators acknowledge that Brazil is a more "global" player than Turkey and therefore is likely to attract both domestically and internationally more investment for RE. The foreign direct investment (FDI) figures show that Brazil has almost always achieved higher percentages than Turkey in the 1990-2010 period with FDI ranging from around 0.2 to 5%. In contrast, Turkey scored between 0.4% and 3.8%, which is much lower than the latter figure in a great portion of the period. In addition, Brazil has always been a more democratic country in the last two decades, providing more press freedom and civil liberties, which could have contributed to a stable and protected business environment. Thus, between 1990 and 2010, Brazil's Freedom House scores were between 3.5 and 2, therefore partly free and free, whereas Turkey was always partly free, between 5 and 2. In contrast, the Index of Economic Freedom does not show a clear trend: Turkey was surpassing Brazil in the early 1990s, then Brazil got ahead of the game until the late 2000s; however, Turkey has been leading the race for the last few years. Hence, two out of three quantitative indicators point at the Brazilian success in RE:

| Table 18: State Prestige and Globalization Indicators, Brazil and Turkey | | | | | |
|---|---|---|---|---|---|
| **The Index of Economic Freedom (Overall score)** | | | | | |
| Years | **1990** | **1995** | **2000** | **2005** | **2010** |
| Brazil | | 51.4 | 61.1 | 61.7 | 55.6 |
| Turkey | | 58.4 | 63.4 | 50.6 | 63.8 |
| **Foreign direct investment, net inflows (% of GDP)** | | | | | |
| Brazil | 0.21 | 0.63 | 5.08 | 1.75 | 2.49 |
| Turkey | 0.45 | 0.52 | 0.37 | 2.08 | 1.24 |
| **Freedom in the World Index** | | | | | |
| Brazil | 2.5 | 3 | 3 | 2 | 2 |
| Turkey | 3 | 5 | 4.5 | 3 | 3 |
| Source: The Heritage Foundation (2013), World Bank (2013), Freedom House (2013) | | | | | |

*Figure 5: State Prestige and Globalization Indicators, Brazil and Turkey*






Researchers in the field believe that globalization has fundamentally changed people's and businesses' perception on Brazil. Baer and Rangel indicate that globalization increased the amount of FDI attracted by Brazil and the economy experienced an enormous growth (Baer and Rangel 2001). Hauge and Magnusson state that globalization has helped Brazil to transform itself from being a developing country to a middle-income nation with an increasingly important role in the world economy (Hauge and Magnusson 2012). For the case of Turkey, the positive effects of globalization on the Turkish economy appear to have been relatively more questionable. Timuçin Yalçınkaya indicates that Turkey has adopted the consumerism as a feature of globalization, yet traditional, small, family-run businesses and financial relationships still dominate (Yalçınkaya 2009). In comparison, Nilgün Önder asserts that the majority of Turkish exports consists of low technology goods and therefore does not create much demand in the global realm, which leads to increasing trade deficit through economic globalization (Önder 2008). Thus, previous studies indicate that globalization has made Brazil a more attractive country for investment, whereas it helped others benefit from Turkey as a new market to a large extent. Secondary sources agree that the Turkish globalization project has not been as beneficial for the country; thus, Brazil's superior

position in this regard and its potential advantages for the progress within the RE sector is apparent.

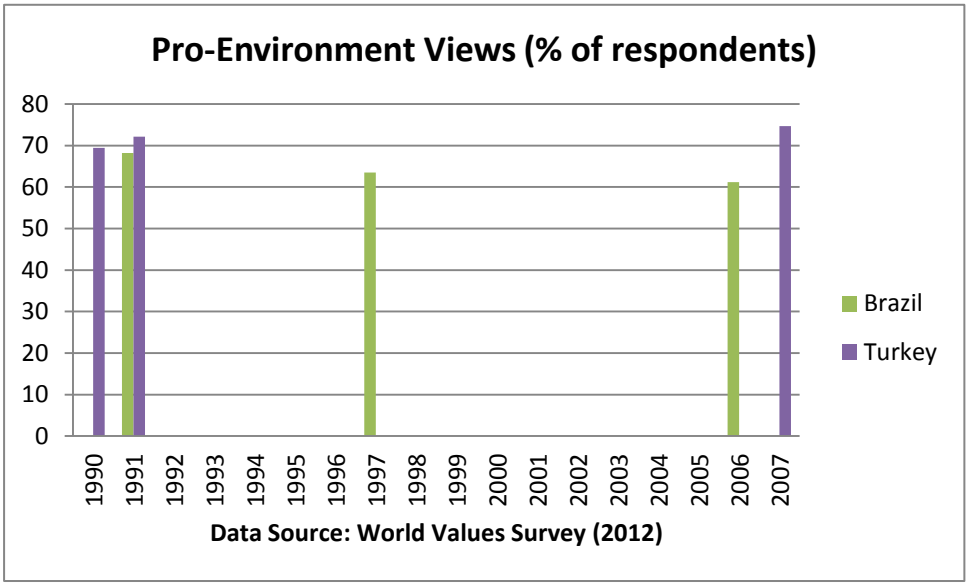
The public attitude towards the protection of environment varies considerably between the cases and does not lead to a credible explanation behind the success in RE. Only existing for a selected number of years in the 1990-2010 period, a composite score created by giving equal weight to questions from the group focusing on the environment from World Values Survey provides consistently higher scores for Turkey than Brazil and does not correspond to the difference in RE performance. In contrast, as indicated in the introduction, the non-governmental bodies supporting environmental causes are much more potent in Brazil than they are in Turkey, which points at a possible political support provided by the Brazilian governments that makes them flourish. The data on civic virtue is limited; however the large differences in RE performance between Brazil and Turkey compensates for this deficiency. The table and the figure below give the percentage of respondents who agree or strongly agree with questions provided in the civic virtue group of hypotheses:

**Table 19: Civic Virtue Indicators, Brazil and Turkey**

| Years | 1990 | 1991 | 1997 | 2006 | 2007 |
|---|---|---|---|---|---|
| Brazil | | 68.23 | 63.5 | 61.2 | |
| Turkey | 69.4 | 72.1 | | | 74.67 |

Source: World Values Survey (2012)

*Figure 6: Civic Virtue Indicators, Brazil and Turkey*



## BRAZIL AND TURKEY: DISCUSSION

An overview of the Brazilian and Turkish RE sectors illustrates that solid biomass and hydropower are two of the most widely used types of RE in both countries. A succinct comparison of the Brazilian and Turkish RE sectors provides many insights into why Brazil might have been more successful in deploying RE than Turkey. First of all, the environmental activism is much stronger in Brazil and environmental NGOs are quite strong; in fact, they are so powerful that some government officials occasionally complain about them, as they prevent many policies to be implemented. On the contrary, environmental activism in Turkey is growing, yet the environmental causes are not paid enough attention by the government and the environmental activism frequently emerges in an ideological, anti-governmental context. Nevertheless, green parties are considerably weak in both states.

Taking the state side of the picture into consideration, Brazil's main strengths are more clear and ambitious goals for RE deployment, effort to create a competitive RE market and offering potential investors more suitable conditions, most importantly higher feed-in tariffs than Turkey. In contrast, the current government in Turkey strongly relies on economic development and did not create clear RE goals with efforts related to energy focusing on efficiency. In a similar regard, feed-in tariffs are lower and there are fewer types of incentives offered to investors, which makes investment in RE less attractive. Importantly, Brazil has relatively many companies that are better-equipped to produce RE equipment, whereas Turkey has to import RE technology for large scale installments.

As in their order, security, economics and welfare, state prestige and globalization and environmental protection emerge as the most appropriate groups of hypotheses at explaining Brazil's success in RE. In this case, the first group provides the strongest explanation with three of four hypotheses in the group being confirmed. Contrastingly, the civic virtue group

does not give any fruitful results. The table below offers an overview of the hypotheses for Brazil and Turkey:

| **Table 20: Dependent Variable and Hypotheses, Brazil and Turkey** | | |
|---|---|---|
| **Index** | **Dependent Variable** | **Result** |
| D | Share of RE in Primary Energy Supply | Brazil is more successful. |
| **Index** | **Hypothesis** | **Does it explain Brazil's success and Turkey's failure?** |
| **Economics and Welfare (a)** | | |
| H1a | Income per capita (real and PPP) | No |
| H2a | R&D Budget for RE and general R&D Budget | Yes |
| H3a | Human Development Index | Yes |
| **Environmental Protection (b)** | | |
| H1b | $CO_2$ emissions per capita | Yes |
| H2b | GDP per unit of energy use | No |
| H3b | Forest area | No |
| H4b | Qualitative sources: environmental politics | Yes |
| **Security (c)** | | |
| H1c | The percentage of energy imports in GDP | No |
| H2c | Hard power (Material Capabilities Index) | Yes |
| H3c | The amount of remaining conventional energy sources | No |
| H4c | Qualitative sources: security | Yes |
| **State Prestige and Globalization (d)** | | |
| H1d | Freedom in the World Index | Yes |
| H2d | The Index of Economic Freedom | No |
| H3d | Foreign direct investment per capita | Yes |
| **Civic Virtue (e)** | | No |

## GERMANY: A WORLD-WIDE RESPECTED COUNTRY IN RENEWABLE ENERGY

Germany is one of the world leaders in RE deployment and the greenest societies in the world. As a developed country, Germany is involved in a significant amount of industrial production and therefore is not expected to experience a substantial growth in energy demand in the following years. Nevertheless, as a strongly industrialized actor, Germany had to put more effort in making its conventional energy sector greener, which multiplies the importance of Germany's RE success. Germany has been enlarging its RE sources since the 1970s. With its revolutionary technological advancements in the wind and solar sectors as well as societal tendencies leading up to the creation of one of the most popular Green parties in the world, Germany is considered to be a role model in RE.

From the 1960s until the second half of the 1980s, Germany's experience with RE and environmental protection was characterized by investing more in hydropower and reinforcing environmental consciousness through political representation. Starting from the 1990s, however, strong attention has been paid to solar and wind power and a greener future with RE was conceptualized. An initial overview of the history of RE in Germany reveals that Germany's interest in RE mainly comes from the environmentalist character of the German population and politics as well as the importance given to welfare and human security. The fertile ground conducive to RE investment in Germany manifests itself in three aspects. First, Green Party has strong influence in German politics and many political fractions ultimately needed to incorporate comprehensive environmental practices in their agenda. In comparison, an extensive regulatory structure has been created in the 1980s and is frequently updated. Second, the incentive framework provided by the government to RE investors along with the strong support for R&D is almost incomparable with other countries. Third, Germany has a federal structure and green city projects, which contagiously encourages other parts of the country to think green too.

Following environmental politics is of utmost importance in Germany, surprisingly since the Prussian times: the Water Rights Act and the Factories Act have been created for the first time in the Prussian Industrial Statute of 1845 (Weidner 1995, p. 1). The Council of Environmental Experts to provide advice on environmental matters was founded in 1971, the Federal Environment Agency was set up in 1974 and one of the first ministries of environment, the Federal Ministry for Environment, Nature Protection, and Reactor Safety was created in 1986 (Schreurs 2003, p. 6). In comparison, as early as 1977, green groups participated in elections to the district parliaments under the slogan of environmental protection and the Green Party won its first seats in Bundestag in 1983 (compared to Britain's first green MP in 2010) (Weidner 1995). Additionally, since the beginning of the 1990s, the

Green Party increased its votes and won 10.7% of the votes and 68 out of 622 seats in the Bundestag in 2009. Greens focus on environmental issues including global warming, nuclear power and alternative energies and their increasing political strength had a significant impact on other political groups with all the political parties in Germany portraying themselves as champions of environmental interests today (Schreurs 1993, p. 6). In fact, Germany is the only major economy to have had a green party in power, in coalition with a centre-left party from 1998-2005 which undertook policies such as the introduction of environmental taxes to reduce the German ecological footprint. The German political parties are highly supportive of regulatory measures to protect the environment. Combined with its political and economic power, this political stance allows Germany to influence the environmental politics within the EU, as concretized by the incorporation of environment as an area of EU competence in the 1986 Single European Act (ibid.). Germany constitutes one of the inspiring states in the world in terms of environmentalism.

An environmentally conscious agenda is strongly supported by the German society. Strong federal and international environmental groups, such as Greenpeace, the Bund für Naturschutz Deutschland (BUND), and the Bundesverband Bürgerinitiativen Umwelt (BBU) boast large memberships (ibid.). Germany has numerous other environmental NGOs, such as the Zeitz Foundation and Germanwatch. In the 1980s, environmental policies have become stricter following the loss of confidence in political institutions to solve environmental problems and the opportunities given to environmentally-involved citizens to translate their demands into purposeful and effective environmental policy activities (Weidner 1995, p. 66). Thus, the induction of greener policies along with the Green Party was a bottom-up process.

