STRATEGIC APPROACHES TO UNCONVENTIONAL RESOURCES TO MEET THE TURKISH ENERGY DEMAND

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ABSTRACT

Increasing demand in energy makes the world revolve around it. Major oil companies have been researching all around the world as to increase reserve and production. What could we do to find more reserves? Thinking backwards is a way to discover new methodology and associated new technology. That is how unconventional methods stepped in to petroleum industry. As it is known, conventional methods are only able to extract oil from reservoirs with fair enough permeability. Unconventional methods focus on those reservoirs and or source rocks within the range from little down to micron level permeability.

What is challenging when we consider unconventional production? As known, associated technology depends on horizontally drilled wells and fracturing the rock to suck hydrocarbons out to surface. Once the horizontal wells are drilled, water is injected through by powerful pumps to crack the rock. Sand is a necessity to keep the cracks open and some chemical additives provides stability of the cracks to efficiently remove water and gas out, they also prevent bacteria growth. The amount of injected water, sand and additives play a key role since millions of tons of water and hundred thousands of tons of associated sand and additives are used in the hydraulic fracturing process. At this point two main concerns should be addressed. First, the wastewater that is pumped out during production requires high attention due to the chemicals it contains. The chemicals pose serious threats to human health and have to be handled carefully. It could be either recycled for usage in another fracking procedure or injected into a sealed reservoir to be sensitive to the environment. To define impermeable zones, which will trap re-injected wastewater, a thorough stratigraphic evaluation has to be achieved successfully. A leaking disposal formation is unwanted as it is certainly undesired to see those wastes pollute our environment. Second, it has been reported also that there has been an increase in the seismic events in those areas where unconventional technology is used. Tactfully, cracking the rock happens to affect natural balance and causes to stimulate more earthquakes. That information points out that location for unconventional wells have to be chosen far from active fault systems as fracturing might trigger earthquakes with higher magnitude.

As we elaborate Turkey's energy supplies, demands and politics regarding the subject, we might try to answer a couple of questions as follows: How much of unconventional potential Turkey has? Or, can Turkey double its proven reserves by this methodology? Answers are not complicated as one might think. Known facts about unconventional studies suggest that they require using a unique but expensive technology and raise important environmental concerns that might slightly change our lives. A few companies worldwide have the technology required for unconventional hydrocarbon production. Turkey has to pay for the expensive technology for its unconventional reserves. On the other hand, information regarding source rocks of Turkey is still questionable and poorly defined. Suitable source rocks need to be examined thoroughly as in thickness and areal extent before going too deep into unconventional business. As a result, Turkey has to carefully examine and properly define its unconventional resources before thinking that unconventional methods are the solution to ease high costs of energy import.

In this study, we share brief information from a technical window regarding global unconventional energy practices, how it affects the market, how it shapes Turkey's energy policies and further on if Turkey have enough reserves to cover its energy demands. Analysis of the technology used and its economic aspects will certainly point out how Turkey's unconventional future will change its energy supply

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and security chain.

INTRODUCTION

It was believed that the major oil fields had already been discovered and it was unlikely that petroleum companies would be able to succeed a reputable increase in their production. However, these companies had the urge to find another way to increase their production with the help of high oil prices, which allowed them to flexibly invest more money on the researchers. It has been known that only certain amount of hydrocarbon, produced by a source rock, is released through a porous and permeable reservoir rock. Total amount of hydrocarbon produced never equals the amount aggregated in a reservoir rock. This is due to some geological restrictions that affect migration of oil and gas out of source rock such as having micron level permeability, low overburden pressure, etc. At this point in the exploration history, researchers were aware that source rocks had great hydrocarbon potential but the question was: "How could they overcome the impermeability and suck all the oil out?".

