THE MINISTRY OF EDUCATION OF THE REPUBLIC OF AZERBAIJAN

AZERBAIJAN STATE UNIVERCITY of ECONOMICS

INTERNATIONAL GRADUATE AND DOCTORATE CENTER

MASTER DISSERTATION

ON THE TOPIC

“ECONOMİC EFFICIENCY OF BUILDING ALTERNATIVE ENERGY SOURCES IN AZERBAIJAN”

Badirkhanli Shahin Imran

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MASTER DISSERTATION

ON THE TOPIC

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AZƏRBAYCANDA ALTERNATİVENERJİ MƏNBƏLƏRİNİN QURULMASININ İQTİSADİ SƏMƏRƏLİLİYİ

XÜLASƏ

Tədqiqatın aktuallığı. Dünyada enerjiyə olan tələbatın artma səbəbilə ölkələr enerji istifadəsində maksimuma çatırlar. Bundan dolayı sosial və iqtisadi inkişafımızla bərabər rifah və sağlamlığımızı təmin etmək üçün enerji və əlaqəli xidmətlərə ehtiyac durmadan artır.

Tədqiqatın məqsəd və vəzifələri. Bu tədqiqatın məqsədi bərpa olunan enerji sahəsində həm yerli həm də dünya dövlət və özəl müəssisələrinin mövcud və proqramlanmış proyektlərdəki strateji yeniliklərin iqtisadi təhlili, eyni zamanda tükənən enerji mənbəyi ilə rəqabətliliyini təmin edən metodların araşdırılmasıdır.

İstifadə olunmuş tədqiqat metodları. Bu dissertasiyada konsepsiya ədəbiyyatında iqtisadi təhlil və ekspert qiymətləndirmə metodlara əsaslanaraq mövcud yerli və beynəlxalq təşəbbüsləri təhlil etmək və müqayisə etməklə Azərbaycanın iqtisadi imkanları nəzərdən keçirilib.

Tədqiqatın informasiya bazası. Tədqiqat üçün informasiyanın toplanması bir çox xarici akademiklərin, Azərbaycan qanunvericiliyinin sənədlərinin, Azərbaycan Statistika Komitəsinin yazıları, eləcə də son beynəlxalq hesabatlar və konfrans sənədlərinin tədqiqi ilə aparılmışdır.

Tədqiqatın məhdudiyyətləri. Bu məhdudiyyətlər bazar uğursuzluqları, informasiya çatışmazlığı, qabaqcıl texnologiyaların zəruriliyi, qanunvericilik dəstəyinin olmaması və xammalın əldə edilməsini əhatə edir.

Tədqiqatın nəticələri. Bərpaolunan enerjinin üstünlükləri və mənfi cəhətləri ilə bərabər onun qabaqcıl texnologiyaların istifadəsi şərti ödənilməklə irimiqyaslı tətbiqinin əsas iqtisadi, sosial və ətraf mühitə olan təsirləri də tədqiq edilmişdir. Tədqiqat həmçinin iqlim dəyişikliyini azaltmaq üçün səmərəli bərpa olunan enerji mənbələrinin davamlılığının qarşısını alan problemlərin həlli yollarını ön plana çəkir.

Nəticələrin elmi-praktiki əhəmiyyəti. Bərpa olunan enerji mənbələrinin inkişafı iqlim dəyişikliyinə təsirlərin azaldılmasına və gələcək nəsillərin enerji istehlakı tələbatının ödənilməsində davamlılıq yaratmağa kömək edəcək mükəmməl yanaşmadır.

Açar süzlər: Bərpa olunan enerji, Alternativ enerji texnologiyaları, İqtisadi səmərəlilik

ABBREVIATIONS AND SYMBOLS

CCS	Carbon Capture and Storage
CHP	Combined Heat and Power
CO2	Carbon Dioxide
DSM	Demand Side Management
E3ME	Energy-Environment-Economy Global Macro Economic
EJ	Exajoule
EU	European Union
EV	Electric Vehicles
GCC	Gulf Cooperation Council
GDP	Gross Domestic Product
GHG	Greenhouse Gases
Gt	Giga tones
IEA	International Energy Agency
IRENA	International Renewable Energy Agency
kWh	Kilowatt Hour
MJ	Megajoule
NOx	Nitrogen Oxides
OTEC	Ocean Thermal Energy Conversion
PEEREA	Protocol on Energy Efficiency and Related Environmental Aspects
PV	Photovoltaic
R&D	Research and Development
RE	Renewable Energy
RES	Renewable Energy Sources
SDG	Sustainable Development Goal
SOx	Sulphur Oxides
TFEC	The Foundation for Enhancing Communities

CONTENTS

INTRODUCTION

The relevance of the research topic: It is known fact that energy is essentially master resource in modern economy. Worldwide demand for energy is increasing every year. Therefore, establishment of newly developed renewable energy systems and technologies has become a priority. There are already possible solutions for the entire energy problems some countries face. However, even the cleanest energy providers such as solar power plants, wind turbines, biomass etc. have a lot of components to consider as obstacles. Concerning technical barriers on the field of renewable energy technologies as well as clean electricity market competitiveness it is essential to identify where are the weaknesses and how the regulatory policy frameworks affect the prospects of efficient alternative power resources in general term.

Level of studying the issue: In this paper we are looking at different world practices by analyzing countries that stand up for renewable energy sector most believing its long-term profitability. Collecting data about each region for our research purpose gives us insights about how comparable diverse techniques used in these countries. The main subject is examined in the context of many scientific works of academic and industry specialists such as J. Domaca, K. Richardsb, S. Risovic, J. Goldemberg, S. T. Coelhob, A.K. Akella, P. Sadorsky, N.D. Mortimer and many others. Great reviews of sustainability practices of power resources for future prospects are covered by C. Lund, N. Vidadili, C. Bulut, M. S. Dresselhaus, I. L.Thomas, D. Gielen, F. Boshell, D. Saygin, M. D. Bazilian, N. Wagner, R. Gorini and others.

Purpose and tasks of the research: The purpose of this research is to establish a ground understanding of competence and competitiveness of renewable energy sources and their implementation strategies through the achievement on efficiency and sustainability standards in selected countries as well as economic

benefits encouragement to make clean energy transition in Azerbaijan in near future.

To accomplish this purpose below tasks were formulated and solved:

-Environmental Components; investigate types of impacts depending on the scale of the system and the technology used.

-Economic efficiency achievement analysis of renewable energy sources in different countries; renewable energy consumption has a positive/negative/mixed effect on countries' economic efficiency for lower and higher consumption levels

-Energy prices and new strategies; low-cost electricity generation impacts to the economy overall change in income and employment in all sectors.

-Potential trade-offs and adjustment efforts;

Object and subject of research: The object of research is a clean energy transition and feasibility of renewable sources for the power generation at national level. The subject of this research is the modern energy strategies in an association with government-community relations in the process of acquiring efficiency and sustainability.

Research methods: Research methods used in this study comply to the economic, environmental, and social perspectives. The main basis for methodology is done by methods of area specialists, scientific forecasting method, systematic approach, socio-economic analysis method.

Research Database: The data collection for the research was done by analyzing academic publications of many foreign academicians, Azerbaijan legal documents, papers of Azerbaijan Statistical Committee as well as latest international reports and conference documents.

Research limitations: The lack of application of local large-scale renewable energy projects.

Scientific and practical significance of the results: The practical and theoretical significance of the research outcomes support applicableness of the implementation of international commitments into the local energy sphere with similar fashion in terms of achieving successful projects via the modern strategies.

Structure and volume of dissertation work: This research consists of an introduction, three chapters, conclusion, 3 tables and 9 figures. In work - 66 pages of text. During the work on the thesis 37 sources were used.

CHAPTER I. ENERGY INDUSTRY REVIEW AND POTENTIAL OF RENEWABLE ENERGY SOURCES

1.1. Energy analysis

Most usable sources of energy supply have been switched one after another over the past couple hundreds of years. This process continued until the most affordable input supply of energy and resources substituted costly ones. Before 1870's majority of population on earth had access to the energy using biomass sources primarily trees and woods.

After 1860 coal became one of the most used energy resources and practically the great cause of carbon dioxide emissions in the world. It didn't take so long for people to explore the new alternative that is undoubtedly still valid in our world, fossil fuels.

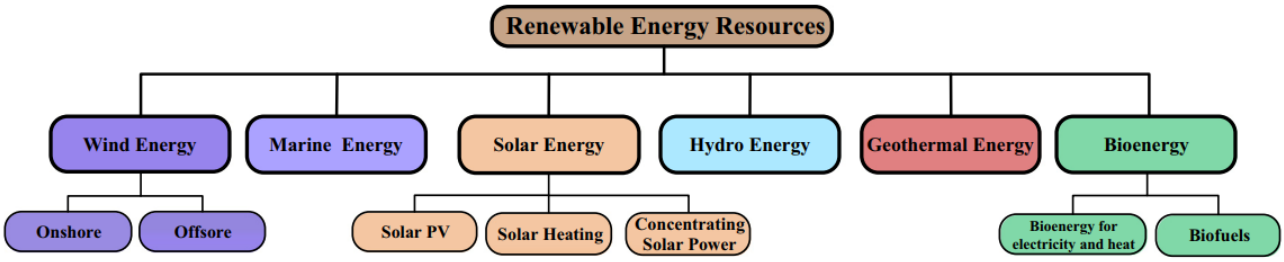
Solar, wind, hydro, biofuels are main alternatives to the conventional sources of electricity. To generate this type of electricity many companies around the world are involved in establishing lots of factories and investing on convenient alternative energy sector.

At picture 1. main renewable energy sources are illustrated. From wind to biomass all these sources have their own significant characteristics depending on the scope of a field they have been deployed. Even though their operating method on the basis of functionality is quite diversified to one another, all these types of energy sources have something in common. In particular, the major resemblance on this point is the extent to meeting main goal of social and economic welfare as well as commitment to the reduction of negative effects that environment has been suffered by the extensive use of conventional energy sources. Whether the direct impact or other externalities caused by the traditional plants bring about serious problems which global community should be worry about the fortune of energy for the next generations.

Concerning the range of capabilities that are indicated about the energy use, Frey and Labay stated that "as population increased 5 times over the last 2

centuries energy use increased 18 times" (1983, p. 643). Thanks to the surplus of energy provided by fossil fuels that countries relied on this source to construct modernized world and step up on technological advancements.

Figure 1: Scheme of Main Renewable Energy Resources



Source: Renewables and Sustainable Energy Reviews 39 (2014)

However, this surplus started to shrink continuously. Despite the fact that gas resources are sufficient enough for the benefit of economy this is not the case for long term. In the past, relatively small amount of energy was required to create small oil rigs to drill through Earth's surface. Today much more energy was required to find energy. At picture 2 sources of energy are illustrated and growing demand for energy is quite noticeable trend.

Net energy was measured by dividing the amount of energy we get by the amount of energy we had used in order to get that energy.

Net Energy=Energy out / Energy in

If in the past, we used to spend 1 barrel of oil to extract 100 barrels now we are only able to do this with 1:3.5 ratio. Plus, water and environmental costs associated with this process are disturbingly high (Adam R. Brandt, 2011, p.1838)

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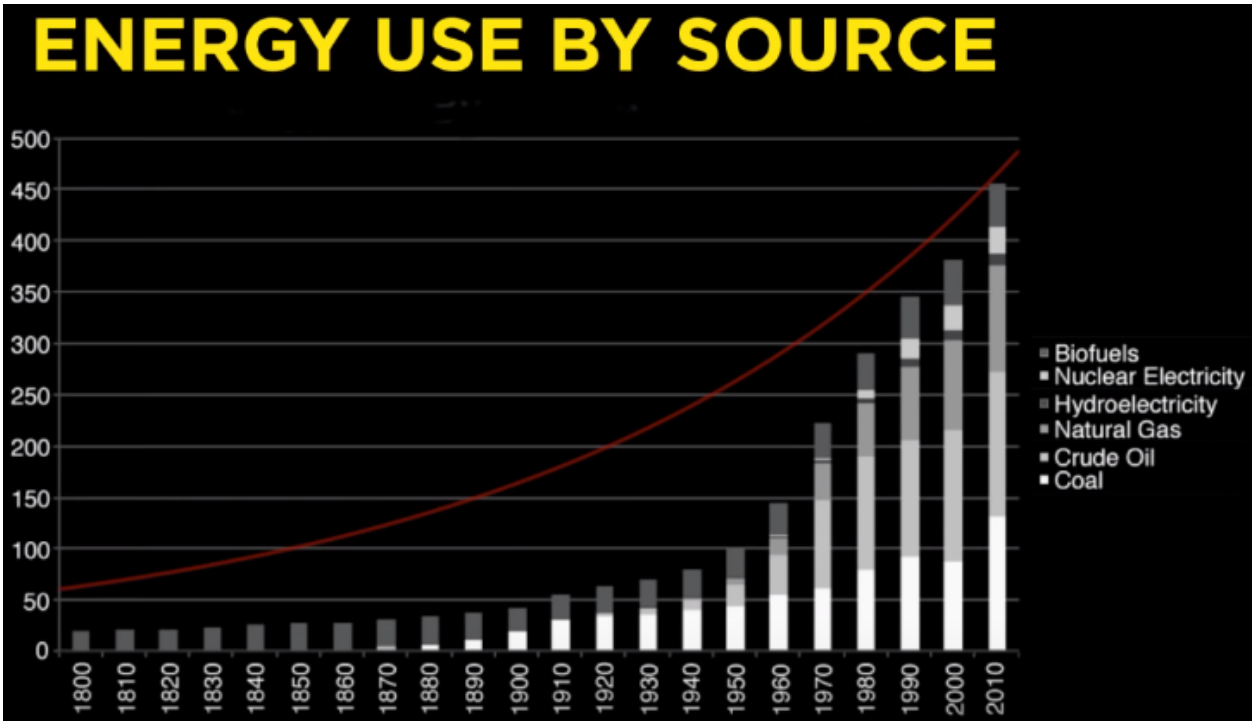
From the economic standpoint the predicted scarcity of fossil fuels does not indicate that at some point all of a sudden oil drills would be shut down. Instead,

supply and demand curve will intersect at increasingly higher prices. “Higher prices, in turn, signal scarcity and thereby induce technological innovations that increase supply, reduce demand and lead to new sources of energy” (Mann, 2013).