The federal structure and the environmental initiatives taken by several cities and states in Germany have allowed certain regions to develop innovative projects and also served as a point of inspiration. Unlike the UK, politics in Germany are decentralized; local and state

administrations have an important role in governance, and the three levels of government have the capacity to legislate energy policies, whereby the federal level has priority. To illustrate, the frequently cited model eco-city Freiburg is a Green Party stronghold and has many eco-houses, an extremely high percentage of RE in energy share and car-free streets. In comparison, many major German cities like Berlin and Munich have been exponentially becoming greener. Some experts argue that municipalities play a key role in German RE governance (Schönberger 2013). In comparison, the first environment ministry was established in Bavaria and this innovation was imitated by other federal states over years. Bechberger and Reiche argue that the federalism in Germany provides the public not only with a political structure allowing for direct participation in concrete politics, but also with the opportunity to campaign and therefore focus more easily on regional issues such as environment (Bechberger and Reiche 2006).

The German RE sector attracts interest also because of its community-owned structure and the employment opportunities it offers. German Renewable Energies Agency indicates that the biggest investors in German RE market are private individuals (40%), project firms (14%), farmers (11%), and investment banks and funds (11%). In comparison, there is an extremely high level of acceptance for RE among the German public and a poll carried out in 2011 by TNS infratest shows that 94% of all respondents attach high or very high importance to expanding RE sector with 65% of them welcoming the potential construction of RE installations in their neighborhoods (ibid.). In regard to employment, the Federal Ministry for the Environment announced that the RE sector employs around 400,000 people as of 2012, up from around 66,600 in 1998. Thus, RE is more than a necessity for the German public, it is a lifestyle.

**Regulations, Laws, and the Market: A World-Wide Recognized Model**

Germany has significantly strict environmental regulations and one of the most successful RE framework models in the world. As indicated, Germany adopted laws related to environmental protectionism significantly early, even starting in the Prussian times. Several core provisions of German energy law are contained in Germany Energy Act of 7 July 2005 which aims to ensure a safe, cost-effective, consumer-friendly, efficient and environmentally friendly supply of power and gas as well as efficient and unrestricted competition (Germanenergyblog.de 2012). Thus, energy production strongly focuses on maximizing the benefits of citizens. Taking RE into consideration, as one of the pioneers, Germany has implemented the first law in 1991—a forerunner of the famous EEG (Erneuerbare-Energien-Gesetz).

EEG became significantly successful and been adopted by a majority of the EU member states. There are four basic principles of EEG: investment security is guaranteed through feed-in tariffs for 20 years, innovation is encouraged through regular reduction in tariffs and investment is not paid by tax money, but the additional costs are assigned to consumers according to the "user pays" principle. Lastly, all electricity users in Germany have to pay an EEG-allocation. The EEG is extremely comprehensive and includes different regulations for many different types of RE, thus attempting to leave no legal gaps and therefore encourage new investors.

As a world leader in RE, Germany has ambitious goals for the future and called its program *Energiewende*-the energy turnaround, which is also included in laws. According to section 1, paragraph 2 of EEG 2012, RE shall account for 35% of the electricity production by 2020, for 50% by 2030, for 65% by 2040 and for 80% by 2050. In comparison, the Renewable Energies Heat Act promotes the increase of heat generated from RE to 14% by 2020. In a similar regard, after the Fukushima nuclear disaster in Japan, Chancellor Angela

Merkel announced in May 2011 that eight of the country's 17 nuclear reactors would be shut down immediately and the remaining plants would close by 2022.

To reach its RE goals, Germany takes advantage of a comprehensive, accurate and motivating incentive program and organizes campaigns to boost RE deployment. Germany's RE investment model that employs feed-in tariffs is seen as one of the most effective in the world (Klessmann et al. 2011, p. 7643; Haas et al. 2011, p. 7; Lipp 2007). The incentive program in effect aims to reduce investment and operating costs in five ways: cash incentives, reduced interest loans, public guarantees, labor-related incentives and R&D incentives. Germany's feed-in tariff system is recognized as one of the most successful frameworks in the world particularly because of the 20-year guarantee, competitive tariff rates and the gradual decline in the amount of tariffs to encourage technological developments. Bechberger and Reiche indicate that Germany has a long tradition in promoting green electricity with feed-in tariffs that started in 1991. In comparison, campaigns such as the 100,000 roofs PV program were implemented—which expired by the end of June 2003 after successfully supporting the installation of 300 MWp of PV capacity.

**The Renewable Energy Performance and Conventional Energy in Germany**

Germany is a coal-rich country with proven resources of hard and brown coal around 40699 million tones—4.7% of world share—as of 2011. In contrast, the country possesses insignificant amounts of natural gas and oil. In Europe, Germany is the second largest coal producer behind Poland and the world's leader for lignite production. Nevertheless, the strong tendency to invest in RE despite the fact that the remaining coal reserves in Germany would satisfy the energy demands for 216 years with the current level of consumption (BP 2012) proves another remarkable characteristic of the German RE success.

Hydropower, wind power and biomass are the most widely used types of RE in Germany; the wind and solar energy has been increasing its share by growing exponentially in

the last few years. Germany is highly strong in small hydropower and has 8000 plants with a capacity over 1.6 GW and many investments are on the way. In a similar manner, the bio energy power plants are prevalent throughout the country and take their energy from biogas, solid biomass (mainly wood and plants), liquid biomass (plant oils), and sewage and landfill gas. The total installed capacity of bio energy power plants is expected to reach an electricity production of 54 TWh in 2020.

Germany is the global leader is solar electricity with installed capacity being 35.8% of the world's total. Similarly, Germany's wind energy market amounts 30% of Europe's installed capacity and 12.1% of the global capacity (BP 2012). In the global realm, Germany has been the leading technology provider in the wind and solar photovoltaic sectors too. The German government greatly encourages the wind and solar investments through feed-in tariffs and motivates technological investments through tariff digression—for instance, eight percent annually for the solar photovoltaics. This strategy led to projections which argue that PV-generated power will cost as much as conventional power by 2015. In contrast, Germany has a slow yet rapidly growing geothermal sector that currently meets two percent of the German energy demand, yet this figure is expected to growth by more than 100% by 2020. There are 150 areas designated for geothermal exploration in Germany and about 62,000 heat pumps installed, mostly in private residences. Germany is an impeccable example of investing in RE by primarily relying on environmental concerns in deciding for investments. Thus, Germany has one of the largest shares of RE among countries in comparable level of development and economic size, and also invests heavily in sectors that emerge as the greenest amount their counterparts, wind and solar.

As previously indicated, Germany is a technology leader in RE and the majority of the largest companies in the sector are German, especially in the case of wind and solar energy equipment. To illustrate, among the RE manufacturers with largest revenues, nine companies

in the top ten are German and an overwhelming majority of the largest companies produce wind power equipment. Conergy, Enercon, Winergy, SolarWorld and E.On Wasserkraft are the largest five German firms in the sector. Additionally, records indicate that there are more than 2100 RE manufacturers in Germany, a large of number of which is engaged in large scale RE equipment production. The German know-how in RE is globally famous and in fact many highly developed countries, including the USA, import equipment from Germany. In this regard, German solar companies have been increasing their share in the US solar market as seen in the example of Schletter, a German solar equipment firm (DW.DE 2009). A short overview of the German RE sector along with the feed-in tariff rates is provided below:

**Table 21: Short Overview of the German Energy Sector**

| | |
|---|---|
| **Are there environmental NGOs?** | Yes, they are highly strong. They have strong approval of governing bodies. |
| **Green parties** | Very old tradition, first Green representation in the parliament in 1983. |
| **Are there RE goals?** | Yes, extremely ambitious. |
| **Is there a competitive RE market?** | Yes, extremely competitive. Private individuals own a great share of the RE market. |
| **Renewable energy and private sector** | Many players in the hydropower, wind and biomass sector. |
| **Most developed RE sector** | Hydropower, wind and biomass. Solar is catching up. |
| **Are there RE equipment producers?** | Yes, numerous, large scale production and large volume of exports. |
| **Feed-in tariffs (maximum rates)** | |
| Small hydro | $16.85 cents/kWh |
| Wind | $17.3 cents/kWh |
| Biomass | $15.52 cents/kWh |
| Geothermal | $21.28 cents/kWh |
| Source: Bechberger and Reiche (2006) | |

## THE UNITED KINGDOM: A WEAKENING TRADITION OF ENVIRONMENTALISM

Despite the long history of environmentalism, the Green Party and the NGOs, the UK is currently one of the poorly performing developed countries in terms of the share of RE. In comparison, the UK has one of the worst RE performances in the highly developed section of Europe. As an advanced economy, the UK has relatively slow economic growth and a large service sector with relatively low energy demand, which underlines the poor standing of the

country. The UK has been a traditional advocate of protecting the environment and joined the RE game in the early 1960s with significant hydropower for the time, earlier than many successful countries in RE, yet it geared down especially after the 1980s. Possessing a mix of strong environmentalism and green technology, yet poor policies and slack RE sector, the UK emerges as a complex, yet certainly an unsuccessful case. The 1960 – 1990 period has witnessed the creation of the first Green Party in Europe and low growth investment in hydropower. In contrast, in the 1990 – 2010 period, firms began to invest in solar and wind energy, yet with a low pace mainly due to the poor incentive framework not conducive to encouraging more investment. Thus, an overview of the British RE sector manifests that the relatively strong will in the British society to invest in RE was curbed because of the weak policies. In a surprising regard, the environmentalist movement lost its steam in the last two decades and green politics did not prove to be strong in times when technological developments in RE have accelerated. Also, unlike some nations in continental Europe, the UK started to pay relatively less attention to welfare and human security in the last two decades. Lastly, especially in contrast to Germany, the UK never had a comparable R&D performance that could initiate cheaper investments in green energy.

Unlike its performance in RE, environmental consciousness has been relatively strong in the UK, as shown by the activities of environmental NGOs, public institutions, and political groups. A review of the British environmental history shows that Britain founded its first conservation-based organizations by the end of the 1890s, an example of which the Royal Society for the Protection of Birds in 1893. Royal Commission on Environmental Protection was established in 1969 and the Department of the Environment was created in 1970. The UK's Sustainable Development Strategy was launched in 1994. In comparison, sustainable politics in Europe was first invented in the UK in 1973 with the creation of the People, a forerunner of the British Green Party. As indicated previously, the first Greens in Germany

had been elected in 1983, yet it is also important to consider that the People's politics cannot be compared to the German Green Party, as they are much less environmentally radical. In this regard, some scholars argue that Britain did not have a policy on the environment until the 2000s, in the sense of a clearly laid-out and consistent plan integrated across a whole range of government activities (Garner 2000, p. 152). Other experts believe that the British environmental policy since 1945 reveals a number of incongruous trends; the integration and fragmentation of government institutions including the Department of Environment have undermined policy stability and dispersed environmental decision making among many actors (Fairbrass 2003). The current politics in the UK and the stance of the New Labour government has shown that the initial green promises have been rapidly replaced with social and economic considerations. The RE industry does not have enough political representation and the needed number of environmental organizations in the UK to exert their role to promote renewable energies (Do Valle Costa et al. 2008, p. 66). Malcolm Wicks, the former Minister of Energy indicates that "the good British people are not going to thank [them], if [they] tackle global warming by the country getting darker" (Financial Times 1st August 2008). Environmental protection does not appear as a primary goal in current British politics with David Cameron having taken no concrete steps yet for revitalizing the British green legacy (Political Ecology & Environmentalism in Britain, 27th September 2013). On the whole, Britain suffers from a discontinuity in pro-green environmental policy, which could have disrupted the fast growth in RE.

From the societal aspect, the evidence is mixed; there are many strong environmental NGOs situated in the UK that are worldwide influential, but there is also signs of insensitivity to the environmental causes. NGOs including WWF, Greenpeace, Friends of the Earth and Christian Aid have been organizing campaigns frequently, yet there are still concerns that they have not been paying attention to important changes in policies, such as the

government's proposed sell-off of the public forest (Porritt 2011). The weakening of the social support for the protection of the environment is also evident as in the case of environmental philanthropy still representing only 3% of the total UK philanthropy (Cracknell and Godwin 2007, p. 4). The public support for getting green is considerably high; however, few people are interested in taking concrete steps.

There are a high number of governmental bodies in the UK that are involved in environmental governance: parliaments of countries, select committees in the Houses of Commons and Lords, central government departments (DEFRA, Treasury etc.) and quasi governments (executive agencies, public bodies, advisory bodies and public corporations). On top of them, the EU has a strong influence on the environmental politics too. Fairbrass argues that devolved bodies may want to create a local or regional environmental policy (Fairbrass 2003); however, the influence of the EU on the British environmental governance is strong and negotiation between the EU and different countries within the UK may lead to conflict between the English governors and others. In contrast to this argument, Costa et al. believe that the relatively centralized planning system that did not favor local and regional participation in RE policies contributed to the unwillingness of the population in accepting the projects (Do Valle Costa et al. 2008, p. 68). Hence, the UK is not in a position to take advantage of its relatively decentralized structure in environmental policy making due to the strong influence of the government and the EU on its environmental policies.