It is well known that conventional methods exercise on the reservoir rocks that have a variety of permeability ranges from low to high enough depending on the texture of the sand minerals in depositional environment. Those who are familiar with the exploration and production practices should know the terms "Oil in Place" and "Recoverable Oil". These terms state that how much of hydrocarbon there is in the reservoir and how much of it is producible. In general, the numbers for oil in place are generally calculated as billions of barrels but those for recoverable are lowered to millions of barrels depending on porosity and permeability distribution of the rock. Conventional reservoirs with lower permeability require more effort and time and higher investment costs than those with higher or high enough permeability. Technique used is based on fracturing the reservoir level to provide flow of hydrocarbon trapped in pores. There had been successful applications of horizontal drilling in conventional reservoirs. As the rock already has some fractures, it is easy to extend them or create new cracks. This same logic could be used in tight shales but more wells had to be drilled.

Having these already applied techniques "Fracturing" and "Horizontal Drilling" on hand, researchers stimulated the idea to a higher level. As if they drilled horizontal wells through an impermeable source rock and fractured it, they could suck most of that non-recoverable oil out to the surface. And that is what they exactly did and succeeded! The only handicap was the fact that they had to drill more horizontal wells to use the advantage of cracking procedure, which is now known as "Unconventional Methods".

United States of America (USA) has become the pioneer and practiced unconventional methods for over a decade now. Statistics indicate that USA is the major oil consuming country and the largest importer in the world. However, it now increased its production by 5 million barrels after American oil companies started to develop from unconventional reserves. An important outcome of these 5 million barrels of increase is the fact that small and mid-range companies have gone under a big change and they grew their assets and succeeded a steady growth. Seeing the unconventional potential and witnessing American glory, many countries now aims to find out if they have economic unconventional reserves. European companies seem to struggle with the legislations since they are having hard time to convince European Union that unconventional practices are safe enough for the people and the environment. Countries in the Middle East such as Saudi Arabia have been doing research to guestimate their unconventional resources. China and India, which seem to be largest oil importers in the future, also have important expectations and current activities on defining their unconventional potential. In near future, we might be seeing other countries joining the profitable unconventional club.

UNCONVENTIONAL METHODOLOGY

Unconventional practices depend mainly on

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hydraulic power, which oil industry has been utilizing for the conventional low permeable reservoirs. In general, the industry used hydraulic fracturing to crack the oil rich but low permeable reservoir rocks. That process has been mostly achieved in wells drilled vertical but has also been practiced in horizontal wells drilled through a reservoir. What makes unconventional approach different is that fracturing is applied in a grid of horizontal wells that are drilled in very low permeability shales that are known as source rocks. It is essential to understand that fracturing a rigid rock requires too much pressure and success is measured as a few meters penetration around the well bore. With the new technologic enhancement, it is now possible to fracture a few hundred meters but just one well never does the job. To be able to crack almost impermeable but oil rich rock that extends a few kilometer squares, more than a few horizontal wells need to penetrate through it. That is why designing a well grid for a successful recovery is a must. Upon defining the horizontal well grid, cracking starts by injecting highly pressured water through the hole.

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Water aims to create channels between oil/gas bearing lobes throughout the rock. These channels provide flow of oil/gas into the well bore. However, overburden pressure tends to close all the cracks, which is why a mechanism to keep the cracks open is necessary. The industry uses propping agents such as fine sand and ceramic beads mixed in water. Gelling agents are also added to the water mix to increase fluid viscosity that will help sand minerals travel along with water into the cracks and stay there. Having sand minerals inside the cracks prevents channels from closing and allows the desired flow of hydrocarbons. Stabilizing flow from cracks is essential and it requires other additives such as biocides, breakers, fluid-loss additives, anti-corrosives, friction reducers and acid. All these additives are intended to overcome certain problems associated with preventing bacteria growth, decreasing viscosity and leaking off of the fracturing fluid, protecting metallic elements, allowing high pressures and flow rates and cleaning the perforations, fractures and the well itself respectively.