Figure 2: Energy use by sources



Source: International Energy Agency (IEA) 2016

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“Nations recognize that the country leads clean energy economy will be the country that leads 21st century global economy”. The logic behind above mentioned phrase by Barack H. Obama, former president of United States is that green energy if it is achieved economically let alone achievement of environmental perspectives then there will be a win-win situation.

Energy and energy independence have become one of the most discussed problems in recent years. Therefore, at European level there was Agenda 2020

which was the main driver to shift to renewable energy. In fact, mentioning the energy independence this sector has attracted great attention in many countries. Alongside with finding ways to sustainable development the issues about the effects of fossil fuel industry to the environment were also priorities.

In this report we focus on the leading players in renewable energy industry by comparing their business performance to the energy producers of fossil fuels. We also analyze how well companies of renewable energy sector run their business mostly in European countries and GCC (Gulf Cooperation Council). In this report we aim to analyze the sustainability of renewable energy sector in Azerbaijan, financial information and performance of companies operating in this country. Obviously, sustainability of alternative energy sectors relies on the role of suppliers and demand for their products. In this regard careful analysis of investment opportunities and government subsidies in different countries is important.

1.2. Potential of renewables

This study is aimed to examine the potentials of sustainable development of renewable energy market in the long run without heavy investments from the government. In many markets including gulf countries wind and solar photovoltaic (PV) projects have been profitable investment opportunities. Long-term and stable capital from renewable energy projects are consistent with long-term performance horizons for some investors, such as institutional investors — sovereign wealth funds, retirement plans, and insurance companies (IRENA, 2017).

Developing countries now realize that better security and affordability for energy is to have its own renewable energy production without relying on the impulse of fossil fuel market abroad. But in general, for energy production in Azerbaijan and many other countries including US, domestic fossil fuels dominate over renewables in terms of cost-effectiveness. Domestic coal is abundant and

cheap, and the availability of natural gas has increased rapidly in recent years, driving down prices that are likely to contribute its affordability in the medium term.

It’s proven that alternative energy technologies have raised up in cost effectiveness over time, but parallel improvements in conventional energy technologies make it harder for the economics of renewables to build up by themselves. In fact, we do not take into account the social and environmental costs and benefits while comparing carbon-based fuel with renewables, so this arouses disparagement that fossil fuels are being unfairly favored despite negative external impacts. Besides certain technological improvements on renewables have shown that there are still more advancements can be made especially considering how much efforts countries like Germany, Denmark, and recently China make for reducing the costs related with solar panels and wind turbines in order to enhance the usage of clean energy.

As discussed earlier one of the long- term economic benefits of renewable and alternative energy sector are creating lots of job opportunities. In global level there are now more than 10 million people employed in this growing sector. The other economic advantage was derived from renewable energy technologies. Because they are labor intensive, so they usually create more jobs per dollar invested compared to traditional power generation technologies. They mainly use local resources so most of the generated revenues from energy can be stored at domestic level. According to the Wisconsin Energy Bureau investments on Renewable Energy Sources (RES) available in the local market generate more jobs, higher wages and higher output than permanent support on imported fossil fuels. The Bureau evaluates that, generally, renewables make multiple times the same number of occupations as a similar dimension of spending on petroleum derivatives.

The upsides of sustainable power source speculations are ending up progressively clear, even in territories that cover fossil fuels support the construction of renewable energy sources. The sustainable renewable energy

industry gives a wide scope of business openings, from cutting edge assembling of photovoltaic plants to diversified employments at wind power plants. Through the multiplier impact the wages and pay rates earned by industry representatives create extra pay and occupations in the domestic economy.

1.3. Competitiveness of Renewable Energy

Electricity generated from wind turbines and plants is presently a standout amongst the most competitive energy sources. Innovation upgrades in the meantime as introduced expenses have kept on declining, imply that the expense of onshore wind is presently inside a similar cost range, or even lower, than for petroleum products. According to the International Renewable Energy Agency (IRENA), without monetary help wind plants have now potential to produce electricity for no more than 1 cent per kWh, with the best ventures costing even less. Expenses for the more developing alternative energy variants like biomass, geothermal and hydropower have been comprehensively steady since 2010. Meanwhile, without even using monetary assets, these advancements in current technologies can give the absolute least expensive source of energy.

Sustainable power source innovations from the economic standpoint are basic to understanding their role in the energy sector, and how rapidly and at what cost we move the alternative energy sector onto a genuinely feasible way. Nowadays, most governments have not deliberately gathered the vital information to follow the patterns in the development of renewable energy technologies cost as well as sustainable power source innovation costs. The outcome is that over and over again misguided judgments about expenses or outdated information have undermined strategy viability.

Global energy transportation report stated that electricity is getting to be the main clean energy carrier. The role of renewables on this transition should be noted too. Firstly, countries support the idea of sourcing electricity from renewables. Also, global trends in different industries such as electric vehicles,

power batteries show that switch to all electricity solution can take place in near future. Energy efficiency stands at the first place for the choice of going this way. Because renewable technology prices are always subjected to the comparison with fossil fuel costs we often come across with different expert analysis.

Consequently, industry analysis more likely favors application of new renewable projects in order to check every possible variant for feasible economic solutions. Therefore, IRENA statistic estimates report the costs associated with solar photovoltaics (PV) have drastically fallen over 70% during the period between 2010 and 2017. This kind of statistics is applicable for other renewable sources like onshore wind practices and the related costs are still on the declining stage. Cost-competitiveness is in the heart of making clean energy decisions while combatting with conventional energy sources.

According to Petticrew and Roberts (2006) there are six different types of literature review, which are; systematic, narrative, conceptual, traditional, critical and state of art reviews. A conceptual review was chosen to be used as a main research methodology in this paper. This review method aims to synthesize conceptual areas of knowledge to better investigate the topic. The objectives of these syntheses are to review different academic and conference papers, articles, magazine publications, thesis's and as well as industry reports published by different researchers and institutions.

There is a tendency that preferably favors electricity as the main energy carrier. In this regard, many countries around the world have come to realization that renewables and other available clean energy options should be the solution for that matter. Electricity is considered as one of the main and cleanest version of efficient energy carrier. Moreover, it is estimated that the record for the share of electricity in the total final global energy consumption (TFEC) reaches to approximately one fifth (D. Gielen, 2019. p 44). In fact, several developed countries are understandably placed higher on this figure having higher consumption rate for electricity as the main energy carrier. Besides, developing countries make efforts to become active player on the energy transition thus

encouraging competitive environment for renewable industry. This tendency especially represented itself in the areas of service, transport, water and space heating. In addition, significant demand for electricity generation from renewable sources is still valid for heavy industry where its use is limited to some specific processes. We can clearly claim that technical feasibility of electricity usage is reachable however on the basis of this issue economic reasons stand out.

Renewables are being presented to other big industries like transport as well. At current state electric vehicles sales demonstrate a huge jump to the all electricity solution in the past ten years. Although big transport options such as aviation and shipping still require technologically progressed solutions for storage purposes we can observe rapid growth in electrification efforts at global scale (Scholtens, B. 2013, p 97). Close examination on the electric vehicles (EV) sales data for 2016 reveals about 1% of total sales belonged to EVs. Furthermore, there are almost 6 million electric cars are available in roads worldwide and this number is continuously increasing.

CHAPTER II. ENERGY PATHWAY: ESSENCE OF DEVELOPING NEW STRATEGIES AND METHODS FOR SUSTAINABLE ENERGY PRACTICES

2.1. Energy transition pathways

"The role of energy from the renewable sources in the global energy transformation" is an important examination of findings in which current datasets for renewable energy are discussed. Also, there is analysis of socio-economic characteristics of how renewable energy industry should present new innovations and techniques for better energy transition. The study suggests that there is a possible technical transformation to ensure the successful energy transformation, however, technological enhancements are not enough for the process to be totally attainable. For this reason, Nicholas W. (2019) is proposing the necessity of developing integrated policy design. The argument is not only applicable for the solution of cost-effectiveness, but overall energy transition of being obtainable in every objective at the same time. In addition, the research findings show that there is a significantly increasing level of resource deficiency of energy due to the improper resource management. In energy sector the deficiency mainly occurs because of the inefficient application and inappropriate strategies. Governments recently make new policies to recover mitigation and adaptation processes.

In the meantime, at global sphere there are now important initiatives one of them namely Paris agreement in which many countries realize in which direction energy transition process should alter. Switching to low-carbon emission and less greenhouse gases option is priority that brings forward renewable energy sector as the main solution. Moreover, this also enables technological innovations as the main players of renewable energy (RE) industry whether private business entities or government supported agencies are seeking the ways to drop down the costs related with whole RE deployment architecture. Hence, this in turn creates a competitive environment where active players are pushing the boundaries of achieving energy transition.

Despite every effort this transition does not happen fast enough as old practices prove that the process takes time like more than half a century. Nicholas W. (2019) emphasized the importance of individual self-determination and business opportunities are the main drivers for the transition.

The research outcomes show that with considerable background in the analysis, some results can now be studied. Hence, from the data provided in the table it is illustrated how conventional fossil fuel input by records of supply comparatively analyzed. Also, this can give an assist to define how different sources of renewable energy classified on the basis of saving potential.

Table 1: Total fossil fuel energy input for energy supply from conventional sources.

Form of energy	Source of energy	Fossil fuel energy input/unit energy supply
Heating fuel	Coal	1.07
	Natural Gas	1.14
	Oil	1.13
Transport fuel	Oil	1.13
Space and water heating	Natural Gas	1.78
	Oil	1.88
Electricity	Coal-fired power station	3.21
	Natural Gas-fired power station	3.52
	Oil-fired power station	3.81
	Nuclear power station	0.27

Source: Based on UK data for 1974 given in the N.D. Mortimer, The Usage of Energy Intensity Multipliers, The Energy Workshop of Report No 22

Traditional energy supply with the simple formula of input/unit as illustrated in table 1 demonstrate what sources of energy can be formed out of different energy carriers. To be more precise, as an example take electricity which for comparison purpose it is the most interested one that we look for.

Obviously, results clearly point out oil and gas fired stations as well as coal fired station is superior on the amount of energy going out of system.

Results which are given in the study carry a fair ground to be trusted for however it should be also noted that there are not enough details in reports regarding with energy analysis and less assurance on coherence due to the great variety of related studies available.

In chapter one we mentioned about the importance of net energy for better efficiency, quality of system and meeting energy requirements. It is not quite straightforward to come to general conclusion in the context of renewable energy for transmission and construction of electricity for consumption. Clearly, due to the site-specific nature of these alternative options there are some difficulties to calculate electricity losses which will be delivered via distribution network thus giving us exact results for net energy requirements.

2.2. Strategic energy modelling frameworks

International Renewable Energy Agency (IRENA) has joint study in the context of introducing global energy modelling framework named as REmap. RE technology costs are the main topic in this dataset. There are other datasets of IRENA which are meant to be used for both technological and economical perspectives of different kinds of renewable energy sources. Various datasets in IRENA were developed for the purpose of cost-effectiveness. Besides globally accepted modelling framework-REmap some countries have developed national energy plans. IRENA take initiatives to cooperate with governments by applying REmap concept as an improvement to their energy planning. In this process IRENA experts are taking responsibilities to control and regulate each step of the framework according to the national energy transition target.

