RENEWABLE ENERGY PROMOTION STRATEGIES OF INDIVIDUAL STATES AND REGIONAL FRAMEWORKS: A COMPARATIVE APPROACH

A THESIS SUBMITTED TO
THE GRADUATE SCHOOL OF SOCIAL SCIENCES
OF
MIDDLE EAST TECHNICAL UNIVERSITY

BY

ALMİRA SİNEMİS ŞEKERCİ

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR
THE DEGREE OF MASTER OF SCIENCE
IN
THE DEPARTMENT OF INTERNATIONAL RELATIONS

JULY 2017

Approval of the Graduate School of Social Sciences

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ABSTRACT

RENEWABLE ENERGY PROMOTION STRATEGIES OF INDIVIDUAL STATES AND REGIONAL FRAMEWORKS: A COMPARATIVE APPROACH

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July 2017, 146 pages

This thesis seeks to examine the importance of using renewable energy by using different promotion strategies, methods, technologies and policies among the different countries and regional frameworks in order to achieve a sustainable future. The main argument of the thesis is that contrary to the views of some scholars, who argue that it is the renewable energy potential of countries that is the key for the development of the renewable energy sectors, this thesis argues that it is mainly the renewable energy friendly policy environment as well as the availability of affordable technology, public support and sufficient financial resources that determine the performance of individual countries and regional frameworks in realizing their potentials in renewable energy production.

The thesis composed of five chapters, the first chapter is the introduction part, and the second chapter is about renewable energy resources in the world market and continues with the methods technologies and incentives of renewables in general. Chapter three is about the comparison among the countries' renewable energy developments. Chapter four is about the comparison of regional framework's renewable energy development and fifth chapter will present the conclusion part.

Keywords: Renewable Energy, Energy, Sustainability, and Renewable Energy Policy

ÖZ

MÜNFERİT DEVLETLERİN VE BÖLGESEL KURULUŞLARIN YENİLENEBİLİR ENERJİ TANITIM STRATEJİLERİ : KARŞILAŞTIRMALI YAKLAŞIM

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Yüksek Lisans , Uluslararası İlişkiler Bölümü

Tez Yöneticisi: Prof. Dr. Oktay Fırat Tanrısever

Temmuz 2017, 146 sayfa

Bu tez, sürdürülebilir bir geleceğe ulaşmak için yenilenebilir enerjinin farklı ülkeler ve bölgesel kuruluşlardaki politikalarını, tanıtım stratejilerini ve yöntemlerini incelemeyi hedeflemektedir. Bu tezin temel argümanı; Bazı yazarların, ülkelerin yenilenebilir enerji potansiyellerinin, yenilenebilir enerji sektörünün gelişmesi için ana faktör olduğunu savunmalarına karşın, bu tez temelde ülkelerin ve bölgesel kuruluşların, yenilenebilir enerjinin kalkınmasını ve üretim potansiyelini anlamalarında ve kullanmalarında, yenilenebilir enerji dostu politikaların, makul fiyatlı teknolojilerin uygunluğunun, toplum desteğinin ve aynı zamanda yeterli finansal desteğin belirlediğini savunmaktadır. Bu tez beş bölümden oluşmaktadır, ilk bölüm giriş kısmından oluşmakta; ilaveten ikinci bölüm Dünya pazarında ki yenilenebilir enerji kaynaklarından bahsetmekte ve genel olarak yenilenebilir enerjiyi teşvik etmek için uygulanan yöntemler ve stratejilerde değinilerek devam etmektedir. Diğer yandan üçüncü bölümde ise ülkelerdeki yenilenebilir enerjinin gelişimi karşılaştırılacaktır. Dördüncü bölümde ise bölgesel kurumların yenilenebilir enerji gelişimleri karşılaştırılacaktır. Son olarak beşinci kısımda ise sonuç kısmı sunulmaktadır.

Anahtar Kelimeler: Yenilenebilir Enerji, Enerji, Sürdürülebilirlik, Yenilenebilir Enerji Politikaları

To My Beloved Family and Friends…

ACKNOWLEDGEMENTS

First of all, I would like to express my deep gratitude to my supervisor, Prof. Dr. Oktay TANRISEVER for his support, encouraging me for conducting this research constructive advises, opinions, motivations and insights during my research and my master studies. Secondly, I would like to thank to members of thesis committee who are also my professors during my master studies for extending my vision and knowledge and their insightful suggestions and comments.

I would also like to thank my precious family, İlknur, Sumru, Zeki and Alinda, for supporting me during this challenging process with patient no matter what happened. I am grateful to them. Thanking you Haydarhan Hayali, Can Eminoğlu, Volkan Erdem, for being beside me and encouraging me during the most challenging moments of my research process.

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COP21	Climate Change Conference in Paris
HDI	Human Development Index
GDP	Gross Domestic Product
UNF-CCC	United Nations Framework Convention on Climate Change
GHG	Green House Gas
IPCC	Intergovernmental Panel on Climate Change
PV	Photovoltaics
IEA	International Energy Agency
ASEAN	Association of South East Asian Nations
CARICOM	Caribbean Community
OPEC	Organization of the Petroleum Exporting Countries
RET	Renewable Energy Technology
RES	Renewable Energy Resources
BAFA	The Federal Office of Economics and Export Control
FITs	Feed and Tariff
REL	Renewable Energy Law
RESP	Renewable Energy Scale-up Program
NDRC	National Development and Reform Commission
CEC	California Energy Commission
IEPR	Integrated Energy Policy Report
NSHP	The New Solar Homes Partnership
NREL	National Renewable Energy Laboratory
DOE	U.S Department of Energy
GCCR	The Green Colorado Credit Reserve
QECBs	Qualified energy conservation bonds
GRU	Gainesville Regional Utilities
MENR	The Energy Ministry of Turkey
EMRA	Energy Market Regulatory Authority

GRDE	General Directorate for Renewable Energy
MTA	Mineral Research and Exploration General Directorate
MEU	The Ministry of Environment and Urbanization
NREAP	National Renewable Energy Action Plan
EBRD	European Bank of Reconstruction and Development
NRSE	New and Renewable Sources of Energy
EAEF	EC-ASEAN Energy Facility
APAEC	ASEAN Plan of Action for Energy Cooperation
ACE	ASEAN Centre for Energy the Energy Efficiency
EE&C-SSN	Conservation Sub-Sector Network
RE-SSN	The Renewable Energy Sub-Sector Network
SCNER	The Sub-Committee on Non-Conventional Energy Research
REPP-SSN	ASEAN Committee on Science and Technology, and the newly established Regional Energy Policy and Planning Sub-Sector Network
EAEF	EC-ASEAN Energy Facility
ACCI	ASEAN Climate Change Initiative
AWGCC	ASEAN Working Group on Climate Change
CIP	Community Industrial Policy
PPA	Power purchase agreements
ECS	Energy Community Secretariat
EEA	European Economic Area
SET-Plan	The European Strategic Energy Technology
CCS	Carbon Capture and Storage
TSO	Transmission System Operators

CHAPTER 1

INTRODUCTION

Increasing environmental interest, as well as economic considerations of fossil fuel consumption and high emphasis of sustainable development for the future helped to bring the great potential of renewable energy into focus. Due to climate change concerns and sustainability, energy issues are high priority as a global political issue in world's agenda. In 2015 Climate Change Conference in Paris (COP21), it has been decided that the international goal is to keep global temperature below 2°C, industrial levels. It is believed that this would reduce the risks of climate change and its savior impacts. Since last few decades, human development of the countries cannot be only measure with per capita Gross Domestic Product (GDP) because income is not the only thing that matters in this situation so, Human Development Index (HDI) proposed in Human Development Report 1990 that near the economic indicators, environmental degradation and natural resource exploitation must be measured in order to understand the average achievements of a country in human development[1] .

Overwhelming human impact and increasing greenhouse effect is highly important for world's environmental agenda. Essential point is the carbon dioxide, which comes out from the fossil fuels in the process of energy production. There is a growing awareness for this on going problem because of many issues. For our future, energy plays an important role and demand for the energy rises pretty fast that cause concerns for the Global Warming. Even though there is an effort from some of the developed nations and organizations to convert their power generation

[1] Ediger, Volkan S,. (2008) "National Energy Report of Turkey: Energy Situation, Challenges, and Policies for Sustainable Development", AASA Beijing Workshop on Sustainable Energy Development in Asia, China, InterAcademy Council, pp. 77-93.

from renewable resources, nations are still heavily depends on fossil fuels. Therefore there has to be a reform in energy system in the world in order to reach to a clean and sustainable future. This reform only could happen with the on going renewable energy policies, public and financial support and technological developments all around the world. Moreover developed nations to help or cooperate with the other nation which has abundant renewable energy resources in their area but lack of sufficient renewable energy policies and technologies would help the world to fight with environmental problems more effectively.

As it is already mentioned before, according the 2015 Paris Climate Agreement, limiting global warming below 2°C is the essential target which is adopted by 195 member countries of the United Nations Framework Convention on Climate Change (UNF-CCC). Fossil fuel consumption has its economic considerations and bad effects on environment so that brought up a huge focus on renewable energy consumption, which is what world needs in order to deal with economical and environmental issues. This new trend has caused a huge growth in many sectors such as transportation fuels, heating, cooling and power generation.

With this energy system, what targeted is to minimize the environmental impacts while creating a socially supportive optimal use of renewable energy resources. Therefore in order to reach to a sustainable future what really matters for national and regional infrastructure is the practical progress towards, renewable energy policies, public support, methodologies, incentives, technologies and financially adoptable energy systems.

1.1 Scope and Objective

This thesis seeks to examine advantages of using renewable energy for energy production, consumption and renewable energy development around the world by comparing countries and regional frameworks. Sustainable energy is the energy that, in its production or consumption, has minimal negative impacts on human health and the healthy functioning of vital ecological system, including the global environment. Increasing environmental interest, as well as economic consideration

of fossil fuel consumption and high emphasis of sustainable development for the future helped to bring the great potential of renewable energy into a primary focus.

The main reason why renewables are handier to use is because today there is a huge climate change issue in the world. Therefore there is no doubt about the effects of fossil energy (coal, oil, natural gas etc) to climate and renewable energy resources considered less harmed to environment. Thus, every country and regional frameworks have their own policies, technologies, methodologies and strategies in order to deal with the climate change issue and to courage nations and its people to use renewable energy. However, some of these nations have more reliable policies, economies, technologies and public awareness to make this work better than the others.

This thesis is an attempt to demonstrate the differences among the selected countries and regional frameworks when it comes to apply renewable energy policies and their differences in renewable technologies, methodologies, incentives and resources. Some of these nations have better technologies yet less resources or vise versa. For to discuss the differences among the countries, Germany, China and USA have been picked as the regional leaders in the development of renewable energy and as models for other countries while Turkey was chosen to understand a country that has great potential in renewable resources but less developed in that matter. Especially, Germany has been picked because it is a very successful country and a role model in renewable energy development for other countries in the world due to their energy policies in last 3 decades.

For the regional frameworks, ASEAN and CARICOM and Energy Community have been chosen to understand the missing elements for to have a stronger renewable energy development while they have great amount of renewable energy resources. On the other hand, Nordic Energy Research and European Union Commission have been selected because they are helping for a great development of renewable energy in their region and to understand in which ways they could be examples for the other regional frameworks. Nordic Energy Research and European Commission have been selected on purpose due to their successful

policies in their regions. Both of the regional frameworks had great success to reach their aimed target to use renewable energy in total energy consumption.
While demonstrating the differences between countries' and the regional frameworks' efforts in renewable energy topic, my aim is to find an answer for which essential aspects needs to be considered as the pillars for the development of renewable energy resources. Moreover to identify the effectiveness of certain strategies and reasons why these countries and regional frameworks apply these.

1.2 Literature Review

There are several academic studies on the topic of the recent important issue, usage of renewable energy as well there are also plenty of studies on climate change concerns and renewable energy policies in the world. On the other hand, there are important studies regarding the role of developed countries, regions on promoting renewable energy policies, technologies, methods, strategies and incentives. Moreover there are studies on developing countries and regions attempts and efforts for to promote renewable energy. All of these studies are focused mostly on the importance of renewable energy usage in order to reach for a cleaner and sustainable future. The main arguments of these studies are the need of the countries and regions to promote and increase the usage of renewable energy resources in total energy consumption for a clean energy.

As an important author under the Renewable Energy topic, Robert Ehrlich argues in his book "Renewable Energy: A First Course "[2], that the greatest level of concern that World is facing now is the global climate change due to the increase level of GHG. These gases are mostly notable and occur by burning of fossil fuels. The Intergovernmental Panel on Climate Change (IPCC) claimed that human actions are the cause of global warming and GHG effect is also rising with these actions and the over population in the world which led to war, famine, pollution,

2 Ehrlich, Robert. Renewable Energy: A First Course. Boca Raton: Taylor & Francis, CRC Press, 2013.

shortages in natural resources, energy and climate change. Renewable energy is an energy that comes from natural resources and almost all-renewable energy's are depending on another renewable energy, "Sun". He also claims that there is abundant renewable energy resource on the Earth and only thing we need to know is to use them in best way to protect our planet. This is the duty for every nation and region in this world because an effort only from some nations or regions wouldn't be enough to deal with the climate change.

Elliot, another important author on the issue of climate change, in his article "Sustainable Energy: Choices, Problems and Opportunities" [3], analyzes that patterns of developments in the energy power generation and their usage which became a hot and urgent topic for our future. In his article, an energy option for a sustainable future is discussed in order to create a potential to reduce the level of carbon dioxide emissions.

In addition to the other scholars, who are not only mentioning the importance of renewables and sustainability but also technologies and incentives in renewable energy in general are Infield and Rowley. In their article "Renewable Energy: Technology Considerations and Electricity Integration"[4], Infield and Rowley discuss the number of Renewable Energy technologies that are available. The most notable ones are the photovoltaics (PV), solar thermal systems, wind power, some forms of waterpower and biomass. Among these sectors PV and wind power experiences a huge growth and investment. They also considered as the fastest growing forms of electricity generation. This growth also raised a question about what resources could be used for to supply societies energy needs. The main idea here is to implement renewable energy generation in electricity supply. Authors also analyze the phase in renewable energy technologies, their stages and

[3] Elliott, David. "Sustainable energy: Choices, problems and opportunities." Issues in Environmental Science and Technology Sustainability and Environmental Impact of Renewable Energy Sources (n.d.): 19-48.

[4]Infield David, and Rowley Paul. "Renewable energy: Technology considerations and electricity intergration." Issues in Environmental Science and Technology Sustainability and Environmental Impact of Renewable Energy Sources (2003): 49-68.

integration in the electricity systems.

On this topic another important author is Bull Stanley and in his article "Renewable Energy Today and Tomorrow"[5] mentions, how energy is important in our society for a quality life and backing up the economies of the societies. He also claims that renewable energy technologies are offering a cleaner future. Abundant resources such as wind, sun, biomass, and hydro energy are present all around the world. Maybe some of them exists more in some nations and others are plenty in other nations, yet it does not change the fact that all nations have some types of renewable energy. He argues that solar, wind, biomass and geothermal technologies are cost effective and with the escalating number of markets, they became commercially available. He adds that all of renewable energies are in different stages of commercialization, development and research. Moreover, all of the renewable energy technologies have differences in expected cost, resources availability and their reduction impact on GHG.

Besides, other than these general evaluations, which made by four scholars, there are other important scholars who analyze specifically the countries. For the country comparisons some scholars like Hake, Fischer, Venghaus, and Weckenbrock, discussing the Renewable Energy in Germany in the article of "The German Energiewende - History and status quo" [6] and argue that industrial nations are depend on fossil fuels for their economy. Therefore renewable energy systems are important to reach for a sustainable future. Luckily in Germany, government focus on sustainable future and to reach their aim, they go for the related energy systems. These aims shape the vision of the "Energiewende" and create a strong and clean energy sector. It is believed that Germany as clean energy promoting country could set a positive example for other nations which highly depend on fossil fuels.

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[5] Bull, Stanley R. "Renewable Energy Today and Tomorrow." IEEE Industrial Electronics Magazine Aug. 2001: 1216-226. IEEE Xplore Digital Library. <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=940290&isnumber=20361>.

[6] Hake, Jürgen-Friedrich,Wolfgang Fischer, Sandra Venghaus, and Christoph Weckenbrock. "The German Energiewende – History and Status Quo." Elsevier, 21 May 2015.08Mar.2017.http://www.sciencedirect.com/science/article/pii/S0360544215004594

Transformation from fossil fuels to renewable energy goes back to almost thirty years in Germany with the politics and conflicts. The country started to have a pioneering role in promoting energy system that has been built on renewable energy resources.

Another author Eric Martinot on the other hand analyzes the China on Renewable Energy power. Within his article "Renewable Power for China: Past, Present, and Future" [7] he examines the history, policies, developments and key renewable power technologies in China. He is discussing that, China has abundant resources mostly when it comes to solar and wind power and the country became a global leader in solar photovoltaic (PV) and wind turbine production. Moreover, China is one of the world leaders in power capacity that came from renewable energy. After the 2005 energy law, renewable energy policy in China took a huge turn. Even though China's renewable energy target is similar to EU's 2020 target, there are challenges in technology development; grid integration and policy frameworks and technologies require greater attention in order to reach their targets.

Furthermore for renewable energy in USA, Izidian, Girrens, Kahyyer in their article "Renewable Energy Policies A Brief Review of the Latest U.S. and E.U. Policies" [8] argue that USA is one of the countries which started major investments to implement smart grids. USA also considered as one of the countries that developed and implement, incentives to promote renewable energy smart grids. It also made long-term investments and energy-generation targets. Even though each state has their own policies towards renewable energy usage, in general USA is one of the leading countries when it comes to renewable energy development.

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[7] Martinot, Eric. "Renewable Power for China: Past, Present, and Future." *SpringerLink*. SP Higher Education Press, 17 Aug. 2010. 08 Mar. 2017. <https://link.springer.com/article/10.1007/s11708-010-0120-z>.

[8] Izadian, Afshin, Nathaniel Girrens, and Pardis Khayyer. "Renewable Energy Policies A Brief Review of the Latest U.S. and E.U. Policies." IEEE Industrial Electronics Magazine 19 Sept. 2013: 21-34. ScienceDirect.

Moreover one of the most comprehensive studies for Turkish renewable energy policies is the article of "Global warming and renewable energy sources for sustainable development: A case study in Turkey" [9] Bilgen, Keleş Kaygusuz, Sarı, Kaygusuz argue that Turkey, with its young population, urbanization, and economic development has a growing energy demand. Besides, it has been one of the fastest growing power markets of the world. Therefore the demands for energy is growing constantly and continue to be so. Turkey does not have enough fossil fuels in the region. Therefore, it depends on energy imports and that affects the economy and air pollution in a bad way. To be able to overcome of this problem, Turkey has to use its great amount of renewable energy resources for energy efficiency, clean and sustainable energy development. Due to its geographical position, there is a great potential in utilizing the renewable energy sources in Turkey.

All of these studies are valuable to the literature of renewable energy resources, policies, incentives, technologies and methods in general or in different countries. However, to add regional frameworks on top of these studies will be more helpful for us to understand the development of renewable energy power in a better way. Most of the analysis and evaluations of regional frameworks on renewable energy power are prepared by the regional institutions in reports not by academic studies of scholars.

For the part of regional framework comparison, from The Solar Energy Research Group in Malaysia, authors, Othman and Sopian talk about the economic growth in ASEAN and its impacts in their article called" Renewable Energy Education For Asean"[10]. ASEAN (Association of South East Asian Nations) had a huge growth in their economy in last few decades. Due to increase in economy sector, need for energy increased. They also claim that there is a need for sustainable development

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[9] Bilgen Selçuk, Keleş Sedat, Kaygusuz Abdullah, Sarı Ahmet, and Kaygusuz Kamil. "Global Warming and Renewable Energy Sources for Sustainable Development: A Case Study in Turkey." *Renewable and Sustainable Energy Reviews* 12.2 (2008): 372-96. *Elsevier*.

[10] Othman, Mohd Yusof, and Kamaruzzaman Sopian. "Renewable energy education for Asean." Renewable Energy 16.1-4 (1999): 1225-230. Pergamon. 10 Mar. 2017. <https://doi.org/10.1016/S0960-1481(98)00492-3>.

and environment friendly atmosphere in the region, therefore renewable energy development increased. However even though there are abundant resources in the region their technological development stayed behind. Therefore they could not reach their renewable energy targets yet.

The authors Ochs, Konold, Auth, Musolino, and Killeen in "Caribbean Sustainable Energy Roadmap and Strategy"[11] report argue that Caribbean region is facing with several challenges with the use of energy. Even though region has great amount of renewable energy resources, they still depend on imported fossil fuels. This situation causes a limit in economic development and disgraces the regional natural resources. Region's dependency on fossil fuels also cause problems in global action towards climate change and this cause great threat to small islands in the region. Authors also believe that with its abundant resources, Caribbean region can play a leading role in global arena while promoting the renewable energy. Moreover due to its geographical place and economically diverse cross sections of the region, CARICOM creates a suitable atmosphere to create regulatory framework for transition from fossil fuels to renewable energy resources.

On the other hand for Energy Community of European Union, in its "Report of the Secretariat to the Ministerial Council on the Progress in the Promotion of Renewable Energy in the Energy Community" [12] mentions that The Renewable Energy Directive 2009/28/EC has been adopted by Energy Community and Contracting Parties must follow the renewable energy targets of 2020 and apply the Renewable Energy Directive in order to assemble with European Union energy and climate change objectives. This Renewable Energy Directive creates platform in

[11] Ochs,Konold,Auth, Musolino, and Killeen. "Caribbean Sustainable Energy Roadmap and Strategy (C-SERMS)." Worldwatch Institute, Washington, D.C., 01 Oct. 2015. 20 Apr. 2017. p 1-179 <https://cleanenergysolutions.org/resources/caribbean-sustainable-energy-roadmap-strategy-c-serms-baseline-report-assessment>.

[12] Report of the Secretariat to the Ministerial Council on the Progress in the Promotion of Renewable Energy in the Energy Community. Rep. no. ANNEX 05a. N.p.: Energy Community, 2015. Energy Community. 10 May 2017. https://www.energycommunity.org/portal/page/portal/ENC_HOME/DOCS/3842311/2194639ACBF1368EE053C92FA8C04E9A.PDF

order to promote renewable energy by setting national renewable energy targets. By taking this step, they aimed to reach binding shares of renewable energy in total energy consumption. Moreover with this energy directive it is targeted that until 2020, %10 of the energy that used in transport sector must come from renewable energy resources. In addition to that it is required that National Renewable Action Plans (NREAP) must be submitted to achieve 2020 targets to promote renewable energy share in total energy consumption.

In the report of "Nordic Energy Research Strategy" [13]it mentions that the region considered and positioned itself as the leader in development of sustainable energy solutions. They are also aware that in order to stay in that position and to reach their 2050 target as a region, due to global competition and constant transition in the energy system they must catch up with the challenges. Report mentions that technology would play an important role in order to achieve to a changing energy system therefore they give a specific importance to research and development. They also believe in a great cooperation in the region to reach their aims and set some cooperate policies among each other. They also aim to have more extensive renewable energy technology in the region with the cooperation among the nations.

Tomas Maltby an author on the topic of European Commission in its article "The Commission's 1968 Community Energy Policy" claimed that there are dependency concerns in EU therefore energy policy set out in 1964 (Maltby p,437)[14]. Later, EU decided that there must be cooperation under the topic of energy for their security and they create a common energy policy and that integrated energy sector into common EU market. By doing this EU was trying to decrease dependence of imports because it is risky and created an alternative by of energy for supplies. After 1970 oil crises, EU became hazardous position of the energy dependency. With the Green Paper in 2000, Commission emphasized the supply diversification.

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13 "Nordic Energy Research Strategy 2015-2018." *Nordic Energy*. Norden, 11 Dec. 2014. 20 Apr. 2017. <http://www.nordicenergy.org/publications/strategy-2015-2018/>.

14 Maltby, Tomas. "European Union Energy Policy Integration: A Case of European Commission Policy Entrepreneurship and Increasing Supranationalism." ScienceDirect. Elsevier, 18 Jan. 2013. 08 Mar. 2017.
<http://www.sciencedirect.com/science/article/pii/S0301421512010798>.

Lastly, in the article of "EU Renewable Energy Policy"[15] it has been mentioned in year 2001, %12 of target was adopted for the electricity from renewable resources and %22.1 target for EU-15 was adopted. All of these targets are binding and important in order to apply commitments of Kyoto protocol. Later in 2007 goal of %20 share for renewables established as a long-term strategy under the name of In "Renewable Energy Roadmap" until 2020. New Renewable Directives has been established on 2009 to reach the 2020 targets and targets were different for each member states. In 2010, for resources efficiency, European Commission also presented Europe 2020 strategy cooperation for climate change targets. Moreover Revised Renewable Energy Directive established in 2016 in order make EU a global leader in renewable energy topic and target of 27%of renewable energy share is expected to be use in total energy consumption. Besides, Progress Reports and National Action Plans measure the progress of EU members to reach their renewable energy.

Even though there are many valuable literatures about renewable energy, country and regional policies, technologies and incentives there has been no comparison made among them. Comparison would be clearer for nations and regions to understand what else they could do and what actions they might take to have sustainable future. Even though there are valuable literatures on renewable energy topic now, soon there will be more literature from different perspectives.

After the discussion of the importance of renewable energy, its resources, technology, promotion and its usage instead of fossil fuels for production and consumption of energy in different parts of the world, the next section will focus on the argument of the thesis.

15 "EU Renewable Energy Policy." EURACTIV.com. 21 Feb. 2017. 08 June 2017. <https://www.euractiv.com/section/science-policymaking/linksdossier/eu-renewable-energy-policy/>.

1.3Argument

There is an ongoing climate change concerns in the world and due to its emergency and importance, it became on the top of the world's agenda. Renewable energy resources started to be promoted more and regulatory framework established in order to reach targets to help reduce GHG and other bad impacts of fossil fuels. Every country and region in the world has some amount of natural resources. Types of these resources might change due to geographical locations for instance while Caribbean Region and Turkey have great amount of solar power, Germany and Nordic Region have limited amount of solar power. However with better legal frameworks, strategies, public support and technological developments, these countries such as Germany and the ones in Nordic region are pioneers and example countries in renewable energy development. In this respect this thesis argues that contrary to the views of some scholars, who claims that it is the renewable energy potential of countries that is the key for the development of the renewable energy sectors, it is mainly the renewable energy friendly policy environment as well as the availability of affordable technology, public support and sufficient financial resources that determine the performance of individual countries and regional frameworks in realizing their potentials in renewable energy production and development.

This thesis clearly demonstrates that success for renewable energy development is beyond renewable energy resources. It is certain that potential of renewable energy resources is very important for renewable energy usage. However as it is discussed, there are examples that also show us with limited renewable energy resources there are more successful countries with the help of the legal frameworks, strategies, public support, financial resources and technological developments. For instance Germany with its "Energiewende" vision of almost 3 decades is one of the best examples on this topic. German government's attempts on changing the use of fossil fuels due to the climate change and security concerns cause to a creation of sustainable energy policies. Since 1990's Germany made several attempts to create carbon free environment. First, they introduced German feed-in law; which was an

act in order to supply energy from renewable resources. After they rewarded for the ones who use renewable energy resources and because of the encouraging incentives, there was a huge success in the wind power market. Later with the successor Renewable Energy Sources Act in April 2000, government allows the market for other types of renewables. Success of renewable energy development in Germany can be also explained by other supports for RES investments, such as tax exemptions and corporate financing schemes. Germany is also a world leader in the development of technologies for generating solar systems in producing heat and electricity.

Parallel to Germany, EU targets for 2020 for sustainable future and energy efficiency also create a breakout renewable energy development in Nordic Countries. Moreover, despite the EU 2020 targets, Nordic Countries also have their own 2050 targets and in order to reach their goals, even though they have different national policies, they work together and create joint comprehensive regulatory frameworks. Most of the Nordic countries show variety of support schemes and measures and like in Germany, it is depending on the maturity of the technology. They also have tax reliefs or investment aids and support measures that are financed by the state.

While these examples set a great platform to develop the share of renewable energy resources in total energy consumption; it also sets a positive example for the other nations, especially, the ones that have great amount of natural resources. Therefore this thesis argues that neither having abundant resources alone is enough for a sufficient development in renewable energy sector and the climate change concerns, nor only having financial and technological potential is enough to promote and transit into Renewable Energy System. Public support, incentives, support schemes, methods, strategies, technological development, legal and regulatory framework and some amount of renewable resources are the key elements that must be all together in order to reach to a successful renewable energy development target.

Developing nations to look up for a renewable energy system in developed nations would be a great contribution to a sustainable future which will not only help significant nations or regions but the world in general. Therefore this thesis compares and analyzes the ways in different countries and regions to develop renewable energy systems and tries to understand the key elements on promoting and using renewable energy resources in energy consumption for a sustainable future.

1.4 Research Method

The renewable energy resources exist anywhere in the world however their types show geographical differences. Measures and support schemes are also shows differences due to cultural, political, economical, financial and technological issues. Parallel to the objectives of the thesis, national and regional resources, policies, incentives, technologies and methodological differences are the main concentration.

Quantitative and qualitative research methodology is used in order to understand the effects of the usage of renewable energy on different nations and regions. Quantitatively, this thesis employs some graphical and numerical analysis to understand the targets of renewable energy development in some countries and regions. Qualitatively, I will have a research that consist from reading and analyzing library resources about renewable energy in general, specific nations and regional organizations. There will be also literatures about renewable energy developments, technologies and incentives. Extensive literature reviews, from both electronic and printed sources, as well as books, articles, academic journals, newspaper archives and magazines will be included in this research. There will be also reports as primary sources, which prepared by the bodies of some of the regional organizations. All of these sources will serve to provide essential background for me to be able to compare countries and regional frameworks in renewable energy development.

1.5 Organization of the Thesis

This thesis structured on 6 chapters. The first chapter includes the introduction part and it includes scope and objective, literature review, argument of the thesis and research method. The second chapter is about the benefits and stages of renewable energy in World market. There is also detailed information about the sources of renewable energy and climate change concerns around the world. This chapter continues with the methods, incentives and technologies of renewable energy resources around the world. There is a brief information about the renewable energy support mechanisms in general.

In the third chapter, selected countries such as Germany, China, USA and Turkey will be analyzed in details due their position in renewable energy development. The aim is to look in to the countries' renewable energy resources, policies, how they promote renewable energy and how far their technological development is helping to increase the share of renewable energy in the total energy production and consumption. Moreover it covers the support measures and strategies of these specific countries.

In addition, in the fourth chapter, near the national development, now the regional frameworks will be analyzed in detail. There are selected regional frameworks that putting an effort to promote renewable energy usage in order to have a cleaner future. These selected regional frameworks are Association of South East Asian Nations (ASEAN), Caribbean Community (CARICOM), Energy Community, Nordic Energy Research and European Commission. These regional frameworks are selected because they are premiers in their region under the topic of renewable energy development. Yet some of the regional frameworks are more successful than the others, therefore, in this chapter, their support measures, strategies, energy resources in the regions and technological developments will be discussed.

The fifth chapter is the conclusion part of the thesis. In accordance with the developments and incentives from the developed countries and regions up to now, it is argued that having a great potential in renewable energy resources is not a key

to a successful renewable energy development and a sustainable future but to have renewable energy friendly policies, affordable technologies, public support, sufficient financial resources all together are crucial for to reach this aim.

CHAPTER 2

RENEWABLE ENERGY IN WORLD MARKETS

All energy sources in the world have an impact on the environment it does not matter if it is fossil or renewable. However what makes difference is their level of impact. Fossil energy resources such as coal, oil and gas are the ones, which made concerns on this issue. It is well known fact that renewable energy resources are the ones, which cause lees damaged to environment. World population is growing instantly and therefore the fossil energy resources impacts are getting worse in time because the usage of them is also growing constantly. Meanwhile climate change is a huge concern for out environment, rising oil and gas prices shows a truth about the available supplies would not be enough for to cover our needs and we need to explore other alternatives (Quasching p,1)[16].

According to Ehrlich "these are the investable consequences of the increasing living standard because the usage of energy and wealth is highly correlated to each other" (p,31). [17]Bad consequences of fossil energy can be summarized as oil spills, sea and air pollution and in the future, this fossil usage would cause greater problems. Even though the connection between the global warning and energy use is well known, final problems with energy and climate change became to the heart of the public attention. "In the late 1980s the German federal government proclaimed climate protection to be one of its main targets. At the time numerous experts were already calling for a speedy restructuring of the entire energy supply, despite the government's declaration, the official response was, at best, half-

[16] Quaschning, Volker. "Volker Quaschning: Renewable Energy and Climate Change." *Volker Quaschning - Erneuerbare Energien Und Klimaschutz*. A John Wiley and Sons, Ltd., 2010. 25 Apr. 2017. https://www.volker-quaschning.de/publis/klimaschutz_e/index.php

[17] Ehrlich, Robert. Renewable Energy: A First Course. Boca Raton: Taylor & Francis, CRC Press, 2013.

hearted"(Quasching p,1)[18]. It was a success for the climate change awareness' because it was no longer unheard. Countries like Germany and USA usage and incentives of renewable energy became a huge success. Before discussing the renewable energy markets in general and benefits of the usage of renewable energy we shall understand the fossil energy, its types and problems that they caused to the environment.