Fracture water is of importance since it flows back to the surface after its injection to the well. This is called flow-back fluid or wastewater. Considering the amount of injected water might exceed one million gallons per well, the amount of flow-back fluid is as huge. Additionally, it should be handled carefully since it contains harmful chemicals and heavy metals that pose serious threats to fresh water sources and environment. There are a few ways to handle this wastewater that flows back to surface after cracking. It could be either recycled for usage in another fracking procedure or injected into a sealed reservoir to be sensitive to the environment. Recycling requires a number of techniques like distillation and it could be done in either onsite or offsite. Municipal wastewater treatment plant might come in handy if there is one nearby. Some companies dilute wastewater and re-inject it but dilution and reinjection of contaminated water might clog up the well. No matter how water treatment is made, the expenses increase up to such level that makes the project uneconomic. Many companies prefer disposal wells that might cost cheaper. Regulations state that disposal wells have to be deep and wastewater has to be injected between impermeable zones. A leaking disposal formation is unwanted as it is certainly undesired to see those wastes pollute our environment. For a successful disposal process, impermeable zones, which will trap injected wastewater, have to be defined by a thorough stratigraphic evaluation.

UNCONVENTIONAL RESERVES (VALUABLE OR NOT)

Hydraulic fracturing of Marcellus Shale in 2003 changed the assumptions regarding proven oil reserves in the world. Since American oil companies started 'use of multi-well pads and cluster drilling' in 2007, oil reserves increased dramatically as opposed to the idea that reserves would diminish day by day. In the beginning of the 21st century, USA was the largest oil importer in the world. After cracking the Marcellus Shale, USA turned the table around and reached over 5 million barrels production from the unconventional reserves. And now, USA seems to be cutting

on its oil imports. What this means is the fact that USA showed the world that having the science and coupling it with the high technology may change the conscience. As a result, each country might follow the lead, do the same and explore what is underneath their borders. However, USA did this when the oil prices capped $100. Notable information states that; a barrel of oil production from an unconventional well may cost around $60, depending on the geological difficulties and technical hardships. That means many countries have to find a cheaper way to succeed the horizontal well grid in their unconventional gold.

LOOKOUT AT TURKEY'S UNCONVENTIONAL POTENTIAL

Every country that has conventional hydrocarbon production should have unconventional hydrocarbon reserves. Turkey produces oil, gas and condensate from its reserves in the South-East Anatolia and Marmara Regions. Most of its Marmara reserves consist of natural gas, whereas oil reserves are mainly located in the South-East Anatolia. Both regions are considered as potential areas for unconventional explorations and exploitations. Other regions in Turkey have some hydrocarbon potential, too. It has been reported to the national oil company (Turkish Petroleum Corporation, TPAO) that there are lots of oil and gas leaks and spills all around the Anatolia. TPAO carefully examines all the reports and has yet to find valuable reserves in those reported areas but Marmara and South-East Anatolia. That is why areas other than those two should be evaluated in another category of unconventional hydrocarbon potential, for instance, bitumen shale or shale-oil. Concept of this study focuses on 'light tight oil and gas' as for unconventional sources definition and examines Turkey's known conventional hydrocarbon resource areas.

In the USA, there are a few known tight shales such as Bakken, Eagle Ford, etc. that led to famous unconventional discoveries. Almost all of these shales contributed to the production as millions of barrels per day. A certain fact that all these formations were mapped and modelled thoroughly before oil companies prepared their horizontal drilling grids to develop from unconventional reserves. American oil companies have been producing oil and gas from their conventional reservoirs for years. All the oil and gas they produced are known to be migrated from those shales (Bakken, Eagle Ford, etc.). What can be inferred from this fact is that hydrocarbons were formed within these shales and migrated to the conventional light tight oil and gas reservoirs. As it was mentioned earlier in the introduction part of this article, not all of the hydrocarbons that were formed in organic rich shales are migrated to the reservoir rocks. Most of the oil still remained in the shales due to some geological restrictions. The most important of all can be referred as very low permeability. Putting together the information above, it is certainly worth knowing the shape and the size of the light tight oil reserves and if they have formed the oil or yet to do so. If there is hydrocarbon trapped in conventional reservoirs, it means organic material rich rock certainly formed hydrocarbons and spilled it out. Then the source rock can be mapped directly and can be characterized for its oil potential.