Moreover, new approach namely REmap is considered to have compelling components that allow countries to fully realize where they place on energy pathway and what should be done in order. The scenario developed by this

framework is helpful for giving assessments to the countries that deploy this approach. To sum up, although various techniques and scenarios regarding with renewable sector have been deployed in different parts of the world REmap represents itself as superior framework because unlike old fashioned unified complicated model, REmap devotes itself on certain tasks which their results are then specifically communicated to various range of audiences.

Paris agreement targets claim that energy transition is affordable by 2050. In the research paper there are two main frameworks namely reference and REmap case discussed over the topic of achieving better efficiency with more share of renewables by the time. Investment opportunities will be enhanced, and governments can sustain economic growth through global energy transition influences on the overall market. In addition, with the implementation of REmap scenario growth will happen with boosted investments mainly on renewables and additional jobs in clean energy industry. Argument in favor of renewable industry is that on average 19 million extra jobs will be created by 2050. Moreover, around 7 million job losses from the traditional energy sector will be offset by new job spaces in renewable sector.

One of the major challenges that renewable industry faces over the past decades is the right technology solution. Of course, proper approach to the top energy transition is to go through innovations. Therefore, alternative energy sector attracts many investors and governments funding for the development of new infrastructure. Thus, contributing to the technology pathway of renewables should be considered a key driver for meeting energy transition target globally. For this reason, more investments are required for R&D on technology for all sectors of clean energy. The urgency is towards bioenergy and solar thermal however majority of investment incentives are allocated for solar PV and wind. To put it in another way, more investments on R&D means more initiatives toward clean energy technology innovations. This in its turn implies that proper technology models offer low cost options, thus bringing down overall transition costs. On the other hand, while addressing investment enhancement issues for R&D authorities

should not skip keeping the track of progress and observing how those investments reach out for energy transition targets.

For almost every country renewable energy source get popular as key segment on the energy efficiency, lowering CO2 emissions and essential energy consumption. For this reason, countries are developing new energy transition model in an attempt to achieve deployment of RE. Because the excess energy demand induced by industrial evolution is thought to be a prominent problem therefore through the regulatory assessment and policy in place RE will be a strategic solution in a long-term interval.

Several research studies conducted to learn the current state of alternative energy sources projects in gulf cooperation countries. It is essential to investigate policies related with renewable energy in broader context. Because the applications of appropriate reforms are designed in such a way that initiate efficiency and overall transition to well-developed energy system, this requires correct execution of such kinds of projects under the supervision of related agencies (Z. Abdmouleh, 2015, p 1184). With that in mind, first aim is the preparation of achievable targets and plans that cover sectorial demand as well as projection of the trends in association with input-output figures.

Correspondingly, gulf cooperation countries (GCC) have also announced their targets and future plans that support adding renewable option to the overall energy mix. These examined countries have their own existing projects and policies for the planning processes. As a matter of fact, it would not be true to claim that the phases of this planning process function in a similar fashion in each of these countries. Because some of them are more concentrated on the R&D whereas others take initiatives to deploy a large-scale pilot projects especially in the solar energy sector. Of course, regarding with energy policies support for RE is important however it should be noted that for countries like GCC well subsidization of energy system does not allow conventional energy industry cope with renewables under the fair competition situation. Despite the fact that RES become vulnerable in such a state losing every aspect of competitiveness to fossil

fuel from the economic perspective gulf countries are deterministic to bring holistic approach to the analysis of saving energy and protecting the environment.

The research reveals the truth about several gaps incorporated with the actual capacity for the RE projects installation, policy mechanisms, governmental administrative frameworks and lack of knowledge. Nevertheless, those gaps do not bother some of these countries to make first steps in relation to creating new policies in order to stimulate renewable energy development.

After analyzing the characteristics of selected countries, in our case these are Qatar, Kuwait, Saudi Arabia, United Arabic Emirates, Oman and Bahrain; the study reviewed the diverse range of methods in an attempt to provide financial support for the development of RE projects. Hence, it was recommended to separate strategy into three dimensions:

1. Removing government incentives in the form of financial aid
2. Adapting government incentives in the form of tariff reforms
3. Proposing new monetary support

Each of these scenarios is investigated to the extent where the priority is being given to secure more efficient and low carbon energy projects.

The first dimension is quite aggressive towards the conventional energy sources and the incentives given to them by government. The reason behind that is to gradually transform to the more sustainable national economy as well as healthy community. Although environmental factors and interests to clean energy are prioritized it does not imply that those subsides for fossil fuels are not necessary for the economy overall. Of course, fossil fuel projects have many positive effects to the contribution of investment volume and therefore it is not so easy to achieve full support for RE projects by removing subsidies. Thereupon, the establishment of pricing reform has been introduced as an optimal decision on that regard. In addition, new pricing reform is acknowledged to bring long-term macro-economic benefits. But this scenario should be carefully examined for the purpose of avoiding any negative impacts on low budget segment of population.

Second dimension is solely focused on tariff reforms as opposed to the unpredicted failures incidents in first dimension. The reasoning is that there is a need to stimulate competition in energy sector where RE developers and producers can evaluate more efficient projects without dealing with long term economic activity of their investments. In addition, government role is crucial at simplifying documentation procedures and expanding the opportunities for credit which in general improving capital market for alternative energy sector.

According to third dimension financial support can be constructed in order to discover new ways of funding renewable energy projects corresponding to area specifications and consent to maintain government incentives for fossil fuel energy sources. The scheme called *Sukuk* has got substantial opportunities that RE projects developers can take advantages of basic investment vehicles with high tradability options available. Although for gulf countries this scheme has not been applied in clean energy projects it is believed as potentially appealing direction to take steps on.

In broad picture the study has brought important factors into the attention of viewers about deployment of RE projects. The sphere of regional policies should not only focus on monetary support but also assist countries on guidelines of RE projects in an attempt to create mutual effort conditions between decision makers and partners of energy sector.

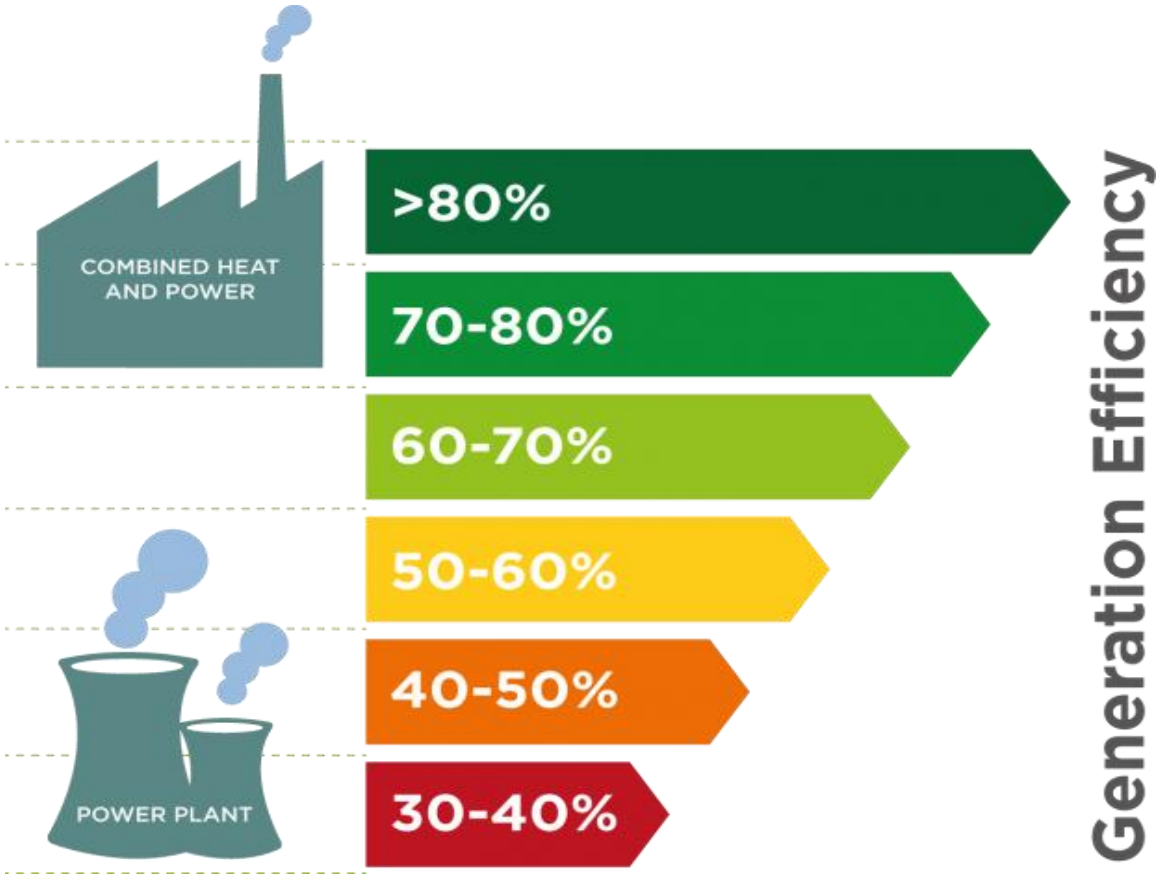
Another prominent academic paper was introduced by Henrik Lund (2007) that discusses necessity of renewable energy sector for Denmark, its three major changes with the explanation of how successful implementation of unique energy flexibility system designed.

Despite the fact that many developing countries are involved in growing their renewable energy supply, approximately only 15 percent of total energy supply is the share of alternative sources.

In this research paper author pointed out main challenges regarding with sustainable development of renewable energy strategies. Intermittent energy

sources and direct association of transportation sector with energy strategies are concentration areas in which potential solutions are given in the paper.

Figure 3: Combined Heat and Power boosts energy efficiency at high level



Source: The Association for Decentralized Energy (https://www.theade.co.uk/resources/what-is-combined-heat-and-power)

Also, district heating has been introduced as one of the primary reasons of how Denmark achieved to be one of the most energy-efficient country in the world. Consequential improvement on electricity consumption especially records on conservation and Combined Heat and Power production (CHP) since the first oil crisis of 1973 had left a positive impact on overall energy sector. Thus, almost 14 percent of fossil fuel were replaced by alternative sources.

Consequently, historical background of country's energy strategies demonstrates that energy efficiency and savings on demand were successfully implemented. Therefore, achieving sustainable development of renewable energy

system depends on the attainability of intermittent electricity from Renewable Energy Sources (RES). Illustrated Picture 3 has covered CHP and traditional plant energy generation comparison information on the efficiency measures in percentage.

Also, the Danish Energy Agency explicitly focus on transportation sector involvement in these future strategies. As mentioned above savings and efficiency was the priority points for a long period of time whereas now developing and deploying new technologies becomes important issue. This carries upmost importance because sustainable energy targets cannot be obtained without having flexible energy technologies which allow comprehensive solutions for the overall energy transition. In addition, industry targets were set high as the country is trying to achieve 100 percent electricity production from renewable sources.

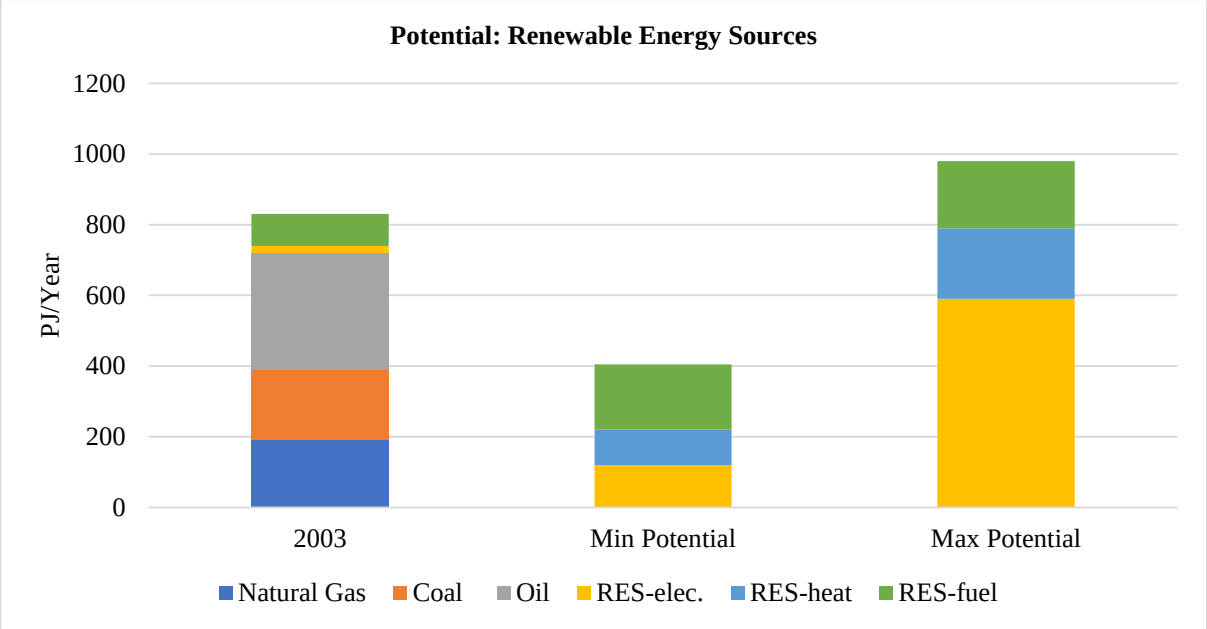
Danish government has estimates that show data of potential renewable energy sources for the year 1996. Lund H. (2007) state that there are some underestimates on the data of RES potential provided back then because flexibility of technologies improves as the new innovations are being introduced on a continual basis. For instance, taking offshore wind electricity production as an example we will see that dependency on technological aspect is quite high and with no doubt this will have a great influence for the years to come. Thus, there is a noticeable difference on potentials of renewable energy sources if all the measures about future developments are undertaken correctly. Following chart represents the comparison in the potential of renewable energy sources (RES) with 2003 data provided by Danish Energy Agency. Axis numbers are shown with power joules per year.

