THE ADVANTAGES AND DISADVANTAGES OF THE PRODUCTION OF SHALE GAS POTENTIAL: THE CASE OF TURKEY

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Abstract:- Energy is a main input for economy. Because of an increase in other fossil fuels' prices and it's accepted as an important resource for energy supply for the countries which don't have enough oil and natural gas resources, shale gas became a current issue in the world. Technically producable shale gas in the world is about 6.621 bcm (billion cubic meter). We can say that this amount may be higher if unsought areas are added. Turkey is one of the countries which has shale gas potential. According to a report published by EIA in 2011, Turkey has approximately 424 billion cubic meter shale gas reserves. This shale gas potential can reduce Turkey's energy dependence if we think of the fact that annual natural gas consumption of Turkey is 46 bcm. Despite all, production of shale gas has not been searched in terms of it's advantages and disadvantages.

The aim of this study is to present the advantages and disadvantages of shales gas for the world and Turkey. Reducing energy dependence, supporting a more clean energy than coal, balancing the oil prices are some advantages. Nevertheless, it's a fossil fuel, it's production is expensive and it gets negative social and environmental reactions.

Key Words: Shale gas, Energy Economics, Turkey, Advantages and Disadvantages of Shale Gas.

1. Introductıon

Energy is a main input for economic activities. Energy is defined as a capacity for doing business and accepted as a power behind every sort of energy and everthing that was changed (Stern, 2004: 37). In literature, the concept of energy was discussed as an ability of doing business for human and animal until industrial revolution. Then industrial revolution caused the usage of steam engine and coal for producing iron. After First World War, oil and natural gas have been used instead of human and animals (Bayramoglu, 2013:5).

Although energy is used in every part of life, it's economic aspects are discussed under a sub-branch of economy, energy economics in this study. Investments and activities to reach natural energy resources provide an increase in accumulation of energy and it's usage in economic activities. Therefore energy is driving force for the development of countries and has importance for countries' strategic positions (LadanaiandVinterbäck, 2009:7).

After energy crisis in 1970s, alternative energy resouces have been sought. Because the reasons like advancement of technology, reduction of costs, international pipeline projects, supporting the security of supply and increasing energy demand day by day; shale gas potential has been analyzed and started to produce. Shale gas is expected to replace other fossil fuels in 2017, and its production is expected to be higher than coal production in the near future (EnergyInstitute, Access Date; 21.03.2014).

Despite all these developments, shale gas is a fossil fuel. Therefore, shale gas is a harmful energy resource for human health and environment from production to final consumption periods. The aim of this study to present the shale gas potential in Turkey and discuss the advantages and disadvantages according to other energy resources. This article will end with conclusion and suggestions.

2. Shale Gas Potentıal In The World And Turkey

Energy demand is increasing day by day both in the whole world and Turkey. It's expected that global natural gas demand will be rapidly increase depending upon its industrial and urban utilization. It's estimated to reach 5 trillion cubic meter in 2035 while natural gas demand was 2 trillion cubic meter in 1990 (Demirbas, 2013:8).Energy crisis in the past compelled the whole world for new energy resources. Shale gas is one of them. Shale gas has been considering as an alternative energy resource especially in USA after developing new technologies and innovations which reduce the cost of its extraction. Shale gas is a type of energy resource which is among the sedimentary rocksthat consist of clay-like minerals with rich organic substance. It can be extracted by horizontal drilling and hydrolic-break method and also it's among non-conventional energy resources (İEA, 2012).

After sharp increases in oil and natural gas prices, shale gas became popular in the worldas a result of alternative energy searching of developed countries and the lack of energy supply in these countries (Asche, Oglend ve Osmnundsen, 2012:122). Drilled oil-wells in the world increase every passing day. In USA, there are thousands of drilled oil-wells but there are less than hundred in China (Centner, T.J. ve O'Connell, L.K., 2014: 359). USA managed to produce more shale gas than it's imported natural gas. These values show that US will soon get out of energy dependence thanks to shale gas.