Turkey claims that it has great unconventional reserves laid out in Trace and South-East Anatolia Basins. In fact, the whole basins are displayed as if source rocks extend throughout those basins. This logic is due to the assumption that known source rocks in those areas are widely sedimented in those basins. However, either oil and gas discoveries or drilled wells in mentioned areas prove that these source rocks appear not to be present within the whole basins. General findings of oil exploration in Turkey states that produced hydrocarbons are sourced to the rocks as Dadas of Silurian, Karabogaz, Karababa-A member and some to the calcispheres parts of Derdere Formations of Cretaceous age. Even though findings claim that Silurian shales are potential source rocks there is very little information about their presence in the South-East Anatolia Basin. Current unconventional practices try this formation but extent of it still requires more work as far as sedimentology and stratigraphy are considered. Additionally, Karabogaz Formation seem to be

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sedimented only in certain areas even though Karababa-A and Derdere Formations can be found almost everywhere in the South-East Anatolia Basin. Specific questions remain unanswered regarding the accountability of the named source rocks since many exploratory wells turned out to be dry in the region. Three major tectonic cycles during Cretaceous, Eocene and Miocene phases play a key role to shape today's geology in the South-East of Anatolia. The cycles are due to the Arabian and Anatolian plate interactions, which apparently mingles two crustal plates and interfere very badly with the geology. Wells that produce oil are the proof of source rocks but dry wells state that there is a catch to be noted. Many explorers think that main reason for oil not to be abundant could be the overburden pressure, which may be insufficient to start organic materials to switch to kerogen. Or the in-situ temperature of the rocks is low so no hydrogen and carbon molecules are able to make a bond. Another reason could be that not all of those source rocks are really a source rock. Perhaps, only those that sedimented in certain areas had the necessary temperature and pressure to achieve hydrocarbon bonds. To have the real answer, there should be more work done to accomplish as far as knowing the areal extents and thicknesses of formations that reserves light tight oil intact.

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Unconventional production requires using horizontal drilling technology and coupling it with fracturing the oil-rich tight rock. Several companies worldwide have the technology or the companies with the technology seem to be abundant but Turkey has to build its own national drilling teams to lower down the high costs of fracturing. Of course, it is still possible to buy the technology and arrange the production efficiently. Flexibility for hiring foreign professionals would be more beneficial if Turkey had invested in its unconventional potential before the oil price had dropped.

Other concerns as far as the technology goes are that chemicals and water usage are the head actors in unconventional business. Chemical additives to keep the cracks open and prevent bacteria growth are of main concerns because these chemicals pose serious threats to the environment. Water amount used in the fracturing process is huge since it averages over millions of tons per well. Companies prefer to use fresh water supplies since it is cheaper in contrast to drilling water wells. Can Turkey favor its fresh water sources to be depleted by fracturing, moreover how economic will it be? Let us say Turkey has no problems with fresh water usage and it is economic, it still has to pay close attention to contaminated water because it comes out back to surface and some gasses released to the atmosphere after production starts in an unconventional well. The wastewater might as well cause problems since there is a high possibility that it may contaminate the drinking water, pollute the air and the soil. Oil companies, in most cases, handle the wastewater carefully as some of them recycle and reuse it in another fracturing process and some prefer pumping it in disposal wells underground. Yet, there are reports that some of them are not that careful and do not dispose the water accordingly. Some disposal wells might be inappropriate due to leaky faults as there are a lot of them in the areas that are exampled to have Turkey's unconventional potential. To decide if a fault is leaking or not might be difficult since it is impossible to go underground and see it. Using available geophysical, geological and engineering data is a must and testing the disposal formation should be able to guide the companies to the right direction. However, regulations have to be in order to keep the control over the companies and the clean environment.

