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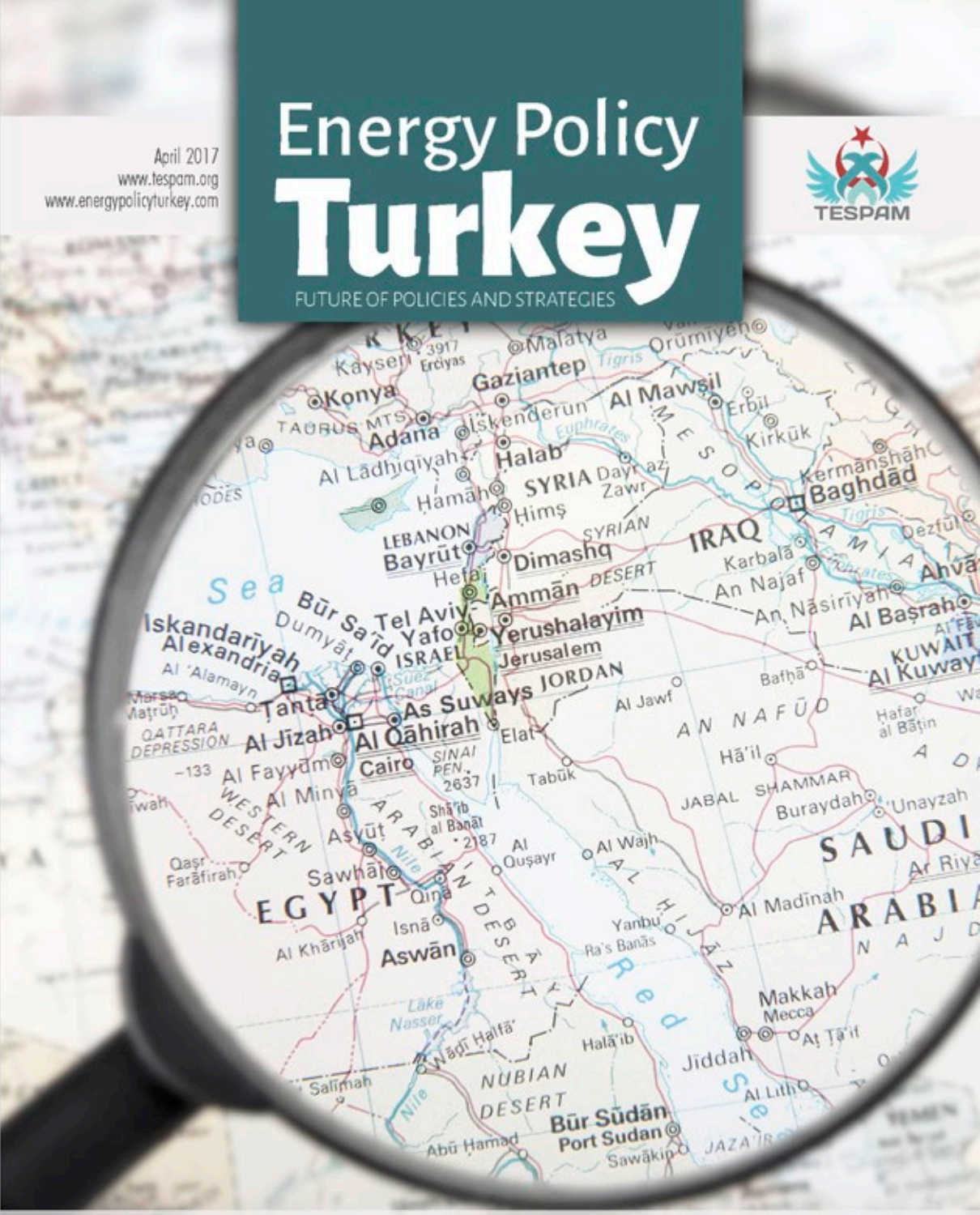
FUTURE OF POLICIES AND STRATEGIES



NEW TURKEY IN THE CENTER OF NEW WORLD ORDER AND THE KEY POINT: ENERGY • MILITARY ALLIANCE ARAB STATES TO CONFRONT IRAN SOON? REALITY AND DISAGREEMENTS HITTING CAPABILITIES • **EGYPT GAS EXPORT POTENTIAL UP TO 2050 & REGIONAL GAS POLICIES** • ENERGY GEOPOLITICS IN THE MIDDLE EAST AFTER THE OPEC SUMMIT • **TRUMP'S FIRST STEPS IN ENERGY POLICIES** • THE USE OF COAL GASES AS AN ALTERNATIVE FUEL FOR ENERGY SUPPLY • **WHAT IS THE SPEED OF ENERGY TRANSITION?** • UNCONVENTIONAL RESOURCES IN TURKEY: MYTH OR REALITY? • **A GLIMPSE ON THE COAL RESERVES AND PRODUCTION IN TURKEY, ECOLOGICAL CARBON CYCLE, AND SOME NEW ERA METHODS OF LOWERING CARBON DIOXIDE LEVELS**

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EDITOR'S NOTE

Sulayman CHAM
(Energy Policy Turkey Editor & TESPAM USA Coordinator)

It is a common knowledge that energy especially gas is the live-wire of the current global economic system since almost every aspect of technology depends on it. Its significances are vast, varied and dependable irrespective of the energy system being studied or talked about. Carat might be produce from a small or larger locations and delivered into a largely multicultural, regional and continental scale purely for our business and home usage. These sources of energy systems could be renewable, nuclear and fossil that might be integrated into electric power networks and may be also fuel infrastructure mainly oil pipelines, natural gas networks, cooling and thermal heating system.

The main purpose of this maiden energy magazine is to unveil a readership forum that will clearly focus on disseminating knowledge on energy systems production in Turkey, its neighbors and the world at large. We aim to provide credible, up to date technologies on energy systems that are vital for human existence since there is a remarkable interdependence between energy and other systems like information networks, data, transport and water.

Turkey is a driving force with an ever-growing economy and its contribution to the global energy system is notable and unrelenting. Such successes could be attributed to standard energy policies that are beneficial, economically viable and environmentally friendly.

The premier of this journal will be highlighting some significant literature reviews on various topic such as global energy policies, resources and their importance. These includes; unconventional resources, coal reserves in Turkey, cost and benefit analysis and much more.

We look forward to your support, suggestions, productive criticism and advertise with our paper.

Thank you for reading and welcome once again to the Tespam's Energy Magazine.

NEW TURKEY IN THE CENTER OF NEW WORLD ORDER AND THE KEY POINT: ENERGY

Oğuzhan AKYENER
(TESPAM President)

World's Changing Dynamics

The shift in the dynamics of the world order resulted in the sharp turns in the international policies of the key players. And these sharp turns has made the governmental predilections changed. These changes started with the USA and expected to be continue with some of the European countries.

But what are the main causes of these changes? Only the economical backdrops?

Offcourse economics is one of the key element effecting the world dynamics but there may be some additional issues influencing both the economics and other balances. Which can be the sovereignty of energy!

THE TOP 10		REVENUES ($M)	
1	Walmart	$482,130	ABD
2	State Grid	$329,601	ÇİN
3	China National Petroleum	$299,271	ÇİN
4	Sinopec Group	$294,344	ÇİN
5	Royal Dutch Shell	$272,156	
6	Exxon Mobil	$246,204	ABD
7	Volkswagen	$236,600	
8	Toyota Motor	$236,592	
9	Apple	$233,715	ABD
10	BP	$225,982	

Graph1: Top 10 Companies in The World According to Their Revenues (Fortune Global 500)

Strenghtening East & Weakening West

Not only by regarding the commercial issues, but also in the technological, military and energy areas, eastern key players have started to become more influential in the international policies.

In order to be able to have more influence in the global dynamics, the companies and related structures of the key players are very important.

From the sight of the owning global companies, the rise of the east can easly be observed. With their financial capabilities, eastern huge companies, can be observed everywhere to compete with the western rivals. And the ongoing results show that they are getting more successfull. This situation can easly be observed by checking the world top 10 companies according to their revenues in 2016.

As can be observed from the graph, with 2 energy companies, China has taken the leadership of the world's giant oil and gas focused structures from the hands of USA. And in addition, it has 3 companies in the top ten list as USA has. This means the balance bells are ringing for the west.

In addition while looking at the number of the world's biggest public companies, China's position after USA and the Russia & India's positions after the European competitors can be seen from the map below.

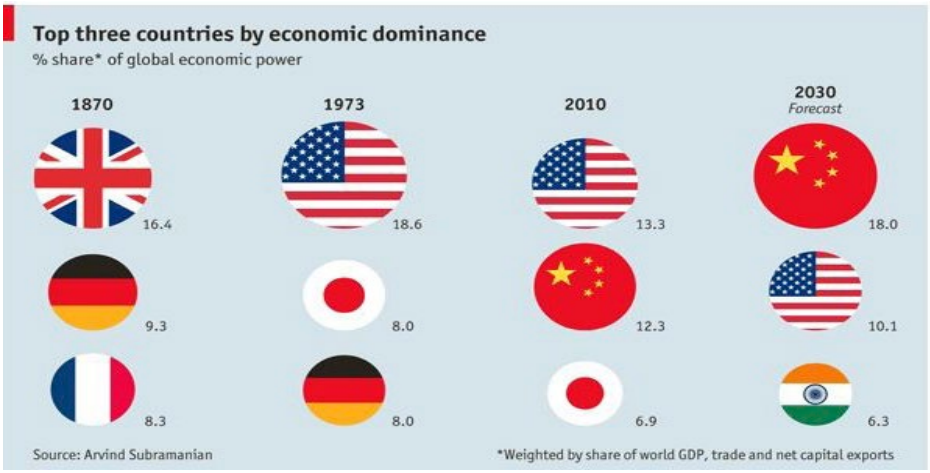
Map1: World's Biggest 2000 Companies 2016 (Source: Forbes)

At last by reviewing the GDP ratios, how dominance is changing hand can easly be observed (as seen in the graph below).

All these clues show that rising east is taking important steps against the west and the world order is fastly continuing to change. Western dominance is ending and the new dominants are the Asian most populated countries.

But can USA or the other European countries allow such a disorder? Are they unified to stop the rising power of China or the other eastern countries?

Actually not!



Graph2: Top 3 Countries by Economic Dominance (Source: World Economic Forum)

They are neither unified nor have parallel policies to change the ongoing situation. Contrarily, they are seperated and this plays in the hands of eastern rulers.

This situation can easly be observerved from the EU & US trillioners' conflicts. Due to their personal investments in China, some European trillioners claims the new leader of the globalisation will be China, instead of the Trump's USA. Conversely, oil and gas trillioners in the US, such as the Rockefeller, directly supported the Trump administration to change all the orders.

Contrarily to China's economical rising, Russia and Iran are increasing their cultural and military influence in the Middle East and in some Mediterranean areas. They are the additional eastern enemies that west is pondering. But again the aggrieved Islam world has lefted to face with many persecutions due to locating in the center of struggling area.

Againg The Black Fog On The Aggrieved Islamic World

Nearly all the actual struggle of the global key actors and their hot war has being continuing since the 18th century in the Islamic geography, where plenty of oil and gas resources exist.

Terrorism, bloody attacks, unrests and persecutions have never ended in the Islamic world since the fall of Ottoman Empire. Initially all the imperialist western countries attacked and tried to share the resources of the region as the hungry wolves. They all had some conflicts between each other and UK used to be the main actor in the region. Then through the first & second world wars and the cold war era key emperial powers continued to compete in the region. After the end of cold war US became the leader of the world. Many diffrent etnic-religious cleansing strategies applied in the dynamics of the due societies and with the beginning of millenium, an intumescent actor China shown its face in the competition.

In addition to China, Russia with the Soviet dreams and Shia exporter Iran were also on the table. An important fraction of the Islamic world made fall into the Arap Spring.

Then it was the turn for one of the most ferocious terrorist organization: Daesh.

With the new government, although US is expected to follow diffrent policies in the region, currently nothing change. There are many conflicts with the Russia and USA in the middle east policies. The Chinese risks are continuing. Iran is stronger and more active in the region and never hesitates to increase the caos in its influential areas.

All the key players -except Turkey- are continuing to work with the terrorist organisations. The black fog on the aggrieved Islamic world couldn't be dispersed.

New Card For The Middle East: Sunni-Shia Conflict

After their chess pawn Daesh has nearly completed its mission, the western block now seems trying to uses next caos card for the region: which ise the Sunni-Shia conflict. Hence they have a good experience on using the conflict management to colonise and direct the regions, they expect to get the demanded results by encouraging such denominations. However, this time new Turkey is trying to be effective in the game. Again!

And USA's current strategy to use Islamic Military Alliance to Fight Terrorism (IMAFT) as a cat's-paw to instigate an hot war between Sunni and Shia forces will not be successful!

Last Chance For The Hopes Of Innocents: New Turkey

All the unrests, coups, terrorist attacks and commercial operations were organized by its Western allies! to weaken the new Turkey in order not to become effective again in its civilization geography.

But the balances this time are diffrent and for the hopes and the prays of the innocents in the region, Turkey has to be successful.

Turkey Being A Key Position In The Altering Balances

In many areas such as technology, economy, indusrty and military; Turkey has made important leaps in the last decades. And from the sights of its civization geography and other due criterias, Turkey holds a key role between the East and the West.

Such a key role means that; in case of a sharp conflict, **the side which Turkey supports will be the winner of the struggle.** While evaluating the commercial, social, military and institutional properties of each sides, that important role of Turkey can easly be understood.

By the way in order to streghten its influence and the due role in the global balances, Turkey mainly has to;

- Continue its political stability (That's why the constitutional referendum in this April is important),
- Continue to ensure its secure investment environment,
- Continue to encourage the developments and studies in the military – energy – industrial technology,

- Focus on having more internationally successful organisations and companies,
- Focus on having huge energy companies,
- Start to deal with all the global balances and its civilization geography,
- Handle the difficult actual milestones related with its closer geography.

Difficult Milestones To Handle: Syria-Cyprus-Iraq-Iran-Terrorism And Insincere Allies

Turkey knows that, anymore it hasn't got a chance to stay away from the affairs in Syria, Iraq and other Shia influencing geographies. There are continuing conflicts, religious-ethnical cleansing operations and millions of migrants are coming to mainly Turkey and some other Western countries. All those innocents migrating and continuing to live in due regions used to be the citizens of Ottoman Empire and now are the heritages of the new Turkey. There is an ongoing and aggravating cruelty in Turkish civilization geography and Turkey does not have a chance to hold on an unconcerned position.

In addition to domestic security policies, social & genetical properties can not let for Turkey to be insensitive on the instances in due regions.

That's why, after the elimination of the rotten eggs in its military structure (after the coup), Turkey steped forward in the regional dynamics with its armed forces.

In addition Turkey started to have closer relations with the eastern countries, by showing this predilection to its insincere western allies. However, ongoing issues in Syria, Iraq and Cyprus showed Turkey that; the east is not more sincere than the west, by taking into consideration of Russian & Iranian steps in due geographies.

Now in Syria, Turkey has to deal with all the unified terrorist groups such as Daesh, PYD&YPG and the Assad Forces and their diffrent allies such as Russia & Iran and the USA.

Turkish forward steps will clearify the results of the choices and the current alliences. However, Turkey seems to have to initially break the dominance of YPG&PYD in all of its southern borders. Then, Assad and Daesh may be the further steps.

In addition, tendency to step back in Bashika, ongoing Mosul operations, etnical cleansing strategies, US's steps to control the "Islamic Military Alliance to Fight Terrorism (IMAFT)" to instigate an hot war between Sunni and Shia forces and the other pressuriorized troubled Cyprus solutions seems as the most important international key issues for Turkey to deal with.

These issues are going to determine the time of the blooming of the Turkish Plane Tree! **In case of a fault, the blooming will be delayed but can not be obstructed!**

Energy Is The Key Of The Gate Of Turkish Domination In Its Civilization Geography

As mentioned above, in addition to the strategic issues that Turkey has to deal with, energy dominance will be the most important leverage for Turkish long term policies

and targets to be successful.

Hence it is obvious that:

- Turkey has a significant civilization geography as the most important heritage of its history.
- From Asia to Caspian, Arabian Plate to all Middle East and Africa in the Turkish civilization geography; there are plenty of energy resources that all the global key players are browing.
- Ottoman Empire used to holding nearly all the due resources in the due regions.
- That's why it was exposed to many attacks by nearly all the Eastern Countries.
- And as the sequel of the Ottoman Empire, the young Turkey made not to focus on energy issues.
- The establishment date of the energy ministry of Turkey and the situations of the related organisations/companies can be understood as the clearification of the above detection.
- Energy is the key issue to consider for all the continuing struggles in the civilization geograhy of Turkey.

So, energy is the most important issue for Turkey and it has to focus on:

- Owning huge energy companies and globally known and successful structures,
- Produce and develop energy technologies,
- Start to take place in the energy projects in its civilization geographies,
- Direct all the energy affairs and declare effective, simple and useful strategies for all due parties to be able accept.

As a result, energy is the key of the gate for Turkey to have dominance in its civilization geography. Therewithal, this geography is the leverage for Turkey to have successful steps in the energy issues.

Not Only The Aggrieved Islam World But All The Human Being Need The Strong Turkey! Why?

All the balances and the dynamics are shifting in the world. With the collapse of the Ottoman Empire, Western Block has taken the global administration. However, in their era humanity has to witness the most cruel face of the imperialism.

By the way new super powers of the Eastern Block: China-India and Russia are not more ingenious than the Western equivalents.

The shifting order of the world will not be more healty, secure, peaceful and humanistic, if the Turkey can not get an influential position in the dynamics.

At this point, the difference between the declerations of the US & Turkish presidents on the Libyan oil resources can be accepted as the clue of this explanation.

Where on the same topic:

Trump rhetoric has given an example of Obama's operation in Libya, which cost US $ 1 billion. In this case, he mentioned that such an operation can only be carried out for Libya's taking of at least half of its oil resources for 25 years.

And The President of Turkey in 2011 related to Libya said that: "Look at Libya, not from the point of petroleum, from the point of conscience!"

The discourse clearly reveals the difference between the painting and the reality.

This is the short view of the new Turkey in the center of the new world order. And also the importance of energy.

MILITARY ALLIANCE ARAB STATES TO CONFRONT IRAN SOON? REALITY AND DISAGREEMENTS HITTING CAPABILITIES

Cyril WIDDERSHOVEN
(Verocy Director)

Since the end of 2016, alliances in the Middle East again have become very fluid. Internal pressure, regional aspirations and the fall-out of the new Trump Administration, are having a detrimental effect on the region's military-political constellation. After several years of a Sunni-Shi'a confrontation in Syria and Yemen, which has led to the setup of a Sunni-led military alliance, bringing together Arab, African and Asian countries, including Turkey, Trump's Administration now has put its weight behind it too.[1] Several American advisors of Trump's skeleton government already have called for an increased Arab-Israeli cooperation to confront the ongoing power build-up of Iran and its regional allies.[2] The Middle East seems to be heading to a military showdown if no diplomatic breakthrough is popping up. The Sunni-Shi'a power struggle, partly supported by the ongoing Russian power projections in the Levant and North Africa, could lead to military clashes not only in the Persian Gulf, Yemen, Syria, but spread even to the North-Africa/Red Sea arena[3]. No clear picture can yet be painted with regards a possible military upper-hand, as both sides are not very transparent about their real capabilities[4]. To block Iran's perceived encroachment on Sunni grounds, the Sunni military alliance or "Islamic Military Alliance to Fight Terrorism (IMAFT)" is being set up. The future success however is decided by three Arab members, Saudi Arabia, Egypt and the UAE, while Turkey (as the only NATO member) is playing an ever-growing role in the setup the last months.

At the end 2015 Sunni Islamic countries have set up a global military alliance, which was at the start being proponed as a global fight against terrorism. At least, the official reason for founding father Saudi Arabia was that it is an "Islamic Military Alliance to Fight Terrorism (IMAFT)"[5]. The latter included from the beginning mostly Arab GCC and North African countries, but excluded Iran, Iraq, Syria and Yemen. Several other countries from Africa and Asia, especially Pakistan, have been included from the start. This obvious division of Sunni-Shi'a military cooperation has however taken over and led to a full-fledged anti-Iran strategy.

Anti-Iran

Since the start of the alliance, which is fully promoted by Saudi Deputy Crown Prince and Minister of Defense Mohammed Bin Salman, a long list of questions has popped up with regards to the main purpose of the so-called Sunni "NATO project". Main issue is the underlying strategic approach of the alliance. Outside analysts have dubbed it to be an anti-Iran or anti-Shi'a alliance, mainly targeting the growing geostrategic position that Iran and its allies, Hezbollah, Houthis, Assad and indirectly Russia, have been acquiring in the MENA region. Under the title of IMAFT, targeting officially the rise of IS/Daesh and Al Qaeda, Saudi Arabia, UAE and Egypt, have been setting up a military cooperation to confront the encroachment of Iranian military and semi-military forces on the borders of the leading Sunni states.

However, the impact of IMAFT has been not very impressive to say the least. Even that leading Arab countries, Saudi Arabia, Egypt, UAE, Jordan, have been able to commit themselves to the whole idea, bringing even in the support of Turkey, Pakistan and others, it still didn't result in a full-fledged military cooperation able to even project power beyond its own territory. Some attempts have been made, such as the February 2016 Saudi Arabia-led massive military exercise, called Northern Thunder, which included military assets and troops of around 20 different countries. The military exercise, which took place in King Khalid Military City in northeastern Saudi Arabia, entailed military exercises of the forces of Saudi Arabia's, Jordan, Bahrain, Senegal, Oman, Qatar, United Arab Emirates, Sudan, Kuwait, the Maldives, Morocco, Pakistan, Chad, Tunisia, Comoro Islands, Djibouti, Malaysia, Egypt, Mauritania and Mauritius. Looking at the full line-up of the exercise, the only functional participation however has come from the GCC states, Egypt, Jordan and Pakistan. The others on the list even don't have any military force to speak of. Still, the first steps towards an integrated cooperation of the main forces have been taken.

The move of Saudi Arabia, aka Deputy Crown Prince Mohammed bin Salman, to set up this alliance has not come as a surprise. The Wahhabi Sunni Kingdom has become a major focal point of Iranian subversive operations. Riyadh, while still supporting the anti-Assad opposition groups, has also become entangled in the Yemen war. In both cases, Saudi operations are facing directly or by-proxy Iranian forces. The Syrian Assad government is heavily backed by Tehran. Without the military support of Iran, and Russia, current successes on the ground would not have been possible. Shi'a support for the Alawi-backed Assad regime, in combination with Hezbollah support, is still the main life-line of the regime. Saudi Arabia, UAE, Bahrain and Qatar, have been since the beginning of the anti-Assad revolt heavily involved, largely supporting financial and military support to the wide-range of opposition groups. Still, the lack of success of these anti-Assad forces, in combination with IS/Daesh related operations, have confronted the Sunni states with a fait accompli. Iran's Shi'a approach was more successful. A Shi'a led Syria, in combination with Iran's growing military-political power in Iraq, confronts Riyadh with an arch of instability on its northern borders.

At the same time, Iran became heavily involved in the ongoing civil war in Yemen. Tehran openly supports the Houthi-rebel forces, which are currently fighting an open war against Saudi-UAE backed Yemen government forces. After initial successes of

the Saudi-UAE involvement, current situation on the ground doesn't bode well for the future. The Houthi forces are getting experienced in addressing the weak-spots of the Saudi-UAE led operations, mainly as both GCC countries are not willing to put a real military force on the ground to challenge the Houthis and their Iranian supporters. Still, Saudi Arabia and the UAE are committed to the continuing battle against the Houthi's and Iranian supported factions.

IMAFT

Several analysts also have openly stated that IMAFT is a Sunni military bloc primarily meant to be a deterrent to Iran[6]. The omission of Shi'ite led countries, such as Iran, Iraq and Syria, shows that the overall strategy is not an anti-terrorism alliance, as the Shi'ite led countries are also fighting against IS/Daesh, Al Qaeda and others. The latter even goes for Lebanon's main political power at present, Hezbollah. In 2016 Saudi Deputy Crown Prince and Defense Minister Mohammed Bin Salman already indicated that the Sunni bloc was not only meant to support counter-terrorism operations. He added several times that the military alliance also would be countering other threats than only IS/Daesh. MBS also stated to the press that the coalition would fight terrorist groups "regardless of their categorization," particularly in Syria and Iraq, where he said there will be co-operation with the international community.

IMAFT is not a new kid on the block, as the Arab Gulf states, and several other Sunni countries, such as Egypt and Jordan, have been heavily involved with US and Western forces in the region. Close cooperation and military training has been in place for years, especially after the Arab Spring and the rise of IS/Daesh. In 2015, the Arab Gulf states, led by Saudi Arabia and the UAE, joined the Western US-led coalition to carry out airstrikes in Syria against IS. After a short period of heavy involvement of the GCC countries, total commitment to Syrian operations however has faltered. Since the Saudi-UAE military operations in Yemen, military activities have been concentrating on the Yemen theatre mainly.

For most Western diplomats and military analysts, the setup of IMAFT was a surprise. US and NATO officials indicated at that time that they had not been informed at all. When asked,

U.S. Defence Secretary Ash Carter, during a visit to the Incerlik Air Base in Turkey, stated "In general, at least, it appears that it's very much aligned with something that we've been urging for quite some time, which is greater involvement in the campaign to combat ISIL by Sunni Arab countries." Josh Earnest, White House spokesman of the Obama Administration, stated that the alliance wouldn't be a substitute or a replacement for the U.S.-led coalition fighting IS militants, noting the Saudi effort was intended to focus on broader targets.

These broader targets, as implied above, were substantiated partly by Adel Al Jubeir, Saudi minister of foreign affairs, who stated that members could ask for assistance from the coalition, which would address the requests "on a case-by-case basis." Al Jubeir did not rule out the deployment of ground troops. In how far this will be put to a test is not yet clear.