Shale gas is not a new subject, especially for some countries. For example; USA, Canada and China have been producing for a long time. Today USA is the country which produces the most shale gas among the countries which have shale gas potential. Shale gas has a power to change the world energy prospect if it's potential is used efficiently as an energy resource. According to a report by EIA, shale gas production in USA is 14% of total production of natural gas and oil and shale gas has a potential to support the half of gas production until 2035. According to estimates made by EIA, the countries that have the most shale gas potential are;

After sharp increases in oil and natural gas prices, shale gas became popular in the world as a result of alternative energy searching of developed countries and the lack of energy supply in these countries. When Table-1 analyzed, it is clear to say that total technically recoverable shale gas potential in the world is 6.621 bcm and first 10 shale gas producer countries have a potential of 5.975 bcm. It's estimated to reach 7.299 bcm today (IEA, 2013). China has 19.2 % per cent of recoverable shale gas potential. USA (13%), Argentina (11.7%) and Mexico (10.3%) follows China respectively. Turkey's shale gas potential has % 1.5 of world total. It'll absolutely make a positive effect to reduce Turkey's energy dependence although the amount of shale gas potential is not too much.

Turkey's energy demand has been increasing in recent years and it's expected to continue to increase in the future. According to the report published by EIA in 2011, Turkey's recoverable shale gas reserve is about 424 bcm (Demirbas, 2013:21). As Figure-2 shows, most of this potential is located atSoutheast Anatolia (Dadas Basin) and Trakya Region (Hamitabat and Mezardere)as estimative areas. Also there are shale gas basins near Salt Lake and Sivas Basins but they are non-estimative. With an agreement between TPAO and Shell, if explorations become successful in Mediterranean Region, this known potential will be able to be drilled in Turkey (TPAO, 2014).

Despite different estimations about Turkey's shale gas reserves, when it is considered that Turkey's annual energy consumption is about 46 bcm, it is possible that this shale gas potential can support at least 14-15 years of Turkey's energy need (Kozakoglu, 2013).On one hand increasing energy demand requires the drilling of shale gas, on the other hand increasing environmental consciousness and negative impact of fossil fuels prevent the production. Advantages and disadvantages of producing shale gas are valid not only for Turkey, but also for the world.

3. Literature Summary

In literature studies, shale gas and shale oil's potential in the world, their roles on supporting the world energy need and finally their economic, politic and environmental effects were discussed with their advantages and disadvantages.

There are many studies about shale gas and shale oil. We can give some examples (Altun vd., 2006; Hepbaşlı, 2010; Boyer vd., 2011; Selley, 2012; Weijermars, 2013; Ahıshalı, 2013; EIA-ARI, 2013; Armor, 2013; Hu ve Xu, 2013; Johnson ve Boersma, 2013; Centner ve O'Connell, 2014) from the world.

Boyer et al. (2011: 23) in their study claimed that shale oil reserve estimations made by EIA in 2011 are much more than estimations made by Roger Study in 1997. In the study shale oil were discussed as a global energy resource and shale oil potential was analyzed all over the world, especially in developing countries such as China, India, South Africa and Argentina. Selley (2012: 100-109) analyzed the shale gas and oil potential in England. Weijermars (2013: 101) emphasized the importance of shale gas for Europe in terms of its economic potential. Accordingly, there are about 150-200 bcm technically recoverable shale gas reserves in Europe.

In addition to shale gas and shale oil's potential in the world, there are also studies about their potential in Turkey in the literature. It's stated that there are intense shale oil potential in South-east Anatolia Basin and Trakya Basin and also there may be shale oil reserves in interior parts of Black Sea Region and Toros Basin (Ahıshalı, 2013: 25). Also Altun et al. (2006:211-227) claimed in their study that shale oil has the second most fossil fuel potential after lignite in Turkey. In the study benefits of shale oil and gas for Turkish economy were analyzed. EIA-ARI (2013:170) in the report named ''Shale Gas and Shale Oil Resource Assessment'' points out that there are 94 billion barrel shale oil and 4.7 billion barrel risky but technically recoverable shale oil resources in Anatolia and Trakya Basins in Turkey. Also in the same report it's added that there are 163 trillion cubic meter shale gas potential and 24 trillion cubic meter recoverable shale gas potential in Turkey.