At last, a point that might be considered as a mild situation and needs attention is the small earthquakes caused by hydraulic fracturing. Pumping high pressured water into a solid rock surely creates cracks. Each crack stimulates a small quake as it is measured by seismometers. Thinking that many cracks are achieved during hydraulic fracturing, the number of quakes recorded increases rapidly in the areas where unconventional work is practiced. Are these quakes dangerous? Probably no, because they are very small in sizes but the point is if there is an active fault that has been drifting by huge energy load, it might, as well, be triggered by those little quakes. This is not to say that big earthquakes

are triggered by fracturing. It only is to point out what seismology states and that is a fact: 'Little forces might trigger huge earthquakes!'. Possibility of this seismological fact is that Arabian Plate is still pushing towards Anatolian Plate, which is why three tectonic stages took place in geological time frame. The interaction is known to be continued and the North and South Anatolian Faults are still active. Geological studies in the area note that some of the faults cuts through Quaternary fluvial sediments. Indeed some of the faults in that area might have had some energy load and that fracturing might fasten the energy load over a fault and might near a potential big earthquake.

STRATEGIC STEPS TO BE CONSIDERED

Each country wants to increase their oil production - reserves since hydrocarbons are the most preferred source used to cover their energy demand. Hydrocarbon usage in Turkey's energy sector is over 700,000 barrels of oil per day (bopd) and Turkey's production only covers 10-15% of the total consumption. Latest news states that USA will become an oil exporter in near future because it started utilizing its unconventional sources. This brings up the question: 'Why not Turkey should do the same?' So it is about the right time to start the challenge. TPAO, as the national oil company, had already signed an agreement with Shell and begun unconventional exploration activities in the South-East Anatolia and Marmara Regions. Even a few wells were drilled in Dadas Fm. The results are hidden at the moment but if there were good news TPAO would definitely share it with public. It looks like new strategies should be considered before going head-down into unconventional reserves of Turkey. At this point, this study aims to pinpoint the needs of a successful start or successful beginning for the unconventional.

According to technical sources or studies, Turkey has a lot of unconventional hydrocarbon potential. A few formations all around Turkey are pointed as having high to very high source rock parameters like total organic carbon (TOC) and hydrogen index (HI) values. Mezardere and Hamitabat from Thrace basin, Dadas, Karabogaz and Karababa-A member from South-East Anatolia basin, Caglayan from Blacksea Region, Karapınaryaylası from Mid-Anatolia, and Akkuyu and Ziyarettepe Formations from the South Anatolia Region are reported to have high TOC and HI values. Those formations with high source rock potential means Turkey has plenty of unconventional oil and gas waiting to be discovered. However, only two of the regions have proven oil reserves or oil has been produced. The other regions have yet to be claimed to have conventional oil reserves since there is no oil discovery. An important step should be to define the source rocks first. A rock might have high TOC or HI values but the question: 'Has it produced hydrocarbon, yet?' has to be answered. If a rock has yielded any hydrocarbon, some of that hydrocarbon would definitely migrate to a nearby reservoir. That knowledge is certain for Thrace and South-East Anatolia Basins. That might be the reason for TPAO, Shell and private companies to consider those basins for unconventional practices. A second question might come in handy since knowing the areal extent and the thickness distribution of the named formations. Have oil companies studied and mapped these formations thoroughly? It was informed that some work has been accomplished in the south east for Dadas Fm. but it was only local and probably not enough to characterize the formation. The knowledge for the proposed potential formations is skeptical because extents of those formations require more seismic work since the information only comes from the well cuttings. As a result, the first step into the unconventional adventure should start at stratigraphic and structural definition of each proposed source rock.