Crisis in the Making?

The military power of IMAFT, in principle involving the armies of GCC countries but also Pakistan, Turkey and Egypt, together with a long-list of smaller states, is on a regional basis a formidable one. However, problems are already building up, as Arab countries don't necessarily have the same goals and strategies. The ongoing diplomatic crisis between two main powers, Saudi Arabia and Egypt, already has put immense pressure on the effectiveness and functionality of the total alliance. In 2015, when the whole strategic approach was discussed between the leading Arab states, a military alliance of GCC-Egypt and Jordan, would have been enough to counter any possible Shi'a encroachment in the MENA region. The military capabilities of the combined forces of Egypt, Jordan and Saudi-UAE, would have been strong enough to counter or even engage third party operations. This however changed dramatically after that the Saudi-Egyptian marriage ended up in almost a divorce. Saudi financial and political ties and influence on Egypt's politics were confronted by Egyptian nationalism and a strategic re-evaluation of Cairo's priorities.

IMAFT confronted by national (Arab) strategies

In addition to the continuing Arab infighting, ongoing military cooperation of IMAFT is also constrained by national security strategies. Saudi Arabia and the UAE are stepping up their own military reach, even outside of their own area, such as the Gulf of Aden and the Red Sea. The latter has become imperative due to the growing influence of Iran in the latter region, aka Yemen. In recent years, Iran has sought to establish alliances with Eritrea, Sudan and other countries in the Red Sea region to enhance its capabilities against two of its key enemies, Israel and Saudi Arabia, which both have naval access to the Red Sea. In Yemen, Iran's involvement is strategic, as it also has given it access to the Red Sea. Arab analysts are very worried about the possibility that Iran's navy could gain naval bases access from which it could threaten shipping through the Bab el Mandeb strait, the Red Sea's southern gateway to the Indian Ocean. The Horn of Africa is particularly important because it has a 2,500-mile coastline that runs from Sudan in the north to Kenya in the south and close to Red Sea and South African Cape maritime routes.

To counter the Iranian encroachment, Saudi Arabia and the UAE have either established or are preparing three military bases strategically located around the western shore of the Red Sea and on the Gulf of Aden. In Somaliland, the UAE has been approved to set up a military base at the port of Berbera on the Gulf of Aden. In Eritrea, the UAE already is since 2015 building a major air and naval base next to port of Assab. Saudi Arabia has been following, as it is now finalizing an agreement for a base in Djibouti. Djibouti has the added advantage of being a member of the Arab League and of the 34-state Saudi-led anti-Iranian "Islamic coalition" announced in December 2015.

Instead of coordinating the security issues in the Red Sea within a framework of the IMAFT, Egypt also is increasing its overall naval presence in the area[7]. In January 2017 the Egyptian navy has established a naval force in the Red Sea. The latter, officials stated, is meant to protect navigation in the Suez Canal, a vital waterway for international trade. Egypt's former Assistant Minister of Defense, Hossam Suweilam, said that "the force will be the backbone of Egypt's new Red Sea strategy…. There is a marked surge of

unrest in the southern entrance to the Red Sea, which needs an aggressive policy." The Red Sea force will utilize recently acquired naval equipment, including a French-made multifunction helicopter carrier. Egypt's Defense Minister Sedki Sobhi was more clear about the underlying reason. He stated that the force would help Egypt impose control on its territorial waters in the Red Sea. Officially, the navy will be use to protect the Suez Canal traffic. Cairo has invested around $8 billion in a parallel channel to shorten transit time in the Suez Canal in 2015.

At the same time, president Sisi ordered in April 2016 Prime Minister Sherif Ismail to sign a maritime border demarcation agreement with Saudi Arabia, handing over two disputed Red Sea islands to Riyadh. However, this has been cancelled as Egyptian courts have overturned the latter[8]. Opposition on the streets also was overwhelming and even threatened Sisi's position.

Some analysts have indicated that one other reason for Egypt's drive for a navy presence in the Red Sea is presumed hydrocarbon reserves. "Such a potential wealth is badly in need of a military power to protect it," said Nasr Salem, a lecturer at Nasser Military Academy, the Egyptian army's strategic and military science institute. All of this could be threatened by external forces, such as the presence of pro-Iranian forces or even Iranian navy. The fear in Egypt is that the Houthis can threaten traffic in the strait, which would deal an irreversible blow to the Suez Canal. An Iranian presence in the area, Yemen-Sudan or Horn of Africa, would also threaten it.

Cairo Confronts Saudi-led IMAFT

Egypt's overall position in and with regards to IMAFT has always already been ambiguous. IMAFT is seen in Egypt as a Saudi answer to a call by Egypt, via an Egyptian-sponsored Arab Summit resolution (March 2015), to create an Arab Rapid Deployment Force. At that time, Egypt, Saudi Arabia and the United Arab Emirates were providing most that contingent's manpower and funding. Arab League Secretary-General Nabil al-Arabi before the meeting in March already called for the establishment of a joint fighting force, one aimed at combating the spread of extremist groups. "There is an urgent need for the creation of a multi-purpose common Arab military force... able to intervene rapidly to fight terrorism and the activities of terrorist groups," the official stated.

Egyptian sources indicated that Arab League/Egyptian plan entailed that the unified command would be a multilateral rapid deployment force based in Cairo. Main forces would come from the Egyptians, as the remaining Arab countries don't have large standing armies. For Cairo, the latter would have been a boost of its regional (Sunni) power position. The months before, Egyptian president Abdel Fattah al Sisi strongly advocated for greater security coordination against terrorism. The Egyptian idea also was supported by the fact that the US and EU rejected Cairo's call for a renewed UN intervention in Libya. The outcome of the overall Arab League proposal however has been rather disappointing, especially to the Egyptians. Even that Gulf Cooperation Council (GCC) efforts until than were rather struggling to reach a coordinated military cooperation, the Saudi idea for IMAFT has been taken on without real discourse. It could be argued that the GCC countries have been behind the setup of IMAFT to counter the possible military power projections of an Egyptian-led military force in future.

IMAFT Imminent Future

Still, the IMAFT future is still undecided, as Arab countries, including possible third party Sunni forces from Turkey, Pakistan and others, have always been riddled with disagreements. The prioritization of a combined military forces, under leadership of a leading Arab country, to counter threats to the region, is still far away. A lack of coordination between the so-called member-states is also again apparent. Different military strategies or regional power strategies of Saudi Arabia, the UAE, Jordan or Egypt, have already shown, as indicated above, to have a debilitating effect on the current military cooperation.

When looking at the IMAFT strategy towards Syria, it has become very clear that GCC countries (Saudi Arabia-UAE) are having a totally different approach at present than is being taken by Cairo. The Gulf Arab countries are still largely combining their efforts to remove the Shi'a alliance of Syrian president Assad from the country. Cairo, after starting a tit-for-tat diplomatic conflict with Saudi Arabia, has shown a willingness to open to a discussion with Russia and Iran on the future of the Syrian ruling elite. This will not go down lightly within the ruling circles in Riyadh and/or Abu Dhabi.

Another possible divisive element will be the role that others in the alliance are playing. The ongoing conflict between Cairo and Qatar is still not resolved at all. The support of the Qatari government of the Muslim Brotherhood government of Mohammed Mursi, after the removal of President Husni Mubarak, is still not forgotten. Mainstream Egyptian politicians and military are still very wary about Qatar's continuing openness to the Muslim Brotherhood, support of Hamas and its role in the Syrian conflict. On this level, Egypt and Saudi Arabia have been agreeing for a very long time, but current developments in Saudi Arabia could change this to the worse.

For Egypt, the Muslim Brotherhood position in national and regional politics is a red-line. Not only Qatar's perceived pro-MB standpoints, but also continuing pro-MB statements popping up in Turkey, are putting pressure on Egypt's overall willingness to commit itself to IMAFT or to confront the Iranian supported groups in the region. For Saudi Arabia, the latter is not a breaking point in any discussion. This already has been proven by the ongoing rapprochement between Riyadh and Turkey, who has been very vocal in the support of Muslim Brotherhood.

IMAFT To End In Arab Disagreement?

The Arab (Sunni) military alliance is until now seen as part of a continuing trend in the Middle East. Military cooperation between Arab states has always been the dream of a long-list of leaders in the region. After all, the Middle East has seen at least five attempts at joining military forces since the Second World War, two of which included Saudi Arabia. As many have written before, none of these succeeded. Whether the Arab League's Joint Defence Pact, the Middle East Command, the Middle East Defense Organization, the Baghdad Pact (officially known as the Middle East Treaty Organization), or indeed the Gulf Cooperation Council (GCC), no previous alliance lived up to its own security standards. Continuing regional political shifts, internal and external strive and power politics of perceived Arab leaders, have always prevented a success. Even during major military events or conflicts, such as the Arab Israeli wars (1947-1973), Lebanon's

Civil War and Syrian intervention, Yemen War in the 1950s, Iraq's invasion of Kuwait or even the Iraq-Iran War (1980-1988), no Arab military alliance has been formed and supported the others. Nevertheless, the idea to cooperate militarily on a more regular basis has again re-emerged.

Even that some indicated it is another old idea in a new bottle, some analysis could show that there is possibly a different geopolitical situation in the region at present. Economic issues are also playing a role, as the hey-days of crude oil revenues streaming in, forming the situation of rentier states, are largely over. Spending patterns have been changed dramatically in most of the Arab Gulf states, while at the same time the Arab periphery, including Egypt, has been hit by economic turmoil and outright revolts. The effects of the Arab Spring, which hit Tunisia, Libya, Egypt and Syria, were largely not felt in the Arab Gulf.

The latter situation of stability in the GCC changed dramatically, when not only Iran showed an increased willingness to project its power to Sunni area (Syria, Lebanon, Iraq and Yemen), but also a Sunni-originated extremist group, ISIS or Daesh, become a prominent destabilization fact. The latter's unexpected success militarily on the ground, threatening even the collapse of Syria and Iraq, while projecting its future threats to Saudi Arabia and the Gulf Arab countries, shocked the rentier states. Military capabilities of the GCC countries, even that looking at their defense expenditure an immense amount of hardware has been acquired, are still below a rationally needed level. Confronted by economic hardship, high unemployment, radicalization and the end to the Pax Americana under former US president Obama, Sunni countries in the region needed to reassess their options and realign their security arrangements with military and economic reality. The need for efficiency to cost-savings to political legitimacy, in combination with a share threat (Daesh/Iran), have led to a renewed fever to build up a military alliance.

At the same time, the IMAFT foundations have not been built on just a dream of the Saudis. Since 2013 Saudi Arabia has been actively pushing for increased regional military coordination. Riyadh pushed in 2013 for a NATO-like integrated command structure for GCC military forces, including 100,000 troops[9]. Until now, all these GCC military integration projects have been progressing very slowly.

In 2015, as already stated before, Riyadh, in strong cooperation with the Sisi government in Egypt, pushed for the creation of a common anti-terror force under the umbrella of the League of Arab States. This 'Joint Arab Force' was to have 40,000 troops, as well as a standing command structure[10]. The underlying reason was the growing threat to the GCC countries, and the ongoing struggle inside of Egypt to remove Muslim Brotherhood and others from power. Egypt even declared openly that it sees GCC security issues as an integral part of its own security environment. However, words were again not met by deeds. Internal regional differences have led that this effort again was put on ice.

GCC countries at that time were heavily involved already in the Syrian conundrum and fighting against Houthis and Iran in Yemen, while Cairo's main target was and is the ongoing battle in the Sinai against Daesh, while it wants to have stability in Libya at the same time. Another major stumble block is the fact that Egypt already in 2016 indicated

that it would be open for any discussion on Syria's future, which indicated even an option to discuss with Russia and Assad how to deal with the ongoing conflict. The latter of course stands contrary to the GCC approach, as all Arab Gulf states are currently supporting the anti-Assad groups in full[11].

Power Politics Breaking Up Saudi-Egyptian Cooperation

Egypt and Saudi Arabia also are having a strategic conflict. Both parties are currently trying to regain their former status or acquire a leading role in the New Middle East. Based on the historically and practical power position of Egypt, and especially its armed forces in the Arab world, a leading role for Cairo's generals in any military operation or configuration would be normal. Sisi's strategy to position the Egyptian forces, its main power base at present, as the leading for in any Arab/Sunni military organization has not only lead to a direct conflict with the Gulf Arab states, but also has caused Cairo to reconsider its strategic options.

At the same time, Saudi's move to set up, almost unilaterally IMAFT, is seen by mainstream Saudi military strategists, and Deputy Crown Prince Mohammed bin Salman, as a legitimate move to acquire a leading position in the Middle East. Riyadh already in 2013-2015 was not keen at all to fund a mainly Egyptian military force, capable of even invading other Arab countries. Some leaders in Riyadh were very wary of the possibility of such as force invading an Arab country (Saudi Arabia) under the pretext of fighting terrorism. Still, without the involvement and support of Egypt's armed forces, IMAFT or whatever it will be called in due course, is a tiger without teeth.

Reality Is Bleak And Hits In?

Gulf Arab countries fully understood that any real military opposition against a covert or direct Iranian attack will only be able to be countered by an Arab army including Egypt. No real other strategic options at present are on the table for the GCC region, considering the partly retraction of US engagement in the Middle East. Gulf Arab countries, especially Saudi Arabia, have been very disappointed by the US support (and the West) of not only the Arab Spring but more importantly the Iran nuclear deal. The support to lift almost all sanctions on Iran has brought a deep feeling of being abandoned by the West. The US also ruled out that they would actively support a mutual defence pact with the GCC countries. A possible NATO-like military cooperation between Washington and the GCC, which would have been a dream come true for the Arab countries, was totally put on ice[12].

No other option than to put a full Arab military cooperation in force was at that time seen as the only option left. However, several Arab countries could not be taken in, Syria, Libya, Yemen and Iraq, were out of the total constellation already. Iran's full military cooperation with Syria and Iraq, even able to overwhelm Western support to opposition groups, confronted Saudi Arabia and its compatriots in the Gulf, with a dire situation. The only option left was to start it with a skeleton force of Arab countries, even leaving out Oman at that time[13], and to ask non-Arab Sunni Islamic countries to join. Hence the surprise move to take in countries from Africa and Asia, including Pakistan. The latter is

still seen as one of the strongest non-Arab Islamic countries, when looking at its armed forces and nuclear capabilities. For some analysts, Saudi's choice to ask Pakistan is clear. Pakistani armed forces are very intertwined with Saudi armed forces, as they have been supporting and training with Saudi forces since decades.

The Pakistani nuclear capability is also regarded as a strong strategic asset. Since the acquisition of a nuclear bomb, Pakistan's arsenal also has been dubbed the Islamic Nuclear Bomb, as part of its research and development was funded by Arab countries. Taking in Pakistan not only increased IMAFT's capabilities, but indirectly also confronted Iran with a second military front on its own borders, this time including a nuclear weapon option.

The distrust between Saudi Arabia and the US (West) also has resulted in another development. Saudi military evolution shows that it has become much more enticed to set up its own military force in full. Since 2003, its army has almost doubled, reaching a level of just above 200,000. The Saudi Air Force, which was not a real force in the 1990s or even beginning of the 21st Century, now is the second largest in the Arab world (behind Egypt), entailing around 300 planes. With its own missile defense systems and a burgeoning navy, the current defense posture is becoming impressive, in GCC terms. Still, a military confrontation with Iran would be looking for trouble and possible defeat.

The ongoing Yemen confrontation also has led to a direr situation in the Syria-Iraq theatre. GCC forces are currently not anymore active in and around Syria. The only Sunni forces still in place are the Turkish army and Jordanian assets. Fighting on a third front, Libya, which would have been a major feature of a real Sunni military cooperation after Syria, is presently not possible. Egypt and the UAE are the only ones willing and able to act in North Africa[14]. The weakness of IMAFT approach at present is showing[15]. Will Turkey come to the rescue the main question is.

Turkey

After being already part of IMAFT from the start, Turkey's role is currently growing. Turkish president Erdogan has shown a willingness to act unilaterally, not only in his fight against terrorism in Turkey, but also willing to put Turkish armed forces in harm's way if this will increase the regional power position of the country. The assertiveness of Turkey in addressing the Daesh, and Kurdish armed groups, in Syria and Iraq, has brought Ankara a lot of praise inside the Arab ruling elites. The aggressive stand of Turkey, even with the danger of coming into a military confrontation with Russia, Iran, Hezbollah or others, is worrying to some but most Arab Sunni countries in the Gulf region are looking at it with positive feelings. The latter already has brought a major change in the relationship between countries such as Saudi Arabia, UAE and Qatar on one side, and Turkey on the other.

In April 2016, it became clear that Saudi Arabia and Turkey were looking at a new marriage of convenience. The visit of King Salman to Turkey, officially to attend the Organization of the Islamic Conference in Istanbul, was showing a thaw in relations. The latter meeting was a follow-up of Turkish president Erdogan in December 2015. The Erdogan meeting in 2015 resulted in a strategic cooperation agreement, entailing

military, economic and investment. When looking back now, it can be a first step of the creation of IMAFT. For Turkey, its strategy is still very diffuse. Some can argue that the alliance with Saudi Arabia has increased Ankara's position to build up its regional strategic capacity in the Middle East. The setup of Turkish military bases in Qatar and Somalia is a sample of this. For Saudi, the Turkish involvement is also important, not only as Ankara can provide the 2nd largest armed forces in NATO, but also opens to Riyadh a highly sophisticated defence and military electronics industries. The latter has already been partly put in place, as there is a growing defense cooperation showing between Saudi and Turkish counterparts[16].

Riyadh seems to be happy to have Ankara in its military constellation, as this keeps Cairo partly in check, while also Saudi Arabia, and its GCC compatriots, have direct links to Turkey in case of a deepening confrontation with Iran. At the same time, Turkey's growing cooperation with Russia (and Iran) presents the Arab countries with a major challenge. A split between the Sunni Arabs and Turkey could lead to a further destabilization of the already embattled region. If Turkey and Russia also can bring in Egypt to the other side (according to main-stream Arab the Dark Side), Saudi Arabia's aspirations to lead the Arab Sunni world in the coming years could be in shambles.

For Riyadh, there is even more at stake than only the military confrontation with Iran and the instability on its borders. Saudi strategists will also be looking at the necessity of increased inter-Arab cooperation and the integration of Turkey in its influence spheres if the economic confrontation with Iran is to be won too. Analysts are referring to Turkey's renewed close relations with Moscow as a USP for Ankara in its discussions with the Arabs. At present, Saudi Arabia (as the main OPEC producer) and other Arab GCC producers are looking at Moscow, leading non-OPEC producers (if taking out the US), for increased coordination in the oil markets. After decades of confrontation between OPEC and Russia, the current situation is the contrary. Leaving geopolitical issues aside (especially Syria-Iraq), Saudi Arabia is looking for cooperation with Moscow. The latter already has opened to this, as it decided in 2016 to openly discuss OPEC-Non-OPEC cooperation in full. Turkey's role in this new relation could be vital, as it holds stakes on both sides. Ankara has reopened its channels with Moscow, even discussing at present military cooperation and Russian military exports to the NATO country. At the same time, Ankara is steadily improving its stand in the Arab world, with as its main focal point Saudi Arabia and Qatar. Growing economic and military cooperation is one of the cornerstones at present. Saudi Arabia (and several GCC countries) fully acknowledge the pivotal role of these Arab countries, but also is more than willing to be a bridge between Russia and the Arab world. As a Sunni European-Asian power broker, it can bring its European/Western approach in line with a Sunni-Islamic flavor. Some even have indicated that Turkey's ongoing economic relations with Iran will be a price asset, as Ankara can discuss Sunni-geopolitical concerns in full in Tehran. Arab political strategists also have said that the Arab rapprochement with Turkey is meant to increase the pressure on the Russian-Iranian military cooperation. By opening to a more normal geopolitical, economic and military relationship with Russia, Arab countries, including Turkey, could become much more attractive to Moscow than its current main ally in the region, Iran and its supporters (Assad-Hezbollah).

For Turkey, the current reorientation on the Middle East has been pushed forward

by an unexpected military coup mid-July 2016. The reactions from the West, and large amount of criticism on president Erdogan, have forced it to focus on the Middle East, looking for a new power position in the Arab world. An alignment with Russia and China, as some have been afraid off, is currently not really on the table. At present, Ankara is in a decision-making process which could lead to a rearrangement of alliances. When looking at IMAFT, Turkey is at present interested in this third alternative, a regional security alliance, led by Saudi Arabia, but supported by Pakistan. For Western analysts, it is very interesting to see if Ankara really is going to break with its old alliances (NATO), and will forge a new one. As stated above, Turkey has been setting up already military and economic agreements with Saudi Arabia (and the GCC) and Pakistan. Turkey is setting up bilateral military development agreements with Riyadh, while already being a major arms exporter to Pakistan[17].

Just before the Munich Security Conference, Turkish president Erdogan already has stepped up his efforts to gain traction in the Arab world again. Erdogan has been touring the GCC countries, including Saudi Arabia, Bahrain and Qatar. According to İbrahim Kalın, assistant to the Turkish President, Turkey developed a wide-ranging relationship with the Gulf countries. The Turkey-GCC High Level Strategic Dialogue mechanism established in 2008 in Jeddah has helped realize new potential but ought to be further activated to create new opportunities. Currently Turkey has large interest in security priorities and economic outlook of the GCC countries. For Turkey, main interest is also GCC support for Ankara's security concerns over the PKK and FETÖ. Saudi Arabia, Qatar and Bahrain have taken several steps to stop the activities of FETÖ institutions and individuals in their countries. At the same time, Turkey and the GCC are confronting Daesh and other terrorist organizations.[18] Erdogan has reiterated during his visit that Riyadh and Ankara have repaired ties strained over the 2013 ousting of Egypt's Muslim Brotherhood president Mohamed Morsi, a Turkish ally.

Since 2016 Turkey has hosted Saudi warplanes at its Incirlik air base as part of the US-led coalition against Daesh militants, who are among an array of factions fighting in Syria. The capture at the end of 2016 by Syria's army of the country's second city Aleppo, backed by Russian air strikes, was a setback for Saudi Arabia and Qatar. Even that Turkey is coordinating part of its operations in Syria with Russia, and Assad-Iran, Saudi Arabia and Turkey are still largely on the same line, a removal of Islamists extremist groups is still the main operational goal of both. During his visit to Ankara beginning of February, Saudi Foreign Minister Al Jubeir stated that the positions of Saudi Arabia and Turkey are "absolutely identical" on Syria[19]. Both Riyadh and Ankara are hoping for better relations with Washington under President Donald Trump. Some issues however still need to be removed before Saudi Arabia and Turkey are again real buddies. Erdogan's full cooperation with Qatar and the build-up of a Turkish military base in the latter country, is still looked upon by Riyadh with suspicion. While both states are united in their backing for rebels fighting Assad's regime, they also shared support for Egypt's Muslim Brotherhood. If this is not cleared, a real open military relationship could still be blocked. Riyadh's issues with Qatar is still unresolved, even that diplomatic warmth has returned in the media. Under the surface, Saudi Arabia is still looking for a real break between Doha and several leading Islamist groups, especially Muslim Brotherhood, but also Hamas and others. Turkey's close ties to Doha will also be a constant

in the ongoing discussions in Riyadh. No Saudi defense minister or heir-apparent will be looking for close relations with either of them, as long MB and others are removed totally. Turkey's political stamina and prowess will be also tasked by Riyadh and others with regards to Israel. Ankara's opening to Israel, after a long period of conflict, could be bringing unexpected gains. Saudi Arabia, Egypt and Turkey are fully aware of Israel's anti-Iran standpoints. The Arab-Turkish coalition could be a major force, in the eyes of the Israelis, to block not only Iran's growing power in the region, but also to deal a blow to its other enemies, Hezbollah, Hamas and Al Qaeda. Ankara has before already been a go-between for both parties. Maybe this will return, to the benefit of all.

New Kid On The Block Israel

At the same time, the IMAFT approach could be receiving some unexpected support, especially in the confrontation with Iran. The last years, media sources reported several times a rapprochement between archrivals Saudi Arabia and Israel[20]. Several Saudi high-rank unofficial meetings occurred with Israeli counterparts, but all were denied by Saudi government statements. However, looking at the Saudi-Iran conflict, Israel's anti-Iran stand could be playing into the hands of Riyadh. Israeli intelligence reports, especially via DEBKA, even have stated that the director of Saudi Arabia's General intelligence agency, Khalid Bin Ali Al Humaidan, has paid a surprise visits to Ramallah (West Bank) and Jerusalem on February 21-22. The latter was not confirmed by Palestinian and Israeli sources, but also not denied. According to the Israeli news site, the visit of the Saudi official has come just after that news emerged that Iranian engineers were working around the clock on a project dubbed "Riyadh First," for adding an extra 100 km to the intermediate range of the Scud-C (600km) and Scud-D (700km) surface missiles, to enable them to reach the Saudi capital and explode in the center of Riyadh. The project, which is going forward at the Al Ghadi base in Big Ganesh, 48km west or Tehran, was ordered by supreme leader Ayatollah Ali Khamenei and President Hassan Rouhani. The latter could be still an empty threat, but analysts have reiterated that Iran is increasing its missile capabilities. Unconfirmed reports have already stated that on February 4, Iranian-backed Yemeni Houthis fired a missile which they claimed was a homemade Borkan with a range of 800km into Saudi Arabia. It struck the al-Mazahimiyah military camp west of Riyadh. Israeli military sources stated that the attack was the first test of the newly-extended Iranian Scud, as a dress rehearsal for the real strike.