Coal like the other fossil fuels has a great negative impact on environment. Even though coal miners are the ones who is getting the direct effect because they associate with coal, every time when coal is mined and burned everyone around get serious effects from this process. Moreover besides land population, air and water population is also getting highly effected with coal mining and that will cause long term effects to both ecosystem and humans on top of that according to researches Coal's atmospheric emission is higher than oil and gas. Oil and gas impacts on environment are at various levels such as extraction, transportation and the usage yet it is mainly at transportation fuels and in electric power generation (Ehrlich p,32)[19].

Practice of fracking, in natural gas could be the most concerned problem and as it mentioned above oil spills are the most significant environmental impact in the case of oil. These oil spills happen regularly yet we do not see them much in the media people only pay attention to that when huge ones happen. For example the one in 2010 was a BP Deep water Horizon Disaster and it captured huge attention. Oil spills can easily affect the wildlife and only few birds can survive after the damages. We also need to mention the 1973 oil crisis, producers in Persian Gulf decided to raise their oil prices by 70% and following this decision Arab members of the Organization of the Petroleum Exporting Countries (OPEC) stopped the oil

[18] Quaschning, Volker. "Volker Quaschning: Renewable Energy and Climate Change." *Volker Quaschning - Erneuerbare Energien Und Klimaschutz*. A John Wiley and Sons, Ltd., 2010. 25 Apr. 2017. https://www.volker-quaschning.de/publis/klimaschutz_e/index.php

[19] Ehrlich, Robert. Renewable Energy: A First Course. Boca Raton: Taylor & Francis, CRC Press, 2013.

shipment to USA and cut their production. The reason behind this was politic because there was a Yom Kippur war was going on between the Arab states and Israel and for retaliation to USA and the other countries who were backing up the Israel OPEC stopped the production and shipment of oil. (Ross)[20].

When embargo over, oil prices were became four times more than pre crisis prices and even though that time OPEC countries were happy to see USA and other countries suffering this crisis also end up for suffered countries to invest more in alternative energy and improve their energy efficiency in long run. Because of the 1973 oil shock there were changes in the energy policies for the fear of quick exhaustion of oil and gas reserves but it turned out to be illusory and these efforts from the non-OPEC countries result in energy conservation and investment policies that causes huge reductions in global carbon emissions. Therefore it won't be wrong to say that OPEC members with oil crisis give world a life saving head to start to avoid or reduce the threat of catastrophic climate change (Ross,5)[21]

Ehrlich also states that economic damage of a these spill are easy to get over it when you compare it with their long-term effect on human health and environment. Therefore it can be said that the main concerns of these fossil energies are global warming and it mainly happens because of the increase of Greenhouse Gases, which caused from burning fossils. Humankind's actions has been changed the climate therefore in 2007 "Statement signed by the national science academies of Brazil, Canada, China, France, Germany, Italy, India, Japan, Mexico, Russia, South Africa, the United Kingdom, and the United States and they all agrees that it is unequivocal that the climate is changing, and it is very likely that this is predominantly caused by the increasing human interference with the atmosphere"(Ehrlich p,32)[22]. Even though it is true that there is a decrease in the

[20] Ross, Michael L. "How the 1973 Oil Embargo Saved the Planet." *Foreign Affairs*. 12 Mar. 2017. Web. 12 Mar. 2017.

[21] *Ibid*

[22] Ehrlich, Robert. Renewable Energy: A First Course. Boca Raton: Taylor & Francis, CRC Press, 2013.

growth of world population however there are already too many people living in the world and that affects the sustainability of the future. It means that impacts of human being actions to environment has already been done and there is no turning back from it yet things can be prevented to go worse and using renewable energy instead of fossil will reduce the effects on climate change. Now we can discuss about the climate change concerns.

2.1 Climate Change Concerns

Elliott argues that "The development of patterns of energy generation and use which can be sustained into the future is increasingly being seen as urgent, given growing concern about the potential social and economic impacts of climate change"(p,19)[23]. In last ice ages climate conditions were stable however our civilization there has been some changes.

Climate change issue is a global problem that gets worse with the industrialization of developing countries. Since developed countries are the main ones, which contributed the most to this problem, they shall also play the leading role in creating ways to reduce it. Since the industrial revolution, fossil fuel combustion increased and this will continue to increase more if nothing would have done about how energy is uses and generated. According to Elliot also "World energy consumption is projected to increase by 59% from1999 to 2020, with fossil fuels providing the bulk of this energy" (p,19)[24].

The usage of fossil fuels in industrialized countries are divided equally between the coal for electricity, natural gas for heating and oil for transport systems, yet this division can be change as gas for electricity and transport. Usage of fossil fuels creates carbon dioxide gas by vehicle engines and acid emissions, greenhouse

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[23] Elliott, David. "Sustainable energy: Choices, problems and opportunities." Issues in Environmental Science and Technology Sustainability and Environmental Impact of Renewable Energy Sources (n.d.): 19-48.

[24] *Ibid*

gases all together have play a huge role in climate change. Many of the World's scientists in Intergovernmental Panel on Climate Change (IPPC) get together and came into a conclusion that human activities are the main cause for the climate change (Elliott p,20)[25]. As it is already mentioned above if an action won't be taken, there will be an increase in ecological problems in the world, which will also lead to social and economic problems. In last 100 years world temperature has been increased around 0.7°C "In some regions of the world the temperature is already higher by 2 °C as an annual average" (Quasching,24)[26].

Moreover, there would be increase in sea levels that would cause more floods, erratic weather patterns will cause violent storms and many more situations like that would occur. Actions must be taken or it would get worse because the demand on energy would continue to be increase. According to Elliot's data for instance from 1999 to 2020, world CO2 emission is expected to rise from 6.1 billion metric tones and until 2050 15.1 billion metric tones would expected and this numbers equal to 152% of increase since 1990(p,21)[27]. Since world energy usage is around fossil fuels reduce the emission level is not easy. Again it is a must that world needs to be turn into a use of renewable energy. Despite the level of their development all countries are facing with to improve a cleaner technology for the use of renewable energy sources.

2.2 Renewable Energy

Climate compatible energy use has a limited effect on reducing the carbon dioxide but the use of renewables is a different story since they are unlimited this usage

[25] Elliott, David. "Sustainable energy: Choices, problems and opportunities." Issues in Environmental Science and Technology Sustainability and Environmental Impact of Renewable Energy Sources (n.d.): 19-48.

[26] Quaschning, Volker. "Volker Quaschning: Renewable Energy and Climate Change." *Volker Quaschning - Erneuerbare Energien Und Klimaschutz*. A John Wiley and Sons, Ltd., 2010. 25 Apr. 2017. https://www.volker-quaschning.de/publis/klimaschutz_e/index.php

[27] Elliott, David. "Sustainable energy: Choices, problems and opportunities." Issues in Environmental Science and Technology Sustainability and Environmental Impact of Renewable Energy Sources (n.d.): 19-48.

would change the situation. “The amount of energy that reaches the earth’s surface from the sun each year is 8000 times more than the total primary energy requirement of the world” (Quaschning,78)[28]. Therefore solar energy is more than enough in order to supply the necessary energy for the mankind.

Renewable energy is an energy, which comes from the natural resources and these resources can be named as, ocean, wind, sun, hydropower and waves. Even though renewable resources have some drawbacks they are still less harmful to the environment and the total energy that comes from the various renewable energy resources is very large. Besides the mentioned renewable resources , there is one more type of energy that is not come from natural resources but wastes of human civilization, which called biomass and in some countries they use this garbage for to create electricity.

Due to the problems that human nature facing the term sustainability became more popular. “Sustainability can be described as maintaining welfare over a long-term and the report of United Nations defines sustainable development as “The development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (Altıntaş, Türk, Vayvay p,7)[29]. Mankind actions had negative effects on environment, which caused unsustainability. According to the definition of sustainability; energy would continue to be used in future and renewable energy would allow this continuation more than the others. There are some renewable energy sources, which are more satisfactory in the case of sustainability such as geothermal energy because it is present everywhere in the world and also in some places to access this energy is much easier than the others (Ehrlich p,16).[30] However on the other hand with the

[28] Quaschning, Volker. "Volker Quaschning: Renewable Energy and Climate Change." *Volker Quaschning - Erneuerbare Energien Und Klimaschutz*. A John Wiley and Sons, Ltd., 2010. 25 Apr. 2017. https://www.volker-quaschning.de/publis/klimaschutz_e/index.php

[29] Altıntaş, Koray, Türk Tuğba, and Vayvay Özalp. "Renewable Energy for a Sustainable Future." *Marmara Fen Bilimleri Dergisi*. Marmara Journal, 2016. 25 Apr. 2017. <http://e-dergi.marmara.edu.tr/marufbd/article/view/5000148570/0>.

[30] Ehrlich, Robert. Renewable Energy: A First Course. Boca Raton: Taylor & Francis, CRC Press, 2013.

energy of wind and solar location is very important because the consistency of them is depending on the location. Therefore it can be said that for specific renewable energies you can reach them in certain areas.

Even though location matters some exceptions must be add to his assumption such as Germany. In Germany there is not much of a sun yet it is a leader in solar energy so sometimes the policies of governments could be count more important than the countries resources. Fossil fuels are also like the renewable energy resources they are not equally distributed through out the world every region has some renewable energy resource and since different types of renewable energy resources complement each other.

So when we look at the general situation the best renewable energy resource changes depend on the location and availability of the resources. Therefore it is not possible to say that what type of renewable energy gives us the best promise in the future. For instance, technological changes could evaluate in favor of one of the resources. However, in the past until now Ehrlich claims that " two sources have generated the greatest amounts of power, namely, hydro-power (3.4%) and biomass (10%), mainly used for heating, with all the other renewable sources constituting about 3% of final energy consumed"(p,17)[31]. Renewables are not something new there are with us for a long time now. Back in day's humans of the world used them to sail or grow food. So what new is that the attention towards them not their existence.

Lately the attention and the effort to use them in some of the nations have been increased. Maybe, for now renewable energy source are not competitive to fossil fuels but this situation changes rapidly. This change would be a huge challenge especially when you compare the cost of fossil fuels and renewable energy, renewables could be expensive. When we look at the basic criteria of the world's energy choices, economic factor is more important compare to environmental

[31] Ehrlich, Robert. Renewable Energy: A First Course. Boca Raton: Taylor & Francis, CRC Press, 2013..

issues. Even though economic criteria is important if the long term health of mankind cannot be maintained then it would not mean much. In addition to that even though there are backsides of the usage of renewables, sufficient energy could be reached from these resources in order to cover our needs. Now we came to the part that we will talk about these resources in detail.

2.2.1 Geothermal Energy

Geothermal energy has been used for a long time. “The Earth’s core, 4,000 miles below the surface, can reach temperatures of 9000° F, this heat geothermal energy flows out- ward from the core, heating the surrounding area, which can form underground reservoirs of hot water and steam”(Renewable Energy p,3)[32]. So this out coming energy can be used to generate electricity or heat. Geothermal use globally increased because of the search for new energy alternatives and rapid technological changes. After looking at the heating usage of geothermal energy, China is the leading nation and it followed by USA. As it is argued before geography is very important when it comes to renewable energy and for geothermal energy it can be easily said that it is mostly found near the volcanic regions (Ehrlich p,155)[33].

Geothermal produce higher energy, when you compare it to other renewable energy resources such as wind. Opposition to intermittent renewable energy sources like wind, geothermal electrical plants provide base load energy. In addition that if the conditions are more favorable in a place, geothermal electric power could produce in a cost competitive level. According to Geothermal Association, in 5 years, capacity of geothermal electric generating would increase up to %80 in the areas, which were not considered as favorable before, and this kind of development would be only possible with the continuing technological improvements. Because geothermal energy could be also used in residential

[32] "Renewable Energy: An Overview." *Energy Efficiency and Renewable Energy | Department of Energy*. U.S. Department of Energy (DOE), Mar. 2001. 25 Apr. 2017.

[33] Ehrlich, Robert. Renewable Energy: A First Course. Boca Raton: Taylor & Francis, CRC Press, 2013.

heating with low heat it could be cost prohibitive even at the non-favorable conditions. (Ehrlich p,157)[34]Moreover, it is proven to be useful in so many heating such as hot water, district, hot thermal baths which are useful for tourism purposes and industrial processes.

Advantages of geothermal energy can be summarized as economical, environment friendly, helpful to climate change, sustainable plus it can be used for both residential and non-residential. Moreover, if the conditions are in favor then it could be easily used to generate electricity power cheaper than the other kinds of resources. The usage of geothermal energy has been increased however it still covers only a small percentage of the power production from solar energy but still has a huge potential.

2.2.2 Wind Energy

For many year people used windmills to harness wind energy it is an application of hundreds of years. Today instead of windmill there are wind turbines to harvest wind energy in more efficient way (Renewable Energy p,4)[35]. Wind Power is the one renewable energy source that attracts the most media attention even though the biomass and biogas are the quickest economic option. Power of wind in the world is huge yet not much of this power is accessible because the enormous power of the wind can be only reached at high altitudes and far out the sea. Even though this is the case, accessible amount of wind estimated around 300million GWh per year, which is highly above the electricity demand of the world and recently improvement in technology caused a huge expansion (Ehrlich p,184)[36].

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[34] Ehrlich, Robert. Renewable Energy: A First Course. Boca Raton: Taylor & Francis, CRC Press, 2013.

[35] "Renewable Energy: An Overview." *Energy Efficiency and Renewable Energy | Department of Energy*. U.S. Department of Energy (DOE), Mar. 2001. 25 Apr. 2017.

[36] Ehrlich, Robert. Renewable Energy: A First Course. Boca Raton: Taylor & Francis, CRC Press, 2013.

Some part of the world electricity in 2010 generated from wind energy and in numbers its capacity equals to 175 GW, World's leading nations in wind capacity are Germany, USA, China and India and all together they covered the most of the worlds installed wind capacity (Ehrlich p, 184)[37]. As it will be seen in the next chapter, China has shown an incredible growth in installed wind capacity and it has doubled its capacity since 2005 and the usage of wind power to generate electricity dominated the agriculture purpose in general. Moreover, in many industrialized and developed countries, wind power became the largest component for electricity generating because of the economic and environmental considerations.

Even though other renewable energy sources have a lot of potential such as solar energy, still the potential of variations are much greater for wind energy. Moreover "Wind energy has been the fastest growing source of energy in the world since 1990, increasing at an average rate of over 25 percent per year. It's a trend driven largely by dramatic improvements in wind technology" (Renewable Energy p,7)[38]. However, it is not wrong to say that if there is no potential for wind power in the area then it is not logical to waste subsidies in order to install wind farms. After the short description of wind power now chapter will continue with another renewable energy resource called "Hydropower".

2.2.3 Hydropower

Hydropower, is essentially depends on solar because even though the motions of the water is related to do the work, the water cycle of the planet is driven by the solar energy itself. Moreover solar power is the one that controls the river flows and ocean waves. Like the other renewable energies, hydropower also started to use at early ages for agricultural purposes for irrigation and until today hydropower continue to play an important role in different civilizations and with the industrial

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[37] Ehrlich, Robert. Renewable Energy: A First Course. Boca Raton: Taylor & Francis, CRC Press, 2013.

[38] "Renewable Energy: An Overview." *Energy Efficiency and Renewable Energy | Department of Energy*. U.S. Department of Energy (DOE), Mar. 2001. 25 Apr. 2017.

revolution is started to account for more advanced applications. “Hydropower plants convert the energy in flowing water into electricity and the most common form of hydropower uses a dam on a river to retain a large reservoir of water” (Renewable Energy p,2).[39] This usage is for to harness to create electricity by controlling the water flow. Some of the Hydroelectric generating plants require large damns but some of them do not and in applications such as “run of the river” for example, it is able to capture the energy immediately when water flows. In addition to that hydropower plants sometimes are used as a tool to store energy (Ehrlich p,220)[40].

Like any other renewable energy resources, hydropower is an energy that will never run out and it is environment friendly. In worldwide, hydropower holds account of most of the electricity among the renewable resources. It does also contain the one of the largest scale power plant on earth. Near these positive sides, it also offers the economies of scale but even though it is the largest renewable energy resources when it comes to create electricity there is still huge amount of underdeveloped potential that can be used to provide a higher amount of energy. Ehrlich argues that power plants go for a long time around 50 -100 years and when you think about the cost- benefit analyses the highest cost you will pay at the beginning for the instruction and after that the provided electricity can be considered as very low cost (p,221)[41]. So the production of Hydropower is highly efficient compare to any other renewable energy and fossil fuel plant because they basically provide electricity at the lowest cost. Now it can be talked about the renewable resource that has one of the highest potential, which is “Solar”.

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[39] "Renewable Energy: An Overview." *Energy Efficiency and Renewable Energy | Department of Energy*. U.S. Department of Energy (DOE), Mar. 2001. 25 Apr. 2017.

[40] Ehrlich, Robert. Renewable Energy: A First Course. Boca Raton: Taylor & Francis, CRC Press, 2013.

[41] *Ibid*

2.2.4 Solar Energy

Solar radiation is the reason for all life at the planet and the amount of this radiation is enormous. It is so much more than the any other renewable energy resources. Thus, it is necessary to know, many of the renewable energies are also driven may the solar radiation. In order to harvest a good amount of solar energy has many dependent on variables. For instance it needs a good number of day light in a year, cloudiness and atmospheric extent are also other variables and according to Elliott, "The sun is a working fusion reactor that already supplies more energy than human beings could use, if technologies can be developed to tap it efficiently" (p,29)[42]. Again, most of renewable energy are driven by solar radiation. Some of the examples are the creation of winds, waves and biomass growth flows.

Harvesting of solar energy could be possible in two ways. First way is the solar collectors, which can convert the solar radiation into heat and the second way, which will go into it more deeply, called the photovoltaic (PV) cells and they can convert solar radiation into electricity (Ehrlich p,281)[43]. By using solar thermal energy it can heat the houses, your food and generate electricity and using solar thermal to generate electricity is the fastest growing renewable energy application. After a brief description of Solar energy it is now time to pass through the solar energy harvest method which, called "photovoltaics".

Definition of Photovoltaic, which also called as solar cells basically, is the conversion of sunlight into electricity. There are no intermediate steps between the processes of sun to convert in to electricity. Even though it is much more expensive, there are efforts to reduce the cost of them because the future of PV seen very bright and therefore many programs of this technology have receives huge support in the world especially in Germany, Japan and USA. When it comes

[42] Elliott, David. "Sustainable energy: Choices, problems and opportunities." Issues in Environmental Science and Technology Sustainability and Environmental Impact of Renewable Energy Sources (n.d.): 19-48.

[43] Ehrlich, Robert. Renewable Energy: A First Course. Boca Raton: Taylor & Francis, CRC Press, 2013.

to the PV's environmental impacts, they are all positive and there is no harm from PV to environment. PV reduces the CO2 emission and it does not create noise pollution (Ehrlich p, 282)[44]. Therefore it can be said that in general PV is need to be supported because it is a great technology and steps need to be taken in order to reduce cost and make its usage more common. Further we will move on to Biomass energy.

2.2.5 Biomass

As an energy fuel there is 3 categories of biomass energy resources which are ; forestry biomass, agricultural biomass and wastes. These defined as "Biomass wastes originate from farm crops, animals, forestry wastes; wood processing by-products and municipal waste and sewage" (Resch, Held, Faber, Panzer, Toro, Haas p,4050)[45]. Moreover, the land, yield and conversion efficiency is very important to release the real potential of the biomass energy crops. Generally when these three terms bioenergy, biomass, and biofuels referred we understand that they do not have fossil fuels. Biofuels contain "liquids, such as ethanol alcohol, biodiesel, and various vegetable oils, gases such as methane, and solids such as wood chips and charcoal"(Ehrlich p,133)[46].

Even though biomass release carbon dioxide when it converts in to an energy, since biomass absorbs carbon dioxide as it grows, "the entire process of growing, using, and re growing biomass results in very low to zero carbon dioxide emissions"(Bull,1217)[47] The differences between the usage of biofuels and fossil

[44] Ehrlich, Robert. Renewable Energy: A First Course. Boca Raton: Taylor & Francis, CRC Press, 2013.

[45] Resch, Gustav, Anne Held, Thomas Faber, Christian Panzer, Felipe Toro, and Reinhard Haas. "Potentials and prospects for renewable energies at global scale." Energy Policy 36.11 (2008): 4048-056.

[46] Ehrlich, Robert. Renewable Energy: A First Course. Boca Raton: Taylor & Francis, CRC Press, 2013.

[47] Bull, Stanley R. "Renewable Energy Today and Tomorrow." IEEE Industrial Electronics Magazine Aug. 2001: 1216-226. IEEE Xplore Digital Library. <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=940290&isnumber=20361>.

fuels are that biofuels would not add any CO_2 to atmosphere during their usage and of course they are renewable. Therefore biofuel can be describe as carbon neutral or we can even say that carbon negative during the growth process so it is not a surprise that biofuels considered as renewable energy.

Globally the most used biofuels are the bioethanol and biodiesel and their usage is expected to grow higher in the future. Furthermore these two biofuels are produced from crops like corn and sugarcane. Biofuels are well-known with their usage in transportation sector however it is also possible to use them in electric power generation.

As an example, plant called Miscanthus is one of the best in order to produce biofuels. Miscanthus is to mix half and half with the coal in electric power generation process. According to the assumption this application would supply the %12 of the EU's electrical energy that will needed by 2050 (Resch,Held,Faber,Panzer,Toro,Haas p,4050)[48]. Even though there are so many promising possibilities on biofuels, most of the production of bioethanol and biodiesel is produced from first generation feed stocks. Therefore it can be said that since it is profitable to environment and producers, more efforts needs to be spend on the development of biofuels. Last but not least, we will look in to the Nuclear Power, which also consider as renewable energy.

2.2.6 Nuclear Power

It can be said that nuclear is a form of a renewable energy and currently world is sustaining %6 of its primary energy from the nuclear power plants (Elliott p,26)[49]. The reason behind that is the same reason with other renewables, it is a response to climate change and nuclear plants do not generate carbon dioxide. It is also

[48] Resch, Gustav, Anne Held, Thomas Faber, Christian Panzer, Felipe Toro, and Reinhard Haas. "Potentials and prospects for renewable energies at global scale." Energy Policy 36.11 (2008): 4048-056.

[49] Elliott, David. "Sustainable energy: Choices, problems and opportunities." Issues in Environmental Science and Technology Sustainability and Environmental Impact of Renewable Energy Sources (n.d.): 19-48.

generally believed that there is enough uranium can be used according to the current use rates. What is well known for the nuclear energy is that it is enormous and a million times of chemical processes on a per atom (Ehrlich p,78)[50].

History of this power goes back to WW2 and it is linked with nuclear weapons. This power can generate 20 times more electricity than the solar power. Like the other renewable energies nuclear energy creates no greenhouse gases at its operation process there from the environmentalist perspective it is reasonable and favorable type of energy to use. What nuclear does not that shares with other energy source is the enormously high energy density. This enormous potential of power is the one which makes nuclear more attractive as a energy sources but at the same time so much more dangerous. Nuclear reactor that built in order to produce electricity firstly built in 1951. Due to the enormous energy release during the production the nuclear reactor that used for to produce electricity begins with the creation of heat. After the electricity generated the later process is very much likely of what occurs what happened in the other fossil power plants. In the modern era there have been two major nuclear accidents occurred and they are the Fukushima in 2011 and Chernobyl in 1986 (Ehrlich p,78)[51].

With the direct result of the tsunami and earthquake that hit the Japan, Fukushima accident occurred at 11th March 2011 and this accident let series of nuclear meltdowns and because of the earthquake there was a loss of power from the grid and the backup generators therefore reactors that operate shut down automatically couldn't operate as expected. This incident caused a long-term health and environmental problem. Besides, it also caused economic problems to Japanese and they decided on not to rely on nuclear power. For Chernobyl USSR try to cover up what happened to Chernobyl reactor yet Sweden immediately reported their founding to USSR and made them to notify to the world that the incident had taken place. Only after this action from the Sweden, USSR ordered Pripyat town to be

[50] Ehrlich, Robert. Renewable Energy: A First Course. Boca Raton: Taylor & Francis, CRC Press, 2013.

[51] *Ibid*

evacuated but it was more then 24 hours after the incident and citizens Pripyat tow had been already faced with the most intense radiation. It is also calculated that the radioactivity that released by the Chernobyl is equal to 100-400 Hiroshima bombs. In many nations it is possible to find uranium ore the supply of this resource is quite abundant it is also at the sufficient level compare to needs of the world. However, Electricity from the nuclear power is much more expensive than the electricity from gas or coal and in some cases it is also harmful to environment Due to is extreme energy density less uranium is needed compare to any fossil fuels, on a per kilowatt-hour generated therefore nuclear is safer than the fossil fuel. (Ehrlich, p116)[52].

Nuclear energy has more negative and irremediable effects than its positive effects."Nuclear has a small land footprint but poses a waste disposal quandary that continues to generate vigorous debate about the role of nuclear power in climate policy"(Outka p,253)[53].Nuclear technology began with the WW2 and it used as a weapon not as a power however later it started to become an important contributor to the electricity in so many nations however after the nuclear accidents public opinion change immediately and citizens started to see nuclear reactors very dangerous and problematic. Due to all of the reasons that been discussed under the Nuclear energy title, it is highly unlikely for majority of the people to be appealed by the Nuclear power in the future. As long as the memories of Fukushima and Chernobyl stay in people's mind it would be hard to convince many people to be positive about the nuclear power. There is still a uncertain economic feasibility, researches continues on nuclear fusion reactors. Now we may pass to part that we will discuss the methods, technologies and incentives for the renewables in general.

[52] Ehrlich, Robert. Renewable Energy: A First Course. Boca Raton: Taylor & Francis, CRC Press, 2013.

[53] Outka, Uma. "The Renewable Energy Footprint." STANFORD ENVIRONMENTAL LAW JOURNAL, 19 Nov. 2010. 27 Apr. 2017. <https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1711891>.

2.3. Support Measures, Technologies and Incentives of Renewables in General

Sustainable energy needs to be provided and it is only possible by transforming the global energy system. Especially in developing countries more steps must be taken in order to satisfy the quick increase in energy demand and reduce the negative impacts of climate as leading countries.'' New and renewable sources of energy stand at the center of global efforts to induce a paradigm shift towards green economies, poverty eradication and ultimately sustainable development'' (Promotion of new and renewable sources of energy,1)[54]. With the gas and oil energy technology dominated energy market, the new renewable energy system technologies look for its own place in order to compete in the market.

There are huge numbers of investments were made in some countries for renewable energy innovation, development, technological improvement and commercialization. The reason for that is; in some countries there are better promotions, awareness, policies, support schemes and technologies, therefore it is safer for investors to make their investment in those countries. In order to reach this global energy system, sustainability and reduce the costs of renewable energy technologies there must be strategy adopted with consistent national policies and cooperation among the states is a must. So what really matters is that a practical progress towards technologically and economically viable energy systems. Next the importance of renewable energy support schemes and strategies will be discussed. Generally, global support schemes, incentives and technologies of renewables will be analyzed to see where the world is at supporting the renewable energy process.

China is the leading country when it comes to install the renewable energy resources and USA is following them. However there are many other developing countries, which are resource rich enough but needs to develop their capacity, and methods. These developing countries are Brazil, Turkey and India (United Nations

[54] Promotion of new and renewable sources of energy Report of the Secretary-General. Rep. N.p.: United Nations, 2011.

p,8) [55] . GHG reduction is the main idea of applications and it is a challenge but the potential for energy from sustainable technologies are huge.

2.3.1 Renewable Energy Technologies

According to Mustafa and Omer, renewable energy resources are area specific therefore regional development plans must be integrate, they claim that almost %50 of the world's area is a desert part and it does not have electricity and water network. A person who lives in these places are getting water from borehole wells that driven from diesel engine which harms the environment. However there are alternative methods to this without harming the environment that much, which are pump by wind system and by photovoltaic (PV) (Mustafa Omer,105)[56].

RE sources are the key constrains for sustainable future and a developed technology is need to use them in better ways. Energy is essential for our society and for to provide the quality of life and economy. Renewable energy technologies present a clean, abundant energy that is gathering from renewable resources. Some of RE technologies are commercially available such as PV, solar thermal, wind power, biomass and some forms of waterpower. Wind power has the lead with the growth rate since 1997 Bechberger and Elliott mentions that "By mid-2002 there was around 23 000 MW of wind-turbine capacity in operation, with Denmark, one of the pioneers, obtaining around 18% of its electricity from wind projects and in Germany the rate of installation has risen to around 1.5 GW pa, with nearly 9000 MW in place by 2002" (p,30) [57] .Therefore, this data shows us the rapid developments in wind technology.

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[55] Promotion of new and renewable sources of energy Report of the Secretary-General. Rep. N.p.: United Nations, 2011.

[56] Omer, Abdeen Mustafa . "Renewable energy technologies and sustainable development." African Journal of Engineering Research 1(4) (2013): 102-16.

[57] Elliott, David. "Sustainable energy: Choices, problems and opportunities." Issues in Environmental Science and Technology Sustainability and Environmental Impact of Renewable Energy Sources (n.d.): 19-48.

When you compare the conventional technologies like natural gas combined cycle power plants, renewable energy systems are capital intensive for centralized energy production yet after investments to this sector, economic benefits of renewable energy technologies showed improvement compare to the conventional technologies. The reason for that is the low cost of the operation and maintenance. It is especially true in the regions where fuel prices are higher (Elliott p,31)[58].

Renewable energy supplies generally are unpredictable depends on technology and intermittency. For wind energy, for instance it is the most variable one yet it is hardest to forecast. From time to time wind speed changes because it depends on seasons, weather and turbulence. All of these changes are caused problems to predict how much energy can catch from a site and also for wind turbine designs. However, Wind Turbine Technology has developed in 20 years so changes in wind energy are fast these are rapid changes and "machines now commercially available up to 2 MW and having hub heights approaching 100 meters" (Infield and Rowley p,58)[59].

The most common of all these wind turbine arrangements are the connected asynchronous generator. In addition to that in order to limit transient currents, the power control soft start arrangements are also common and these kind of wind turbines work only at fixed speed. Because of the rapid development in technology there are improvements in power quality and quick operation lead variable speed turbines to become more useful therefore they are more common. This technology also let delivery in higher energy yields because it can make wind turbine rotor to work in better aerodynamic conditions for a longer time (Infield and Rowley p,59)

[58] Elliott, David. "Sustainable energy: Choices, problems and opportunities." Issues in Environmental Science and Technology Sustainability and Environmental Impact of Renewable Energy Sources (n.d.): 19-48.

[59]Infield David, and Rowley Paul. "Renewable energy: Technology considerations and electricity intergration." Issues in Environmental Science and Technology Sustainability and Environmental Impact of Renewable Energy Sources (2003): 49-68.

[60].

For the wind technology it is also possible to go offshore without having any hesitation about the environmental problems because there would not be any constrains and wind speeds are higher. Even though offshore would be more expensive it will be worth it when the power delivers back to land. In EU offshore leaders are the Netherlands, Denmark and Sweden however now they are follow by Germany, UK, Belgium and France (Elliott p,31)[61].

Solar radiation is the most fundamental renewable energy resource that arrives to the world. This energy is huge enough to power the bio system, affect the climate system near the ocean and atmospheric system. However it is not easy to record detailed solar radiation data because there are only few weather stations can do this recordation. In order to have statistical significance, solar radiation data must be captured for a long period of time. "It is not easy to design the work of engineers, agricultural scientists and energy planners because reliable radiation information is needed to provide input data in modeling solar energy devices and a good database is required" (Omer,106)[62]. However after the data collection so many applications can be served with the usage of solar thermal energy and it is an advantage that these solar applications grow fast.

Photovoltaic Technology that integrated with buildings is rising quickly and getting great responses. PV modules can be change with roofs and facade elements by integrated into buildings and these application reduce the cost. At the National Renewable Energy Laboratory through the National Center for Photovoltaic, researchers in many institutions work together to lower the production costs by

[60]Infield David, and Rowley Paul. "Renewable energy: Technology considerations and electricity intergration." Issues in Environmental Science and Technology Sustainability and Environmental Impact of Renewable Energy Sources (2003): 49-68.

[61] Elliott, David. "Sustainable energy: Choices, problems and opportunities." Issues in Environmental Science and Technology Sustainability and Environmental Impact of Renewable Energy Sources (n.d.): 19-48.