Turkey's drilling technology unsuits the multi well horizontal drilling and high pressured hydraulic fracturing process. Choices for Turkey are either to take the baby steps and learn from scratch as building high pressured pumps and rigs to go with that or to hire service companies to do the job. Another choice might be to find a partner with technology such as Shell and share the profit. TPAO seems to be doing this as it cooperates with

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Shell in south east and with TransAtlantic in Thrace. Hiring service companies seems to be reasonable and will provide more profit as opposed to collaborating with other companies but that will also reduce the profit because production expenses per barrel will increase dramatically. Taking the baby steps should be the main purpose of the national oil company or other private companies operating in Turkey. Waiting for the staff to gain the necessary skills and expertise means a long and painful journey. Designing and building the rigs and the high pressure pumps is never a bad idea. It will open up new frontiers for the Turkish investors and help with economy as well. If Turkish companies acquire the necessary technology and the experienced staff, they might provide services to other companies worldwide, which might drive the economy to a higher level in the long run.

Water supplies are of another concern. Turkey seems to have enough fresh water sources. It may be unfair to criticize losing its water supplies but if the wastewater from unconventional production pollutes the surface water, there might be huge concerns expected to be aroused. Legal authorities need address known allegations and prepare associated laws and regulations to prevent the unconventional pollution to the environment. Laws and regulations need to cover disposal wells, water treatment facilities and specific solutions for air pollutant gasses.

Turkey is located on Anatolian Plate, where too many seismic activities are recorded on a daily basis. Some major earthquakes happen in the strike-slip fault zones. It is possible to come across lots of faults of different geological type (Strike-Slip, Normal, and Reverse Faults) in Anatolia. High pressure hydraulic fracturing may not cause big seismic activities; however, seismology states that one small push might move big mountains. That is why active strike-slip fault zones and faults that might be triggered by these fault zones should be carefully examined.

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CONCLUSION

Unconventional discoveries succeeded in US points out that the countries with low hydrocarbon potential such as Turkey should evaluate and utilize their unconventional resources. It is well known that pioneers in any industry always struggle with the pitfalls. In this unconventional case, the process might be easier for those countries because they have the upper-hand of minimizing the risks and mistakes done in US. Any country that considers investing on their unconventional resources should assess the pros and cons to stay on the safe line for the country and the environment. Economic aspects of the hydrocracking technique should meet the expectations whereas the environment should be kept clean.

As for Turkey with very limited known conventional reserves, it makes sense to examine its unconventional potential to secure its energy supply in the future. However, as mentioned earlier, Turkey should start with considering certain facts and taking a few steps into unconventionals as listed below:

- Unconventional resources have to be studied geologically to assess their economic value. If there is no economic reserve, there is no need to invest. As of today, Turkey's hydrocarbon bearing basins and related source rocks are yet to be mapped thoroughly. To be able to define the basins and reserves, coherent analysis must be designed both structurally and stratigraphically (new seismic and wells) and such source formations should be mapped correctly at each basin.
- Comparison of unconventional production cost in US, averaging about $60 bopd, to about $ 40 bopd for conventional oil production cost in Turkey states that unconventional reserves to be found in the country have to be in great amounts to be a hope for the future. It is obvious that hydrocracking technique is a fairly new technology that Turkey has to pay for. That is why; developing the unconventional resources will never be any cheaper than the rate succeeded in US. Since the technology is expensive, the commercial risks will draw the private companies out of the picture but the governmental support such as awarding

unconventional exploration and development projects in certain potential areas might bring them back in. These awards may also include easy & long term bank loans, tax reductions, etc.