If the Saudi visit to Jerusalem is confirmed, Al-Huymaidan may have explored security issues. DEBKAfile's sources note that the Saudi spy chief is a professional soldier and the first commoner to hold the post of Director of Saudi General Intelligence. Among his predecessors were high-ranking princes such as Bandar Bin Sultan, Turki Bin Faisal and Muqrin bin Abdul Aziz.The Israeli news, even that it is unconfirmed, falls in line with the statements made by Saudi Minister of Foreign Affairs Al Jubeir and his Israeli counterpart Israeli Defense Minister Avigdor Liberman, who both have accused Iran of being the main cause of instability and threats in the Middle East. When looking at their statements, made during the Munich Security Conference 2017, a large amount of synchronization is shown. Both have accused Iran of being a threat to Arab Sunni countries, increasing instability and threatening not only Riyadh but also Israel.

Pakistani To Lead IMAFT, The Odd Duckling?

The members of IMAFT will also need to deal with another surprise move. Retired Pakistani military chief of staff General Raheel Sharif was appointed as commander of the Saudi-led, anti-Iranian military alliance in February 2017. Analysts have indicated that the appointment, which could indirectly lead to some confrontations with other member countries, could be a defining moment in Saudi- Pakistani relations. The appointment could kill several birds with one stone. Until now, the alliance has been a paper tiger. The appointment of General Shareef could assist the alliance to set up a real force. Strategically it could be Saudi coupe de grace, as Riyadh seems to award Sharif for opposing the Pakistani parliament rejection in 2015 of a Saudi request for military support in Yemen[21]. The latter took Riyadh at that time by surprise, as Pakistan until than was considered a strategic ally, fully aware of its economic dependency on Saudi Arabia (remittances). Pakistan is also at present fighting a new formed alliance of Daesh and Taliban. Saudi Arabia and Pakistan have been historically intertwined, including in its religious issues. The country has part of Saudi's ongoing proxy war against Iran, since the Islamic Revolution in 1979. The appointment would build on decades of Pakistani military support of Saudi Arabia dating back to war in Yemen in the late 1960s.

The Future

Looking at the current developments, there are no rational indicators showing that IMAFT will be able or willing to confront Iran in the region. The ongoing internal discussions or outright conflicts prevent the Sunni alliance to even consider or prepare a full-fledged military force able to withstand or confront Iran on the battlefield. The only positive effect of the possible integration of these forces in future would be that there is a movement to integrate military capabilities and investments. Before however the Arab countries, in combination with other Sunni countries, will be able to present themselves as a new "Arab or Sunni" NATO, a lot of water will flow through the Nile or the Euphrates. Iran should not be getting anxious about the ongoing efforts. The picture could however dramatically change if Turkey (NATO), Israel and Pakistan would be willing to coordinate direct military action against Iran with their Arab neighbors. Combining two nuclear forces (Israel, Pakistan) and the 2nd largest NATO army (Turkey), with the Arab confrontational strategy, would present Tehran with a force to reckon with. IMAFT 2.0 would be without any question can bring Tehran on its knees. This however, as a lot in the Arab region, can still be a fata morgana.

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EGYPT GAS EXPORT POTENTIAL UP TO 2050 & REGIONAL GAS POLICIES

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INTRODUCTION

Although having around 3.5 billion barrels of oil and 2.2 trillion m3 proved gas reserves, Egypt is facing with the crisis of meeting the demands of its domestic market. Mainly due to increasing in-country consumption volumes, Egypt has lost its position of being an energy exporter in 2014.

In contrast to these negative strides, new offshore gas discoveries again can change all the scenarios, and so Egypt's plans to be an exporter after 2020.

In intercalary years, new discoveries in Egypt offshore increase the importance of Eastern Mediterranean resources. A plenty of reserve estimations and potential about the region's hydrocarbon resources, development scenarios, gas export strategies, Israel, Cyprus and Lebanon's situations have been declared here and there.

However, questions of curiosity arise as:

- What will be the actual export potential of Egypt?
- Will it change all the gas balances in the region and European markets?
- What are the chances of transporting Egypt gas to Europe via Turkey, if a solution through Cyprus is unachieved?

Above questions will be subjected in this study. For starters, gas reserves, new discoveries and the fields to be developed, production-consumption-export potential estimations of Egypt will be analyzed. Analyses will yield evaluation of regional gas policies by including Turkey's role in the future dynamics.

GAS RESERVES & EGYPT'S CURRENT SITUATION

The country is known as having around 2.2 tcm of proved gas reserves. This amount is expected to increase after more tests and drillings to be completed in the new explored fields.

The main milestone in Egypt's gas market is to develop newly discovered fields and the fields to be discovered. However political instability, low levels of oil prices, unsolved political disputes in the region, financial/economic problems in the country and high investment requirements for deep offshore fields complicate the situation. As a result, handling this milestone becomes the main energy strategy of the country.

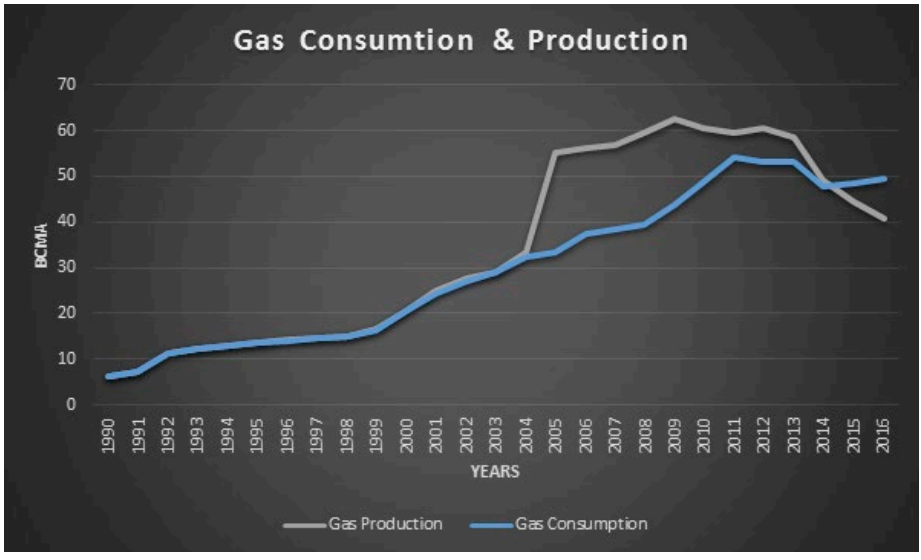
Not to mention, financial situation of the country getting worse and Egypt is trying to complete the due economic reforms to be able to get 12 billion $ loan from IMF, which typically means bogging down while trying to jump out of the swamp. Additionally, the country has around 3 billion $ of overdue payments to the due foreign investors. Indeed, such environment makes experts fear additional delays in the development periods of the new discoveries.

Although having plenty of reserves, Egypt due to high increase in domestic demand, became a gas importer instead of being an exporter. Gas is the dominant energy resource in the country's primary energy consumption with a rate of more than 50%. And sadly, the strategies followed by the due authorities show that, this rate will continue to increase (Hence, gas being domestic and cheaper).

In addition, in the electricity markets, with higher than 75% of gas usage to generate power puts natural gas as again the dominant energy resource.

In order to handle the negative gas balance and meet the domestic demand via imports, Egypt delivered 2 floating storage & reclassification units (FSRU) with capacities 5.7 bcma and 7.7 bcma. In addition to these volumes, the country was planning to open a tender for a third FSRU with a capacity of 7.8 bcma; however, due to the current balance projections and the financial situations had to delay the tender.

The charts on Graph 1 below summarizes the annual consumption and production rates of Egypt. As can be observed from the charts, around 2004's Egypt has become a gas exporter and in 2014 has lost its position to be a net importer.



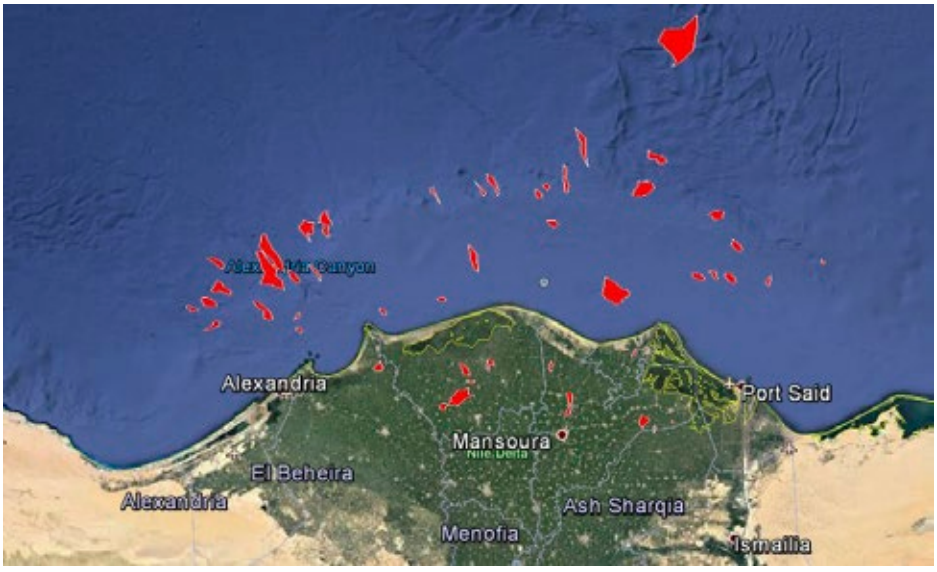
Graph 1: Egypt's Annual Gas Production & Consumption.

As currently being a gas importer country, Egypt's main goal should be to develop its new discoveries to be able to meet the increasing demand. That's why in the next part, those new discoveries and the due discovered but not developed fields are going to be defined.

NEW GAS DISCOVERIES & FIELDS TO BE DEVELOPED

There are around 50 discovered but not developed (onshore and offshore) gas fields in Egypt's territories. These fields can be observed on Map 1 below. As seen from the map, Zohr is the most important and largest field among the other discovered fields in Egypt within the last decades.

In addition to Zohr Field, West Nile Delta area, Atoll and Selamet can be accepted as the other important discoveries for the last years.



Map 1: Discovered But Not developed Gas Fields in Egypt. Zohr field is located far in the north.

Table 1 gives the estimated / officially declared reserves of the due important gas discoveries.

Field / Group	Reserves (bcm)
Zohr	628
Notus	22
Tao, Kamose, Setiplio	10
WND	140
Abu Sir, El King, El Max, Al Bahig	23
Mina, Silva	20
Rahamat	9
Sienna Up	17
Idku	20
Atoll	42
Baltim SW	28
Ringa	17
Myas, Asfour, Abu Seif	12
Taalab	20
Salmon	20
Salamat	63
Satis	15
Tennin	35
TOTAL	1,141

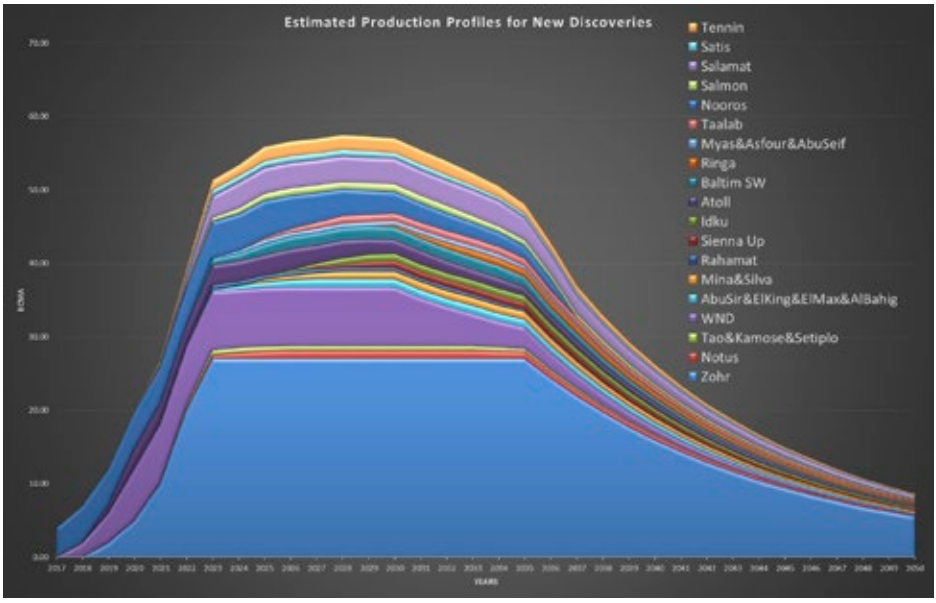
Table 1: Discovered but not developed gas fields and reserves in Eygpt.

Note that; The West Nile Delta (WND) project comprises 11 gas discoveries, which are Giza, Fayoum, Libra, Maadi, Polaris, Ruby, Taurus, Viper, Raven, Taurus Deep and Hodoa.

Table 1 suggests that Egypt has around 1.1 trillion cubic meters of gas reserves to be developed and produced. However, at this point the question is how these reserves will be able to be developed and how those developments will reverberate in the gas balances of Egypt?

ESTIMATED PRODUCTION PROFILES FOR NEW DISCOVERIES

With the estimated reserves of each field (or field group), by considering the regional properties, operators financial and technical capabilities and the benchmarking results, production profiles have been tried for estimation and the results of estimations are presented in Graph 2.



Graph 2: Estimated production profiles for new discoveries.

Note that:

- Although Nooros field is an already developed gas field, hence going to effect the total gas balance of Egypt, its profile also is added to the cumulative equation.
- For all other estimations;
  - For each field, production is assumed to be done technically in full capacity. No market, transportation limitations are taken into consideration.
  - Development plans and plateau rates are evaluated to reach nearly the %90 (or higher) of the due reserves in 20 years.
  - In addition, some public statements about the due projects are to be taken under consideration. However, for some fields it has understood that; with the declared production profiles by due companies exceeds the gas in place volumes. So, those declarations which no scientific base, are not taken under consideration.
  - Decline rates are assumed by benchmarking the current producing fields in the region. And for bigger structures (reserve volumes), decline rates are assumed to be lower.
  - For smaller fields, plateau periods are assumed to be lower, hence, less investment is expected to keep the plateau period longer.
  - Commercial – political – security and international oil & gas price issues to be able to produce these fields are not taken into consideration.
  - Only the financial and technical capabilities of the due operators of the fields are taken into consideration to estimate the possible (nearest) development period of the due field.

- All fields are assumed to be produced up to the life of the field by not considering the economical limitations to abandon or license periods. Only for the international operators' fields, the profiles are designed to get maximum possible & commercial recovery in the minimum period (which is 20 years of license time).

Videlicet, by adding the currently producing Nooros field into consideration, Egypt's new discoveries will have a potential of adding up around 55 bcma extra peaked supply for the Egypt's gas equation. However, after 2035's with the increasing decline in the production levels might hit Egypt as a slap in the face.

CONSUMPTION ESTIMATIONS

After estimating the contribution of the new discoveries into Egypt's gas production, consumption profiles should be prepared in order to define the gas balance of the country.

So, before estimating the gas consumption profiles, in the concept of country's energy policies, Egypt has decided to:

- Develop all discovered gas fields as soon as possible,
- Stabilize the investment environment of the country for the foreign companies,
- By upgrading the distribution systems and encouraging the shift of power plants, increase the domestic gas consumption,
- By this way, swelling the gas utilization rate in the countries' energy equation (where gas is the most abundant domestic energy resource),
- Again become an LNG exporter, with the surplus gas after meeting the domestic demand.

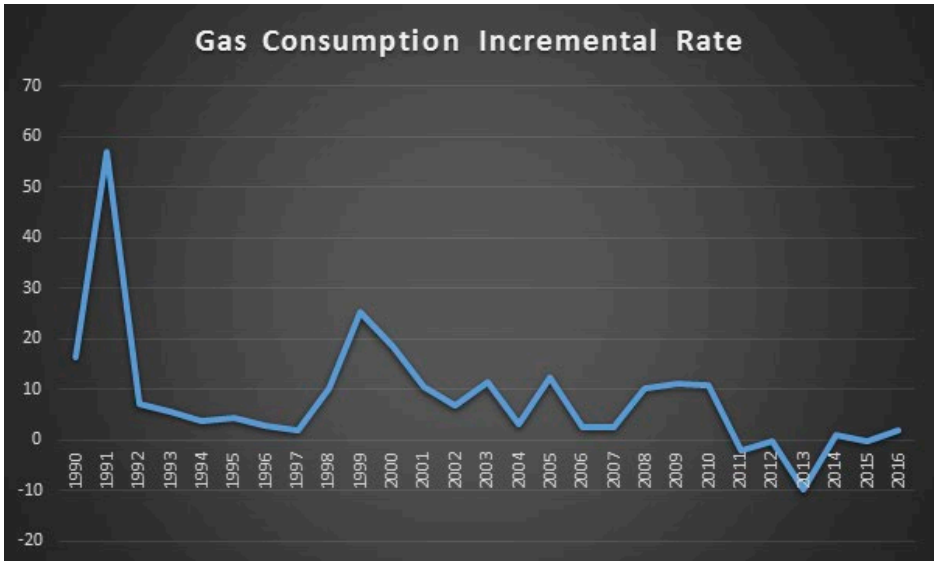
Which basically means; produce more gas and then increase the consumption.

These policies are expected to result in a sharp increase in the gas consumption values.

In addition, high population growth rate is the main directing element in the consumption balances.

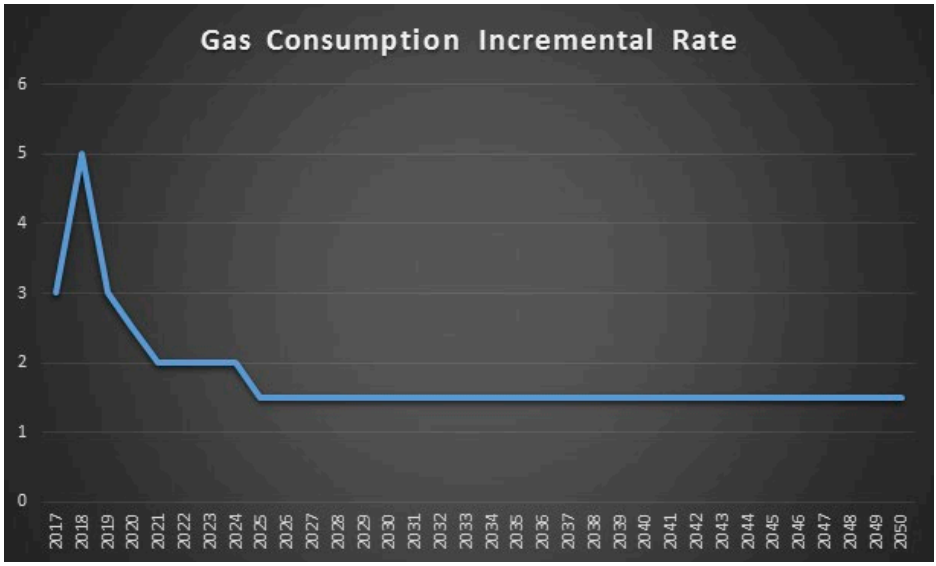
By keeping these in mind, while evaluating the current gas consumption incremental rates of the country, as seen in Graph 3:

- Effects of the Arab Spring in the country can be observed from the decline in the incremental rate of gas consumption.
- The increase observed in 2016 is expected to continue in 2017.



Graph 3: Egypt's gas consumption incremental rate (1990 – 2016).

Then, while estimating the future profiles, as seen in Graph 4:

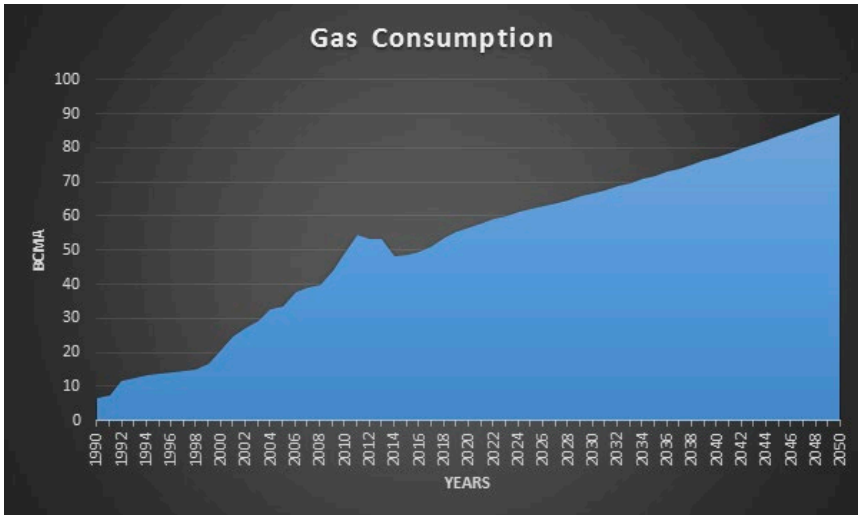


Graph 4: Egypt gas consumption incremental rate (2017 – 2050).

- After 2018 with the demanded precautions in energy efficiency and population growth rate, gas consumption incremental rate is assumed to be declined.
- After 2024 the incremental rate is assumed to be stable at 1.5 % ratio (By considering a more stable Egypt).
- This scenario can be accepted as the most optimistic scenario for gas consumption of Egypt. Hence for such unstable and poor country, it is not easy to apply effective

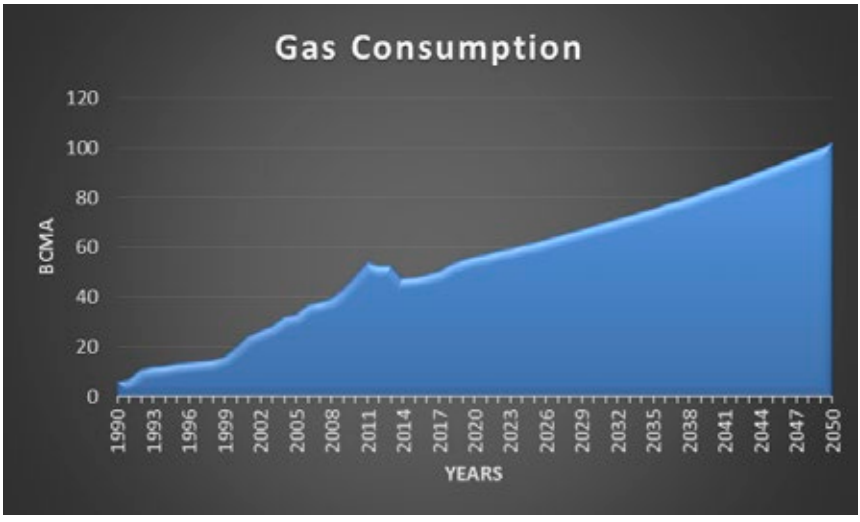
precautions to balance the increasing energy demand. While the hunger to consume energy is growing in the industry and social areas.

Then, with those incremental rate estimations, the total gas consumption profile of the country, up to 2050, can be observed in Graph 5:

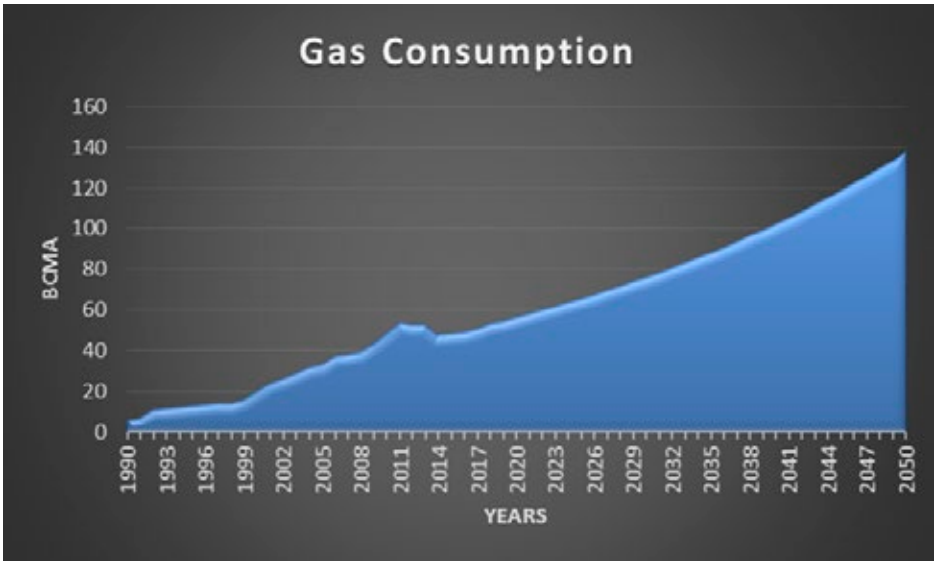


Graph 5: Gas consumption profile of Egypt up to 2050 (with an incremental rate of 1.5% annually after 2024).

In this scenario as shown in Graph 5, Egypt's total gas demand will be around 90 bcm in 2050. However, this scenario seems as the most optimistic one, by considering the population growth and the hunger of the industry after the Arab Spring effects. That's why, two more scenarios with annual gas consumption incremental rates of 2% and 3% are studied below.



Graph 6: Gas consumption profile of Egypt up to 2050 (with an incremental rate of 2% annually after 2024).



Graph 7: Gas consumption profile of Egypt up to 2050 (with an incremental rate of 3% annually after 2024).

As can be observed from the graphs of the other scenarios, with an annual gas consumption incremental rate of 2% (after 2024), 2050 Egypt gas demand is calculated to be around 100 bcm. And for 3% the demand volume rises up to around 140 bcm for 2050.

These factors also have to be considered during the estimation of the total gas export potential of Egypt.