There are many studies about advantages and disadvantages about shale gas and shale oil in literature. Hepbaşlı (2010: 107-118) mentioned about tarry shale oil fields in Turkey and added that fluidized ones can be profited for generating electricity. It was stated that fluidized shale oil was a good tool for igniting various combustibles from wood to hard coal and it has being used since 1980s in industrial area, but it wasn't preferable because mining cost from shale oil fields were higher than the cost of crude oil. Armor (2013:21-26) emphasized the fact that the usage of shale gas as dynamic and chemical were more environment-friendly than petroleum and coal. Altun et al. (2006: 224) explained that the ash of shale oil was used as a raw material of cement in China today. Also it was predicted that a development at the production of shale gas will cause serious environmental disasters and water scarcity in China without taking measures towards environmental pollution, using advanced technology, providing balanced water consumption, preparing a good relationship between industry and local community (Hu ve Xu, 2013: 21-26).Johnson ve Boersma (2013: 389-399) referred the economic, politic and environmental problems which are possible to encounter for Poland, which is a country that begins to build its shale gas industry. It's emphasized that Polish people won't be non-reactive to fast hydrocarbon emission just like North Americans. In addition to this, development in shale gas industy may increase the tension between Poland and Russia. Centner ve O'Connell (2014: 364) claimed that an increase in air and water pollution may prompt new technologies, innovations and job opportunities in health and environment protection sectors.

4. Advantages and Disadvantages of Shale Gas

Although shale gas has been known before, negative or positive results of its production are not still certain. Shale gas is a fossil energy resource. It carries all negative effects of a fosil fuel, but also it offers someopportunities as a new energy resource. Its positives are: It reduces the energy dependence, it can be used instead of coal which is more contaminant than shale gas, it balances the oil prices, it breaks the monopoly of oil exporting countries, it has the power of providing employment and it has the power of improve the economic indicators. It's negatives are shortly: It is a resource which quickens the global warming, it may be one of the reasons of earthquake, its production is highly costly, may pollute the water sources, negative environmental and social reactions and continuity of the usage of fossil fuels.

The main advantages of producing shale gas:

- **It reduces the energy dependence:** Turkey, for example, is a country which import over 60 billion dollars energy every year. China is also dependent to imported energy. China's technically shale gas production potential is approximately 1.275 bcm. Turkey's is around 50 bcm. It is expected that if countries which are dependent to imported energy and have shale gas potential, use these resources for energy, they diminish their energy dependence(EE, 2014). According to estimations made by OGT, shale gas will reduce Europe's energy dependence about % 89 in 2035 (OGT, 2014).
- **It can be used instead of coal which is more contaminant than shale gas:** Shale gas can be stay in diagenesis in good condition for many years. It is drilled by hydrolic breaking method. Therefore it's a new resource to get coal gas and also it can be easily substituted for coal. China gets 70 % of its

energy need from coal. If China uses its shale gas potential, it can pollute the environment less and take the heat off the rest of the world (Xingang, Jiaoli ve Bei, 2013:607).

- **It balances the oil prices:** Oil prices are expected to decrease in case of using shale oil and gas potential by the countries which have shale reserves. USA beginned to produce shale gas and it has already showed its effect on prices (EİA, 2014, Medlock III, 2012: 37,Johnson ve Boersma, 2013: 37).
- **It breaks the monopoly of oil exporting countries:** USA and China are the biggest oil exporting countries. Also they have the biggest shale gas potential. This dual structure will cause the income of oil exporting countries decrease. Especially Arabic countries will be affected badly(Medlock III, 2012: 37).
- **It has the power of providing employment:** It is projected that producing shale gas will contribute to grow employment globally. For example in Texas state, 12.000 people are employed in shale gas sector. It's estimated that shale gas will create more than 70.000 people employed in England. According to OGP, in the long term shale gas will make more than 1.1 million people employed in Europe (OGP, 2014).
- **It has the power of improve the economic indicators:** It's expected that shale gas production will increase competition and reduce the imported energy dependence in the region and also it provides 1.7-3.8 trillion euros for European economy between the years 2020-2050 (OGP, 2014).

The main disadvantages of producing shale gas are:

- **It is a resource which quickens the global warming:** It's recommended to use renewable energy resources and to stop carbon emission before global warming exceeds the critic line for any living thing. Environmentalists and climate change experts mentioned their worries about production of shale gas. As a result of this development, many governments like French Government[*] banned the drilling of shale gas. While drilling shale gas, carbon emission is 3.5 %- 12 % more than conventional gas (Filoğlu, 2013:20).
- **It may be one of the reasons of earthquake:** Drilling the shale gas is made by hydrolic cracking method. This method causes spaces undergound thus it is thought one of the reasons of earthquakes(Filoğlu, 2013:13). Besides, experts point out shale gas as a responsible for small earthquakes in Weeton, England.
- **Its production is highly costly:** Drilling ofshale gas is two times more expensive than natural gas because the existing technology is still so expensive and there is no other suitable technology for shale gas.
- **It may pollute the water sources:** Shale gas is a resource drilled by hydrolic cracking method and some chemicals are used during the application of this method. There are some worries about some chemicals may mix in underground water(Hu ve Xu, 2013: 23). Environmentalists, claims that chemicals which occurs after drilling shale gas, may pollute water sources. Another problem about water is using too much water while drilling shale gas. 182 tons of water is used while a standard well bore but 13.650 tons for shale gas drilling (Xingang, Jiaoli ve Bei, 2013:608). Water purification of used water can be provided by new technologies but cost of purification and too much water use are two negative factors for underground water.(Yıldız, 2013:23).
- **Continuity of the usage of fossil fuels:**Oil, natural gas and coal will run short one day, even if these are different dates. The usage of these resources should be lowered to reduce environmental pollution. Fossil fuel usage will continue for many years by the help of turning shale gas potential into production(Filoğlu, 2013:20).

Also other disadvantages of using shale gas are: negative environmental and social reactions, infringement of habitat, environment pollution, changes in underground structure, disputes between global companies and local residents etc. (Hu ve Xu, 2013:23, Filoğlu, 2013:20).

5. Conclusion and Assessment

[*] French Constitutional Council approved the law in 13 July 2011, which banned shale gas drilling.

All countries have to produce in order to increase their income. Energy is an indespensable factor for production. Energy crisis refers countries to different energy resources. Shale gas is one of them. Shale gas wasn't produced until last few years due to the lack of technology, cost of its extraction and its unknown potential. Now today shale gas is considered as an important energy resource. Shale gas has a big potential to produce energy primarily for China and USA. USA beginned to evaluate this potential and other countries do scientific researches for shale gas production. Technically recoverable shale gas potential is 6.621 bcm and Turkey's potential is 424 bcm.

Thanks to countries' interests in shale gas and abundance of recoverable shale gas potential in the world, its advantages and disadvantages come into prominence. On one hand shale gas gives especially environmental damages because it's a fossil fuel, on the other hand it has some benefits because it has potential to support energy supply security. In this study its possible advantages and disadvantages were discussed as a result of turning shale gas potential into production. The results show that even if its potential and and its production opportunities are known, its advantages and disadvantages should be considered.

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Table1: Technically recoverable shale gas potential (Billion cubic meter)

Source: EİA, World Shale Gas Resources: An İnitial Assesment of 14 Regions Outside the United Satates,

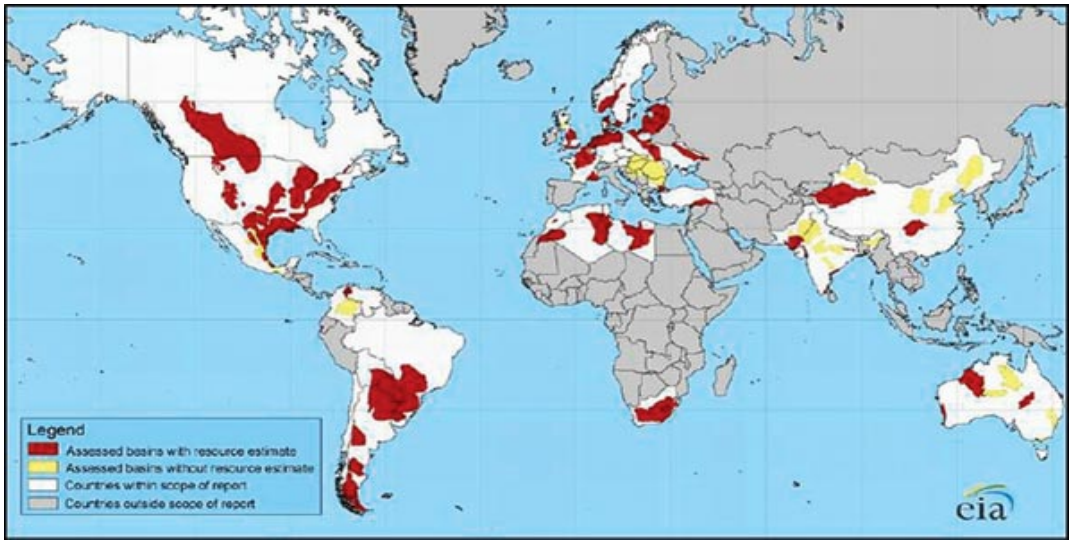
Number	**Country**	**Shale Gas Potential**	**Per cent (%)**
1	China	1,275	19,2
2	USA	862	13,0
3	Argentina	774	11,7
4	Mexico	681	10,3
5	South Africa	485	7,3
6	Australia	396	5,9
7	Canada	388	5,8
8	Libya	290	4,3
9	Algeria	231	3,4
10	Brazil	226	3,4
11	Poland	187	2,8
12	France	180	2,7
13	Turkey	100*	1,5
14	Lithuania	100*	1,5
15	Others	647	9,7
World Total		**6,621**	**100**