As it is shown in the figure max potential is noticeably high compared to present data. Also, real potential of renewable energy sources has overwhelmingly increased due to the advancement on flexible technologies and attainability of new energy system options. The main point is that Danish government supports the implementation of such energy system with high efficiency in accordance with keeping sustainability targets. Because harsh period of first oil crisis had been a

pragmatic experience for which long term decisions were made in favor of overall sustainable development of renewable energy strategies.

Because harsh period of first oil crisis had been a pragmatic experience for which long term decisions were made in favor of overall sustainable development of renewable energy strategies. According to the statistics provided by Danish Energy Agency before 70's energy production was solely provided by conventional sources.

Figure 4: Potential of RES in Denmark in comparison with 2003 fuel consumption



Source: Danish Energy Agency, 2003

In addition, because that fact was perceived as a signal to call for new alternatives, the necessary energy policy step was made to expand Combined Heat and Power generation. Obviously, one of the first objectives of Danish energy transition is to substitute conventional fossil fuel-based energy production by different sources of renewable energy.

After all, investigations approve the feasibility of 100% renewable energy system if major changes are accomplished. With this in priority an analysis model called EnergyPLAN was prepared in order to form a combination of each energy system to avoid an excess electricity production issue. Thus, this model takes

energy balance into consideration as well as extra services in relation with flexible energy technologies. Apparently, these changes are crucial because above mentioned balance issue could obviously be derived from the fact that energy production from RES occurs at an irregular interval. As an example, during some term strong wind led to the excess production of electricity which in turn created some challenges on demand side.

Current state of energy production in Denmark is done through the district heating method. It has been calculated that over 40% of demand is met by this technique. Also, further analysis required to look up different variants on the change of existing supply of energy. There are three scenarios are represented in the study, which are:

1. District heating should be used as the source for combining buildings slightly over 50%;
2. Additionally providing 63% more built structures with energy from district heating which are close to the source;
3. Lastly, extra 70% buildings within the range of 1 km away from district heating sites.

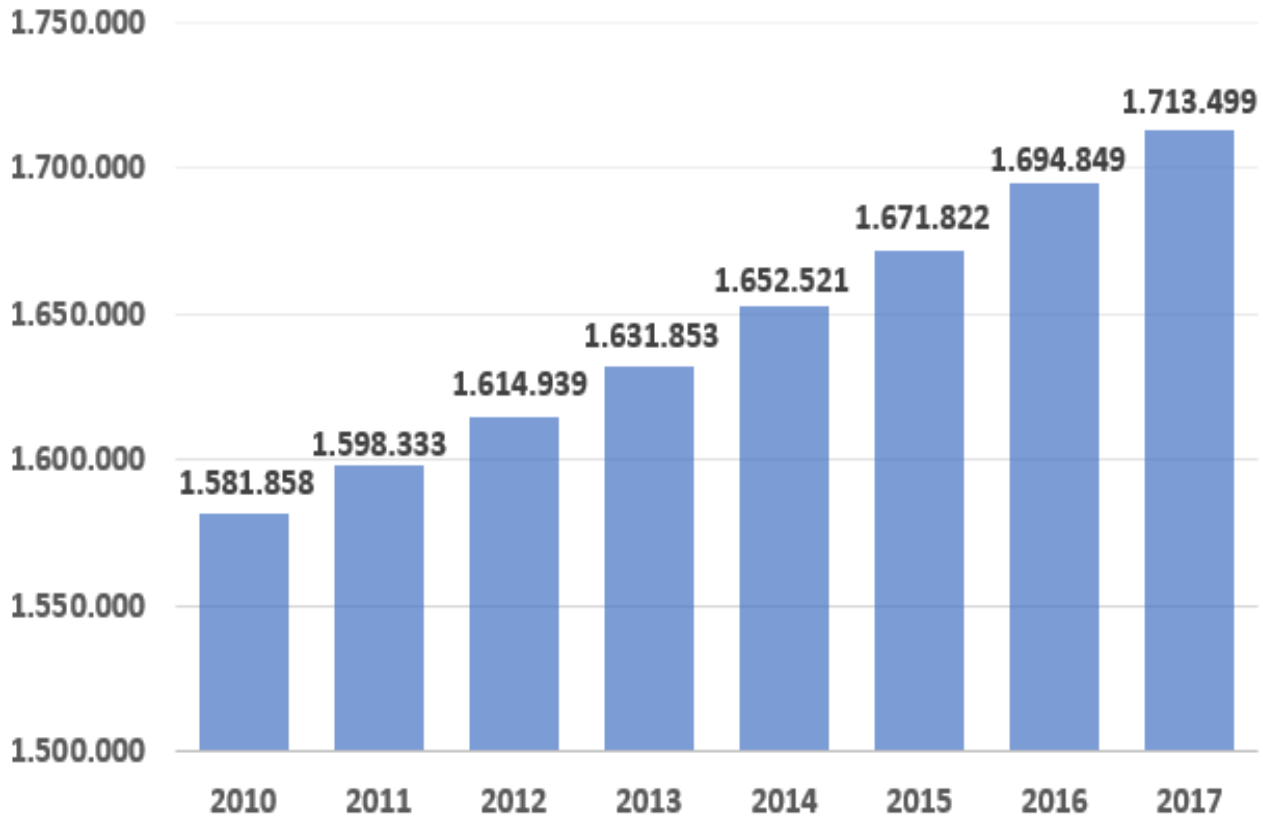
As it is shown in Picture 4 household buildings connecting to district heating are increasing every year. This is the direct result of promoting renewable energy options with respect to the initiatives in energy agreements that country was involved in. Furthermore, in 2013 government proposed a ban on the installation of fossil fuel-based boilers in new buildings.

In an overall perspective, it is great achievement for Danish government because the heating system under the cities of Denmark is comprised of gigantic network of pipes that deliver heat from the wastes generated by factories, plants and etc. This method is not considered as power efficient for nothing.

At the very minimal cost the district heating collaboratively work with power stations hence giving huge benefits to the energy system by providing community not only with the supply of heat but also electricity generation. It is estimated that

redistribution of heat to the household usage allows the district heating to be superior over standard power plants which provides an approximate 50% more efficiency.

Figure 5: Households connected to district heating in Denmark during the years 2010-2017



Source: Statistics Denmark **(**https://www.danskfjernvarme.dk/sitetools/english/statistics**)**

On the other hand, avoiding the waste of heat to the environment like traditional plants generally operate in that way modern energy scheme is much more environmentally friendly by reducing carbon emissions. In addition, existence of such network also allows the integration of other renewable options such as biogas production, straw-fired biomass as well as geothermal heating. The study recommends acquiring further examination on district heating technologies in order to integrate clean energy sources in near future. As the development of these technologies will somehow bring about full conversion to alternative energy.

Consequently, 100% conversion to the renewable solutions are not only obtained by full replacement but also there should be a proper system to make

necessary balance adjustments to the total electricity supply considering the intermittent nature of renewable energy sources. On this regard, energy system analysis model was introduced with consensus scenario that is consisted of implementation plans. In the final analysis, it was concluded that 100% energy replacement is possible with the right distribution share of energy resources in accordance to the developed analysis model.

2.3. Technology role in energy transition

RE technologies are developing and more price reductions due to the innovative solutions for technologies are anticipated. The application of a full energy vision in which the thermal and electric systems considered as a whole is not proper way. However, considering separately renewable power integration can offer better results. For even additional performance many technological components in power system can be modified in the long run. Therefore, it is highly likely to observe more investigation on the topic of RE flexibility and efficiency of power system in the future.

Power utilization is the most essential driver for all renewables and wind energy, however the driving impact was not strong for solar energy and biomass. Innovative work power is the most essential driver for biomass, it is just the second most vital driver for all renewables, solar oriented and wind energy. Unexpectedly, electricity price has had significant negative impacts on technological innovations to renewables. This indicates that pushing down electricity prices will bring about better levels of innovation in alternative energy sector. The driving effect of renewable energy tariff additional charge subsidy is not significant. The driving effect of installed renewable energy capacity is also minimal. Alternative energy source subsidy systems are vital instruments to advance the application and advancement of most inexhaustible technologies until they end up developed enough and can contend with existing energy innovation choices.

Considering the fact that cost of implementing renewable technologies is getting down and configuration of such clean energy systems becomes much easier as the years pass we might live in the era of real energy transformation. A.K. Akella (2009) had investigated energy industry in the context of not only economic but also social and environmental impacts regarding with the absent of renewable options.

In the same argument conventional fuel-based energy sources are losing due to the fluctuations in the prices, scarcity of resources in some areas, and most importantly externality costs that those projects carry. It is important to realize that traditional oil, gas, and coal suppliers have negative impacts on human health and destructive potential on the environment. Therefore, a number of protocols worldwide have been accepted in order to cope with the challenges of greenhouse gas emissions. The struggle is real when it comes to dealing with the devastating state of traditional power plants that reveal hazardous chemical substances to the air and water as well. Renewable energy mechanisms hereby offer alternative solutions to the problem with the help of proper policy system in place.

Besides positive environmental effects renewable industry is offering a good deal on job creation. For every coin invested in these new alternatives job opportunities extend to a great extent whereas fuel-based plants do not provide such economic benefits. Speaking of job creations other major benefit renewable energy projects bring is to let jobs contribute to the disproportionate rise in overall income better known as multiplier effect in economy. This is explained by the increase in spending creates healthy environment where other sectors get benefits at the same time.

Technologies today have certain categorized costs assessed for the clarification of how much spending should be done on electricity. Of course, this may give an opportunity to compare those renewable energy applications to the usual energy production on cost-basis.

2.4. Types of renewable energy sources

Ocean energy

Renewable sources go beyond the scope of landfills as ocean is considered a great energy source as well. Although more research is required for the development of comprehensive energy plan in future extremely large stores of energy from the ocean will become most spoken topic. Today because of the harsh environmental conditions ocean face there are skeptical approaches to the renewable energy plans. Generally speaking renewables were no economic competitor to the conventional power sources in the past however extensive technology improvements had closed that gap considerably. Moreover, even considering additional costs generated by fuel plants renewables gained popularity over the short period of time. Detrimental effects traditional existed plants caused plus long-term economic feasibility that new alternatives promise has had an important role on development of such energy mechanisms. Rod M. Fujita (2002) stated that for the costs of energy generated from ocean to drop down pilot projects must be implemented so that overcoming technological challenges let that process take less time.

Plants called ocean thermal energy conversion (OTEC) works with the steam of bringing cold water from deep ocean to the surface with constructed turbines and thus creating a heat. This heat is then used to operate generator apparently producing electricity. There are two open and closed-cycle versions determined to have full access of ocean energy production with the operation of OTEC plant. It is also worth to mention that these plants can be built on coastal or away from the shoreline. If it is built on off-shore, then there will be a floating platform with no land connection directly. Moreover, it was indicated that having offshore infrastructure has its own downsides regarding with economic factors. Additional expenses of building such a big plant on the sea and transporting electricity to the shore have inevitable extra costs. Furthermore, cold water pumped up by the plant from the deep ocean contains rich nutrients that could be used for different industrial purposes later on.

Obviously, potential of ocean stored energy is realized and base energy generating technology with proper mechanism developed however comparing the cost incurred in the production of ocean energy approximately between 10-24 cent/kW h with fossil fuel costs unfortunately today the status of conventional sources still remains as more economically sound variant against ocean thermal energy conversion.