GAS EXPORT POTENTIAL UP TO 2050

After defining the consumption scenarios up to 2050, in order to estimate the Egypt's annual gas export potential, equation below is considered for calculations:

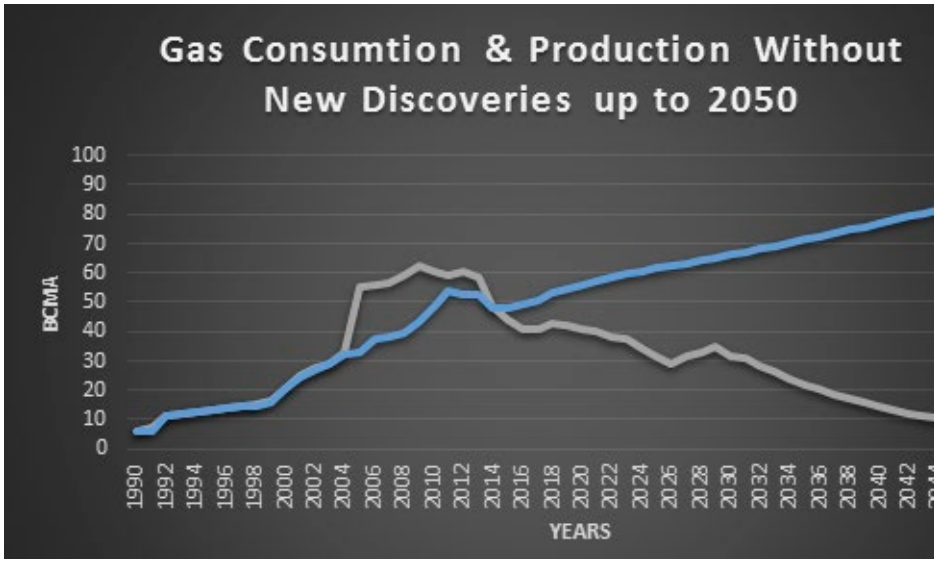
Gas Export Potential = Gas Production (Current Fields + New Discoveries) – Gas Consumption

Note that;

- As mentioned above, Nooros field is considered as a newly discovered field in this scenario. And its production is added to the new discoveries' production profiles graph.
- After 2025, by assuming the new due discoveries are developed and as a result, the financial situation of the country will get better; enhanced recovery techniques are thought being used for lowering the decline in the total production in the existing (old) fields.
- While there are no small size new onshore discovery assumptions, and new enhanced oil recovery projects, the average decline of the existing gas fields is taken as 8%.

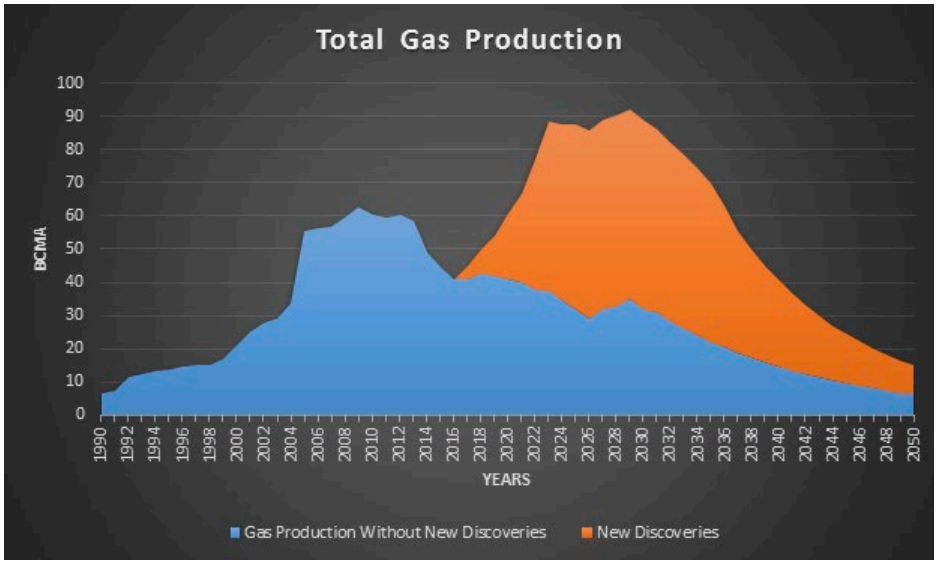
(Where 8% decline is again an optimistic approach.

Then, Graph 8 clarifies the most optimistic gas consumption and production -without the development of new discoveries- rates of Egypt.



Graph 8: Gas consumption & production rates without new discoveries up to 2050.

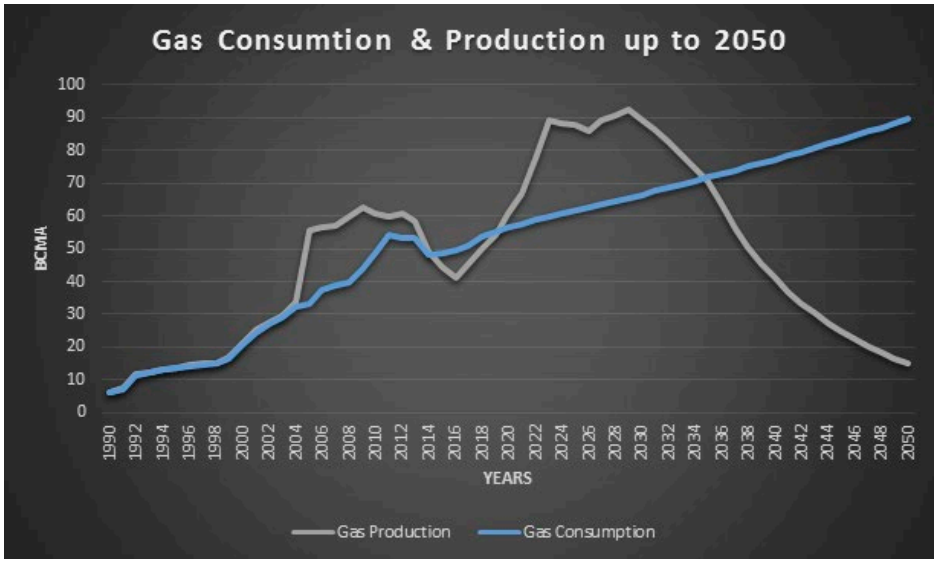
After adding the production expected to come from the new discoveries to the current producing fields of Egypt, then the total annual gas production volumes are given in the Graph 9:



Graph 9: Egypt total gas production including new discoveries & current fields.

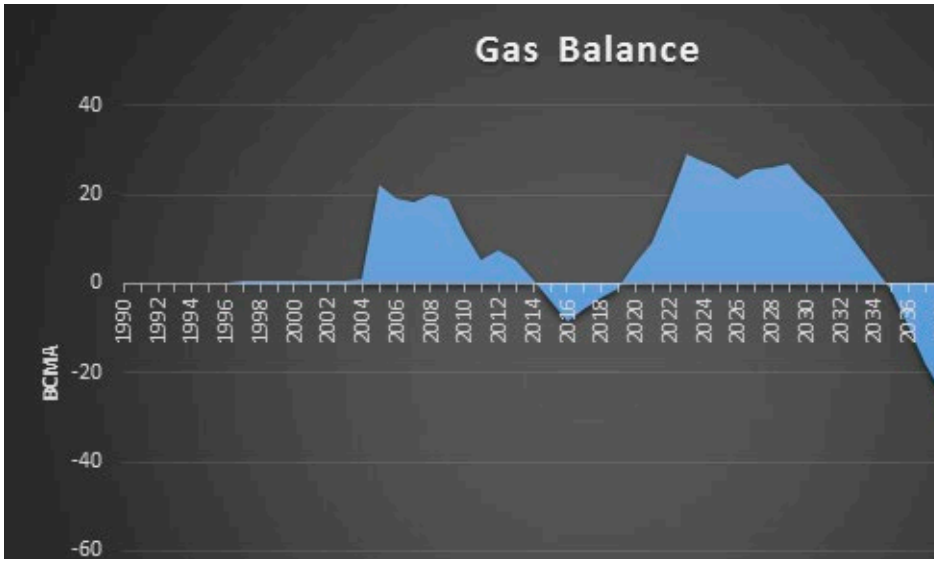
Where Egypt seems to have more than 80 bmca gas production rates between 2023

and 2032. And while adding this total production graph, the total consumption will be as given in Graph 10:



Graph 10: Egypt total gas production & consumption.

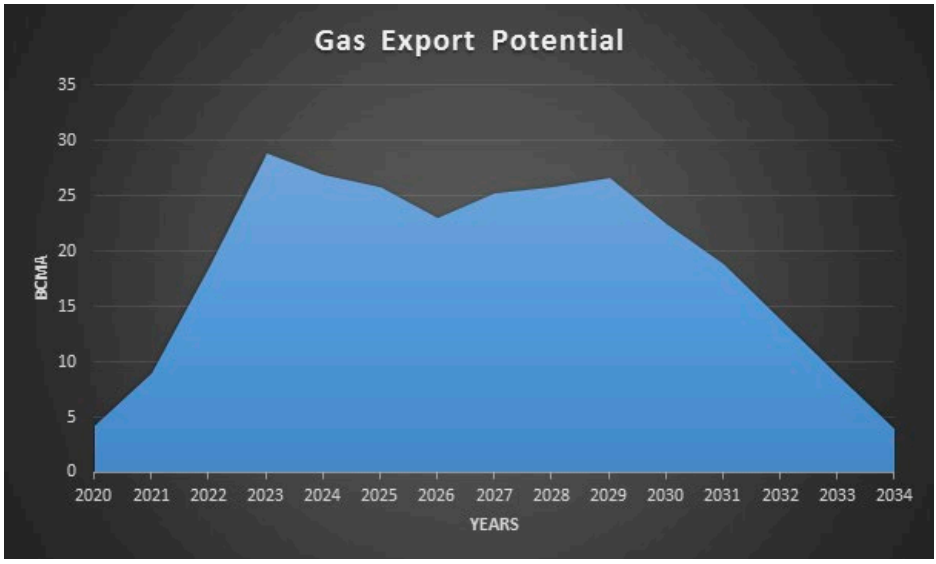
Then, after extracting the consumption from the total production, gas balance graph is prepared as seen in Graph 11.



Graph 11: Egypt's gas balance.

Videlicet, Egypt has an around 20 bcma (and a little more) surplus between 2022's and 2032's and again a huge increasing deficit after 2035's in its gas balance.

Then, the export potential of the country is given in Graph 12:



Graph 12: Egypt gas export potential (for annual consumption incremental rate is 1.5%).

As can be observed from the Graph 12, in the most optimistic scenario, Egypt will totally have around 283 bcm gas to export and the average peak rate can be accepted over 25 bcma.

However, while taking the domestic gas consumption annual incremental rate as 2%, then as shown in Graph 13; total gas to export volume will be around 260 bcma and the average peak rate can be accepted below 25 bcma.

Graph 13: Egypt gas export potential (for annual consumption incremental rate is 2%).

In addition, while taking the domestic gas consumption annual incremental rate as 3%, then total gas to export volume will be around 224 bcma and the average peak rate can be accepted below 20 bcma. And export potential becomes zero after 2032. Which means, Egypt will be an importer again after that year.

Graph 14: Egypt gas export potential (for annual consumption incremental rate is 3%).

Only new huge discoveries can change the prepared scenarios. And the total export potential of Egypt seem unlikely to influence the global markets.

ENOUGH INFRASTRUCTURES TO EXPORT?

In order to export its surplus gas to the global markets, Egypt has 2 domestic LNG facilities and 2 export pipelines. LNG export plants are IKDU ELNG Plant with a capacity of around 10 bcma and Damietta LNG Plant with a capacity of 6.8 bcma. In addition, the export pipelines are Arish–Ashkelon pipeline to Israel with a capacity of 9 bcma and the Arab Gas Pipeline with a capacity of 10.3 bcma to Jordan. However, the export pipelines may require maintenance works to be utilized with the due capacities. Moreover, for the pipeline exports, due markets' demands also have to be considered as Israel is going to be an exporter during the same period. That is to say, there seems to be market constrains for the pipeline exports.

However, the current infrastructures seem as nearly enough with the current conditions.

NEW INFRASTRUCTURES?

In addition to existing LNG facilities and pipelines, there are some other options for Egypt to export its energy resources via new (or extended) infrastructures, which will be a possible underwater electricity line to Southern Cyprus and the possible extension of Arab Gas Pipeline.

CYPRUS ELECTRICITY LINE?

As can be understood from the title, in this option, which has already been signed by the due authorities, Egypt is planning to produce electricity from its surplus gas and export the production via underwater cables to the Southern Cyprus.

This option can be considered as possible. However, the main milestones to handle are the market risks in the Southern Cyprus and the financial problems of the both sides.

As for the further steps, Egypt is working on the possible electricity export to Crete and then to Greece after a successful start by exporting electricity to Cyprus first. However, in those steps also, there are important risks which make the project commercially unfeasible. Those risks are the small market size of Crete, where such a big investment seems redundant and EU's electricity markets' average prices, where Egypt's production has no chance to recess by considering the high transportation costs. In addition, all due sides have financial problems to handle such an expensive project.

EXTENSION OF ARAB GAS PIPELINE TO TURKEY?

There is a possibility of extending the Arab Gas Pipeline from Syria to Turkey. However, the situation of Syria and the political conflicts between Egypt and Turkey are the main milestones of the idea.

Political conflicts between Turkey and Egypt can be solved in the near term but there are huge security risks in Syria that is unlikely to be resolved.

By the way this option can be suspended for the midterm scenarios.

CYPRUS GAS PIPELINE?

Egypt has signed an agreement with Southern Cyprus for an import pipeline from Aphrodite field with a capacity of 8 bcma. However, while considering the existing export infrastructures of Egypt, there seems no free capacity to handle Aphrodite gas. So, Aphrodite investors or the Egypt government has to construct a new LNG export facility, which makes the transportation costs higher.

That's why, this option does not seem to be viable.

ISRAEL GAS TO EGYPT

After due offshore discoveries (such as Leviathan) being developed, surplus gas of Israel also have been considered to be transported to Egypt's LNG facilities (via Arish–Ashkelon pipeline) and then to be exported. However, because of the main obstacles placed by the unknowns about the free LNG capacity of the existing terminals and political instability in Egypt, the idea to transport the Israeli gas via Egypt's ports has been cancelled.

By the way, it is known that Israel's total export potential -after subtracting the consumption and the agreed volumes to sale- is not high enough to require more free ca-

pacity in Egypt's LNG facilities. That's why, in the future, there may be a 3 or 4 bcma portion for Israel. So, the idea can stand a chance to be a solution.

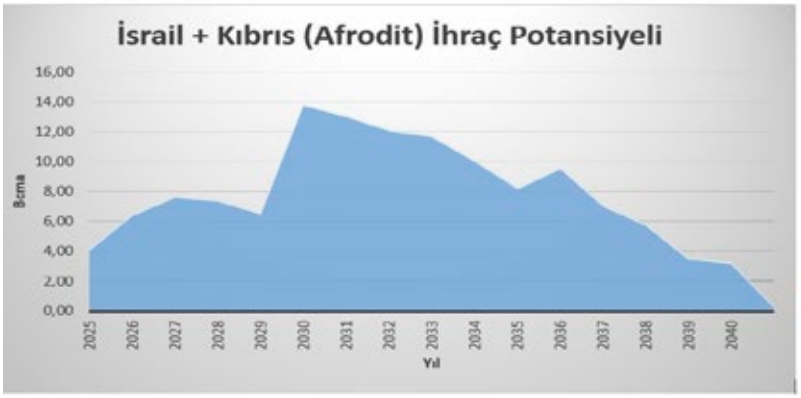
REGIONAL GAS POLITICS

After estimating the long term export potential of the most important gas possessing country in the Eastern Mediterranean: Egypt's, to analyze the potential of the region, total estimated reserves have to be identified.

As mentioned above, total proved gas reserves of Egypt is around 2.2 trillion m3. As the second highest gas reserves bearing country, Israel has around 1 trillion m3 proved gas reserves. At last Southern Cyprus with the only Aphrodite field has around 0.1 trillion m3 proved gas reserves. So, the total proved gas reserves in the region is around 3.3 trillion m3. By comparing with the Russia, the total proved reserves of the Eastern Mediterranean is around 10% of Russia.

Then what about the total estimated gas export volume of these countries?

For the export potential of Southern Cyprus + Israel (where Israel's total consumption and the agreed sales volumes are subtracted from the projected production volumes) Graph 15 summarizes the situation up to 2050.



Graph 15: Israel + Cyprus total gas export potential (Reference: http://www.tespam.org/kibris-sorunu-cozulse-turkiyeye-ne-kadar-gaz-gelecek/**).**

By adding the Egypt's export potential (the optimistic one) into this scenario:

Graph 16: Eastern Mediterranean gas export potential up to 2050.

So, as seen from Graph 16:

- If new huge fields cannot be discovered, the export potential of the region will become zero in 2042's.
- The peak values are around 25 bcma for nearly 10 years, which cannot be taken as vitally important for the global gas markets.
- In the near term, Lebanon offshore and Cyprus exploration activities may change the scenarios.
- However, in the current situation, there is no need to exaggerate the region's potential.
- In addition, from the sight of European markets, in terms of finance or the capacity, Eastern Mediterranean cannot be a rival for Russia.

So, is there a possibility of the Eastern Mediterranean gas to be transported to Europe via Turkey?

By neglecting the political conflicts and only considering the technical and commercial aspects, the Eastern Mediterranean gas can be transported to Europe via pipelines through Turkey. However, there will be market price risks while trying to struggle with the Russian gas sales.

In addition, being the supply volumes not stable (such as around 25 bcma for 10 years and then fall into 5 bcma levels) discomforts the long term design and investment environments.

For the rest, Egypt will not be a part of such transportation project, hence it already has existing free LNG capacities in the country. And also, Turkey will not let such federal solution in Cyprus, which will restrict its sovereignty in the area.

Cyprus conflict?

The conflict does not seem to be solved by pushing from the sight of energy policies and insubstantial pledges of Turkey being an energy center by disclaiming its rights over Cyprus and transporting the gas of Leviathan and Aphrodite.

Other roots via pipeline or electricity?

Scenarios	Risks
Aphrodite gas to Egypt	Free LNG capacity and market risks
Aphrodite gas to Egypt via Israel	Free transportation capacity, free LNG capacity and market risks
Aphrodite gas to Greece	Commercially not possible
Aphrodite gas to Israel	Free transportation capacity and market risks
Egypt electricity to Cyprus	Possible but finance risks
Egypt electricity to Greece	Commercially not possible
Aphrodite gas to be liquefied in a new facility in Cyprus then being exported	Commercial, technical and financial risks
Aphrodite gas to Turkey	Only political conflicts

Table 2: Some export scenarios and risks.

As mentioned in Table 2, Southern Cyprus does not have many choices to maneuver with. The best option is to sale its gas to Turkey. From the Egypt's sight, the electricity export to Southern Cyprus and only some amount of gas volumes to be exported if there is any free capacity in its due LNG facilities can be subjected.

Lebanon & Syria Offshore?

There may be an important potential in Lebanon and Syria offshore. For Lebanon, if there is no other unexpected delays in the due tenders, exploration periods will start and the results will be observed in 2-5 years. For Syria, security risks and in-country conflicts have to be solved before starting the exploration step. So, there is minimum of 10 years to make clearer estimations.

By the way, for both countries, Turkey and Europe (through Turkey) will be the best feasible market options.

Cyprus New Discoveries?

After the discovery of Zohr Field, there are new expectations around the Egypt boundaries. And the new licenses have been agreed with some eastern companies (including Qatar Petroleum) near Zohr. From the geological sight, there are possibilities, hopes and also many unknowns which will affect the results. And those results may not meet the expectations.

In addition, some parts of the 10th, 11th and 6th blocks –those Southern Cyprus government has given to the due companies illegally- are occupying the Turkish boundaries. And there are huge conflicts among the disputed territorial waters.

Turkish spurt over the exploration activities in the due region will be another important issue by considering the politics.

It's early to say anything about the results of the due illegal blocks of Southern Cyprus –while there are no seismic studies in the region- but the best and convenient choice for the Southern Cyprus seems to develop its discovery after 2040's. Or to officially join the Turkish side!

FROM THE SIGHT OF TURKEY?

From the sight of Turkey;

- Initially there is no important volumes of gas in the region to help Turkeys strategy to be a gas transit hub
- By the way, Cyprus and other potential countries need Turkey as a transit gas and market to develop the due/possible fields.
- Any of the energy issues cannot be used as a leverage to solve the Cyprus conflicts against the Turkish rights.
- There is not any option for Egypt to transport its export potential to Turkey via an offshore pipeline through Cyprus or EU through Turkey.
- Egypt's export potential is limited and will be on the wane after 2035's.
- Turkish boundaries are officially being occupied by some international oil companies and the Southern Cyprus Government.
- Turkey has to intercept this and firmly focus on its exploration spurt in the region.

RESULTS

As being mentioned above, Egypt is going to be an exporter once again between the years 2020 and 2035's. However, the increasing hunger in the domestic consumption will not let the country to maximize its export potential. In addition, the financial and legislative situations also have some risks for the foreign investors.

Egypt's most important target is to develop all the new discoveries in the country with the international investors. Although by assuming this goal being able to be a gain, the discovered structures are not as big as dreams for being the biggest supplier of Europe and global markets. While the peak export potentials are around 26 bcma.

By considering the estimated export potentials, Egypt's current infrastructures are nearly enough to meet the demand. However, there seems no available capacity to handle extra gas from Cyprus or Israel.

In addition, the export volumes are not as high as meeting the need to feed the European hunger. There is no chance for Egypt to compete with Russia in the European markets.

Egypt is again going to be a gas exporter in the near future. As a result, black clouds will come back over Egypt if the findings from the new research areas is not able to compensate the expectations.

ENERGY GEOPOLITICS IN THE MIDDLE EAST AFTER THE OPEC SUMMIT

Serhat S. CUBUKCUOGLU
(Tufts University, Researcher & Strategist)

Overview of the OPEC Summit's Implications

The Middle East is home to 65% of OPEC's oil reserves and, with 32 million b/d, provides just over a third of the global oil supplies. Since 2014, the group of GCC (Gulf Cooperation Council) countries, lead by Saudi Arabia, had seen a worldwide oversupply send prices lower and reduce revenues to government budgets.[1] Defending and expanding market share had been the primary goal of the low-cost Middle Eastern states with the aim to squeeze potential rivals in Russia and the Americas out of the game. However, in a classic case of prisoner's dilemma, price wars resulted in loss-making for all producers.[2] Aside form deep budget deficits, low prices induced demand surge for motor vehicles around the globe that undermined efforts for resource diversification. Persistent global warming due to human-induced greenhouse gas (GHG) emissions created a much gloomier issue with long-term repercussions than merely regional political dynamics, necessitating cooperation and immediate action.

The global economic slowdown and the accompanying slump in oil prices dragged down growth in oil exporting countries of the Gulf. Faced with fast depleting sovereign reserves, which were saved as cushion to weather turbulent times, lead oil producers of the Gulf announced new measures such as abandonment of capital-intensive infrastructure projects, cost-cutting, introduction of the VAT, and far-reaching reforms such as privatization, diversification and removal of subsidies to fight fiscal deficits. Of special concern was Saudi Arabia's exposure to persistent low oil prices creating an ever growing burden on the kingdom's finances that are spread thin over efforts to sustain foreign aid and proxy warfare in as far afield as Syria, Iraq, Yemen, and Libya. On top, Iran's nuclear accord with the P5+1 and the subsequent prospect to grow, expand and dominate the Gulf monarchies forced policymakers of the region to rethink their strategy and consolidate their positions against a rising rival power. Pragmatism has prevailed and paved the way towards a well-coordinated effort to provide breathing space to oil producers of the Gulf at an international summit in 2016.

In accordance with market expectations, the November 2016 OPEC summit in Vienna concluded with a cornerstone deal at the last minute that reversed the cartel's long-held

policy of defending market share over oil prices. The agreement to curb output by 1.2 million b/d within six months, the first since 2008, took effect in January 2017 with crucial non-OPEC producers such as Russia and Mexico joining to shoulder an additional output cut of 600,000 b/d, reaching a total of 1.8 million b/d. Iran has been permitted a symbolic increase on its quota forecasted for growth in 2017, thus giving a signal that OPEC is still credible and relevant,[3] surging oil prices above the $50 pb level. Reports have confirmed that most member parties reliably comply by their commitment[4] to clear the enormous supply overhang accumulated over years, although doubts remain about the contribution of non-members, crucially of Russia. EIA's short-term energy outlook for 2017 projects $53-$55 oil price for Brent and WTI crude,[5] which are yet lower than the fiscal break-even price of the Gulf countries.

Geopolitics of Oil in the Gulf Region and Beyond

The road to the OPEC deal coincided with Donald Trump's victory at the US presidential elections. The US administration's promises of pulling out of the Paris climate accord, extending full support for increasing shale oil production, lifting restrictions on drilling in the Gulf of Mexico and the Arctic, and building up American energy independence and energy exports are expected to result in more hydrocarbons flowing to the international markets. This will only add to the global oil glut and will potentially depress oil prices in the long term,[6] effectively undermining OPEC's efforts. In addition, any move to cut oil production sends a signal to shale producers to boost activity. American producers, whose break-even oil price is below $30 thanks to improvements in efficiency, are quick to seize the opportunity and ramp up production as the market recovers. Supported by 1.3% oil demand growth in 2017 to reach 97.4m b/d[7] according to IEA's estimates, oil price within $50-$55 band is sufficient for US shale production to be profitable.

Meanwhile, regional rivals Riyadh and Tehran find opportunities to improve their standing across the Middle East, often in zero sum ways.[8] Despite having reached a compromise deal at OPEC, their economic profiles are in stark contrast with each other. Saudi Arabia's crude reserves of 266.5 bb are seen to last for only 70 years[9] due to which the kingdom plans to enact radical reforms by reducing overreliance on oil, sell off state-owned assets, and harness the power of markets.[10] The effects of measures are already visible with the 14% drop in Riyadh's fiscal break-even price of oil from $92.90 pb to $79.70 pb,[11] albeit much lower than what the IMF had forecasted in 2015. Iran, by contrast, thanks to its more diversified economy, exceeded IMF's expectation with a break-even price of $55.30 pb.[12] As an exceptional case, the mutually hurting stalemate of low oil prices made possible a financial deal in the OPEC despite huge political differences in Riyadh against Tehran and Moscow. Iran, at the time, certainly appeared to be better equipped to weather oil-price shocks.