[62] Omer, Abdeen Mustafa . "Renewable energy technologies and sustainable development." African Journal of Engineering Research 1(4) (2013): 102-16.

increasing the production capacity, developing more efficient design and increasing the product quality. “Capital costs for photovoltaic panels have decreased from more than $50/W in the early 1980s to about $5/W today; energy costs have declined from about $0.90/kW h in 1980 to about $0.20/kWh” (Bull,1217)[63].

Even though these costs are higher than the conventional electricity, commercial markets are growing in developed countries for different usage. Moreover corporate photovoltaic systems in roofing to generate power on buildings are another application that grows fast. Conventional solar photovoltaic, use the energy of light to generate electricity where Thermo photovoltaic uses the energy of heat to generate electricity and both of them also has an advantage to operate at night or when is to much cloud on the sky (Bull,1217)[64].

It is a clear fact that rational and efficient use of energy is the fundamental base for a good and reliable energy policy. As it already clarified in the technology part there is no technical problem for renewables to deliver energy, therefore the main issue is the policies. By increasing the investment in renewable energy technologies it will help to meet future energy demand and at the same time reduce the risks of the fossil energy supply. These kinds of investments are now increasing and they are supporting by favorable policy frameworks (Wüstenhagen, Wolsink, and Bürer p, 2)[65].

Technology is important but to have good and favorable policies are far more important because they would attract people to use and invest on renewables. Governments must take steps in order to promote and courage renewable energy and take a lead to opening access to renewable energy resources to energy markets and this is only possible by creating favorable conditions and economic rates

[63] Bull, Stanley R. "Renewable Energy Today and Tomorrow." IEEE Industrial Electronics Magazine Aug. 2001: 1216-226. IEEE Xplore Digital Library. <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=940290&isnumber=20361>.

[64] *Ibid*

[65] Wüstenhagen, Rolf, Maarten Wolsink, and Mary Jean Bürer. "Social acceptance of renewable energy innovation: An introduction to the concept." Energy Policy 35.5 (2007): 2683-691. Elsevier.

(United Nations p,9) [66]With the support and involvement of local communities RET's can be developed environment sensitive in necessary way. High potential of renewables need to be used also rising demand for renewable energies must be meeting in a cost effective way and good approaches must be implemented.

United Nations encouragement by the General Assembly to raise awareness of the importance for sustainable energy development and for promoting it in global energy system caused to raise awareness in technological improvements and dynamics in renewable energy market. "Investment in renewable energy was fairly limited until the early 2000s. According to Bloomberg New Energy Finance (2011), total investment in clean energy amounted to USD 52 billion in 2004. Since then, investment in clean energy has recorded a substantial growth, reaching USD 180 billion in 2008" (Wüstenhagen, Wolsink, and Bürer p,2)[67]. According to UN data financing the global energy has been raised %30 from 2009 to 2010 and the investment that made to renewables is around $211 billion (p, 12)[68]. Moreover due to their stable and long term policies developing countries like China and Brazil are leading at attracting investors for renewable energies.

In 2010 China's investment in renewable energy is around $48.9 billion and this record is followed by USA and Germany, the investments are firstly made for wind power $94.7 billion and then for solar power $26.1 billion. (United Nations p,12)[69]. So, it can be said that the countries, which showed growth, also have efficient renewable energy policies. Different countries have different strategies and methodologies in their investment, for instance if we look into USA's strategies it is easy to see that highest investment is in venture capital and it is the technology

[66] Promotion of new and renewable sources of energy Report of the Secretary-General. Rep. N.p.: United Nations, 2011.

[67] Wüstenhagen, Rolf, Maarten Wolsink, and Mary Jean Bürer. "Social acceptance of renewable energy innovation: An introduction to the concept." Energy Policy 35.5 (2007): 2683-691. Elsevier.

[68] Promotion of new and renewable sources of energy Report of the Secretary-General. Rep. N.p.: United Nations, 2011.

[69] *Ibid*

development cycle at early stage and their objective is to capitalize it after. On the other hand Europe wants to promote renewable electricity generation and therefore focused on the encouraging demand by using regulatory policies like feed-in-tariffs. Lastly Asia is concentrating on capturing the supply chain of technologies like wind turbines and PV modules. (United Nations p,13)[70]. We can say that all regions and all countries have their own way in promoting the usage of renewable energy with different policies methods and strategies. We will deeply look into some of the countries and regions in following chapters.

[70] Promotion of new and renewable sources of energy Report of the Secretary-General. Rep. N.p.: United Nations, 2011.

CHAPTER 3

NATIONAL STRATEGIES FOR PROMOTING RENEWABLE ENERGY

In this chapter, different policies and strategies of the different countries by promoting the renewable energy will be analyzed. But first as an example in order to understand a successful development in renewable energy, a successful regional institution is necessary to be discussed. European Commission is successful in promoting the usage of renewable energy for its member states. Use of renewable energy resources for electric power generation is successful in the European Union member states because of its binding obligations.

For instance in Germany case it has given the priority and a grid feed in to get power from renewable energy resources. Many other EU member states had adopted these laws in order to encourage the use of renewable energy resources instead of the others. In 2009, European Parliament and European Council created a directive 2009/28/EG in order to increase the usage of renewable energy's role at energy consumption. The aim is to increase it from 8.5% to 20% by the year 2020 and the targeted decrease in transportation aimed around %10 by 2020 in all EU member states (Kohl, Dürrschmidt p,4)[71]. Technology, as it has been already discussed definitely one of the key constraints of this process yet policy and organizational structure are also playing huge part of it. So it can be easily said that without a doubt both energy and environment policy frameworks are very significant in this development process.

Therefore from here it can be seen that the efforts of regional frameworks are as much important as the national efforts and we will look in to effects and efforts of

71 Kohl, Harald, and Wolfhart Dürrschmidt. "Renewable Energy Sources – a Survey." Renewable Energy. 2nd ed. Weinheim: WILEY-VCH Verlag GmbH & Co. KGaA, 2013. 1-172. Web.

the regional organizations in the next chapter. Now we will pass on countries and start with a country, which has a significant development in this sector, Germany.

3.1 Germany

Germany showed a great success in renewable energy development. In 2002 they reached to %9 of green electricity and in 2003 became a world leader in installed wind capacity. It estimated as %40 of the global capacity and same year they became as the second biggest installed PV capacity in the world. Moreover at the end of year 2002, Germany became a European Leader in the sale of biodiesel and solar heating system (Bechberger and Reiche p, 49)[72].

Due to German renewable energy policies through out the years, Germany is a perfect example when it comes to how efforts of individual people with the backup of R&D, Renewable Energy Act, incentives and cooperation of scientific institutions and industrial firms on renewable energy can cause to a new technology industry. This high tech industry over time became a huge power and a global player. Like many other industrialized nations Germany is also highly depended on fossil fuels as an economic factor that is why in energy systems how to reach to a sustainable society play an important part. German governments all specified their ideas on sustainable development and energy system. Germany therefore plays a leading role on promoting renewable energy with "Energiewende". With the help of all these encouragements Renewable energy use has been increased in Germany. According to researchers in 2011, "20 % of the power from German grids came from renewable energy sources, nearly seven times as much as in 1990"(Kohl and Dürrschmidt p,6).[73] The help of the development in wind energy was covering the huge part of this success yet bioenergy and PV also

[72] Bechberger, Mischa, and Danyel Reiche. "Renewable energy policy in Germany: pioneering and exemplary regulations." Energy for Sustainable Development 8.1 (2004): 47-57.

[73] Kohl, Harald, and Wolfhart Dürrschmidt. "Renewable Energy Sources – a Survey." Renewable Energy. 2nd ed. Weinheim: WILEY-VCH Verlag GmbH & Co. KGaA, 2013. 1-172. Web.

had an important contribution.

Energiewende goes back more than 30 years because Germans compare to other EU countries were way more skeptical to nuclear energy since 1980. “Even the climate change debate did not modify that attitude substantially. It was this constellation that made the Fukushima core melt accident on March 11, 2011, an event that changed the government's view on nuclear energy forever”(Hake,Fischer,Venghaus,Weckenbrock p,542)[74]. After Fukushima accident the support for nuclear power dropped. Chancellor Merkel announced a “nuclear moratorium” and immediately seven oldest German reactors shut down and never go online again. Moreover nuclear power plants were suspended.

Clearly, Fukushima created the social and political consensus among German parties on energy issues so renewable energy policy is coordinated and Federal Environment Agency is also dealing with environmental matters. It backs up the scientific support to government in order to implement environmental laws and raise the awareness of the public by giving information about environmental matters. Other institutions like KfW Bankengruppe provides low interest long term loans to renewable energy programs and many measures implemented by The Federal Office of Economics and Export Control (BAFA) in order to support the usage of renewable energies and limit the usage of fossil fuels for climate protection. Among the Federal government and Länder there is a division of duties. While federal government taking care of Renewable Energy Sources Act, the Renewable Energies Heat Act and regulations, Länder approves the regional planning (Hake,Fischer,Venghaus,Weckenbrock p,543)[75].

Germany supports the renewable energy developments, usage and investments. Both public and private institutions are supporting the renewable energy projects in

[74] Hake, Jürgen-Friedrich,Wolfgang Fischer, Sandra Venghaus, and Christoph Weckenbrock. "The German Energiewende – History and Status Quo." Elsevier, 21 May 2015.08Mar.2017.http://www.sciencedirect.com/science/article/pii/S0360544215004594

[75] *Ibid*

recent years. According to Germany report of IEA, in 2011 the total investment in Germany for renewable energy is about 31.9 billion, China and USA are the only countries which passed that number but in Germany the cost of capital is lower compared to other countries therefore it is more profitable (IEA p,113)[76]. Therefore Germany can attract investors easily in this sector.

3.1.1 Renewable Policies, Strategies and Support Measures

The first German feed in law, the act on supplying electricity from renewables which called Stromeinspeisegesetz, StrEG, came into the force in 1991, according to this law reimbursement is fixed for the electricity that has been based on RES and this caused an attack of wind energy in the market. Later in 2000-it successor Renewable Energy Act (Erneuerbare-Energien-Gesetz, EEG) introduced with more improved regulations of the StrEG. It also allows market entry for the solar PV and biomass energy (Bechberger and Reiche p, 48)[77]. Moreover, in 2010, Germany decided on the increase the share of renewables in total energy consumption by %80 until 2050, a year later in 2011 Germany decided on terminate the nuclear power until 2022 and this policy is called "Energiewende"(Joas, Pahle, Flachsland, and Joas p,42)[78].

The Renewable Energy Sources Act (Erneuerbare-Energien-Gesetz) is the main support instrument in the renewable electricity and it promotes electricity from renewable sources and that based on the feed and tariff (FITs) scheme, different technologies and preferential grid access for 20 years of time. For the electricity production, FIT policies offer long term guaranteed payments for renewable energy developers and it will implement to support for all kinds of renewable energies

[76] Energy Policies of IEA Countries: Germany 2013. Paris: OECD Publishing, 2013. p,5-212.

[77] Bechberger, Mischa, and Danyel Reiche. "Renewable energy policy in Germany: pioneering and exemplary regulations." Energy for Sustainable Development 8.1 (2004): 47-57.

[78] Joas, Fabian, Michael Pahle, Christian Flachsland, and Amani Joas. "Which goals are driving the Energiewende? Making sense of the German Energy Transformation." Energy Policy 95 (2016): 42-51. Elsevier. 4 Apr. 2016.

(Coutre and Cory p,4)[79]. These policies increase the development of different types of technologies, sustainable energy and job creations

Transmission System operators sell the EEG produced electricity the day ahead market and "The differential costs between the guaranteed remuneration payments made to the plant operators and the revenues made on the electricity market are passed through to the so-called privileged and non-privileged electricity consumers on the basis of different tariffs"(IEA p,114)[80]. FITs show differences among the generating capacity of the production type and source of renewable energy. In order to encourage the technology they also decline annually and by doing that they take into account of the decreased cost that associated with the technology. The budget is also independence from the public and research is comprehensive and there is also a regular evaluating and monitoring process. With a huge success of policies in 2011 Germany took a second place in the world after China for the investment in renewable energies with half of it for PV (Palz p,2)[81].

There were some changes in FIT regime that provided by the 2012 EEG. For instance optional market Premium offers operator's incentives like selling the electricity generated directly on the market and give a space to align their offerings closely with the requirements of markets. Besides that flexibility Premium is new and its purpose is to promoting the investment in biogas fired flexible power generation capacity. This can apply both to old and new installations and also gives an opportunity for investments in larger heat or gas storages and generator capacities that allow to a demand-driven electricity generation. (IEA p,115)[82]. It is crucial to know that since the beginning Germany 's success on promoting RES

[79] Coutre, Toby, and Karlynn Cory. State Clean Energy Policies Analysis (SCEPA) Project: An Analysis of Renewable Energy Feed-in Tariffs in the United States. Rep. N.p.: n.p., 2009. NREL. <http://www.osti.gov/bridge>.

[80] Energy Policies of IEA Countries: Germany 2013. Paris: OECD Publishing, 2013. p,5-212.

[81] Palz, W. "Photovoltaic solar energy, spearheading Germany's renewable energy policy: an example to others." EPJ Photovoltaics 3 (2012): 1-3. Elsevier. 26 June 2012.

[82] Energy Policies of IEA Countries: Germany 2013. Paris: OECD Publishing, 2013. p,5-212.

was depend on 4 main instruments that are direct investment subsidies, soft loans , subsidies for the operational costs/feed-in tariffs and tax allowances (Bechberger p, 49).[83] Now we can pass on the policies in transport sector.

The EU-Commission has declared itself as the premier with its target of %20 decrease in GHG emission until 2020 also with the increment of energy efficiency by %20 and biofuels in transport sector by %10. The EU aimed to overcome their dependence on increasing oil prices and harmful effects of fossil fuels (Dieter and Park p,324)[84]. Since these targets are binding among the member states, Germany also has to take actions. In transport sector Germany introduce the Biofuels Quota Act. This act contains the minimum levels of biofuels that must be used in Germany's road transport.

Renewable energy policy mostly targets the transport and electricity sectors and in the transport sector biofuels plays an important role. "Since bio-fuels were introduced in 1992, their share in total transport fuel consumption has grown from 0.5 per cent in 2000 to 7.2 per cent in 2007, but it fell again in 2008 and it is expected that the consumption of bio-fuels will increase continuously up to 8 per cent by energy content of all transport fuels by 2015 due to the introduction of a bio-fuels quota in 2007" (Dieter and Park p,330). According to the biofuels quota act, since 2010 quota is determined as 6.25%, however after 2015, climate protection quota replaced the biofuels quota and after specified the net contribution, it decided that the amount of biofuels it can have in order to reduce the GHG emission is %7 by 2020 (IEA p,120)[85].

In addition to that in 2011, the Biofuels Sustainability Law also entered in force and the aim of the law is the consider biofuels sustainable only if it can save at

[83] Bechberger, Mischa, and Danyel Reiche. "Renewable energy policy in Germany: pioneering and exemplary regulations." Energy for Sustainable Development 8.1 (2004): 47-57.

[84] Dieter Eissel, and Park, Sang-Chul. "Alternative Energy Policies in Germany with particular Reference to Solar Energy." Journal of Contemporary European Studies 21 Oct. 2010: 323-339. Tandfonline. <http://dx.doi.org/10.1080/14782804.2010.507917>.

[85] Energy Policies of IEA Countries: Germany 2013. Paris: OECD Publishing, 2013. p,5-212.

least the %35 of GHG emission when it compared with fossil fuels and it is an implementation of EU policy in national level (IEA p,120))[86]. In 2011, federal government approved the Electro mobility Program and it was based on the National Development Plan for Electro mobility that launched in 2009. Aim of this program was to develop the R&D of electric battery-powered vehicles in Germany. In addition to that target was to promote their launching and commercialization on the German market. It is also targeted that until 2020 there will be one million electric vehicles on the German market and this will expected to increase 6 million by 2030. Therefore Germany is the lead market for the electro mobility for now. (IEA p,121)[87].

Germany became a world leader in transforming fossil fuels economy to renewable energy economy. "This transition is remarkable for its speed the first national "feed-in law" facilitating the development of renewables was passed in 1990, and by 2013 renewables accounted for nearly 25 percent of Germany's gross electricity consumption" (Heger p, 2).[88]

According to Renewable Energy Sources Act it is decided that by 2020, federal government decided on %35 of gross electricity consumption would be received from renewable energy and by 2030 this number expected to be around 50% lastly 80% by 2050 (IEA p,121)[89]. With the growing roles of renewables in Germany there were increments in capacity additions also in onshore wind capacity and Solar PV installations. In addition to that 2012 winter in Europe, Germany was the net exporter in solar PV.

[86] Energy Policies of IEA Countries: Germany 2013. Paris: OECD Publishing, 2013. p,5-212.

[87] *Ibid*

[88] Hager,Carol German Politics and Society, Issue 115 Vol. 33, No. 3 (Autumn 2015): 1–27 doi:10.3167/gps.2015.330301 • ISSN 1045-0300 (Print) • ISSN 1558-5441 (Online)

[89] Energy Policies of IEA Countries: Germany 2013. Paris: OECD Publishing, 2013. p,5-212.

3.1.2 Renewable Energy Power

As it has been already mentioned, in Germany renewable energy is very important and considered as the key component in the Energy concept. “In 2000, a fixed feed-in tariff for wind power was introduced under the Renewable Energy Sources Act (EEG) with the goal of enabling stable framework conditions for investments with a cost-covering remuneration: Plant operators received a fixed remuneration for every kilowatt hour fed into the electricity grid and in 2012, an option for direct marketing with a floating market premium was introduced: Plant operators must sell their wind power themselves or via a service provider, receiving the electricity market price plus the difference between the EEG-determined plant-specific tariff and the average market value of the total wind power in Germany “(May, Neuhoff, and Borgreffe p, 315)[90].

In order to have experience in wind farm sector for the Offshore Wind Power Programme, there was a support around 5 billion Euros for the first 10 offshore wind farms also in addition to that to the Offshore Installations Ordinance (Seeanlagenverordnung) there is an amendment that make the approval of the installations easier and faster in the German Exclusive Economic Zone (IEA p,118)[91]. By implementing this amendment it became easier to change the old wind installations with new and more efficient turbines. Besides that government and Länder work together to designate the suitable sites for the onshore wind energy.

For the heating market in Germany, federal government used the Market Incentive Program for Renewable Energies as the main tool for to promote renewable energy in this market. It has been a decade that market incentives program supporting the investments in renewable heating technologies and therefore it helps to enter the new and innovative products into market. Moreover, guidelines for funding in this

[90] May, Nils, Karsten Neuhoff, and Freider Borgreffe. "Market incentives for system-friendly designs of wind turbines." DIW Economic Bulletin (2015): 313-21. 21 May 2017.

[91] Energy Policies of IEA Countries: Germany 2013. Paris: OECD Publishing, 2013. p,5-212.

program are regulate on annual basis depends on the current market trends and technological progress (IEA p,120)[92].

In 2011 guidelines in the Market Incentive Program includes the grants for investment costs mostly for private investors for single or two family houses and smaller installations and that are available from Federal Office of Economics and Export Control (BAFA) and it also includes repayment subsidies with low interest loans that are part of the Renewable Energies program and this program operates by the Bank for Reconstruction. It is for the heating solutions and most of these heating solutions are implemented for municipal authorities or commercial customers. According to 2010 data funding reached around the 349 million EURO under the Market Incentive Program and that caused more than EUR 2.15 billion investments in total (IEA p,120)[93].

Since 2002, Solar heating systems/solar collectors market of Germany is by far the biggest in Europe. German individuals and communities changed the trend and invested more than one million individual PV systems and with "25 GW, PV already accounts for a significant proportion of the total equipment required to sup ply electricity to the whole of Germany, whose requirements at peak hours are 80 GW"(Palz p,1).[94]

In 2011, for the solar energy in Germany, shown to be 22.2 TWh which is equal to %16.8 of the total 132.3 TWh of energy is supplied by renewable energy sources and that was generated by PV technology and according the National Renewable Energy Action Plan data installation capacity was also grown from 7.7 GW in 2011 to 7.6 GW in 2012 and it is expected to reach the number 51.8 GW by 2020 and to generate 41.4 TWh of electricity (IEA p,124)[95]. FIT regime for PV has been gone into revision and some adjustments because deployment exceeds the suggestive

[92] Energy Policies of IEA Countries: Germany 2013. Paris: OECD Publishing, 2013. p,5-212.

[93] *Ibid*

[94] Palz, W. "Photovoltaic solar energy, spearheading Germany's renewable energy policy: an example to others." EPJ Photovoltaics 3 (2012): 1-3. Elsevier. 26 June 2012.

[95] Energy Policies of IEA Countries: Germany 2013. Paris: OECD Publishing, 2013. p,5-212.

corridor levels overheating. Attempts were taken in order to aimed to keep the FIT levels close to PV costs in Germany for the net present value of future payments which is lower than the sunnier countries because of the market maturity.

For biomass energy, it does cover the second largest share for electricity generating among the other renewable resources. Biomass also covers biogas, solid and liquid biomass, sewage gas, biogenic share of waste and lastly the landfill gas. "Biomass energy production in German now represents the largest share in the EU, and it shares top spot with Japan in relation to both technology and global market share in solar PV" (Dieter and Park p, 338)[96].

National Biomass Action Plan in Germany has been produced along with the cooperation of the Federal Ministry for Food, Agriculture and Consumer Protection and Federal Ministry for the Environment, Nature Conservation and Nuclear Safety in 2009 and this plan targeted to have the best potential for the use of biomass and also to identify the available biomass reserves. Besides this plan also used in federal government's strategies in order to promote the usage of bioenergy and measures to implement for heating, fuel sectors ad highlights the actions and the strategies to promote efficient production of biomass. Moreover with the help of all of these Germany is the leader in electricity production from biogas in Europe. Generation of biogas mostly includes the agricultural manure and energy crops as the primary substrates (IEA p,127)[97].

3.1.3 Overview

Germany has a strong policy framework for renewable energy deployment it has solid set of FITs and it has guarantee for 20 years of time. Federal targets such as in Renewable Energy Sources Act (EEG) and the NREAP go along with the EU's

[96] Dieter Eissel, and Park, Sang-Chul. "Alternative Energy Policies in Germany with particular Reference to Solar Energy." Journal of Contemporary European Studies 21 Oct. 2010: 323-339. Tandfonline. <http://dx.doi.org/10.1080/14782804.2010.507917>.

[97] Energy Policies of IEA Countries: Germany 2013. Paris: OECD Publishing, 2013. p,5-212.

2020 targets in renewable energy deployment. However plans of the federal government for the renewable energy goes way further than 2020 it targets to 2050 and it also goes correlated with the country's industry strategy.

Because of the general FIT structure, renewable energy sources are way more attractive than the traditional energy investments. The reason for that is there is no market risk with the generator and they can even sell electricity when there is a decrease in demand. It is also expected that the cost of solar PV projects and components prices would continue to decrease both in Germany and also globally. In the IEA report it claims that the "Greater levels of renewables deployment and higher renewable energy tariff spending, which is funded through electricity bills, have raised concerns over the impact on consumers but the overall impact of deployment on prices remains complex, particularly with high shares of variable renewable energy decreasing wholesale market prices in periods of high wind levels, reflecting merit-order effect"(p,121)[98].

For the targets of Renewable energy in Germany there is a debate going on and this debate is about the role of feed- in tariffs. Environmentalists in Germany are supporting the system because it leads to an increase in renewable energy usage and capacity. However critiques were about the regressive effect of tariffs in favoring rich consumers over poor ones. Other was complaining that "feed-in tariffs only encourage micro-generation instead of massively reducing greenhouse gas emissions by large scale installations or improving energy efficiency" (Dieter and Park p, 334)[99]. Even though there are arguments on the role of feed and tariffs, high public support exists for to fight with global warming and energy dependency by promoting renewable energy resources.

[98] Energy Policies of IEA Countries: Germany 2013. Paris: OECD Publishing, 2013. p,5-212.

[99] Dieter Eissel, and Park, Sang-Chul. "Alternative Energy Policies in Germany with particular Reference to Solar Energy." Journal of Contemporary European Studies 21 Oct. 2010: 323-339. Tandfonline. <http://dx.doi.org/10.1080/14782804.2010.507917>.

3.2 China

It is a fact that, global warming cannot be fought if China would not involve in it. In total renewable power capacity China is one of the World leaders. It is also a global leader in wind turbine and solar photovoltaic (PV) production. Since 2005 with the Renewable Energy Law its policy frameworks continues to upgrade itself. After Renewable Energy Law (REL) passed in 2005, it is showed the demonstration of China's commitment in developing the renewable energy. After 3 years from the adoption of REL, renewable energy capacity of China showed a rapid growth and wind capacity doubled each year in that 3 years until 2008 (Wang, Feng, Yin, and Li p,1872)[100].

2020 target of China is also similar to one that EU aimed. In 2007, China implemented the medium and Long-term Program for Renewable Energy Development in order to push themselves in renewable energy consumption and increase it %10 for 2010, %15 by 2020, Moreover Chinese government also introduce a book named "China's Energy Conditions and Policies" and aimed to show the plans for developing the energy diversification that will help the increment of the renewable energy development as an important part of the national energy development strategy (Xinyu, , Jin, Li, Yang, Zhang, and Fan p, 1288)[101].

Even though China is a strong competitor on renewable energy development topic it has challenges in technology development, policy frameworks and grid-integration. Technologies for wind, turbines, ocean energy and solar thermal power need more attention and there are resources constraints on biomass power and that cause limitations. Nevertheless renewable energy power plays an huge role on

[100] Wang, Feng, Haitao Yin, and Li Shoude. "China's renewable energy policy: Commitments and challenges." Energy Policy 38.4 (2010): 1872-878. Elsevier.

[101] Xinyu, Gao, Jin Bo, Li Bin, Yang Kai, Zhang Hongguang, and Fan Boyuan. "Study on Renewable Energy Development and Policy in China." Energy Procedia 5 (2011): 1284-290. Elsevier. <doi:10.1016/j.egypro.2011.03.224>.

China's development since 2005 with the Renewable Energy law, wind power capacity grew from %30 from 0.8GW at the end of 2004 to 26GW in 2009 and it is aimed to reach 150 GW by 2020 (Martinot p,287).[102] With this law economic incentives to support renewable energy investment has been also set by Article 25 and Article 26 which were promoting financial institutions to support renewable energy development projects and tax benefits for eligible renewable energy projects that providing from the Chinese government (Wang, Yin, and Li p,1872)[103].

China has a good place for wind power in global scale and it also became the fastest growing energy technology in the country. Renewables in total started to cover 17% of China's power in 2008 and China recorded as the highest renewable power capacity in the World by 2009. Country had also accounted as the %20 of the World total renewable energy power capacity, Besides, according to the development plans of China for 2020 it targeted "300GW of hydropower, 150GW of wind power, 30GW of biomass power, and 20GW of solar PV in the future, for a total of 500GW of renewable power capacity"(Martinot p,287) [104].We will also briefly look into some of the policy developments and renewable energy resources in upcoming sections.

3.2.1 Renewable Policies, Strategies and Support Measures

In order to develop and promote renewable energy, China's State Council and National People's Congress in 2005, approved extensive Energy law. The law has some basic principles and regulations which aim to first establish the importance of

[102] Martinot, Eric. "Renewable Power for China: Past, Present, and Future." *SpringerLink*. SP Higher Education Press, 17 Aug. 2010. 08 Mar. 2017. <https://link.springer.com/article/10.1007/s11708-010-0120-z>.

[103] Wang, Feng, Haitao Yin, and Li Shoude. "China's renewable energy policy: Commitments and challenges." Energy Policy 38.4 (2010): 1872-878. Elsevier. 22 May 2017.

[104] Martinot, Eric. "Renewable Power for China: Past, Present, and Future." *SpringerLink*. SP Higher Education Press, 17 Aug. 2010. 08 Mar. 2017. <https://link.springer.com/article/10.1007/s11708-010-0120-z>.

renewable energy in the national energy strategy, secondly in order to remove the market barriers, thirdly to create market for renewable energy and lastly to create understanding awareness and skills towards renewable energy sector. The main point of this action was to encourage the development of targets plans and strategies for the government and to have renewable energy financial measure. Besides this law also established in order to share the cost of renewable energy among the specified segments of the consumers and for economical perspective it will cause penalties, incentives and that will cause companies to act along with the strategies and targets. In addition to that it provided a long-term government development plan Research and Development(R&D), technology standards and resource surveys (Martinot p,288)[105].

In 2006 The Renewable Energy Law entered into force and there were obligations, which were not exist before and required power consumers to pay extra cost of renewable power as a national cost sharing movement. Besides these feed-in tariffs also pricing mechanisms for wind power and biomass were established in order to attract foreign investment (Martinot p,289)[106]. "In August 2007, the NDRC established the Medium and Long-Term Plan for Renewable Energy Development (2010, 2020) and It is the first national plan for renew able energy development in China, which has set both overall targets for renewable energy shares and specific targets for hydropower, biomass, wind, solar, geothermal and ocean energy by 2010 and 2020" (Hong, Nan, Fridley, and Raczkowski p,1536)[107]. This plan indicates that the share of "non-hydro renewables must reach 1% of the total power generation by 2010 and 3% by 2020 for regions served by centralized power grids" also it is mentioned that the ones who have a greater capacity than 5 GW must

[105] Martinot, Eric. "Renewable Power for China: Past, Present, and Future." *SpringerLink*. SP Higher Education Press, 17 Aug. 2010. 08 Mar. 2017. <https://link.springer.com/article/10.1007/s11708-010-0120-z>.

[106] *Ibid*

[107] Hong, Lixuan, Nan Zhou, David Fridley, and Chris Raczkowski. "Assessment of China's Renewable Energy Contribution during the 12th Five Year Plan." *Energy Policy* 62 (2013): 1533-543. *Elsevier*. 10 Apr. 2017.

increase its capacity 8% percent by 2020 (Martinot p, 289)[108].

With the three main decrees the updated law in 2009 entered in to force in 2010, firstly a detailed planning and coordination is established and that include the development of coordination and transmission of renewables in all electric power system in national and local wise. The reason for to update this provision is because wind power in the renewable energy sector had been showed a rapid growth and inter connection and transmission rapidly fall behind the wind turbine installations which caused a problems in transmission access in completed wind capacity because sometimes projects lacked official approval maybe they were not coordinated with national planning or they had some issues their operational status. Secondly, updated provision all renewable energy power must be purchased by electric utilities and before the update electric utilities were just obligated if there was a sufficient power demand on the grid yet with the 2009 update in every circumstances they must purchase power yet they can be able to transfer this power to national grid company in order them to use somewhere else. In addition that it also put economic penalties and deadlines for the utilities which fail to fulfill this requirement. Thirdly, the renewable energy fund that under the Ministry of Finance has been strengthened. It started to allow the ministry to have funds from the general revenues because the old way of collecting funds which is by surcharge on electric power sales among the nation, started to not to cover the costs of feed in tariffs and government supported renewable energy projects (Martinot p,289)[109].

3.2.2 Renewable Energy Power

Due to the enormous rising demand from the world market especially from European countries in 2004 , PV industry in China developed very fast . However domestic PV market in China until 2010 was small because of the lack of sufficient

[108] Martinot, Eric. "Renewable Power for China: Past, Present, and Future." *SpringerLink*. SP Higher Education Press, 17 Aug. 2010. 08 Mar. 2017. <https://link.springer.com/article/10.1007/s11708-010-0120-z>.

[109] *Ibid*

incentives in order to promote domestic PV deployment. However, later that picture changed due to incentives that implement by the Chinese Government. Moreover, with the "11th Five Year Plan (11th FYP), the production of solar cell had and China's solar PV production technology and the quality of solar cell have improved year by year" (Zhang, Yongxiu p,394)[110].

Even though China has significant potential in renewable energy resources such as wind and biomass, in the case of Solar PV it has a huge growth potential among the all-renewable technologies. Policies established in order to support the growth for the potential of all renewable power technologies and by time growth started to increase in grid-connected solar. Policies enacted in 2009 to promote domestic development of grid-connected solar PV will begin to increase growth. Same as the other renewable technologies when solar PV cost decline further there will be an increase in these types of applications and solar PV will start to integrate in buildings. As same as wind storage technologies, Solar PV also needs same of energy storage technologies (Martinot p, 293)[111].

3.2.3 Renewable Energy Technology Development

It is a fact that Renewable energy developed and utilized by using new and constantly developing technology and China is working on developing its technology for renewable energy since 1980's. It has investments and supports for wind power, solar PV power, ocean biomass and geothermal power technologies. Back in time Hydropower, solar and wind power mostly used for the rural electrification. Township Electrification Program which ran for 1 year between 2003-2004 was for to provide electricity by using hydro and solar power to 1.3 million people and after few years China's focus shifted to bulk power generation on centralized grids (Martinot p,287). "Renewable Energy Scale-up Program

[110] Zhang, Sufang, and Yongxiu He. "Analysis on the Development and Policy of Solar PV Power in China." *Renewable and Sustainable Energy Reviews* 21 (2013): 393-401. *Elsevier*.