Wind energy

Wind is a variable resource therefore to get the most energy out of it there must be accurate placement of wind turbines and wind plants. Compared to hydro wind energy producers took serious steps in XXI century. From 1995 to 2011 there has been a huge improvement on energy production capacity 4.8 MW all the way up to 240 GW worldwide. Technological advancements are still on progress in Northern Europe, China, and US. As an example, a single smart wind turbine unit with capacity of 3.57 MW at West Texas A&M University shows a better picture of how top-notch facility designed nowadays. Direct costs are the installation and operation expenditures whereas revenues are highly dependent on wind turbine performance, wind resource in specific area, and the quantity of energy produced. For other costs G. Cornelis stated that;

> *"There are the externality or spillover costs related to noise pollution, adverse health effects, loss of visual amenities, impacts on wildlife, risks associated with falling ice, and so on. The estimation of externalities is associated with a large number of uncertainties and there are no universally accepted methods for estimating them" (p.11.)*

Wave energy

One of other energy production methods from the ocean is the wave energy. It is considered one of the favorable renewable energy technologies. Small comparison is enough to point out the productive nature of this source. For example, while wind and solar energy supplies availability vary between 20-30 percent of the time, whereas same scenario is accounted as 90 percent of the time for wave energy. Apparently, wave energy securing unlimited supply of electricity

has drew attention of many investors. Moreover, advanced implications on wave technologies have positive impact on the favorable competition with fossil fuels and this situation is getting improved every year. Of course, more improvements on technology drive down costs that affect the price of electricity making plants inherently work on full potential.

The author has explicitly brought up the claims for the environmental protection when dealing with energy technology. In this manner, ocean energy plants are likely causing some level of threats to the ocean ecosystems. The reason is that large scale ocean energy projects especially can cause disruption on the interaction between ocean and atmosphere hence it creates negative effects on ecological balance. For this matter, experts have prepared plans where structural change on technology for some specific areas enables plants operate as artificial reefs so that avoiding any harm on the environment.

More investigations and research are required to achieve economic feasibility of renewable ocean energy technologies and the environmentally friendly structures. Undoubtedly, we should not proceed to use harmful fossil fuel plants without making significant efforts for the development of renewable ocean energy technologies such as OTEC and wave energy.

Ferguson A. (2008) made an analysis to highlight important points that is being discussed repeatedly when it comes to the wind power as renewable energy source. His investigations were mainly focused on the acute measures of how wind power matches against other sources of energy. Basically, the way these measures are introduced by the method of defining energy density for resolving uncertainty we must look at different factors. Accordingly, the output of wind power which is electricity should be taken as the basis to understand the real capacity in kW(e)/ha. Here “e” refers to the electricity as it is calculated with kilowatts of electricity. To proceed the analysis author has taken two main energy sources as comparable measures to look for the differences in energy density. Clearly, biomass and coal were more compatible energy sources rather than fossil fuels for the comparison purpose.

In the context of this study we observe new term namely renewable fuel which is sustainable and low-carbon energy carrier. Unlike liquid fossil fuels that spread threats of greenhouse gas emissions to all over the world renewable liquid substitutes are demanding. Under those circumstances, in near future when the deficiency of traditional energy sources becomes problem the new renewable source should be considered. Thus, it is highly crucial to determine which one of those alternatives have higher energy density that could possibly resolve aforementioned issue.

All the measures accounted we have come to conclusion that wind turbines obtain considerably high energy density compared to the biomass and even opposing close to coal.

Further study suggested to extend the analysis because of the fact that intermittent nature of renewable energy in this case wind power is not controllable. For this reason, electrical input cannot be seen as only driver to make conclusion about sufficient electricity production. To meet the minimum level of electricity demand the role of controllable energy source is vital. Because at the time of no wind plant will operate in harness with wind turbines apparently putting efficiency under a big question mark. Consequently, there is no accurate estimations demonstrating how much effect the plant running in harness with wind turbines will have on total electrical production.

Proceeding to further examination of the controllable source plant and each scenario of wind turbines operate under certain circumstances we are introduced with the case of USA electricity production as an example. Furthermore, calculating the amount of total electricity with the actual numbers acquired from reliable sources help us determine how well the contribution of wind farms to the total electricity is. As previously mentioned, controllable plant is required. In fact, only 38% proportion of total electricity can be provided by wind and the rest by controllable plant. However, it does not just mean that wind is capable of providing 38% of total electricity all by itself.

The reality is that without operating nuclear plant that is permitted to work along with plants for the purpose of baseload production, we will need to observe this proportion to the level of low demand which is 60%. So that estimating 38% of 60% which is 23% of electrical demand. Converting it to the amount compared in the total energy it makes approximately 10% of energy demand in total. With this in mind, in US case with the help of above estimating amount it becomes apparent that in only a decade it takes wind power to provide 10% of total energy demand.

More interesting evidence is that considering constant population growth of 1.06% per year in USA energy demand will increase making overall situation much worse as the electricity generated from wind farms are outweighed by the increase in energy demand. As a result, these kinds of projects pass through controversial stages even when considering the economic welfare of entire community at a most probable minimal cost.

Solar

Various government agencies and non-governmental organizations for solar energy technologies have helped assemble strong basis for the use of this renewable energy system. Moreover, policies, investment and support (such as research financing) by offering incentives and discounts can be used to increase the efforts to reduce the financial burden of these policy incentives. As there should be effective reasons for the development of these markets, however, solar energy subsidies are already interrupted in many countries. Accordingly, these situations may create a delay for the growth of renewable energy sector. To recover this potential decline, policies are changing to support the distribution of solar energy systems for large-scale energy production. In addition, more subsidies should be provided for residential solar energy.

In this article study was conducted to display the global scenario for solar energy production. Their potentials, current capacities, expectations, constraints and policies help the viewers understand how we can rely on solar energy as a main future energy source.

This study not only shows comparison of global power capacity in different countries but also point out claims and policy frameworks in each region. As renewable energy sector is considered an increase in national generation of power, therefore, traditional power sources are now aggressively followed by energy from undepletable sources in a lot of states. For instance, in Germany solar photovoltaics provided approximately additional 7% of electricity for which this number high up nearly 8% for Italy and Greece.

It is also worth to mention that there is a serious improvement on the total solar capacity worldwide. For the year 2015 in global sphere there was recorded base of 256 GW total capacity on solar energy. In fact, Europe is the continent where most of the solar power generation occurs. However, when it comes to renewable energy transition efforts China is not falling behind either. Most compelling evidence is the total installation of solar power capacity of 45 GW (giga watt) for the year 2015 which China replaced Germany-top listed competitor for a long time. By 2020 China has also planned to reach the total solar power capacity of 150 GW. It is assumed that lobbying efforts are being undertaken with protecting the major investment in traditional energy industry forcing some European governments to make no serious efforts to keep support on solar energy sector. Although solar energy systems require prior investment for their installation, they otherwise work at a very low cost. Unlike the price of fossil fuels, which are subject to significant price fluctuations, the financial demand for solar energy is relatively stable for long periods. In addition, there are no (mechanically) moving parts in the solar panels, make them noise-free and durable (no wear), with a very small amount of necessary maintenance.

In addition, solar panels can be easily installed on the roofs and building walls so that installation process is flexible. Also, solar energy systems are less susceptible to large-scale failures because they are distributed and consists of numerous individual solar cells

Therefore, if any the section of arrays was recognized as faulty, the rest can continue to work. However, additional solar modules can also be added above

time to improve power generation capacity. These concepts reveal tremendous advantages in the strength and flexibility of solar energy systems compared to other energy sources that have already been created.

Table 2: Total Installed Solar PV Capacity in Countries and the World, 2000-2013

Year	Germany	China	Italy	Japan	United States	Spain	France	Australia	Others	World
	---------- Megawatts ----------									
2000	76	19	19	330	0	0	0	29	776	1,250
2001	186	30	20	453	0	0	0	34	847	1,569
2002	296	45	22	637	28	0	0	39	945	2,012
2003	435	55	26	860	73	12	0	46	1,070	2,575
2004	1,105	64	31	1,132	131	24	26	52	1,133	3,698
2005	2,056	68	38	1,422	172	50	33	61	1,149	5,048
2006	2,899	80	50	1,709	275	154	44	70	1,338	6,619
2007	4,170	100	120	1,919	427	739	82	83	1,652	9,291
2008	6,120	140	458	2,144	738	3,635	186	105	2,537	16,063
2009	10,566	300	1,181	2,627	1,172	3,698	377	188	4,156	24,265
2010	17,554	800	3,502	3,618	2,022	4,110	1,194	571	7,959	41,330
2011	25,039	3,300	12,803	4,914	3,910	4,472	2,953	1,377	12,450	71,218
2012	32,643	7,000	16,139	6,743	7,271	4,685	4,019	2,407	21,169	102,076
2013	35,948	18,300	17,600	13,643	12,022	4,828	4,632	3,255	29,409	139,637

Source: Figures are as published in BP, *Statistical Review about World Energy* (London: 2014).

Importance of Flexibility in RE Scheme

Another academic review by Peter. D. Lund was done to investigate the flexibility of renewable energy system and supply in the context of providing energy flexibility with the main purpose of maintaining supply and demand match point at each time. According to "Review of energy system flexibility measures to enable high levels of variable renewable electricity" (p 787, 2014) by the time more countries such as Denmark, Germany and Ireland moving forward on the process of shifting to RE (Renewable Energy) more reliable energy scheme is vital.

Correspondingly, well manageable power system is an advantage to improve energy system flexibility. On the contrary, traditional power suppliers accomplish energy flexibility with union of different power plants in an assembled

way. Beside achieving large amount of electricity provided by RE the distribution and transmission networks should be designed in a proper way to avoid any demand and supply mismatches. For a better understanding we were given an explanation on how the flexibility is important for proper operation. Defined characteristics were split into different means. Hence, from the power supply system point of view, flexibility is closely related to the frequency of the grid and voltage control, delivery uncertainty and variability and power rates of growth. Metrics for defining flexibility can be obtained from these effects.

Huber M. used three metrics to characterize flexibility requirements, namely:

1) The magnitude of the linear change;
2) The frequency of the linear change and the response time;
3) The net load that leads when variable renewable generation was subtracted from gross load.

DSM as an Innovative Model

As a result, applicable solution to this issue is shown as Demand Side Management (DSM). Author claims that DSM in experience have been tested on traditional power supply before. Though it was not incorporated to the renewable energy industry very widely its positive effects cannot be denied. The main principle of this technique is to provide electricity for end consumption keeping balance of electricity generation and flexibility. DSM was examined in different countries such as Denmark, Germany, Norway, Switzerland to see the real potential of the effect on variable renewable energy.

Results figured on a graph was contemplated over different sectors (household, industry, and service). One of the essential categories in DSM is load shifting. Its functionality allows energy experts to allege that load shifting is superior to other DSM categories. In fact, unlike conservation and peak shaving method that are set up to reduce the energy demand or load growth and valley filling for the opposite purpose, load shifting does not let demand flexibility

hindering the cohesion of the process nor any distortion on the final product quality.

Load shifting is useful because it allows DSM work in a 100% efficiency without a need for energy conversion between intermediate storable form. Obviously, as Huber M. stated we often recognized energy system flexibility issues from the technological perspective however in order to achieve successful flexibility system there are other factors related to electricity market. For instance, as the market for RE electricity is in large-scale energy flexibility is desirable.

Apparently, because it offers no marginal cost average electricity price would decline immediately. In addition, energy tariffs may also be helpful for boosting renewable energy flexibility since electricity market has link to that. Considering the fact that, this study was investigated around 2 main renewable energy options; wind and solar, hence, their large-scale production was taken into account while comparing them to the traditional energy supplies. Given these options, there are a lot of variants to increase energy system flexibility in accordance with expanding the proportion of renewable power in electricity production.

Biomass

One of the main energy sources is biomass. Biomass is considered other type of renewable energy source where it is made by human, organic, and living plant wastes. Since resources are available everywhere biomass requires excellence on waste management and high technology. There are different types of biomass for energy production purposes such as wood, sewage, animal residues, agricultural and industrial. Netherland and Sweden are the most developed countries to generate electricity, heat, and chemical feedstock from biomass. For instance, recently Sweden started to import rubbish from abroad as the country currently runs out of local household wastes to keep its recycling plants going. It is now considered revolutionary achievement because of the implementation of heavy taxes on fossil fuels in 1991 (H. Sheffield, p.2)

Biomass is a general term for the majority of the Earth's plant and creature matter as it is mentioned before. Therefore, in the alternative energy source industry, in any case, biomass normally alludes to specific crops developed explicitly to be utilized as fuel, for example, quickly growing trees, agricultural buildups and else, for example, straw, sugarcane fiber, and rice frames and deposits from farm service and other wood-preparing factories. Biomass can be used, rather than derived from petroleum, for various reasons. Biomass is a sustained source of energy that can be used to meet the vast majority of future energy needs. It is a naturally well-located, sustainable source of energy whose natural damage, for example, nursery gas (GHG), NOx emissions and SOx emissions have less impact on the ground than petroleum sources. Similarly, due to the emergency situation of the 1970 oil value, the costs of petroleum products are constantly increasing. Consequently, biomass has a significant economic potential, moreover, biomass from sustainable energy sources will create its ubiquitous prevalence and attract much attention from countries around the world.