Nevertheless, Donald Trump's protectionist trade policies and fiscal stimulus package at home are expected to reduce demand for foreign goods and slow down the global recovery, stimulate FED interest rate hike and support US dollar's appreciation, effectively capping further rise in the oil price. This deals a major blow to Iran's plans to revive its economy, attract foreign investment to its fast-aging fields let alone to dig new wells at

a time of heightened insecurity, instability, and risk. Stagnant oil price and rising interest rates reduce windfalls and squeezes liquidity also in the Gulf states that are all the more dependent on the US for political, economical, and military support. Amid budget deficits, Saudi Arabia is preparing for a pro-longed period of low oil prices by hedging its risks through economic diversification, leaner public administration, reduced military spending, and stronger regional alliances to share the increasingly unsustainable burden.

The US administration clearly stated its aim to counter Iran's rising regional influence and court Israel's security by reversing the tide from Barack Obama's liberal internationalist policies and instead hand-picking its friends of convenience. Israel joined the coir by recently going as far as to say "the real division is not Jews, Muslims... but moderate people versus radical people,"[13] pointing squarely at Iran's extremist policies. Saudi Arabia and Israel formed a de facto united front, joined by Turkey, for a new push against Iran, signaling a growing alignment in their interests, while US lawmakers promised to seek new sanctions on the Shi'ite Muslim power.[14] In stark contrast with the higher perceptual positioning that Iran leveraged following the nuclear-accord, it now seems to be cornered out not only as the major source of destabilization but also as a potential spoiler in any political deal over the fate of the region.

Perhaps the most interesting case was Turkey's turbulent political course since the end of 2015. Amid growing rift with the Western alliance, Turkey was largely isolated over the Syrian front after downing of the Russian jet in November 2015, raising its risk profile to an unsustainable level. Hit hard by economic slow-down, loss of influence, prestige, and leverage it did not take long for Turkey to re-evaluate its regional policy and realize the benefits that would accrue through realignment with crucial powers in the neighborhood. Reconciliation process with Russia and Israel demonstrated Turkey's strategic maneuverability and interest to consolidate its influence as a power-house in as wide a geography as Europe, Middle East, and the Eastern Mediterranean. The failed coup attempt in July 2015 drew the rift with US wider upon allegations of involvement, since when Turkey has declared state of emergency to recover from a drastic year of 2016 economically, politically, and militarily. Donald Trump's victory in December 2016 started a new chapter in Turkey's Transatlantic relations, restoring cautious optimism in Ankara to form a more amicable partnership with the US and overcome common, regional challenges.

Turkey's long-standing alliance with the Sunni Arab Gulf states, confronted by Iran's Shi'ite crescent, experienced hurdles through the flow of the past turbulent six years. The front of GCC states categorically rejects cooperation with Iran until it ceases to prop up the Syrian government, ballistic missile tests, funding Shi'ite insurgents throughout the region, and meddling in its neighbor's affairs. The change of course in US foreign policy entails detachment from idealistic democracy-building experiments, limitation to subsidizing alliances, and adoption of a more antagonistic stance towards Iran, which, as a by-product, seems to have strengthened bonds in the Sunni Muslim camp including Turkey. However, although Turkey and Iran have been regional rivals for decades and aim to restrain each another's hegemonic ambitions, both have shared interests in herding stability, economic cooperation, and preventing formation of a belligerent Kurdish state at their door step. In an increasingly multi-polar world, Turkey indeed threads a thin line of balance in this shifting power-play of partnerships for benefit maximization, power, and leadership.

Ramifications of the New Regional Equation for the Syrian War

It is not a coincidence that the US administration singles out Iran as its arch-enemy in the region by using a tough rhetoric to accuse it of offensive acts. The offshore balancing strategy adopted by Donald Trump enables the US to concentrate on preventing the rise of a rival hegemon of China in the Asia-Pacific and of Iran in the Middle East, while preserving its dominance in the Western Hemisphere.[15] The US officials calculate that Russia is a reactive, declining power and does not pose a major long-term threat as would a rising China in the Pacific or would a resurgent, nuclear Iran against Israel. As evidenced in Donald Trump's statements on NATO and the US contribution to the Gulf's defense, the US prudently prefers to let allied states take more ownership and responsibility for burden-sharing in regional security.

In Syria, a key arena for Iran's power projection, each party to the conflict has their own vision for a desired end-state to the conflict.[16] In 2016, the regime of Bashar Al-Assad re-gained control over a significant part of the main population centers with the help of the Iranian Quds Force, its allied militias, and the Russian air power. The US attempted to reap apart the Russian-Iranian alliance while continuing to provide air support and heavy armory to the Kurdish-dominated SDF in the north, courting Turkey's co-operation against ISIS, and consolidating its influence over Iraq. From this perspective, Turkey's rapprochement with the Russian-Iranian axis and successful incursion into northern Syria under the operation code-named "Euphrates Shield" has worried the US administration. If nothing else, the Turkish offensive prevented SDF from joining the cantos of Afrin and Kobane to form a continuous Kurdish belt along northern Syria.

Seeing an opportunity to fill the void before the new US administration has fully taken on the helm, the three guarantors agreed on a plan to support Syrian truce[17] at the Astana peace process amid America's declining regional assertiveness. The US then quickly resumed relations with a rifting Turkey to map out a join plan of action to capture Raqqa, the defacto capital of ISIS, and contain Russian-Iranian influence. This recent development took place as Russia warmed relations with the Kurdish YPG and Iran traded accusations with Turkey over their role in Syria.[18] In this power struggle, Turkey on one hand joined forces with Russia to consolidate its gains in northern Syria and on the other hand offered to cooperate with the US to take out ISIS, with the role given to SDF, if any, still to be decided. As the war reaches a critical juncture, if the US and Russian policymakers strike a grand bargain over the future of Syria, as the two may do in their own interest at the expense of regional powers, it will be appealing to see the impact on the regional equilibrium.

Conclusion

Oil's role as the most important commodity in the world is evident in its impact on political developments around the world. As the epicenter of the global economy and the demand for oil shifts from the West to fast-growing Asian markets, the Middle East has gained competitive advantage and heightened in importance by its crucial geostrategic location, both as a rich supplier and as a conduit. The fiscal break-even price of oil in producers of the Gulf, Russia, and Iran has been above market prices since 2014, putting pressure on their export revenues, government spending, and welfare, thus enabling an

agreement at the OPEC summit in November 2016. The interplay between geopolitics of oil, economic reforms, and security requires vigilance to shifting regional dynamics and raises sensitivities to realities of the multipolar world order. Great power politics occupies an important place in world affairs, albeit to a smaller extent in comparison to a unipolar or bipolar order. Regional alliances are formed with greater flexibility, creating micro spheres of influence, and raising uncertainty. The US assumes an offshore balancer role with focus on Asia-Pacific while the Middle East appears ever-more divided along ethnic, religious, and sectarian lines. Iran and Saudi Arabia, the two arch-rivals of the Gulf, aim to improve their standing while Turkey and Israel play pivotal roles to sustain their influence over developments in the region. The ultimate arena of this power politics is Syria, the fate of which depends on negotiation skills of intervening parties to create a framework agreement where there are no winners or loosers.

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TRUMP'S FIRST STEPS IN ENERGY POLICIES

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Contrary to the predictions made by many experts, Trump, who was also supported by large oil cartels, was elected as the new US president. This election's was not only limited to the US, but also like a reflection in the US of different changes happening simultaneously in Europe and globally. In other words, it was already on the verge of a significant change in the world (Brexit was one of those markers.). The US also needed an appropriate president for this process; therefore, it chose a change. After the US (especially under the management of many European countries, such as France and Germany), various changes in the world could be expected in turn.

The results of the election, along with the old enemies that the US handed over during the Obama era, many governments, especially those who are notable members of the EU, followed with concern. Though, this anxiety reflected in the international public (as it can be perceived as a sign of significant changes in global politics), it was also important that the perceptions of the entrenched perceptions should not be at the level of generating resources to inconsistent conspiracy theories.

How This Change In The Us Would Affect Energy Politics As Well As Global Policies

There are some main goals which affect Trump's energy policies:

- Producing cheap energy by lowering cost and maximizing the use of national resources by focusing on fossil resources. In this way, the US can reduce their dependency on foreign oil.
- Eliminating "burdensome regulations" and "harmful and unnecessary policies" on energy industry to produce energy abundantly and less costly.

Given the clarifications made by Trump or its advisers at this point, the post-election international energy policies would be affected in two ways in general. First; the consequences of the steps the US has taken towards its internal markets will be affected. Second, some balance of energy will change as a result of changes in the US's international political initiatives.

Expected changes in US national energy policies and their international effects

Some inferences made in this context are examined in terms of their materiality.

US domestic energy resources will be developed. Import will be reduced most: Thereby:

Prevention of environmental pollution and clean energy will be put on the back turner

- The sanctions for the development of coal resources will be removed and support on them will be provided
- Restrictions and sanctions in the area of oil and gas exploration will be removed and new incentive regulations will be introduced.
- The production of unconventional resource will increase.
- Nuclear power plants will be supported.
- Trends and support for technologies with low productivity and long turnaround times, such as solar and wind, will decrease.

Potential impacts of changes in US international policies:

- While international policies are being set, commercial action of steps taken and four initiatives will be kept in the foreground.
- Relations with Russia will be improved compared to the Obama era.
- The deal with Iran will be revised and or canceled.
- Good and close relations with European countries will continue but relations with them will be reviewed again on some issues.

Impacts of the Policies on Energy Sources

The above statements, which are expected to influence global energy policies, are briefly evaluated in terms of their effectiveness and applicability. It is an expected and feasible step for the US to make moves into areas such as coal, unconventional, oil and gas, and sea exploration. It is understandable that an administration that naturally leads to fossil resources and makes incentives to this area and environmentalist approaches and developments in clean energy fields will be put on the back turner. It should also not be forgotten that oil cartels are the ones who are behind the new administration.

From the coal perspective:

- As production and consumption are almost equal, this will not affect international coal markets very much.
- With the development of domestic coal resources and the encouragement of coal conversion plants, it will be possible to increase the electricity production from coal.
- In addition to these options, it is also possible to export more carp products to be produced with incentives.
- Nonetheless, coal is one of the weakest elements to influence international energy policies, although it attracts much attention.

In terms of oil and natural gas:

- The US is the largest oil importer in the world and also one of the biggest producers. The excess of domestic consumption makes it the largest importer; however, the US also has a considerable amount of oil reserves.
- When these reserves and potentially containing regions are analyzed, the search and development of domestic oil resources is very important in terms of reducing the current account deficit. Stretching at this point in environmental legislation and incentives to be provided at the current low oil price levels will speed up the investment steps and make investments attractive.
- Potential domestic petroleum and gas supplies will partly reduce oil imports by the US. The reason for the reduction is that the oil used in the refineries where the petroleum is processed has certain characteristics. Thereby, if the US produces much more oil than its total consumption 50 years from now, some refiners may have to continue importing to continue to work. Or it will be necessary to revise the relevant refiners. The decline in imports and possible additional production and supply in global markets will also have a negative effect on oil prices.
- The development and production of gas and unconventional gas resources will support the goal of becoming one of the major medium and long-term gas exporters of the US, which is already a self-sufficient country for gas.
- Stretching environmental legislation and sanctions, particularly in the development of anchor resources, will further accelerate sector development.
- Though, as low oil prices in general are not affecting gas markets, it will be one of the key point the US government should be careful about to intervene to make the projects economical, so as to ensure that global oil prices are minimized and national sectors are least affected.

From environmental perspectives:

It will become impossible for the EU-centered, environmentally friendly and clean energy policy to be imposed on the whole world.

- The fact that China and India, the biggest consumers of this future, will not pay much attention to reality in this matter will affect other countries with fossil resources, lukewarm though nevertheless tending to be clean and environmentalist.
- In addition, countries that initiate this movement in the EU and make investments and incentives in this area are generally those that do not have fossil resources and sustain their energy import and development.

Thus, it can be concluded that EU-centered clean energy policy cannot be applicable within even Europe. The EU, which is already weak and tends to fragment, will not be able to influence the international public game in these matters. The development of green and clean energy policies will slow down. Nevertheless, with developing technology, renewable investments and energy efficiency will continue. Nonetheless, decisions made in joint declarations such as the Paris climate summit will not be implemented.

Trump management; will not listen to such so called environmental sanctions because

climate change and environmental considerations are believed to be ineffective at the forefront of measures taken to limit the development of countries.

Solar & Wind

It is considered that the trend towards renewable energy in Obama era will be ceased in Trump period. Investments to solar energy became the leader among the new energy sources by increasing 95 % in 2016. It is the first time that solar panel set up exceeds oil and wind investments. According to Solar Energy Industries Association (SEIA), it was set a record by adding 14.6 Gwatt solar panels in 2016. It is argued that solar power makes a significant contribution to the energy source diversity in the US. Moreover, it is claimed that this clean energy source has an important economic impact by regarding 260,000 people work in this sector. On the other hand, this number is just 2 % of new job in US's total employment. High set up costs and low operation expenses make solar power less contributor to employment than oil sector.

Compared to fossil fuels such as oil, the cost per unit of energy produced by solar and wind power plants is high; therefore, they are not preferred because oil has both long-lasting returns and low-productivity investments. In addition, low-cost new technologies should be developed to produce and set up solar and wind power plants regarding the low-price trend in oil.

Bloomberg New Energy Finance anticipates that US growth of solar energy industry will continue and total capacity will reach 105 Gwatt till 2021. SEIA does not expect a record growth like in 2016 but a low-rate and stable growth.

In terms of nuclear energy:

Trump and his administration stated that thanks to high technology, they will spread nuclear energy safely. In other words, the inclination of the US in this field will change the estimates of nuclear energy use in the world energy equation.

Mainstay of Trump's Policy

This view is valid and in place for all countries with fossil resources.

Significant changes are expected when the expected trends in US national energy policies and their possible international impacts are briefly assessed as above. The US has returned to logical, consistent and clear discourse from changes in the (political) rhetoric of the Rockefeller group, in the face of Obama's (inconsistent) clean and environmentally friendly energy policies. (See: http://www.tespam.org/petrolun-devri-kapaniyor-mu/)

Projections and estimates show that, although renewable energy is important, oil and natural gas will continue to be the most important energy resources of the world in the next 50 years. Hence, these approaches of the Trump administration are realistic and in place, even in the case of excess capitalist perception.

Also, it should be noted that, long before the Trump administration, Turkey, except for oil exploration and production, was also aimed at domestic politics by foreseeing renewable energy support. It continues to take steps at this point. The missing direction is oil

and gas resources. Which, in turn, has solutions and steps that can be taken. TESPAM continues to work on these issues.

Energy Policy's Effect on International Policy

There are possible issues that can be deduced from the Trump administration's foreign policy discourse and effect on international energy policies. When international policies are set, commercial interests of steps and initiatives taken in the forefront are kept.

At this point Trump rhetoric has given an example of Obama's operation in Libya, which cost US $ 1 billion. In this case, he mentioned that such an operation can only be carried out for Libya's taking of at least half of its oil resources for 25 years.

Hence in this case; the dirty petrol cards will continue to grow and become ugly, increasingly bloody games (only for the purpose of funding and earning money) that they play in the present and past centuries, which will in turn lead the world's strongest state.

This rhetoric is a taboo that the whole world should worry about the weak states and oppressed societies that have oil and gas resources. Even when evaluated from an angle; with the Arab Spring Project, the US is supposed to be intelligent (which is likely to be the dirty oil cartel that holds Trump in power) and some western powers have made the wider Islamic geography, which has significant reserves of oil and natural gas, uneasy and desperate. Now it is the time of sharper and harder steps to share the cake.

At this point, the Sunni-Shiite conflict trying to fuel the Middle East and the political changes on the Saudi Arabia are very thought provoking. The only state that has the potential to make moves and defend oppressed against such a game is Turkey. For this reason, the world needs a strong Turkey. The President of Turkey in 2011 related to Libya said that: "Look at Libya, not from the point of petroleum, from the point of conscience!" The discourse clearly reveals the difference between the painting and the reality. In summary, it may be possible that the US will have military intervention in some oil-rich countries in the coming periods, such as Saudi Arabia. Of course, for this, the Islamic world needs to be brought to the desired degree of confusion, and such an intervention may need to take Egypt and perhaps Iran. It should also be forgotten that such an intervention would increase the US domestic market and accelerate exploration activities to increase oil prices.

The relations expressed with Russia to heal:

The EU's attitude to prevent Russia's gas export policies will weaken since at this point the greatest impact and support for the EU is provided by the US. But it also shows that recent developments in Ukraine and Nord Stream II have also failed to address US policy.

With regard to the nuclear deal, which is likely to be revoked with Iran:

Although Iran is perceived as a preferred ally in the Middle East by Obama to encourage the Sunni-Shi conflict, the fact of the active Turkey in the region has also raised the thoughts that some plans should be revised.

Relations with the EU:

In the post-Brexit period, it may be possible that the US, which has given cooling signals from the EU with a German influence, could reduce the political and military support provided by the post-Trump EU. It may also be expected in the EU member countries that an increasing nationalist movement, anti-immigrantism, a deterrent in the EU and a deterrent to weakening. In this case, the US will be expected to prefer not to support only the politically close members of the EU, instead of the entire EU, which cannot implement common strategies, instead of supporting the EU, on energy politics and energy supply security issues. Within this expectation, it is known that some gas (LNG) sales agreements between the US and Great Britain were also made.

Impacts on Turkey:

- The possibility of oil and gas prices continuing at a low level,
- The weaknesses of the administrations that support and are behind FETO (the Obama administration in the US and others in the EU)
- Question marks emerging about Iran as a regional competitor

They lead to a positive picture for Turkey in general. On the other hand, in the direction of the dirty games of the US petroleum cards mentioned above, only countries that have oil and gas resources for income and resource purposes, the likelihood of being found in military intervention is upsetting all positive scenarios.

As a result, along with Trump management, the petroleum cartels that are thought to be the support of the new president and whose share value in the stock market has increased after the election, can influence the future and international politics will be the most important issue. Together with that, we can only talk about the future of oil and gas resources which will become devalued but not clean and renewable resources, as it is expected.

THE USE OF COAL GASES AS AN ALTERNATIVE FUEL FOR ENERGY SUPPLY

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Coal gasification

Coal gasification is a process to produce syngas fuels. Syngas is a mixture mainly consisting of carbon monoxide (CO), hydrogen (H_2), carbon dioxide (CO_2), methane (CH_4) and water vapor (H_2O). Historically, coal was gasified using early technology to produce coal gas (also known as "town gas"), which is a combustible gas traditionally used for municipal lighting and heating before the advent of industrial-scale production of natural gas.

Natural gas is replaced by synthetic fuels, which are generally produced by gasification process, due to depletion of fossil fuels including natural gas resources. If synthetic fuel is produced by an air-blown gasification process, it is called as low calorific value syngas and may be used mostly in IGCC (Integrated Gasification Combined Cycle). Air is directly blown over the coal in a gasification reactor resulting in the production of the syngas that is composed chiefly of high amounts of nitrogen and carbon monoxide as well as a smaller amount of hydrogen as a combustible gas.

Alternatively, coal-derived syngas can also be converted into transportation fuels such as gasoline and diesel through additional treatment via the Fischer-Tropsch process or into methanol which itself can be used as transportation fuel or fuel additive, or which can be converted into gasoline by the methanol to gasoline process.

A review of the use of coal gases as an alternative fuel

Dependence on fossil fuels has not declined recently even though most attempts are tried to find clean and inexhaustible energy resources. Because, the fossil fuels are widely used in industrial systems, domestic applications, furnaces and etc. to produce electricity or to heat any places. Especially, electricity is mostly still generated by fossil fuels at a rate of over 80% nowadays. However, rapid depletion of fossil fuels continues all over the World. Readily available fossil fuels are getting difficult. Environmental limitations are more stringent as fossil fuels are quite pollutant. For example, coal includes N and S as pollutant as well as combustible components. Coal as solid fuel is a huge challenge due to containing pollutant and burning difficulties. Because of these justifications, coal-derived fuels are very attractive in terms of pollutant and burning technologies.

Coal-derived fuels are gaseous fuels and are mostly known as syngas or synthesis gas due to gasification products. But, coal-derived gases are not only syngas. Coke oven gas is also known as coal-derived gas because that gas is obtained from coal during the carbonization. The other coal-derived gases are generally known as town gases that are principally produced by mixing with coke oven gas and gasification products. Common characteristic of coal-derived gases is to be chiefly composed of hydrogen which includes high amounts of energy. In addition to this, coke oven and town gases comprise of near about methane of 25 % that is essential component of natural gas. For these reason, these fuels have named as hydrogen-rich coal gases in the present study. Hydrogen-rich coal gases are entirely alternative to natural gas when taking into account these reasons.

Due to the growing interest regarding blending fuels such as syngas, coal gas or any blending fuels, many researchers investigate these fuels. Although many research groups have studied related to blending fuels combustion, these studies are very restricted in the literature. As researchers in this field, Joo et al. [1] have studied NO_x pollution of the syngas using artificial neural networks. This study has been performed in model gas turbine combustor. Flame temperature and NO_x level are determined as 1350 K and 25 ppm for fuel containing 75% hydrogen and 25 % methane under stoichiometric conditions. Khalil et al. [2] have designed, manufactured and performed performance experiments of low calorific value fueled in a distributed combustor under colorless distributed combustion conditions. It is concluded that low levels of NO (9 ppm) and low CO (21 ppm) has been achieved under non-premixed colorless distributed combustion conditions. Liu et al. [3] determine the effect of hydrogen and helium addition to methane on soot formation. Results show that helium addition is more effective than hydrogen addition for soot reduction. Kutne et al. [4] have experimentally investigated combustion behaviors of low calorific syngas mixture. These experiments have been implemented under the three-thermal power and different equivalence ratios in a range of 0,4 – 0,6. It is demonstrated that changes in combustion conditions such as equivalence ratio and thermal power has slightly influenced the flame shape. Ghenai [5] have determined the effect of the variability for syngas components and heating value on combustion performance and emissions. It is exhibited that the flame temperature increases with increasing hydrogen amounts in syngas. It is also concluded that the maximum flame temperature emerges as 2200 K under methane combustion conditions. Ilbas [6] have modelled the hydrogen-hydrocarbon combustion to investigate the effect of thermal radiation and radiation models on combustion characteristics. Ilbas have performed modellings without radiation and with the P-1 radiation model and with the discrete transfer radiation model. Ilbas finds out that the usage of a radiation model is highly effective for more accurate prediction. Habib et al. [7] have studied combustion and emission performances of syngas in a package boiler. Syngases having different components (67% CO:33% H2, 50% CO:50% H2 and 33% CO:67% H2) have been modelled and according to the predictions, syngas including 33% CO:67% H2 have been determined to have the shortest flame in comparison to the other syngas compositions. Louis et al. [8] have developed a model to predict nonadiabatic combustion of syngas. They have also implemented the experiments for fuel including 40% CO, 40% H2 and 20% N2 and compared with the predictions. They conclude that the predictions are in good agreement with the measurements. Ranga Dinesh et al. [9] have examined the combustion characteristics

of some syngases which comprise of H2/N2 and H2/CO. They have modelled turbulent nonpremixed syngas flames using 3D large eddy simulations and used the laminar flamelet combustion model. The downstream motion is highly affected depending on fuel components. This is because of the differences in diffusivity in case of presence of hydrogen in the fuel. Lee et al. [10] have conducted an experimental study to investigate the combustion performance of syngas including hydrogen and carbon monoxide. The results are also compared with methane combustion. It is concluded that the maximum NO_X formation occurs during the hydrogen combustion. Lee et al. [11] have investigated the effect of N_2, CO_2 and steam on combustion performance of H_2 and CO in another study. They have found out that NO_X emissions decrease as the amount of diluents is increased. They have also revealed that the best diluent is steam because managed to reduce NO_X and CO emissions. Syred et al. [12] have studied flashback and blow off limits of different fuel blends that are methane, methane/hydrogen blends, pure hydrogen and coke oven gas. Coke oven gas and pure hydrogen behave prominently different as compared with the methane and methane containing up to 30 % hydrogen. Yilmaz and Ilbas [13] have experimentally examined hydrogen-methane blending fuels in a combustor. The experiments have been performed under different combustion conditions. The results show that the flame temperature increases whereas CO and CO_2 emissions decrease in flue gas when the hydrogen amount is increased in the fuel. Ziani et al. [14] have predicted combustion of CH_4-H_2 blending fuels using the PDF approach. They have used three turbulence models that are k-□ model, modified k-□ model and RSM model. They have determined that the modified k-□ model is the best selection for this kind of flame. Hasegawa et al. [15] have explored combustion characteristics of gasified coal fuel. These gases have a calorific value of 4-13 MJ/m^3. It is evidenced that the flame temperature increases as the fuel calorific value rises. They have also declared that NO_X level is higher for fuels containing nitrogen such as ammonia. Dattarajan et al. [16] have developed a combustor that can be burned the producer gas. This combustor has tangential fuel and air inlets that can be provided swirling flow. The results show that the presence of stable flame and complete combustion of fuel have been achieved in this study. Lee et al. [17] have conducted an experimental study related to combustion characteristics of coal-derived syngas. They used two different syngas type coming from Taean IGCC plant in Korea and Bugenum IGCC plant in Netherlands. They have compared with each other for cases without and with nitrogen dilution. İlbaş and Karyeyen [18] have modelled the combustion behaviors of the hydrogen-enriched low calorific value coal gases in their previous study. Results indicate that the flame temperature rises as the amount of hydrogen in the fuel is increased.