[111] Martinot, Eric. "Renewable Power for China: Past, Present, and Future." *SpringerLink*. SP Higher Education Press, 17 Aug. 2010. 08 Mar. 2017. <https://link.springer.com/article/10.1007/s11708-010-0120-z>.

(RESP) China-Denmark Bioenergy CDM Province Level Capacity Building Project Implement the Jiangsu Rudong 25 MW straw power project to investigate the current situation of biomass energy technologies and resource utilization, set up research centers and consultancies, and provide trainings" (Zhao, Yu, Zuo, Feng, and Zillante p,110).[112]With its detailed measures, it's created a National Action Plan for rural biomass energy in China.

However the science and technology research is not enough in China. More over not mature technologies do not have the potential for further development. "The national standard and industrial standard of technology and product is not complicated, and the same for security architecture of product and facility. It is lacking of institutions of sound project approval and new product introduction and so on in Chinese energy market" (Xinyu, Jin, Li, Yang, Zhang, and Fan p, 1288)[113].

Due to China's long and vast coastlines, wind energy development potential is high. As it mentioned before in 1980's China's grid connected wind power started to develop and in 1986 first wind warm was established (Wang p,704)[114]. Later in late 1990's China's wind power industry emerged with new companies like "Goldwind" and it began to produce turbine models with 600-kW and 750-kW. An important and a turned point in the wind industry in China was the "Concession policy" in 2003, which promoted the domestic projects with the competitive biding, and it also requires manufacturing %70 of wind turbines domestically. It can be also called as localization process. This policy helped to improve the

[112] Zhao, Zhen Yu, Jian Zuo, Tian Tian Feng, and George Zillante. "International cooperation on renewable energy development in China – A critical analysis." Renewable Energy 36.3 (2011): 1105-110. Elsevier.

[113] Xinyu, Gao, Jin Bo, Li Bin, Yang Kai, Zhang Hongguang, and Fan Boyuan. "Study on Renewable Energy Development and Policy in China." Energy Procedia 5 (2011): 1284-290. Elsevier. <doi:10.1016/j.egypro.2011.03.224>.

[114] Wang, Qiang. "Effective policies for renewable energy—the example of Chinas wind power—lessons for Chinas photovoltaic power." Renewable and Sustainable Energy Reviews 14.2 (2010): 702-12. Elsevier.

technology and industry development in China. (Martinot p, 287)[115].

In 2007 near the 4 domestic manufacturing firms there were other firms in order to develop prototypes and to aspire commercially produce turbines. Therefore with the help of all these developments, China became the dominant manufacturer of wind turbines in the World and its companies placed in top 10 global manufacturers in 2009 and China continued to rise in this sector by number of initiatives such as competitive bidding in 2009. As an example government selected 7 firms in order to supply more than 5GW of wind turbines to 25 projects in Inner Mongolia and Hebei provinces, after 2008 Chinese companies also started to export components and turbines to other countries also in period of 2007-2009 they also started to began with the offshore wind power development with the Project called Shanghai Dongdaqiao with 100MW and its construction started in 2009 and other projects were also planned in China (Martinot p, 288)[116].

However, there are some barriers of market and non-market conditions that affect the investment conditions for renewable energy. Renewable energy development needs good policies needs supportive policy in order to reach their goal. Therefore China's wind power development is a great example because before these supportive and effective polices were introduced power development was slow and after China showed a rapid growth. "In 2007, cumulative wind installations in China exceeded 5 GW, the goal originally set for 2010 by The Medium and Long-term Renewable Energy Development Plan So, in 2008, policymakers had to double their wind power prediction 10 GW for 2010, still the total of wind power installed capacity reached 12.15 GW by 2008 and China's wind power installed capacity is expected to 100GW, ranking the country's third-largest power resource

[115] Martinot, Eric. "Renewable Power for China: Past, Present, and Future." *SpringerLink*. SP Higher Education Press, 17 Aug. 2010. 08 Mar. 2017. <https://link.springer.com/article/10.1007/s11708-010-0120-z>.

[116] *Ibid*

after coal and hydroelectric power by 2020 " (Wang p,703)[117].

3.2.4 Overview

Like other nations in the world China as one of the world leaders is seeking to have effective measures against the energy crisis the pollution and also for the energy security. However as I already explained above the cost is a very important factor in this situation so it hinders the usage of renewable power generation in the commercial environment therefore China like many other countries, implemented FIT policies in order to support the generators employing renewable technology.

Countries who give importance to renewables have effort to in order to improve renewable energy policies and to have revisionist policies periodically. It is a fact that FIT policy is the most effective government aim in order to promote installed capacity because the guaranteed payment structure ensures a great deal of investment security and encourage participations and investors who are risk averse in order to develop renewable energy.

China became leader in the solar industry with the establishment of FIT policies in China since it helped the development at green power market. National Development and Reform Commission (NDRC) in 2013 instituted a FIT via fixed subsidy policy in order to promote the application of solar energy. This commission stated that solar power could be bought from the market price by the grid company and the for the generators it would be able to receive a subsidence of a fixed price of 0.42 Yuan/kWh and in addition to this with this favorable policy in green power, in 2013 China was again became to one of the tops at the world rank in PV generation with an installed capacity of 18.1 GW which was above the 10

[117] Wang, Qiang. "Effective policies for renewable energy—the example of Chinas wind power—lessons for Chinas photovoltaic power." Renewable and Sustainable Energy Reviews 14.2 (2010): 702-12. Elsevier.

GW the government target. (Liu,Li,Zha p,252).[118]

However, there were problems occurred because of the rapid Chinese growth was beyond the all expectations therefore it caused financial problems for the government and at the same time it effected the stability of the power system. Therefore as a result of this Chinese government proposed the CFCC policy in order to provide stable and smooth construction for the PV. This policy was aimed to installed capacity of solar energy in every province will be arrange evenly with the national goal and excessive amount of solar power no longer be subsidized (Liu,Li,Zha p,253).[119]

These policy changes and already existed policies are prepared groundwork for the renewable energy development until 2020 and for China they might reach their aim even before 2020. Still the technological developments play a huge role on these targets and they can change the course of events in a good or average way. If technological trends continue, costs will decline and transmission constraints were solve then according to Martinot, China will be able to reach half of its electric power comes from renewables instead of one third of the power he also argues that the "International Energy Agency's "Blue Map" global scenario shows the world achieving half of its total power from renewable energy by 2050 and China made highly significant progress with renewable energy from 2000 to 2010, and promises to make even greater progress in the 2010 to 2020 period and beyond"(p,293)[120].

[118] Liu, Cengceng, Li Nan, and Zha Donglan. "On the Impact of FIT Policies on Renewable Energy Investment: Based on the Solar Power Support Policies in China's Power Market, 26 Mar. 2016. 08 Mar. 2017. <http://www.sciencedirect.com/science/article/pii/S0960148116302178>.

[119] *Ibid*

[120] Martinot, Eric. "Renewable Power for China: Past, Present, and Future." *SpringerLink*. SP Higher Education Press, 17 Aug. 2010. 08 Mar. 2017. <https://link.springer.com/article/10.1007/s11708-010-0120-z>.

3.3 United States of America

Individual states near the federal government in USA are different mechanisms in order to promote the development of renewable energy growth. Different policies in different states are depends on the different amount of resources and renewable energy potentials. "Energy Independence and Security Act and Energy Policy Act of 2005 have gone further than previous legislation in addressing the twin global challenges of energy security and climate change, both pieces of legislation were intended to stimulate significant energy market transformation in the United States and bring about major improvements in energy conservation and efficiency in all sectors and regions"(Dixon,Mcgowan, Onysko, and Scheer. p,6401)[121]. In 2006 some of the US states have been implemented policies with feed in tariff features. In 2008, 2 states has been introduced the feed-in tariff bills. So, there has been a change in US policy landscape and states started to implement feed in tariffs in order to promote Renewable energy policies even though there was a conflict between feed-in tariffs and tradable credit policies in Europe (Rickenson, Wilson and Bradbury p,3)[122].

3.3.1 Renewable Policies, Strategies and Support Measures

"Despite the high GHG emission levels, the US has performed well in decreasing the growth rate of CO_2 emissions relative to its real GDP growth rate, from 2000 to 2005 the US was ranked fourth (after Germany, the United Kingdom and Russia) in terms of its ability to reduce CO_2 emissions growth relative to its economic growth" (Dixon,Mcgowan, Onysko, and Scheer. p,6399)[123].

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[121] Dixon, Robert K., Elizabeth Mcgowan, Ganna Onysko, and Richard M. Scheer. "US energy conservation and efficiency policies: Challenges and opportunities." Energy Policy 38.11 (2010): 6398-408. Elsevier.

[122] Rickerson, Wilson, Florian Bennhold, and James Bradbury. *Feed-in Tariffs and Renewable Energy in the USA – a Policy Update*. Rep. Washington DC.: Heindrich Böll Foundation, 2008.10 Apr. 2017.

[123] Dixon, Robert K., Elizabeth Mcgowan, Ganna Onysko, and Richard M. Scheer. "US energy conservation and efficiency policies: Challenges and opportunities." Energy Policy 38.11 (2010): 6398-408. Elsevier.

In order to reduce and limit the production of greenhouse gases in U.S the American Clean Energy and Securities Act is designed a trade policy and this bill ensures tradable allowances that may be distributed to power suppliers. By time it is believed that there will be a reduction in carbon emission among the country. With the act of the American Clean Energy and Security, a mandatory renewable energy generation rate became required for energy-generation companies. In addition to this, utility companies became obligatory to generate their 20% of the power from renewable sources by 2020 and the government adopted other incentives in this act for clean and energy efficient technology which, includes a US$90 billion investment by 2025 for renewable energy and "in 2010, the Rural Utilities Service (RUS) provided more than US$7 billion in loans for the modernization of the rural electric infrastructure and more than US$152 million for smart meters, US$37.2 billion was paid as federal energy subsidies, an almost 200% increase from US$17.9 billion in 2007" (Izadian, Girrens, and Khayyer, 24)[124].

For 2035 previous president Obama set a national goal, which aimed to reach 80% renewable energy penetration besides this bill also included the aim of reaching the production of 1 million electric vehicles by 2015. In addition to this with the act called "American Recovery and Reinvestment" which, introduced in 2009, grid modernization and smart grid demonstration and implementation projects will be funded for about US$4.5 billion and public- private investors funded US$8 billion (Izadian, Girrens, and Khayyer, 24)[125]. Many states in USA have instituted renewable energy targets and different methods in order to reach the balance in consumption. Even though grid, power plants and energy efficiency is part of initiatives, some states has been developed much more methods for their goals.

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[124] Izadian, Afshin, Nathaniel Girrens, and Pardis Khayyer. "Renewable Energy Policies A Brief Review of the Latest U.S. and E.U. Policies." IEEE Industrial Electronics Magazine 19 Sept. 2013: 21-34. ScienceDirect.

[125] *Ibid*

USA is a wide country and therefore it is not easy to reach to a national agreement, rules and developments therefore individual states has been develop their own policies in order to reach their goal in power generation from renewable energy sources. The states that we will shortly look into are California, Colorado, Florida and Oregon so we will briefly see the implementations and methods.

3.3.1.1 California

California plays a leading role not only in USA but also in worldwide in the development of renewable energy. It established FIT system for 1.5 MW capacities and below and generators became able to choose from 10,15 and 20 years of contracts, besides opposite to German law, in California FIT rates are depending on time of delivery, instead of generation cost of specific technologies (Rickenson, Wilson and Bradbury p,4)[126].Therefore automatically all technologies offered the same prices, however these prices are depend on the time of delivery.

California's energy generation demographic shows; 47% gas, 20% hydro, 18% nuclear, 7% geothermal, 3% biomass, and 2% wind However still the energy consumption in California is more than the consumption of its 4 neighbor states (Izadian, Girrens, and Khayyer, 26)[127]. Not surprisingly, state of California has a long history of supporting development of the renewable energy projects. For instance, in the year of 1998, Californian Energy Commission creates renewable energy programs for to increase the electricity production from renewable energy in statewide. Between the years of 1998-2006, Emerging Renewable Energy Program of the Energy Commission funded grid connected PV systems and solar thermal for the residential sites. Many other larger projects for businesses were funded by the California Public Utilities Commission in order to generate their own

[126] Rickerson, Wilson, Florian Bennhold, and James Bradbury. *Feed-in Tariffs and Renewable Energy in the USA – a Policy Update*. Rep. Washington DC.: Heindrich Böll Foundation, 2008.10 Apr. 2017.

[127] Izadian, Afshin, Nathaniel Girrens, and Pardis Khayyer. "Renewable Energy Policies A Brief Review of the Latest U.S. and E.U. Policies." IEEE Industrial Electronics Magazine 19 Sept. 2013: 21-34. ScienceDirect.

electricity. The state of California managed the reached all of their aims and set of goals with the funds from California Energy Commission to use for the construction of solar power on new houses. California was able to reach its renewable energy goal of %20 in 2009 by generating 20.8% of it electricity from renewables also the state has more than 87,170 solar projects and in 2011, the governor of the state signed a legislation that required renewable resources must used to produce 33% of the electricity by 2020 (Izadian, Girrens, and Khayyer, 26)[128].

As it is mentioned earlier in this sector and renewable energy generation, California is not only the leader in U.S but also in the world. It has set Renewable Energy Portfolio Standards that regulates the increase generation from renewable energy sources and "California Energy Commission (CEC) has been exploring feed-in tariffs through its Integrated Energy Policy Report (IEPR) process" (Rickenson, Wilson and Bradbury p,3)[129].Grants, rebates and funds were also offered by The California Solar Initiative (CSI) for the installation and development of the solar PV and heating system. Rebates are only provided for the projects that could consider increasing the power generating capacity and the effectiveness of solar panels (Izadian, Girrens, and Khayyer, 25)[130].

There is also a program called "The New Solar Homes Partnership" (NSHP) which encourages and offer incentives to homebuilders to use solar panels to build energy efficient homes and this is also beneficial for both homeowners and environment. The state of California continues to develop many plans and methods for the implementation of smart grid. 11 million meters had been installed in 4 years after

[128] Izadian, Afshin, Nathaniel Girrens, and Pardis Khayyer. "Renewable Energy Policies A Brief Review of the Latest U.S. and E.U. Policies." IEEE Industrial Electronics Magazine 19 Sept. 2013: 21-34. ScienceDirect.

[129] Rickerson, Wilson, Florian Bennhold, and James Bradbury. *Feed-in Tariffs and Renewable Energy in the USA – a Policy Update*. Rep. Washington DC.: Heindrich Böll Foundation, 2008.10 Apr. 2017.

[130] Izadian, Afshin, Nathaniel Girrens, and Pardis Khayyer. "Renewable Energy Policies A Brief Review of the Latest U.S. and E.U. Policies." IEEE Industrial Electronics Magazine 19 Sept. 2013: 21-34. ScienceDirect.

California start the deployment of smart meter in 2006 with its fast processes they managed to reach the 2012 aims even before the due date (Izadian, Girrens, and Khayyer, 25)[131].

3.3.1.2 Colorado

It is important to know that they have the only federal renewable energy lab in the country, which called the National Renewable Energy Laboratory (NREL) operated by the U.S Department of Energy (DOE) (Izadian, Girrens, and Khayyer, 26)[132].

In 2009, NREL's entire site energy consumption came from the renewable energy resources. Besides, Energy Office's governor also established finance options in order to encourage the renewable energy production. Since slow returns are more likely because the repayment of these loans are usually based on energy production, for renewable energy system, The Green Colorado Credit Reserve (GCCR) provides loan and this loan provided for lender to help to meet loan losses. There is also "Direct Lending Revolving Loan Program" which provides more than US$100,000 and this has a huge impact on the renewable economy (Izadian, Girrens, and Khayyer, 26)[133].

Near this there is a "Qualified energy conservation bonds" (QECBs) and this provides bonds for projects that can reduce energy use in public buildings, encourage starting green community programs, research on renewable energy and developing rural renewable energy. Another incentive is that the purchases for the equipment to produce renewable energy and solar thermal energy are expedient for the state sales tax exemptions. For the residential and commercial sites grants and

[131] Izadian, Afshin, Nathaniel Girrens, and Pardis Khayyer. "Renewable Energy Policies A Brief Review of the Latest U.S. and E.U. Policies." IEEE Industrial Electronics Magazine 19 Sept. 2013: 21-34. ScienceDirect.

[132] *Ibid*

[133] Izadian, Afshin, Nathaniel Girrens, and Pardis Khayyer. "Renewable Energy Policies A Brief Review of the Latest U.S. and E.U. Policies." IEEE Industrial Electronics Magazine 19 Sept. 2013: 21-34. ScienceDirect.

rebates are also available for the renewable energy system. “Xcel Energy” has been completed as the world’s first functioning smart grid city in 2009 and its test system allows preventing the outrages.

Therefore later in 2011, the project that involves natural gas and renewable energy power generation and onsite facilities in order to have data acquisition and research has been accepted (Izadian, Girrens, and Khayyer, 26)[134].

3.3.1.3 Florida

Florida has so many credits available some of them are for the consumers and businesses and that includes biofuels tax credit, solar tax credits, renewable energy funding, renewable energy tax credits. There are also guaranteed grants for renewable energy preconstruction cost and production recovery for self-reliant plant owners who builds renewable energy plants. “In 2007, Florida Governor Crist, issued several Executive Orders aimed at greenhouse gas emission reductions and renewable energy generation and he also formed a State Environmental Task Force to review various policy options for achieving these objectives. The Task Force is due to report on its final recommendations in October 2008” Rickenson, Wilson and Bradbury p,8)[135].In addition to this, 2 years later in 2009, Gainesville Regional Utilities’ (GRU), which is a FIT policy for to have more benefits from solar energy, has been approved and this policy is only in force in USA and it form on the levelized cost of generating electricity from RE sources (Coutre,Cory p,8)[136].

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[134] Izadian, Afshin, Nathaniel Girrens, and Pardis Khayyer. "Renewable Energy Policies A Brief Review of the Latest U.S. and E.U. Policies." IEEE Industrial Electronics Magazine 19 Sept. 2013: 21-34. ScienceDirect.

[135] Rickerson, Wilson, Florian Bennhold, and James Bradbury. *Feed-in Tariffs and Renewable Energy in the USA – a Policy Update*. Rep. Washington DC.: Heindrich Böll Foundation, 2008. 10 Apr. 2017.

[136] Coutre, Toby, and Karlynn Cory. *State Clean Energy Policies Analysis (SCEPA) Project: An Analysis of Renewable Energy Feed-in Tariffs in the United States*. Tech. no. NREL/TP-6A2-45551. Colorado: National Renewable Energy Laboratory, 2009. <http://www.osti.gov/bridge>.

3.3.1.4 Oregon

For the development of the renewable energy, Oregon has made some long-term commitments. The state aimed to have %10 of the total power generation of the state to be from renewable energy and for the 2025, target of the government has to met %100 of their needs from renewable sources (Izadian,Girrens,and Khayyer, 27)[137]. In addition to this, Oregon has many short-term goals to create power from wind generators, biofuel generators, geothermal electric generation, biogas generation and determined units of PV systems and hydropower. It also offers renewable energy products at stable price. The Eugene Water and Electric Board, proposed a pilot project for solar PV in 2007 and for the electricity production larger than 10 kW that comes from solar PV it offers incentives for fixed-price sources (Coutre,Cory p, 14)[138].

3.3.2 Renewable Energy Technology Development

"The Energy Policy Act of 2005 contained many new provisions for energy conservation and efficiency in the transportation, buildings, and electric power sectors, EPAct05 authorized even greater levels of federal funding for technology development efforts across the board in energy efficiency and renewable energy, and also for supply-side options such as nuclear energy and coal with carbon capture and sequestration" (Dixon,Mcgowan, Onysko, and Scheer. p,6401)[139].

In the USA, renewable energy resources are accounted for the %10 of the energy that generally consumed in the country and they are mostly consist of hydropower

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[137] Izadian, Afshin, Nathaniel Girrens, and Pardis Khayyer. "Renewable Energy Policies A Brief Review of the Latest U.S. and E.U. Policies." IEEE Industrial Electronics Magazine 19 Sept. 2013: 21-34. ScienceDirect.

[138] Coutre, Toby, and Karlynn Cory. *State Clean Energy Policies Analysis (SCEPA) Project: An Analysis of Renewable Energy Feed-in Tariffs in the United States*. Tech. no. NREL/TP-6A2-45551. Colorado: National Renewable Energy Laboratory, 2009. <http://www.osti.gov/bridge>.

[139] Dixon, Robert K., Elizabeth Mcgowan, Ganna Onysko, and Richard M. Scheer. "US energy conservation and efficiency policies: Challenges and opportunities." Energy Policy 38.11 (2010): 6398-408. Elsevier.

and biomass sources (Bull p,1216) [140] . The reason for the broader commercialization and increase number of markets in USA is because of wind, biomass, solar, and geothermal technologies are cost effective. All of these renewable energy technologies have differences and they have different stages at the development process, and at future expected costs, resource availability, and their impact on greenhouse gas emissions. Since renewable energy resources are abundant, compare to conventional energy sources, renewable energy technologies offer more benefits. According to Bull, renewable sources of electricity in U.S. help to avoid 70 million metric tons of carbon emissions every year (p, 1216)[141]. After the 20 years of R&D in USA, developments that invested by the industry and government mostly by DOE, there were improvements occurred in the renewable energy system, its cost and also its performance.

3.4 Turkey

In order to not repeat the environmental and social legacy of instability of industrial area, developed countries must act in partnership with the developing countries. Industrial countries have technology and wealth to responsibility solve the problems of climate by preventing the globalization of fossil fuel economy and Turkey is one of the developing countries, which can have advantage to use renewable resources because of its geographical location. It said that for it's future passing through renewables from fossil fuels would be a better alternative for Turkey. Even though it has a lot of potential, Turkey is an energy importing country for this reason, Turkey must supply its demands by using its own domestic resources and it needs a shift from traditional energy sources to renewable energy resources to be less dependent on foreign sources.

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[140] Bull, Stanley R. "Renewable Energy Today and Tomorrow." IEEE Industrial Electronics Magazine Aug. 2001: 1216-226. IEEE Xplore Digital Library. <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=940290&isnumber=20361>.

[141] *Ibid*

Therefore, by the government and other authoritative bodies, investments for renewable energy supplies are encouraged and incentives were provided with the help of Electricity Market Law of 2001 and Energy Efficiency Law of 2007. Later on for the first time RES-E was defined in the Law on Utilization of Renewable Energy Resources for the Purpose of Generating Electricity of 2005 and incentives became more efficient. Same law also required RES Certificate for electricity generation to be grant by Energy Market Regulation Authority and ensure a purchase guarantee for 10 year for price to not to be below 5 euro cent/kWh (Ediger p,87)[142].

In order to solve the energy supply security and environmental concerns of Turkey, The Energy Ministry of Turkey (MENR) is dedicated to escalate the usage of renewable energy resources because this escalation will provide economic benefits and political benefits such as the accession process of Turkey to EU. According to the electricity generation strategy paper by the MENR until 2020, Turkey is planning to increase the share of renewables in electricity generation up to %25 and in all segments of renewable energy the target is to increase the installed capacity (Ediger p,88).[143]It is a fact Turkey has a great potential in hydropower and in Europe its potential comes as second after Norway. Moreover, following the New Zealand, Turkey has a strong position in geothermal energy between the IEA countries and in solar power this ranking is at the seventh highest, hydro ranks eighth while wind ranked as the seventeenth highest (IEA p,165)[144].

However Turkey is only able to use one third of its potential and that clearly needs to be changed. Many people agree on the fact that renewable energy development

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[142] Ediger, Volkan Ş. (2008) "National Energy Report of Turkey: Energy Situation, Challenges, and Policies for Sustainable Development", AASA Beijing Workshop on Sustainable Energy Development in Asia, China, InterAcademy Council, pp. 77-93.

[143] *Ibid*

[144] Energy Policies of IEA Countries - Turkey 2016 Review." *IEA*. N.p., 2016. 20 Apr. 2017. <https://www.iea.org/publications/freepublications/publication/energy-policies-of-iea-countries---turkey-2016-review.html>.

in Turkey will be shaped by the rules and directives from the EU during the country's accession period because EU gives target to its member states and candidates for to promote renewable energy development. For renewables, Turkish Government ratified the Kyoto Protocol after sending a draft law to the Parliament for ratification in 2008. Even though there was no decrease in CO2 emission in the country because of the lack of carbon policies, efforts of the government officials and government itself caused an increase the sustainability of the economic and social development (Ediger p,89).[145]

In Turkey, Renewable energy deployment is increasing since 2009 and there were investments to new generation facilities, usage of renewable energy resources by Turkish power sector. These are all occurred because of the supporting and promoting schemes. Turkey's good potential in renewable energy is in solar, geothermal and wind and "in 2015, the share of renewable energy in total primary energy supply stood at 12.1%, and 32.3% in electricity generation"(IEA p,165)[146].

3.4.1 Renewable Policies, Strategies and Support Measures

In order to charge policies to support the renewable energy Ministry of Energy and Natural Resources (MENR) and the Energy Market Regulatory Authority (EMRA) are the main government entities in Turkey. Near the being in charge of policies to develop renewable energy, General Directorate for Renewable Energy (GRDE) is also responsible for legal framework, research, develop and deployment for the implementation of the objectives which set by the government. For the charge of development of the geothermal energy, it is the Mineral Research and Exploration General Directorate (MTA) and for oversees environmental impact evaluation methods there is an institution called The Ministry of Environment and

[145] Ediger, Volkan S,. (2008) "National Energy Report of Turkey: Energy Situation, Challenges, and Policies for Sustainable Development", AASA Beijing Workshop on Sustainable Energy Development in Asia, China, InterAcademy Council, pp. 77-93.

[146] "Energy Policies of IEA Countries Turkey 2016 Review." Review. International Energy Agency 2016: 1-223. IEA. <https://www.iea.org/publications/freepublications/publication/energy-policies-of-iea-countries---turkey-2016-review.html>.

Urbanization (MEU). On the other hand institution called Turkish Electricity Transmission Corporation (TEİAŞ) the system operator is in charge of the tenders grid capacity for wind and solar projects and also for the collection and distribution of the FIT IEA p,168).[147]

Turkey has its own targets and goals that are going along with the EU targets. There are several targets for the electricity to be generated from the renewable resources. For instance there is Electricity Market Law (No. 6446) and 2009 Electricity Market and Security of Supply Strategy. By these attempts what is aimed is to underline the importance of the renewable energy when decreasing the reliability on import dependence, meet the constantly increasing energy needs and diversifying the electricity mix (IEA p,169).[148] Moreover "Turkish government primarily targets to increase the share of renewable energy sources in electricity generation to at least 30% while decreasing the share of natural gas below 30%, in this context, Turkish government has planned to make the required changes in Law No. 5346 in 2010 to (i) utilize the whole economically feasible hydropower potential in electricity generation, (ii) utilize the whole economically feasible wind energy potential in electricity generation, (iii) provide full utilization of economically feasible geothermal energy potential of 600 M W, (iv) encourage and expand the utilization of solar energy for electricity generation until 2023"(Küçükali, Barış p, 2457)[149].

One of the most important steps that Turkish government take in order to promote the renewable energy was to present the National Renewable Energy Action Plan (NREAP). This plan presented in 2014 with the collaborative work of Deloitte, European Bank of Reconstruction and Development (EBRD) and MENR. The plan

[147] "Energy Policies of IEA Countries - Turkey 2016 Review." *IEA*. N.p., 2016. 20 Apr. 2017.<https://www.iea.org/publications/freepublications/publication/energy-policies-of-iea-countries---turkey-2016-review.html>.

[148] *Ibid*

[149] Kucukali, S., and K. Baris. "Renewable Energy Policy in Turkey." Proceedings of the World Renewable Energy Congress – Sweden, 8–13 May, 2011, Linköping, Sweden (2011): 2454-461. Elsevier.

was for the period 2013-23 and it was in the direction of the requirements and methods of the EU. NREAP utilize the renewable energy potential and policies of Turkey. It set up some targets for different renewable energy technologies and from these technologies it aimed to reach 61 GW of total capacity by 2023. It target to generate 34GW electricity by using all applicable hydropower potential, increasing the installed power generation capacity of wind to 20GW, using all the geothermal potential of Turkey, supporting the use of total 1GW of biomass, increasing the usage of solar power in the electricity generation and lastly for the transport sector, manage to have a usage of 10% share of renewable energy (IEA p, 169)[150].

For the legal framework, Turkey adopted the Law on the Utilization of Renewable Energy in Electricity Generation No. 5346, YEKA Law in 2005 for the support of renewable energy. This law encourage to choose between FIT and direct sales of renewable electricity into the market. Moreover it also contains obligations for suppliers to purchase renewable electricity, exemptions from license obligations for small generators, priority connection and it reduces the fees for project preparation and land acquisition. Especially until 2014, during the periods when sales margins higher in the spot market than FITs, encouraged renewable generators preferred to sell their electricity to the market directly with the completion of the 2008-2012 electricity market reforms and the creation of Turkish electricity wholesale market (PMUM) (IEA p, 170)[151].

Even though the legal framework applied in 2005, only with the introduce of YEKDEM which is a technology specific and longer term support mechanism in 2011 with the Law No. 6094, investments in renewable energy started to grow. This law authorizes an immunity for the renewable energy generation facilities which has a capacity below 1MW from licensing and this mechanism also gives

[150] "Energy Policies of IEA Countries - Turkey 2016 Review." *IEA*. N.p., 2016. 20 Apr. 2017. <https://www.iea.org/publications/freepublications/publication/energy-policies-of-iea-countries---turkey-2016-review.html>.

[151] *Ibid*

long term guarantee for speed up the lending of Turkish and foreign banks and also the financial institutions to renewable energy sector. Near the FITs, under the New Investment Incentives Program in 2012, local and regional supports for the domestic manufacturing were introduced with four different support structures which are General Investment Incentive Plan, Regional Investment Incentive Plan and Large Scale Investment Incentive Plan and all incentive plans above, they could use in renewable energy facilities and for their R&D (IEA p, 170)[152].

3.4.2 Renewable Energy Power

Turkey has a high potential for the biogas production because of the high organic content in their waste; it continues to develop in this manner. In the rural areas of Turkey, biomass resources used as the primary sources for cooking and heating purposes. Near the potential for the biomass, Turkey also has a potential for the bioenergy production and this type of energy also has a lot potential when it use as an energy source. In 2003, based on the recoverable energy potential from livestock farming wastes, forestry and agricultural residues in Turkey, bioenergy potential estimated to be around 36,92 Mtoe (Yüksel, Kaygusuz p,4137)[153]. It is not hard to say that there is no increment is waiting for the wood fuel production because there is a fast deforestation is going on in the world and according to data Turkey's annual growth in rate of forests is around %3 and highly remarkable percent of its potential is a high productive forest (Yüksel,Kaygusuz p,4137)[154].Therefore it can be said that the best solution is the energy forests because there is an huge amount of productive forest that can be used as energy forests in Turkey. Even though Turkey has a great potential for using the biomass in order to produce renewable energy and a law of utilization that have been

[152] "Energy Policies of IEA Countries - Turkey 2016 Review." *IEA*. N.p., 2016. 20 Apr. 2017. <https://www.iea.org/publications/freepublications/publication/energy-policies-of-iea-countries---turkey-2016-review.html>.

[153] Yuksel, Ibrahim, and Kaygusuz Kamil. "Renewable energy sources for clean and sustainable energy policies in Turkey." Renewable and Sustainable Energy Reviews 15.8 (2011): 4132-4144. Elsevier.

[154] *Ibid*

established in 2005 No: 5346 for renewable energy resources to generate electricity, still its share in energy production is low.

Turkey has hydro electrical potential, which covers the %1 of the World and 16% of Europe, however, Turkey's economically viable potential is lower than both its technical and hydro electrical potential because annual energy consumption of Turkey reaches more than the world average and Turkey has 172 hydroelectric power plants and the average of the generator is only equal to 35% of the Turkey's economically viable hydroelectric potential (Yüksel, Kaygusuz p,4136).[155]

According to national development plan by 2020 all hydroelectric potential of Turkey must be harvest. GAP project, which is known as The Southeastern Anatolia Project, is one of the largest development, irrigation and power generating projects in the world. It almost covers 3.0 million ha of the agricultural land in Turkey and that number is equal to 10% of the cultivated land (Yüksel,Kaygusuz p,4136).[156]

Turkey has an important geothermal potential due to its more than 600 existed hot springs, wide spread volcanism and fumarole hydrothermal alterations. Therefore Turkey considers as one of the countries, which have significant potential in geothermal energy, and it is ranked as the seventh in the world and the usable geothermal energy for electrical power generation is increasing in high enthalpy zones. Since Geothermal heating is not as much costly as natural gas, it would be feasible for many regions in the country (Bilgen, Keleş, Kaygusuz, Sarı and Kaygusuz p,386)[157]. World is expecting a decline in the usage of fossil fuels due their high prices and threat to environmental problems and geothermal energy is

[155] Yuksel, Ibrahim, and Kaygusuz Kamil. "Renewable energy sources for clean and sustainable energy policies in Turkey." Renewable and Sustainable Energy Reviews 15.8 (2011): 4132-4144. Elsevier.