Similar to Germany, the UK launched a microgeneration strategy in March 2006 to encourage households to produce their own RE through wind turbines and solar panels; however, the program was not successful. The Climate Change and Sustainability Energy Act 2006 was expected to increase the number of microgeneration installations; nevertheless, funding was not at all enough to compensate the demand (BBC 29th March 2006). In 2011, instead of the model with grants, a feed in tariff system was introduced. In addition, the

Renewable Heat Incentive introduced in 2011 expanded the support scheme to various types of RE including biomass boilers and heat pumps. The UK is a latecomer in the game.

**Regulations, Laws, and the Market: A Poorly Performing Case**

The RE came into the agenda of lawmakers in the UK in the 1990s. In 1990, the Environmental Protection Act created English Nature in England. In Scotland, Scottish National Heritage was established and the Countryside Commission for Wales was created in Wales. Similarly, the UK has had a delivery program for renewable electricity since 1990, initially the Renewable Non-Fossil Fuel Obligation (NFFO) followed by the RE portfolio obligations. The NFFO was coupled with a tax, the Fossil Fuel Levy (FFL) to pay for purchase of the higher priced non-fossil fuel based power and for a brief period capital grants to technologies viewed as having long term potential. The NFFO system forced distribution network operators in England and Wales to buy electricity from nuclear power and RE sectors, therefore attempting to boost a low-carbon energy sector. In fact, experts argue that the NFFO program was initially thought for providing support to the nuclear sector, yet the opportunism in the RE sector helped the UK to gain green technology (Mitchell and Connor 2004).

Introduced in 2002, the Renewables Obligation (RO) is the government's main mechanism for RE and places an obligation on electricity suppliers to source an increasing share of their power sales from renewable sources. To illustrate, for 2007-2008 the percentage of RE that must be supplied was 7.9%, whereas it will become 15.4% in 2015. Tax breaks such as the Climate Change Levy were also introduced in the same period to exempt RE equipment from taxation. The sector did not have a feed-in tariff system until 2010, for which solar PV, wind turbines, hydroelectricity, anaerobic digesters and micro combined heat and power qualify. The late introduction of feed-in tariffs in the system is frequently stressed by commentators as one of the major reasons of the RE deployment in the UK being largely

unsuccessful. Experts such as Peter Connor believe that the UK has performed poorly with respect to most of its policy goals when contrasted with nations such as Denmark, Germany and Spain (Connor 2003, p. 66).

In contrast to the UK, the strong competition among German project developers for new sites indicates that a large share of the margin between project costs and feed-in tariff can end up with the landowners (Butler and Neuhoff 2008, p. 1854). Butler and Neuhoff found out that, as opposed to common belief that feed-in tariff does not generate sufficient competition, German turbine producers and constructors are in a stronger competition than those under the UK support scheme (ibid.). Also, there are problems associated with market liberalization: RE was not seen as particularly practical or feasible during the market transition period and policy makers did not realize that they could be a realistic alternative (Do Valle Costa et al. 2008, p. 68).

From a legislative perspective, the UK environmental governance became greener in the 2000s. The 2007 White Paper: "Meeting the Energy Challenge" explains the government's international and domestic strategy to address the long term energy challenges under four policy goals: the reduction of $CO_2$ emissions by 60% until 2050, the maintenance of reliable energy supplies, the promotion of competitive markets in the UK and beyond and the supply of every home with adequate and affordable energy. Thus, following a relatively ambitious agenda with a welfare perspective, the 2007 White Paper is likely to lead to a greener future in the UK, yet, as in other cases, it is a step taken late in the game. In comparison, the January 2008 Energy bill updated the legislative energy framework in the UK by incorporating the challenges faced on climate change and security of supply; key themes were nuclear energy, carbon capture and storage, renewables and offshore gas oil. In the simultaneously published Nuclear White Paper, a new regulatory environment to invest in

nuclear power was introduced. Thus, unlike Germany, the UK is still primarily concerned with energy security, not environmental protection or human security.

In comparison to Germany, the UK's RE goals are more modest and are frequently in line with the EU goals, not more ambitious. The UK government announced in January 2000 a target of 10% of electricity to be supplied from RE; by 2003, a target of 20% was announced for 2020, which is the EU goal. In comparison, there is a mandatory target to supply 15% of total energy from RE and at least 10% of energy spent on transportation from RE. In comparison, the UK aims to reduce the $CO_2$ levels by 26% below 1990 levels by 2020. As mandated by the EU, the UK's goal appear to be ambitious; however, there are also other countries in the EU that will have to achieve the same percentages with much lower levels budget dedicated to the same issue.

**The Renewable Energy Performance and Conventional Energy in the United Kingdom**

The UK has relatively low reserves of conventional energy sources; British Petroleum indicates that, as of 2011, the UK has enough oil to cover its oil demands for 7 years, whereas its gas and coal reserves will meet its demands for 4.5 and 12 years respectively; hence it is an energy-dependent country (BP 2012). In addition, the recent discovery of a shale gas basin in the UK revealed that the UK has enough shale gas to meet its domestic gas consumption demands for nearly a decade (Dailymail 11$^{th}$ June 2013). The relatively low level of conventional reserves stresses another aspect of the problem associated with reluctance about investing weakly in RE.

As in Germany, solid biomass, hydropower and wind constitute the largest RE sectors in the UK; the share of the hydropower has been strongly declining, whereas the investments in wind energy have been rapidly increasing. The UK produced 15.8 TWh of wind power in 2011 and is ranked as the world's eighth largest producer of wind power (BP 2012). RenewableUK estimates that more than 2 GW of capacity will be deployed per year for the

next five years (RenewableUK 2013) and the UK is currently the world's leader in offshore wind power; in fact, wind power is a tradition in the UK with the first wind turbine in the UK having been installed by the Scottish academic James Blyth in 1887 for private use. Solar power, on the other hand, has not reached a significant level of development yet. As of 2011, there were 230,000 solar power projects in the UK with a total installed generating capacity of 750 megawatts.

In terms of hydropower, the Dinorwig Power Station with 1,800 MW capacity in northern Wales constitutes the largest hydropower plant in the UK. The UK has 1.65 GW of installed electrical generating capacity. Having produced almost half of the UK's RE in 1990, hydropower fell out of fashion and now accounts for close to 10% of the RE produced. In comparison, biofuels have grown strongly in the beginning of the 2000s representing almost 40% of the UK RE supply, yet the growth slowed down since then. Britain is also involved in further developing technologically advanced "boutique" sectors such as ocean power; thus, a wave farm project has been completed in Scotland in 2012. Nevertheless, the investments in this sector are relatively low as the R&D budget. The UK is a considerably green country in RE and invests in relatively green sectors, yet it has not achieved a level comparable to that of Germany. The RE's share in primary energy supply has been constantly growing and the UK is expected to move higher in rankings among developed countries only in the next decade.

The UK has notable RE manufacturers, especially in solar equipment, yet its technological advancement is not as significant as Germany. The weaker aspects of the British RE manufacturing sectors are smaller-sized and internationally less recognized firms, the concentration of the production only on particular sectors such as solar energy and the low number of companies engaged in RE equipment production. In the solar energy case, Solar Century and Romag emerge as the most successful companies. Taking the wind power into consideration, the UK used to have only one firm among 146 major wind turbine

manufacturers in the world, in a list that includes manufacturers from developing countries such as Egypt and Iran, as well (thewindpower.net 2013). Similarly, a review of the Internet shows that the UK has only hundreds of RE companies, whereas Germany has more than two thousand. A short overview of the British RE sector along with the feed-in tariff rates is provided below:

**Table 22: Short Overview of the British Energy Sector**

| | |
|---|---|
| **Are there environmental NGOs?** | Yes, they are highly strong; however, they do not have significant political power. |
| **Green parties** | Very old tradition, first Green Party in 1973. |
| **Are there RE goals?** | Yes, modestly ambitious. |
| **Is there a competitive RE market?** | Yes, competitive. The sector is largely owned by private companies. |
| **Renewable energy and private sector** | Many players in the hydropower and wind sector. |
| **Most developed RE sector** | Hydropower, wind and biomass. Wind sector is ambitious. |
| **Are there RE equipment producers?** | Yes, many, not very competitive internationally. |
| **Feed-in tariffs (maximum rates)** | |
| Hydro | $33.91 cents/kWh |
| Wind | $33.91 cents/kWh |
| Solar | $25.06 cents/kWh |

Source: Energy Saving Trust (2013)

## A COMPARATIVE EVALUATION OF RENEWABLE ENERGY PERFORMANCE: GERMANY AND THE UNITED KINGDOM

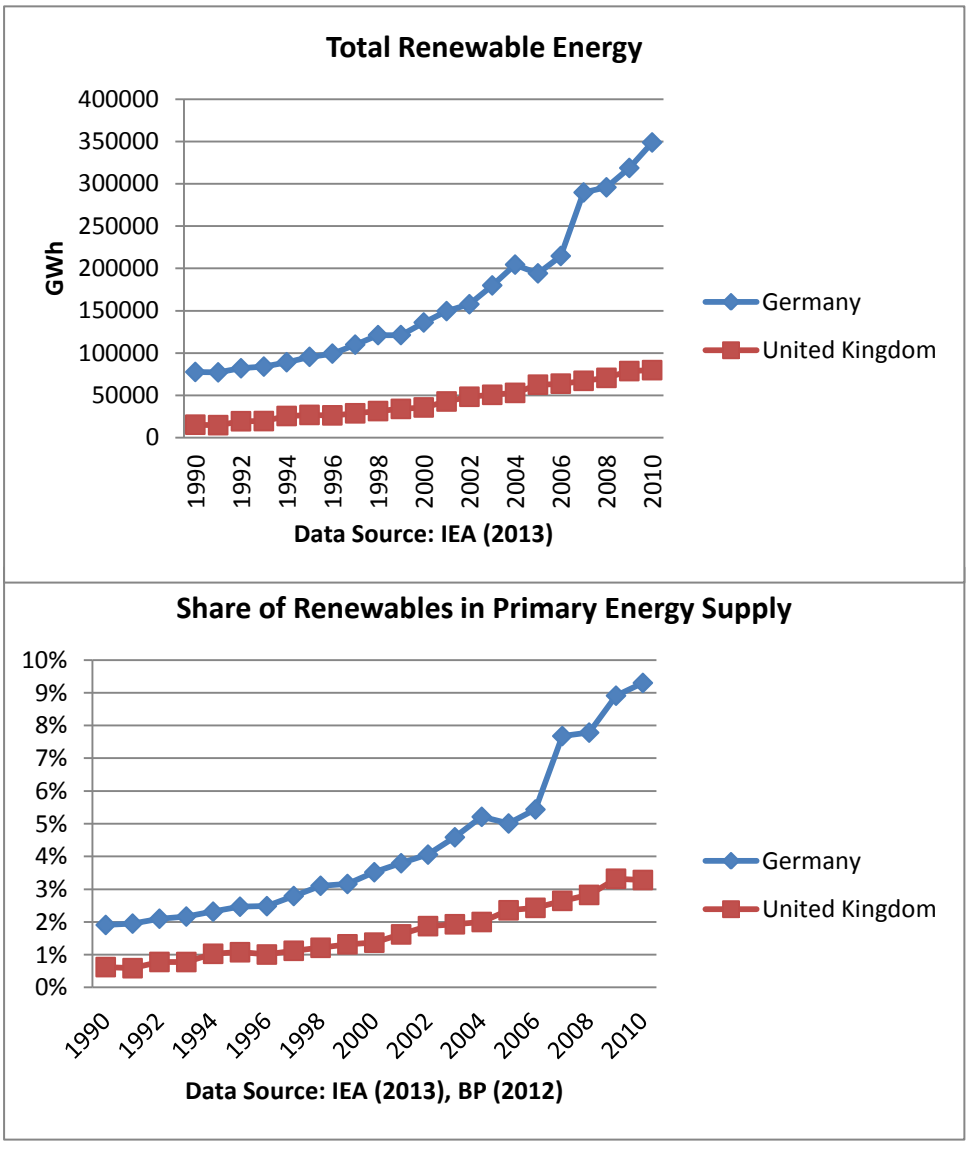
Taking the share of RE in primary energy supply into consideration, Germany is a more successful country than the UK. Germany's success in RE is not due to its RE potential, but the greater value attached to the RE R&D sector, the power of non-governmental bodies and the Green Party to affect politics in the direction of environmental protection and the societal approach to embrace RE as a lifestyle. From 1990 to 2010, the share of RE in primary energy supply increased from 1.9% to 9.3%, whereas in the UK these figures went up from 0.6% to 3.3% (IEA 2013). The energy consumption in Germany and the UK decreased by around 7.8% and 10.4% respectively, which resulted from energy efficiency measures related to Kyoto Protocol and the shifting of some portion of industrial production to developing countries. This fact contributed to the rise of RE shares in both countries too; however, as a country still possessing large industrial horsepower, Germany's performance in RE is

remarkable. Taking the developed countries into consideration, Germany and the UK do not emerge as countries satisfying a great share of their energy needs from RE; however, among developed countries of larger size, Germany is one of the world leaders and the UK is close to the bottom of the list.