Although there are some studies about combustion characteristics of coal gas or syngas as mentioned above, many challenges still remain in this field due to containing high amounts of hydrogen in coal gases. For example, combustor and burner geometries must be resigned to provide stable flame of coal gases depending on coal gas composition and examined the inside of the combustor to understand the combustion behaviors of the coal gases. A new type burner coupled with the combustor has been designed and manufactured to achieve flame stability and to reveal the combustion behaviors of the hydrogen-rich coal gases.

The hydrogen-rich coal gases compositions are given in Table 1 in volumetric basis. Coke oven gas has high amount of hydrogen and methane as shown in Table 1. Therefore, it has the maximum heating value among the hydrogen-rich coal gases. As can be also seen in Table 1, water gas is a considerable different coal gas due to containing high amount of carbon monoxide that can affect the flame structure. However, the heating value of that gas is low compared to the others as it includes miserable amount of methane.

Table 1. The hydrogen-rich coal gas compositions [19]

	H2 (%)	CH4 (%)	CO (%)	CO2 (%)	N2 (%)	LHV (kcal/m3)	Density (kg/m3)
Coke Oven Gas	55	27	6	2	10	3678	0,452
Town Gas, I	51	21	18	4	6	3434	0,539
Town Gas, II	44	24	12	4	16	3335	0,600
Water Gas	50	0,5	40	5	4,5	2385	0,659

Conclusions

- The use of coal gases in power stations and other aplications as an alternative gas fuel is an advantage for economy in the following ways.
- Turkey is a country importing 98% of its natural gas consumption. The use of coal gases will decrease the amount of natural gas importation.
- The cost of building the coal gas power stations are going to be lower than the cost of the coal power stations.
- The emission of air pollutants from the use of coal gases will be lower than that from the use of coal.
- In one of our research study, axial and radial temperature distributions have been determined in the combustor and compared with each other. The maximum flame temperature has emerged for the coke oven gas flame due to the presence of high amounts of hydrogen and methane in the fuel.
- In another work, it is concluded that the presence of hydrogen in the fuel affects considerably the high temperature regions of the coal gases in the combustor. In particular, this situation has showed up at radial temperature measurements towards the combustor outlet.
- It is revealed that NOX formation is considerable level for hydrogen-rich coal gas flames because the coal gases include a trace of molecular nitrogen and this nitrogen contributes to NOX formations due to the thermal NOX mechanism.
- It is demonstrated that molecular CO2 and CO gases in the fuel cause significantly excess CO2 and CO formations in the flue gas.
- Finally, in our research studies, the hydrogen-rich and low calorific coal gases have been properly burned in a new type burner coupled with the combustor. Therefore,

it is proved that the hydrogen-rich coal gases and coal gases in general as alternative fuels may be burned by means of the new type burner.

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WHAT IS THE SPEED OF ENERGY TRANSITION?

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Introduction

The headlines like "coming age of renewables" or "phasing out of coal" seems likely to happen in a matter of years. Despite having these changes already initiated, the speed is a matter of question for investors as well as consumers.

After Paris agreement, "stranded asset" discussions were widespread. The oil and coal companies have been warned to be careful for having stranded assets. Making matter worse, as the commodity prices plunged, it became an imminent threat for shareholders. From the IPO of Saudi Aramco to the bankruptcy filing of coal powerhouse Peabody, the economic fortunes of the fossil fuel companies are closely monitored and analyzed.

In this article, the speed of energy transition within an analytical framework will be investigated. By using data from IEA World Energy Balances database, historical energy transition speeds will be examined for the world and different countries. A hypothetical country's energy transition to solar and electric cars is briefly introduced in the last part.

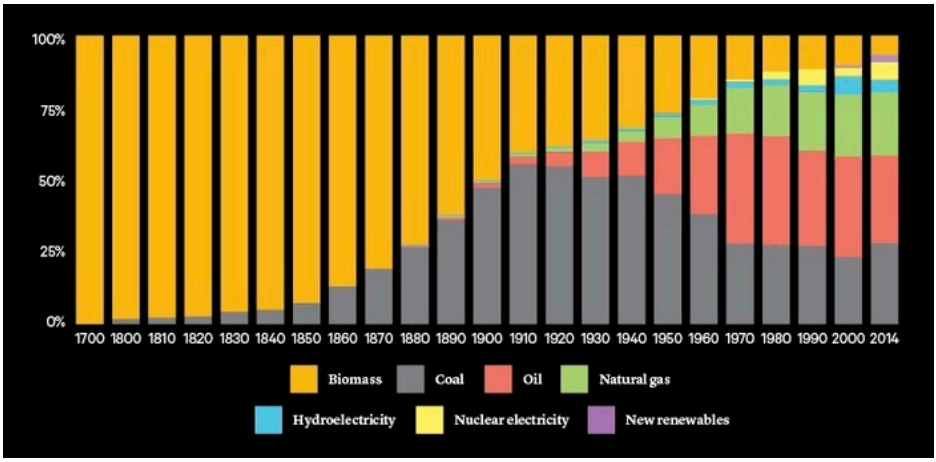
The findings suggest that transition speed is constrained by technology in several parts of the energy system (infrastructure, production, consumption). One of the fastest transitions in OECD countries happened in France. Even in Germany, pace is slower than expected. The developmental stage is also affecting the speed.

Primary Energy Transition

World's energy transitions are driven by both technology and policies favoring technologies or resources. Having those resources doesn't guarantee the accelerated utilization of that particular fuel, because it is closely linked with the technological tools to utilize it. A recent example can be given for natural gas. Natural gas needs pipelines to be delivered and heaters for consumption. Pipelines are one kind of infrastructure technology while liquefaction or LNG plants, ships and regasification units are other competing or complementing ones. So, what will be the speed of transition to natural gas? It depends on all those factors mentioned above.

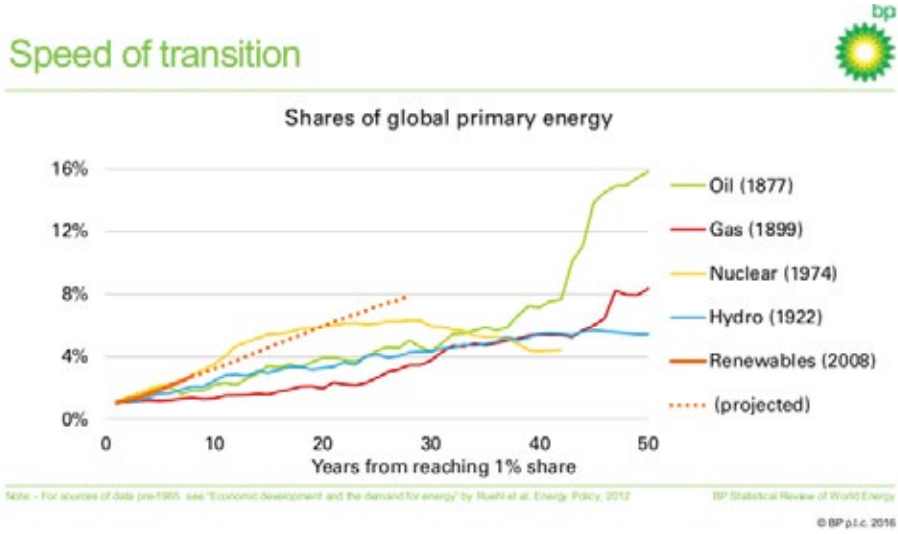
Daniel Yergin's The Prize book[1] starts with two important technologies that paved the way for oil dominance in the 20th century. The first one was refining, the second one was drilling. These technologies increased oil's share against coal's. However, the new

fuel also nurtured new technologies such as petrol cars. Coal however, didn't wiped out completely, but prices and developing countries' needs supported its resistance.



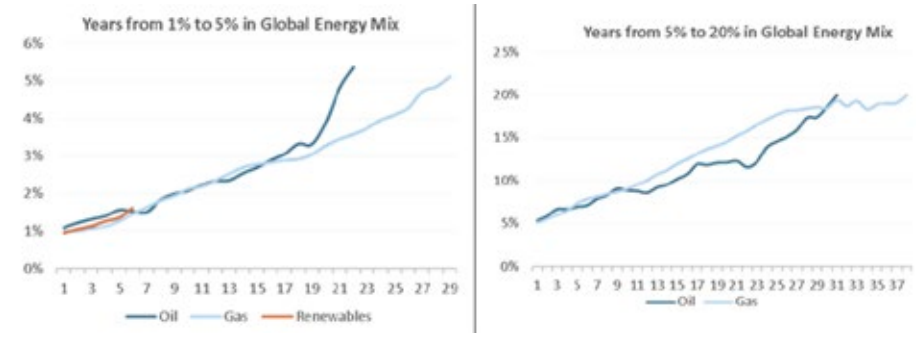
Primary energy transitions in global energy mix[2]

In BP, Statistical Review of World Energy, "Speed of Transition" slide[3] is a summary of historical pathways. It took more than 50 years for oil to reach %16 share in global primary energy. One wonders, whether this data should be looked more globally or countrywide. Since global change will be much slower than the frontier countries.



BP Presentation slide on energy transition

Coney Kazokoglu from FG Energy[4] has two graphs. First graph showing the progress path from 1% to 5% of global energy mix. The second graph is the change of this share from 5% to 20%.

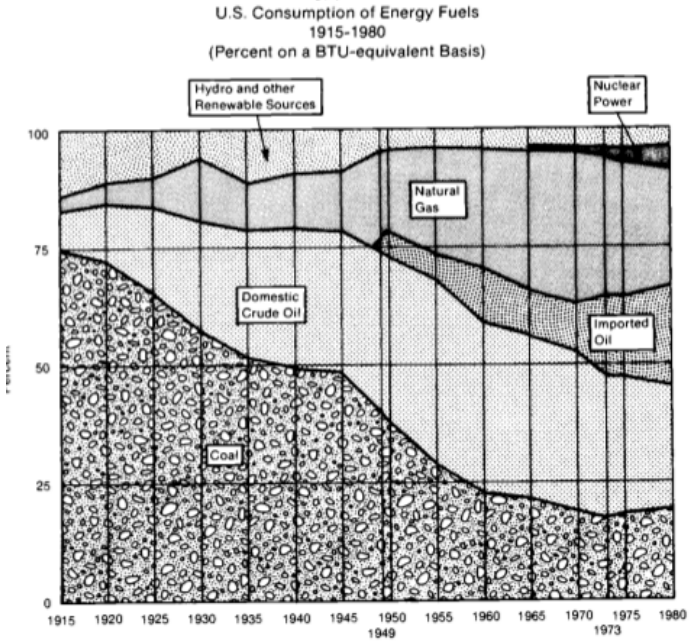


The speed of change in the share from 1% to 5% and 5% to 20% in global energy mix

These global energy transitions may hint us about the speed of the transition but country level data also needs some consideration. Long term historical datasets are not readily available for most countries, but developed countries like USA can be helpful for extensive research.

USA's Energy Transition

USA's energy transition between 1915-1980s is a high-speed transition compared to world transition above. In 1915 coal was 75% of energy mix, by the year 1940 it was close to 50%. 25% drop in 25 years has happened. Meanwhile crude oil and natural gas increased their share.



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US energy transition from 1915-1980s[5]

Between 1945-1958, US economy moved towards liquid and gaseous (fluid) fuels from solid fuels. Coal price dropped 7.4% as well as its share ebbed from 43% to 22%. A 21% drop in 13 years.

The other important conclusion from the above graph is how oil embargo of 1973-1974 and 1979 energy crisis affected US fuel consumption patterns. Thus, the return of coal after 1973 is worth mentioning.

Another element in transitions is the energy security concerns. Energy security concerns may overturn an ongoing transition in a limited way. Although no major coal breakthroughs happened during 1970-1980s, coal preserved its place and even gained some share. Can there be a complete reversal of an expected energy transition? Historical evidence does not provide sufficient material for a conclusion.

Examination of Historical Data

The second part of the article, examines world and country level data to contemplate on the speed of change. For this study, IEA database was used. IEA World energy balances database includes data from 1960s to 2015 for OECD countries. For non-OECD countries, the data starts from 1971. The energy balances of countries include primary fuels and electricity imports or exports. The dataset is quite detailed, however for the sake of simplicity a much briefer subset is examined. The subset used in this analysis includes:

- Coal, peat and oil shale,
- Primary and secondary oil (oil products)
- Natural gas
- Nuclear
- Renewables

Electricity (electricity line in the primary energy supply) has not been included in the analysis, since the values represent import or export balances. It is included on the primary energy balance to correct for trades. It is not a real indicator for energy transition.

Methodology used is as follows:

1. Share of each primary resource in total mix has been calculated.

2. This share has been compared with the share for the previous year and 10 years ago.

3. Maximum positive change among the share of any primary resource is recorded as "1 year" or "10 year" increase. A positive number is seeked, since a gain of the new comers is generally the loss of incumbent resource. Therefore, gains are better indicators for our purposes.

"1-year increase in the share of primary energy supply" means, fastest growing one primary resource for that period has increased its share by a given percentage. This increase translates into decrease in other primary resources' share. "10-year increase" follows the same logic.

A dynamically linked spreadsheet is constructed to allow selection among countries. The countries selected are chosen based on the criteria of size, development path as well as geographical proximity.

1 year change and 10-year change will show the pace of transition in the short term and relatively long term. Generally, 1 year change is observed to have a much smaller value than the 10-year change.

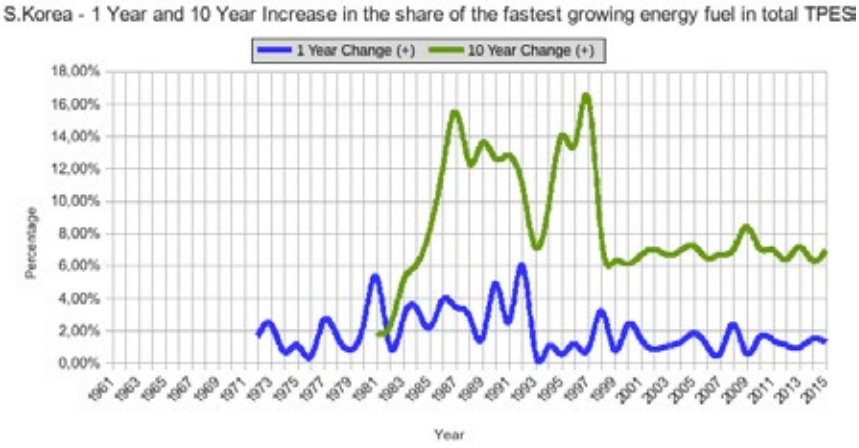
The world level data represents two fundamental increases. In the chart below, the first peak of 1985-1991(green line) is the rise of nuclear compared to 1970s. Much larger second peak around 2011 is the rise of coal by developing countries. For the last 40 years year-on-year change didn't exceed 1% frequently. The maximum 10-year change is 5.7%, approximates to roughly 17 years for full transition.

USA's energy transition resembles world until 2000s. But after 2009 the shale revolution and natural gas's rise can be traced from the graph below. Compared to world, due to its decreasing weight in world energy consumption, USA is diverging from the overall picture.

USA's maximum year-on-year change has happened in 1967 with natural gas with 2.2%. During the 1980s coal, has gained considerable share of maximum 5.4% compared to 1970s. In 1977 and 1978, just before the 1979 energy crises oil gained share but lost afterwards. As mentioned, in recent years natural gas made considerable gains compared to 2000s.

China however has frequently seen more than 1% gain in the total energy mixture. Most of these changes happened in coal's share in total primary energy supply. Recently this change has lost some steam.

South Korea is one of the countries achieving high speed growth. The first high speed transition has happened with the increase of nuclear, the second change in the late 1990s is due to oil.



When it comes to nuclear, France has a particular importance in understanding energy transitions. The country has established a dedicated nuclear program to move away from fossil resources. In a sense, this looks like a renewables transition since both resources don't involve fossil resources and they both used mainly for power generation.

France has achieved 25% and 30% change in 10 years. The first peak of 1971 and 1972(just before 1973 oil embargo) is due to oil gaining share in consumption. The second one is nuclear gaining share from oil. During that period, nuclear has surpassed 5% y-o-y change in its increase in general energy mix.

Germany on the other hand, despite Energiewende, hardly sees more than 10% increase in total mix change in 10 year periods. In 2005 share of renewables in TPES was around (since I excluded electricity in this analysis) 5%, this increased to 12%. 7% increase in total mix.

Chile on the other hand has shown one of the most impressive changes in energy transitions. The peak in 2004-2005 is due to natural gas. The recent y-o-y changes are a complex interplay between renewables (2012-2011), coal (2008-2007), oil (2014-2013) and natural gas (2009-2008).

Finally, Turkish energy transition first experienced and increase in oil and then natural gas. Recently coal, oil and natural gas dominates the maximum y-o-y changes.

All these country specific examples show that every country has its own energy transition path within a much slower global energy transition. The countries with more renewables have seen a more complex interplay due to weather events (drought etc.). For developing countries, renewables may have biomass accounting for a larger percentage than hydro, solar and others. However, France's nuclear transition is one of its kind growing from 2.7% in 1977 to 32.6% in 1987. It is a dramatic change with an impressive speed.

An Empirical Transition Example

In the last part, a hypothetical country with 100 mtoe (million tons of oil equivalent) TPES (total primary energy supply) is presented. That country has no net demand increase and supplying all its energy needs from oil. Therefore 100 mtoe is totally supplied from one single fuel, oil.

To clarify certain concepts, TPES is the total primary energy supply. It is the energy supplied to that country from domestic and exported resources. A fraction of TPES is used as an input to transformation sector (refinery, power generation etc.). This transformation outputs secondary fuels and electricity. So, the difference between TPES and transformation sector input, with the addition of transformation sector outputs is considered total final consumption (TFC).

For this setup, 100 mtoe supply's 30 percent is used for power generation with uniform 50% efficient power plants. The rest is directly passed to the final consumption. The electricity generated from primary energy resources is also added to that sum. The simplified balance sheet of this hypothetical country is given below:

	Million Ton Oil Equivalent
Total Primary Energy Supply(1)	100
Power Generation(2)	-30
Total Final Consumption(3=1-2+4)	
Electricity(4)	15
Transport(5)	35
Other(6)	35
Sum (4+5+6)	85

A Simplified energy balance sheet for 100% oil consuming hypothetical country

In a real-life balance table, only demand sectors will appear under TFC. Electricity should be in columns. Since there is only one kind of fuel used -namely oil, in this economy, electricity is converted to rows.

Now, this country decided to invest in solar panels at t=0 and within a certain time frame achieves 35 million households having 1kW solar panels each. The capacity factor for these solar panels is roughly 20%(1800 hours per year). The total solar capacity is 35,000 MW, and total electricity generation will be (35000 MW * 1800 hours/year) 63 Terawatt-hours.

From IEA's unit conversion site[6], 1 MTOE equals 11.63 TWh. So, 35000 MWs generate 63 TWh that is equal to 5,4 mtoe/year. This is avoiding 10.8 mtoe of oil consumption in power generation. So as total final consumption does not change, but TPES (1) drops to 94.6 mtoe (-10.8 mtoe plus 5,4 mtoe solar as primary energy)

So, when this country decides to move away from oil consumption to solar panels in electricity generation, with 35000 MW it can only change 5,6 mtoe of primary energy supply. A change of -10% in oil consumption is substituted with an increase in renewables in 5%. This is due to thermal generation efficiency assumption of 50%.

1 mtoe of renewable-sourced generation increase in electricity substitutes 2 mtoe's of oil consumption. Total primary energy supply drops by 2 mtoe (reduced oil consumption and supply) and increased by 1 mtoe (solar as primary energy).

	Oil only (MTOE)	Oil +35000 MW panels (MTOE)
Total Primary Energy Supply(1)	100	94,6
Power Generation(2)	-30	-19,2
Total Final Consumption(3=1-2+4)		
Electricity(4)	15	15
Transport(5)	35	35
Other(6)	35	35
Sum (4+5+6)	85	85

The result of shifting from oil to solar panels in power generation in that hypothetical country.

This is the supply side effect of this transformation. Now demand side effect will be discussed with electric cars. What if this country shift all its passenger car transportation to electricity from oil products?

The main assumptions in this setting are petrol engines are 30% efficient and only 30 mtoe of transport fuels (5) is for road transport. 50% of road transport is used in passenger cars. Electric cars, with their batteries are assumed 90% efficient. Half of road transport fuels (30/2=15 mtoe) is consumed in passenger cars. Only 30% of this energy is transformed in to mobility services (15*0.3=4.5 mtoe). Setting constant, the energy required for mobility services, electricity needed for the same activities are (4.5/0.9=5 mtoe).15 mtoe of oil mobility converts to 5 mtoe of electromobility.

	Scenario 0	Scenario 1	Scenario 2
MTOE	100% Oil Consumption	Electric Cars (electric from oil)	Electric Cars (from Renewables)
Total Primary Energy Supply(1)	100	95	90
Power Generation(2)	-30	-40	-30
Total Final Consumption(3=1-2+4)			
Electricity(4)	15	20	20
Transport(5)	35	20	20
Other(6)	35	35	35
Sum (4+5+6)	85	75	75
Total Balance (mtoe)	100	95	90
Oil	100	95	85
Renewable	0	0	5
Total share(%)	%100,00	%100,00	%100,00
Oil	%100,00	%100,00	%94,44
Renewable	%0,00	%0,00	%5,56

The final energy balance sheet of both supply and demand side scenarios are given above. Electricity from renewable energy reduces both TPES and TFC, since renewables are assumed to have 100% efficiency. Shift from oil to electric cars primarily reduce TFC,

thus TPES drops as well. With electric cars oil consumption in transport (5) is converted into electricity consumption (4). Still the transition pace doesn't reach even 10%.

Conclusion

Energy transition requires technology transition. Technology transition is induced through new inventions or government policies due to energy security, environment or others. Therefore, energy transitions by themselves are bounded by technology (including infrastructure) and the impact of policies.

The technological change means a change in infrastructure, appliances, equipment. To retire existing machine park for the sake of technological change may not be economically efficient for the decision makers. The sunk costs, amortizations, asset lifetimes are all considerations to be carefully examined.

In this article, the speed of energy transition is investigated from historical records. There are important results:

1. The pace of change depends on the country's development path and status (developing or developed)

2. Shale gas revolution in US is one the major energy transitions happening around the world

3. World is much slower in terms of energy transition, developing countries are faster (since their technology base is newly forming)

4. Transitioning to electricity from other fossil fuels decrease primary energy needs

5. Transitions in power sector among fossil fuels is twice as large compared to renewables since fossil fuels are used with an efficiency factor. (3 units of coal produce more than 1 units of electricity)

6. France's nuclear transition in 1980s with 30%(nuclear) change in the share TPES is remarkable and an example of the fastest energy transition to non-fossil resources.

7. With French example in mind it may take at least 30 years to fully change an energy system

8. German example is roughly 10% change in renewable share in 15 years. More than 100 years to have a 100% renewable energy system

9. Electric cars may not save the day but increase efficiency of the energy system substantially

10. Roughly world has achieved a maximum of 6% change in 10 years time since 1971.

Therefore, the speed of transition may not be that fast, despite having all the technologies readily available. But the way transition happens can be more disturbing than its speed.

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UNCONVENTIONAL RESOURCES IN TURKEY: MYTH OR REALITY?

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After the Shale Revolution in North America in early 2000's, a huge interest rose all over the world and Turkey, no doubt, is among those countries.

In this article, I will try to explain what unconventional resources are, which caused a revolution particularly in USA and turned this biggest hydrocarbon consuming and importing country into a hydrocarbon exporting one. I will also try to discuss, where in Turkey, might be these resources and how it can contribute to Turkey's energy independence.

UNCONVENTIONAL RESOURCES

In order to understand what unconventional resources are one must first understand the terminology and how hydrocarbons (a term used both for oil and gas) are formed.

Terminology

Especially in Turkish community, the term "unconventional" causes confusion. From a fluid type point of view Unconventional Resources are the same oil and gas that we produce conventionally. Actually, the term unconventional refers to the rock type where hydrocarbons are produced and the methodology that is used to extract them. Apart from the term Unconventional Resources, Shale Gas, Shale Oil, Tight Gas, Tight Oil and Self Sourced Resources are used widely in the industry.

In Turkish press or other publications, the term "Rock Gas" is used. Technically it is not correct to use such a term since all hydrocarbons are produced from rocks. So, rather than using "Rock", we strongly recommend to use the term "shale" which is a type of rock which (if available) is capable to transform in situ organic matter into oil and gas.

Origin

What are these resources which is described with such different terms? As mentioned above unconventional resources is not something different from conventional oil and gas. The unconventional side of these resources are the rock from which hydrocarbons are produced and the methodology that is used to extract them.

Conventional oil and gas is produced from certain type of rocks where porosity and permeability is high. In other words, such rocks referred to as reservoirs are capable to transmit oil and gas without any stimulation. In such reservoirs, fluids exist from top to bottom as gas, oil and water.

Unconventional oil and gas, on the other hand, are those hydrocarbons which are produced from the same petroleum system with conventionals, but from a different rock type (Fig.1). These rocks, as stated above, are referred to as shales. If a shale is rich in organic matter it is referred to as Source Rock. Despite conventional reservoirs, it is very difficult to extract oil and gas due to very low transmissibility of fluids. To have economic flow rates, horizontal drilling and hydraulic fracturing is a must.