[156] *Ibid*

[157] Bilgen Selçuk, Keleş Sedat, Kaygusuz Abdullah, Sarı Ahmet, and Kaygusuz Kamil. "Global Warming and Renewable Energy Sources for Sustainable Development: A Case Study in Turkey." *Renewable and Sustainable Energy Reviews* 12.2 (2008): 372-96. *Elsevier*.

seen as the replacement of fossil fuels and in Turkey the usage of geo thermal energy has been already inclined because of the rise of oil and gas prices.

In the case of solar energy Turkey's geographical location is very favorable as you can also see at the chart below. However even though it has a great potential it is not widely used and became commercial except for flat-plate solar collectors (Bilgen, Keleş, Kaygusuz, Sarı and Kaygusuz p,386)[158].

Table 1: Solar Radiation and Sunshine Duration by Regions of Turkey

	Solar radiation ($cal/cm^2.day$)	Sunshine duration (hour/day)
Southeast Anatolia	344.8	8.2
Mediterranean	328.3	8.1
East Anatolia	322.4	7.3
Central Anatolia	310.3	7.2
Aegean	308.0	7.5
Marmara	275.9	6.6
Black Sea	264.5	5.4
Turkey Average	309.6	7.2

Source: (Ediger,Kentel p,751)[159].

Solar is a huge energy and in sunny nations it is widely used for domestic hot water production especially in the coastal regions. In 2006, Turkey had 7.0 million m^2 solar collectors and the predicted outcome energy production is around 0.39 Mtoe (Yüksel,Kaygusuz p,4138)[160]. Even though some countries have a great potential of solar energy such as Turkey, solar energy source has not become a widely commercial in the world. In Turkey more than half of the energy consumption in house hold is needed for space heating and in the summer, especially at the south parts of Turkey demand for cooling increased rapidly.

[158] Bilgen Selçuk, Keleş Sedat, Kaygusuz Abdullah, Sarı Ahmet, and Kaygusuz Kamil. "Global Warming and Renewable Energy Sources for Sustainable Development: A Case Study in Turkey." *Renewable and Sustainable Energy Reviews* 12.2 (2008): 372-96. *Elsevier*.

[159] Ediger, Volkan Ş, and Elçin Kentel. "Renewable energy potential as an alternative to fossil fuels in Turkey." Enegy Conversion and Managment. N.p.: Pergamon, 1999. 743-55. ScienceDirect.

[160] Yuksel, Ibrahim, and Kaygusuz Kamil. "Renewable energy sources for clean and sustainable energy policies in Turkey." Renewable and Sustainable Energy Reviews 15.8 (2011): 4132-4144. Elsevier.

"In Turkey, only the Ministry of Environment and Forestry (forestry observation towers), Turkish Telecommunication Companies (transfer stations), the Highway Board Department (emergency calling, traffic management systems), Electrical Power Resources Survey and Development Administration and various research associations have a common installed PV capacity of 300 kW, PV cells are produced in various research establishments in order to study the feasibility of local manufacturing. So far none of these studies yielded a positive result in order to justify a mass production facility in Turkey (Yarbay,Güler Yaman p, 187)[161]. Even though Turkey has a great potential for PV market because country has abundant solar radiation and there are great areas for to establish solar farms, Turkey does not have any feasible legal structure to promote and enable the production of more PV energy and to sell the extra solar energy to the grid (Yüksel,Kaygusuz p,4138)[162].

In Turkey Wind energy has more awareness from the society compare to solar. Recently, there have been more developments in wind energy sector and its renewable energy technologies yet huge percentages of the society do not have enough knowledge about the solar energy potentials or the other alternative resource (Yüksel,Kaygusuz p,4138)[163].

Turkey surrounded by the Black Sea to the north, the Marmara and the Aegean Sea at the west and the Mediterranean Sea to the south therefore it has an huge potential for wind power generation. "Turkey is reported as one of the countries with the best wind maps among European countries, after the United Kingdom. Due to its geographic position, Turkey is under the influence of different air masses that give rise to potential wind energy generation possibilities in different

[161] Yarbay, R.Z., A.Ş. Güler, and E. Yaman. *Renewable Energy Sources and Policies in Turkey*. Proc. of 6th International Advanced Technologies Symposium (IATS'11), Turkey, Elazığ. İstanbul, 2011. 185-90. 23 Dec. 2017

[162] Yuksel, Ibrahim, and Kaygusuz Kamil. "Renewable energy sources for clean and sustainable energy policies in Turkey." Renewable and Sustainable Energy Reviews 15.8 (2011): 4132-4144. Elsevier.

[163] *Ibid*

areas"(Yarbay,Güler Yaman p, 187)[164].

In Turkey, regions of Marmara, Aegean and Southeast Anatolian are the best places for wind energy applications. In most of the mentioned areas wind power exceed 3 m/s therefore these regions are suitable for the wind power generation (Ediger,Kentel p,752)[165]. At the table below we can also see that wind potential in Turkey by regions.

Table 2 : Wind Potential by regions of Turkey

	Annual average wind density (watt/m^2)	Annual average wind speed (m/s)
Marmara	51.9	3.3
Southeast Anatolia	29.3	2.7
Aegean	23.5	2.6
Mediterranean	21.4	2.5
Black Sea	21.3	2.4
Central Anatolia	20.1	2.5
East Anatolia	13.2	2.1
Turkey Average	24.0	2.5

Source: (Ediger,Kentel p,752)[166].

Turkey has a great wind energy potential, which accounted for more than 400 billion kWh and 124 billion kWh of it is the technically feasible potential. (Ediger,Kentel p,752)[167]. In 2002 it is concluded in the study that the only 1000 MW capacity of wind farms were operating and that generation was unfortunately only equals to 0.5% of total electricity consumed (Yüksel,Kaygusuz p,4140)[168].

[164] Yarbay, R.Z., A.Ş. Güler, and E. Yaman. *Renewable Energy Sources and Policies in Turkey*. Proc. of 6th International Advanced Technologies Symposium (IATS'11), Turkey, Elazığ. İstanbul, 2011. 185-90. 23 Dec. 2017

[165] Ediger, Volkan Ş, and Elçin Kentel. "Renewable energy potential as an alternative to fossil fuels in Turkey." Enegy Conversion and Managment. N.p.: Pergamon, 1999. 743-55. ScienceDirect.

[166] *Ibid*

[167] *Ibid*

[168] Yuksel, Ibrahim, and Kaygusuz Kamil. "Renewable energy sources for clean and sustainable energy policies in Turkey." Renewable and Sustainable Energy Reviews 15.8 (2011): 4132-4144. Elsevier.

In 2009, Electrical power resources survey and development administration started to compile a wind energy atlas carries and wind measurements at several locations in order to estimate the wind energy potential around the country. In addition to this, The European Wind Energy Association claimed that Turkey is able to meet its %20 of the electricity demand by its wind power capacity, even though %8 of annual growth in power consumption is expecting (Yüksel,Kaygusuz p,4140)[169]. So it can be understood that the Turkey's wind energy power is good enough even if the power consumption increases.

As it is mentioned above Turkey has plenty of great natural resources and it has a great geographical advantage because of its location. It has an advantageous climate and surrounded by Mediterranean, Black and Aegean Sea. With the country's nice and warm weather and nice stable wind speeds it has a huge potential. Wind energy is a great source for Turkey to develop itself economically in the future. Even though there are so many advantages like this, plenty of renewable resources in Turkey still are not utilized.

3.4.3 Overview

Since Turkey's fossil fuel resources are only limited with lignite which has environmental, geochemical disadvantages, country needs to implement renewables and technology for sustainable development and energy efficiency. Turkey is importing its energy and by using its renewable resources it is possible to have future with clean energy and this must consider as the best solution.

By the awaited expansion of solar and wind power in Turkey, biomass share in renewable energy usage expected to be decline. Due to its location, Turkey has a great potential both in solar and wind power due to its location. For the geothermal energy it is also staged as seventh worldwide, however only a small portion is considered to be economically feasible.

[169] Yuksel, Ibrahim, and Kaygusuz Kamil. "Renewable energy sources for clean and sustainable energy policies in Turkey." Renewable and Sustainable Energy Reviews 15.8 (2011): 4132-4144. Elsevier.

For the 2023 which is the 100th anniversary of the establishment of the Republic of Turkey, the aim was to reach 30% of renewable energy in its electricity mix (IEA P,177)[170]. It is highly possible that Turkey could increase its share of renewable energy resources due to its new adopted measurements and an expected lower growth in its future electricity demand. Even though there are several attempts to implement renewable energy, more successful new targets must be adopted for the future maybe after 2023 in order for a faster and more trustable and for a long term development. Government role in formulating and implementing renewable energy policies are very important however private sector must also involve in renewable energy development.

In this case, we must remember that developed countries such as Germany and USA must partner up with developing countries such as Turkey. By doing that they don't do the same mistakes as they did in industrial era for the environment because they have the technology and wealth to solve the climate concern.

[170] "Energy Policies of IEA Countries - Turkey 2016 Review." *IEA*. N.p., 2016. 20 Apr. 2017. <https://www.iea.org/publications/freepublications/publication/energy-policies-of-iea-countries---turkey-2016-review.html>.

CHAPTER 4

REGIONAL STRATEGIES FOR PROMOTING RENEWABLE ENERGY

Reducing the CO2 emission can be reached in many levels, with the help of individual awareness, state, local and international. From individual to international level the difficulty of this is getting increased. Therefore it can be said that it is harder to reach to an international agreement in order to reduce the emissions than national agreement because it involves many other countries and regions to reach to a consensus. However in the different regions of the world there are some organizations, which focus on the promoting renewable energy in regional levels. The organizations and communities, which will be looking into are the Association of South East Asian Nations (ASEAN), Caribbean Community (CARICOM), European Union Energy Community, Nordic Energy Research and European Commission. These regional frameworks has been chosen because they are the most outstanding organizations in their region for promoting the renewable energy development and in order to see the regional differences when it comes to promoting renewable energy development with the help of policies, technologies and resource potential.

4.1 Association of South East Asian Nations (ASEAN)

Association of South East Asian Nations (ASEAN) consist of 10 countries which are Brunei, Indonesia Malaysia, Philippines, Singapore, Thailand, Cambodia, Laos, Myanmar, and Vietnam. It also has 2 countries that are at the observer status Papua New Guinea and Timor-Leste. The region is distributed by the more than thousand islands, which are mainly, belong to Indonesia and Philippines and due to the global warming concerns and green house effects there is a need to address how energy needs can be handled in sustainable basis (Othman Kamaruzzaman p,

1225)[171].

ASEAN member entered into an ASEAN Energy Cooperation Agreement in 1986 and before this agreement was only covering the energy systems. However,"The New and Renewable Sources of Energy (NRSE) Sub-Sector was established under this agreement in 1995, this Sub-Sector was charged with carrying out programs and activities promoting the development and commercialization of technologies utilizing new and renewable sources of energy" (Yatim p,1188)[172].

By the increase in fossil fuel prices and abundant renewable energy resources in the ASEAN countries, renewable energy resources became more attractive for the electricity generation in ASEAN region. Even though there has been a long-term effort in ASEAN region for energy efficiency and abundant renewable resources still they could not been able to utilize close to their potential. The population and the economy of the ASEAN countries are expected to grow and that will bring a rapid rise in energy demand. ASEAN region also has not enough fossil fuels to satisfy the increasing energy demand therefore it is expected that the share of imported fossil fuels will increase and that will cause a huge gap in energy security. Therefore ASEAN region were benefited from the Clean Development Mechanism projects in the places of renewable energy and energy efficiency when Kyoto protocol entered into force in 2005. Besides, every country has to adopt policies and regulations in order to promote and encourage these concepts (IRENA p,10)[173].

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[171] Othman, Mohd Yusof, and Kamaruzzaman Sopian. "Renewable energy education for Asean." Renewable Energy 16.1-4 (1999): 1225-230. Pergamon. 10 Mar. 2017. <https://doi.org/10.1016/S0960-1481(98)00492-3>.

[172] Yatim, Baharudin Bin. "Asean initiatives in renewable energy development and promotion." Renewable Energy 16.1-4 (1999): 1187-189. Pergamon. <https://doi.org/10.1016/S0960-1481(98)00470-4>.

[173] IRENA and ACE (2016). *Renewable Energy Outlook for ASEAN: a REmap Analysis*. International Renewable Energy Agency (IRENA), Abu Dhabi and ASEAN Centre for Energy (ACE), Jakarta.

One year project about the capacity building for to promote of renewable energy and energy efficiency policy instruments in ASEAN region was created in order to give ASEAN countries a chance to promote the concepts together by freely giving practical recommendation to each other. In addition to this, there was another project was funded by the European Commission through its EC-ASEAN Energy Facility (EAEF). This project is also seen as the main cooperation act between two institutions under the theme of sustainable development. As a target "The Association of Southeast Asian Nations (ASEAN) has set the aspirational target of securing 23% of its primary energy from modern, sustainable renewable sources by 2025" (IRENA p,10)[174].

4.1.1 Renewable Energy Resources and Technology

Efforts for shifting in energy also an important factor for the climate change and after the Paris Agreement, shared idea on keeping climate change below 2 degrees Celsius became common global issue and usage of renewable energy is clearly a important factor on the path to reach this goal. In ASEAN countries renewable energy resources are abundant and however like many other country in the world ASEAN countries are also depend on conventional energy for power generation. By analyzing the different energy resources in the region, it can be seen that there is a great potential for clean and sustainable future in ASEAN countries. This region has the best-untapped hydropower potential in the region, which will help to create a low cost option for the electricity. There are variety of natural resources that help to support the life and eco system. "Apart from providing water, food and energy, these natural resources play an important role in sustaining a wide range of economic activities and livelihoods and the strategic location of ASEAN has also brought about numerous economic advantages to the region, particularly through

[174] IRENA and ACE (2016). *Renewable Energy Outlook for ASEAN: a REmap Analysis*. International Renewable Energy Agency (IRENA), Abu Dhabi and ASEAN Centre for Energy (ACE), Jakarta.

international shipping and foreign trade"(Letchumanan p,50).[175]

Since all the ASEAN countries are located at the tropical region, daily solar energy radiation is very high for all of them. It is estimated that average is more than 4.5kWh/m^2 and solar technologies are mostly used in Indonesia, Vietnam, Philippines and Thailand compare to other ASEAN countries (Lidula, Mithulananthan, Ongsakul, Widjaya, and Henson p,1442)[176]. However, these technologies are still underutilized if you think of the high solar radiation with large lands so it has to be further developed.

Wind power potential is mostly in the mountain and coastal areas of Vietnam central part of Laos, and central and western Thailand. These are the areas that have a great potential for the large-scale wind generation. When it comes to Hydropower it is not wrong to say that there are plenty of resources in most of the ASEAN countries. However, Hydropower resources are located especially in Indonesia, Laos, Malaysia,, Thailand, Philippines and Vietnam yet the problem is the gap between the utilization of hydropower and technical potential (Lidula, Mithulananthan, Ongsakul, Widjaya and Henson p,1445)[177].

Due to the different types of agriculture, industry and forestry biomass resources changes in ASEAN countries however the potential is mostly high in Indonesia, Malaysia, and Thailand. Again there is a waste of energy potential because of not enough utilization because Indonesia and Malaysia have used about 1% of their potential, Thailand has utilized 8% of its biomass resource potential and Vietnam has utilized 12.5% of its resources (Lidula, Mithulananthan, Ongsakul, Widjaya

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[175] Letchumanan, Raman. "Is There an ASEAN Policy on Climate Change?" *LSE Research Online*. LSE IDEAS, London School of Economics and Political Science, n.d. 25 Apr. 2017. <http://www.lse.ac.uk/IDEAS/publications/reports/pdf/SR004/ASEC.pdf>.

[176] Lidula, N.W.A., N. Mithulananthan, W. Ongsakul, C. Widjaya, and R. Henson. "ASEAN towards Clean and Sustainable Energy: Potentials, Utilization and Barriers.p,1441–1452" *Elsevier.com*. N.p., 27 Oct. 2006. <http://www.sciencedirect.com/science/article/pii/S0960148106002217>.

[177] *Ibid*

and Henson p,1445)[178]. This shows us that there must be a region wise analyzes needs to be made in order to maximize the utilization.

Two of the ASEAN countries are very strong in geothermal energy after USA, Philippines has the second highest geothermal energy capacity in the world and Indonesia also has a great potential. In this sector Philippines has been use its capacity very well while the other countries are still not able to use their potentials. Some countries like Thailand has less potential than the others, however it was able to utilize its weak potential better than the others (Lidula, Mithulananthan, Ongsakul, Widjaya and Henson p,1445)[179].

Due to its high potential of solar and bioenergy and ASEAN region's abundant renewable resources, it gives an opportunity for renewable energy technologies as a cost effective deployment for heating and cooking. Therefore, renewable energy resources are competitive with other heating technologies. Initial alternative to fossil fuel heating technology is the biomass because biomass residues can create heat at cost competitive prices. Moreover for low temperature applications, solar energy with solar thermal heating technology will be cost competitive in ASEAN countries. It is the most affordable technology and according to the studies that IRENA made, by 2025, ASEAN countries will have the technology to supply electricity at better cost from renewable energy resources than rather than the non-renewable energy sources (IRENA p,12)[180].

After brief information about the renewable energy resources and technologies at ASEAN region it can be seen that there is a great potential in general, however

[178] Lidula, N.W.A., N. Mithulananthan, W. Ongsakul, C. Widjaya, and R. Henson. "ASEAN towards Clean and Sustainable Energy: Potentials, Utilization and Barriers.p,1441–1452" *Elsevier.com*. N.p., 27 Oct. 2006. <http://www.sciencedirect.com/science/article/pii/S0960148106002217>.

[179] *Ibid*

[180] IRENA and ACE (2016). *Renewable Energy Outlook for ASEAN: a REmap Analysis*. International Renewable Energy Agency (IRENA), Abu Dhabi and ASEAN Centre for Energy (ACE), Jakarta.

resource utilization is not enough when you compare it to their potential. Thus with the establishment of ASEAN Power Grid (APG) there will be a good market among the ASEAN member states. Moreover it is expected to be the one of the biggest energy infrastructures in the world that adopted under the ASEAN Vision 2020 in order to create renewable energy trade between the countries (Lidula, Mithulananthan, Ongsakul, Widjaya and Henson p,1448)[181].

4.1.2 Renewable Policies, Strategies and Support Measures

With the ASEAN Plan of Action for Energy Cooperation (APAEC) 2004–2009 policies were established. Energy meetings with ASEAN Ministers give an opportunity to discuss the common interest and issues of the countries. Moreover provide a platform to set policy in ASEAN energy cooperation. Under the formulation and implementation of ASEAN energy cooperation activities there are bodies such as "ASEAN Centre for Energy (ACE), the Energy Efficiency and Conservation Sub-Sector Network (EE&C-SSN), the Renewable Energy Sub-Sector Network (RE-SSN), the Sub-Committee on Non-Conventional Energy Research (SCNER) under the ASEAN Committee on Science and Technology, and the newly established Regional Energy Policy and Planning Sub-Sector Network (REPP-SSN) " (Lidula, Mithulananthan, Ongsakul, Widjaya and Henson p,1448)[182].

Moreover ASEAN Secretariat enables coordination and support for these special bodies for their implementation activities under APAEC for instance program no 4 covers the EE&C and program no 5 covers the renewable energy. Also ASEAN countries were not alone on their effort to promote renewable energy. There were other sources that supporting the projects and European Union was the main one. It supported the renewable energy project and EE&C under the ASEAN. In 2002, the

[181] Lidula, N.W.A., N. Mithulananthan, W. Ongsakul, C. Widjaya, and R. Henson. "ASEAN towards Clean and Sustainable Energy: Potentials, Utilization and Barriers.p,1441–1452" *Elsevier.com*. N.p., 27 Oct. 2006. <http://www.sciencedirect.com/science/article/pii/S0960148106002217>.

[182] *Ibid*

EU through giving funding assistance to ACE has established EC-ASEAN Energy Facility (EAEF).These joints projects were under 4 categories, which are; institutional frameworks, market awareness, demonstration projects and feasibility studies. (Lidula, Mithulananthan, Ongsakul, Widjaya and Henson p,1447)[183].

EAEF also funded the "Capacity building in formulating harmonized policy instruments for the promotion of renewable energy and energy efficiency in the ASEAN member countries" project. There are policies for each strategy at the ASEAN level. Moreover, loans and incentives are considered as financial assistance also in EE&C, legislative options, energy conservations and Demand Side Management programs considered as possible policy instruments. In addition to that ASEAN Environment Minister confirmed the Terms of Reference of the ASEAN Climate Change Initiative (ACCI) and this platform created for to strengthen the regional cooperation in climate change. "The scope of collaboration through the ACCI will include: (i) policy and strategy formulation; (ii) information sharing; (iii) capacity building; and (iv) technology transfer. The ASEAN Environment Ministers have also established an ASEAN Working Group on Climate Change (AWGCC) to implement the ACCI and D10 actions of the environment ASCC Blueprint" (Letchumanan p,57).[184]

Now after the regional perspective, it can be briefly look into country specific base, among the ASEAN countries. So, Brunei and Singapore don't have any policy on renewable energy. Besides Brunei is a country which is highly rich in oil and natural gas. On the other hand Singapore does not have any economically viable renewable energy resources so there is no effort to introduce and promote

[183] Lidula, N.W.A., N. Mithulananthan, W. Ongsakul, C. Widjaya, and R. Henson. "ASEAN towards Clean and Sustainable Energy: Potentials, Utilization and Barriers.p,1441–1452" *Elsevier.com*. N.p., 27 Oct. 2006. <http://www.sciencedirect.com/science/article/pii/S0960148106002217>.

[184] Letchumanan, Raman. "Is There an ASEAN Policy on Climate Change?" *LSE Research Online*. LSE IDEAS, London School of Economics and Political Science, n.d. 25 Apr. 2017. <http://www.lse.ac.uk/IDEAS/publications/reports/pdf/SR004/ASEC.pdf>.

renewable energy resources. Therefore right know renewable energy for them does not have much importance. Philippines are the country, which implemented interest for its renewable energy policy instruments. Under the non fossil fuel obligations there are social cost pricing, support renewable energy and priorities as an energy sources. These Renewable Energy bills are implemented in order to enter new capitals into power sector by overcoming the existing law. By implementing the required policies Small-Power-Producers are encouraged by Indonesia and Thailand and in order to enable the utilization of renewable energy in power generation, Malaysia implemented the Small Renewable Energy Program (Lidula, Mithulananthan, Ongsakul, Widjaya and Henson p,1449) [185].

For financial manners, it also shows differences among the ASEAN countries. For instance Thailand introduced different states for the financial support to renewable energy and uses renewable energy funds for R&D for the renewable energy related areas and technologies. Moreover, financial incentives that implement law interest rates and tax exemptions practiced in all ASEAN countries except Lao PDR. However Lao PDR has an effort to set strategies in order to have financial support to renewable energy technologies. Lastly in Vietnam only short-term loans occurred for RE projets. (Lidula, Mithulananthan, Ongsakul, Widjaya and Henson p,1449) [186].

4.1.3 Overview

For the ASEAN region it can be said that it is definitely a renewable energy rich region and among all the members Philippines, Indonesia, Malaysia, Thailand and Vietnam are having more type and power of renewable energy resources. Even though this region is highly blessed with renewable energy almost all of it is underutilized. Inconvenient and powerless policies and regulations are the main

[185] Lidula, N.W.A., N. Mithulananthan, W. Ongsakul, C. Widjaya, and R. Henson. "ASEAN towards Clean and Sustainable Energy: Potentials, Utilization and Barriers.p,1441–1452" *Elsevier.com*. N.p., 27 Oct. 2006. <http://www.sciencedirect.com/science/article/pii/S0960148106002217>.

[186] *Ibid*

barrier between the ASEAN countries and their path toward clean energy. These need to be changed as supportive policies for renewable energy and energy efficiency for to further development of ASEAN countries. In addition to that there must be more effort and incentives to implement policies to develop renewable energy technologies. However for now this region don't seem to be ready yet to harmonized policies. Even though ASEAN countries have variations to approach renewable energy and energy efficiency, more efforts needed to for a region to develop itself.

4.2 Caribbean Community (CARICOM)

Heads of Governments of the Caribbean Community get together in 2003 and agreed to establish a task force. In 2008 energy program asked forced has been established with the cooperation of regional initiatives in energy-sector development. This community included Guyana, Grenada, Jamaica, Barbados, Suriname and Trinidad and Tobago and it was for to develop a regional energy policy and they addressed some issues."The development of the service sector, pursuant to Article 54 of the Revised Treaty of Chaguaramas Establishing the Caribbean Community Including the CARICOM Single Market and Economy, is to stimulate economic complementarities and accelerate economic development in the Caribbean Community and its Member States. The development of the service sector in the Caribbean Community is an integral part of the Community Industrial Policy (CIP), which has as its goal; market-led, internationally competitive and sustainable production of goods and services for the promotion of the Region's economic and social development"(Griffith p,1)[187].

After the first meeting started, eventually topic came to besides the petroleum and petroleum product pricing, they need to recognize some other issues such as Natural gas, Renewable energy, Investment requirements in the Regional Energy

[187] Griffith, Mark D. A Concept Note on Trade in Environmental Services: Towards the Formulation of a Strategic Framework and Action Plan for the Caribbean Community Single Market and Economy (CSME). Rep. St. Michael: Caribinvest Publishing, 2009. Caricom. <http://cms2.caricom.org/documents/13189-concept_paper_environmental.pdf>.

sector, Energy efficiency, Environmental Impact, and Rationalization of the Regional Energy Sector. Usage of Renewable energy for power generation, energy conservation and energy efficiency is important for the sustainable future and green economy of the Caribbean. Caribbean region faces with challenges related with the distribution and usage of the energy. Even though like in the example of ASEAN region, Caribbean region also has vast amount of renewable energy resources, it depends on the imported fossil fuels and that constantly increases the oil prices effects the region's economic development, and diminishes the enthusiasm for local natural resources. This dependence cause enormous long-term effects on climate especially for small islands and coastal states (Caricom Energy Policy p,1)[188].

Despite these common challenges region has a vast amount of potential to reach sustainable future and since CARICOM represents the countries in the region by constructing regulatory and legislative frameworks it will also provide a good platform for this achievement. Currently CARICOM expanded and it represents 15 diverse member states which are Guyana, Haiti, Jamaica, Antigua, Barbados, Belize, Dominica Barbuda, Bahamas, Nevis, St. Vincent, Grenadines, Suriname, Montserrat, Saint Grenada, , Saint Lucia, St. Kitts and, and Trinidad and Tobago. These states may have different cultures, diversification in economy and other differences, however they face a joint energy challenges (Caricom Energy Policy p,1)[189].

4.2.1 Renewable Energy Resources and Technologies

In the region, every single state has unexploited renewable energy resources, there is a great potential, however it needs to be developed and then these countries may become energy exporters. All of the CARICOM member state has significant potential in renewable energy resources including hydropower, biomass, solar, geothermal and hydropower, solar, wind, tidal and ocean power. Around the

[188] "Caribbean Community Energy Policy." *Caribbean Community (CARICOM)*. P, N.p.1-66, 1 Mar. 2013. <http://caricom.org/>.

[189] *Ibid*

Caribbean renewable energy resources are abundant and every island there has a great potential for solar and wind resources. When technologies evolve for renewable energy resources, for the long term biomass and biofuel development will give a strong economy-wide effort. “The Caribbean region has geographical and geological features that lead to unique opportunities for renewable energy technology implementation, primarily, the active geological zone of the eastern Lesser Antilles chain offers a geothermal powerhouse”(Contreras, Williams and Cuba p,16)[190].

In CARICOM states, hydropower composes the huge part of the renewable power generation and the sources are pretty ideal since the region has high rainfall rates and hilly topography. Hydropower is mostly used in the states; Haiti, Jamaica, Suriname, St.Vincent and Belize yet it is only exist as a small-scale installation which can supply electricity access to distance populations. For Biomass, due to the common agricultural activity in the region states, it provides an easy access point for renewable energy generation. Near this, as it is mentioned already, besides the fact that there is a utilization problem, Solar PV and wind resources are abundant in the region. Further more CARICOM states that have been located in the volcanic arch therefore have a huge amount of unexploited geothermal resources. This potential of geothermal in CARICOM states could also make some of the members as renewable energy exports. Lastly we need to mention the ocean wave and tidal power generation because all of the member states have cost to ocean therefore they could also utilize and use this type of renewable energy. Even though most of the renewable energy technologies has been started to use in some parts of the region it is still left behind compare to its great renewable energy potential. Due to the domestic conditions in the region, technologies couldn’t

[190] Contreras, Ruben , Williams, Michelle-Ann and Cuba , Kevin"Energy Policy and Sector Analysis in the Caribbean (2010–2011)." *Caricom*. NREL, 18 Apr. 2015. 23 March 2017. <http://cms2.caricom.org/documents/13193-lccc_report_final_may2012.pdf>.

develop to their full potential (Caricom Energy Policy p,12)[191].

Despite the fact that there is an enormous potential for renewable energy in each CARICOM member states, development is far left behind and it would not fix automatically. Development of renewable energy potential is depending on the effective policies and measures from both regional and national government bodies. They need to be supportive on renewable energy projects together. Everywhere in the world these policies are the main drivers to encourage the renewable energy technologies. "Number of countries with support policies in place just for renewable power generation increased from 48 in 2005 to 138 by early 2014" and developed countries are leading the support mechanism and being a role model for other nations in this matter (Ochs, Konold, Auth, Musolino, and Killeen p,72)[192].

4.2.2 Renewable Policies, Strategies and Support Measures

CARICOM plays an important role in region's transition to sustainable energy. It adopted its regional Energy Policy in 2013 by recognizing the importance of renewable energy and energy efficiency solutions in the Caribbean. This policy was climate friendly and it refers to the use of domestic renewable energy resources, minimizes the damages against the environment, innovation and economic growth. In order to execute these intentions, Secretariat of CARICOM entered the Caribbean Sustainable Energy Roadmap and Strategy (C-SERMS) in to force to provide a strategy to transform CARICOM member states in to a future with sustainable and clean energy (Caricom Energy Policy p,14)[193].

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[191] Caribbean Community Energy Policy." *Caribbean Community (CARICOM)*. P, N.p.1-66, 1 Mar. 2013. <http://caricom.org/>.

[192] Ochs,Konold,Auth, Musolino, and Killeen. "Caribbean Sustainable Energy Roadmap and Strategy (C-SERMS)." Worldwatch Institute, Washington, D.C., 01 Oct. 2015. 20 Apr. 2017. p 1-179 <https://cleanenergysolutions.org/resources/caribbean-sustainable-energy-roadmap-strategy-c-serms-baseline-report-assessment>.

[193] "Caribbean Community Energy Policy." *Caribbean Community (CARICOM)*. P, N.p.1-66, 1 Mar. 2013. <http://caricom.org/>.

In C-SERMS, it evaluates the region's current energy and energy policy situation, regional potential for renewable energy, energy efficiency solutions, and energy sector's transformation in short and long term and also recommendations. With the draft version of this report in 2013, delegates of the Commission on Trade and Economic Development, has been approved the target of 48% of regional renewable energy installed power capacity for the year 2027. Moreover it also included the targets for renewable energy, carbon dioxide (CO_2) emission and energy efficiency for each member state and it suggested that it would become a regional target in the act of a local success. (Ochs, Konold, Auth, Musolino, and Killeen p,11)[194]. Therefore this report is important as a key strategy for the sustainable energy and climate goals and it also includes policies, priority projects and initiatives that have been targeted in CARICOM region. It also encourages the CARICOM community to commit to this road as a part of C-SERMS and other o sustainable energy initiatives.

As it mentioned before, due to its enormous potential robust and dynamic framework of regulatory policies are needed for the sake of the energy efficiency in CARICOM. What exists is not enough for the region and the community needs help from the regional and national governing bodies to dynamically implement these frameworks in order to encourage the investment, which is needed for renewable energy projects and sustainability. Even though there are efforts for to increase the incentives for the renewable energy, again they are either not enough or cluttered for a stable and coherent long-term vision, they need a well-designed policy mechanism and a stronger government framework.