The advantage of biofuel industry is that byproducts and other types of biomass outputs can be used as fuels in transportation and energy. There is an examination for the causal connections between biomass energy consumption and real GDP for Azerbaijan, by using the statistical hypothesis test for the time of 2000-2018. The report also investigates short and long-run causality analysis between biomass energy consumption and genuine GDP.

So far, we have known there are two separate types of biomass for energy use. Undoubtedly, several factors contribute to the viral use of this energy source as the main driver in many areas. Firstly, biomass as degradable sources of crops and other types of organic plants that are used to burn and directly get energy from it is called traditional method of biomass. In this process energy reveals as the type of heat and not sourced. Secondly, biomass energy is also considered sustainable if it acquired in a proper manner. Because it does not require high capital investments and availability of resources is not problematic at all, the biomass energy has gained popularity for a long period of time.

Additionally, it is also highly effective on the reduction of greenhouse gas emissions. Thus, ecological commitment and sustainability characteristics made this source of energy diversified as renewable. On the other hand, better developed option of biomass energy generation comes as the modern biomass. As the name indicates that modern biomass is mainly used as fuel and electricity since it can support these energy carriers unlike traditional one.

"Biomass and bioenergy" (2003, p119) provides consequential study of investigations on the topic of biomass potential. In addition, it was conducted to seek for factors influencing the growth of this potential to the extent long term economic projections are met. There are ranges which should be analyzed such as biomass production, land availability, and wastes as well as allocation of residues.

The study presents significant influence factors in an association with interaction of biomass and land for food. Furthermore, meat and dairy products consume certain amount of land areas which it crosses interests of biomass energy supply with agricultural demand. In this case, Luyten (2001, p6) conducted a research examination on the possible combinations of ranges affecting productivity of biomass energy potential. At the final step 7 main categories were determined which are:

1. Biomass production on surplus agricultural land;
2. Biomass production on degraded lands;
3. Agricultural residues;
4. Forest residues;
5. Animal manure;
6. Organic waste;
7. Bio-materials.

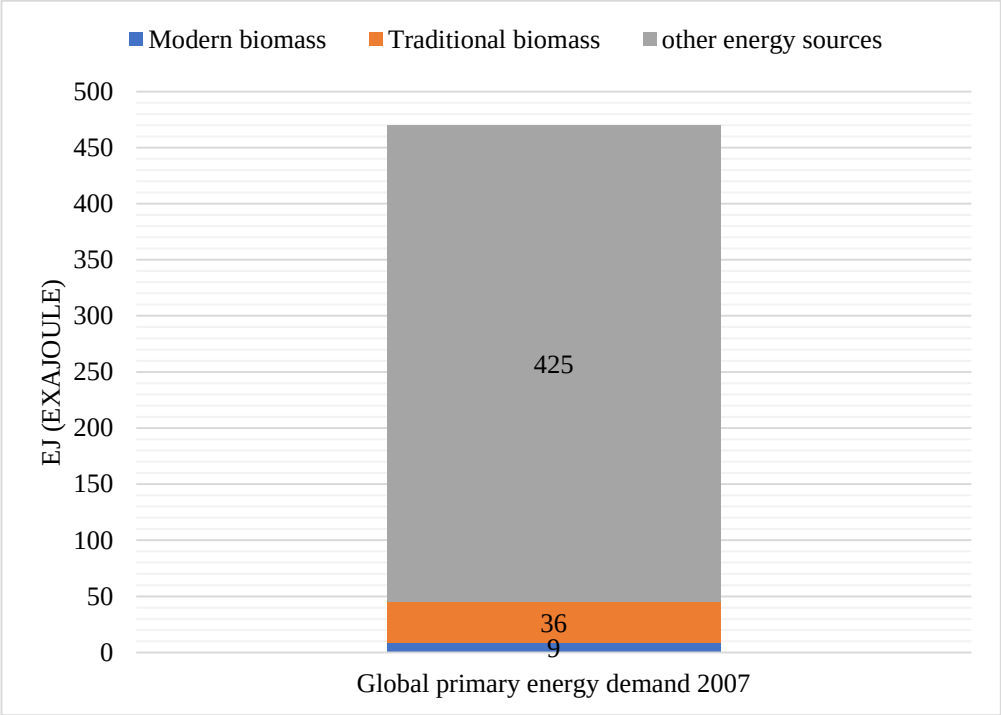
Each category was investigated separately in order to get the results for biomass energy potential on the context of geographical term. In reality, many factors are essentially interacted however careful examination of each scenario in an integrated way was suitable for the purpose of obtaining more transparent outcomes.

Results demonstrate that high productivity of biomass energy potential depends on many factors. Among them one of the main determinants is local aspect. To be precise, water availability, management criteria, quality of soil featured as main drivers for biomass productivity. In a crossing circle land requirement are essential for both food demand and biomass energy crops. So that assessment of proper agricultural land use and necessary transition in this scheme is required to achieve higher energy inputs by biomass sources. For this reason, western agricultural development achievements should not be concentrated in one area rather spread out over large areas of developing countries.

In an examination of realizing huge potential of biomass energy as a source of most sustainable option we can clearly see the trend going to the direction of high-intensive and efficient management systems. To the extent biomass is used as most promising alternative energy source in especially rural areas is quite comparable to other options. It is no doubt that biomass as renewable energy source is most widely spread of them all over the world with the estimate about 10% contribution to the global energy demand. Consequently, main reason behind this record is easy accessibility to the biomass resources worldwide, making it all-time best energy source in comparison with other renewables (WEC, 2004). However, it is not as widely used as fossil fuels because of the economic perspectives.

In European union it is calculated that only 10% of biomass use relates to the electricity generation, transport fuel and chemical use. On this regard, majority of resources are spent on heating function. Moreover, decisions toward the application of which energy carrier should be formed of biomass is not straightforward. While many precedents have to be considered for feasibility of various alternatives (Krstulovic & Barbiar, 2008).

Figure 6: Contribution of biomass to global primary energy demand of 470 EJ in 2007



Source: Faaij, 2008

When the discussion is about sustainability practices of energy from renewable sources it is known that all three criteria must be fulfilled. Bioenergy produced from biomass resources should be acquired by following every order and compliance descripted on the certification. If any social, economic, and environment requirement is distorted then sustainability is not achieved. Therefore, for high level of sustainability establishment the precision is to make sure that there are no huge negative influences on environment caused by the production of biodiesel made from biomass.

In other words, currently EU demonstrates great importance and prioritize the sustainability issues in accordance to the certification principles.

Government Policy on Alternative Energy Sector

Many European countries realize that renewable energy stands out best approach in achieving economic strategic positioning in future. Also, energy security is accepted as the main driving force in making clean energy choices. Because of the positive impacts governments can play vital role in regulating policies that stimulate investments. Policy measures should be taken in a way that

distribution of costs and revenues adjust to the degree risk factors allocate. This allocation is need because investors can freely make their technology and business choices.

To achieve a success of global economy by transforming to green economy, governments should make reasonable rivalry for clean energy investment through supporting private sector, upgrading speculation conditions and investment environments, rather than being confident on subsidies to alternative energy industry.

In a fair market renewable energy industry is challenged by a few difficulties. In order for renewable sources of energy, such as solar photovoltaic cells, to effectively compete with fossil fuels, such as coal, it is necessary to reduce the price of both installed solar panels and batteries for full order. Moreover, predicted long haul projections express that both sun-oriented panels and battery stockpiling will achieve development at generally triple the expense of fossil fuels. Industry players state that until the better cost-effective variants for the deployment of sustainable energy ventures step in global market, steady progress of this sector will be delayed for a half of century more.

CHAPTER III. SUSTAINABLE RENEWABLE ENERGY PRACTICES IN AZERBAIJAN

3.1 Local energy analysis

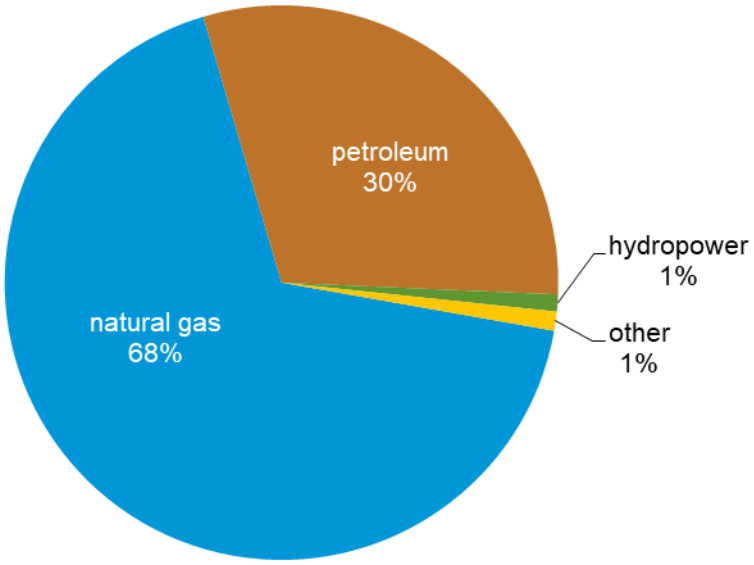
Azerbaijan has been known as one of the oldest energy rich countries in the world. Because this country has oil and gas resources it is considered as main driver for the economic growth especially during the period of the middle of 2000s. But the fluctuations on oil prices and the last decreasing point explicitly demonstrated the world how dependency on fossil fuels can have negative effects on the economy of oil rich country. Hence, this situation does not only account for the realization of developing other non-oil sectors like tourism but also placed great importance on the search of new diverse energy strategy for sustainable development. Apparently, foreseeable solution is being given as renewable sources which recently oil-based countries like Qatar and UAE are even taking tremendous initiatives to achieve carbon-free energy alternatives. For example, A. Marafia (2003, p 1960) stated that recent results indicate the favorable comparison on the cost of electricity generated from the wind sources with fossil fuels.

Especially considering the fact that Azerbaijan has extensive resources available to install alternative energy sources it is planned to implement an important project related to this sector. Azerbaijan intends to establish a wind power plant in the oil-producing zone in Caspian Sea. The uniqueness of this project is that it will be one of the first wind power plants to be installed on the offshore. The cost for this project was estimated at 450 million AZN. The project will be fully developed in near future. Investors from a number of countries - Saudi Arabia, Germany and China are interested in the project. Azerbaijan plans to sell electricity from the Caspian Sea to other countries by generating electricity. While the oil and gas sector remain the main source of GDP of the country, economic policy in Azerbaijan pays more and more attention to diversification. It is driven by several factors. First, country tries to get rid of the risks correlated with the fluctuations in oil prices and economy’s dependence on that. The other

critical factor is the process of switching to a such economic diversification that growing range of sectors especially private sector can have an increase in the level of economic activity and job creation.

Transition to clean energy mainly in oil-based industry is a tough proposal for the Republic of Azerbaijan that its economy is highly dependent on the fossil fuels as it is represented on fig. Taking into account the fact that transition is very expensive and promises higher economic growth in the long term, creating problems for Azerbaijan to ensure whether to keep its fossil fuel-based economy going or choose sustainability with energy development that it is then required a long-term fulfillment more than economic growth? It is, in fact, a big challenge because more than 90% of country's export coming in the form of oil (Asian Development Bank, 2016). Surely, the basis of success is the transition to sustainable energy, which provides sustainable energy and its overall development in Azerbaijan.