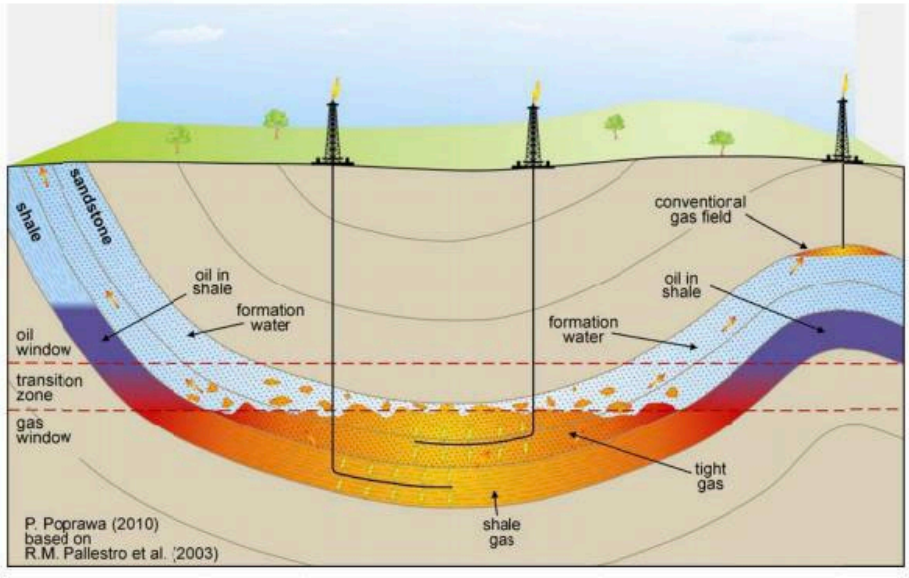

Figure 1: Conventional and Unconventional Resources in a Petroleum System. The distinction is made by the presence of free water. (Poprawa, 2010)

A less known unconventional resource is called "Basin Centered Gas Systems" or "Pervasive Tight Gas Systems". The difference from shale gas is that these resources consist of various rock types. These various rocks, are very close to source rock and hence, have high gas saturation values. Despite conventional reservoirs, they exist below free water level and do not need any trap. The fluids exist from top to bottom as water, oil and gas which is just the opposite of a conventional system.

UNCONVENTIONAL RESOURCES IN THE WORLD

Exploration for unconventional resources go back to 1980's. However, economic success and a well understanding of these systems are achieved in 2000's. Due to this reason, I would like to discuss activities related to unconventional resources from 2000's to nowadays. The basic question is, whether the success story achieved in North America can be replicated or not?

North America

There is no doubt that shale success story began in U.S.A. From 1980's with the support of federal institutions and Ministry of Energy, different oil companies made investments for shale gas. Oil and gas pioneer George Mitchell's economic extraction of shale

gas and afterwards are well documented in the literature. The point I want to emphasize here is rather the persistent exploration activities supported with technological innovations. Let's take a close look from two examples:

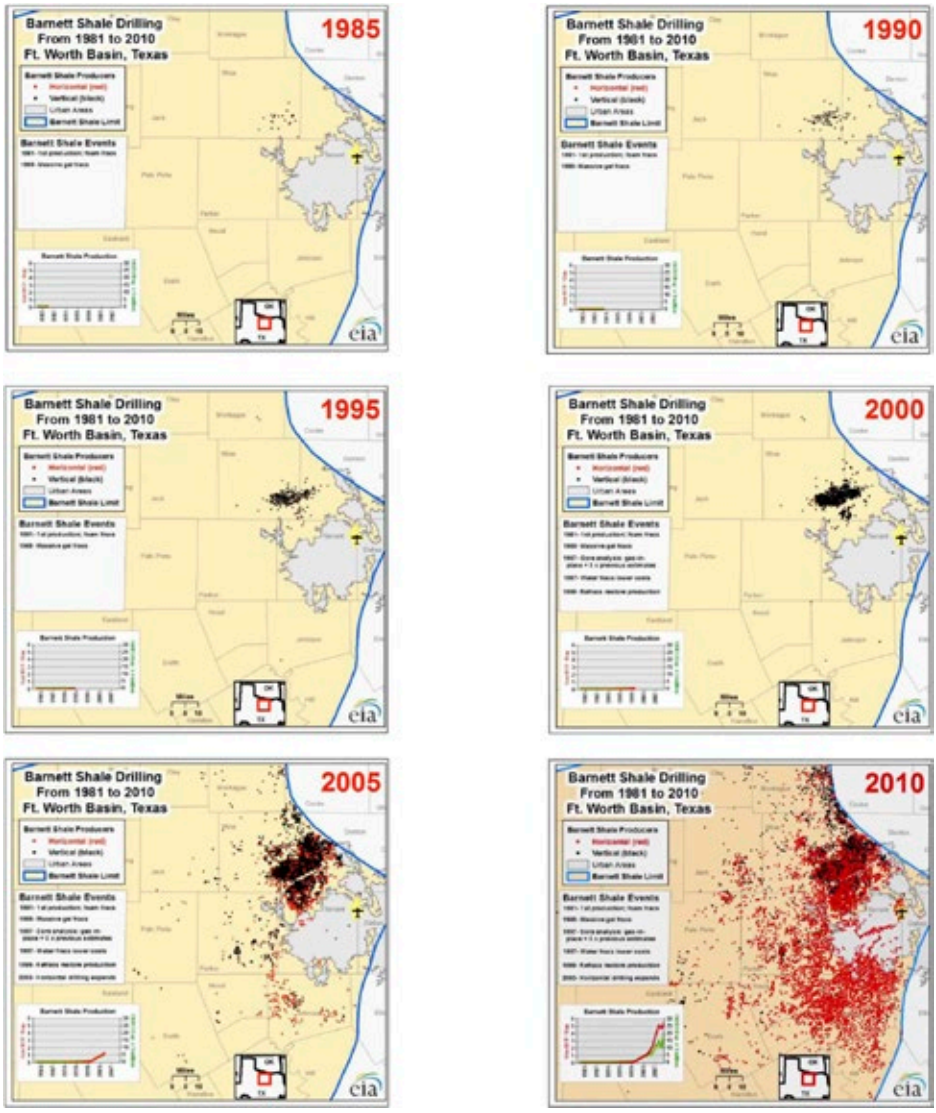

Figure 2: Wells drilled in Barnett formation between 1985 and 2010. Black dots represent vertical wells, red dots represents horizontal wells.

Mineralogy and number of wells drilled. First shale gas is extracted from a formation called Barnett, located in Texas, U.S.A. One of the major characteristic feature of this formation is its quartz rich content. The importance of high quartz content comes from the fact that it increases brittleness, which at the end, helps the formation to be hydraulically fractured much easier. The belief in high quartz content was so high that most geoscientist believed that other shales can not produce hydrocarbons. In this early era, oil companies searched for other "Barnett"s. Unfortunately, not only in U.S. but in

the whole world shale mineralogy was different. It was so hard to find quartz rich shales like Barnett. This is the point where passionate explorationists and innovative engineering created a difference. Ongoing geological and engineering R&D activities showed that not only quartz rich, but also carbonate rich or even clay rich (which badly affects hydraulic fracturing) shales can produce hydrocarbons. Concerns related with fluid type was exactly the same. At the beginning very few people believed that oil can be produced from shales. However, today technology allows us to produce both oil and gas.

The second example is about the well types and numbers. In different platforms, we all hear that in U.S.A. tens of thousands of wells were drilled. So the question is, whether here in Turkey, we should drill the same number or not? The simple answer is No. Let's discuss this question by examining the development process of Barnett shale.

Figure-2, shows the wells drilled between 1985 and 2010 in Barnett formation, Fort Worth Basin, Texas. Red dots represent horizontal wells; black dots represent vertical wells. On the lower left hand corner production rate is shown.

First economic production rates were achieved in 1981. In 1985 massive gel fracs were implemented. In 1997 cores were extensively taken and gas in place estimations almost tripled. In the second half of 1990's oil companies began to use water in their hydraulic fracturing operations which lowered the overall costs. In 1999, fracked intervals were re-fracked and helped to restore production. Till 2005, the majority of the wells were vertical. However, after 2005 horizontal wells became almost a standard in the industry. The increase in red dots can be clearly seen in Figure-2.

Although first economic production was achieved in 1981, total production started to create a difference after 2000. The rule is simple: More wells you drill; more production you get. Just at this point, it is vital to understand that production performance of each well might be so different. Let's take a close look to Figure-3.

Figure-3 illustrates wells drilled in Eagle Ford shale, located in south Texas, between 2006 and 2010. Each circle represents a well, where the radius of the circle is proportional to its performance by means of barrels equivalent of hydrocarbons produced per day. Pink, orange and green zones represent gas, condensate and oil zones respectively.

Two points are important. First, production rates per well is not homogeneous, which means that wells with relatively high production rates and low production rates are close to each other. In other words, they are not concentrated in some certain areas. This shows us that unconventional reservoirs are much complex and relatively unpredictable than conventional reservoirs. Second, we can see that more wells were drilled in orange area. The main driving mechanism is economy. Orange area, as mentioned earlier represents areas rich in condensate which is easier to exploit than oil and gives a better profit rate than gas zone. This, for sure, does not mean that oil or gas zones are not worth to drill wells, but rather means that the economy in that area today, does not allow to drill. They will be drilled later in the future when oil price is high enough.

North America is a huge laboratory both for geoscientists and all professionals trying to understand the energy policies. There are lots of lessons learned in the industry and it is possible todiscuss more topics here. However, not to bore the reader and to create space for different topics, now let's take a look to other parts of the world.

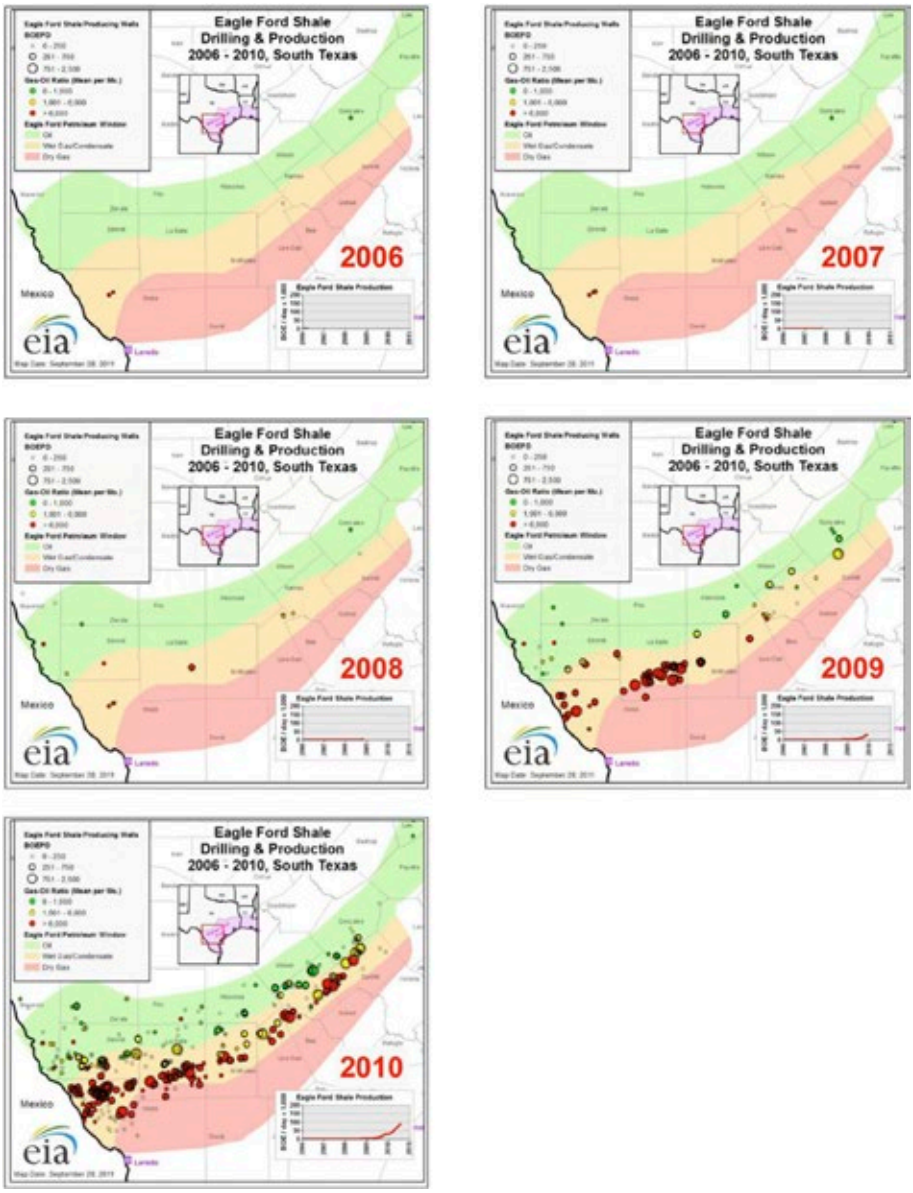

Figure 3: Wells drilled in Eagle Ford formation between 2006 and 2010.

Europe

European experience in unconventional is not as exciting as in North America. Several reasons exist. First of all, there are lots of countries in Europe, which means different bureaucracies, tax regimes etc. On top of that, European Union's environmental regulations creates extra difficulties for oil companies. At the moment, prevailing environmental sensitivities in Europe depends on political concerns rather than scientific facts. Almost always the arguments do not change: Polluting underground fresh water resources or creation of man-made earthquakes. It is not the purpose of this article to discuss such

issues, but let me state that all industrial activities include certain degree of environmental risk. Whether it is petroleum related or not, there is no zero risk industrial activity on the earth. Potential pollution of water resources is not limited to unconventional exploration or production. Bad engineering practices always did create environmental problems and will create in the future. At this point it is nonsense to discuss whether we need to extract these resources or not. The point is, how the industry can develop better standards to protect the environment while exploring and producing such resources.

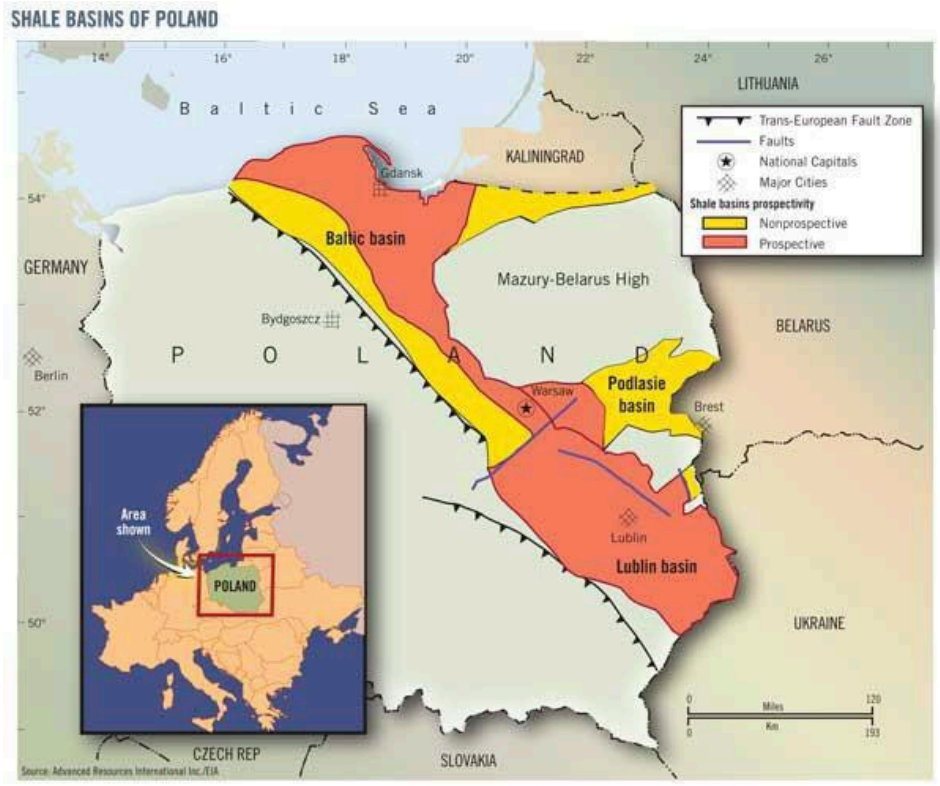

Figure 4 Baltic and Lublin Basins in Poland.

Putting aside environmental discussions, I think Poland is so far, the most important country in European experience. Favorable taxenvironment and less bureaucratic processes helped the country to turn into an attraction point. Together with the desire of both majors and small oil companies, Poland became the most active country in Europe regarding unconventional exploration. Exploration activities concentrated in two basins: Baltic and Lublin (Fig.-4).

First exploratory well was drilled in 2010. Almost by the end of 2014, 66 exploration wells were drilled within 50.000 km^2. 11 of them drilled horizontally and 24 of them were hydraulically fractured. The cost for a vertical well was around 12 million USD. It increases to 20 million USD if one wants to drill horizontal well and frac it. Despite 750 million USD spent, production rates were not encouraging. Together with Poland governments' decision to increase tax rates almost up to 40%, many oil companies, in-

cluding majors like Exxon decided to exit the country. Poland today does not seem to be an attraction point but exploration activities still continue.

In other European countries, there is an ongoing unconventional exploration. However, all activities end up with hot debates about hydraulic fracturing. Such operations are banned in France and by June 2016, Germany announced that fracking operations are banned for shale gas exploration but limited activity might be allowed for sandstone reservoirs. This is just another example which shows that such decisions are made with political concerns, since there is no difference between fracking a shale and a sandstone. It seems that current public opinion and regulations in force will not allow short and mid-term progress in exploration activities.

United Kingdom seems to follow a different path. Although regulations are tight, no ban exist for hydraulic fracturing. Following Brexit, industry might feel more comfortable environment to explore unconventional resources.

Other

The quest for unconventional resources continue all over the world with different levels of exploration. China is believed to have one of the biggest resources in the world. Despite 150 wells drilled so far, no economic flow rates were achieved. The potential areas are in mountainous areas and lack of transportation infrastructure makes it very difficult to extract these resources. In 2012, Chinese government announced that it will open its shale gas blocks to foreign bidders. However, all blocks were rewarded to NOCs. Monopolistic nature of China's oil and gas industry does not seem to allow a production from shale gas in short and mid-term.

It seems that promising future will be in Argentina. So far, Argentina is the first country outside North America which succeeded to produce hydrocarbons from shales. Although Argentina government decided to nationalize assets from time to time, oil industry somehow survived and managed to invest in this country. Exxon, Shell, Repsol, Chevron, Wintershall are some of foreign oil companies. Together with YPF, Argentina's National Oil Company they focus on Vaca Muerta formation in Neuguen Basin (Figure-5). Just to clarify what is going on in Argentina, let's take a look to two Exxon wells. Bajo del Choique X-2 well was drilled to a total depth of 5750 m. Vertical well section is 4750 m deep and lateral length is 1000 m. Production rate is 770 bbl/d. The Invernada X-3 well is drilled to a total depth of 4600 m, in which 3600 m comprises the vertical and 1000 m the horizontal section of the well. It produces 448 bbl/d oil with 29,000 m^3 of gas.

Another operator, Chevron, together with YPF, produces 35,000 bbl/d. If Argentina can sustain current investment environment and give more assurance not to nationalize shale blocks, the country will enjoy their own shale success story within a very short time period. Within 5 to 10 years cumulative shale oil production will follow the same trend as in North America.

UNCONVENTIONAL RESOURCES IN TURKEY

Figure-6 shows Turkey's sedimentary basins. In theory, these are the areas where potential unconventional resources are. However, the reality is a little bit different. Turkey,

despite wide range of people argue, is not an underexplored country. Petroleum geology of Turkey is well known and even in very high risk basins, wells were drilled.

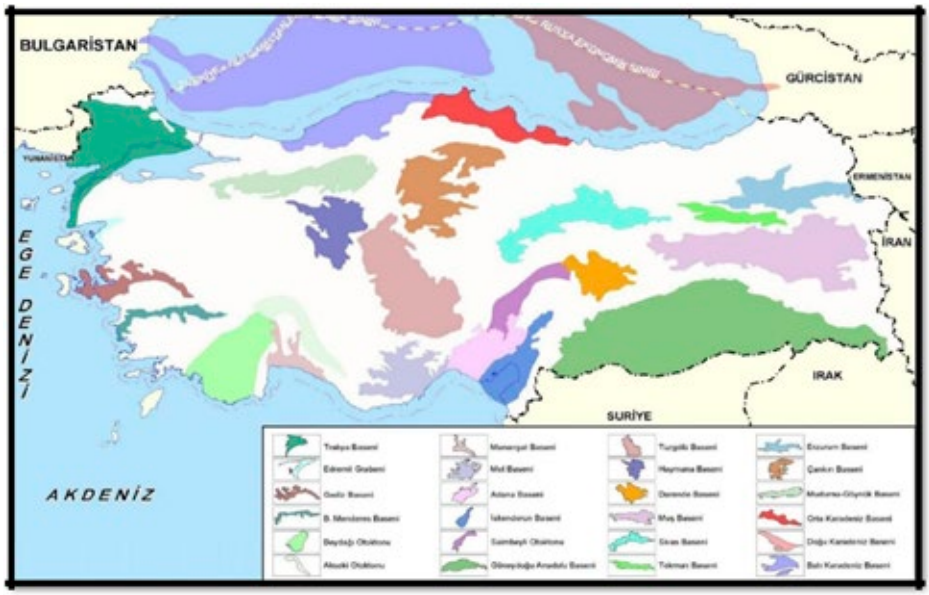

Figure 6: Sedimentary Basins in Turkey.

Thanks to those wells, in the majority of basins we know that source rocks are not mature enough to produce hydrocarbons. In other words, these basins are not capable of producing economic amounts of shale gas or shale oil. Two basins are exception. Thrace and South East Anatolia (SEA) Basins. These basins are also the ones where conventional oil and gas is produced. It is no surprise that the oil industry in Turkey, at the moment, focuses in these two basins. The exploratory wells drilled so far aims to prove the concept and show that economic flow rates are possible.

Shale Gas/Oil Activities in Turkey

Unfortunately, very few oil companies exist in Turkey. TransAtlantic Petroleum is probably the most important operating foreign company. Their successful operations contribute to the oil and gas industry in Turkey. Since I am working for National Oil Company, and public is more curious about her activities, in this section I will try to cover Turkish Petroleum's (TP) efforts.

Since TP was not experienced enough to explore and exploit its potential unconventional resources, she sought to sign Joint Venture Agreements (JVA) either with small oil companies or majors. As a result of such philosophy, after various negotiations with different firms, in 2011, TP decided to sign an JVA with Shell oil company. The purpose was to understand whether Dadaş formation, located near Diyarbakır, can produce oil or gas. Two wells were drilled in the following years and one of them were hydraulically fractured. Recovering high gravity oil in this very first shale oil exploration well, was a major milestone and important success in the project. Although the concept was proven, relatively low flow rates showed geoscientists that there are still lots of homework to do.

After completing operations in these two wells, Shell decided to exit the project. It was not only due to the low flow rates, but a combination of internal policy changes, low oil prices with related downturn of the industry and Turkey's new petroleum law which caused trouble for areal integrity of licences. In 2016, Shell and TP signed termination agreement.

Today Turkish Petroleum continues its own exploration activities in Thrace and SEA basins. So far, one pilot well was drilled in 2015 and drilling of second pilot well is going on. In SEA, two wells will be drilled in 2017. After the geological evaluation of the wells, hydraulic fracturing is planned.

Up to now, I tried to explain what unconventional resources are and what is the situation right now including Turkey. I believe the critical question is whether the success in North America can be replicated? As some analysts claim, can unconventional resources supply Turkey's hydrocarbon demand for 40 years? Can it really be a huge resource to help Turkey declare her own energy independence. The simple answer is NO. Let me explain why by discussing items that is critical for a working shale play and comparing it with US analog. Items are listed in Table-1, explanations are as follows:

Number of Operators

Turkey, as we all know is not an oil country. In order to be successful in shale oil, existence of various operators is crucial. So, how can this dilemma be resolved? When we look at North America example, we see that it's the small oil companies that allowed shale plays to produce not the majors. Being able to adopt different geoscientific perspectives and having the ability to implement innovative technology allowed them to create this success story. Today, as a major, Exxon is an important player.

However, it was after she acquired XTO, a relatively small company specializing in the drilling and production of unconventional oil and gas, for 36 billion USD. So, the solution might be to create an attractive environment for these relatively small oil companies that specialize in unconventional exploration.

Data Available in Public Domain

Hydrocarbon exploration is an expensive and risky business. Sharing information is very crucial in minimizing the risk. It should be noted that when compared with U.S.A. there is a huge cultural difference regarding confidentiality. In U.S.A., many information including wireline logs, core analysis etc. is available in public domain. On the other hand, it is difficult for individuals or even oil companies to get geological data in Turkey. General Directorate of Petroleum Affairs (GDPA) is the main government organization responsible for storing oil business related information such as well related geological data, seismic data or production rates etc. For a certain degree this information can be purchased. Defining standards on which data should be considered as confidential and which other should not will help the industry to delineate the plays.

Property Rights

Apart from U.S.A., land owners do not have any right for underground resources. Operator companies negotiate with land owners to rent certain part of their land. This of

course is a minor issue compared with the situation in U.S.A. where oil companies negotiate how to share the resource. The major problem regarding property rights is related to population density where there is an upward trend in rental prices.

Service Companies in a Competitive Environment

Being an oil poor country there is very limited service companies in Turkey. Lack of a competitive environment results in relatively high service prices which in turn, increases total project cost.

Political Support

Political support is crucial for unconventional exploration activities. Poland, as discussed before, is a good example how exploration can boost when extensive political support exists. Such a strong political support is also available in Turkey. In order to maximize domestic energy input, Turkish government stated her support to the development of unconventional resources in the 10th

Development Plan (2014-2018). For details please refer to item 805. Consistently, deposits temporarily taken in exchange for investment plan (especially those for well commitments) are subject to Ministry of Energy's approval. In other words, if a company states that it will make unconventional exploration and drill wells just for this purpose, with the permit taken from Ministry of Energy, it doesn't pay any deposit.