In both countries, solid biomass and wind energy appear as the largest sectors in RE achieving higher percentages than hydropower and solar energy. To illustrate, the share of solid biomass decreased from 44% to 41% in Germany and increased from 23% to 30% in the UK from 1990 to 2010. In comparison, the share of wind in Germany increased from nothing to 11% and the share of wind power in the UK increased from zero to 13% (IEA 2013). Taking other sectors into consideration, Germany is one of the top countries that invest in solar energy—which constituted 3% of all of its energy supply in 2010. Similarly, the UK shows a more than satisfactory performance in biogas and biofuels. Being at frontiers of technological innovation, the developed states were able to acquire greener technologies such as wind and solar more quickly than their developing counterparts and this reflects itself in the RE shares. Additionally, in contrast to Brazil and Turkey, Germany and the UK are in less favorable locations to develop cheaper RE supply, such as hydropower and solar thermal, therefore they had to pay greater attention to other sectors. The advanced networks of energy facilitated the distribution of electricity to comparably rural areas of both developed cases and led them to implement green electricity in a more confident manner. The tables and graphs below show the share of RE in Germany and the UK in five-year intervals starting from 1990:

| Table 23: Energy Figures and Share of Renewables, Germany and the United Kingdom | | | | | |
|---|---|---|---|---|---|
| **Years** | **1990** | **1995** | **2000** | **2005** | **2010** |
| **Germany** | | | | | |
| **Consumption** | | | | | |
| Mtoe | 349.56 | 332.87 | 332.29 | 333.23 | 322.41 |
| Total (GWh) | 4064672.74 | 3870534.23 | 3863867.21 | 3874797.36 | 3748965.40 |
| Total Renewable (GWh) | 77634.43 | 95499.12 | 136045.18 | 194118.14 | 348755.13 |
| **Renewable Share** | 0.02 | 0.02 | 0.04 | 0.05 | 0.09 |
| **United Kingdom** | **1990** | **1995** | **2000** | **2005** | **2010** |
| **Consumption** | | | | | |
| Mtoe | 211.19 | 214.47 | 223.96 | 228.20 | 208.98 |
| Total (GWh) | 2455659.31 | 2493834.70 | 2604240.02 | 2653495.38 | 2430032.73 |
| Total Renewable (GWh) | 15296.57 | 26859.68 | 35666.30 | 62562.06 | 79769.71 |
| **Renewable Share** | 0.01 | 0.01 | 0.01 | 0.02 | 0.03 |
| Source: IEA (2013), BP (2012) | | | | | |

*Figure 7: Total Renewable Energy and Share of Renewables, Germany and the United Kingdom*

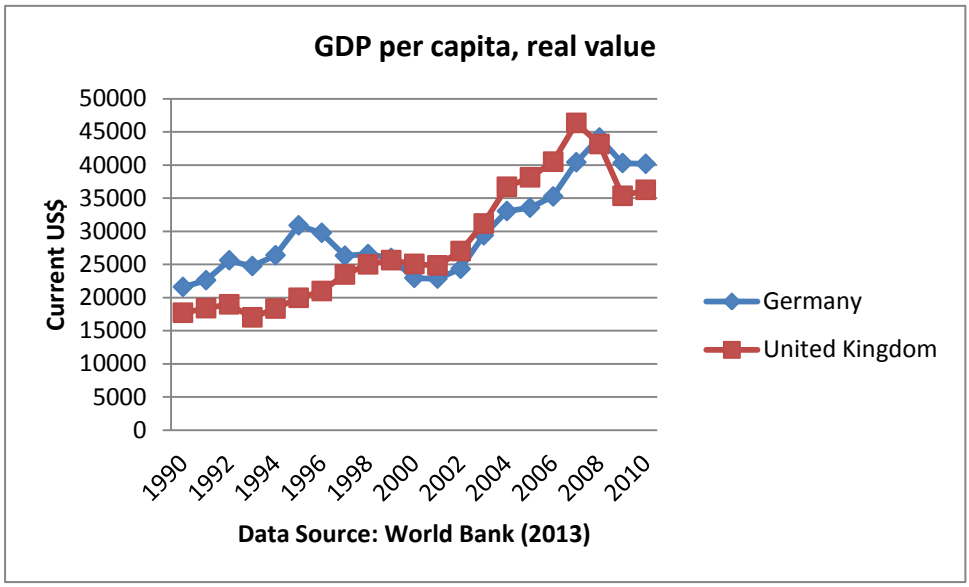


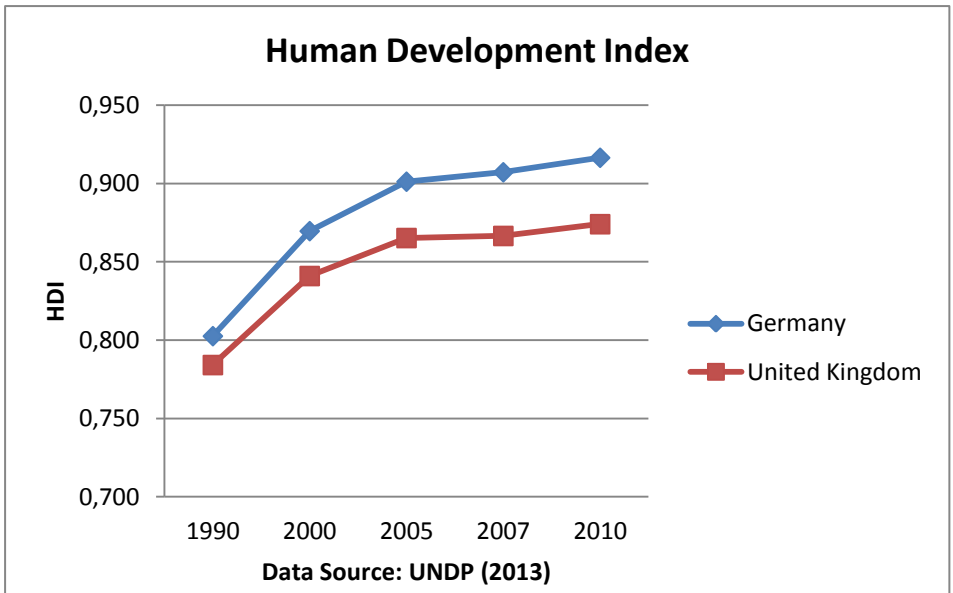
| Table 24: Different Types of Renewable Energy, Germany and the United Kingdom | | | | | |
|---|---|---|---|---|---|
| Years | **1990** | **1995** | **2000** | **2005** | **2010** |
| **Germany** | | | | | |
| Hydro | 0.25 | 0.27 | 0.19 | 0.14 | 0.08 |
| Wind | 0.00 | 0.02 | 0.07 | 0.14 | 0.11 |
| Solar photovoltaics | 0.00 | 0.00 | 0.00 | 0.01 | 0.03 |
| Solar thermal | 0.00 | 0.00 | 0.01 | 0.01 | 0.01 |
| Geothermal | 0.00 | 0.01 | 0.01 | 0.01 | 0.02 |
| Solid Biomass | 0.44 | 0.36 | 0.40 | 0.47 | 0.41 |
| Biodiesels | 0.00 | 0.00 | 0.00 | 0.04 | 0.07 |
| Other | 0.30 | 0.33 | 0.32 | 0.18 | 0.26 |
| **United Kingdom** | **1990** | **1995** | **2000** | **2005** | **2010** |
| Hydro | 0.47 | 0.24 | 0.22 | 0.13 | 0.08 |
| Wind | 0.00 | 0.01 | 0.03 | 0.05 | 0.13 |
| Solar photovoltaics | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Solar thermal | 0.01 | 0.00 | 0.00 | 0.01 | 0.01 |
| Geothermal | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Solid Biomass | 0.23 | 0.38 | 0.21 | 0.25 | 0.30 |
| Other | 0.29 | 0.36 | 0.54 | 0.57 | 0.48 |
| Source: IEA (2013) | | | | | |

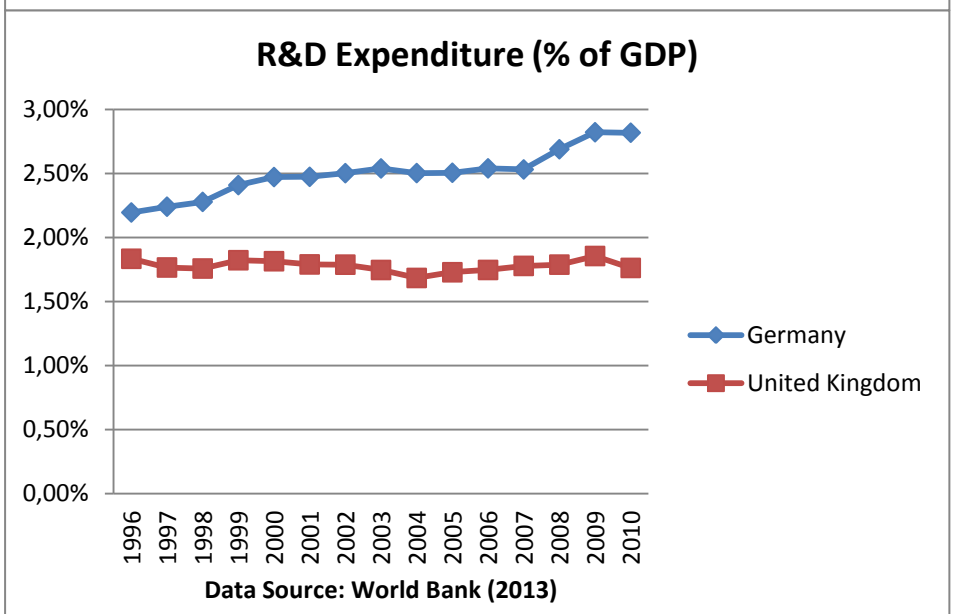
The economics and welfare hypothesis is strongly confirmed in the Germany and the UK comparison. Despite sharing a relatively similar GDP per capita in the period taken, Germany has achieved better HDI scores than the UK by far and appears to be a much more citizen-centered state. The HDI results indicate that Germany has better scores in income, income inequality, education and gender inequality. The UK is only able to show a similar performance to Germany in health, sustainability and communication. Germany has been constantly classified as a country of very high development level, whereas the UK is in the high development level category. In comparison, Germany has invested much more generously in R&D and Germany is ahead of the UK in RE R&D by a large margin. In the 1990-2010 period, the German R&D spending has always been above 2% of GDP, whereas the British spending on R&D was never able to reach 2%, but has always been above 1.5%. In comparison, the investment made in RE sources and energy efficiency has been several times higher in Germany. The tables and figures below demonstrate the economic and welfare performances of both countries:

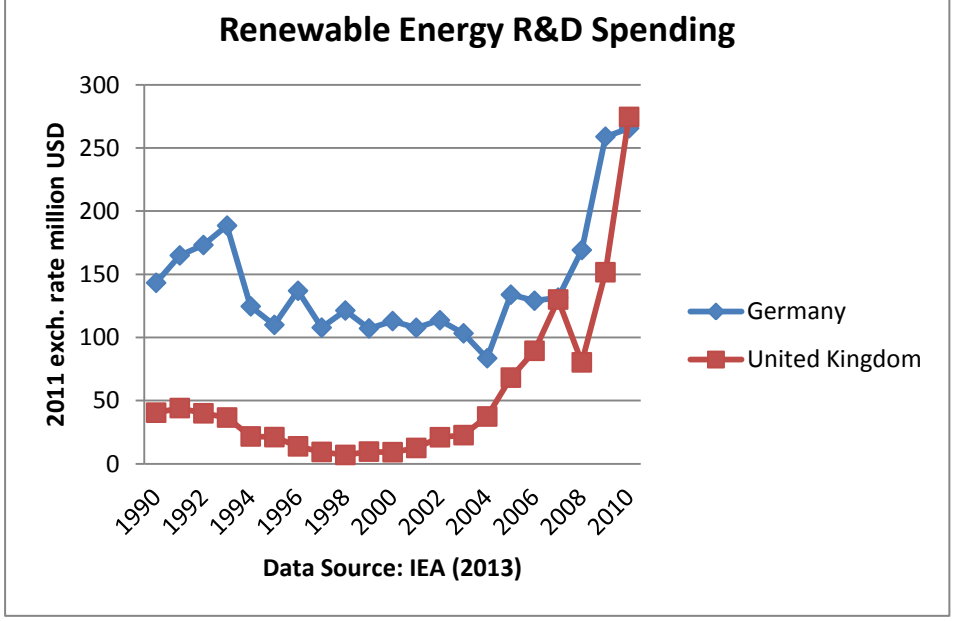
| Table 25: Economics and Welfare Indicators, Germany and the United Kingdom | | | | | |
|---|---|---|---|---|---|
| Years | **1990** | **1995** | **2000** | **2005** | **2010** |
| **GDP per capita, PPP (current international $)** | | | | | |
| Germany | 18504.46 | 22446.38 | 25756.73 | 31114.53 | 37651.59 |
| United Kingdom | 16288.95 | 19681.14 | 26039.14 | 32957.67 | 35298.43 |
| **GDP per capita (current US $)** | | | | | |
| Germany | 21583.84 | 30887.87 | 22945.71 | 33542.78 | 40163.82 |
| United Kingdom | 17687.67 | 19943.78 | 25057.61 | 38121.56 | 36237.70 |
| Source: World Bank (2013) | | | | | |
| **HDI** | | | | | |
| Years | **1990** | **2000** | **2005** | **2007** | **2010** |
| Germany | 0.803 | 0.870 | 0.901 | 0.907 | 0.916 |
| United Kingdom | 0.784 | 0.841 | 0.865 | 0.867 | 0.874 |
| Source: UNDP (2013) | | | | | |
| **Research and Development (% of GDP)** | | | | | |
| Years | **1996** | **2000** | **2005** | **2007** | **2010** |
| Germany | 2.20 | 2.47 | 2.51 | 2.53 | 2.82 |
| United Kingdom | 1.83 | 1.81 | 1.73 | 1.78 | 1.76 |
| Source: World Bank (2013) | | | | | |
| **R&D: Renewable Energy Sources (Million USD, 2011 prices and exch. rates)** | | | | | |
| Years | **1990** | **1995** | **2000** | **2005** | **2010** |
| Germany | 143,257 | 109,944 | 112,953 | 133,851 | 265,594 |
| United Kingdom | 40,429 | 21,071 | 9,139 | 68,179 | 274,583 |
| **R&D: Energy Efficiency (Million USD, 2011 prices and exch. rates)** | | | | | |
| Germany | 24,117 | 22,256 | 13,903 | 27,017 | 179,662 |
| United Kingdom | 45,75 | 3,401 | 2,986 | 0 | 283,748 |
| Source: IEA (2013) | | | | | |

*Figure 8: Economics and Welfare Indicators, Germany and the United Kingdom*




Human Development Index
0,950
0,900
0,850
0,800
0,750
0,700
HDI
1990
2000
2005
2007
2010
Germany
United Kingdom
Data Source: UNDP (2013)


R&D Expenditure (% of GDP)
3,00%
2,50%
2,00%
1,50%
1,00%
0,50%
0,00%
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
Germany
United Kingdom
Data Source: World Bank (2013)


Renewable Energy R&D Spending
300
250
200
150
100
50
0
2011 exch. rate million USD
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Germany
United Kingdom
Data Source: IEA (2013)

Previous studies in the field of welfare confirm that Germany ranks higher than the United Kingdom; the total social expenditure the UK ranks just above the EU average, but below Germany, France and Italy. Similarly, when the benefit levels between two countries are compared, the UK performs much poorly, as in the case of pension benefits amounting to less than half of a person's actual salary. When the history of welfare state in Germany and the UK are compared, Germany has a much older tradition; in the 1880s, Germany initiated workers' health insurance, industrial accident insurance and old-age insurance and unemployment insurance in 1927. In contrast, the current welfare system of the UK began to take shape only after the Second World War. Taking energy and environment into consideration, Schreurs indicates that Germany has implemented high taxes and government regulations to tame market forces to promote social equality and environmental protection, even though this strains the government's budget (Schreurs 2003, p. 4). Similarly, the German citizens expect government to play and interventionist role and redistribute wealth, and also implement regulations to protect the environment (Schreurs 2003, p. 11). Weidner confirms that Germany is a "conservative welfare-seeking" state, as starting from the 1960s, the German society had the opinion that market correction and planning mechanisms were needed (Weidner 1995, p. 4). In fact, by playing an interventionist role, German state also fosters the growth in the green sector by employing hundreds of thousands of people and thereby improving its citizens' economic standing in the reverse direction. Commentators and experts in the field as well as the quantitative data confirm that the German success in RE is strongly connected to welfare politics. In this group of hypotheses, income per capita does not lead to any meaningful result, but HDI and R&D emerge as suitable variables for the explanation of Germany's superiority in RE over the UK.

The group of indicators that focus on the environment provides a more blurry result in comparison to the first group. In this case, $CO_2$ emissions per capita have been traditionally

higher in Germany and they have been decreasing at similar pace with the UK over the last two decades. Thus, in 1991 and 2009 11.6 and 9 metric tons per capita respectively, whereas the UK emitted 10 and 7.7 metric tons for the years 1990 and 2009 respectively. In comparison, the GDP per unit of energy has been higher in the UK than Germany for a great portion of the last two decades. In contrast to the first two indicators that do not explain the reasons behind Germany's success, the forest area could be an explanatory factor of moderate strength; thus, the forest area in both countries has been slowly increasing over the last two decades and Germany has always had a much bigger forest area than the UK. To illustrate, forests constituted 30.8% and 31.8% of the land area in Germany in 1990 and 2010 respectively, whereas the figures are 10.8% and 11.8% for the UK.

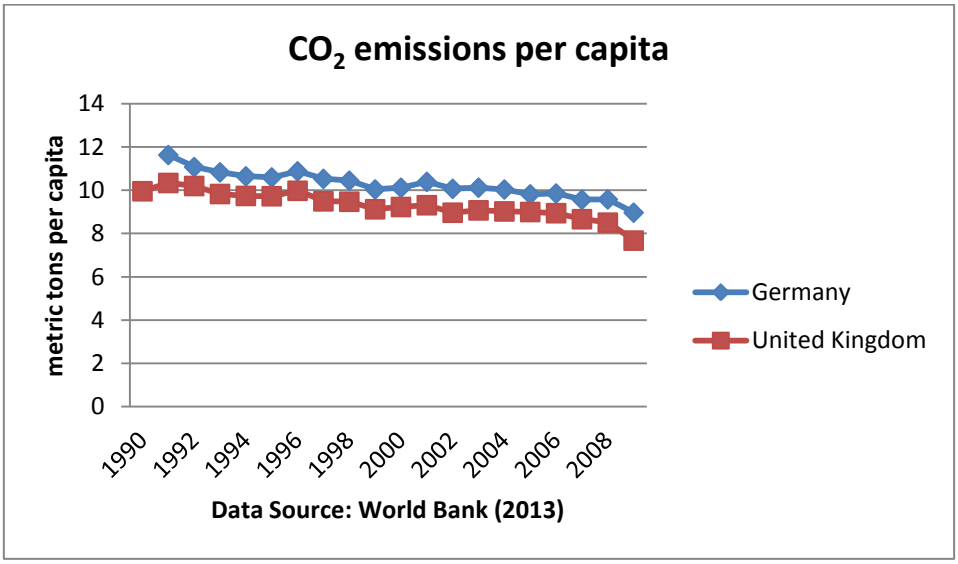
As indicated in the case analysis, Germany and the UK share similar characteristics in environmental awareness, especially when the NGOs are taken into consideration; nevertheless, the fact that the political representation of the Greens in the UK are not as strong as in Germany is a considerable indicator that the German society advocates for the protection of the environment more passionately. The divide between Germany and the UK is not as strong as in the Brazil and Turkey case; therefore, it is not possible to confirm the qualitative hypothesis. On the whole, this hypothesis group does not provide a satisfactory result with only the forest area emerging as explanatory for the RE results:

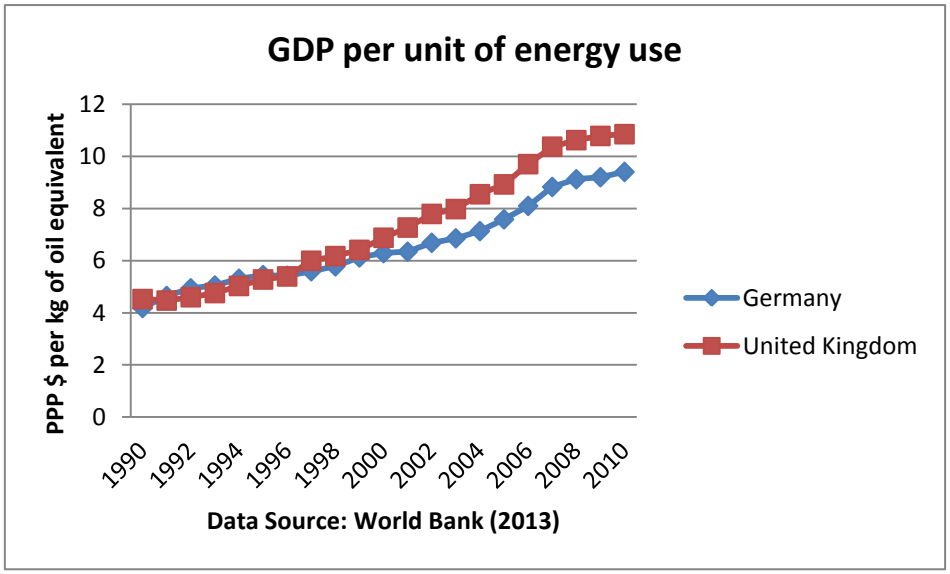
**Table 26: Environmental Indicators, Germany and the United Kingdom**

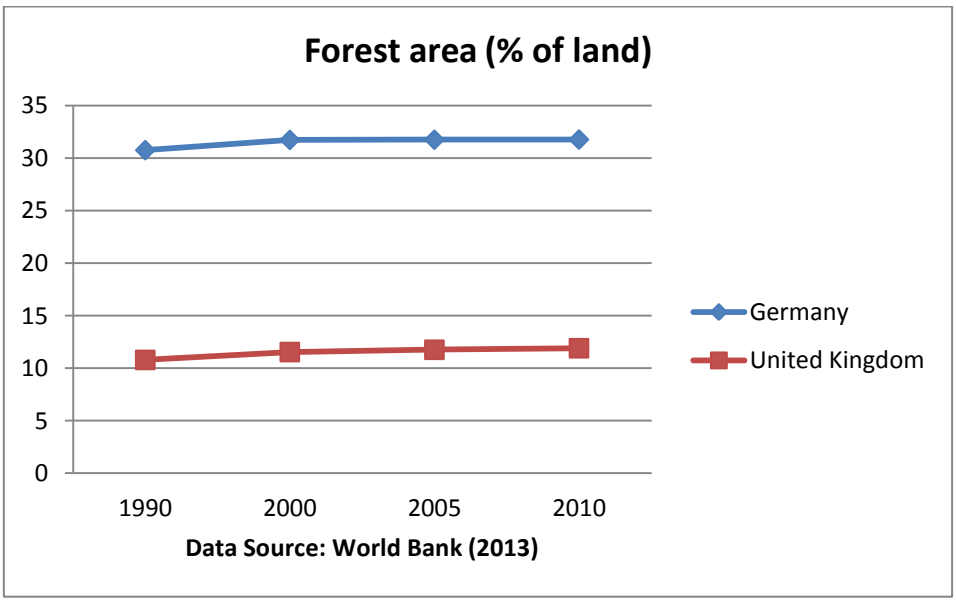
| Years | **1991** | **1995** | **2000** | **2005** | **2009** |
|---|---|---|---|---|---|
| **$CO_2$ emissions (metric tons per capita)** | | | | | |
| Germany | 11.63 | 10.60 | 10.12 | 9.82 | 8.97 |
| United Kingdom | 10.34 | 9.73 | 9.23 | 9.00 | 7.68 |
| Years | **1990** | **1995** | **2000** | **2005** | **2010** |
| **GDP per unit of energy use** | | | | | |
| Germany | 4.19 | 5.45 | 6.29 | 7.59 | 9.41 |
| United Kingdom | 4.53 | 5.28 | 6.88 | 8.93 | 10.85 |
| **Forest area (% of total land area)** | | | | | |
| Germany | 30.77 | | 31.74 | 31.76 | 31.78 |
| United Kingdom | 10.79 | | 11.54 | 11.76 | 11.91 |

Source: World Bank (2013)