- Ensuring the safe environment should be a must for the government since the development of unconventional resources poses danger to the environment. Chemical additives used in the development process are dangerous to human health and the nature as they pollute the fresh water sources, soil and air. In USA, certain regulations were ordered by the US Senate and some other rules are waiting to be discussed. Turkey should start working on the known cases of environmental hazards caused by pollutants and rule out the terms and procedures in the process of development of unconventional sources. It will be much easier to regulate the oil companies on their work once the environmental legislation system is settled.
- Being in the center of oil and gas related global energy politics and running its industry by the most consumable energy sources as oil and gas, Turkey has to remain firm as far as having energy as the most important item in its political agenda. In the last decade, Ministry of Energy and Natural Resources (MENA) attempts to make Turkey an energy hub between oil producers and exporters. However, being a transit route alone is never enough to control or build the pipelines. In addition to all the efforts for making Turkey a transit route, MENA should be determined to establish a steadfast growth in exploration activities so that oil and gas reaches a desired importance in Turkey's political agenda. If national oil company is unable to lead the industry, MENA should encourage private companies by providing solid investment opportunities and economic support on oil and gas market especially in exploration activities.
- Current statistics regarding Turkish Petroleum Corporation (TPAO) states TPAO's financial situation, experience and technology are insufficient to handle such an uptrend in unconventional exploration and production. MENA should affirm national and international investors to carry the flagship in unconventionals.
- In the case of successful unconventional reservoir discoveries, more service companies for drilling and well completion will be necessary. MENA should clarify any allegations that such companies might encounter under current laws while entering the country.
- An important part of unconventionals is the utilization of fresh water. MENA should regulate plans for fresh water usage and handling the wastewater produced during unconventional development stage.
- Micro earthquakes are of another important concern since Turkey lays on active fault systems. Securing Turkey's future before starting the fracturing shale reserves should be definitely considered. MENA should define a safe tremor scale for fracturing especially nearby active fault systems.
- At last, the oil price is the key element for unconventional investments to be able to continue or stop.

Two scenarios can be derived depending on whether or not the above items are applied:

THE WORST CASE SCENARIO: (AS THE ITEMS IN THE LIST ABOVE ARE NEGLECTED)

National oil company, TPAO will be the main and only actor investing on unconventionals, which means investment capacity is limited to TPAO's own resources. Considering TPAO's current investments and financial situation being very negative, and current low oil prices, it is unlikely that TPAO will favor great investment to the unconventional activities. Being inflexible to invest more TPAO might double its current production number from conventional reserves by adding unconventional resources, which will be estimated as about 0,5 bcma of unconventional gas production and about 30000 bopd of unconventional oil in 2035's.

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THE BEST CASE SCENARIO: (AS THE ITEMS IN THE LIST ABOVE ARE APPLIED)

If MENA succeeds the above list items, there will be more company involvement for investing on unconventional resources. More investment will provide better exploration results and draw the success rate to a higher level as it happened in US. Too many companies (small-mid-large scale) utilized different unconventional basins in US. The production increased 10 times higher than the conventional production. Supposing Turkish government applied the list items presented above, production rates will definitely increase 10 times higher than the current production rates. Estimations will be 5 bcma for unconventional gas and 350,000 bopd for unconventional oil in 2035.

"In conclusion, minimum 20 years needed to define the possible resources. An additional 30 years needed to organize a suitable investment environment, which will help investors to develop the resources and turn into production."

Assuming oil prices will be at again $100 levels after 2020 (if not happens earlier), Turkey's unconventional investment portfolio should be as follows:

BETWEEN 2015 AND 2020:

- Unconventional resources should be defined properly. Each basin and reservoirs should be mapped structurally and stratigraphically.
- Rules and regulations should be written and ready until 2020.
- Economic models should be prepared for the potential reservoirs.

BETWEEN 2020 AND 2025:

- 2020 should be the start for the investments since the oil price will be high enough to extract the unconventional oil and gas.
- MENA should call for the national and international investors.

BETWEEN 2025 AND 2035:

- This interval will be the time to develop the market and adjust rules and regulations as the market grows.
- New laws should be mandated as necessary.

In conclusion, minimum 20 years needed to define the possible resources. An additional 30 years needed to organize a suitable investment environment, which will help investors to develop the resources and turn into production. As it is clear, unconventionals have to be a long term strategy to be followed and the benefits will be rewarding after the first 20 years of 50 years in total.

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