Different Shallow Plays within Extensive Areas

Areal extent is the most important parameter contributing to the resource size. In this manner, it is very clear that Turkey does not have huge resources as U.S.A. The extent of Marcellus shale, for example, is almost equal to Turkey's total area (Figure 7). This, creates the huge difference in resource size, market, number of wells drilled etc. It is also vital to state that shale formations in Turkey is deeper (3000-5000m) than US analogs, which is more difficult and expensive to develop.

(a) (b)

Figure 7 Map showing areal extent of shale plays in US (a) and Comparison of Surface Area of Turkey and USA

High Oil/Gas Prices

Oil prices is the biggest motivation for oil companies. Hundreds of wells need to be drilled in unconventional plays and high oil prices definitely helps to achieve a sustainable activity. The question for Turkey is, whether it will be logical to invest in unconventionals with nowadays low oil prices or not? The answer is Yes, with twofold, one; as an NOC, TP has the responsibility to unlock this potential and two: low oil prices mean low service prices, which is good not only for NOC's but also for private sector. Let's not forget that unconventional projects are in "Exploration Phase" in Turkey. No oil company, including TP, is drilling in factory mode. Few exploration wells were drilled at the moment and apart from the cost of hundreds of wells drilled in production phase, the impact of low oil prices is limited. Actually, low oil prices create a favorable environment for those companies who want to explore unconventional plays, not for those who produce.

Infrastructure

Unconventional activities, as mentioned earlier, is going on in two areas: Thrace and South East Anatolia. It can be clearly stated that having a plain terrain and, when compared to SEA, being a relatively small basin with 50 years of extensive conventional gas exploration, Thrace basin is a low cost basin when it comes to infrastructure. Extensive gas pipeline network is attractive for oil companies. On the other hand, in a potential development scenario for Dadas shale (SEA Basin), some investment must be made for pipelines. Several conventional oil fields and related pipeline network creates a base for infrastructure, but extensive pipeline network must be constructed during development or production phase.

Population Density

Population density in Turkey is relatively high. Compared to US, where population density is around 25 to 30 people per km^2 , Turkey has a population density of 150-300 people per km^2. This is important not only from an operations point of view, where you have to take proper measures, but also from project economy where land costs and environmental measures increase expenses.

Learning Curve

Learning curve can be described as the increase of learning with experience or time. For example, to understand how well a formation can be fractured, an operator must perform the operation in several wells. Using some sort of fluid might not work for a certain formation. Proppant size, how it is distributed in the near wellbore, have an impact on overall production performance. Pre-frac models might change. Under such circumstances, operator writes down each lessons learned and increases its experience by time.

Let me give an example from drilling experience in US. An operator, Anadarko, drills 4200 to 4500 m long wells in Eagleford formation. In the beginning they were finishing drilling in 30 days. Last year, they set a US record and finished 4500 m long well within 5 days. Another operator, in Utica Shale Play, drilled 8243 m long well, which 2605 m is vertical and 5638 m is horizontal, only in 18 days. 124 stage frac is completed in 6 days.

No doubt companies in Turkey are building their own learning curves. However, overall experience seems to be far away from the North American experience.

Fiscal Regime / Regulations

As a project manager working for National Oil Company, it won't be fair to make such a comment, but I should say friends in the industry tell that Turkey, with her tax regime etc. has a relatively favourable environment to invest.

Water Resources

Water resources are crucial especially during hydraulic fracturing operations. In general, there is no problem reaching the water resources in Turkey. However, demand for water is increasing every day and water resources must be used carefully. Recycling the water used for hydraulic fracturing is an option but if one chooses to do so, it might create a problem in the project budget. During a development or production phase, another issue might pop up. That is the disposal process of contaminated water. Pumping them back into reservoirs deep (2000-5000 m) in earth seems to be limited for the moment. Either old wells must be used or new wells should be drilled (I would like to warn the reader that deep reservoirs mentioned here should not be confused with shallow fresh water reservoirs which exist from 20-300 m. in general).

Geology

All factors aside, Geology is the most important factor to have a good resource potential. What do we mean by geology? Simply having correct rock types, with good properties which exist in a relatively shallow depth. As geoscientists we always argue that Turkey is not an oil country. What does this mean from an unconventional point of view? In the majority of the basins we do have very limited thick source rocks (>25 m) with good organic matter content where we can easily interpret in 3D seismic and place a horizontal well. SEA and Thrace Basins, on the other hand, exhibit a good geology. By having a proven petroleum system, achieving economic flow rates in these two basins, may encourage oil companies to take some risk in other basins.

FACTORS NEEDED FOR A SUCCESSFUL RESOURCE PLAY	USA	TURKEY
Various operators in a play	P	O
Open Data	P	×
Property Rights	✓	?
Availability of Service companies in a competitive environment	P	O
Strong Political Will	✓	✓
Diverse shallow play types with large areal extent	✓	×
High gas/oil prices (Market)	P	P
Infrastructure	✓	P
2 Low population per km	P	×
Learning Curve	P	O
Fiscal and Regulatory Regimes	✓	P
Extensive Water Supply	✓	?
GEOLOGY	P	P

Table 1: Factors needed for unconventional plays and a comparison between Turkey and USA.

I hope all the arguments that I have written so far help us to find an answer to the question I mentioned several times. Can Unconventional Resources help Turkey to declare its energy independence? Unfortunately, No. By 2023, Turkey's hydrocarbon consumption is expected to exceed

1 million barrels/day. It is unlikely for unconventional resources to supply the demand on its own. However, the importance of unconventional resources comes from the fact that it certainly has the great potential to cause a serious decline in net hydrocarbon imports. Turkey produces 15-20 million barrels of oil per year and 600 million m^3 gas per year (Figure-8). My personal opinion is that apart from offshore exploration, it is very hard to increase the domestic production except unconventionals. As TP, although we do have an estimation about the Oil In Place and Gas In Place, we prefer not to declare these values due to two reasons. One; in the public opinion, any declared number is understood as if it is the recoverable reserve, second; reserve estimations must depend on data coming from pilot wells.

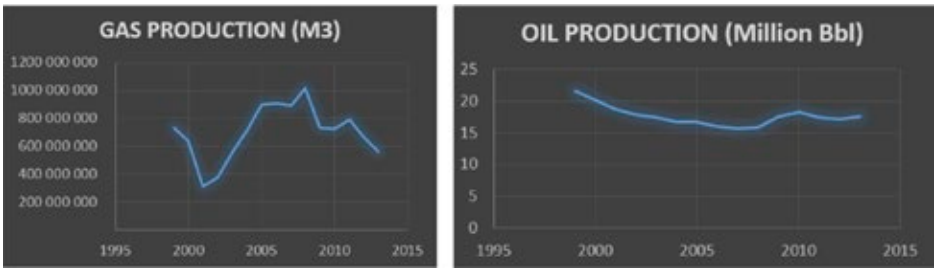

Figure 8: Oil and gas production of Turkey between 1999 and 2013 depending on GDPA data.

All the values which exist in public domain, including EIA report, depends on certain assumptions. Nobody has enough solid data, which in this case are the core data and flow tests. As argued by some professionals in the industry, having a resource which can supply the demand in Turkey for 40 years is not realistic.

In conclusion, all unconventional resources including shale gas/oil, tight as/oil, Coal Bed Methane has the potential to dramatically increase the domestic production. Not only TP's, but all companies' efforts are worthwhile since 1 drop of domestic oil is much precious than exported counterpart.

A GLIMPSE ON THE COAL RESERVES AND PRODUCTION IN TURKEY, ECOLOGICAL CARBON CYCLE, AND SOME NEW ERA METHODS OF LOWERING CARBON DIOXIDE LEVELS

Fatih TEMIZ
(TESPAM Researcher)

Introduction

It is estimated that the oil will be sufficient for us for a couple of generations of humanity. Forbes Magazine estimates we will run out of it between 2055 and 2070 (How Much Oil Does the World Have Left, 2015). Also, in an International Business Times a more specific date is given i.e. 2067 (World Energy Day 2014: How Much Oil is Left and How Long Will It Last, 2014). The numbers stand for proved reserves, of course, as new discoveries arise and technological recoverability upsurges, we may see a modification in these estimations.

And for coal, the most copious among fellow fossil fuels with proved reserves of exceeding 841 billion tons, and almost 8 billion tons of it is used in the world each year (World Energy Council, 2016). World Coal Association gives a more optimistic datum on this issue stating the proven coal reserves worldwide is 892 billion tons that would last for another 110 years whereas oil and natural gas would deplete by half this time (Where is coal found, no date). In summary, it is easy to say that coal will be above and underground for many more decades to come.

According to 2006 figures, Turkey's coal reserves are 4.2 billion tons in total and 3.9 billion tons of it are subbituminous and lignite; and, 0.3 billion tons of the reserves is anthracite and bituminous (BP Statistical review of world energy June 2007, 2007). Turkey extracts 77 million tons of coal annually (Statistical Review of World Energy 2008, 2008). A more up to date shares that Turkey's coal reserves are about 8.7 billion tons and the yearly coal production is the same as in the older report (World Energy Resources: 2013 Survey, 2013). In addition, The Ministry for Energy and Natural Resources (MENR) of Turkey states that there has a giant leap in proven lignite reserves of the country during the decade between 2005 and 2015, bringing lignite reserves from 8.3 billion tons to above 15 billion tons (MENR, 2015).

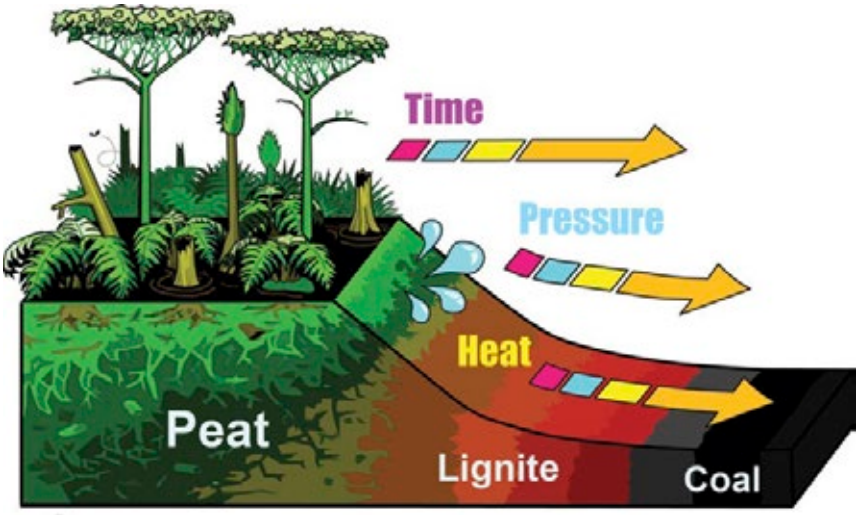

Image: Coal formation (uky.edu)

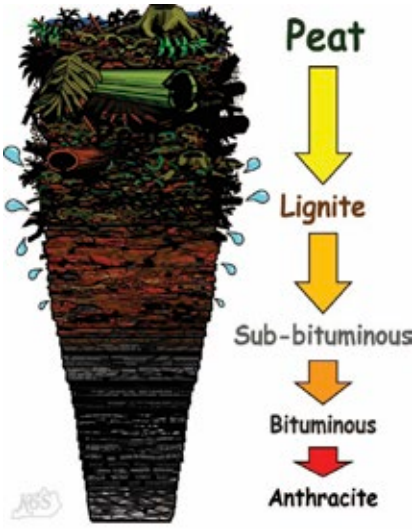

Image: Coal formation (uky.edu)

The previous and following diagrams simply show how coal is formed. The carbon-rich organic debris piling up in the swamps become peat. Next, peat goes under coalification by being affected by the heat and pressure during the process. Microbiological effects, pressure, heat and time all contribute to the transformation of peat to lignite. Bacterial decay cannot catch up with debris build up in these coal-generating swamps and the lack of oxygen limits aerobic bacterial activities. Lignite is formed if this piled up peat is buried under pressure and the water is drained away. Other elements in the pile are sequestered and given enough time we can theoretically find pure carbon in the form of graphite in these fields (How is Coal Formed, uky.edu). Given these, it can be said that Turkey's coal fields did not spend enough time underground and neither received sufficient heat or pressure.

The wetlands that generate coal are a simple laboratory that we can analyze the results of climate changes. There are limited changes to species since they are semi-closed systems (Dimichele and Phillips, 1995). Further research can be conducted in such areas in the world to give us more insights about the fate of our planet.

Ecological Carbon Cycle

Just like water in the globe, a carbon molecule finds its way in the world to and from the earth and its atmosphere. The biogeochemical cycle of carbon between the soil, the

water, and the air is called "carbon cycle" where carbon is reused and recycled in the biosphere.

This cycle gives birth to a global carbon budget, which translates to saying if a carbon molecule enters the system, it needs to go somewhere. And this "somewhere" happens to be the atmosphere where greenhouse gases reside and accumulate. With the global temperatures rising more polar and glacial ice melts uncovering barren rocks which capture heat where the ice sheet used to reflect this heat. More heat evaporates more water that in its gas form is another greenhouse gas, that brings the temperatures even further higher. The accumulation ultimately brings global climate change.

Carbon cycle is nature's way of recycling carbon. As we know, this material is essential for all living beings. The carbon in your hair might have derived from a now extinct dodo bird or even a primordial dinosaur. The carcass of the animal decomposes and the nutrients are passed to the soil, from which a plant captures it and metabolizes other molecules in its body. And the fruit of this plant is carried by some bird or it travels inside some other animal. After all, these decomposed materials accumulate and with millions of years passing under pressure and heat, fossil fuels are produced. In the exhaust gas of a car there is part of an ancient being.

However, some of the atom that was once part of the shells of marine crustaceans and mussels might become entombed inside lime rock at the bottom of the seas and oceans. These atoms are left outside the carbon cycle for long periods of time but once the water travels elsewhere they are exposed to weathering conditions, and once again become part of this biogeochemical cycle (Carbon cycle, Science Clarified). The other kind of entrapped carbon is the amount of all the fossil fuels underground waiting to be extracted to the surface. After that, also via natural occurrences like seepages etc., these carbon deposits will enter the carbon cycle once again.

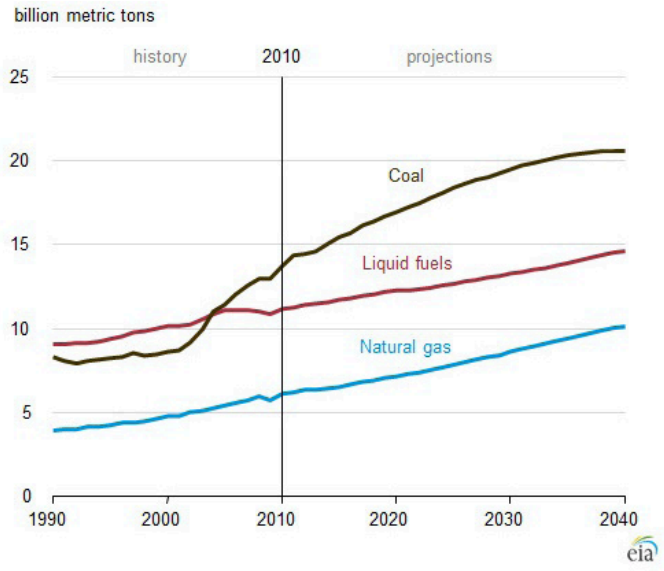

Image: World CO2 emissions by fuel type (theenergycollective.com)

Burning more and more coal and oil with the advance of industrial revolution to generate more steam power to run the mills, factories and so on, released colossal amounts of carbon dioxide into the atmosphere. As we can see in the graph above, coal is and will be the leader cause of CO2 emissions in the world. Within the last one and a half centuries, nearly 250 billion tons of carbon has been given to the air. Thankfully, soil itself, the plants and the oceans capture the bigger half of carbon dioxide released. Scientists fear that this vast input of carbon dioxide, which is a greenhouse gas that thwarts heat reflecting back to space, could alter the balance of carbon cycle (Carbon cycle, Science Clarified). Hence, we have global climate change.

Carbon capture and storage is the process of transferring the waste CO2 into storage facilities from large point sources of CO2. The Global Carbon Capture and Storage Institute published a report on the issue. Net carbon storage potentials for different industries are as follows (the Global CCS Institute, 2011):

- Mineralization of Carbonate
- Cultivation of Algae
- Enhanced Coal Bed Methane
- Enhanced Oil Recovery
- Bauxite Residue Carbonation
- Enhanced Geothermal

As we can see from the list, there can be greener approaches in a variety of fields. We will discuss algae cultivation later in the paper.

Some New Era Methods Of Lowering Carbon Dioxide Levels

In order to prevent accelerated heat building up on Earth, the natural balance needs to be restored. The budget of carbon could perhaps be balanced again. There have been implementations like banning CFCs to slow down the global greenhouse effect. Also, carbon taxation is devised in several places in the globe.

This article is listing some newer and less acknowledged methods of combatting carbon dioxide and other greenhouse gases.

Bioremediation

This method is the type of waste management strategy that include living beings in eliminating or neutralizing the wastes. United States Environmental Protection Agency defines it as "treatment that uses naturally occurring organisms to break down hazardous substances into less toxic or non-toxic substances".

Several research has been going on in this field. The fungus species of Trametes versicolor was found to be able to digest natural coal (Biodegradation of coal-related model compounds, Campbell et al.). Diplococcus bacteria can reduce coal by raising the temperature of the resource (Bacteria as agents in the oxidation of amorphous carbon, Potter).

Attempts on bioremediation will reverse the effects of coal, natural gas, and oil extraction by returning the field back to its original form and by neutralizing the excess amount of pollutants and other matter.

Reforestation

Reintroducing the lost canopy, reversing deforestation has many positive effects including prevention of erosion, introducing a milder climate and more carbon dioxide absorption from the atmosphere.

Evliya Çelebi, a famous Turkish traveler of 17th century, once wrote that in Turkey, then part of the Ottoman Empire, a common squirrel could jump from one tree to another without stepping on the ground, it could travel from Sinop in the north to Mersin in the south in that manner. This sort of "legendary" depiction of the flora of the past gives an idea of how much forest we lost through centuries. There have been several national attempts by the Turkish government and non-governmental organizations to reintroduce forests and attempting to save the ones under current threat. The Turkish Foundation for Combating Soil Erosion, for Reforestation and the Protection of Natural Habitats (TEMA) is perhaps the most widely known of the NGOs in Turkey. Another example is the Foundation for the Protection and Promotion of the Environment and Cultural Heritage (ÇEKÜL). There are a number of these foundations trying to bring public attention to this great cause.

Although not about reversing global climate change or other new era causes, New Deal Agencies during the Great Depression times in the United States, employed millions of people for public service which also consisted of planting forests in the areas which lost their fauna after unrestrained industrialization.

Image: Indian man single handedly plants 5.5 km2 of jungle (sanskritimagazine.com)

One Indian man took things in his hand and started with a sandy area near his village in India. So, in 3 decades' time, he managed to grow 5.5 km2 of jungle all by himself (Sanskriti Magazine, 2013).

In 2013, Pakistanis planted almost 850,000 trees in one day. Three years later, 800,000 volunteers in India spent 24 hours to break this record. These Indian volunteers planted 80 different species trees and exceeding 49 million trees. During the Paris Climate Conference in December 2015, India agreed to reforest 12% of her land area. Noting that, African nations promised to reforest 1,000,000 km2 of land. There is a big downside to these mass reforestation projects: these saplings of trees are quite vulnerable with 2/5 mortality rates in such attempts (Howard, 2016). Still there is optimism and with better management of upkeep and watering a copiously improved exertion can be accomplished.

Green Architecture

In the modern times, when the land is scarce and everything expands outwards, an Italian architect came up with an idea: Bosco Verticale - building forests upwards. His design skyscraper hosts as many as a hectare's worth of trees on a building.

Image: Bosco Verticale – Vertical Forest (stefanoboeriarchitetti.net)

The first project was set in Milan on two towers measuring 112 and 80 m tall that host nearly one thousand trees with addition to thousands of shrubs and flowering plants. These plants capture pollution and greenhouse gases, cool down the offices and residences with their shade, and generate a local micro-climate which is more humid than the rest of the area (dezeen.com, 2014).

The same concept is being implemented in Nanjing, China. This new project expects to produce 1,800 kg of oxygen every single month on one single project. In 2018 the two towers of Nanjing will be completed. The same architect is also planning a vertical forest in Lausanne, Switzerland (photovide.com, 2017).

Green Roofs

In the north, in Iceland, people tried surviving the harsh winters by thickly insulating their houses. The tradition goes back to Iron Age. They had earthen roofs and some houses were semi-subterranean (The Turf House Tradition, unesco.org).

Nowadays, the amount of land used for housing, commercial and industrial use is noticeable. Some buildings use their roof area to host green plants. These green roofs insulate the building, so the residents use less energy to heat or cool the spaces.

This setup also helps to reduce the heat island effect. Water that evaporates from the roof cools down the surrounding. All of this cuts down the energy need for air conditioners.

Using local plants also help the local fauna.

Image: Green roof on Penn State University (self-credit)

Image: Green roof on Penn State University (self-credit)

Farming in the Desert

Qatar is a country known for immense heats especially in summer time. The Sahara Forest Project in Qatar came up with the idea of using seawater for the cooling of their greenhouses in the desert.

The findings are promising. They lowered their energy consumption by using solar power, and the greenhouses use less freshwater since the cooler pipes collect water vapor from the air and they fall down as drops.

With less energy and less freshwater to produce crops the future is optimistic. Also, let us not forget about the fuel needed to carry all that fruit if they were grown elsewhere (McGar, 2013).

Qatar is also implementing using hydroponics which uses less water and less land area to produce even more food than in open field. This method is good with vegetables but

cereal need an immense amount of water when compared to other crops so the Qataris may still prefer importing the latter (Fuchs, 2012).

With local farming possible, the planet's carbon dioxide production will decline even further.

Algae cultivation

These tiny creatures are humble yet prolific beings. The algae and the cyanobacteria together produce a staggering ¾ of the oxygen we inhale. Algae grow on fresh water and salt water, also on some plants when there is sufficient moisture in the system, and on some animals as well (Algae, Microbe World).

Image: The Urban Algae Canopy (inhabitat.com)

In 2015 in Milan, The Urban Algae Canopy project met the public. This design is said to produce 150 kg of biomass and generate the amount of oxygen that a 4-hectare-woods would produce in a day (Brooks, 2015). The biomass can then be converted to biofuel, or animal feed or perhaps used for human consumption – all locally sourced.

Image: Algae-Fueled Building (weburbanist.com)

This design can go under green architecture title as well. German designers put glass panels of algae reactors on their building. These panels block sound and light from the outside while providing power and heat for the dwellers – hot water and warm rooms are on the algae (Kohlstedt, Web Urbanist).

The studies on flue gas are going on. Some micro-algae which are tolerant to high temperature, NOx and Sox gases, high CO2 concentrations are selected to fix the high amount of CO2 emissions coming from flues. This bio-fixation method does not limit thermal capacity of the previous process, is environment-friendly and sustainable. However, we still do not know how to handle the big mass of biomass produced by algae – all the technologies used are altered from other food industries, yet we need algae-specific approaches. Although biofixation of CO2 by micro-algae is economically and technically feasible IEA Clean Coal Centre still consider there is more time needed for this to become widely used in their report (Zhang, 2015).

Alternative Plants

Next, a rather controversial method of combatting carbon dioxide in the atmosphere is growing hemp (We are not talking about the medically used kind, we focus on the industrial kind). It is a carbon-negative product which eliminates more carbon dioxide during its life cycle than the amount of carbon dioxide it takes to produce it.

Hemp can be used as a fiber source for textile, as an insulation material or even in concrete. The article refers to an issue of Popular Science magazine from 1937 to add on to the suggested benefits of the crop. For example, hemp concrete is a natural insulator and humidity regulator which in the end cuts down greenhouse emissions (Top 5 Most Innovative Uses for Hemp, 2013).

Furthermore, Turkey legalized growing hemp for legal issues for registered farmers who would take special permits in 19 provinces on 29.9.2016. This has been reviewed in the press in 2016. One website comments on the issue:

- One unit area of hemp produces 25 times the oxygen that would be produced by a forest in the same area
- Hemp can give 4 times more paper than trees
- 2 to 5 decades is need for a tree to be fully matured yet hemp only need 4 months
- Biofuel can be produced from hemp.

Given the list above, Turkey's approach is seen as a promising one (tarim.com, 13.10.2016).

Another example is the Barbados nut tree (Jatropha curcas) which grows in hot and arid littoral zones. This tree was found to be an alternative to carbon capture and storage. A hectare of this tree can capture more than 20 tons of carbon dioxide annually. The use of desalinized water and special minerals cost around 50 Euro per ton of carbon dioxide sequestered (Becker et al., 2013).

Summary

At the moment, we see CO2 as an end product that we treat as waste. But as we discussed earlier it can be used as a raw material in the industry and in farming. Dr. Gernot Klotz, Executive Director Research and Innovation at European Chemical Industry Council, strongly recommends that we look at CO2 as a potential not as waste (theenergycollective.com, 2014).

Turkey has more coal than oil. As a fast-growing nation, Turkey needs energy to support herself. Local coal reserves and hydropower are directed into electricity production. Natural gas is imported from neighboring regions. The country can widen the variety of energy resources used and give chance to the newly implemented methods of energy recovery.

The world has more coal than oil. Nations will use their resources. As long as we can balance, firstly nation-wide carbon budget and then a global carbon budget, with great efforts and moving towards greener ways, we can still survive this global climate change.

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TURKEY'S ENERGY STRATEGIES AND POLITICS RESEARCH CENTER (TESPAM)

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- conducts useful analyses,
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