Figure 7: Azerbaijan primary energy consumption, 2015



Source: U.S. Energy Information Administration based on International Energy Agency

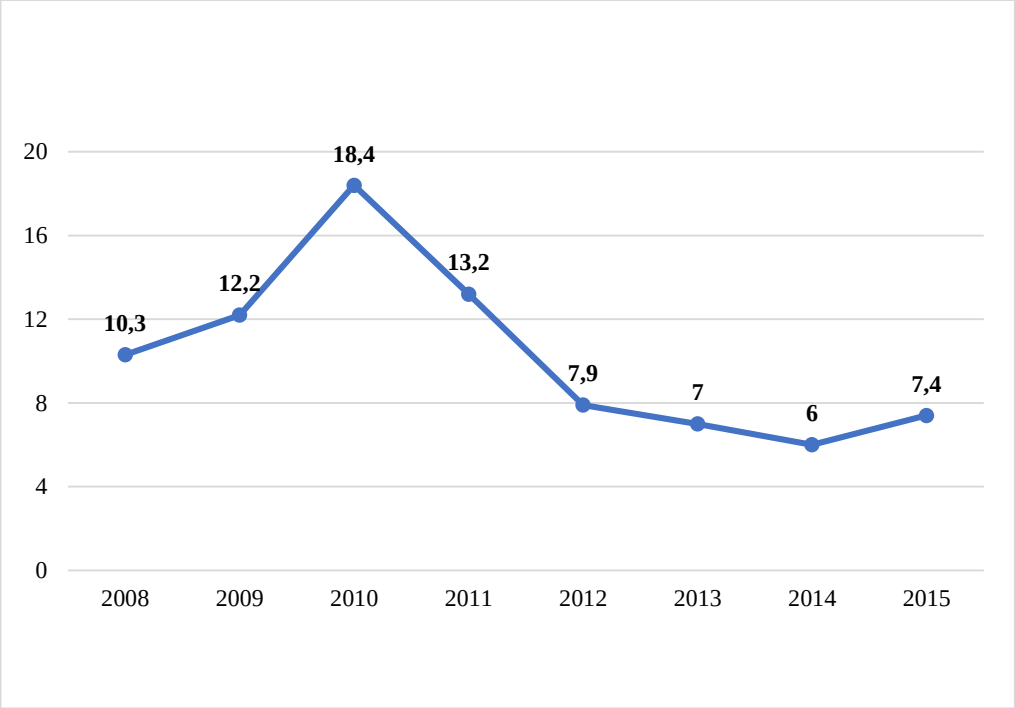
In terms of energy efficiency Azerbaijan is in the early stage of developing. In order to prevent some losses and inefficient use of energy several governmental plans of action accepted. Moreover, it is also worth to note that Azerbaijan has

active participation on the international conferences and debates about development of energy efficiency by upholding the Energy Charter Treaty and related Protocol on Energy Efficiency as well as Related Environmental Aspects (PEEREA). In spite of latest efforts towards energy efficiency by the government corporate commitments are not in the satisfactory level.

3.2. Renewable energy potentials

In order to fully understand the ways to implement alternative energy projects in Azerbaijan it is crucial to first concentrate on the identification of renewable power sources potential in this territory.

Figure 8: Share of electricity generated from renewable sources in total production of electricity, in percent.



Source: Azerbaijan Statistics Committee (https://www.stat.gov.az/source/balance_fuel/?lang=en)

Current data confirms the assumption that Azerbaijan is rich with RES, like wind, hydro, geothermal and also biomass energy.

Azerbaijan is equipped with the abundance of renewable energy which is a real advantage for the transition to sustainable energy to perform in proper way. It aims at sustainable energy development. Therefore, the development of clean energy sources is a priority government strategy

Table 3: Renewable energy supply in Azerbaijan, thousand TOE

	2009	2010	2011	2012	2013	2014	2015	2016	2017
Total energy supply	**13011.5**	**12566.5**	**13,594.9**	**14,390.0**	**14,630.6**	**15,085.5**	**15,569.4**	**15,393.5**	**15,471.9**
from those:									
Hydropower	198.5	296.4	230.1	156.6	128.1	111.8	140.8	168.5	150.2
Share of hydropower in total energy	1.5	2.4	1.7	1.1	0.9	0.7	0.9	1.1	1.0
Biomass and waste	73.3	90.2	96.6	98.4	157.1	158.9	160.7	100.8	102.4
Share of biomass and waste in total energy	0.6	0.7	0.7	0.7	1.1	1.1	1.0	0.7	0.7
Wind power	0.2	-	-	-	0.1	0.2	0.4	2.0	1.9
Share of wind power in total energy	0.0	-	-	-	0.0	0.0	0.0	0.0	0.0
Solar (photovoltaic) power	-	-	-	-	0.1	0.2	0.4	3.0	3.2
Share of solar power (photovoltaic) in total energy	-	-	-	-	0.0	0.0	0.0	0.0	0.0
Total renewable energy supply	272.0	386.6	326.7	255.0	285.4	271.1	302.3	274.3	257.7
Share of total renewable energy supply in total energy	2.1	3.1	2.4	1.8	2.0	1.8	1.9	1.8	1.7

Source: Azerbaijan Statistics Committee (https://www.stat.gov.az/source/balance_fuel/?lang=en)

The presence of small mountain rivers inside territory opens the way for development in different regions of the country with small HPS. It carries out a promising part of renewable energy politics in recent period. Wind energy is very

popular among the Ministry of Interior of the Republic of Azerbaijan with its high annual speed.

The wind that spends more than 250 days every day can be generated about 2.4 billion kWh of electricity each year is the most selectable alternative energy source with its unlimited availability.

Figure 9: Total amount of alternative energy equipped capacity

Source: World Bank collection of development indicators, Azerbaijan report 2012

In addition, 2500-3300 h of sunshine per day makes the solar energy potential high undoubtedly because of the country's geographical conditions. Biomass burning, and gasification availability reaches out 2 million tons of solid household and production due to extensive waste coverage every year.

Note that, geothermal energy is also available covering part of the demand for thermal energy. Basically since 2004, numerous researches on RES have been riches sustainable energy, Azerbaijan has to realize its potential in a single way. Government policy should not leave all liabilities in the hands of the private sector which carries risk at the maximum level if not supported through the whole adoption process of RES.

3.2 Feasibility of clean energy with types and economic power

Hydro Power

In previous chapter we have discussed the importance of hydro energy and its vital role on the electricity production of many countries. It is also worth to note that Hydrogen energy is not freely abundant in every location because it binds to other mixtures, such as water and biological compounds. Thus, it is considered an energy carrier, and not the main source of energy. Because it takes effort to separate the hydrogen from these connections it is mainly used in areas such as heat energy, transportation, electricity generation, moreover, it is even useful of them to operate in portable devices in the liquid or gas form. In addition, hydrogen can be obtained from both fossil energy sources and sustainable energy sources. In spite of the fact that hydropower technology is much more expensive now, it is highly more experienced than fossil fuel technology if problems such as production, storage, transfer and distribution will be resolved.

Despite the fact that the largest contribution to the overall energy of the country needs, the hydropower likelihood of Azerbaijan is not developed at optimal level. A closer look at the information background shows what circumstances are for hydropower potential of rivers in Azerbaijan estimated at over 40 billion kWh, which only contains a potential of about 16 billion kWh achievable. Given the above potential, you can locate lots of small hydropower plants on rivers and other water bodies that may generate approximately up to 3 billion kWh per year. Problems like regulation floodwaters, clean energy production and the creation of new developed irrigation systems can be overcome by construction of hydroelectric power stations on irrigation canals as well as rivers with uncontrolled flow.

The usage of small hydropower plants can solve several problems such as electricity and social problems. According to AzerEnerji, the practical capacity of hydropower plants in Azerbaijan is 1,200 MW. Share of big scale hydro plants' functional equipped capacity is - 14%, and small hydropower plants - 2%. Approximately 1,100 rivers of various lengths can generate 40 TWh of electricity

per year. At current state, potential of hydro energy by technically achievable state is 1.6 W, from which 0.5 W can be obtained from small hydroelectric power plants. (Asian Development Bank, 2008)

As a result, the state program for the expansion of small hydropower plants with the privatization are constructed in the regions of Guba, Gusar, Sheki, Chichakli, under the hydro power plants name "Mugan", "Zayhur", Nuganda "," Balakan "and" Chinarly ". The annual capacity of the station increased from 750 kWh to 1.3 MW. Besides, the result from the restoration of a small hydroelectric station on the Kish River in Sheki has been achieved. Besides, the UNDP office in the country supported the reconstruction and rehabilitation of a small hydropower plant with an installed capacity of 580 kWh in Sheki (ME, 2009).

New power plants launched in Azerbaijan over the past decade working on modern technologies with a capacity of 7149 MW power generation systems in the country. Lately, this Azerenergy OJSC has announced that Azerbaijan is about to complete construction of three small hydropower plants that two of them situated in Ismayilli and one in Astara.

Construction of such small hydropower plants can solve problems of nationally important topics such as flood control, the production of clean electricity and the construction of new irrigation systems. It is also worth mentioning that small hydroelectric power station at Goychay hydroelectric station with the equipped capacity of 3.2 MW produced more than 750,000 kWh electricity in the first three months of 2016.

Although Azerbaijan faced the problem of energy supply to the population due to the old-fashioned power plants and power lines during 2003-2004, with the help of restoration of existed power infrastructure as well as the construction of modernized power plants in the country has not only led to the achievement on covering domestic demand, but also it started to export electricity.

Hydroelectric power plants are capable of generating the country's power supply about 377 million kilowatts per hour electricity in the first quarter of 2016 (State Statistics Committee of Azerbaijan), approximately 60.4% increase

compared with January-March 2015. A capacity of 6 billion kilowatts of electricity per an hour was generated in Azerbaijan in first quarter of 2016 (SSC, 2016).

Wind energy

Compared to other alternative sources of wind energy is considered as one of the most desirable sustainable energy sources in Azerbaijan because of its excessive prospect of using wind power facilities. Evidence suggests that due to its geographical setting and economic infrastructure, the Azerbaijan Republic has got approximate annual wind capacity of 800 MW. Mentioning of electricity generated from this renewable source that is 2.5 billion kWh of electricity from existing capacity will save 1 million tons fossil fuel getting away large amounts of carbon dioxide.

Since comfortable windy conditions are superior at Absheron Peninsula, as well as along the coast of the Caspian Sea and the islands situated in the north-west side of the Caspian, it is advisable to construct the wind facilities on those areas. In addition, based on the estimation that the annual average wind speed in regions like Ganja-Dakhsksesen zone and Sharur-Julfa as well as Nakhchivan Autonomous Republic is 3-5 m / s it creates huge opportunities for establishing the base of such energy carrier tools. Azerbaijan Scientific-Research Energy and Design Institute in partnership with the Japanese company Thomen determined that the yearly average wind speed at Absheron is 7.9–8.1 m / s. Hence, the average long wind speed of 6 m / s demonstrates cost effectiveness and technical potential to use wind energy. Therefore, two wind turbines operated by Caspian Technology in Yani Yashma on the northern coast of the Caspian Sea Baku with a capacity of 1.77 MW is the current initiative for the country in energy generation from wind resource.

In order to expand the wind farm capacity of 40 MW, the ongoing policy has reached its optimal stage in the system of German joint venture. It will mainly function for Sumgait area at a special rate in accordance to the decision with the

tariff authority. The company forecasts that this park will grow to the extent possible power generation of 250 MW capacity.

For the purpose of developing offshore wind power capacities for servicing drilling deep rigs in the Caspian Sea, the initial wind turbines were built by Caspian Technology Company (CTC) in cooperation with Energy Competence Center GmbH (ECC). Also, these two 1.7 MW of power wind turbines along the route Baku-Guba, in Yeni Yashma, Khizi region contributes 36 kW of total green electricity primarily to the national energy sector grid. This project gives 6.5 million kW of energy and saves 2.5 million m3 natural gas annually.

Project CTC in "Shurabad", land wind park in the Khizi region includes 16 wind turbines, each one of them with a total energy capacity of 3 MW. Wind Park was planned to contribute on high wind speeds in the area (8.7 m / s and a density calculated 1.2 kg / m3). Full capacity 50 MW and installation will happen in three stages: at first, 15 MW; in the second - 18 MW; and in the last one - 15 MW. This predictably, 47% of the electricity produced will be connected to a national network of 183 GW per year. Every wind turbine will be combined to the network via a 120/38 kWh distribution line. Yearly estimated reduction in CO2 emissions is about 101,500 t. Architecture of turbine and installed software allows each turbine to be arranged in an independent way.

After all, Azalternativenerji LLC controls several important programs on the use of not only solar panels and collectors but also wind turbines and heat pumps in the framework characterized for the State Program for the Republic of Azerbaijan in 2014-2018 years.

Solar Energy

World practices regarding with the implementation of solar photovoltaics and basic solar panel farms are discussed for acquiring best likewise conditions in different countries. Their policy frameworks for the development of RES especially solar energy projects showed that there are various factors to be considered for the successful energy strategy deployment. It is best known that

solar energy is abundant, easily accessible and one of the main safest forms of renewable energy production systems. Solar power technologies should be categorized into three groups. Photovoltaic (PV) system mainly produces electricity by direct conversion through the process of solar radiation using semiconductor material. Concentrating collectors mainly operates via the process of concentrating solar energy to heat the receiver, which is placed in focus collector point to reach certain prescribed high temperature, after that thermal energy can be transformed into mechanical energy using a well-known turbine system and then into electricity. Consequently, solar heating and cooling systems consume solar thermal energy in the process of heating and cooling water and home space. Based on current evidence, it seems fair to suggest that solar thermal collectors contain considerable potential in deducting fossil energy consumption used for heating as well as cooling applications. The use of solar technology in a desalination system is one of from clear choices of fresh water from salt or sea water. The efficiency and availability of solar energy systems is extremely dependent on daily solar radiation amount and radiation fluctuation.