*Figure 9: Environmental Indicators, Germany and the United Kingdom*



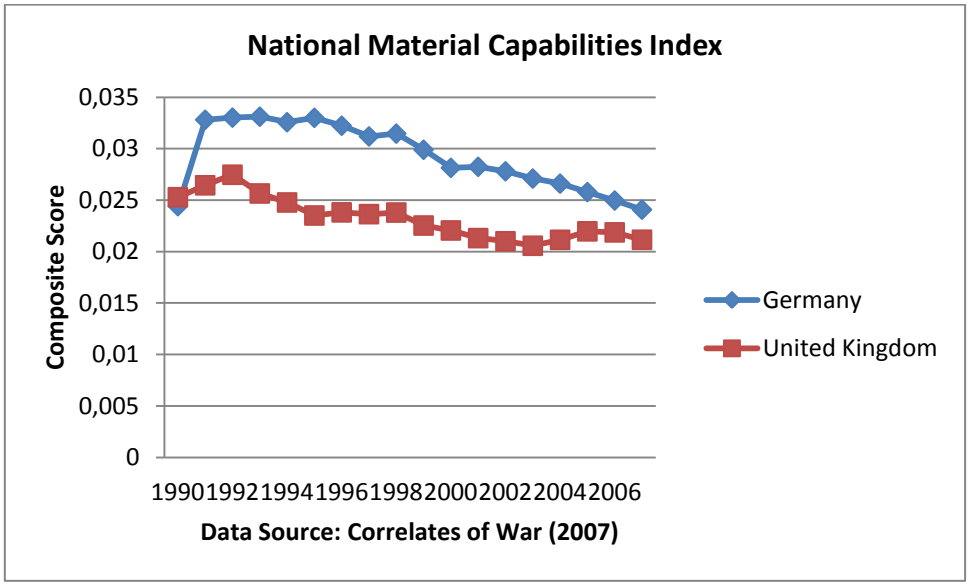
According to their policies, Germany and the UK invest in RE to achieve energy security and also protect the environment, as confirmed by qualitative sources in the introduction section. Quantitative indicators from the 1990-2010 period demonstrate a strong trend in the same direction too; thus, higher hard power, larger amounts of energy imports and low amounts of remaining conventional energy lead to higher investment in RE. In terms of material power, Germany has always been a stronger state than the UK starting from 1991. Thus, as energy security constitutes a portion of national security, Germany might have poured more financial resources into RE as a state with greater hard power. In comparison, as an economically smaller state, the UK might have needed to invest in other priorities before RE. The National Material Capabilities Index shows that Germany had a composite score of 0.0244 in 1990 and 0.0240 in 2007, whereas the UK had a score of 0.0252 and 0.0211 in 1990 and 2007 respectively. Similarly, the German energy imports increased from 47% to 59.9% over the last two decades, whereas the UK used to be a net exporter in 1990 (exported 1% of energy that it consumed), yet became 26.5% dependent on foreign energy in 2010; thus, Germany has always been more dependent than the UK on foreign sources and therefore may have chosen to invest in RE more rigorously. In the case of oil and gas, the UK has always had larger reserves than Germany; however, Germany is one of the richest states in coal globally. Hence, indicators on conventional reserves do not provide an explanation of Germany's superiority in RE, whereas the hard power and energy dependence might have led to higher level of investments in Germany. An overview of the security indicators is below:

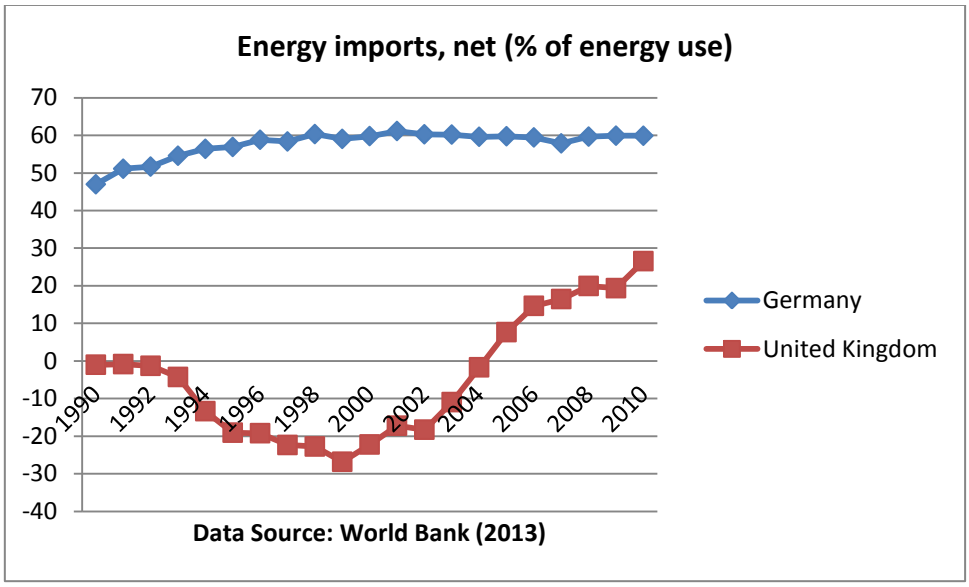
**Table 27: Security Indicators, Germany and the United Kingdom**

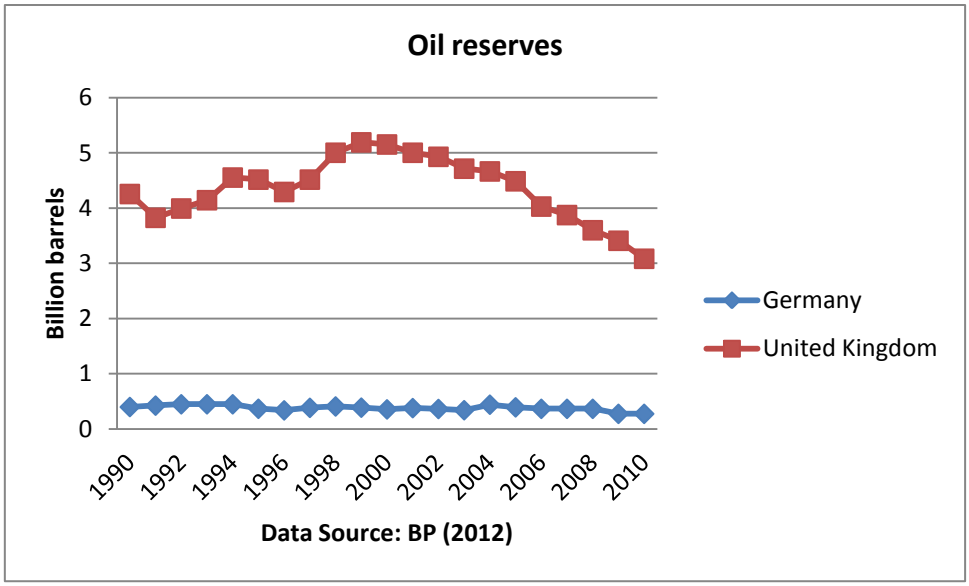
| **National Material Capabilities Composite Index Score** | | | | | | |
|---|---|---|---|---|---|---|
| Years | **1990** | **1995** | **2000** | **2005** | **2007** | **2010** |
| Germany | 0.0244175 | 0.0330062 | 0.0281456 | 0.0257897 | 0.0240815 | |
| United Kingdom | 0.0252901 | 0.0235146 | 0.0220596 | 0.0219773 | 0.0211575 | |
| **Energy imports, net (% of energy use)** | | | | | | |
| Germany | 46.98 | 56.90 | 59.79 | 59.75 | 57.86 | 59.88 |
| United Kingdom | -1.01 | -19.08 | -22.22 | 7.66 | 16.46 | 26.54 |

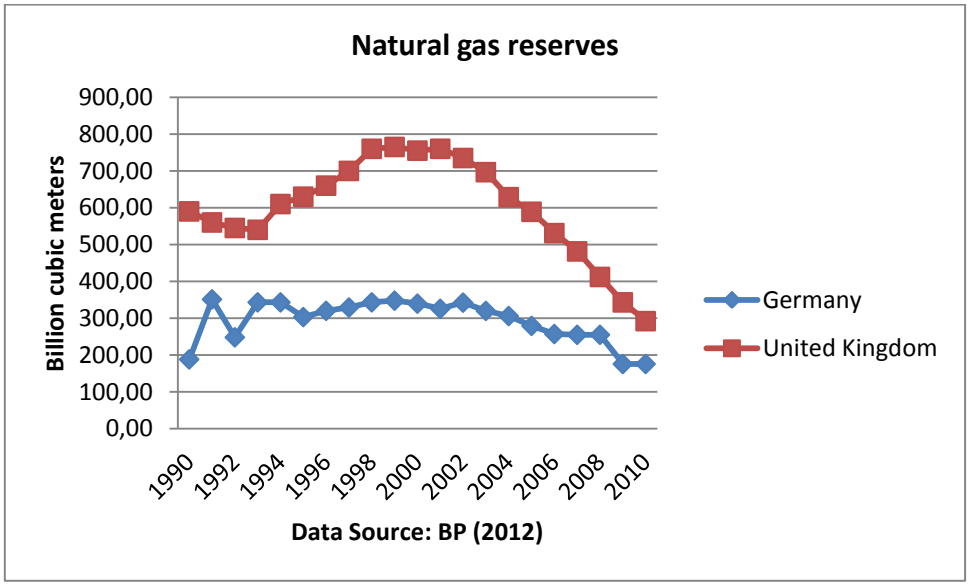
| | | | | | | |
|---|---|---|---|---|---|---|
| **Remaining Resources** | | | | | | |
| **Oil (billion barrels)** | | | | | | |
| Germany | 0.40 | 0.37 | 0.36 | 0.39 | 0.37 | 0.28 |
| United Kingdom | 4.26 | 4.52 | 5.15 | 4.49 | 3.88 | 3.08 |
| **Natural Gas (billion cubic meters)** | | | | | | |
| Germany | 188.02 | 302.99 | 339.49 | 279.09 | 254.85 | 175.56 |
| United Kingdom | 590.01 | 629.99 | 755.01 | 588.99 | 481.39 | 292.00 |
| **Coal (million tons)** | | **2011** | | | | |
| Germany | | 40699 | | | | |
| United Kingdom | | 228 | | | | |
| Source: Correlates of War (2007), World Bank (2013), BP (2012) | | | | | | |

*Figure 10: Security Indicators, Germany and the United Kingdom*





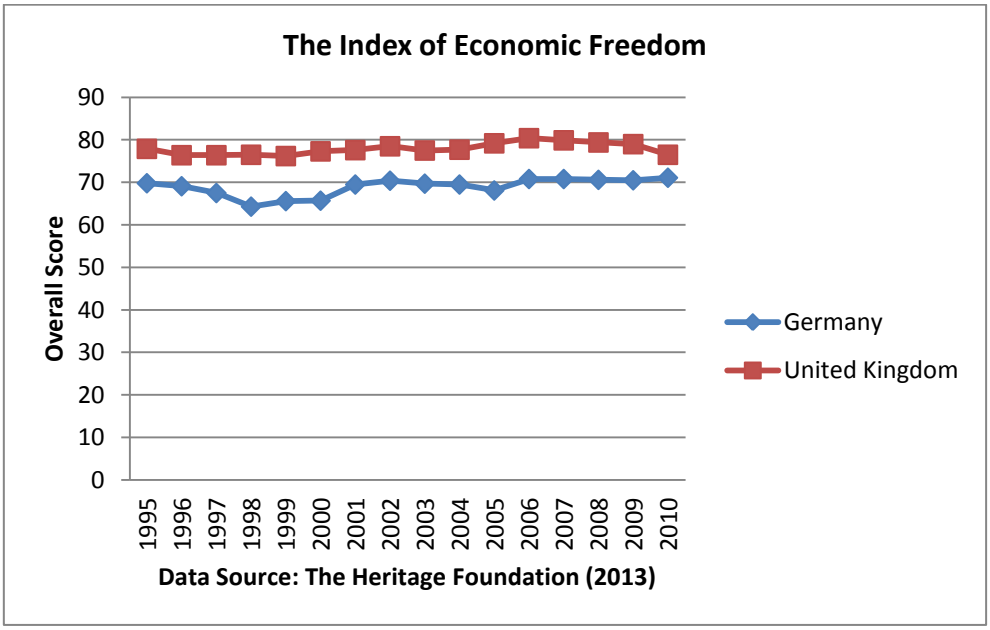



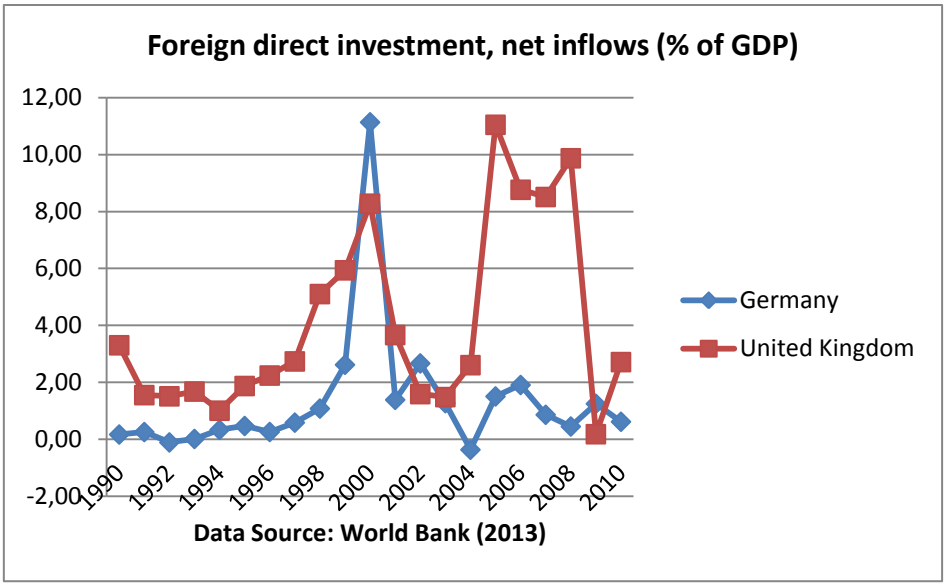

Taking the indicators in the state prestige and globalization group into consideration, the UK emerges as a country that is more integrated into the global network of nations, as it has offered more economic freedom and attracted higher FDI over the last two decades. In the case of Freedom in the World Index, Germany and the UK has always achieved the same scores. The Index of Economic Freedom indicates that Germany and the UK scored 69.8 and 77.9 in 1995, whereas the scores for 2010 were 71.1 and 76.5 respectively and the UK has always achieved higher scores than Germany in 1990-2010. Similarly, the UK has attracted higher FDI ranging from 1% to 11% of the GDP, whereas Germany was able to attract FDI