After adopting the regional Energy Policy, now CARICOM states also have national energy strategies either in development or in implementation. Some of the member states have set targets, establish domestic policy mechanisms and set up responsible agencies for to reinforce renewable energy. Across the CARICOM,

[194] Ochs,Konold,Auth, Musolino, and Killeen. "Caribbean Sustainable Energy Roadmap and Strategy (C-SERMS)." Worldwatch Institute, Washington, D.C., 01 Oct. 2015. 20 Apr. 2017. p 1-179 <https://cleanenergysolutions.org/resources/caribbean-sustainable-energy-roadmap-strategy-c-serms-baseline-report-assessment>.

with the help of the policy support, they created a suitable environment for the investments in sustainable energy technologies. However, due to inadequate policies, data and administration, sustainable energy development in the region holds to be restricted. There have been many overreaching plans and targets made for to use renewable energy, however they all were lacking concrete mechanisms therefore they are not enough to reach their goals. Only half of the CARICOM states were adopted the targets for the renewable energy power and energy efficiency improvements as their national strategies. (Ochs, Konold, Auth, Musolino, and Killeen p,13)[195]

Near the sustainable energy targets some of the member states also adopted emission reduction targets and with these efforts they transfer the regional commitment to national level which will cause specific contributions also from national levels and it makes a stronger commitment. Regional targets are important for CARICOM and they also unite the member states under a vision for sustainability in the Caribbean and national actions plans are the greater contribution to this vision. Member states have been already agreed on "a framework of regional renewable energy capacity share targets in the short term (20% by 2017), medium term (28% by 2022), and long term (47% by 2027)" (Ochs, Konold, Auth, Musolino, and Killeen p,13)[196]. Therefore CARICOM member states now have an aim to achieve these goals by strengthen their national targets. With the help of the abundant resources, some of the member states could set their target so much higher than the given numbers.

All of the member states have enough renewable energy potential in order to dedicated them self to a specific share renewables generation by 2027. For to address to regional energy challenges, CARICOM started to develop a regional

[195] Ochs,Konold,Auth, Musolino, and Killeen. "Caribbean Sustainable Energy Roadmap and Strategy (C-SERMS)." Worldwatch Institute, Washington, D.C., 01 Oct. 2015. 20 Apr. 2017. p 1-179 <https://cleanenergysolutions.org/resources/caribbean-sustainable-energy-roadmap-strategy-c-serms-baseline-report-assessment>.

[196] *Ibid*

strategy in 2002 and in 2003 Energy Task Force has been implemented. After a decade promoting renewable energy for sustainability became a priority among CARICOM states and became a main focus of the CARICOM Energy Policy (Caricom Energy Policy,1)[197].

4.2.3 Overview

CARICOM Member Sates have been shown an effort to formulate CARICOM Energy Policy and to promote renewable energy resources for sustainable future. The reason for that is CARICOM Member States have huge potential in renewable energy in so many ways yet they are still depend on imports. They have a great potential for power generation from the RE and energy efficiency. Islands have both geothermal prospect and due to their climates they have huge amount of wind and solar capacity. By expanding the usage of these renewable energy resources they could be able to strength their economy and life standards.

Even though there needs to be more efforts for to reach their goals, CARICOM Energy Policy is still an important and critical step towards the member's future. Technology for renewable resources must have been developing in order to use these resources because right now they are not able to fully utilize their potential. Members of CARICOM have a huge potential and they could even go further to lead the world in new energy future. However in order to do this national and regional policies and plans towards sustainable future needs to be strengthen and then they may be able to fulfill their energy potential in the future.

4.3 Energy Community

For the members of the energy community to have energy efficiency and energy from the renewable energy resources is very important therefore this organization brought together countries from South East Europe and Black Sea. Both of the regions have a great-untouched potential of renewable energy resources in order to

[197] "Caribbean Community Energy Policy." *Caribbean Community (CARICOM)*. P, N.p.1-66, 1 Mar. 2013. <http://caricom.org/>.

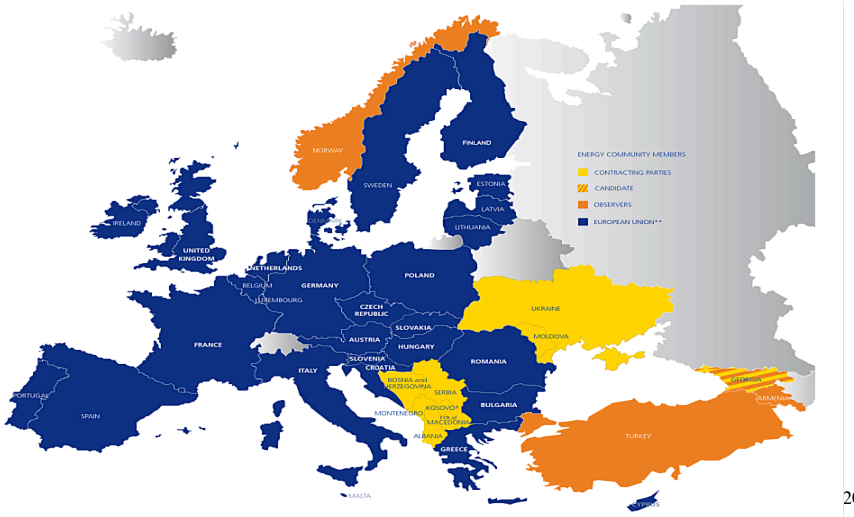
reduce the bad environmental effects and increase the economic development. It believed that if the right conditions created then it will become a right place for the private investments and it is the biggest challenge that region is facing today and those right conditions are the support of the renewable energy policies by legal and institutional framework, good implemented policy measures and great amount of financing Therefore the Energy Community is established in order to reach these objectives with 8 member countries. (Kopač p,5)[198].

At October 2005, Treaty signed for to establish the Energy Community as an international organization and in 2006 it entered in force. Contracting parties are to this organization is European Union and other 8 countries which are "Albania, Bosnia and Herzegovina, Kosovo, Republic of Macedonia, Moldova, Montenegro, Serbia and Ukraine" (Kopač p,6)[199]. The goal is to internal energy market of European Union to extend South East Europe by implementing legal bindings. Treaty contains, membership countries to commit to binding reforms and deadlines for to implement EU energy legislation and it includes the areas of renewable energy, energy efficiency, gas, oil, electricity competition and industrial emission.

[198] Kopac, Janez. "Energy Efficiency and Renewables in the Energy Community." The Macedonian Foreign Policy Journal 4 (n.d.): 4-11. ScienceDirect.

[199] *Ibid*

Table : 3 Members of Energy Community



200

Source:Energy Community, www.energy-community.org,(accessed on 15 May 2013)

4.3.1 Renewable Energy Resources and Technologies

Energy Community members have higher percentage of renewable energy resources when compare with the renewable energy share, which recorded in EU and this because of the relatively high consumption of biomass and hydropower. Two of these energy resources are also represents the highest potential resources of the Energy Community, however due to the late awareness for renewable energy resources and encouragement, potential of the region is highly underdeveloped. "Whilst some form of action has now been commenced, by and large the policy, legal, regulatory and institutional frameworks in the region remain at an early stage"(Kopač p,9).[201]

[200] Energy Community. N.p., n.d. 22 May 2017. <https://www.energy-community.org/portal/page/portal/ENC_HOME>.

[201] Kopac, Janez. "Energy Efficiency and Renewables in the Energy Community." The Macedonian Foreign Policy Journal 4 (n.d.): 4-11. ScienceDirect.

The Renewable Energy Directive 2009/28/EC was adapted for the Energy Community. Energy Community parties has decided to implement and commit to these binding targets for 2020. By concurrent with energy objectives and climate of Europe, this Renewable Energy Directive created a framework to promote renewable energy. Contracting parties set national goals to reach their renewable energy targets for their energy consumption and %10 uses of renewable energy in transport by 2020. (Energy Community p,1)[202]. They also obligated to submit their NREAPs to Energy Community Secretariat (ECS) as a prerequisite and by doing that countries show that they prepared in the line with a template, which published by European Commission.

Content of the NREAP's are the sector targets which includes the mix of technology that they expected to use, path that they will follow in upcoming years and detailed descriptions for the reforms and measures in order to overcome the obstacles to develop renewable energy. According to the Ministerial Council Decision 2012/04/MC-EnC "Contracting Parties to report to the Secretariat on the progress in the promotion and use of the energy from renewable sources for the first time by 31 December 2014 and every two years afterwards"(Kopač p,9) [203].

By looking up to European experience and also benefiting from the lower technological costs in recent years, Contracting parties introduce the essential support in order to promote renewable energy. In some of the Contracting Parties, this is supplemented by investment support such as tax reductions and incentives. However these feed and tariff models are not used as in traditional way and neither applicable to all technologies in EC. Right now only in Albania there is support scheme up to 15 MW for small hydro producers but in other countries except

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[202] Report of the Secretariat to the Ministerial Council on the Progress in the Promotion of Renewable Energy in the Energy Community. Rep. no. ANNEX 05a. N.p.: Energy Community, 2015. Energy Community. 10 May 2017. https://www.energycommunity.org/portal/page/portal/ENC_HOME/DOCS/3842311/2194639ACBF1368EE053C92FA8C04E9A.PDF

[203] Kopac, Janez. "Energy Efficiency and Renewables in the Energy Community." The Macedonian Foreign Policy Journal 4 (n.d.): 4-11. ScienceDirect.

Serbia, the limit is 10 MW for to support hydro. Again except Albania all the other countries introduce feed-in tariffs for technologies such as PV solar, wind, biomass, and biogas and even for geothermal. For the energy production from waste and land fill gas only Serbia and Montenegro adopted feed-in tariffs. Non-hydro technologies mostly have sharp budgetary limits and that restricts the diversification of the renewable energy technology mix. This method used in order to limit the influence of renewable energy on electricity end user prices. Capital costs are more in Contracting Parties compare with the EU. (Karina, Uslu, Beurskens, Tuerk, Frieden, Symeonides, Sidiropoulos, Zehetner, and Resch p,14) [204].

But, on contrary, In European Community, costs like labor and operation are lower for renewable energy projects. Electricity production from the renewables registered as the biggest process in Contracting Parties. However non-hydro technologies are only established in few countries. Even though feed and tariffs were placed many years ago, there are few countries, which has wind parks. Among the Contracting parties' only Ukraine showed powerful investments in Solar PV and Wind energy. However, Ukraine is facing crisis at the eastern part of its country and there is a decrease in renewable support. All of these problems increased the risk for investment so plans for new investments are waiting in hold. Therefore bottleneck in renewable energy investment is not feed in tariffs but the administrative measures that raise risk for the potential investors who want to operate in Contracting Parties. The reason for that are the constant changes and uncertainties of support measures in Contracting Parties(Karina, Uslu, Beurskens, Tuerk, Frieden, Symeonides, Sidiropoulos, Zehetner, and Resch p,14)[205].

[204] Veum Karina, Ayla Uslu, Luuk Beurskens, Andreas Tuerk, Dorian Frieden, Mira Symeonides, Lazaros Sidiropoulos, Christoph Zehetner, and Gustav Resch. *Assessment of Renewable Energy Action Plan Implementation and Progress in the Promotion and Use of Renewable Energy in the Energy Community*. Rep. Energy Community, 20 July 2015. p 1-183

[205] *Ibid*

Power purchase agreements (PPA) are important to finance renewable energy projects. In the Contracting Parties, PPA needs to be signed in different stages of development of a renewable energy project. However it does not always provide an enough security for investors and to finance and provide investors confidence in renewable energy projects therefore secure the support scheme applicable at the time of signature of a PPA is very important. Moreover as it is talked, for the operational support feed in premium is the most suitable to replace feed-in tariffs that based on the first-come, first-served. "A feed-in premium, with the premium granted through a tendering process, is compatible with the internal market principles and will lead to a phase-out of the subsidies needed overtime while several technologies will reach market parity" (Energy Community Report p,5).[206]

4.3.2 Renewable Policies, Strategies and Support Measures

We will now look into the most important new legal measurements of 2015 in order to understand the current regulatory and legislative process in Contracting Parties of the Energy Community. If we start with Albania it can be said that on 11 February 2015 "Enacting the methodology for the fixed tariff for electricity purchased by small hydro power producers for the year 2015" DCM no. 125 has been adopted and a day after Law No.6/2015 introduced on another law that has been introduced in 2009 and this was about the licenses and permits in Albania and in same year on April, power sector law was adopted. For the Bosnia and Herzegovina, in 2015 there was no regulatory activity just a few regulations, which were introduced after the RES Law and REAP in 2014 (Karina, Uslu,Beurskens, Tuerk, Frieden,Symeonides, Sidiropoulos, Zehetner, and Resch p,23)[207].

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[206] Report of the Secretariat to the Ministerial Council on the Progress in the Promotion of Renewable Energy in the Energy Community. Rep. no. ANNEX 05a. N.p.: Energy Community, 2015. Energy Community. 10 May 2017. <https://www.energy-community.org/portal/page/portal/ENC_HOME/DOCS/3842311/2194639ACBF1368EE053C92FA8C04E9A.PDF>

[207] Veum Karina, Ayla Uslu, Luuk Beurskens, Andreas Tuerk, Dorian Frieden, Mira Symeonides, Lazaros Sidiropoulos, Christoph Zehetner, and Gustav Resch. *Assessment of Renewable Energy Action Plan Implementation and Progress in the Promotion and Use of Renewable Energy in the Energy Community*. Rep. Energy Community, 20 July 2015. p 1-183.

In Kosovo, even though there weren't any outstanding legal acts in 2015, there were many activities at the end of the year 2014 for the RES sector. For instance on December 2014, the rule on support of electricity generation from RES has been introduced and same day Energy Regulatory Office has been adopted a decision for the determination of FIT for generating electricity from RES. Later in November 2014, in order to simplify the procedures the rule on "Authorization Procedure for Construction of New Generating Capacities" has been adopted. For the case of FYR of Macedonia, amendments were introduced under the Energy Law and changes been made also the Law on Construction and Spatial and Urban Planning Law was adopted. In Moldova, on contrary to its performance in 2014, there weren't any remarkable legislative activity in 2015. Again for Montenegro there weren't any outstanding legal activity either in the RES sector in 2015. However there were few important activities occurred in 2014. For instance: submitting the new Energy Law to the Parliament made some amendments passed and introducing the Energy Efficiency law. In 2015, Serbia passed several regulations like Energy Permits, Regulating the energy manager training and energy consultant certification Rulebooks. Lastly for the Ukraine, Law No. 222-VIII for to license the types of business activity and Law No. 284-VIII, which one will be efficient were adopted in 2015. Besides, the National Electricity Regulatory Commission of Ukraine established tariffs, FIT and Government's plans on implementation of EU legislation (Karina, Uslu,Beurskens, Tuerk, Frieden,Symeonides, Sidiropoulos, Zehetner, and Resch p,23)[208].

In order to reach to energy efficiency, usage of sufficient amount of renewables and at the same time has the social and environmental benefits at maximum level needs important amount of investment. In energy infrastructure both private and

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[208] Veum Karina, Ayla Uslu, Luuk Beurskens, Andreas Tuerk, Dorian Frieden, Mira Symeonides, Lazaros Sidiropoulos, Christoph Zehetner, and Gustav Resch. *Assessment of Renewable Energy Action Plan Implementation and Progress in the Promotion and Use of Renewable Energy in the Energy Community*. Rep. Energy Community, 20 July 2015. p 1-183

public investment require to mobilize. Even though, investment in renewable energy is significant for to increase energy demand, it is a serious challenge in the region. Barriers for the investments are due to regulated prices. Regulated end user prices failing take the cost of generation into account. Lack of long-term predictability of long term tariffs, innovative financial instruments and unavailability of grid capacity negatively effect the generate energy from renewable sources. Besides encouraging the investment on renewable energy resources are not only a legal obligations for the Contracting Parties but they are also "stimulates development of the aging and outdated facilities of their energy sectors while responding to requirements for environmental protection, reducing dependence on energy imports and creating premises for sustainable development and growth" (Energy Community p,1)[209].

Investor confidence in EU Member provided with the combination of technology specific feed-in tariffs and industrial policies. Whenever this support is not designed then investor confidence decline and burden created for end consumer. In 2013, European Commission issued the Communication "Delivering the internal market in electricity and making the most of public interventions" which has specific guidelines for to regulate renewable energy support schemes. This was for the flexible market based solutions in order to prohibit the market. So, endorsement for renewable energy must be provide in a way to enable a better ground for the market signals to draw renewable energy producers but also needs to be responsive towards decreasing production costs. By following this methods feed in premiums (FIP) shall replace feed-in tariffs. It is a quota system, which incentivizes investors to react to market developments (Energy Community p,12).[210]

[209] Report of the Secretariat to the Ministerial Council on the Progress in the Promotion of Renewable Energy in the Energy Community. Rep. no. ANNEX 05a. N.p.: Energy Community, 2015. Energy Community. 10 May 2017. <https://www.energy-community.org/portal/page/portal/ENC_HOME/DOCS/3842311/2194639ACBF1368EE053C92FA8C04E9A.PDF>

[210] *Ibid*

4.3.3 Overview

Although there is a huge potential in region there are not enough implementations for the use of renewable energy sources and energy efficiency measures. For the Energy Community Member Countries, implementations under the Energy Community framework provide huge opportunities. Security supply and environment, economic developments are well known as benefits. However it is important to guarantee the protection for the vulnerable customers. Therefore EC member countries has to implement law or regulation to define the vulnerable customer and establish special protection and support for them.

NREAP is the only tool and a legal obligation that ensures transparency to investors for renewable energy policy objectives and also to reach 2020 targets. Contracting parties are reluctant to open energy market and remove non-cost barriers. Therefore they cannot attract the investors for small renewable energy projects. Institutions in power delay the process of new legislations or change in current framework. "The assessment of the submitted NREAPs and the progress reports for 2012-2013 shows that the Contracting Parties are, in general, not on track to meet their 2020 targets if no enhanced policy initiatives are put in place as the trajectories become steeper closer to 2020" (Karina, Uslu, Beurskens, Tuerk, Frieden, Symeonides, Sidiropoulos, Zehetner, and Resch p,25)[211].

Except Montenegro non of the Contracting Parties was able to meet their first interim target. For the upcoming period countries needs to strengthen the policy initiatives which offers market based support for technologies that generate energy from the renewables and a low effect on electricity price for the end customers.

[211] Veum Karina, Ayla Uslu, Luuk Beurskens, Andreas Tuerk, Dorian Frieden, Mira Symeonides, Lazaros Sidiropoulos, Christoph Zehetner, and Gustav Resch. *Assessment of Renewable Energy Action Plan Implementation and Progress in the Promotion and Use of Renewable Energy in the Energy Community*. Rep. Energy Community, 20 July 2015. p 1-183

4.4 Nordic Energy Research

As it has been already accepted that the greenhouse gas affects the environment negatively and lead to a global climate change. The changes will be varying different regions in the world. For the Nordic Region it is estimated that until 2100 in the region temperature will increased around 3°C and due to increase rainfall, sea level will also increase 40 cm (Fenger p,11)[212]. So, in order to fight these changes or at least with their impacts there are series of Nordic Research Projects has been initiated.

In 1975, Nordic cooperation in energy research has been created and in 1985 it became a research funding institution. Later in 1999,,Nordic Energy Research established under the Nordic Council of Ministers. Their board consists of representatives from the Nordic countries that contribute the funding of the organization. It operates in 4 year time of periods and strategies guide all activities in the organization (Nordic Energy Research p,2)[213].

In the Nordic Regions, energy and environment considered as the public matter for a long time. However due to changes, this situation also became an important matter for the other actors such as industrial companies, innovative entrepreneurs, researchers and NGOs. Due to liberalization, more market orientation and globalization in general, in policies, these other actors also started to involve in the development of the energy sector. It is also considered that these actors would help more for the economic potential, development in energy sector and find solutions for sustainable energy (Mapping Biogas in the Nordic Countries p,9)[214]

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[212] "Nordic Energy Research." Impacts of Climate Change on Renewable Energy Sources – Their role in the Nordic energy system –. Ed. Jess Fenger. Nordic Research, 2007. 23 Apr. 2017. <http://www.nordicenergy.org/publications/impacts-of-climate-change-on-renewable-energy-sources-their-role-in-the-nordic-energy-system/>.

[213] "Nordic Energy Research Strategy 2015-2018." *Nordic Energy*. Norden, 11 Dec. 2014. 20 Apr. 2017. <http://www.nordicenergy.org/publications/strategy-2015-2018/>.

[214] "Mapping Biogas in the Nordic Countries ." Nordic Energy. Sund Energy, 30 Nov. 2010. 25 May 2017. <http://www.nordicenergy.org/publications/mapping-biogas-in-the-nordic-countries/>.

Although use of fossil fuels amount is higher than the renewables in the world and general contribution to use of renewable energy is modest, as it mentioned before, in the EU member countries, in this part of the world, situation is different and the usage amount of renewables are increasing. Moreover in Nordic Countries, this amount is calculated as %75 for the contribution of the sources of renewable energy. (Fenger p, 32)[215] .

Even though there are different potentials of usages among the Nordic Countries, in general renewable energy plays an important role. For instance,"Hydropower accounts for more than 50% of electricity production, mostly in Norway, Iceland and Sweden, biomass is responsible for 3% and wind power for 1% (almost all of which is in Denmark), solar power has, so far, played an unimportant role. For heat production, 34% is accounted for by biomass, mainly in Sweden and Finland" (Fenger, 35)[216]. However, these countries in terms of energy situation, share some similarities. As it will be seen below, renewable energy resources are showing differences among the countries yet what is common between them is the increasing role of the renewables as energy resources. Besides, electricity production in the region is linked with each other therefore because of the common Nordic Energy Market; any small impact on one of them, will affect the others.

4.4.1 Renewable Energy Resources and Technologies

In the region, Hydropower consider as the most important source for the electricity. Wind power on the other hand is less reliable when you compare it with the hydropower. Moreover compare with other sunny places on earth, Nordic region is less lucky with solar power. According to data "The annual energy density varies between 1,100 kWh/m^2 in the south of the region and 700 kWh/m^2 in the north also a sunny summer's day without clouds may give about 8 kWh/m^2, whereas a

[215] "Nordic Energy Research." Impacts of Climate Change on Renewable Energy Sources – Their role in the Nordic energy system –. Ed. Jess Fenger. Nordic Research, 2007. 23 Apr. 2017. <http://www.nordicenergy.org/publications/impacts-of-climate-change-on-renewable-energy-sources-their-role-in-the-nordic-energy-system/>.

[216] *Ibid*

cloudy winter's day gives only 0.02 kWh/m^2"(Fenger p, 35)[217]. Therefore solar energy usage is mostly for thermal systems and of grid applications of solar cells in Nordic Countries. Lastly for biomass, energy crops for primary agricultural production in Nordic Regions estimated around 82million tons each year. Biogas has been given a huge importance in Europe because attention to biogas and due to its developed country costs of it has been decreased. Biogas in the Nordic region is very small two of the largest producer countries are Denmark and Sweden. Even though Norway and Finland had potential, their biogas production is low (Mapping Biogas in the Nordic Countries p,3)[218]

Electricity from Renewable Resources supported by the combination of different support schemes in Nordic Countries. In Nordic Countries, developed technologies are supported at the operation level and they also support investment aid. For instance Denmark and Finland have technology specific premium tariff-based systems. Besides to support power production from RES, Norway and Sweden have an essential technology neutral support scheme and it called "the Joint Electricity Certificate scheme". This scheme is on force from 2012 to 2035 (Walsh, Nordström, Sargant, Larsson, Görling, Wallmark, and Damsgaard p,42)[219].

For energy innovation, Nordic region is very good comparing with the other countries in the World. Even though Nordic Countries' populations are not much, with their effort on promoting the usage of renewable energy, they are covering the huge portion of the total energy innovation activities in the world. For renewable energy technologies, they are also very visible in the picture all around the world.

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[217] "Nordic Energy Research." Impacts of Climate Change on Renewable Energy Sources – Their role in the Nordic energy system –. Ed. Jess Fenger. Nordic Research, 2007. 23 Apr. 2017. <http://www.nordicenergy.org/publications/impacts-of-climate-change-on-renewable-energy-sources-their-role-in-the-nordic-energy-system/>.

[218] "Mapping Biogas in the Nordic Countries ." Nordic Energy. Sund Energy, 30 Nov. 2010. 25 May 2017. <http://www.nordicenergy.org/publications/mapping-biogas-in-the-nordic-countries/>.

[219] Walsh Rachel, Mattias Nordström, Rose Sargant, Mårten Larsson, Martin Görling, Cecilia Wallmark, and Niclas Damsgaard. New Game plan RES Support in the Nordics. Working paper. Nordic Energy Research, 05 Oct. 2016. <http://www.nordicenergy.org/publications/new-gameplan-res-support-in-the-nordics/>.

For instance, for wind energy, it can be said that all countries in Nordic region is covering a significant position in the world. (Borup, Per Dannemand and Walter p,9). [220]

4.4.2 Renewable Policies, Strategies and Support Measures

Nordic countries are highly interested in forefront development to low carbon energy and sustainability. Therefore they also interested in to explore and create more in this field. With the Nordic Council Ministers, The Nordic Working Group of Renewable energy has been established. 5 Nordic countries are cooperating on policy department for the renewable energy field. Moreover, in the electricity and transport sectors, there is more pressure with the policy measures that support renewable energy. As it has been already mentioned several times before, EU has 2020 strategy for the climate change and energy sustainability and Nordic Countries are also following up these targets (Walsh, Nordström, Sargant, Larsson, Görling, Wallmark, and Damsgaard p,7).[221]

Most of the Nordic countries are the members of EU, therefore they need to adopt national policy framework for the development of energy from renewables resources and also for the transport sector there has to be alternative fuels. Framework needs to consider the current state and the future development for the market of alternative fuels in transport sector and national targets for recharge points for electric vehicles. Both for the EU and national governments, increase the share of renewables is an important issue. Each country has taken different measures in order to meet with targets.

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[220] Borup, Mads, Per Dannemand Andersen, and Walter J. Sanchez. "Nordic Energy Innovation Systems - Patterns of Need Integration and Cooperation." (2008): 1-129. *Nordic Energy Research*. <http://www.nordicenergy.org/wp-content/uploads/2012/02/Nordic-energy-innovation-systems-Patterns-of-need-integration-and-cooperation.pdf>.

[221] Walsh Rachel, Mattias Nordström, Rose Sargant, Mårten Larsson, Martin Görling, Cecilia Wallmark, and Niclas Damsgaard. New Game plan RES Support in the Nordics. Working paper. Nordic Energy Research, 05 Oct. 2016. <http://www.nordicenergy.org/publications/new-gameplan-res-support-in-the-nordics/>.

The Renewable Energy Directive set national targets for share of renewable energy final energy consumption which EEA states are very much obligatory to reach until 2020. These targets are legally binding to each member states for their total consumption yet it is different among the members. However for the renewable energy share from total consumption in transport sector set as %10 for all the countries (Walsh, Nordström, Sargant, Larsson, Görling, Wallmark, and Damsgaard p,34)[222]. We can easily see the comparison of national targets for renewable energy until 2020 and 2005 of Nordic countries' from the table.

Table 4: Mandatory National overall targets for the Nordic countries in 2020

	Overall renewable energy share in gross final consumption: 2005	Overall renewable energy share in gross final consumption: 2020
Iceland[24]	63.4%	72.0%
Norway[25]	60.1%	67.5%
Sweden	39.8%	49.0%
Finland	28.5%	38.0%
Denmark	17.0%	30.0%

Source: (Walsh, Nordström, Sargant, Larsson, Görling, Wallmark, and Damsgaard p,34)[223]

NREAPs for every country which is also mentioned in the Article 4 of the Renewable Energy Directive, give details about the national sectorial targets such as transport, electricity, heating and cooling which in total has to reach the expected target until 2020.

[222] Walsh Rachel, Mattias Nordström, Rose Sargant, Mårten Larsson, Martin Görling, Cecilia Wallmark, and Niclas Damsgaard. New Game plan RES Support in the Nordics. Working paper. Nordic Energy Research, 05 Oct. 2016.. <http://www.nordicenergy.org/publications/new-gameplan-res-support-in-the-nordics/>.

[223] *Ibid*

Table:5 Estimates 2020 shares of RES energy in overall energy consumption and by sector in the Nordic Countries

	Overall RES share[28]	Heating & cooling[29]	Electricity generation[30]	Transport[31]
Iceland[32]	76.8% (76.0%)	96.1% (96.0%)	100.0% (100.0%)	9.9% (0.9%)
Norway	67.5% (69.2%)	43.2% (32.5%)	113.6% (109.6%)	10.0% (4.8%)
Sweden	54.8%[33] (52.6%)	62.1% (68.1%)	62.9% (63.3%)	13.8% (19.2%)
Finland	38.0% (38.7%)	47.0% (52.0%)	33.0% (31.4%)	20.0% (21.6%)
Denmark	30.4% (28.5%)	39.8% (38.4%)	51.9% (48.5%)	10.1% (5.7%)

Source: (Walsh, Nordström, Sargant, Larsson, Görling, Wallmark, and Damsgaard p,34)[224]

From the table, it can be easily seen that the progress that Nordic countries give for the 2020 aims is going well. In the region Iceland is the only country that produce its electricity only from RES. Besides, for the country it is very important to decrease the fossil fuel usage in the transport sector. In 2014, RES share in the transport sector was 1.9% and due to EU Renewables Directive %10 shares in renewable energy is also a target for Iceland. Except Iceland, Norway has one of the highest targets for the renewables in the total consumption until 2020. As it can be seen in table above the target of RES share is 67.5% for the total energy consumption. (Walsh, Nordström, Sargant, Larsson, Görling, Wallmark, and Damsgaard p,34)[225].

Nordic Energy Research has strategy for to reach the mentioned goals. "As a follow-up to the organization's main research funding program for 2011-2014, entitled Sustainable Energy Systems 2050, three new central instruments are planned and these three instruments cover all three goals for the period and will account for the majority of Nordic Energy Research's direct funding from member

[224] Walsh Rachel, Mattias Nordström, Rose Sargant, Mårten Larsson, Martin Görling, Cecilia Wallmark, and Niclas Damsgaard. New Game plan RES Support in the Nordics. Working paper. Nordic Energy Research, 05 Oct. 2016. <http://www.nordicenergy.org/publications/new-gameplan-res-support-in-the-nordics/>.

[225] *Ibid*

countries" (Nordic Energy Research Strategy p,5).[226] Flagship Project is the largest instrument for the cooperation and it is result oriented. It is also backed up with other two instruments called, Network-Building Projects and Expert Groups.

With the help of these strategies, Sweden has been achieved their general goal for 2020 already in 2014 and the aim was to reach %50 which is even more than the EU's target. In addition to that Sweden already reached to their goal again in 2014 for the transport, heating and cooling and electricity generation. On the other hand, Finland also met its total consumption of renewable energy share and transport sector target already in 2014. Therefore the same year, Finnish Ministry for Employment and the Economy feature another roadmap to sustainable energy and climate for 2050. In this roadmap, there was an aim to reduce much of the green house gas emission in 2050 yet there was no policy to show a way to reach this aim. (Walsh, Nordström, Sargant, Larsson, Görling, Wallmark, and Damsgaard p,40)[227].

For 2020 target, Denmark aimed to reach %30 for the total consumption of RES in energy and on top of that Denmark set up %35 of non-binding target again for the total consumption of RES in electricity consumption. (Walsh, Nordström, Sargant, Larsson, Görling, Wallmark, and Damsgaard p, 41). In 2012, in order to meet 2020 aims, Denmark introduces a policy agreement that contains strategies. For instance to meet with the %50 target in wind generation, Denmark established offshore wind turbines and also established new planning tools.

Except the Join Certificate system in Norway and Sweden other support schemes are financed by the state. For Denmark and Finland, they use different ways to limit policy cost. Danish and Finish have premium tariff system, which are

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[226] "Nordic Energy Research Strategy 2015-2018." *Nordic Energy*. Norden, 11 Dec. 2014. 20 Apr. 2017. <http://www.nordicenergy.org/publications/strategy-2015-2018/>.

[227] Walsh Rachel, Mattias Nordström, Rose Sargant, Mårten Larsson, Martin Görling, Cecilia Wallmark, and Niclas Damsgaard. New Game plan RES Support in the Nordics. Working paper. Nordic Energy Research, 05 Oct. 2016. <http://www.nordicenergy.org/publications/new-gameplan-res-support-in-the-nordics/>.

administration intensive. Due to their efficient support scheme, renewable resources and with the fast technological development, joint certificate market seen as cost-efficient in the region. In general, with the tax exemption and quota obligations in the region, there has been a fast introduction of renewable resources into the market (Walsh, Nordström, Sargant, Larsson, Görling, Wallmark, and Damsgaard p,42)[228].