Due to its geographical position, Azerbaijan is considered as one of the phenomenal places in terms of the potential of solar energy. Climatic condition allows the country to provide great opportunities for the production of electricity and heat energy consuming solar energy. These conditions confirm evidence that 2400–3200 annual sundials Azerbaijan is not holding back in terms of its potential progress. It is worth to note that, the yearly number of hours of sunshine in the US and Central Asia is around 2500-3000 hours. In addition, the involvement of Azerbaijan photovoltaic program (PVP) can solve its energy problems in a great extent.

Solar energy coming to earth is 1560–2100 kWh /m2 per year in the USA, 850–1580 kWh / m2 in Russia, 1300–1450 kWh /m2 in France, 1,780–2,000 kWh / m2 in China, and 1,700–2,100 kWh / m2 in Azerbaijan. Obviously, the amount of solar intensity in Azerbaijan is very good compared to other country. Sunny

days are best suited for the areas where central river valleys are located as well as north and northwest.

Construction of electric station in Surakhani and Pirallakh districts of Baku city was finished. Surakhani SES covers an area of 6 hectares and will generate about 1.3 MW of electricity through 8,000 solar panels. An additional 4,000 solar panels should be installed at this electric station. It is estimated that the capacity of the project is 2.8 MW, and the yearly production of electricity is 4,000 MW, equivalent to saving 1.5 million M3 of natural gas annually. IES will be connected to the network by 2015 to meet the demand for electricity in the village of Chilov Surakhani district, SAARES started feasibility study creation of an additional hybrid station with a capacity of 10 MW. Currently, SAARES has installed 80 m high wind turbine for observation and measurement targets. Initial capacity of Pirallahi SES is 1.2 MW. This SES is the first power station to be built on the island of Pirallahi.

In addition, Azguntech LLC installs solar cells (photovoltaic modules) and also heat pumps in primary schools, kindergartens and as well as health sector in relation with the State program on the consumption of alternative and renewable energy sources in the Republic of Azerbaijan and the state program on the socio-economic development of the capital city and its estimations in 2011–2013.

These projects organized for the purpose of increasing environmental awareness and support energy sustainability by providing residents with green electricity as well as heating. Despite the fact that this entity is not anymore supported by the government due to the business inactivity reasons through those years of operations several of the following company achievements were made:

In order to provide schools with clean electricity and heating and also raise up the awareness of environmental protection and sustainability among younger generation, solar panels and heat pumps are installed in each 10 schools in different areas of Baku.

1. The company constructed solar panels and heat pumps indoors playgrounds in Beylagan and Masalli, which have 50 kWh, and Power 76 kWh for heat pumps;

2. The company constructed a solar station with a total capacity of 35 kWh and also heating program with an calculated capacity of 60 kWh in children's health center in the village of Hovsan, Baku.

Considering the huge potential of solar energy in Azerbaijan construction of solar power plants in the country continues.

Biomass

Biomass energy is produced from a biological material collected from several sources such as wood, wood waste, crops, animals waste, food waste, aquatic plants, etc. In addition, due to its low-cost feature, biomass energy is seen as a short-term solution to the energy crisis in transition to clean energy sources. In addition to direct combustion of biomass, there are cleaner options to use biomass, such as gasification and paralyses methods. To use the source of biomass in gasification at the same time the source of biomass should have a moisture content of 5–30% (Gunjan N. 2010) There are two methods of gasification: indirect heating and direct heating gasification. Biomass sources can also be used for special method of producing hydrogen and methane.

The rapid growth of industry, agriculture and social services in Azerbaijan opens up new opportunities for electricity production from biomass collected from the following bio substances:

- combustible industrial waste;
- waste of wood and woodworking production;
- agricultural and organic waste;
- household and municipal waste;
- Waste recycled from fields polluted by oil and oil products.

Many countries have already discovered methods to solve such kind of problems using incinerators that are built in a tight settlement to burn any kind of

household waste in those plants. Nearby localities are then provided with electricity and heat from waste energy combustion. The residues of baked waste are broadly used as fertilizer with the purpose of improving soil fertility. Therefore, the creation of such plants will be meaningful for Azerbaijan.

Foreign investments and practical knowledge on renewable industry especially new methods to handle these sources in proper manner is extremely important to achieve both economic and ecological prospects of building and maintaining such infrastructure. Therefore, the French-based company CNIM led the built of the first plant for the incineration of municipal solid waste in Azerbaijan under inclusive action plan to improve the environmental condition in Republic of Azerbaijan, 2006–2010. This plant is capable to generate about 231.5 million kWh per year and this result meets the environmental requirements of EU.

As further details provided by plant authorities, the pollution revealed by plant is caught by special big filters and neutralized as last step of the process. In addition, the Balakhani solid waste incinerator have got two turbines for the production of electricity, each of which contain a capacity of 250 million kWh, which means that in general the equipped capacity of the station is 500 million kWh of electricity (Tamiz Shahar, 2017).

In addition, “Azalternativenerji” LLC is leading feasibility study production of biomass from manufactures, crop production and municipal waste, and explores the potential of clean energy and energy generated from renewable sources in the mountainous (Daglyg) Shirvan, Guba-Khachmaz, Ganja-Gazakh, Lankaran and Sheki-Zagatala industrial regions. It is noteworthy that the Siyazan poultry farm has acquired technology for heating and power generation from biomass waste.

Based on the study, waste incinerator mainly located near residential settlements that open up the possibility for them to use the energy which is produced from the incineration of waste. At current state, approximately 200 landfills with a total area of 900 hectares are available in Azerbaijan (Ministry of Ecology and Natural Resources, 2015). Institute of Energy Design of AzerEnerji

JSC predicts the actual amount (all amounts are in m3) of municipal solid waste as following (Hajjar H., 2014)

Baku - 30,500 tons (42.8 million);

Ganja - 5000 tons (7.2 million);

Sumgait - 4850 tons (6.9 million);

Mingachevir - 1500 tons (2.3 million);

Nakhichevan - 1300 tons (1.7 million);

Shirvan - 1500 tons (1.7 million).

Studies show that most of the waste composition are from industrial sites that have a collection of huge amounts of biomass substances. Thus, that can potentially be used in the production of biogas, bio-liquid as well as solid bio-substance which are meant to later produced electricity generation.

Recently, in this area a new private sector player is operating at a reasonably medium scale for now. Bioropean LLC in Azerbaijan is the local company that mainly focused on the collection of used cooking oils from the restaurants, catering services, kitchens and small and big fast food chains. Apparently, raw materials collected from these objects are a great source for the above-mentioned bio-liquid form precisely biodiesel production.

Despite the fact that the company is just a new entity in this market their properly managed operating system allows factory to work in accordance to meet significant criteria of ISCC (International Sustainability and Carbon Certification) standards. Also, this business enterprise has achieved to export used cooking oil to the foreign market which in its turn is a quite favorable step to contribute to the national economy of Azerbaijan besides benefits to the energy sector with new sustainable practice.

Data from close examination revealed that annually more than two million tons of solid household and industrial waste is disposed of to waste digestion areas in Azerbaijan. Recycling of solid household and industrial waste to some extent solve problems with heating of households in Baku as well as other big industrial cities.

Geothermal

Geothermal energy is known as renewable, sustainable, unlimited, cheap and environmentally friendly source of energy. Geothermal (geo means ground, thermal means thermal energy) is a simple component of hot water, steam and gases containing some chemicals. The source of geothermal energy is hot magma and destroyed the radioactive materials which remain in the deep layers of the earth crust. The geothermal power in the world is sufficient for human needs for energy, but only a very small part of geothermal energy is beneficial for the production of electricity. The heat in depth of the earth is widely used in industry, agriculture, everyday life, utilities and the health sector in many countries of the world. Advantage of the use of geothermal energy in the production and consumption of energy lies in the fact that its employment does not require a large amount of funding.

There is no doubt of important potential for thermic form of waters in Azerbaijan, that relates much in common with economic, legislative, administrative and trust issues but have nothing to do with technical problems. They are usually found in the Greater and Small Caucasus, Absheron peninsula, Talish mountain zone, Kurs lowland and Caspian-Guba district. Household and other needs for thermal energy can be moderately covered by the discovery of thermal waters in prescribed areas.

According to SAARES, the geothermal energy potential of Azerbaijan is up to 800 MW. Initial studies show that 11 geothermal zones in Azerbaijan are available. Temperature maintained in water in these wells situated in those zones vary between of 30–100 ° C. They can generate electrical or thermal energy determined by the type of thermal water. For illustration purpose the temperature in the Guba area is about 36–85 ° C, and it rises up to 95 ° C in the Kura-Aras lowland. Considering everything the role of the government of Azerbaijan will be crucial in realizing its potential and allowing the private sector to effectively participate in realization of ambitions of alternative and renewable energy sources.

CONCLUSION

Many renewable energy practices currently used in some countries produce different results with different levels of efficiency. Obviously, further research and studies are needed to maximize efficiency by maintaining sustainability standards. This is especially important from an economic point of view, so that renewable energy can compete with traditional energy resources.

In addition, the discussion of the net effects of renewable energy was also a somewhat related topic. Reducing fossil fuel use and associated external factors such as global warming, local air pollution or damage extraction of fossil fuels can be seen as major changes in the presence of alternative energy sources.

Consequently, if national accounting systems accept fully consideration of these extra benefits of RE with comparison to fossil fuels in accordance with the green growth strategy, the RE rating will be even more positive. Until now, few studies have tried to quantify these effects for many countries. Thus, a systematic approach to fully assessing the costs and benefits of expanding the use of renewable energy sources, including operating costs, savings from reducing energy imports, improving energy security and preventing damage is absolutely important.

The question of the economic consequences of the expansion of renewable energy will be part of the discussion about sustainable development for the future. On the one hand, an increase in installation will reduce costs due to learning curves and scale effects. On the other hand, the ratio of the cost of producing electricity from renewable energy will only achieved within the next two decades.

Renewable energy efforts carry great importance at national level too. Azerbaijan hold great potential in the aspect of renewable energy capacity especially in wind and solar energy. Using these sustainable energy sources Azerbaijan can meet its own energy needs, advance in energy saving and preserving the environment by reducing greenhouse gas emissions (GHG). With the growing energy demand and increasing emissions and air, environmental

pollution, the transition to sustainable energy based renewable energy becomes mandatory solution. Sustainable energy development improves the quality of human life in the economic and environmental aspects in the long term in a manner that must be maintained by renewable energy, technology and country policy.

Considering the fact that the concept of renewable energy is quite young there are obvious problems in Azerbaijan, such as exploitation, costly renewable energy along with other economic and political obstacles that hinder the development of alternative and the renewable energy sector and the implementation of EE projects. For the private companies and enterprises operate successfully the investment on this sector should be attracted with very careful initiatives by Azerbaijani government that is responsible for simplifying the regulations.

Recently, the government of Azerbaijan adopted a number of regulations to increase the attractiveness of the renewable energy market in Azerbaijan. First of all, there is an increase on the prices for utilities these figures will soon be possible to attract private sector interest to invest in this area. Secondly, in December 2016, the government adopted the Strategic Roadmap for the development of public services, where it was mentioned about the effective use of renewable energy sources of the country. In this roadmap it is predicted that in case of a sufficient and long-term investment program, the significant share of alternative energy sources, in particular as the main energy carrier-electricity, may increase dramatically. Thirdly, Azerbaijan is more interested in exporting natural gas to the world markets rather than consuming it at domestic. Since it is more economically sound variant. According to the main assessment of the government of Azerbaijan the average cost of natural gas used to produce electricity varies about $ 30- $ 35, that is perhaps considered the same price as with sustainable energy sources, especially with solar energy.

Considering that Azerbaijan is involved in construction of a huge energy project because of Southern Gas Corridor which aims to provide European

markets with the extra amount of natural gas, mainly from Azerbaijan. The government of this natural gas rich country should supply this corridor with more gas. Estimated number of pipelines including for SGC - 50 billion cubic meters and Azerbaijan can provide a maximum of 18 billion cubic meters in the future. However, expected that some other oil rich countries of Central Asia and the Middle East will join this project, currently Azerbaijan is still the only country that will provide Europe with natural gas through this project.

Therefore, to ensure the effectiveness of the corridor Azerbaijan government need to work on maximizing its potential for pipeline in the supply of natural gas. Given that Azerbaijan's opportunities are limited given in order to reach then somehow an increase in the export potential, there is only way to reduce the volume of gas in the domestic market and set them for export. In this case, an alternative for natural gas for domestic consumption is renewable energy.

In conclusion, it can be summed up that the recent development in global and Azerbaijani energy markets boosted potential use of alternative energy in the country. It can be expected that the government of Azerbaijan is highly motivated by realities economic efforts will be more focused on investment as well as usage of renewable energy, especially in electricity generation which ultimately will increase the level of these sources in general power consumption of this country.

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