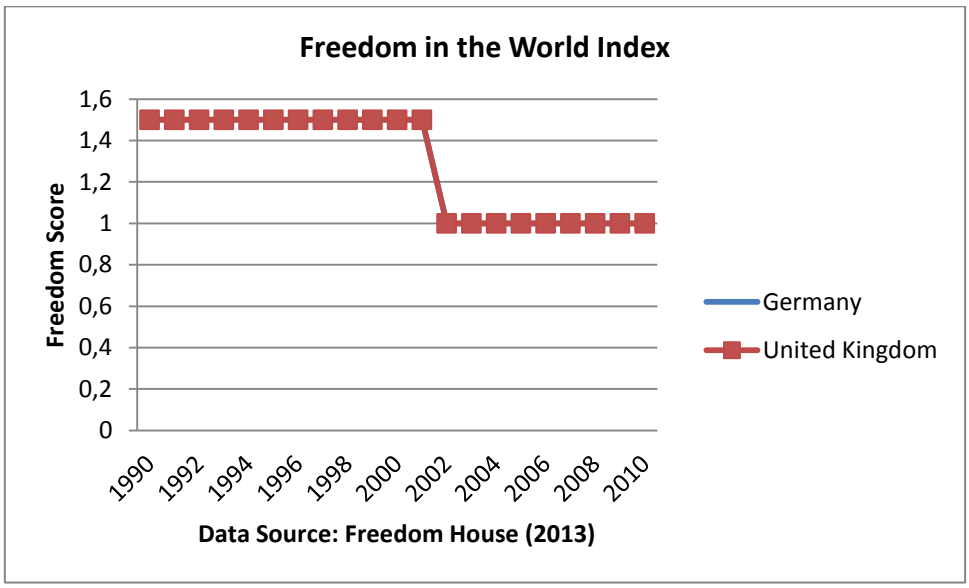
that constitutes between -0.1% and 11.1% of the GDP. Thus, none of the indicators in state prestige and globalization group illuminates the Germany's standing in the RE realm. A table and a figure are provided below:

| **Table 28: State Prestige and Globalization Indicators, Germany and the United Kingdom** | | | | | |
|---|---|---|---|---|---|
| **The Index of Economic Freedom (Overall score)** | | | | | |
| Years | **1990** | **1995** | **2000** | **2005** | **2010** |
| Germany | | 69.8 | 65.7 | 68.1 | 71.1 |
| United Kingdom | | 77.9 | 77.3 | 79.2 | 76.5 |
| **Foreign direct investment, net inflows (% of GDP)** | | | | | |
| Germany | 0.18 | 0.48 | 11.14 | 1.51 | 0.62 |
| United Kingdom | 3.31 | 1.88 | 8.28 | 11.05 | 2.72 |
| **Freedom in the World Index** | | | | | |
| Germany | 1.5 | 1.5 | 1.5 | 1 | 1 |
| United Kingdom | 1.5 | 1.5 | 1.5 | 1 | 1 |
| Source: The Heritage Foundation (2013), World Bank (2013), Freedom House (2013) | | | | | |

*Figure 11: State Prestige and Globalization Indicators, Germany and the United Kingdom*






The public attitude towards the preservation of the nature and implementation of RE provides an unclear result for Germany and the UK; in fact, there are studies undertaken by different organizations indicating that the public support for RE is significantly high in both countries. Providing a limited set of data, the World Values Survey surprisingly shows that a relatively low percentage of Germans support RE when compared to Brazil and Turkey. Similarly, a study undertaken by IPSOS demonstrates that a relatively low percentage of the British constituency has been interested in pro-environment politics over the last twenty years—with percentages ranging from 20% to 30% (Ipsos MORI 2013). Nevertheless, there are many single year studies proving a high percentage of pro-environment opinion in

Germany and the UK. Thus, a poll commissioned by the Institute of Mechanical Engineers in the UK show that 51% of people support an increase in RE (Clickgreen.org.uk 2013). In comparison, the DECC public attitudes tracking survey shows that 82% of the British public are in favor of RE (pfr.co.uk 2013). In the case of Germany, according to World Values Survey, the pro-environment opinion in Germany used to be around 61.6%, whereas it is 33.2% now. Nevertheless, other polls disagree with this result claiming that 90% of the Germans find the *Energiewende* important or very important and a poll from 2012 shows that 80% of Germans are in favor dropping nuclear energy and 70% of them support the *Energiewende*. Taking the significant difference in RE success between both cases, the civic virtue hypothesis does not provide any explanatory results for Germany's superiority in RE.

**GERMANY AND THE UNITED KINGDOM: DISCUSSION**

Hydropower, wind and biomass emerge as the types of RE with the largest share. A brief analysis of both countries reveals some reasons behind Germany's success in RE. Both countries have very old traditions of environmental activism and the percentage of people supporting environmental protection are almost equally high in both societies; nevertheless, the green movement is much more strongly represented in the German parliament, all of the German parties have embraced the advocacy of environmental causes to a considerable extent and thus created policies conducive to the deployment of more RE. Thus, the will of the British society to invest in green technologies has not found an as strong answer from the British parliament yet. In comparison, the German goals related to RE have been much more ambitious and Germany has proven itself as an agenda setter rather than a successful player in the game.

Taking the RE policies into consideration, Germany has also largely benefitted from its carefully designed incentive mechanisms, the world-wide known feed-in tariff policy, whereas the UK has frequently been criticized for the RE portfolio obligations that do not

create enough motivation to invest in RE. Additionally, owing due to its technological level of development, Germany has been able to collect significant know-how in RE manufacturing. The fruitful environment for public investment, large employment in RE sector along with the high returns has allowed the German society to more passionately adopt "being green" as a lifestyle and to achieve worldwide recognition. Security and economics and welfare groups of hypotheses are the most successful at analyzing the current difference between Germany and the UK and other groups provide an even weaker explanation than the Brazil and Turkey cases. The table below offers an overview of the hypotheses for Germany and United Kingdom:

**Table 29: Dependent Variable and Hypotheses, Germany and the United Kingdom**

| **Index** | **Dependent Variable** | **Result** |
|---|---|---|
| D | Share of RE in Primary Energy Supply | Germany is more successful. |
| **Index** | **Hypothesis** | **Does it explain Germany's success and United Kingdom's failure?** |
| **Economics and Welfare (a)** | | |
| H1a | Income per capita (real and PPP) | No |
| H2a | R&D Budget for RE and general R&D Budget | Yes |
| H3a | Human Development Index | Yes |
| **Environmental Protection (b)** | | |
| H1b | $CO_2$ emissions per capita | No |
| H2b | GDP per unit of energy use | No |
| H3b | Forest area | No |
| H4b | Qualitative sources: environmental politics | No |
| **Security (c)** | | |
| H1c | The percentage of energy imports in GDP | Yes |
| H2c | Hard power (Material Capabilities Index) | Yes |
| H3c | The amount of remaining conventional energy sources | No |
| H4c | Qualitative sources: security | Yes |
| **State Prestige and Globalization (d)** | | |
| H1d | Freedom in the World Index | No |
| H2d | The Index of Economic Freedom | No |
| H3d | Foreign direct investment per capita | No |
| **Civic Virtue (e)** | | No |

## A COMPARISON OF DEVELOPED AND DEVELOPING CASES

A comparison of developed and the developing countries analysis presents two insightful results; first, interestingly, the decisions to invest in RE in developed and developing countries come from a similar rationale. Countries that are financially more powerful have the means to invest in RE, as RE requires expensive technology along with

great R&D and therefore a possible investment is taken into consideration only after other priorities, such as health services, education, military and consumption in general are taken care of. Similarly, countries that have traditionally proven themselves as forerunners of citizen-centered politics, as well as those that have recently had or currently have governments with citizen-centered policies in power are more likely to invest in RE. As the financial and technological powerhouse of Europe, Germany appears to invest in RE more comfortably than the UK; in comparison, as strongly suggested by higher HDI values and the active presence of environmentally concerned, influential parties in politics, such as the Green Party, Germany has an advantage in RE sector. In the case of Brazil and Turkey, a similar divide exists with Brazil having had higher levels of HDI over the last two decades and a much larger economy.

Second, security proves itself as a considerable stimulus for countries of different levels of development in making decisions in favor of RE. In fact, although some countries in the analysis attach greater importance to RE in providing energy security by reducing dependence on foreign reserves, official sources belonging to all of the cases confirm that investing more RE is a way of improving energy security. Also, policy experts writing on individual cases, especially Brazil and Turkey, believe that investing in RE will improve the energy security of these countries. As the cases lack conventional energy reserves to a large extent—with the exception of Germany to a minor extent and Brazil, RE receives priority.

The importance attached to environmental politics and the strength of environmental NGOs appears to have a considerable part in furthering RE deployment. In the case of Brazil and Turkey, there is an irrefutable difference between the environmental consciousness of policy circles of two nations and the power of environmental NGOs to affect the decisions of the governments. Starting from the 1990s, the Turkish state has generally favored economic development over environmental protectionism, whereas Brazil has had a more balanced

stance. In comparison, the NGOs in Turkey have been undertaking relatively large campaigns, yet their lobbying power has never been as strong. In the case of developed examples, the UK has had a tradition of strong NGOs and governments in favor of environmental causes; however, the German society has been supporting environmental NGOs since the Prussian times and the significance of the environment for different political groups has not been as variegated as in the British case. For that matter, there could be a direct connection between championing environmental politics, allowing NGOs to intervene in environmental policy making and the RE success.

The administrative structure of a country contributes greatly to the development of a green agenda. As exemplified by Brazil and Germany, when local administrations have a firmer grasp on designing environmental policies and also possess financial resources, they reach better results compared to a state with a strong central government. RE potential is almost always unevenly distributed within a country and not all of its regions have the necessary means to invest in it. Therefore, local governors who take the initiative to prioritize some RE sectors and thus better channel the investments create successful results in a shorter time. On the other hand, having other economics and political priorities, central governments may not always be in a position to satisfy the needs of local communities which may again be provided with haute couture policies through local governors.