4.4.3 Overview

In the region there is a high potential of renewable energy resources and they are very much involve in this sector and considered this as a public matter for a long time. Nordic countries used both national and joint schemes in order to promote investment for the renewable electricity generation. For Norway and Sweden there has been an on going on joint scheme since 2012 yet Finland and Denmark has their national schemes. While Denmark and Finland use technology-specific premium tariff-based systems for to support power from RES, Norway and Sweden uses the main technology- neutral support scheme "the Joint Electricity Certificate scheme" that provide aid. In terms of degree of market integration and investor risk, Nordic schemes show differences. However, all of these price schemes provide certainty and confidence to investors. Lastly, one of the most important common points among the Nordic countries is the independent support schemes that causes rapid increase in the share of renewables in electricity production and their integration into power system.

4.5 EUROPEAN COMISSION

With the Lisbon objective, European Union tries to become as the most competitive renewable energy and sustainable growth based economy in the world. Moreover, transport sector supported the long-term sustainable energy from the renewables and energy security. Development of EU's energy sector depends on

[228] Walsh Rachel, Mattias Nordström, Rose Sargant, Mårten Larsson, Martin Görling, Cecilia Wallmark, and Niclas Damsgaard. New Game plan RES Support in the Nordics. Working paper. Nordic Energy Research, 05 Oct. 2016. <http://www.nordicenergy.org/publications/new-gameplan-res-support-in-the-nordics/>.

few variables such as energy dependence increment, energy prices increment, enlargement of EU and their history with Russia. Due to these variables, energy security in EU became highly vulnerable therefore a policy window has been necessary to define. With the work of European Commission, policies were developed for energy security and increasing import dependence because energy security issue is one thing that represents concerns in EU for a long time. Even in time of The European Coal and Steel Community in 1951, the concerns were high due to dependence on coal (Dreger p,356)[229].

"The Commission's 1968 'Community Energy Policy' (European Commission, 1968), set out dependency concerns, and a Community energy policy was a stated aim of the Council as early as 1964 (Council of the European Union, 1964)" (Maltby p ,437).[230] In 1968, it believed that the lack of cooperation in energy topic is dangerous and they decided on creating a community energy policy that integrate energy sector in EU's common market. By this attempt they were trying to decrease risk of dependence on imports and also increase the alternative and diversification of supplies for energy.

This continued in 2012 proposal because in both of them it claimed that EU should have general frameworks when action is needed and the creation of a common energy market is a must. With the oil crises in 1970 as it has been mentioned in previous chapters, EU became more aware of the hazardous potential and vulnerability in energy dependency. However they continue to have individual state solutions and recommendation of the EU Commission has been ignored

229 Dreger, Jonas. *The European Commissions energy and climate policy: A climate for expertise?*1st ed. London: Palgrave Macmillan, 2014. Energy, Climate and the Environment. *Palgrave Macmillan*. Palgrave Macmillan UK, 2014. Web.

230 Maltby, Tomas. "European Union Energy Policy Integration: A Case of European Commission Policy Entrepreneurship and Increasing Supranationalism." ScienceDirect. Elsevier, 18 Jan. 2013. 08 Mar. 2017.
<http://www.sciencedirect.com/science/article/pii/S0301421512010798>.

(Maltby p,438).[231]

Renewable energies like hydropower, solar energy and biomass also expected to play a major role in creating technologies and therefore new jobs for Europeans. From this aspect EU could get rid off current economic crisis that they have been facing. After 1970's energy crises nations started to have renewable energy solutions as an alternative energy however when the lower prices of oil came back, it prevented renewable energy solutions and development to have further success. Nevertheless, by the efforts of promoting renewable energy, between the years of 2005 and 2013, The EU-28 became one of second regions in the world, which increased its renewable energy share in a great manner. In addition to this only China was able to suppress, The EU-28 in new renewable energy investment in 2013 but through out 2005-2012, EU was the highest investor (Tomescu, Ils, Wouter, Lukas, Förster, and Benjamin p,51).[232]

4.5.1 Renewable Energy Resources and Technologies

Sustainable biofuels are important for the development in EU because they targeted %10 of renewable usage in transportation field. In The Renewable Energy Directive it has been mentioned that all of the biofuels, which consumed in EU need to be produced and consumed in sustainable manner. Biofuels and renewable waste are covering the huge amount of renewable energy consumption in EU countries. Therefore among the EU-28 countries, it is considered as the most important renewable energy resource. After biofuels, hydropower came as the second most important resource in the Union and it is followed by the wind energy. Even though wind and solar energy is coming after biomass and hydropower still

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[231] Maltby, Tomas. "European Union Energy Policy Integration: A Case of European Commission Policy Entrepreneurship and Increasing Supranationalism." ScienceDirect. Elsevier, 18 Jan. 2013. 08 Mar. 2017.
<http://www.sciencedirect.com/science/article/pii/S0301421512010798>.

[232] Tomescu, Mihai , Ils Moorkens, Wouter Wetzels, Lukas Emele, Förster Hannah, and Benjamin Greiner. Renewable energy in Europe 2016 Recent growth and knock-on effects. Rep. no. No 4/2016. Luxembourg: European Environment Agency, 2016. European Environment Agency.

with their rapid growth they are also candidate to became as new phenomena. Tide, ocean and wave energy are currently has a very low percentage in renewable energy production and found mainly in UK and France in the EU (Renewable Energy Statistics)[233].

In order to reduce the GHG emission, Low-carbon technologies like PV and wind power, are essential to protect environment and develop sustainable energy system. As it has been already mentioned, by developing and improving the renewable energy technologies it is also possible to reduce the reliance on external fossil fuels and it would help to increase in job creation, which will lead to an economic growth. For the future development in technology, favorable public policies, investments and cooperation with private sector is necessary. All of them together would boost the development in low carbon technologies. So; The European Strategic Energy Technology Plan (SET-Plan) has been established in order to create economically viable low carbon technologies. This plans targeting to develop the new technologies by reducing the cost and increasing the energy efficiency. It includes the "SET-Plan Steering Group, European Industrial Initiatives, the European Energy Research Alliance, and the SET-Plan Information System" Moreover, more than 6 billion Euros were spent for the energy projects in the EU in order to help the creation of low carbon energy technologies (Technology and Innovation).[234]

For the energy challenges, technology is a crucial factor. EU as one of the leaders in renewable energy development needs to introduce new low cost and low carbon energy market technologies into market. These low carbon energy technologies are very important to reach for the targets of climate, social and economic policies for the future. Constant evolving and changing energy landscape require for different types of developments in renewable energy technologies. EU needs to support

233 "Renewable Energy Statistics." Eurostat Statistics Explained. Eurostat, July 2016. <http: // ec. europa. eu/ eurostat/ statistics-explained/ index. php/ Renewable_ energy_ statistics>.

234 "Technology and Innovation, Accelerating the energy transition." European Commission Energy. European Commission, n.d. <https://ec.europa.eu/energy/en/topics/technology-and-innovation>.

industrial competitiveness in energy technology and innovation in order to reduce the cost to help the economic growth, which will help national economies and private investors (Commission To The European Parliament p,2).[235]

In order to reach their 2020 goals, EU energy polices has been shift towards the low carbon generation technologies. With the support from Renewable Energy Directive and Member States there is a great growth and also decrease in cost. With changes in energy system, EU encouraged, Carbon Capture and Storage (CCS) technologies and nuclear power generation that is safer than the previous. Internal market in EU creates competitive markets and that encourages its citizens to invest in new technologies. There have been 12 corridors identified by the EU in order to integrate solar and wind power. For the internal market, technical rules have been developed by giving attention to integration of technologies for the changing energy system. Transmission System Operators (TSO) developed new models and smart grid operation tools as part of integrating technologies. With the Energy Efficiency and Eco Design Directives, technologies went into market. In transport sector, EU encouraged the electrical vehicles and low emission. In building sector, it encourages the energy efficient building construction and zero energy buildings (Commission To The European Parliament p,3).[236]

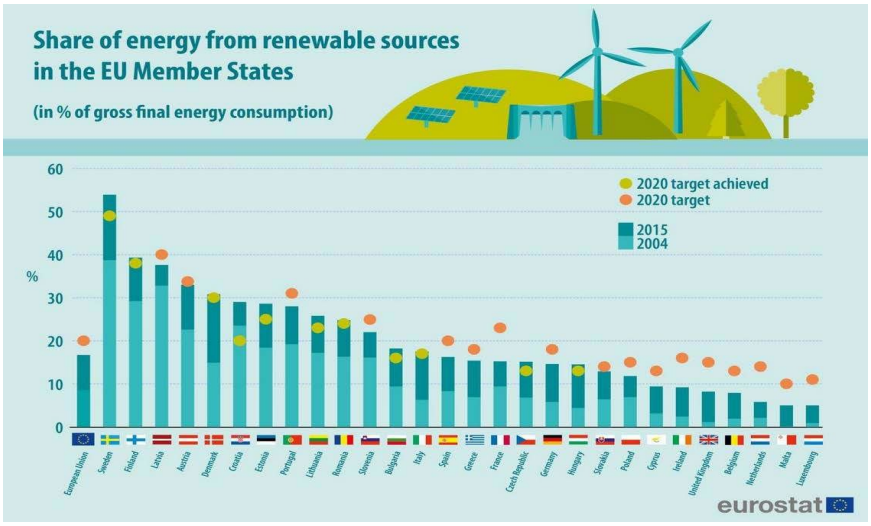
In 2015 the share of renewable energy in total consumption has been raised %17 in EU. From the Eurostat statistic, different countries progress toward 2020 target can be seen. In 2015, 22 countries out of 28 member states have been shown a great improvement in the share of renewable energy. However countries showed different levels of processes in the Union. 11 member states already achieved their 2020 target and these member states are Sweden, Denmark, Finland, Croatia, Lithuania, Estonia, Italy, Bulgaria, Romania, Czech Republic and Hungary. All of these mentioned states were very successful to exceed their national targets of

235 Communication From The Commission To The European Parliament, The Council, The European Economic And Social Committee And The Committee Of The Regions Energy Technologies and Innovation . Rep. no. COM(2013). European Commission, n.d. <https://ec.europa.eu/energy/sites/ener/files/comm_2013_0253_en.pdf >.

236 *Ibid*

renewable energy. There are also some countries that are only few points below their target. On the other side, countries like Germany, UK, The Netherlands and France were not able to reach their targets (Gray).[237]

Table: 6 The Share of Renewable Sources in the EU Member States



Source: *Gray*[238]

4.5.2 Renewable Policies, Strategies and Support Measures

As it has been mentioned already with the concerns of security of supply and protection of the environment, in 1997, The EU Commission published a White Paper that set out a strategy for Community in order to achieve %12 share of renewable targets in total EU energy consumption. In 2001, %12 of target was adopted for the electricity from renewable energy resources and %22.1 target for electricity from EU-15 has been adopted. These targets are binding in EU member countries and they are also important to apply Kyoto protocol commitments. Later in 2007, "Renewable Energy Roadmap" has been established as a long-term strategy. This strategy established in order to reach for %20 share of renewable

237 Gray, Alex. "The Best Countries in Europe for Using Renewable Energy." World Economic Forum. 3 Apr. 2017. 10 May 2017. <https://www.weforum.org/agenda/2017/04/who-s-the-best-in-europe-when-it-comes-to-renewable-energy>.

238 *Ibid*

energy goal in total energy consumption until 2020.

In order to reach this target in 2009, EU adopted new Renewable Directives; EU put different targets for each member states. Moreover in 2010, Commission presented the "Europe 2020" strategy cooperation along with 2020 climate goals in order to promote resource efficient Europe (EU Renewable Energy Policy).[239]

The Renewable Energy Directive established for the promotion of renewable energy from energy resources. It requires EU to fulfill its total energy consumption at least %20 from the renewable energy resources by 2020 with achieving individual targets. EU countries also need to ensure that their %10 of transport fuels must come from renewable energy resources also by 2020. Revised Renewable Energy Directive has been established in 2016 to make EU as a global leader in renewable energy and to make sure %27 target to use renewable energy in total energy consumption is met by 2030. National action plans and progress reports are necessary for to measure the progress of EU countries renewable energy targets. It shows differences due to each countries situations in renewable energy potential and their capacities in renewable energy development. For instance as in EU commission website mentioned for Sweden this target is %49 while for Malta it is %10. Every 2 years, with the guidance of national renewable energy action plans, countries policies are shaped and progress is measured. Another important point is that Renewable Energy Directive encourages cooperation between in both EU countries and the ones outside of EU by doing joint renewable energy projects, support schemes and transfer of renewable energy statistics (Renewable Energy Directive)[240].

4.5.3 Overview

In order to comply with the Kyoto protocol and United Nations Framework Convention on Climate Change, European Union Energy consumption has been

[239] "EU Renewable Energy Policy." EURACTIV.com. 21 Feb. 2017. 08 June 2017. <https://www.euractiv.com/section/science-policymaking/linksdossier/eu-renewable-energy-policy/>.

[240] "Renewable Energy Directive." European Commission Energy. European Commission, n.d. <https://ec.europa.eu/energy/en/topics/renewable-energy/renewable-energy-directive>.

increased the use of renewable energy resources. Moreover, energy efficiency and savings has been also increased in order to reduce the GHG emission. All of the mentioned factors above played an important role in securing energy supply, technological and regional developments. Increment of the usage of renewable energy resources in transport sector and with technological improvements, Community would be able to reduce its interdependence on imported oil. Energy potential in every state varies but there is a necessary target of %20 for the EU. Therefore depends on their renewable energy potential and energy mix, every state has individual targets. However for the transportation sector, %10 targets for renewable energy usage is fixed for every state. Member states need to establish national progress reports in order to ensure to achieve final mandatory targets. At national level, each states has different potentials and different support schemes for renewable energy resources therefore a functioning support scheme is very important.

CHAPTER 5

CONCLUSION

Problems occurred from the usage of fossil fuels and increasing climate change concerns let significant changes in energy policies around the world. Therefore, discussions on the topic of the importance of the usage of renewable energy, types of renewable energy, climate change problems, and transition of the energy system from fossil to renewable energy have been started. The climate change threat caught great attention from the world leaders and makes them to commit to reduce emissions.

Average temperature of earth is rising and that causes an increase in carbon dioxide emission and GHG, which caused by burning fossils. Therefore significant changes occurred in climate, which became a threat to a human life and environment. Due to this reason, efforts must be taken to promote sustainable energy. Adoption of environmental friendly policies and alternative energy usages would reduce the risk of climate problems. It would also control the GHG emission, which would help global warming to be under control. With these attempts and changes, countries and regions would benefit from energy efficiency, security, social and economic developments. Besides, International arena would benefit from the reduction in pollution and climate mitigation.

Most of the developed and industrialized countries has been supported the Kyoto Protocol, in order to reduce the GHG emission. Countries have different targets, however common aim is to reduce the GHG and carbon emissions in order to create a sustainable atmosphere for the future. Moreover, some countries have reached to their targets but some have not yet. In any case there is a common understanding in the world about the importance of the climate change issue and changes in how we look to energy also changed the landscape of energy policies.

Accordingly, this thesis aimed to report and identify the renewable energy resource potentials, renewable energy technologies, incentives, methods and financial resources of specified countries and regional frameworks. It also compared selected countries and regional frameworks to see the key elements of the renewable energy development for a cleaner future.

As discussed in the second chapter of the thesis, there are several renewable energy resources and can be found anywhere in the world. However in following chapters we discussed that policies, technologies and support measure are more important for the development of renewable energy systems. So it can be easily said that there is a basic relationship with the development of renewable energy and renewable energy policy targets, support measures and technologies. Moreover, examples from the countries and regions are also showing us that policies, support measures and technologies are key for countries and regional frameworks to realize their potentials in renewable energy production.

It is certain that existing of renewable energy resources is very important for renewable energy system development, there are examples that also showed us with the limited renewable energy resources, there are more successful countries with the help of the legal frameworks, effective support measures and technological developments. In every country there are different ways of policies to promote renewable energy. Even though there is a regional cooperation that expected from its member countries to reach to specific national and regional targets for determined year, countries could still have different ways.

As it is discussed in chapter four, in Germany, focus was “Energiewende”, which is an energy policy development process. An origin of “Energiewende” goes back to thirty years. For to understand what caused the emergence of this energy policy, understand the events, social dynamics and political power constellations are important. All of these developments have been shaped Germany’s energy policy and with Fukushima incident in Japan and a great public attention resulted in ending the usage of nuclear energy. It is showed that Germany is one of the

pioneers in renewable energy development. The country has been managed to reach its target for renewable energy development to reduce climate change concerns. With its energy policies, support measures and technological developments, Germany has been taking the lead in renewable energy sector that can easily set an example for the other countries in the world.

Due to significant problems with the usage of fossil fuels and increasing population in China, some changes occurred in the energy consumption and policies. By analyzing the 12 Five Years Plans between the years 1953 and 2010, China has witnessed significant changes. Energy production started to increase and with the increment of domestic energy production and consumption, China started to import energy and started focus on improving the energy efficiency. There was a new phase of promoting renewable energy started in Five Years Plans in order to reduce the carbon dioxide emission. China also started show more attention to increase the share of renewable energy usage in total energy consumption because climate change issue became a huge global problem and energy policies of Chinese government have changed according to this. So, China is also in transition to reach for a cleaner and sustainable future and with current energy policies, it is also increasing their energy efficiency and developing renewable energy to deal with the climate change concerns.

Renewable energy is also a current major force in USA. Near the great amount of natural resources and state based green policies, there are also vast varieties of technologies for renewable energy development in order to reach sustainability. Therefore, even though some states are way ahead of the others in renewable energy development such as California, there are also many other states, which show great efforts. So, there is a great process going on in the USA for to generate clean energy from renewable energy resources.

Furthermore, Turkey is heavily depending on fossil fuels even though it has abundant renewable energy resources such as solar, biomass, wind and geothermal. These renewable energy sources cannot provide total energy demand of Turkey so

the government needs to create more efficient energy policies. Due to fossil fuels import from the other countries, financial problems occurred in Turkey. Therefore Turkish government focused to assure energy supply and one of the best ways of doing that was to focus more on the country's abundant renewable resources. In order to get rid of the harmful effects of fossil fuels the best way is to focus on the utilization of renewable energy. Even though, government's role in promoting policies of renewable energy is crucial in Turkey, in order to take a huge step, private sectors must be involved in renewable energy development.

As it was mentioned in chapter five with its abundant resources, ASEAN countries have huge potential and recently there is an increasing awareness for to promote renewable energy. There is a potential for applications of renewable energy, which are available in ASEAN. However technological developments need to be extended. In order to use the full potential of the resources, technology must be developed then renewable energy potential will be promising for a better future. On the other hand China as a regional and also a global leader in renewable energy development, has a leadership potential and a great influence to ASEAN countries. Therefore, this regional framework would definitely show further development with the help of China.

CARICOM community spent some time and interest in formulating energy its policy. In this policy one of the aims is to increase the share of renewable energy production in total energy share and differentiate the energy mix. Besides, for a quality life in Caribbean region, member states are required to adopt this energy policy. By the adoption of this policy cooperation among the member states occurred in order to guarantee clean and affordable energy. Therefore CARICOM Energy Policy is an important approach for the region's energy production and consumption. But, even though CARICOM members show an effort to increase the promotion of renewable energy share in total energy consumption and also have great amount of resources, they are still lack from necessary level of technology to be more successful.

For Energy Community, contracting parties required adopting and submitting their NREAP and near being a legal tool, it also guarantees transparency to investors for renewable energy targets of 2020. Even though there are commitments taken by the member states in the region and great potential of renewable energy resources in the region, there are still doubts from Contracting Parties in order to open the energy markets and remove non-cost barriers for to attract renewable energy projects. Due to this reason the adaptation process of the new legislation is going slow in the region. Germany as a regional and a global leader in renewable energy development could give a great influence to Energy Community contracting parties. As a EU member Germany has a leadership potential on contracting parties and development of these countries in this matter would also help to development in the region, which will be in favor of Germany.

On the other hand, Nordic Countries are very conscious on renewable energy and mature technologies, which gives a low risk for the investors. Therefore this region is very successful at using renewable energy resources in total energy consumption, even though there are other regions, which have more potential in renewable energy resources than the Nordic Countries. Moreover, in order to reach their long-term aims, Nordic region creates a long run support schemes and policies also in the process of doing this, they consider the public support and political acceptability.

Lastly for European Commission, member states are highly aware of the dangers of fossil fuels. They are conscious about both economic and environmental problems that fossil fuels cause. Therefore in order not to depend on foreign countries for energy and security reasons, EU became as the most competitive renewable energy and sustainable growth based economy in the world. Due to concerns in energy security, EU policies focus into diverse and alternative energy types. They created a common energy market and increased their energy share in a great manner. Renewable Energy Directive established in 2009 and it is one of the main attempts to promote renewable energy among EU countries. With this directive they have individual targets due to their renewable energy resources potentials and

development capacity.

So, even though some scholars claim that renewable energy development depends on the renewable energy resource potential in the country or region, in other parts of the literature it can be clearly seen that, success in renewable energy development besides renewable energy resources is depend on several factors such as renewable energy friendly policy environment, availability of affordable technology, sufficient financial resources, efficient support measures, incentives and public support. Beyond the scope of the thesis it can be said that Non-State actors such as United Nations could play a key role as an advise guidance and a leadership in promoting renewable energy by setting binding regulations for all member states. Even though there are great investments has been made in some countries for innovation, development and commercialization of renewable energy technologies, there must be global strategy adopt among the nations. Therefore UN could be a great instructive for to reach a global sustainable development.

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APPENDICES

A: Turkish Summary/Türkçe Özet

MÜNFERİT DEVLETLERİN VE BÖLGESEL KURULUŞLARIN YENİLENEBİLİR ENERJİ TANITIM STRATEJİLERİ KARŞILAŞTIRMALI YAKLAŞIM

Bu tez, sürdürülebilir bir geleceğe ulaşmak için yenilenebilir enerjinin farklı ülkeler ve bölgesel kuruluşlardaki politikalarını, tanıtım stratejilerini ve yöntemlerini incelemeyi hedeflemektedir. Bu tezin temel sorusu; ülkelerin ve bölgesel kuruluşların, temiz bir gelecek için, yenilenebilir enerjiyi geliştirip, genel enerji tüketimindeki payını artırmak için neler yapmaları gerektiğidir. Bu tezin temel argümanı ise şöyledir; Bazı yazarların, ülkelerin yenilenebilir enerji potansiyellerinin, yenilenebilir enerji sektörünün gelişmesi için ana faktör olduğunu savunmalarına karşın, bu tez temelde ülkelerin ve bölgesel kuruluşların, yenilenebilir enerjinin geliştirilmesini ve üretim potansiyelini anlamalarında ve kullanmalarında, yenilenebilir enerji dostu politikaların, makul fiyatlı teknolojilerin uygunluğunun, toplum desteğinin ve aynı zamanda yeterli finansal desteğin belirlediğini savunmaktadır.

Bu tez beş bölümden oluşmaktadır, ilk bölüm giriş kısmından oluşmakta; ikinci bölüm Dünya pazarındaki yenilenebilir enerji kaynaklarından bahsedip, devamında yenilenebilir enerjiye destek için alınan önlemler, teşvik etmek için uygulanan yöntemler ve stratejilere değinmektedir. Üçüncü bölümde ise ülkelerdeki yenilenebilir enerjinin gelişimi karşılaştırılmış ve bu ülkeler Almanya, Çin, ABD ve Türkiye olarak belirlenmiştir. Dördüncü bölümde ise bölgesel kurumların yenilenebilir enerji gelişimleri karşılaştırılacaktır. Bu kurumlar ise ASEAN (Güney Doğu Asya Ülkeleri Birliği), CARICOM (Karayipler Topluluğu), Energy Community (Enerji Topluluğu), Nordic Research (İskandinav Araştırma) ve

European Comission (Avrupa Komisyonu) olarak belirlenmiştir. Son olarak da beşinci kısımda sonuç kısmı sunulmaktadır.

Bu tez, aynı zamanda yenilenebilir enerji politikaları, teknolojileri, metodolojileri, teşvikleri ve kaynakları arasındaki farklılıkları uygulamaya geçirmek söz konusu olduğunda, seçilen ülkeler ve bölgesel kuruluşlar arasındaki farklılıkları göstermeye yönelik bir girişimdir.

Ülkeler arasındaki farklılıkları tartışmak için Almanya, Çin ve ABD yenilenebilir enerjinin geliştirilmesinde bölgesel liderler oldukları ve aynı zamanda diğer ülkelere model olacak kapasitede oldukları için seçilmişlerdir. Türkiye, yenilenebilir kaynaklar açısından büyük potansiyele sahip ancak yenilenebilir enerjinin geliştirilmesi konusunda daha az yol kat etmiş bir ülkenin bu konuda nasıl geliştirilebileceğini anlamak için seçilmiştir. Bölgesel çerçeveler için ASEAN ve CARICOM ve Enerji Topluluğu, yenilenebilir enerji kaynaklarının büyük bir bölümü elinde bulundurulmasına rağmen daha güçlü bir yenilenebilir enerji gelişimine sahip olmamalarının nedenini ve eksikliklerini anlamak için seçilmiştir. Öte yandan, İskandinav Enerji Araştırma ve Avrupa Birliği Komisyonu bölgelerinde yenilenebilir enerjinin gelişimi için yardım etmekte oldukları ve diğer bölgesel kuruluşlar için hangi yönden örnek olabileceklerini anlamak için seçilmiştir. Her iki bölgesel kuruluşta, yenilenebilir enerjiyi toplam enerji tüketiminde kullanma hedefi doğrultusunda büyük başarı elde etmişlerdir.

Fosil yakıt tüketiminden dolayı çıkan ekonomik ve çevresel problemler ve gelecek için sürdürülebilir kalkınmaya ağırlık verilmesi gibi çevresel çıkarların gözetilmesi, yenilenebilir enerji potansiyelinin ve kullanımının önemini dünya gündeminde üst sıralara taşımıştır. İklim değişikliği endişeleri ve sürdürülebilirlik nedeniyle, enerji konuları, dünya gündeminde küresel bir siyasi mesele olarak öncelik taşımaktadır. İklim değişikliği tehdidi, dünya liderlerinden büyük ilgi görmüş ve emisyon azaltma taahhüdünde bulunmuşlardır. Gelişmiş ve endüstrileşmiş ülkelerin çoğu Kyoto Protokolünü imzalayarak sera gazı emisyonunu azaltmak için destek vermişlerdir. Ülkelerin farklı hedefleri vardır, ancak ortak amaç çevreye yardım etmek ve sürdürülebilir bir atmosfer yaratmaktır. Bazı ülkeler hedeflerine ulaşmış ancak bazıları henüz hedeflerine ulaşmamıştır.

Son yıllarda ülkelerin insani kalkınması, kişi başına düşen Gayri Safi Yurtiçi Hâsıla (GSYİH) ile ölçülememektedir. İnsani Gelişme Endeksi (HDI) 1990 İnsani Gelişme Raporunda ekonomik göstergelerin yanında, bir ülkenin insan gelişimindeki ortalama kazanımlarını anlamak için çevresel bozulma ve doğal kaynak kullanımının da ölçülmesi gerektiğini bildirmiştir[241].

İnsanoğlunun sebep olduğu çevresel problemler ve artan sera etkisi dünyadaki gündemde son derece önemli bir yerdedir. Temel sorun, enerji üretimi sürecinde fosil yakıtlardan çıkan karbondioksittir. Birçok nedenden dolayı bu konuyla ilgili giderek artan bir farkındalık vardır. Geleceğimiz için enerji çok önemlidir. Enerji talebi her geçen gün oldukça hızlı bir şekilde artmakta ve küresel ısınmaya ilişkin kaygılara neden olmaktadır. Çevre dostu politikaların ve alternatif enerji kullanımlarının benimsenmesi iklim sorunları riskini azaltacaktır. Ayrıca, küresel ısınmanın kontrol altında tutulmasına yardımcı olacak olan Sera Gazı emisyonunu da kontrol edecektir. Bu girişimler ve değişikliklerle, ülkeler ve bölgeler enerji verimliliği, güvenlik, sosyal ve ekonomik gelişmelerden fayda sağlayacaklardır.

Bazı gelişmiş ülkelerin ve kuruluşların güç üretimlerini yenilenebilir kaynaklardan dönüştürme çabaları olsa da, ülkeler genel olarak hala fosil yakıtlara bağımlıdır. Bu nedenle, temiz ve güvenli bir geleceğe ulaşmak için Dünya'nın enerji sisteminde bir reform yapılmalıdır. Bu reform ancak devam eden yenilenebilir enerji politikaları, kamu ve finans desteği ve dünyadaki teknolojik gelişmelerle gerçekleşebilir. Bölgelerde bol miktarda yenilenebilir enerji kaynağına sahip ancak yeterli sayıda ve kalitede yenilenebilir enerji politikası ve teknolojisinin bulunmadığı ülkelere gelişmiş ülkeler dünyanın çevre sorunlarıyla daha etkin bir şekilde mücadele edebilmeleri için yardım etmelidirler. Bu nedenle, 2015 Paris İklim Anlaşması uyarınca, küresel ısınmayı 2 ° C'nin altına düşürmek Birleşmiş Milletler İklim Değişikliği Çerçeve Sözleşmesi (UNF-CCC), 195 üye ülkenin de benimsediği temel hedeftir(Letchumanan p,50).[242]

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[241] Ediger, Volkan S,. (2008) "National Energy Report of Turkey: Energy Situation, Challenges, and Policies for Sustainable Development", AASA Beijing Workshop on Sustainable Energy Development in Asia, China, InterAcademy Council, pp. 77-93.

[242] Letchumanan, Raman. "Is There an ASEAN Policy on Climate Change?" *LSE Research Online*.

Fosil yakıt tüketiminin, ekonomik ve çevre üzerindeki kötü etkileri nedeniyle yenilenebilir enerji tüketimine büyük önem verilmeye başlanmıştır. Yenilebilir enerji ekonomik ve çevresel konularla başa çıkabilmek için dünyanın ihtiyaç duyduğu şey olmuştur. Bu yeni eğilim ulaşım yakıtları, ısıtma, soğutma ve enerji üretimi gibi pek çok sektörde hızlı bir büyümeye neden olmuştur. Bu sistemle hedeflenmesi gereken şey, yenilenebilir enerji kaynaklarının eşit miktarda optimum bir şekilde kullanılması ve çevresel etkilerin en aza indirgenmesi olmalıdır. Dolayısıyla, ulusal ve bölgesel altyapı için gerçekten önemli olan şey, büyük bir sürdürülebilir enerji sistemi için yenilenebilir enerji politikaları, kamu desteği, metodoloji, destekler, teşvikler, teknolojiler ve maddi açıdan uygun enerji sistemleri için pratik bir ilerleme olmasıdır. Bu yüzden, bu tez, ülkeleri ve bölgesel kuruluşları kendi içlerinde karşılaştırarak, yenilenebilir enerjiyi, enerji üretimi, tüketimi ve gelişimi açısından dünyadaki avantajlarını incelemeyi amaçlıyor.

Sürdürülebilir enerji, üretiminde veya tüketiminde, insan sağlığı ve küresel çevreyi de içeren ekolojik sistemin sağlıklı işleyişi üzerinde en düşük olumsuz etkilere sahip olan enerjidir. Fosil yakıt tüketiminin ekonomik olarak değerlendirilmesi ve gelecek için sürdürülebilir kalkınmaya ağırlık verilmesi gibi çevresel çıkarların gözetilmesi, yenilenebilir enerjinin büyük potansiyelini birincil odak haline getirmeye yardımcı oldu. Bu nedenle, genel olarak her ülke ve bölgesel kuruluş, iklim değişikliği sorununu çözmek ve halkı yenilenebilir enerjiyi kullanmaya cesaretlendirmek için kendi politikalarına, teknolojilerine, yöntemlerine ve stratejilerine sahiptir. Bu ülkelerin bazıları, örnek olarak Almanya, bu işi daha ciddiye alıp bu konuda daha başarılı olan bir ulustur. Bu konuda daha gelişmiş olan ülkeler, yenilenebilir enerji gelişiminin daha iyi yönetmek için daha güvenilir politikalar, ekonomiler, teknolojiler geliştirmişlerdir ve halklarının farkındalığı da daha yüksektir.

Tez için seçilen ülkeler ve bölgesel kuruluşlar arasında, yenilenebilir enerji politikaları ile bunların yenilenebilir teknolojileri, metodolojileri, teşvik yöntemleri ve kaynakları arasındaki farklılıklarını göstermeye çalışacağım. Bu ülkelerin ve

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LSE IDEAS, London School of Economics and Political Science, n.d. 25 Apr. 2017. <http://www.lse.ac.uk/IDEAS/publications/reports/pdf/SR004/ASEC.pdf>.

bölgelerin bir kısmı daha iyi teknolojilere sahipken daha az kaynağı olmasına karşın yenilenebilir enerji sistemleri ve kullanımları daha gelişmiştir veya tam tersi bir durum görülmektedir. Ülkelerin ve bölgesel kuruluşların yenilenebilir enerji konusundaki çaba farklılıklarını belirlerken, amacım yenilenebilir enerji kaynaklarının geliştirilmesi için temel unsurların neler olduğuna bir cevap bulmaktır.

