ASERC Journal of Socio-Economic Studies

Journal homepage: www.ajses.az Volume 3, Number 2,(2020) Pages 9-33

ENERGY SECTOR OF AZERBAIJAN – THE POTENTIAL OF TRANSITION TOWARDS RENEWABLES

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ABSTRACT

This paper aims to examine the energy sector of Azerbaijan and its potential transition towards renewable energy. Predominantly, I must analyze if Azerbaijan applies any possible strategy in the field of renewable energy development. To address this issue, I intensely scrutinize Azerbaijan's energy sector with a focus on the level of renewable energy usage and projects that are inclined to develop its green energy sector. As a result of the research conducted, it is highly crucial to highlight that Azerbaijan enforces renewable energy with the country's scope of resources. Also, Azerbaijan has implemented different strategies to accelerate the creation of RES infrastructure at a state level and collaborate with international companies accordingly. In the meantime, there are still ongoing projects and developments underway for the inclusion of cutting-edge technologies in the field of RES.

Keywords: Azerbaijan; Renewable Energy; Green Energy Sector; RES.

INTRODUCTION

Nowadays, generating energy has been addressed as an important topic, as there are two ways of producing energy, either by using conventional energy sources or renewables sources. Countries across the world have given a lot of attention to develop their energy generating facilities and harness the process of utilizing renewable energy sources. The increasing use of renewable energy is considered one of major trends, since it is willing to satisfy greenhouse gas reduction requirements and reduce dependency on fossil fuel resources. Besides, there have been individual strategies for the transition towards renewables led by states and strategies accepted by interested private companies. As Azerbaijan is a resource-rich country, it has utilized its oil and gas resources to supply energy for its population domestically and export the remaining part to collect revenues. According to Azerbaijan Statistics 2020, Azerbaijan's primary energy production comprises crude oil with 68.7%, natural gas with 30.8% and renewable energy at 0.5%.

On the other hand, states have addressed several ways to develop the installation of renewables on a national level and tackle loopholes arising in the implementation of renewables' infrastructures in individual countries. Azerbaijan also tries to achieve its progress of facilitating the usage of renewable energy sources and trying to reduce greenhouse gas emissions. The analysis conducted within this thesis may change in the forthcoming future due to the Coronavirus pandemic striking the world and oil prices falling drastically. Thus their effect will not be able to be covered here as they are quite ongoing cases.

My reason behind choosing this topic is that I come from Azerbaijan. It encouraged me to delve into my country's energy sector and examine the extent of the usage of renewable energy sources there. This paper aims to explore the energy sector of Azerbaijan and its potential transition towards renewable energy. Predominantly, I must analyze if Azerbaijan applies any possible strategy in the field of renewable energy development. To address this issue, I intensely scrutinize Azerbaijan's energy sector with a focus on the level of renewable energy usage and projects that are inclined to develop its green energy sector.

The methodological basis of this study is desktop research based on secondary data and statistics. In the study, I collected relevant data regarding Azerbaijan's energy sector from different sources to support the more objective conclusions.

This thesis is made up of three main chapters, a conclusion, and a bibliography. The second chapter contains the theoretical background of the relationship between energy and the wealth of nations and the transition towards renewables worldwide. It elucidates how world countries perform in renewable energy generation and consumption and the enlightening position of energy companies in the transition to renewable energy. The third chapter clarifies Azerbaijan's energy sector by separately explaining its oil and gas sector, electricity market, and oil and gas transportation to target markets. The fourth chapter describes the renewable energy sector of Azerbaijan, focusing on decarbonization, thus the greenhouse gas emission level and achievements and projections concerning renewable energy sources (RES). Besides, this section touches on challenges arising in the way of installing renewables' infrastructure in Azerbaijan, as well as bringing Norway as a best practice.

1. ENERGY TRENDS ALL OVER THE WORLD

People had been using renewable energy historically from the very first day of human beings. Initially, they were using wood for cooking and heating and wind energy for transportation. Afterward, they utilized mechanical power for the development of at that time new - machinery equipment during the pre-industrial times (Gritsevskyi 2008). There is currently so much discussion regarding the transition from conventional energy sources to a renewable and sustainable energy system worldwide (Wang et al. 2018). A white paper for governments states that renewable energy transition should be carried out on the occasion that economic and environmental crisis has to be passed untouched once fossil fuel use should shrink due to rising resource scarcity or worldwide environmental restrictions or when conventional energy resources happen to be unreasonably costly before reaching those limits (ISES-Aitken 2003).

In this section, I will introduce the theoretical background of the energy concept and its relation to GDP (Gross Domestic Product) and energy trilemma, security-affordability-sustainability trilemma of energetics. By investigating the energy concept, we will be able to formulate our mind regarding energy's role in the world and people's welfare. In the meantime, delving into overall energy trends worldwide will make up an insight that can pave the way for the Azerbaijani energy sector and its capability in renewables to be examined.

1.1 Energy ladder concept

A decade ago, the energy ladder model was the outstanding concept of illustrating how households form their energy choice in developing countries. It depicts the way households move up to a new fuel choice once their economic situations are changing (Kowsari, Zerriff 2011). According to the energy ladder model, households experiencing increasing income are likely to follow a utility maximizing consumer's behavior. They are willing to switch to more sophisticated energy types and thus have their utility boosted. Swapping fuel types turn out to be necessary, while the energy transition process occurs when another crowd out one fuel. Once a new fuel type appears in the energy mix, at the same time, it causes the previously used ones to be ruled out. Fuels that comprise the energy ladder are categorized based on households' desire to fulfill physical characteristics that embody cleanliness, efficiency, ease of use and cooking speed, affordability, and consciousness. (Kroon et al., 2011). It is considered that the energy ladder concept props up to the microeconomic theory of rational choice by presuming that all types of fuel are reachable for households and they will step up the ladder as far as they possess enough budget to do so (Kowsari, Zerriff 2011).

1.2 Relationship between energy and GDP

Energy plays a vital role in creating economic development and economic productivity. Industrial growth is also partially led by energy sources in some points. Firstly, the first industrial revolution came to the stage at the end of the 18th century to the 19th. So-called mechanization replaced agriculture with the industry, and it is considered the backbone of the societal economy. In the meantime, people also experienced big coal mining with the steam engine's very significant invention, which gave birth to a new type of energy stimulating economy. A steam engine was built with iron and propelled by coal, and this invention is accepted as the atmospheric engine. Later, this engine was developed to produce a great deal of coal-powered energy efficiently (Mohajan 2019). The second industrial revolution brought about the emergence of electricity and widespread use of gas and oil in 1870. Besides that, it enhanced chemical synthesis and methods of communication such as the telegraph and the telephone. Vaclav Smil, a Czech-Canadian scientist and policy analyst, interpreted 1867–1914, a second industrial revolution, as the Age of Synergy. Most of the important inventions and novelties were brought up within that period (Mohajan 2020).

Subsequently, in the second half of century, 1969, a recent invention by the third revolution, the Advanced Research Projects Agency Network (ARPANET) has been developed and caused the internet to create. According to transformational theorist Rifkin, the following five energy pillars support Third Industrial revolution: transition to renewable energy, implementation of green micropower plants in building for collection of renewable energies on-site, installation of hydrogen and other storage infrastructure in buildings for gathering energy, applying internet technology to change each continents' power grid to energy internet which behaves like the internet, transforming vehicles to use electric energy (Roberts 2015). What is more, the fourth industrial revolution is called industry 4.0. However, it is debated by some people if industry 4.0 is the 4th industrial revolution. Yet, it brought out the existence of the internet, which advances virtual reality worlds. (Pouspourika 2019). The fourth IR is increasingly paired with energy efficiency and energy savings with the increased focus and use of renewables. Transformation of the energy sector by installing more sustainable energy systems and digital transformation of energy systems is intertwined and concurrent. Industry 4.0 and sustainable energy transition carry some common features, such as being exposed to technological innovations and being dependent on the progress of new infrastructure and regulations. Digital technologies can play a vital role in solving the arising challenges of interconnect-

ting renewable energy sources into small and large power grids. Another necessary part of industry 4.0 is digitalizing the manufacturing process, which gives away to energy optimization and saves a significant amount of energy (UNIDO 2017).

As it was evident to everybody, in the 1970s energy crisis, hit the world, which caused increasing energy prices, especially oil. It considerably affected the economic activity of both developed and developing economies. Due to this crisis, numerous academics, scholars, and practitioners have researched the link between energy consumption and economic growth by applying different methodologies. Georgantopoulos and Tsamis (2011) state that energy consumption holds a positive correlation with economic growth. However, it is not clear enough to emphasize whether economic growth makes a condition for more energy consumption or accelerates economic consumption growth, as there is not quite unveiling evidence to illustrate it. As to the situation mentioned above, some critical questions are left unanswered concerning whether economic growth paves the way for energy consumption or whether energy consumption points towards economic growth. This has been debatable for many years.

Campo, Sarmiento (2013) refer to Ozturk (2010), Squalli (2007), Magazzino (2011), who highlight that four hypotheses illustrate the direction of causality between energy consumption and GDP. The first argument, neutrality, stands for the fact that no relationship exists among these two factors. The second hypothesis regards energy conservation, which denotes the statement that there is evidence of unidirectional causality from GDP growth to energy consumption. Subsequently, the third hypothesis, which is defined as the growth hypothesis, elucidates that energy consumption propels GDP growth. In contrast, the fourth hypothesis is known as the feedback hypothesis, which displays bidirectional causality between energy consumption and GDP growth.

Akinlo (2008) addresses the issue of causality between energy consumption and economic growth. He broke it down into three types, namely unidirectional causality, which concerns the direction of relation from energy consumption to economic progress or, opposite. The second one is bidirectional causality, while the third one is stated as the absence of causality.

Moreover, there is a scenario that causality can originate from GDP to energy consumption. In these circumstances, there will not be any impact on economic progress and employment linked to any changes in energy (Masih et al. 1997). With bidirectional causal relationships, energy consumption and economic progress will be exposed to any changes simultaneously (Jumbe 2004). Finally, if no causal relationship appears to be dominant, energy consumption does not have anything to do with economic growth. It turns out that economic progress does not reflect on energy policy (Borozan 2013).

The European Commission has also drawn its opinion about the relationship between energy and economic growth, which, in the meantime, can also be a reflection of the energy ladder concept. The growing proportion of renewables in the country's energy mix is likely to help satisfy rising future energy demands and affect economic development. Renewables lessen environmental impacts linked to fossil fuels. It can diversify energy sources into more ranges, contributing to energy security and creating energy supply available in the long run. Furthermore, renewable sources can accelerate regional development stemming from the fact that renewables are eligible to be employed in less developed areas in the absence of traditional energy sources and could reduce the costs arising from climate change (European Comission, 2013).

Apergis and Payne (2012), setting up statistic models by utilizing data from eighty countries, considered GDP to be a dependent variable while they take electricity consumption from renewable energy sources and from conventional energy sources with some macroeconomic as main explanatory variables. Ultimately, this research brings about the outcome of the two-way relationship between energy usage from renewables, traditional energy, and GDP, both in the short and long term. Besides that, it also reveals the two-way short-term relationship between renewable and conventional energy forms. In the meantime, it stands for the fact that it is viable to switch from one energy form to another.

Analysis of the relation between renewables and GDP in the USA reveals that consumption is linked to biomass energy. There is not any other link between real GDP and all other renewable energy sources. As a result, this study deduces the necessity of producing energy made from waste (Yildirim et al. 2012).

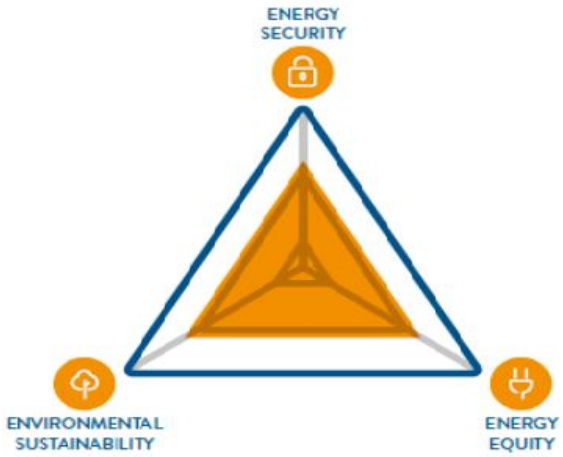
1.3 Energy trilemma, security-affordability-sustainability trilemma of energetics

The energy trilemma, namely, security-affordability-sustainability of energy, is elucidated by scrutinizing the World Energy council's definition below. The World Energy Council also defines the three points of dilemma (WEC, WYMAN 2017). Energy security encompasses the handling of significant energy supply from internal and outer sources, vitality of energy foundation, and energy supplier capacity to satisfy present and future needs.

1. Energy equity depicts how energy is accessible and affordable for the inhabitants of any country.
2. Environmental sustainability studies energy efficiencies based on the supply and demand side of energy, in the meantime, it reflects accomplishment in the generation of energy from renewable and other sources with less carbon emission (WEC, WYMAN 2017).

Examining these three challenges in a satisfactory way is usually referred to as the energy trilemma. A trilemma has been portrayed as a decision between three troublesome choices or a trade-off between three objectives in which two are sought after to the detriment of the third (Carbon Brief 2013). Overall, the benefits of naming three components as a trilemma create a chance to emphasize a crystal-clear relation between those components (Gunningham 2013). The figure below illustrates the energy trilemma by indicating its three dimensions: energy security, environmental sustainability, and energy equity. Besides, World Energy Trilemma Index Reports (2019), which was enhanced by the help of Oliver Wyman, shows ten countries that achieved the top AAA in all three dimensions, Switzerland, Sweden, Denmark, United Kingdom, Finland, France, Austria, Luxembourg, Germany, and New Zealand, respectively. The extent to which countries improve themselves in overall Trilemma performance is highly dependent on the speed of the transition process and countries' progress in their energy policy (WEC, WYMAN 2019).

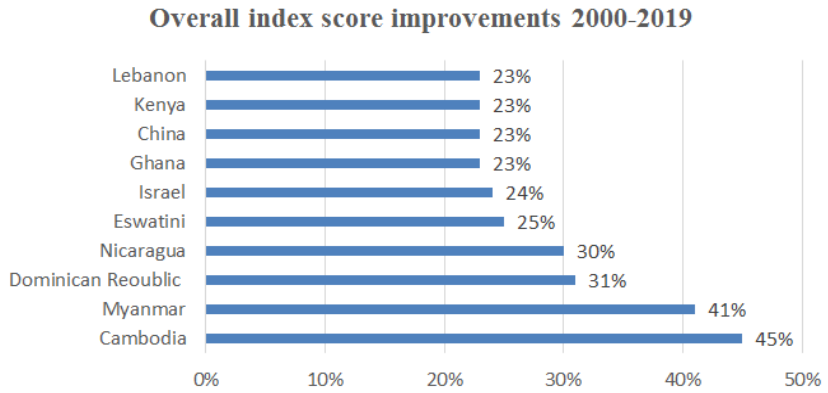
Figure 1. Energy trilemma



Source: Retrieved from World Energy Trilemma Index 2019 (WEC, WYMAN 2019 p.13)

In World Energy Trilemma Index, the top ten performers improved their policies to reach high performance in all three dimensions and intertwined with sustainable economic growth. They attained substantial transition from their performance in 2000, which is primarily interlinked with remaining concentrated on electrification, energy generation diversity, and infrastructure investment. The figure below shows top high improvers in World Index Scores between 2000 and 2019, by percentage point changes in their performances (WEC, WYMAN 2019).

Figure 2. Energy trilemma index score improvements, 2000-2019



Source: Own construction based on World Energy Trilemma Index 2019 (WEC, WYMAN 2019, p. 21)

World Energy Council sheds light on the fact that every energy trilemma component relies on achievable results; therefore, all these three dimensions should be accomplished to attain energy sustainability. Offsetting three main components of the energy trilemma is the root for development for individual countries. Suppose the energy sector is required to satisfy climate targets and contribute to the accomplishment of development goals. In that case, it must comply with those requirements by sustaining balance with the other two components to reach energy sustainability (WEC, WYMAN 2015).

1.4 The recent trends of transition towards renewables all over the world

Energy transition paves the way for the worldwide energy sector to switch from conventional energy sources to energy forms with zero carbon emission by 2050. There is the high importance of diminishing CO_2 emission with traditional energy consumption to restrain the environmental change. Besides, to decarbonize the entire energy sector, the energy sector has to take worldwide ac. Keeping-ping in mind that a global energy transformation is in progress, further movement is required to lessen carbon outflows and weaken environmental change impacts. Thus, 90% of carbon emission goals can be accomplished if renewable energy and energy efficiency metrics are applied accordingly (IRENA 2019a).

Child and Breyer (2017) addressed the concept of transition and transformation within energy systems' capacity, proposing that any alterations in physical forms should be referred to as transformations. In contrast, changes in broad socio-technical systems should be alluded to as transitions, demonstrating how culture inspires, promotes, and profits from a change at a significant extent. The three-phase model (3 PM) was enhanced by Ruppert-Winkel et al. (2016) to model regional energy transition, and three case studies in Germany implemented this model within itself. The core of these studies was to discover how to incorporate the transition to the local, renewable energy system in Marin district. Moreover, Lind and Espegren (2017) demonstrated how Oslo's city could be a pioneer in sustainable energy transition through novelties and constructive ideas. Several energy climate metrics were raised by them and evaluated their ability to turn Oslo into a little carbon-emitting region. Their case studies' primary objective was to analyze local energy transition with a city's scope, which is not relevant to deduct any results for the whole country's energy transition.

Furthermore, Sun et al. (2016) examined how renewable energy sources performed in China's sustainable energy transition. They highlighted the need for renewable energy production to satisfy Nationally Determined Contribution (INDC) after the 2020 period. They examined the extent to which China is capable of generating renewable energy and delved into a way of meeting the INDC targets. The Energy PLAN was devised to scrutinize eight alternative cases of forty percent electricity coming from renewables. Ultimately, the outcomes indicate that 20 percent of non-fossil energy in primary energy and 40 to 50 percent of electricity production can be generated by renewables.

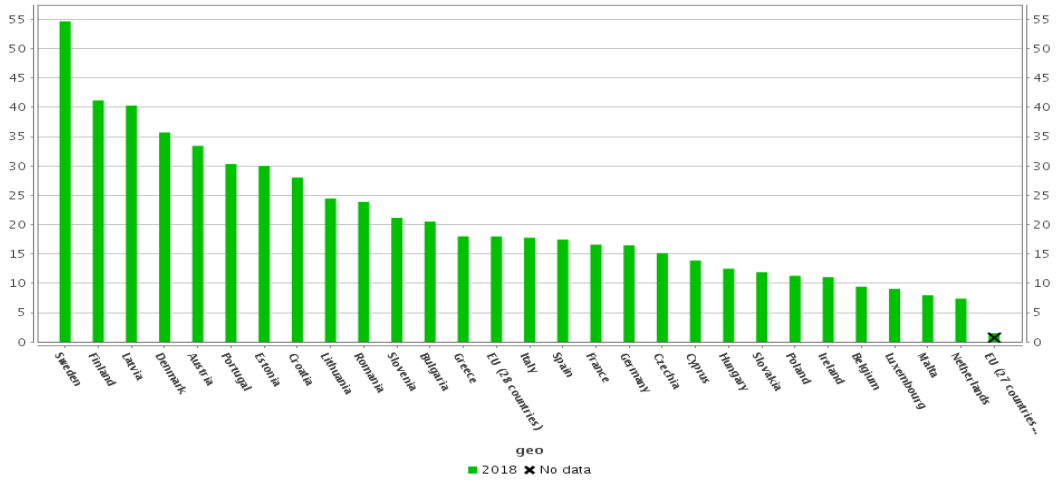
Regarding the retrospective analysis of renewables, it is important to highlight the trends that renewables have drawn so far and consistently form. Correspondingly, the proportion of renewables in total final energy consumption was recorded to hit approximately 19 percent in 2015 globally, enjoying consistent gradual speed-up of trends that is obvious per se (IRENA, IEA 2017). According to the report of IRENA, in 2017, 6191 Twh of electricity was produced by renewable sources, which is a significant amount, and 65% of that power was comprised of hydropower (4037 TWh). Thus it dominates the wind, bioenergy, solar, geothermal, and marine energy. It is also highly crucial to highlight that there has been a steady increase in electricity generation of rene-wables since 2013. In parallel to that, the solar and wind energy generation has seen a significant rise in power generation.

Meanwhile, in terms of renewable electricity production by region, IRENA indicates Asia as a region rendering the highest growth in 2017 as it was experienced in other recent years. Asia also experienced a consistent rise in worldwide renewable energy generation, hitting the peak of 39 %. In contrast, Europe and North America lag by holding a 20 % share, which outpaces South America and Eurasia with 13 and five percent, respectively though (IRENA 2019b).

Considering that the EU is a leader in implementing and using renewable energy sources, it is important to emphasize that the share of renewable energy in gross final energy consumption in the European Union has reached up to 18.0 % in 2018, which is more than twofold of the share of 2004 with its 8.5%. Twelve member states of the EU, namely Bulgaria, Czechia, Denmark, Estonia, Greece, Croatia, Italy, Latvia, Lithuania, Cyprus, Finland, and Sweden, have already achieved their 2020 goals regarding the share of renewables. Share of renewables in final gross consumption of energy stands as one of EU 2020 targets' major indicators. Those members who have not reached their goals yet have to introduce additional efforts to meet their targets in the following fields: overall share of energy from renewable sources in the gross final energy consumption and a particular percentage of energy from renewable sources in transport (Eurostat 2020).

To interpret the graph, we must point out the fact that Sweden is a leading country in terms of employing renewable energy in its final gross consumption of life with more than half 54.6 % in 2018, which is also followed by Finland (41.2 %), Latvia (40.3%), Denmark (36.1 %) and Austria (33.4 %). In contrast, the Netherlands (7.4 %), Malta (8.0 %), Luxembourg (9.1 %), and Belgium (9.4 %) register for the lowest share of renewables. Given the data for renewables in 2018, France and the Netherlands have to thrust ahead their share of the renewable energy in final energy consumption by at least 6.4 and 6.6 % percentage points, accordingly. However, those countries that have already outperformed their targets sign up for the rate with which they have exceeded their targets, ranging from 5.0 to 8.0 percentage points, namely Croatia, Sweden, Denmark, and Estonia (Eurostat 2020).

Figure 3. The share of renewable energy in gross final energy consumption (%)



Source: author, retrieved from Eurostat.

Veerle Dossche, the EU Energy Policy Coordinator at Climate Action Network (CAN) Europe, quoted: "*The share of renewable energy in the EU continues to be on the rise, but the current pace of growth is losing steam. EU leaders must fix this and translate their climate commitments into tangible policies that further steer investments away from fossil fuels towards 100% renewables-based energy systems. This is all the more necessary as drastic emissions cuts in the short term are needed to stay on a 1.5°C pathway*" (CANE 2020).

According to the projections, it is stated that electricity consumption will be twofold of its current situation until 2050. In the meantime, renewables will account for almost half of electricity generation by 2035. Besides that, renewables are expected to cost less than coal and gas in most of the world before 2030. China, India, and the OECD (Organisation for Economic Co-operation and Development) countries are core countries contributing to building solar and wind energy constructions. These renewable energy forms will make up half of the total global capacity. In the meantime, worldwide coal usage hits the going-down trend in most parts of the globe due to undergoing economics and restraining regulations (McKinsey 2019).

To meet the EU's 2030 targets, the EU must raise the share of renewables to 25 % in its gross inland energy consumption. Meanwhile, wind and solar are expected to increase by three times their current capacity to make up half of the rise in renewable energy generation. The use of biomass will also grow in relative and absolute terms, whereas hydro and geothermal will record smaller increases. Renewables will be significantly utilized to facilitate the decarbonization process by spreading them to the electrification of buildings, transport, and the industry and using solar thermal, geothermal, and biomass in heating-cooling and advanced biofuels in transport. However, there is some economic and production restriction on the usage of biomass-based renewables, main constraints related to consistently supplying them.

On the other hand, renewable gaseous fuels produced from renewable electricity are anticipated to hold the breeding ground through sectors. Having those above realized for 2030, they will pave the way to carbon-neutral Europe by 2050 (Agora Energiewende 2019). To enforce the 2030 plan, European Commission proposed a Clean Power Programme asking for reform of the Renewable Energy Directive, reform of the Renewable Energy Efficiency Directive, and good energy union regulation (COM 2016).

1.4.1 The use of RES regarding different sectors of the economies

Regarding renewables with sectors across the globe, it is worth pinpointing that development on renewables stays focused on the power sector. In contrast, there has been far less progress in heating, cooling, and transport. The slow uptake of renewables originates in heating and cooling from a lack of policy support. The heating and cooling sector maintain effective policies primarily at a local level. Yet, policy solutions that combine renewable energy and energy efficiency are required to curb heat demand growth and raise the adoption of modern renewable technology. Correspondingly, the use of renewable energy in transportation also continues to be small. While biofuels are the leader in contribution from renewables, electric vehicle markets are developing markedly. Following rises in ethanol and biodiesel production, some policy uncertainties hamper the increasing use of biofuels in the transport sector. It includes slow progress in developing renewable fuels for markets such as aviation.

On the other hand, there is a statistical fact, which indicates the expansion of renewable energy in the power sector, with 181 GW newly installed in 2018. Yet, new capacity additions touch down after the years of growth. Approximately 100 GW of solar photovoltaics was deployed, making up 55 % of renewable capacity additions, which outpace wind power and hydropower 28 %, 11 %, respectively. All in all, renewables have expanded to capture more than 33 % of total deployed power generating capacity across the globe. Renewables have been deployed more than 90 countries, at least establishing one GW of generating capacity. In the meantime, more than 30 countries outperformed ten GW of capacity. Apart from that, wind power and solar PV enjoyed increasing the proportion of their installation and capturing marked part in some countries' electricity mix. Overall, global renewable power capacity has recorded a total of 2318 GW in 2018 (REN21 2019).

Regarding renewables' role in the energy industry, it could be seen that renewables play a vital role in the energy industry, thereby major oil companies prepare themselves to go through inevitable energy transition since the renewable energy sector involves significant growth potential and hydrocarbon extraction incurs rising costs (Weijermars et al. 2014).

1.4.2 The trends of transition on company level

To follow up with individual companies' cases, large gas and oil companies also believe that as long as the world population rises, it will cause a rise in the energy demand. In the meantime, renewables are to play a significant role in energy production in the future. Nevertheless, the opinions of companies on the future role of fossil fuel differ markedly. Most oil and gas companies do not believe that renewables will be the leading energy type in the future. For instance, ExxonMobil, the largest Supermajor, asserts that it will not focus on renewables that reap less profit.

In contrast, nowadays, British Petroleum (BP) is inclined to sell its renewables business due to undergoing outer influencers. On the contrary, both Royal Dutch Shell and Chevron welcome the rising renewable energy tendencies because of the future renewable energy market (Csomós 2014). The precursor to Royal Dutch Shell's case, its chief executive officer, Mr van Beurden, told investors that Royal Dutch Shell is no longer solely oil and gas company and energy transition company, which signifies the move to low carbon energy system (Sheppard et al. 2018).

Although these companies' renewable energy business is worth merely 1-2 % of their total investments, it builds up considerable marketing value. With that in mind, Chevron adopts renewable energy as its main component of the worldwide corporate social responsibility campaign. At the same time, Total, a France-based company, employs renewable energy as an energy source, and it is also considered a worldwide renewable market player by using its subsidiaries (Csomós 2014).

To sum up, renewable energy creates new tendencies by drawing governments and major, traditional oil and gas companies. It is crucial to follow up with shift to low carbon emission and provide energy for consumers without exploiting fossil fuels. Thus, it has led some countries to be pioneers and leaders in renewable energy generation, particularly EU countries. They enhanced these renewable energy trends by adopting specific targets planned to be accomplished by a certain period. Besides, they are escaping forward and either putting a "green face" on and finding new more ways of energy production to react to recent consumption trends. Those trends will improve as time passes and various unique measurements are implemented.

2. AZERBAIJAN'S ENERGY SECTOR

Azerbaijan lies in the South Caucasus bordering Turkey, Iran, Russia, Georgia, and Armenia. It occupies an area covering 86.6 thousand square kilometers. In 2018, GDP per capita was recorded at 8247 US dollars (SSCRA 2020a). Its strategic position on the Caspian Sea offers tremendous potential for having access to oil and gas resources. Azerbaijan is a necessary oil exporter with ample fertile farming lands and a well-educated workforce. It serves as a European-Central Asian transport corridor.

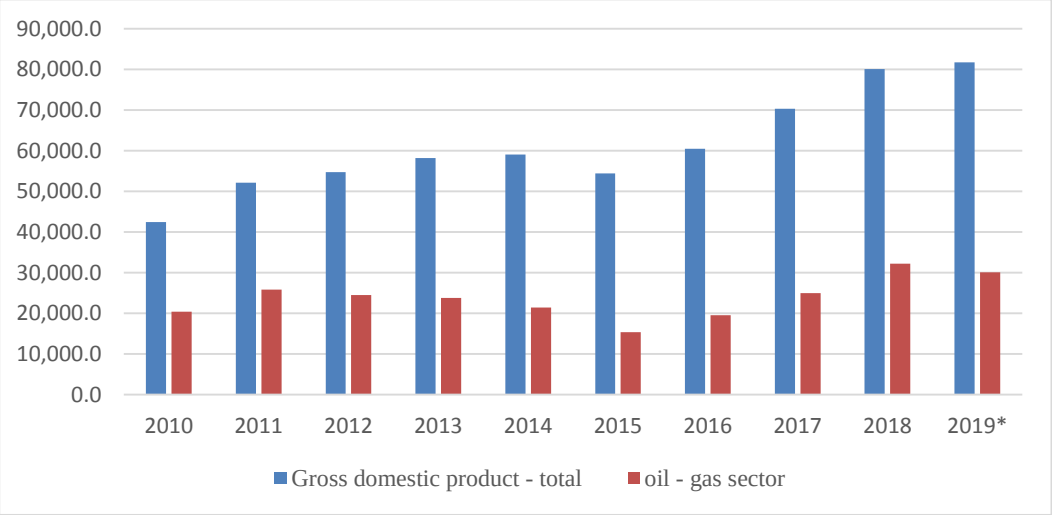
It is a must to analyze trends and achievements of the energy sector in Azerbaijan to derive a potential strategy of renewables based on the country's position in the energy sector, all in all. Examining the whole energy sector of Azerbaijan will help reveal the country's capability to implement renewable energy usage; therefore, the following section will elucidate Azerbaijan's energy sector, including energy efficiency and intensity measures.

Azerbaijan's large energy reserves are one factor that determines its economic structure. Thus, in the first half of 2019, Azerbaijan's economy was backed by the expansion of natural gas production and sustainable growth in the non-energy sector. The economy grew at an annual speed of 2.2 %. In the meantime, Non-energy sector saw the growth of 3.5 % year on year, stemming from the progress of agriculture, manufacturing and service sectors, whereas construction sector stayed on downturn. Due to favorable terms of trade in the first phase of 2019, Azerbaijan was

able to generate a trade surplus of 12 % of GDP. Thus, Azerbaijan was relaxed regarding its currency rate. As the economy continued to improve, authorities decided to keep the exchange rate at 1.7 manats (AZN) per US dollar, and no further currency devaluation was necessary. However, it was exposed to two notorious devaluations in 2015 due to a noticeable drop in oil price, as Azerbaijani's economy is mainly oil and gas industry. By the end of 2019, the Central Bank of Azerbaijan kept $ 6.3 billion in foreign reserves. At the same time, State Oil Fund (SOFAZ) assets constituted 90 % of GDP, equal to $43.3 billion. On the other hand, Azerbaijan's economy, which is dependent on its hydrocarbon resources, undergoes external risks deriving from uncertainties and deceleration in the global economy and current conflicts in the Middle East. Thus, as long as there is little growth, this causes a reduction in demand for Azerbaijani exports, and oil price volatility substantially impacts the economy (MPO 2020).

After signing the contracts with international oil companies in 1994, a large amount of foreign investment was injected into the oil and gas sector, which levered the GPD to rise consistently. Subsequently, the government started adopting economic programs supported by the World Bank and IMF (International Monetary Fund). The inflation dropped down to a minimum by 1997, yet 20-22% percent inflation was experienced in 2008 (Ciarreta, Nasirov 2010). A sudden increase of oil production resulted in GDP growth to swell in 2006 and 2007, reaching 29.8 % annual growth prior to seeing about 10% growth levels at the beginning of the 2000s. Azerbaijan realized the economy's vulnerability to oil production volatilities once it was hit by fallen GDP growth to 0.1% and 0.2% in 2011 and 2012, accordingly, because of occurring lower oil production. If we examine the figure below, we could notice GDP relation to oil-gas sector and share of the oil-gas sector in the GDP in Azerbaijan, visually (CPS 2014).

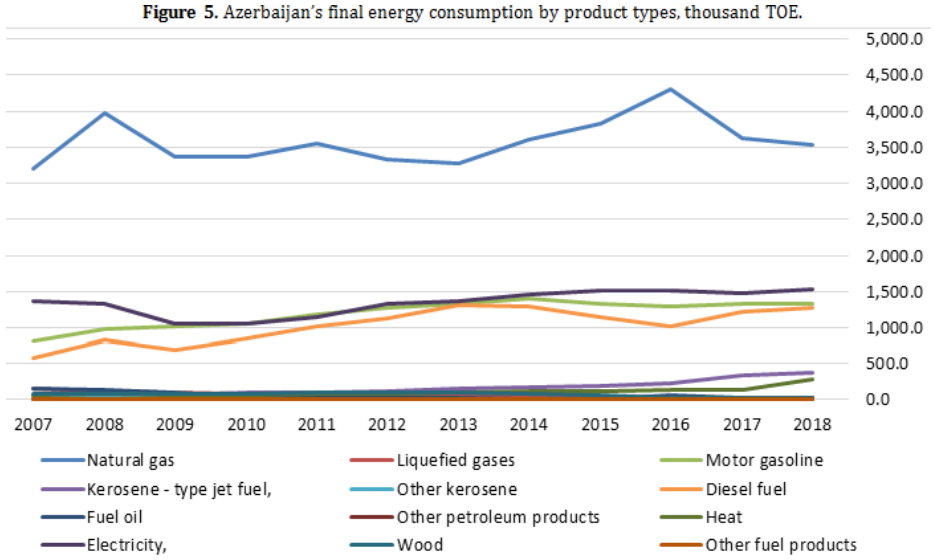
Figure 4. GDP production and oil-gas sector, at current prices, million manats (AZN)



Source: Own construction by Azerbaijan Statistics, 2020.

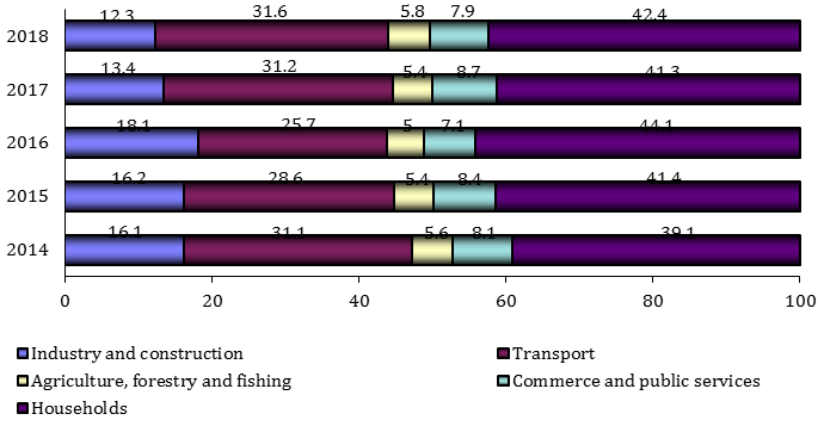
Regarding Azerbaijan's final energy consumption, it is crucial to highlight that oil and natural gas are major energy carriers in the country's energy generation, with a share of over 99 percent. On the other hand, around 80 percent of generated oil and gas is sold to foreign markets outside Azerbaijan. In terms of final energy consumption, the figure below depicts the final consumption of different energy types. As can be seen from the graph, natural gas captures the largest share in final energy consumption over ten years. Subsequently, natural gas, motor gasoline, diesel fuel appears to hold relatively less proportion in the final consumption of energy whereas, the other seven types of energy seem to stay behind those mentioned above with less share (UNECE 2019).

Figure 5. Azerbaijan's final energy consumption by product types, thousand TOE.



Source: Own construction by Azerbaijan statistics 2020.

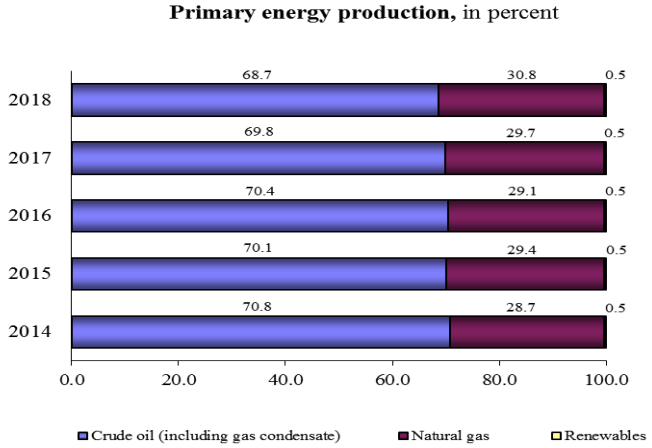
Figure 6. Final energy consumption by sectors of the economy in Azerbaijan, (%)



Source: Retrieved from Azerbaijan Statistics 2019.

To examine the primary energy products of Azerbaijan, Energy generated from three core resources stands out, namely, crude oil (including gas condensate), natural gas and renewables.

Figure 7. Primary energy production in Azerbaijan, in percent



Source: Retrieved from Azerbaijan Statistics 2020.

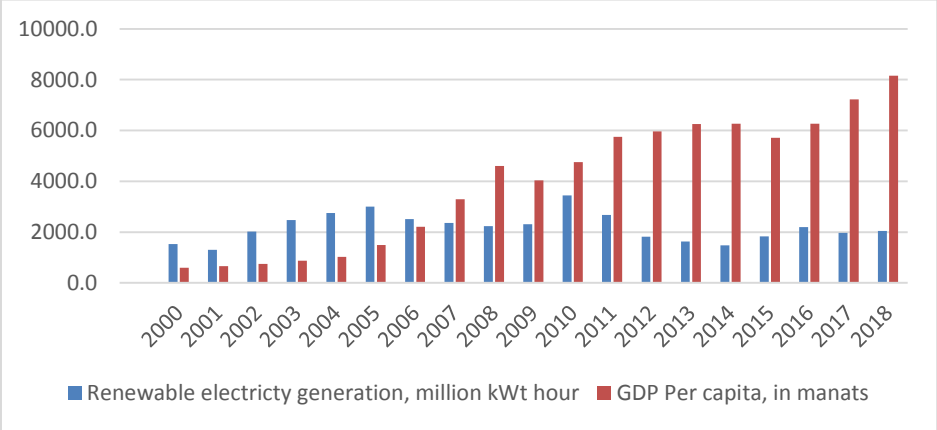
As seen from the graph (Figure 7), which covers the period over four years from 2014 to 2018, crude oil has always dominated the other energy carriers throughout the indicated period. However, the proportion of crude oil keeps declining while natural gas experiences a consistent rise in the share of primary energy production. Meanwhile, renewables stay on holding the same ratio with 0.5 percent.

3. TRANSITION TOWARDS RENEWABLE ENERGY IN AZERBAIJAN

Hence referring back to the energy ladder would be plausible to reflect how a country acquires energy usage transition. To put it simply, the wealthier a country is, the more sophisticated and reliable a country is on RES. With a resource-rich country's case to be ascertained in the energy ladder, it is desirable to delve into Azerbaijan's energy ladder position retrospectively. Examining the figure below helps to reveal Azerbaijan's performance with the energy ladder concept by comparing Azerbaijan's GDP per capita and renewable energy generation in Azerbaijan from 2000 to 2018. As shown in the following graph, GDP per capita in Azerbaijan has been subject to a surge throughout the examined period.

In contrast, renewable energy generation has dipped down during that period. Not having rising renewable energy production is linked to power plants' usage operating with fuels in Azerbaijan as the country owns a significant amount of oil and gas resources. It can be concluded that Azerbaijan has not put on an adequate performance with the energy ladder concept based on interpretations from the figure. Yet, it is still trying to develop RES infrastructure.

Figure 8. Renewable energy generation and GDP per capita



Source: Own construction by Azerbaijan Statistics, 2020.

To have a more detailed picture in the upcoming sections, the two fields of decarbonization – Greenhouse gas emissions and renewable energy source-will be introduced with Azerbaijan in the center.

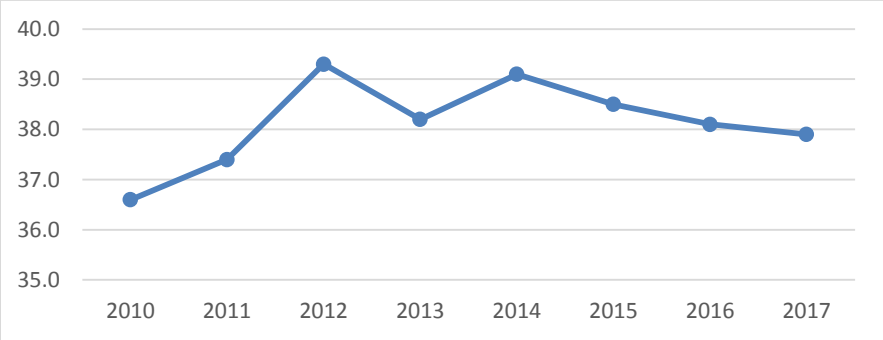
3.1. Greenhouse gas emissions

To reveal the potential usage of renewables and the implementation of renewables strategies, it is important to examine the greenhouse gas emission across the country as conventional energy usage is a major reason for the soar in greenhouse gas emissions. Thus, it could help formulate insight into how renewables are applied in the country.

According to the World Resources Institute Climate Analysis Indicators Tool (WRI CAIT) in 2012 report, Azerbaijan's energy sector holds a lion share of greenhouse gas emissions by making up 85 % of total emissions. Besides, fugitive emissions make up half of the CO2 emission from the energy sector, while electricity and heat amount to 24 %. In the meantime, agriculture comprises 10 percent of the total. However, waste and industrial processes are the least greenhouse emissions, whereas there is no CO2 emission originating from land-use change and forestry (USAID 2016).

The ecosystem enjoys a positive result in greenhouse gas emissions as the renewable climbs' usage up the trend. Electricity production with natural gas and water sources releases more CO2 into the atmosphere than generating electricity with wind and solar energy. Thus, it grows the importance of renewables to be able to protect the environment and eco-system. Furthermore, the energy sector is held accountable for 24% greenhouse gas emissions into Azerbaijan's atmosphere. The trend of greenhouse gas emission by energy sector is described throughout ten years in the figure below. As can be seen from the figure, there has been a visible fluctuation in greenhouse gas emissions from 2010 to 2017. However, the emission was sustained at 38 million tons in 2017 in accordance with steady usage of natural gas in the overall balance of energy consumption (UNECE 2019).

Figure 9. Greenhouse gas emissions in energy sector, mln ton



Source: Own construction by Azerbaijan Statistics, 2020.

Aside from that, there is a projection with a reduction of greenhouse gas emissions by 2030. To live up to this projection, there will be a considerable reduction in fuel consumption for the generation of per unit electricity by allowing new generating capacities of around 2400 MW to function and terminate old electric plants' functioning. In the meantime, the increase of renewable energy usage will also cause greenhouse gas emissions in the total amount of energy consumption to decline significantly. Besides, diminishing electric energy losses to seven percent and eight percent in Baku and the regions, respectively, due to the strategic roadmap, will also contribute to natural gas save and lessen greenhouse gas release (UNECE 2019).

3.2. Renewable energy sector

Azerbaijan maintains an energy policy that is based on ensuring energy independence. As discussed in previous chapters, Azerbaijan is rich with energy resources and net energy exporter. It has already guaranteed energy independence. To be able to have the economy enhanced comprehensively, raise the energy efficiency and reduce greenhouse gas emissions (GHG), Azerbaijan has given certain care to the development of renewable energy sources (RES) for 2004-2013 employing SAARES setting specific targets such as:

1. Giving attention to the potential of alternative and renewable energy sources as part of electricity production.
2. To live up to the energy efficiency, looking for an alternative and renewable energy sources
3. Creating novel vacancies by new fields of energy production
4. Expanding and developing the country’s energy capacity into multiple areas to achieve energy security (Vidadili et al., 2017).

Furthermore, on December 29, 2011, the president of Azerbaijan applied a national strategy that encompasses the exploitation of alternative and renewable energy sources for 2012-2020. The document was to be advanced by SAARES, which collaborates with relevant central and local authorities and national and foreign corporations. In essence, this document set out to go about the categories below.

- To assort considerable places to be able to generate electricity and heat from renewables in 2012-2020
- To establish a regulatory framework concerning alternative and renewable energy sector
- To introduce incentives to increase the use of renewables
- To propel renewables' usage in all fields of the economy (Vidadili et al., 2017).

To reveal the national strategy of Azerbaijan on renewable energy usage, it is necessary to examine renewable energy sources and so-far achievement in renewable energy implementation in Azerbaijan. Thus, Azerbaijan is rich with renewables' potential, and the state is also inclined to utilize it across the country. The usage of renewables has many advantages, such as raising the security level, decreasing total costs of electricity generation, sparing natural resources, etc. However, given the potential of renewable energy sources, their exploitation is negligible, excluding large hydropower plants. In the meantime, prevalent usage of renewables, particularly wind and solar energy, is set to diversify electricity generation (UNECE 2019). Stemming from Azerbaijan's geographic location and condition, it possesses the technical potential of RES, as indicated in the table below.

Table 5. The technical potential of RES in Azerbaijan

Type of RSE	Capacity, MWt/bln.kVts
Solar Energy	>115200
Wind Energy	>15000
Bioenergy	>900
Geothermal Energy	>200
Small Hydro	>650
TOTAL:	>130000

Source: Own construction by IRENA, 2018

Safarov (2015) addresses the fact that there is a close collaboration between Azerbaijan and the EU in economic viability processes. Besides, some loans and grants are directed to Azerbaijan by some donor countries and organizations. German consulting company, "MVV Decon" has executed the most prominent economic and technical feasibility research by the financial help backed by German Development Bank KfW, and it was finalized in May 2014, as a result of a research period lasting 18 months. The bank stated that the research consisting of two phases with 18 months period involved technical and economic perspectives. In contrast, the second phase was dedicated to developing its environmental and social fields.

Additionally, Azerbaijan utilizes self-finance and loans intending to foster its green energy fields. Meanwhile, the head of SAARES, Akim Badalov brought up the fact in an interview with the Azer News State Agency that there has been 380 million USD investment placed in developing alternative and renewable energy sources in these fields in Azerbaijan (Safarov 2015). It shows that Azerbaijan also tries to cooperate with private organizations to stimulate the RES sector.

Table 6. Renewable Energy Source-related projects

Name of the Project	Amount of energy produced (MW)	Budget (Euros)	Investors
Pirakushkul Wind Park	110	165 million	Azerbaijan Gov. KFW Bank
Hovsan Sewage-Gas station	50	75 million	Azerbaijan Gov. POSCO
Absheron Solar Park	25	87,5 million	Azerbaijan Gov. JLCA
Sea Wind Park	100	250 million	Azerbaijan Gov. Private Investor
1000 House / 1000 power plant	50	80 million	Azerbaijan Gov. Private Investor

Source: Own construction based on Renewable Energy Perspectives of oil exporter Azerbaijan by Safarov, 2015, Azerbaijan by Safarov, 2015

Moreover, Vidadili et al. (2017) assert there has been high existence of RES in Azerbaijan. That's why Azerbaijan has to exploit this potential at the highest level via government policy more than passing it to private companies, which is quite risky (Vidadili et al., 2017). Given the discussion

above, there is a significant indication of Azerbaijan's strategy towards renewable energy as it has been involved in various projects, and the President of Azerbaijan passed some regulatory statements regarding the development of renewables in Azerbaijan. Azerbaijan has made some investments on RES itself and also tried to attract some funds from foreign companies. To come to clear conclusion, the usage and implementation of renewable and the position of Azerbaijan in RES usage will be explored in subsequent paragraphs.

3.2.1. Hydropower energy

From the usage of hydrogen energy perspective, it could be pointed out that this type is the most prevalent one among renewable energy sources. Thus, there has been a continuous increase in electricity generation from this source since 1990 in Azerbaijan. Hydroelectric power plants currently contain 17.8 % generation power in the total energy system of the country. There are so many rivers on which it is possible to build up small hydropower stations, and it also contributes to regulating floodwater in those rivers (UNECE 2019). Hydropower has been utilized in the country since Soviet times, and it was estimated that Azerbaijan owns 40 Billion kWh hydroelectric power sources. Its 16 Billion kWh is viable, including five Billion kWh deriving from small hydroelectric power plans. However, there appears to be one core issue with small and mini hydroelectric plants that regards them functioning longer than their lifespan. The condition and quality of technologies do not allow them to operate in compliance with modern standards. Thus far, this situation pertains to almost 35% of Azerbaijan hydropower stations with longevity operating more than 30 years. The state itself is also willing to deploy investments in the hydro energy sector and intends to raise the number of plants. The Ministry of Industry and Energy said to Azernews in September 2013, their plan to construct 34 small hydropower plants, which maintains 239.9 megawatts total capacity (Safarov, 2015).

Furthermore, there was a state program concerning the expansion of small hydropower plants which also ended up with privatization of the following hydropower plants, “Guba”, “Gusar”, “Sheki”, “Chichakli”, “Mughan”, “Zaykhur”, Nugandy”, “Balakan” and “Chinarli”. The small power plant constructed on Kish river in Sheki has raised its annual power generation from 720 kWh to 1.2 MW by renovation. Moreover, the UNDP office in Azerbaijan has backed up the restoration and renovation of a small hydropower plant containing 580 kWh in Sheki. Over the last decade, several power stations started working, which are based on state-of-the-art technologies with the potential of 7149 MW electricity production in Azerbaijan (Vidadili et al.m 2017).

According to the State Statistics Committee of Azerbaijan, the country's hydroelectric power plants produced 1,768 million kilowatts per hour of electricity in 2018, lower than electricity production in 2016 with 1959.3 million kilowatts per hour electricity. Meanwhile, it started showing a decreasing trend from 2016 (SSCRA 2020). Table 7. below displays both big and small hydropower plants in the country.

Table 7. Hydropower Plants of Azerbaijan

Hydropower Plants	Small Hydropower Plants (SHP)
Mingachevir HP – 424 MW	Goychay SHP – 3.1 MW
Shemkir HP – 380 MW	Ismailli – 1 SHP – 1.6 MW
Yenikend HP – 150 MW	Ismailli – 2 SHP – 1.6 MW
Fuzuli HP – 25 MW	Balakan – 1 SHP – 1.5 MW
Tahtakopru HP – 25 MW	Kusar SHP – 1.0 MW
Shemkirchay HP – 25 MW	Astara – 1 SHP – 1.7 MW
Varvara HP – 18 MW	
Nakhichevan AR	
Aras HP – 22 MW	Vayhir SHP – 5 MW
Aras HP – 22 MW	
Arpacay – 1 HP – 20,5 MW	
Arpacay – 2 HP – 1.4 MW	
Ordubad HP – 36 MW	

Source: Own construction by Azerenerji ASC

As can be seen from the table (7), the largest hydropower plant in Azerbaijan in electricity production is Mingachevir HP – 424 MW, followed by Shemkir HP – 380 MW.

3.2.2. Wind energy

To compare wind energy with other renewable energy sources, it can be concluded that wind energy is the most applicable one because of its viable perspective for wind power facilities. Correspondingly, Azerbaijan's geographic location plays a vital role in possessing 800 MW annual wind power capacities. If used adequately, there will be a production of 2.4 billion kWh of electricity from accessible potential, which would help save one million tons of fossil fuels, hindering large quantities of greenhouse gas from being released into the atmosphere (Vidadili et al., 2017). Azerbaijan owns quite desirable places to apply wind power facilities, particularly the Absheron peninsula, the coastline of the Caspian Sea, and islands in the northwestern part of the Caspian Sea, the Ganja-Dashkesan zone in the west of Azerbaijan, and the Sharur-Julfa area of the Nakhchivan Autonomous Republic. As regards the implementation of wind projects, in 1999, Japan's Tomen Company cooperated with the Azerbaijan Scientific Research Institute of Power Engineering and Energy in deploying two towers in size of 30 and 40 meters in Absheron. Here, it was measured average annual speed of the wind to be 7.9 to 8.1 m/sec. Aside from that, one more feasibility research has been prepared concerning the deployment of windmills owning 30 MW total capacity in Qobustan region (UNECE 2019).

To develop offshore wind energy potential, which is inclined to provide energy for rigs in the Caspian Sea, the Caspian Technology Company (CTC) put up the first wind turbines in collaboration with Energy Competence Center Gmbh (ECC). There are two wind turbines with a capacity of 1.7 MW located in Yeni Yashma, Khizi region, and supply 35 kW of renewable electricity to the national energy system. Owing to this project, 6.5 mln KW energy is produced, and 2.5 mln m^3 natural gas is saved per year (Vidadili et al., 2017).

There is also quite recent development in the field of wind energy deployment regarding drawing the attention of a foreign investor to the Azerbaijan renewable energy sector. Azerbaijan signed two new contracts in value of 400 million USD to develop solar and wind energy fields. One of the contracts was made with Saudi Arabia's ACWA to erect 240-megawatt wind infrastructure in Khizi and Absheron regions on Azerbaijan's Caspian Sea shoreline. I will discuss the second deal in the solar energy paragraph (O'Byrne 2020).

3.2.3. Solar energy

To put it simply for solar energy usage in Azerbaijan, it should be noted that Azerbaijan possesses a significant potential for solar electricity and heat generation by having 2400 to 3200 hours of sunshine per year. However, this potential has not been utilized adequately. However, there is still one main hindrance to deploy solar photovoltaic power plant, which concerns too high production cost of electricity from the photovoltaic power plant, which is not in a position to be compared with low electricity tariffs in Azerbaijan, despite that, the government has applied significant strategies to solidify solar energy generation. Correspondingly, the Surakhani solar power station of the 'AzAlternativEnerji' Limited Liability Company under SAARES has launched an operation with an opening ceremony in which the President of the Republic of Azerbaijan participated. For long-run operation, robust financial incentives are to be introduced to draw the attention of private investors in PV deployment (Safarov 2015).

Furthermore, numerous deployments of solar panels are executed in schools, kindergartens, and the healthcare sector by Azguntech LLC, following up with the State Program on Use of Alternative and Renewable Energy Sources in the country and Renewable energy sources in Azerbaijan and its execution in 2011-2013. These projects desired to supply green electricity in the country and sustain environmental stability. In pursuing these objectives, several solar panels and heat pumps were constructed in 10 schools within Baku's different regions. Apart from that, the company deployed solar panels and heat pumps in Beylagan and Masalli with the capacity of 50 kWh and 76 kWh power production, as well as installation of a solar station which is capable of generating 35

kWh and heat pumps with the capability of producing 60 kWh in a child healthcare building in Hovsan district, Baku. Installation of Solar Electric Stations in Azerbaijan are continuing (Vidadili et al., 2017).

As discussed in the wind energy paragraph, the second deal which Azerbaijan has made was with Masdar, which comes from Abu Dhabi, and it was for the construction of a 200-megawatt solar plant around Alat region. The overall value of these two large-scale projects is 400 million USD (O'Byrne, 2020).

3.2.4. Biomass energy

Delving into the use of biomass energy in Azerbaijan, it must be underpinned that Azerbaijan owns some biomass roots such as industrial waste, wastes from forestry and wood processing, and wastes of household and communal regions, wastes originating from oil and oil products pollution, crops, and organic compounding wastes. Gas, liquid and solid can be rendered through the aforementioned biomass substances. Two million tons of solid and industrial wastes are dumped to the areas named as neutralization zone in Azerbaijan annually, which is more or less considered to foster heating public buildings in Baku and some other large industrial regions (UNECE, 2019). Besides, Safarov (2015) asserts that based on feasibility studies by independent energy analysts, Azerbaijan has the adequate capability of generating biomass energies in the countrysides of Azerbaijan. However, there is a high price of benzene and diesel, which gets in the way of launching respective biogas generation. The production of a green maze and other crops for obtaining biogas is inclined to exhaust so much fuel.

On the other hand, there has not been seen the sign of selling biomass to customers. Thereby people living in those areas are unwilling to cultivate biomass such as green maize. Furthermore, installing a household size biogas device costs nearly 1700 euros in the areas where people keep cattle, which means super existence of a biomass potential. That is the reason behind having only a few minor projects dedicated to biomass for energy production. Initially, it is true that the Azerbaijan waste dumping site amounted to 200 places with 900 hectares. In 2012, The largest plant in Post-Soviet countries started the production, establishing French CNIM Company in Baku. Owing to this plant, Azerbaijan evades wasting 60 million m^3 for electricity production by an annual generation of 231,500 MWh, which supplies electricity to over 100,000 households with electricity (Safarov, 2015).

3.2.5. Azerbaijan's RES strategies

Given the performance in the erection of RES infrastructure in Azerbaijan illustrated in previous paragraphs, it can be concluded that Azerbaijan tries to lead the national strategy with RES and collaborates with private companies abroad.

The table below contains the data regarding electricity production from renewable energy sources and how much individual renewable energy sources contribute to electricity production. As can be seen from the table below, there is no indication of the amount of electricity generated from biomass incineration. Simultaneously, wind and the solar power station has increased the production of electricity from 2013 to 2018. In the meantime, there have been slight fluctuations in the quantity of electricity produced from wastes incineration. Hydroelectric power plants have always accounted for most of the electricity generated from renewable energy sources from 2011 to 2018.

Table 8. Renewable production of electricity (million kWh)

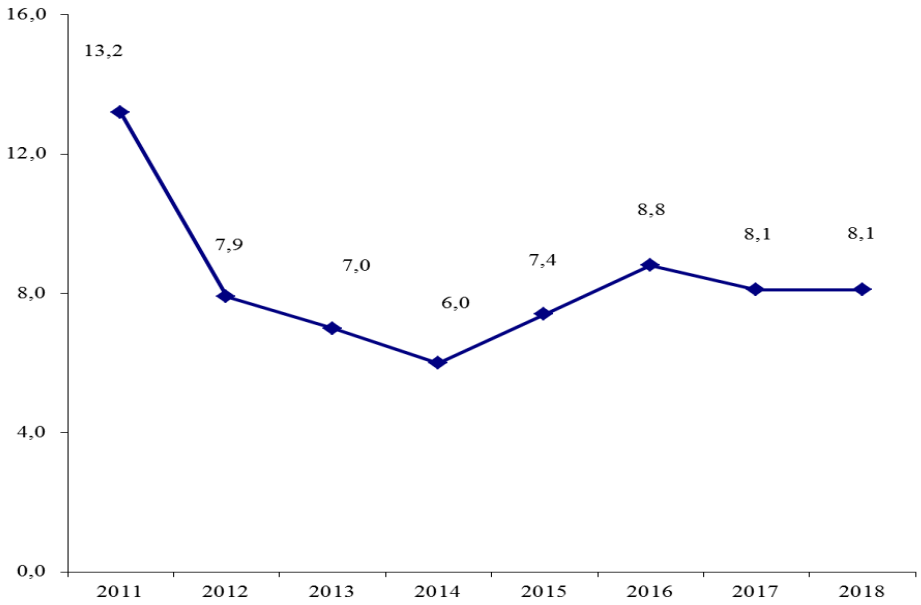
	Production of electricity	Renewable production of electricity million kWh				
		hydroelect-ric power plants	wind power station	solar (photovoltaic) station	waste incineration	biomass incineration
2011	20,294	2,676	-	-	-	-
2012	22,988	1,821	-	-	-	-
2013	23,354.4	1,489.1	0.8	0.8	134.1	-
2014	24,727.7	1,299.7	2.3	2.9	173.5	-
2015	24,688.4	1,637.5	4.6	4.6	181.8	0.0
2016	24,952.9	1,959.3	22.8	35.3	174.5	0.0
2017	24,320.9	1,746.4	22.1	37.2	170.3	0.0
2018	25,229.2	1,768.0	82.7	39.3	162.2	0.0

Source: Own construction by Azerbaijan Statistics, 2020

Moreover, the following figure denotes the share of electricity generated from renewable sources in total electricity production with percentage points. The proportion of renewable energy sources in total electricity production has curtailed from 2011 to 2018, slightly rising in 2016, and yet undergoing constant decrease later. There appears to be a solid reason for the reduction in renewables' share after 2011, which pertains to the fact that new heat power stations operating with fossil fuels were constructed at that time. For instance, Janub heat power stations began to operate in 2013, possessing 780 MW capacity, which outperforms half of the overall hydropower plants' overall capacity (HP) and solar hydropower plants (SHP), with 1,174.4 MW in Azerbaijan. Due to new plants, overall electricity generation has risen, and it caused the share of electricity supply from renewable to hit the decreasing trend, respectively (Aydin, 2019).

Azerbaijan desires to grow the share of RES in total electricity production to diversify its energy sector and, consequently, exporting the rest of the natural gas after domestic provision to European markets. The following figure identifies the power of renewable energy sources projection denoted in Strategic Road Map Goals of Azerbaijan with the certain capacities until 2030 (Aydin, 2019). The table elaborates projections on which renewable types will attain up to 2030. Based on these projections, there will be a substantially steady increase in power of all renewable power plants, with exclusion of the Hydro PP, and hitting 35 to 40% of power installation by RES.

Figure 20. Share of electricity generated from renewable sources in total production of electricity in percent



Source: Retrieved from Azerbaijan Statistics, 2020

Table 9. Power installation up to 2030

	2020	2025	2030
Wind PP	350 MW	440 MW	465 MW
Solar PP	50 MW	150 MW	190 MW
Hydro PP	10 MW	220 MW	220 MW
Bioenergy PP	20 MW	30 MW	50 MW
Total (MW)	430 MW	840 MW	925 MW
Total (RES%)	20 %	25-30%	35-40 %

Source: Own construction based on Overview of the renewable energy developments in Azerbaijan by The State Agency on Alternative and Renewable Energy Sources of the Republic of Azerbaijan.

In implementing renewable energy production and infrastructure construction in Azerbaijan, several challenges arise in the way that the state must handle. Although the government has been willing to make progress in the installation of RES, a few challenges get to achieve progress in the RES field. First and foremost, it is linked to legislation for usage and generation of RES. Thus, there should be a regulatory framework that should be formulated by the fundamental law. To make it clear, investments are mainly deployed by the government and international organizations. However, the business environment in RES is not plausible due to a lack of technical, legal, and regulatory framework. Therefore private corporations are not inclined to pour investment in RES here. In the meantime, the production, transfer, distribution, and delivery channel of RES should be organized (Aydin, 2019).

Subsequently, the second obstacle comes to the stage, which pertains to technology transfer. Given the high price of RES technologies and imported from other countries to Azerbaijan, these technical processes have to be alleviated. The third necessary obstacle signifies the shortage of financial resources and high interest rates. Predominantly having experienced a decline in oil prices in mid-2014, the Azerbaijani economy was adversely impacted, and this adverse effect considerably spread to the RES sector. Next, the fourth challenge concerns the low public awareness, which derives from the fact that international organizations and local authorities do not present enough care to fill people with RES-wise information.

Additionally, most research studies and projects dedicated to enhancing RES and raising public awareness were conducted between 2009 and 2015 by national and international entities. Along with that, steady economic order after the oil price shock contributed to the rise of RES in Azerbaijan (Aydin 2019). Thus, BP and Azerbaijani Energy Ministry signed the memorandum of understanding to cooperate in the search for renewable energy development in Azerbaijan in December 2018. The memorandum was signed based on the fact that the government betters its regulatory framework in renewable energy sources (Mahmudova, 2018).

For facilitating and propel the use of RES, Azerbaijan executes tax incentives. According to these tax incentives, legal entities and individual entrepreneurs who obtain investment promotion papers following the framework issued by specific executive authority are exempted from being incurred import custom duties and value-added tax for technical materials over seven years starting from receipt time of the respective paper. Aside from these, they do not forgo half of their total income and half of total profit for taxes and be exempted from property and land taxes. Those measures which have been taken pushed the usage of RES and applied technological infrastructure forward in Azerbaijan. Thus, Sumgait Technology park has been the Azguntex Solar Panels Plant site, holding a 50 MW generation capacity and the Solar Collector Factory. The RES capacities and RES share of total electricity generation are still not as plausible as anticipated, although the state has mostly poured considerable investments into RES infrastructure. Given the fact above for RES investments, Azerbaijan faces the same issue as the other world's countries, which stands for the fact that the private sector is reluctant to deploy long-run investments in RES installation. Aydin (2019) refers to Yoshino, Taghizadeh-Hesary, and Nakahigashi (2019). They address this reasoning that private sectors reckon long-run investments in RES are not entirely reasonable due to would-be risks and little benefit.

As discussed in previous chapters, Azerbaijan has access to the great potential of renewable energy sources, but the decline of oil prices restricted the availability of the investments to RES, and it also revealed the crucial evidence that the development of RES by only the state fund and investments does not arrive at the successful deed. Therefore significant involvement of private funds must be realized by building up private investors' status under competitive market rules. The target that Azerbaijan aims to hit at by 2020 is to produce 20 percent of total electricity production from RES, so that it requires for the country to eradicate all the legal, financial and technical barriers and raise the awareness of RES sector, as well as exerting "green finance" stated by Sachs et al. (2019) whom Aydin (2019) referred to, which is the only sensible way to reach 2020 goal, from 8.1 % (2008) to 20% (2020) share in total electricity production (Aydin, 2019).

To expand and develop its renewable energy deployment, Azerbaijan can put Norway's experience into practice as well, since Norway is one of the leading countries executing renewable energy transition. Bardi (2019) stated that Norway was one of the biggest oil-producing countries globally, the leader in Europe. Hence, while Norway hit the peak of oil production in 2002, its production has decreased to half of what it has produced during its heyday. They placed necessary funds into renewables, which they collected by selling oil. Bardi (2019) names this strategy as "Sower's Strategy", which illustrates the necessity of utilizing remaining fossil fuels to give birth to and strengthen renewable infrastructure. As regards Norway's success, it generates all its electrical power from renewables, especially hydrogen energy. Nowadays, Norway has statistics that one-third of all vehicles purchased in Norway happens to be electric, which is a steadily increasing segment and takes hold of 13 percent of a total number of vehicles. Given the number of plug-in hybrid vehicles plus electric vehicles, it will come to 24 percent of total vehicles. Moreover, Norway expects to reach 100 percent of electric vehicles by 2025 (Bardi, 2019).

Furthermore, Recently, for spreading renewables' implementation, Norway's independent wealth fund, which is valued at 1 trillion USD, declared to start to pour investments in renewable energy infrastructures such as solar and wind park. They reckon that this will contribute to the spreading of renewables in Norway. This move can be an example to countries that rely on heavy fossil fuel to initiate clean energy production (Charles, 2019).

To delve into Norway's electricity production, a seemingly high share of renewable electricity production can be observed. To put it merely, Norway captures the highest percentage of electricity production from renewable energy sources within Europe and the lowest emission from the power sector. In early 2018, Norway's power supply system possessed a deployed capacity of 35 755 MW and contained annual generation with 141 TWh. Its renewable power generation capacity is growing larger, compared to its performance observed back in previous decades. There is one more the fact that wind power holds a medium proportion of energy generation capability, however, it draws more investment than others (NMPE, 2019).

To sum up, Azerbaijan's renewable energy generation performance is relatively low compared to other energy carriers. In the meantime, Azerbaijan tries to increase the share of renewable energy in total energy production to reduce gas emissions and meet electricity needs with clean energy, which will pave the way for exporting remainders of gas production to customer markets such as Europe. In the meantime, creating a more sustainable future with clean energy has recently been one of Azerbaijan's major objectives by establishing regulatory projects, which helps set appropriate strategies and attract investments for renewable energy projects from international organizations. With projections for renewable power generation, Azerbaijan desires to capture a considerably higher share of renewables in total electricity production.

CONCLUSION

The implementation of energy generation from renewables has been quite a hot topic. The states and private investors have made considerable investments due to the rising trend of renewable installation and the possibility of leaving behind conventional energy carriers' usage in the coming

decades. The energy sector of Azerbaijan and its potential of transition towards renewable energy usage were discussed in this thesis. They examined the worldwide use and share of renewable energy in total energy carriers.

Initially, the theoretical background has been introduced by explicitly displaying the energy ladder concept, energy trilemma, security-affordability-sustainability trilemma of energetics, and relationship between energy and GDP. In examining the theoretical background of the energy, the energy ladder concept stands to show consumers' availability to move alongside the ladder in respect to changes in their economic situations. In contrast, energy trilemma is followed to be reached the highest points by countries across the world. In the meantime, there have been different theories regarding the relationship between GDP and energy consumption, where sometimes it is described to have a two-way relationship between these two factors. However, there is no clear fact denoting which side is dependent.

Subsequently, due to the energy transition, the global energy sector has the ground for moving from conventional energy form to energy with less carbon emission. There have been several studies shedding light on the transition and transformation of energy systems and demonstrating Germany and China employs the ways to carry out sustainable energy transition by relevant projects. Aside from that, the rising trend of renewable in the globe helps to identify the proportion of electricity generation from renewable energy sources. Thus IRENA (2019) reported that in 2017, a significant amount of 6191 TWh of electricity was generated by renewable sources, which is a considerable outcome, and hydropower (4037 TWh) makes up 65% of that power. Thus the wind, bioenergy, solar, geothermal, and marine energy stays behind it. It is also quite important to emphasize that there has been a continuous rise in electricity production from renewables since 2013. Equally, solar and wind energy generation has experienced a significant increase in terms of power generation. Besides, Asia was shown to be subject to the highest renewable electricity growth in 2017 by hitting the peak of 39% while Europe and North America are left behind by holding a 20% share. Yet, it outperforms South America and Eurasia with thirteen and five percent, respectively.

Meanwhile, the EU is a leader in implementing and using renewable energy sources. It doubled the share of renewable energy in gross final energy consumption to 18.9 in 2018, compared to 2004. The highest percentage belongs to Sweden among EU countries. The EU seeks a condition to meet its 2030 targets by soaring the share of all types of renewables to go about 2050 goals later on.

Overall, renewables have grown to maintain more than 33 % of total installed power generating capacity worldwide. Renewables were activated in more than 90 countries, at least building up one GW of developing capacity. Meanwhile, over 30 countries outpaced 10 GW of capacity and a growing share of wind and solar power in the electricity mix. The global renewable power capacity scores total 2318 GW in 2018 (REN21, 2019).

In pursuing the private sector's prospect towards renewable energy, supermajor energy companies own different opinions in term of moving towards renewables such as ExxonMobil rejecting to head towards renewable due to not giving enough profits, however other energy companies, Royal Dutch Shell, Chevron, and France-based Total backs the usage and transition towards renewable energy by believing inevitable future of renewable energy market.

What's more, Azerbaijan owns an energy sector that is built upon the oil and gas sector, and its economy is mainly dependent on oil and gas revenues. However, the Azerbaijani government launched a diversifying economy strategy with the desire to evade fossil fuel resources due to experiencing shaking oil prices in the world energy market. They also make up the major part of Azerbaijan's export products and become major energy carriers in final energy consumption. After declaring its independence from the Soviet Union, Azerbaijan embarked on establishing its energy sector by signing "the Contract of the Century" with 13 international energy companies. Revenues were coming from oil fields deployed upon the establishment of infrastructures in the country. The most significant oil and gas fields comprised the largest share in the production and extraction of oil and gas, namely, the Azeri-Chirag Gunashli (ACG) oil, Shah Deniz natural gas,

thereby breeding center for major investments to be able to drill tremendous amount of fossil fuels. In the meantime, Azerbaijan has turned itself from a gas importer to major gas exporters.

Delivering produced oil and gas international markets, Azerbaijan established several oil and gas pipelines: Baku- Novorossiysk pipeline, Baku-Supsa, Baku-Tbilisi-Ceyhan oil pipelines, and Baku-Tbilisi-Erzurum (South Caucasus Pipeline-SCP) gas pipeline and South Caucasus Pipeline Expansion which is comprised of Trans Anatolian Pipeline (TANAP), Trans Adriatic Pipeline (TAP) under construction.

Regarding electricity generation, Azerenerji, state-owned power production, and transmission entity, is larger than 80 percent of the total electricity. Thus, most electricity production has been coming from Electric Plants (EP) working with fuel, while renewable energy sources still generate negligible electricity in Azerbaijan. In the electricity market, Azerenerji and Azerishig share generation and transmission, distribution, and supply. Besides, concerning electricity prices and tariffs in Azerbaijan, Azerbaijan is compared to Georgia. As a result of the comparison, it is deducted Azerbaijan to exercise quite fair prices. To turn into the gas tariffs, Azerbaijan's gas price and tariffs are on the same page with the countries such as Kazakhstan, Uzbekistan, Georgia, and Ukraine, etc. In the meantime, the country's efficiency indicators such as energy intensity show that Azerbaijan has seen a decrease in the energy intensity to around 500 kg oil per 1000 USD of its GDP from 2003 to 2017 (SSCRA, 2020b).

Furthermore, the usage of renewable energy in Azerbaijan helps to diminish the amount of greenhouse gas emissions, which is reported to be 38 million tons in 2017, and 24 % of greenhouse gas emissions emerge as a result of energy sector activities. To develop the renewable energy sector of the country, on December 29 in 2011, the President of Azerbaijan has executed a request to develop the strategy of usage of alternative and renewable energy in Azerbaijan, for 2012-2020, that falls under SHARES, which cooperates with relevant central and local authorities, as well as national and foreign corporations. This document aims to fulfill the following categories below:

- To allocate necessary fields for generating electricity and heat from renewables in 2012-2020
- To build up a regulatory framework for the alternative and renewable energy sector
- To bring up incentives to advance the use of renewables
- To encourage the utilization of renewables in all fields of the economy (Vidadili et al., 2017).

Besides, Azerbaijan also received some loans from donor countries and organizations to increase the installation of renewable infrastructure and conduct valuable feasibility research in the green energy field. Huge amount of investments were attracted in this field as well. On the other hand, there has been a reduction of renewable energy in total electricity production from 2011, which was linked to the construction of heat power plants operating with fossil fuels in 2011 that produced a significant amount of electricity and caused the share of renewables to stagger down. To refer to individual renewable energy share in total electricity production, hydropower plants hold a lion share followed by electricity generation from wastes incineration, wind which outpaced the solar energy, in 2018. Apart from that, the projection of power installation from renewable is predicted to climb up to significant results, such as 35-40% power from RES by 2030, which was indicated in Strategic Road Map Goals of Azerbaijan.

However, during the trying to develop renewable energy sector, Azerbaijan faces several challenges, such as developing necessary legislation and regulatory framework, technology transfers with high prices, shortage of financial resources after a decrease in the oil prices in mid-2014, and low awareness of renewables in the country. Azerbaijan currently deals with these issues accordingly. For instance, for the alleviation of RES usage in the country, it levies tax incentives for legal entities and individual entrepreneurs who attain investment promotion papers in line with legislation. In the meantime, based on the memorandum between BP and Azerbaijani Energy Ministry, Azerbaijan develops its regulatory framework in the field of renewable energy. Besides, recently, Azerbaijan signed a deal with two popular companies, Saudi Arabia's ACWA, Masdar from Abu Dhabi, which

caused a large investment in wind and solar energy, respectively. Azerbaijan's potential energy strategy is pretty much covered above. It also involves eradicating all its pitfalls for implementing renewable energy development both by state funds and attracting investments from private investors.

On the one hand, Azerbaijan can take Norway's case as best practice since they used to collect massive funds from oil resources and switched to renewables energy more by devoting their funds from oil sales to renewable energy infrastructure. Despite falling oil prices, it can still be plausible for Azerbaijan to devote some of oil and gas revenues to renewable energy fields as Azerbaijan heads towards collecting one of the major funds from natural gas export. With the projection of renewable installation at 35-40% of total electricity, Azerbaijan tries to ensure sustainable energy development and create a sustainable future.

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