A cross–group comparison provides the most and least surprising results in the analysis in terms of the share of RE in total primary energy supply and the factors leading to the deployment of RE. In the former case, results are interestingly unexpected: developing cases produce similar, or even more RE than the developed cases, as Brazil is the largest RE producer in the analysis with Germany, Turkey and the UK following it. The large RE shares in developing cases emphasize this difference, as well. Arguably, this does not owe to the fact that developing cases are more concerned with providing RE, but they are endowed with

larger RE potential, i.e. in the case of hydropower, and use biomass—including fuel wood and animal dung—to a greater extent especially because of the poor energy networks and low economic power in rural areas. Expectedly, the other side of the coin shows that developed cases invest more in technologies that require technological advancement, such as wind power and solar photovoltaics; as wind and solar power produce electricity, not thermal energy, the energy produced in this way is transferrable to some extent too. In the case of hypotheses, a cross-group comparison does not bring any fruitful explanation illuminating the decisions on RE investment due to the developmental differences between cases. A concise overview of the key indicators and study results is provided below:

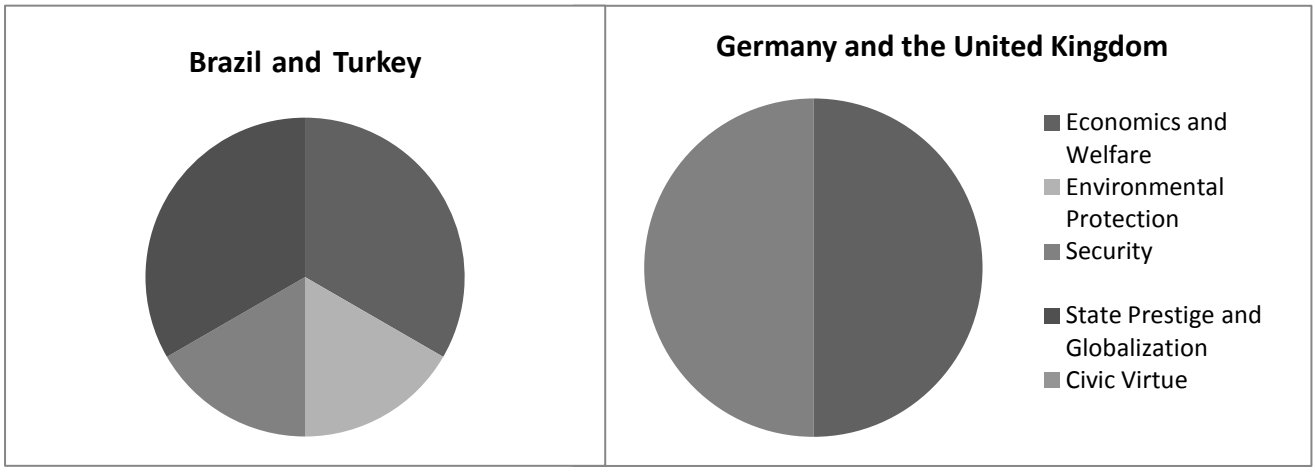
| **Table 30: Overview of Key Indicators** | | | | | |
|---|---|---|---|---|---|
| **Brazil** | | | | | |
| **Indicator Name** | **1990** | **1995** | **2000** | **2005** | **2010** |
| Population, total | 149650206 | 161848162 | 174425387 | 185986964 | 194946470 |
| GDP per capita (current US$) | 3086.88 | 4751.07 | 3696.15 | 4743.27 | 10992.94 |
| Consumption | | | | | |
| Mtoe | 124.54 | 153.74 | 185.98 | 206.96 | 257.97 |
| Total (GWh) | 1448151.3 | 1787642 | 2162556.6 | 2406507.3 | 2999671.8 |
| Total Renewable (GWh) | 698086.92 | 733211.56 | 786429.99 | 1005602.7 | 1223363 |
| **Renewable Share** | **0.48** | **0.41** | **0.36** | **0.42** | **0.41** |
| **Turkey** | | | | | |
| **Indicator Name** | **1990** | **1995** | **2000** | **2005** | **2010** |
| Population, total | 54130268 | 58864649 | 63627862 | 68143186 | 72752325 |
| GDP per capita (current US$) | 2783.59 | 2879.25 | 4189.48 | 7087.72 | 10049.77 |
| Consumption | | | | | |
| Mtoe | 46.2 | 59.1 | 73.4 | 86 | 108.8 |
| Total (GWh) | 537788.66 | 686947.22 | 853033.34 | 999540.25 | 1265461.1 |
| Total Renewable (GWh) | 112370.1 | 125602.54 | 117873.8 | 118232.65 | 135866.38 |
| **Renewable Share** | **0.21** | **0.18** | **0.14** | **0.12** | **0.11** |
| **Germany** | | | | | |
| **Indicator Name** | **1990** | **1995** | **2000** | **2005** | **2010** |
| Population, total | 79433029 | 81678051 | 82211508 | 82469422 | 81776930 |
| GDP per capita (current US$) | 21583.84 | 30887.87 | 22945.71 | 33542.78 | 40163.82 |
| Consumption | | | | | |
| Mtoe | 349.56 | 332.87 | 332.29 | 333.23 | 322.41 |
| Total (GWh) | 4064672.7 | 3870534.2 | 3863867.2 | 3874797.4 | 3748965.4 |
| Total Renewable (GWh) | 77634.43 | 95499.12 | 136045.18 | 194118.14 | 348755.13 |
| **Renewable Share** | **0.02** | **0.02** | **0.04** | **0.05** | **0.09** |

| United Kingdom | | | | | |
|---|---|---|---|---|---|
| **Indicator Name** | **1990** | **1995** | **2000** | **2005** | **2010** |
| Population, total | 57247586 | 58019030 | 58892514 | 60224307 | 62262786 |
| GDP per capita (current US$) | 17687.67 | 19943.78 | 25057.61 | 38121.56 | 36237.7 |
| Consumption | | | | | |
| Mtoe | 211.19 | 214.47 | 223.96 | 228.2 | 208.98 |
| Total (GWh) | 2455659.3 | 2493834.7 | 2604240 | 2653495.4 | 2430032.7 |
| Total Renewable (GWh) | 15296.57 | 26859.68 | 35666.3 | 62562.06 | 79769.71 |
| **Renewable Share** | **0.01** | **0.01** | **0.01** | **0.02** | **0.03** |

Source: IEA (2013), BP (2012), World Bank (2013)

| **Table 31: Overview of Study Results** | |
|---|---|
| **Brazil and Turkey** | **Result** |
| Share of RE in Primary Energy Supply | Brazil is more successful. |
| **Hypotheses** | **Does it explain Brazil's success and Turkey's failure?** |
| Economics and Welfare (a) | Yes |
| Environmental Protection (b) | To some extent |
| Security (c) | To some extent |
| State Prestige and Globalization (d) | Yes |
| Civic Virtue (e) | No |
| **Germany and United Kingdom** | **Result** |
| Share of RE in Primary Energy Supply | Germany is more successful. |
| **Hypotheses** | **Does it explain Germany's success and the United Kingdom's failure?** |
| Economics and Welfare (a) | Yes |
| Environmental Protection (b) | No |
| Security (c) | Yes |
| State Prestige and Globalization (d) | No |
| Civic Virtue (e) | No |

*Figure 12: Overview of Study Results, Weighted Reasons of Success Behind Renewables*



## CHAPTER SIX

## CONCLUSION

This study is an attempt to accomplish two goals. First, as indicated in the introduction, it is a most different systems analysis and includes two pairs of comparisons. Brazil and Turkey, Germany and the UK are two pairs that consist of countries with similar backgrounds—size, economic power and level of development—that have strikingly different RE performances. Second, energy security, citizen-centered politics and environmentalism have been gaining greater importance, as countries become more dependent on each other through the forces of globalization. Also, politics become more transparent through increased means of communication and the power of the electorate, and nature becomes more fragile through increased consumption and the resulting pollution. The phenomenon of RE offers a scenic juncture, as it includes these important issues as a matter of its existence and thus both reminds people in general what could have been made better in the past and what should be done in the future.

The selection of the particular cases came naturally to some extent. In the case of developed nations, there are only few unsuccessful states in RE, the most important of which is the USA; yet, there are only few nations that can be compared to the USA, being a superpower, the USA has different priorities and goals. In contrast, Germany is the leading country among economically most powerful nations in terms of the value it attaches to RE; The UK, on the other hand, is one of the most poorly performing countries in Europe and among the developed nations in general and therefore emerges as a suitable companion. For the developing nations, the picture is more blurry, as there are many states that did not have the chance to invest in RE, yet have considerable economic power and size, such as the Eastern Europe. Nevertheless, there are also other states endowed with large amounts of conventional energy reserves, which makes a possible selection in an RE study problematic,

as in the case of MENA region. Thus, as a resource poor nation that has started to attract greater interest in the global scene and a considerable economic size that would potentially allow it to invest in RE, Turkey is selected. In the case of successful countries, China emerges as another viable option; however, like the USA, it is an economic powerhouse, which makes a comparative analysis difficult. In this case, emerging as one of the BRICs, Brazil is a viable and interesting option.

The literatures on environmentalism, security and globalization are helpful in examining the effects of different factors on RE investment, as they illuminate possible motivations behind state behavior from a relatively heterodox perspective; thus, theoretical frameworks that value the importance of a military-oriented security above all, such as some schools of realism, are relatively misleading. Theories of security maintain that, on the personal level, energy security will be achieved through a more democratic distribution of energy and that everyone has adequate and reliable supplies of energy at reasonable prices; in comparison, energy is a fatal component of national security, as the lack of it may result in dependence on foreign powers and the abundance of energy sources may lead energy rich states to employ coercive foreign policies. Environmental politics are strongly related to a nation's security and RE is offered as a cure to stop the further degradation of the environment by improving the chances of survival for future generations and avoiding the outbreak of major energy-related conflicts between states. Globalization is a connection point between the problems and solutions related to environment, as it both accelerates the speed of environmental degradation and also offers the means to decrease its pace or to avoid it.

The results of this analysis provide several outcomes related to the production of RE in developed and developing cases along with the factors leading to success in RE. In accordance with James K. Boyce's argument, the fact that the developing cases in this study produce more RE than their developed counterparts on average may once again underline that

the green North and brown South argument may not be valid anymore at least for some cases. Thus, the demand for RE is not as elastic as it used to be, possibly due to increasing conventional energy prices through increased consumption of energy. In this regard, having experienced the oil crisis in the 1970s, countries that are financially less powerful have developed policies and mechanisms to produce their own energy, thus to save significant financial resources, and therefore unintentionally contributed to the rise of alternative energies. From a financial perspective, as opposed to the 1950 and the 1960s, findings indicate that RE is not viewed as a luxury good anymore. In comparison, the aggressive campaigns initiated by states to expand in the RE sector, as in the case of Turkey's plans to increase its hydropower production emphasizes that states have started to approach RE much more opportunistically than the past. Thus, especially hydropower and geothermal energy offer lucrative investment returns that are comparable to conventional energy and allow nations to satisfy their economic needs without being dependent on foreign resources and increasing their current account deficit. At this point, it is important to restress that having the required natural potential to develop RE is of utmost importance for all cases.

The strong relationship between economics, welfare and RE also manifests itself with the renewable shares of developed and developing cases. Germany and the UK have been increasing their RE share over the last two decades, whereas Brazil and Turkey have entered a period of steep decline. Having achieved an admirable level of economic standing, the developed cases could be more interested in increasing their utilities from various sources of welfare. In contrast, as shown by their extremely fast doubling rate of energy consumption, developing countries might still be more interested in fueling their economic growth and production to achieve better economic figures.

In a similar regard, the consumption patterns could have evolved over time, which could have led to more innovative and effective use of energy among less well-off or rural

communities as well as environmental awareness. To illustrate, increasingly more people in the Brazilian countryside have started to take advantage of RE, especially through thermal means related to solar energy. Similarly, the hydropower plant projects in rural parts of Turkey have met with opposition by local people, many of whom argue that they would agree with the installation of green energy that could satisfy their own needs. In this case, it is important to mention that governments have become unintentionally more accountable and transparent within the last decades especially through increased means of communication technologies, most importantly social media. Acts of the governments related to welfare provisions are being increasingly questioned and criticized by the citizens. In fact, the rising protests in May and July 2013 in Brazil and Turkey shows that citizens have been seeking larger amounts of welfare provided by their governments, green or not. "Gezi Protests" in Turkey that have mainly advocated the preservation of one of the few remaining green areas in central Istanbul have been characterized by the considerable power of citizens to sanction acts of environmental governance. In comparison, the "Free Fare Movement" in Brazil has been directed towards the rising transportation fares in Brazil, another welfare provision. This common trend between developing countries implicitly formulizes a significant trend: globalization has been acting as a converging factor in welfare provision between developed and developing nations, thus making the borders of green energy between two groups more blurry.

The other interesting aspect of this study is the similarity between the factors leading to RE success: economics, welfare and security needs. Taking into consideration that the civic virtue group did not deliver any fruitful outcomes, this result did not come as unexpected, as energy security provides significant benefits for the cost paid and economic power forms the means that enable its cultivation. In other words, green energy and an impeccable state prestige emerge as luxury goods when compared to national or energy security. In fact, the

findings of the study tacitly confirm this result, as countries that are relatively powerful in their region and attempt to act as a regional hegemon, Brazil and Germany, are much more successful in RE, as they have possibly been able overcome hurdles related to security and welfare earlier than their counterparts. Assuming that governments are bodies of rational actors, it is more important for governments to improve their economic standing and security measures, as those might attract more support from the electorate compared to green welfare provisions. Interestingly, state prestige and globalization proves itself as a significant factor for the RE success of developing cases, which understandably comes from the need of developing countries to attract more capital from developed nations and to become more global player so that they can achieve higher economic growth. The rejection of environmental protection group of hypotheses is a surprising result; however, it should be kept in mind that the indicators that explain the importance attached to environmental protection only act as proxies.

Energy, and particularly RE, constitutes one of the newest branches of research in political science and therefore the field is almost unexplored. Similarly, as the RE technology quickly advances, the ways for states to take advantage of RE continuously change too—which should provide the researchers in the field motivation to explore today's RE politics and update their research. In this sense, although case studies might be preferred due to the lack of data and availability of appropriate countries, large-N studies that employ a narrower scope focusing on fewer variables might be much helpful to see a picture of current RE politics. Similarly, as RE is confined to studies of policy analysis and to a minor extent economics, research from other disciplines of social sciences focusing on energy should be given strong priority. Nikola Tesla's inspring words for the science community may serve as a means to encourage more research on energy in social sciences: "If you want to find the secrets of the universe, think in terms of energy, frequency and vibration."

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