http://www.eia.gov/analysis/studies/worldshalegas/ E.T.23.03.2014

*Turkey’s and Lithuania’s potentialat most 100 billion cubic meter.According to estimations by Turkish Petroleum Corporative (TPAO) it’s 20 bcm for sought areas.

*Total per cent may not be 100 % due to rounding off.

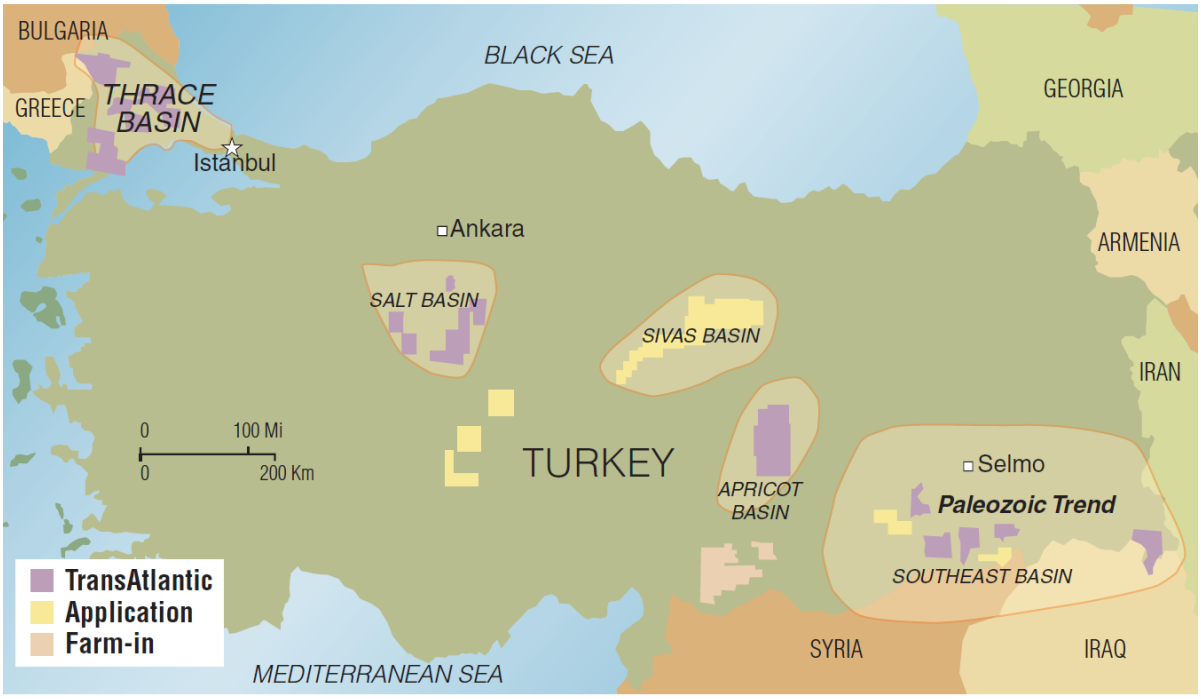
Figure-1: Map of World Shale Gas Potential



Source: EİA, http://www.eia.gov/analysis/studies/worldshalegas/, E.T. 26.03.2014

Figure-1 shows where the shale gas potential is in the world. As figure shows, world potential has a power to change energy prospect in the future.

Figure-2: Shale Gas Potential of Turkey



Source: TPAO, http://www.tpao.gov.tr/tpfiles/userfiles/files/2012-sektor-rapor-mayis-tr.pdf, A.D. 26.03.2014