Son zamanlarda yenilenebilir enerjinin kullanımı, dünyadaki iklim değişikliği endişeleri ve yenilenebilir enerji politikaları üzerine çok sayıda akademik çalışma yapılmaktadır. Gelişmiş ülkelerin, yenilenebilir enerji politikalarını, teknolojileri, yöntemleri, stratejileri ve aynı zamanda bu konular hakkında bölgelerin rolü ile ilgili önemli çalışmalar bulunmaktadır. Ayrıca, gelişmekte olan ülkeler ve bölgelerin bu konu hakkındaki yenilenebilir enerji teşvik çabaları üzerine de çalışmalar bulunmaktadır. Bu çalışmaların tamamı daha temiz ve sürdürülebilir bir geleceğe ulaşmak için, yenilenebilir enerji kullanımının önemine ağırlık vermektedir. Bütün bu çalışmaların temel argümanları, temiz enerji için toplam enerji tüketiminde, yenilenebilir enerji kaynaklarının kullanımını teşvik etmek ve arttırmaktır.

Yenilenebilir Enerji konusundaki önemli bir yazar olan Robert Ehrlich, "Yenilenebilir Enerji: Birinci Kurs"[243] adlı kitabında, Dünya'nın karşı karşıya olduğu en büyük tehlikenin, sera gazının artış seviyesine bağlı olarak, küresel iklim değişikliği olduğunu savunuyor. Bu gazların dikkati çeken bir çoğunluğu fosil yakıtların yakılması ile oluşur. Yenilenebilir enerji doğal kaynaklardan gelen bir enerjidir ve hemen hemen tümüyle yenilenebilir enerji başka bir yenilenebilir enerji olan Güneş'e bağlıdır. Bilmemiz gereken tek ve en önemli şey, Dünya üzerinde bol miktarda yenilenebilir enerji kaynağı olduğu ve onları gezegenimizi korumak için en iyi şekilde kullanmamız gerektiğidir. Bu Dünya'daki her ülkenin ve bölgenin temel görevi budur çünkü yalnızca bazı ülkelerin ya da bölgelerin bu konuda gösterdikleri çabalar, iklim değişikliği ile başa çıkmada yeterli olmayacaktır.

[243] Ehrlich, Robert. Renewable Energy: A First Course. Boca Raton: Taylor & Francis, CRC Press, 2013.

İklim Değişikliği konusunda bir diğer önemli yazar olan Elliot, "Sürdürülebilir Enerji: Seçimler, Sorunlar ve Fırsatlar"[244] başlıklı yazısında, enerji üretiminde yaşanan gelişmeleri ve gelecek için bunların kullanımının ne kadar önemli bir konu olduğunu analiz etmektedir. Makalesinde, karbondioksit emisyonu seviyesini düşürme potansiyeli yaratmak ve sürdürülebilir bir gelecek için enerji kullanımı seçeneği tartışılmaktadır.

Infield ve Rowley sadece yenilenebilir enerjilerin ve sürdürülebilirliğin öneminden bahsetmekle kalmayıp aynı zamanda yenilenebilir enerji teknolojileri ve teşviklerden de bahsediyorlar. Infield ve Rowley, "Yenilenebilir Enerji: Teknoloji Hususları ve Elektrik Entegrasyonu"[245] başlıklı yazılarında, mevcut Yenilenebilir Enerji teknolojilerinin sayısını tartışmaktadırlar. Bu teknolojilerden en dikkat çekici olanları ise fotovoltaik, güneş enerjili termik sistemler, rüzgar enerjisi, bazı su gücü çeşitleri ve biokütle'dir. Bu sektörler arasında fotovoltaik ve rüzgar enerjisi büyük bir gelişme gösterip aynı zamanda iyi miktarda yatırım almaktadır. Ayrıca, elektrik üretiminin en hızlı büyüyen çeşitleridir. Bu büyüme toplumun enerji ihtiyaçlarını karşılamak için hangi kaynakların kullanılabileceği sorusunu da ortaya atmıştır. Buradaki temel fikir, elektrik arzında yenilenebilir enerji üretiminin uygulanabilir olmasıdır. Bunun yanı sıra yazarlar, yenilenebilir enerji teknolojilerindeki evreleri, aşamaları ve elektrik sistemlerine olan entegrasyonunu analiz etmektedirler.

Bu konuda bir başka önemli yazar olan Stanley, "Günümüzde Yenilenebilir Enerji"[246] başlıklı yazısında, toplumun kaliteli bir yaşam sürdürmesi için enerjinin önemini ve ülke ekonomisinin bu durumundan nasıl desteklenebileceğini anlatıyor.

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[244] Elliott, David. "Sustainable energy: Choices, problems and opportunities." Issues in Environmental Science and Technology Sustainability and Environmental Impact of Renewable Energy Sources (n.d.): 19-48.

[245] Infield David, and Rowley Paul. "Renewable energy: Technology considerations and electricity intergration." Issues in Environmental Science and Technology Sustainability and Environmental Impact of Renewable Energy Sources (2003): 49-68.

[246] Bull, Stanley R. "Renewable Energy Today and Tomorrow." IEEE Industrial Electronics Magazine Aug. 2001: 1216-226. IEEE Xplore Digital Library. <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=940290&isnumber=20361>.

Ayrıca, yenilenebilir enerji teknolojilerinin daha temiz bir gelecek sunduğu tezini de savunuyor. Rüzgar, güneş, biokütle ve hidroenerji gibi bol miktarda kaynağın tüm dünyada mevcut olduğunun da altını çiziyor. Ülkelerde kaynakların bazılarının daha az bulunurken bazılarının ise bol miktarda bulunduğunu ama bu durumun ülkelerin çeşitli yenilenebilir enerji türlerine sahip olduğu gerçeğini değiştirmediğini savunuyor. Yazar Güneş, rüzgar, biyokütle ve jeotermal teknolojilerin maliyet açısından uygun olduğunu ve piyasada mevcut olduğunu da belirtmiştir. Bunun yansıra, tüm yenilenebilir enerjilerin ticarileştirme, geliştirme ve araştırmanın farklı aşamalarda olduğunu da ekliyor. Ayrıca, yenilenebilir enerji teknolojilerinin tümünde beklenen maliyet, kaynakların kullanılabilirliği ve bunların sera gazının azaltması üzerindeki etkilerinde de farklılıklar bulunduğunun da altını çiziyor.

Dört akademisyen tarafından yapılan bu genel değerlendirmelerin dışında, ülkeleri spesifik olarak analiz eden önemli akademisyenler de vardır. Hake, Fischer, Venghaus ve Weckenbrock "Almanya Energiewende - Tarih ve Statüko"[247] başlıklı makalelerinde, Almanya'daki Yenilenebilir Enerjiyi tartışıyor ve endüstri ülkelerinin ekonomilerinin fosil yakıtlara bağımlı olduklarını savunuyor. Bu nedenle, sürdürülebilir bir gelecek için yenilenebilir enerji sisteminin önemini vurguluyorlar. Neyse ki Almanya'nın yakın geçmişteki hükümetlerinin hepsi bu konu üzerinde aynı hassasiyetle durarak sürdürülebilir bir gelecek için enerji sistemlerinde değişikliğe gitmekte ve güçlü, temiz bir enerji sektörü yaratmayı amaçlamaktadırlar. Temiz enerjiyi teşvik eden bir ülke olarak, Almanya'nın fosil yakıtlara bağımlı diğer uluslara olumlu bir örnek olacağı aşikardır. Almanya'da fosil yakıtlardan yenilenebilir enerjiye geçiş, neredeyse otuz yıllık siyasi çatışmalı bir süreçte olmuştur. Bu yüzden Almanya, yenilenebilir enerji kaynakları üzerine kurulmuş olan enerji sisteminin geliştirilmesinde iyi bir yerde bulunmaktadır.

Almanya'da "Energiewende" odak noktası enerji politikası geliştirme olan bir süreçtir. Bu enerji politikasının ortaya çıkmasına neden olan olayları anlamak için,

[247] Hake, Jürgen-Friedrich,Wolfgang Fischer, Sandra Venghaus, and Christoph Weckenbrock. "The German Energiewende – History and Status Quo." Elsevier, 21 May 2015.08Mar.2017.http://www.sciencedirect.com/science/article/pii/S0360544215004594

toplumsal dinamikler ve siyasi güce bakmak gerekmektedir çünkü bütün bu gelişmeler Almanya'nın enerji politikaları ve Japonya'daki Fukushima olayıyla şekillenmiş ve halkın dikkatini çekerek nükleer enerjinin kullanımına da son verilmiştir. Enerji politikaları, destek önlemleri ve teknolojik gelişmelerle Almanya, dünyadaki diğer ülkelere örnek olabilecek bir şekilde yenilenebilir enerji sektöründe öncü rol oynamaktadır.

Eric Martinot, "Çin için Yenilenebilir Güç: Geçmiş, Bugün ve Gelecek"[248] makalesinde, Çin'in Yenilenebilir Enerji çalışmalarını analiz ediyor. Çin'in güneş ve rüzgar enerjisi konusunda zengin kaynakları vardır. Ülke güneş, fotovoltaik ve rüzgar türbini üretiminde küresel bir lider haline gelmiş durumdadır. Dahası, Çin yenilenebilir enerjiden gelen güç kapasitesinde dünya liderlerinden biri olarak görülmektedir. 2005 enerji yasasından sonra, Çin'de yenilenebilir enerji politikaları büyük bir hız kazanmıştır. Çin'in yenilenebilir enerji hedefi AB'nin 2020 hedefine benzer olsa da, teknoloji geliştirme konusunda zorluklar yaşamaktadır; Bu yüzden, şebeke entegrasyonu, politika çerçeveleri ve teknolojileri, konusunda hedeflerine ulaşmak için daha fazla çaba sarf etmeleri gerekmektedir

Fosil yakıtların kullanımı ve Çin'de nüfus artışı ile ilgili önemli sorunlardan dolayı, enerji tüketiminde ve politikalarında bazı değişiklikler meydana geldi. 1953 ve 2010 yılları arasındaki 12 Beş Yıllık Plan ile birlikte Çin'de önemli değişiklikler yaşandı. Enerji üretimi artmaya başladı ve tüketiminin de artmasıyla, Çin enerji ithal etmeye başladı. İklim değişikliği konusu büyük bir küresel sorun haline geldiğinde, Çin hükümeti de enerji politikaları buna göre değiştirmiş ve yenilenebilir enerji kullanımının toplam enerji tüketimindeki payını artırmaya daha fazla önem vermeye başlamıştır. Çin, daha temiz ve sürdürülebilir bir geleceğe ulaşmak için geçiş aşamasında olan bir ülkedir. Mevcut enerji politikaları, iklim değişikliği endişeleri ile başa çıkmak için enerji verimliliğini arttırmakta ve yenilenebilir enerjiyi geliştirmek konusunda çaba sarf etmektedir.

[248] Martinot, Eric. "Renewable Power for China: Past, Present, and Future." *SpringerLink*. SP Higher Education Press, 17 Aug. 2010. 08 Mar. 2017. <https://link.springer.com/article/10.1007/s11708-010-0120-z>.

İzidian, Girrens, Kahyyer'de "Yenilenebilir Enerji Politikaları" [249] başlıklı makalesinde ABD'nin yenilenebilir enerji teknolojilerini uygulamak için büyük yatırımlar başlatan ülkelerden biri olduğunu bildirmektedir. ABD'nin akıllı yenilenebilir enerji şebekelerini teşvik eden ve bunları geliştirerek uygulayan ülkelerden biri olduğunun altını çizmiştir. Aynı zamanda uzun vadeli yatırımlar yapıp enerji üretim hedeflerini de uygulamaya sokmuştur. Her bir devletin yenilenebilir enerji kullanımına yönelik kendi içinde politikalarının olmasına rağmen, genel olarak yenilenebilir enerji gelişiminde ABD önde gelen ülkelerden biridir. Yenilenebilir enerji ABD'de mevcut olan önemli bir güçtür. Büyük doğal kaynakların ve devlete dayalı yeşil politikaların yanı sıra, sürdürülebilirliğe erişebilmek için yenilenebilir enerji gelişiminde çok çeşitli teknolojiler bulunmaktadır. Bu nedenle California gibi bazı eyaletler yenilenebilir enerji gelişiminde diğerlerinin önündeyse de, büyük çaba gösteren pek çok eyalet vardır.
Türk yenilenebilir enerji politikaları için en kapsamlı araştırmalardan biri Bilgen, Keleş Kaygusuz, Sarı ve Kaygusuz'un "Küresel Isınma ve Sürdürülebilir Kalkınma için Yenilenebilir Enerji Kaynakları: Türkiye'de Bir Örnek Olay" [250] başlıklı makalesidir. Türkiye genç nüfusu, kentleşmesi ve ekonomik kalkınması ile artan bir enerji talebine sahiptir. Ayrıca, dünyanın en hızlı büyüyen güç piyasalarından biridir. Bu nedenle, Türkiye'nin enerji talebi sürekli olarak artmaya devam etmektedir. Türkiye'nin bulunduğu bölgede yeterli miktarda fosil yakıt mevcut değildir. Bu nedenle, enerji fosil yakıt ithalatına bağımlıdır ve bu durum hem ekonomisini ve hem de hava kirliliğini kötü yönde etkilemektedir. Sorunun üstesinden gelebilmek için Türkiye, enerji verimliliği, temiz ve sürdürülebilir enerjinin geliştirmesi için yenilenebilir enerji kaynaklarını büyük miktarda kullanmalıdır. Bunun yanı sıra, Coğrafi konumu nedeniyle, Türkiye yenilenebilir enerji kaynakları açısından büyük bir potansiyele sahiptir.

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[249] Izadian, Afshin, Nathaniel Girrens, and Pardis Khayyer. "Renewable Energy Policies A Brief Review of the Latest U.S. and E.U. Policies." IEEE Industrial Electronics Magazine 19 Sept. 2013: 21-34. ScienceDirect.

[250] Bilgen Selçuk, Keleş Sedat, Kaygusuz Abdullah, Sarı Ahmet, and Kaygusuz Kamil. "Global Warming and Renewable Energy Sources for Sustainable Development: A Case Study in Turkey." *Renewable and Sustainable Energy Reviews* 12.2 (2008): 372-96. *Elsevier*.

Türkiye, güneş, biyokütle, rüzgar ve jeotermal gibi çok miktarda yenilenebilir enerji kaynağına sahiptir ancak bu yenilenebilir enerji kaynakları, Türkiye'nin toplam enerji talebini sağlayamamaktadır. Bu nedenle hükümetin daha etkin enerji politikaları yaratması gerekmektedir. Türk hükümeti enerji arzını sağlamak için ülkenin bol miktarda yenilenebilir kaynaklarına odaklanması gerektiğini anlamıştır. Hükümetin yenilenebilir enerji politikalarının geliştirmesi için özel sektörün de yenilenebilir enerji gelişimine dahil olması gerekmektedir[251].

Tez içinde geçen bütün genel ve ülkelere yönelik çalışmaların tamamı yenilenebilir enerji kaynakları, politikaları, teşvikleri, teknolojileri ve genel ya da farklı ülkelerdeki bunları geliştirmek için alınan yöntemler literatür için değerlidir. Bununla birlikte, bu çalışmaların üstüne bölgesel kuruluşları eklemek, yenilenebilir enerjinin gelişimini daha spesifik olarak anlamamız açısından bize yardımcı olabilir. Bölgesel örgütlerin yenilenebilir enerji gücü üzerine analiz ve değerlendirmelerinin çoğu bölgesel kurumlar tarafından hazırlanmaktadır.

Malezya'daki Güneş Enerjisi Araştırma Grubu'ndan bölgesel çerçeve karşılaştırması için yazarlar, Othman ve Sopiat, ASEAN'daki (Güney Doğu Asya Ülkeleri Birliği) ekonomik büyüme hakkında "ASEAN için Yenilenebilir Enerji Eğitimi"[252] Makalesinin için de bilgilendirme yapmışlardır. ASEAN ekonomisi son yıllarda büyük bir büyüme yaşadı. Ekonomi sektöründe ki artış nedeniyle enerji ihtiyacı arttı. Ayrıca, bölgede sürdürülebilir kalkınma ve çevre dostu bir atmosfere ihtiyaç olduğu iddia edilmeye başlandı, bu nedenle yenilenebilir enerji üretimi ve gelişimi arttı. Ancak, bölgede bol miktarda kaynak bulunduğu halde, teknolojik gelişmeleri geride kaldı. Bu nedenle henüz yenilenebilir enerji hedeflerine ulaşamadılar. ASEAN bölgesinde bulunan yenilenebilir enerji uygulamaları için

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251 Bilgen Selçuk, Keleş Sedat, Kaygusuz Abdullah, Sarı Ahmet, and Kaygusuz Kamil. "Global Warming and Renewable Energy Sources for Sustainable Development: A Case Study in Turkey." *Renewable and Sustainable Energy Reviews* 12.2 (2008): 372-96. *Elsevier*.

252 Othman, Mohd Yusof, and Kamaruzzaman Sopian. "Renewable energy education for Asean." Renewable Energy 16.1-4 (1999): 1225-230. Pergamon. 10 Mar. 2017. <https://doi.org/10.1016/S0960-1481(98)00492-3>.

potansiyel vardır. Ancak kaynakların tam potansiyelini kullanmak için teknoloji daha çok geliştirilmelidir.

"Karayip Sürdürülebilir Enerji Yol Haritası ve Stratejisi" [253] raporundaki yazarlar Ochs, Konold, Karayip Bölgesinde büyük miktarda yenilenebilir enerji kaynağı olsa dahi, ithal edilen fosil yakıtlara hala bağımlılığın sürdüğünü bildirmektedirler. Bölgenin fosil yakıtlara bağımlılığı, ekonomik gelişiminde ve iklim değişikliğinde küresel sorunlara neden oluyor.Yazarlar ayrıca, bol yenilenebilir enerji kaynakları ile Karayipler bölgesinin, yenilenebilir enerjiyi teşvik ederek küresel alanda öncü bir rol oynayabileceğine inanıyorlar. Ayrıca, coğrafi konumu ve bölgenin ekonomik açıdan farklılık gösteren ülkeleri nedeni ile CARICOM (Karayipler Topluluğu), fosil yakıt kullanımından yenilenebilir enerji kaynaklarına geçişte düzenleyici politikalar oluşturmak için uygun bir bölge olarak da görülmektedir.

Karayipler'de kaliteli bir yaşam için üye devletlerin yenilenebilir enerji politikasını benimsemeleri gerekmektedir. Bu politikanın benimsenmesi ile birlikte temiz ve uygun enerjiyi garanti altına almak için üye ülkeler arasındaki işbirliği gerçekleştirilmiştir. Bu nedenle CARICOM Enerji Politikası, bölgenin enerji üretimi ve tüketiminde önemli bir yaklaşımdır. Ancak CARICOM üyeleri, toplam enerji tüketiminde yenilenebilir enerji kullanımının teşvik edilmesi ve aynı zamanda büyük miktarda kaynağın bulunması için bir çaba gösterirken, halen daha başarılı olabilmek için gerekli teknolojiden yoksundurlar.

Öte yandan Avrupa Birliği Enerji Topluluğu için, "Enerji Topluluğunda Yenilenebilir Enerjinin Geliştirilmesi İlerlemesine İlişkin Bakanlık Konseyi Sekretaryası Raporu'nda" [254] 2009/28/ EC Yenilenebilir Enerji Direktifi, Enerji Topluluğu tarafından kabul etmiştir. Aynı zamanda tarafların 2020 yenilenebilir

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[253] Ochs,Konold,Auth, Musolino, and Killeen. "Caribbean Sustainable Energy Roadmap and Strategy (C-SERMS)." Worldwatch Institute, Washington, D.C., 01 Oct. 2015. 20 Apr. 2017.p 1-179 <https://cleanenergysolutions.org/resources/caribbean-sustainable-energy-roadmap-strategy-c-serms-baseline-report-assessment>.

[254] Report of the Secretariat to the Ministerial Council on the Progress in the Promotion of Renewable Energy in the Energy Community. Rep. no. ANNEX 05a. N.p.: Energy Community, 2015. Energy Community. 10 May 2017. https://www.energycommunity.org/portal/page/portal/ENC_HOME/DOCS/3842311/2194639ACBF1368EE053C92FA8C04E9A.PDF

enerji hedeflerini takip etmesine ve Avrupa Birliği enerji ve iklim değişikliği hedefleri ile bir araya getirmek için Yenilenebilir Enerji Direktifinin uygulanmasına karar verilmiştir. Yenilenebilir Enerji Direktifi, Ulusal yenilenebilir enerji hedeflerini belirleyerek yenilenebilir enerjiyi teşvik etmeyi öngörür. Bu adım atılarak, yenilenebilir enerjinin toplam enerji tüketimine ilişkin belirlenen hedeflere ulaşılması uygun görülmüştür. Bu enerji direktifiyle 2020'ye kadar ulaştırma sektöründe kullanılan enerjinin % 10'unun yenilenebilir enerji kaynaklarından gelmesi hedeflenmektedir. Buna ek olarak, toplam enerji tüketiminde yenilenebilir enerji kullanımını teşvik etmek ve 2020 hedeflerine ulaşmak için Ulusal Yenilenebilir Eylem Planlarının (NREAP), Avrupa Birliği komisyonuna sunulması zorunlu kılınmıştır.

"İskandinav Enerji Araştırma Stratejisi" [255] raporunda, bölgenin kendisini sürdürülebilir enerji çözümlerinin geliştirilmesinde lider olarak gördüğü ve konumlandırdığı belirtiliyor. Ayrıca, bu pozisyonda kalmak ve küresel rekabet ve enerji sistemindeki süre gelen değişim nedeniyle zorluklarla mücadele etmeleri gereken bir bölge olarak 2050 hedeflerine ulaşabilmenin öneminin de bilincinde olduklarını vurguluyorlar.Rapor, teknolojinin değişen bir enerji sistemine ulaşılmasında gelecek için önemli bir rol oynayacağından bahsettiğinden, yenilenebilir enerji konusu üzerinde araştırma ve geliştirmeye özel bir önem verdiklerinin altını çiziyor. Hedeflerine ulaşmak ve politikaları belirlemek için bölgede büyük bir işbirliğinin gerekliliğine inanmaktadırlar. Ülkeler arasındaki işbirliğiyle bölgede daha kapsamlı yenilenebilir enerji teknolojisine sahip olmayı hedefliyorlar.

İskandinav Ülkeleri, yenilenebilir enerji ve gelişmiş teknolojiler konusunda çok bilinçli olmaları nedeniyle yatırımcılar için düşük bir risk oluşturmaktadırlar. Bu nedenle, bu bölgedeki ülkeler, yenilenebilir enerji kaynakları açısından kendilerinden çok daha fazla potansiyele sahip olan bölgeler ve ülkeler olmasına rağmen, yenilenebilir enerji kaynaklarını toplam enerji tüketiminde kullanma oranı konusunda çok daha fazla başarılıdır. İskandinav bölgesi ülkeleri, uzun vadeli

255 "Nordic Energy Research Strategy 2015-2018." *Nordic Energy*. Norden, 11 Dec. 2014. 20 Apr. 2017. <http://www.nordicenergy.org/publications/strategy-2015-2018/>.

hedeflerine ulaşmak için destek planları ve politikaları oluşturup bunlar için halkın desteğini de almaktadırlar.

Son olarak, 2001 yılında Maltby "AB Yenilenebilir Enerji Politikaları"[256] başlıklı makalesinde, Kyoto protokolünün taahhütlerini uygulamak için tüm hedeflerin bağlayıcı ve önemli olduğunu belirtiyor. Aynı zamanda 2007 yılı sonunda 2020'ye kadar "Yenilenebilir Enerji Yol Haritası" adı altında uzun vadeli bir strateji olarak kurulan yenilenebilir kaynaklar için % 20 pay hedefi belirlendi. 2009'da 2020 hedeflerine ulaşmak için yeni Yenilenebilir Direktifler kuruldu ve hedefler her bir üye devlet için farklıydı. 2010 yılında kaynakların verimliliği için Avrupa Komisyonu, iklim değişikliği hedefleri için Avrupa 2020 strateji işbirliğini kuruldu. AB'nin yenilenebilir enerji konularında küresel bir lider olması için 2016 yılında belirlenen Revize Yenilenebilir Enerji Direktifi, toplam tüketimde yenilenebilir enerji paylaşımı hedefini 2030 'a kadar % 27'ye çıkardı. Ayrıca, bu hedefler doğrultusunda, İlerleme Raporları ve Ulusal Eylem Planları, AB üyelerinin yenilenebilir enerjisine ulaşma sürecini ölçüp, üye ülkeleri kontrol etmektelerdir.

Yenilenebilir enerji, ülke içi ve bölgesel politikalar, teknolojiler ve teşvikler konusunda birçok değerli yayın bulunmakla birlikte, bunlar arasında bir karşılaştırma yapılmamıştır. Bu konu üzerinde yapılacak olan karşılaştırmalı çalışmaların, ülkeler ve bölgelerin sürdürülebilir bir geleceğe sahip olmak için neler yapabileceğini anlamaları açısından faydalı olacağı ve daha net bilgiler vereceği kanısındayım. Yenilenebilir enerjiye ilişkin değerli yayınlar olmasına rağmen, yakın gelecekte farklı perspektiflerden çok daha fazla yayın olacağına inanıyorum.

Daha önce de belirtildiği gibi yenilenebilir enerji kaynaklarının üzerinde, iklim değişiklikleri tehlikeleri, sera gazı ve fosil yakıtların kötü etkilerinin azaltılmasına yardımcı olmak için daha çok düzenleyici politikalar oluşturulmaya başlanmıştır.

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256 Maltby, Tomas. "European Union Energy Policy Integration: A Case of European Commission Policy Entrepreneurship and Increasing Supranationalism." ScienceDirect. Elsevier, 18 Jan. 2013. 08 Mar. 2017.
<http://www.sciencedirect.com/science/article/pii/S0301421512010798>.

Dünyadaki her ülke ve bölgede bir miktar doğal kaynak vardır. Bu kaynakların türleri coğrafi konumlara bağlı olarak değişebilir, örneğin Karayipler Bölgesi ve Türkiye'nin güneş enerjisi fazladır, fakat Almanya ve Kuzey Avrupa Bölgesi'nin güneş enerji miktarı sınırlıdır. Ancak, daha iyi yasal çerçevelerle, strateji, halk desteği ve teknolojik gelişmeler nedeniyle Almanya ve İskandinavya bölgesinde olan ülkeler yenilenebilir enerji gelişiminde öncü ve örnek ülkelerdir. Bu bağlamda yenilenebilir enerji sektörlerinin gelişimi için esas önemli olan ülkelerin yenilenebilir enerji potansiyeli olduğunu iddia eden bazı yazarların görüşlerinin aksine bu tez, yenilenebilir enerji dostu politika ortamının, teknolojilerinin, stratejilerinin, kamu desteğinin, yeterli mali kaynakların ve bu konuda alınan destek tedbirlerinin esas olduğunu savunmaktadır.

Yenilenebilir enerji kaynaklarının potansiyelinin, yenilenebilir enerji kullanımı için çok önemli olduğu kesin olarak bilinmektedir. Ancak tartışıldığı gibi, sınırlı yenilenebilir enerji kaynakları ile yasal çerçeveler, stratejiler, halk desteği, mali kaynaklar ve teknolojik gelişmelerin yardımıyla daha başarılı olan ülkeler vardır. Örneğin Almanya, neredeyse 30 yılda "Energiewende" vizyonu ile Dünya'da bu konudaki en iyi örneklerden biridir. Daha önceden de bahsedildiği gibi Alman hükümetinin iklim değişikliği ve güvenlik kaygıları nedeniyle fosil yakıtların kullanımını değiştirme çabaları sürdürülebilir enerji politikalarının oluşturulup geliştirilmesine neden olmuştur.

1990'lı yıllardan beri Almanya, karbon gazı içeriği daha düşük olan bir çevre yaratmak için çeşitli girişimlerde bulundu. Öncelikle, çıkardıkları yasa ile yenilenebilir kaynaklardan enerji tedarik etmeye başladılar. Yenilenebilir enerji kaynaklarını kullananları teşvik edip ödüllendirdikten sonra rüzgar enerjisi piyasasında büyük bir başarı elde ettiler. Daha sonra Nisan 2000'de imzalanan Yenilenebilir Enerji Kaynakları Kanunu ile hükümet, diğer yenilenebilir enerji türlerinin pazara çıkması için piyasaya izin verdiler. Almanya'da yenilenebilir enerji gelişiminin başarısı, vergi muafiyetleri ve kurumsal finansman planları gibi yenilenebilir enerji yatırımları için yapılan diğer desteklerle de açıklanabilir.

Almanya aynı zamanda ısı ve elektrik üreten güneş sistemleri teknolojilerinin geliştirilmesinde dünya lideridir. Almanya'ya paralel olarak, AB'nin 2020 yılı için

sürdürülebilir gelecek ve enerji verimliliği hedefleri, Kuzey Ülkeleri'nde de yenilenebilir enerji geliştirme programı yaratmaktır. Birbirlerinden farklı ulusal politikalara sahip olsalar da hedeflerine ulaşmak için birlikte çalışmakta ve ortak kapsamlı düzenleyici politikalar yaratmaktadırlar. Bunun yanı sıra İskandinav ülkelerinin çoğunda Almanya'da olduğu gibi destek planları, devlet tarafından finanse edilen vergi indirimleri veya yatırım yardımları ve destek önlemleri vardır.

Bu örnekler, yenilenebilir enerji kaynaklarının toplam enerji tüketimindeki payını geliştirmek için mükemmel bir platform oluştururken; Diğer uluslara, özellikle de doğal kaynaklara sahip olan ülkeler için olumlu birer örnek oluşturmaktadırlar. Daha öncede bahsedildiği gibi başarılı bir yenilenebilir enerji geliştirme hedefine ulaşmak için genel destek, teşvikler, destek planları, yöntemler, stratejiler, teknolojik gelişme, yasal ve düzenleyici çerçeve ve bir miktar yenilenebilir kaynak, hep birlikte olması gereken temel unsurlardır. Bu konuda gelişmiş ülkeler sadece uluslara ya da bölgelere değil yenilenebilir enerji sistemi için genel olarak dünyaya yardımcı olarak sürdürülebilir bir geleceğe büyük katkıda bulunacaklardır. Bu nedenle, bu tez, farklı ülkelerin ve bölgelerin yenilenebilir enerji sistemlerini geliştirme yollarını karşılaştırıp analiz ederek sürdürülebilir bir gelecek için enerji tüketiminde yenilenebilir enerji kaynaklarını tanıtarak, kullanımda kilit unsurları anlamaya ve anlatmaya çalışmıştır. Ülkeler ve bölgelerden alınan örnekler bize, bu unsurların, yenilenebilir enerji üretiminde potansiyellerini gerçekleştirmek için ülkeler ve bölgesel çerçeveler için anahtar olduğunun göstergesidir.

Tezin ötesinde, Birleşmiş Milletler gibi Devlet dışı aktörlerin, tüm üye ülkeler için bağlayıcı düzenlemeler belirleyerek yenilenebilir enerjinin geliştirilmesinde rehberlik ve iyi bir liderlik rolü oynayabileceği söylenebilir. Bazı ülkelerde yenilenebilir enerji teknolojilerinin yenilenmesi, geliştirilmesi ve ticarileştirilmesi için büyük yatırımlar yapılmış olsa da, ülkeler arasında küresel bir strateji benimsenmelidir. Bundan dolayı Birleşmiş Milletlerin kapsayıcı düzenlemeleri küresel sürdürülebilir kalkınma için iyi bir yol gösterici olabilecektir.

B: Tez Fotokopisi İzin Formu

TEZ FOTOKOPİSİ İZİN FORMU

ENSTİTÜ

Fen Bilimleri Enstitüsü ☐

Sosyal Bilimler Enstitüsü ☐

Uygulamalı Matematik Enstitüsü ☐

Enformatik Enstitüsü ☐

Deniz Bilimleri Enstitüsü ☐

YAZARIN

Soyadı : Şekerci
Adı : Almira Sinemis
Bölümü :Uluslararası İlişkiler

TEZİN ADI (İngilizce) : Renewable Energy Promotion Strategies of Individual States and Regional Frameworks: A Comparative Approach

TEZİN TÜRÜ : Yüksek Lisans ☐ Doktora ☐

1. Tezimin tamamından kaynak gösterilmek şartıyla fotokopi alınabilir. ☐
2. Tezimin içindekiler sayfası, özet, indeks sayfalarından ve/veya bir bölümünden kaynak gösterilmek şartıyla fotokopi alınabilir. ☐
3. Tezimden bir (1) yıl süreyle fotokopi alınamaz. ☐

TEZİN KÜTÜPHANEYE TESLİM TARİHİ: