TURKSTREAM IMPACT ON TURKEY'S ECONOMY AND ENERGY SECURITY

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Executive Summary

With a population of 80 million people and a rapidly growing emerging economy, Turkey has been one of the fastest growing energy consumers in the world. Fossil fuels are the main energy resources for Turkey and natural gas has become the most important element in Turkey's energy mix since the 1990s. Nevertheless, the country does not have enough reserves of domestic fossil fuel resources to meet its demand, and hence imports some 75% of its total energy needs, including almost all of its oil and gas. Turkey's energy policies and strategies are shaped by two concerns.

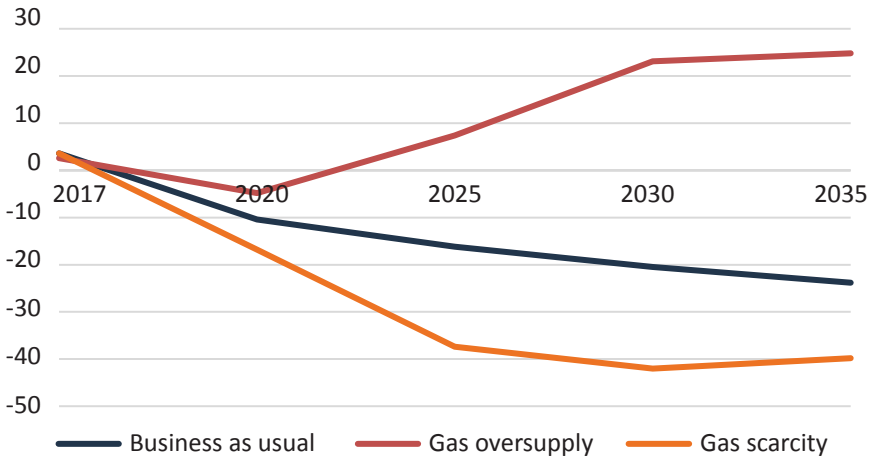
First, Turkey wants to ensure security of supply through maintaining an availability of adequate resources for consumption, as well as ensuring the diversification of its energy mix and portfolio of suppliers and the supply routes, particularly in natural gas imports. Second, Turkey also wants to generate geopolitical and geo-economic leverage in its international relations through hosting as many energy infrastructure projects on its territory as possible, including pipelines. All in all, Turkey does not want to remain vulnerable with regards to gas supply security for its domestic market. Despite very limited local production meeting only 0.8% of total demand, the fact that the country is surrounded by 63 percent of the world's gas reserves compels Turkey to play an increasingly "proactive role" in energy and natural gas markets, both in geopolitical and geo-economical terms.

Beyond providing a geo-political backdrop to Turkey's foreign energy relations, this report includes an economic assessment of the most recent pipeline project, entitled TurkStream. TurkStream will run circa 900 km across the Black Sea from the Russian port of Anapa to Kıyıköy, in Turkish Thrace. Developed by the South Stream Transport BV, a subsidiary of Gazprom registered in the Netherlands, the pipeline will be composed of two parallel strings and will carry a total of 31.5 bcm per year. Of this capacity, one string will serve the Turkish market.

The economic assessment explores two questions that have not been fully addressed in the public debate. The first one is regarding the role to be played by TurkStream in Turkey's gas supply security in the light of the supplies to be received from all possible sources. The adopted methodology provides a detailed examination of Turkey's portfolio of natural gas purchasing commitments with a view to estimate the approximate guaranteed supply quantities over a time horizon extending to 2035. It is complemented by an estimate of the domestic demand for natural gas over the same time horizon. A bottom-up energy Modelling Platform developed by Bogazici University has been calibrated for this purpose. The outcome of the supply and demand analysis has then been used to assess the potential contributions of TurkStream to Turkey's energy supply security.

The combination of the supply and demand curves demonstrates that with the exception of the "Gas Oversupply" scenario, which is based on a set of optimistic political and economic assumptions, Turkey will be in need of additional sources of natural gas supply after 2020 that exceeds the supply capacity of TurkStream. By 2025, the shortfall – if potential supplies from TurkStream are to be excluded - will be around 16 bcm under the business as usual scenario and 37 bcm under the gas scarcity scenario. For 2035, the shortfall will have reached 24 bcm under the business as usual scenario and more than 40 bcm for the gas scarcity scenario. It is clear that under these circumstances, Turkey will greatly benefit from the 15.75 bcm to be supplied from TurkStream. Turkey may even want to augment its purchasing commitments from TurkStream in the years following 2025.

Finally, in addition to the contributions that TurkStream is set to provide for Turkey's energy supply security, it should be underlined that the project will also generate other economic benefits, during its construction and operation phase, for the Turkish economy. This study analyzed the economic impact of the on shore construction part of the project. The



methodology differentiated between direct, indirect and induced impacts. The Direct Economic Impact covers the employment, income and GDP associated with the construction of the pipeline. The Indirect Economic Impact includes the employment, income and GDP generated by downstream industries that supply and support the construction activities. Finally the Induced Economic Impact captures the economic activity generated by the employees of firms directly or indirectly connected to the construction work spending their income in the national economy.

The calculations showed that this project would lead to the creation of an additional employment of 4000 linked to jobs associated with the construction activity. Household incomes would be raised by $ 21 million and national income by $ 155 million. Calculations for the indirect impact of this project showed an employement increase of 8000, and an increase in household and national incomes respectively in the order of $ 67 million and $ 312 million. For the induced impact, the number of additional jobs stood at 1494, additional household income at $ 12,5 million and additional value added at $ 79 million.

It was demonstrated that this task will generate in total close to 13500 direct, indirect and induced jobs, around $ 100 million of additional household income and a contribution to Turkey's GDP of around $ 546 million.

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1 Overview

With a population of 80 million people and a rapidly growing economy, Turkey has been one of the fastest growing energy consumers in the world. Fossil fuels are the main energy resources for Turkey and natural gas has become the most important element in Turkey's energy mix since the 1990s. Nevertheless, the country does not have enough reserves of domestic fossil fuel resources to meet its demand, and hence imports some 3/4 of its total energy needs, including almost all of its oil and gas. According to the International Energy Agency (IEA), in 2016 Turkey has consumed 46.16 bcm gas, representing a 4.4 percent decrease from 2015. While Turkey's dependence on imported gas is around 99 percent of its total consumption in 2016; almost 52.8 percent of its gas imports came from Russia, followed by Iran (16.7 percent), LNG (16.5 percent) and Azerbaijan (14 percent).

Turkey's energy policies and strategies are shaped by two concerns. First, Turkey wants to ensure security of supply through maintaining an availability of adequate resources for consumption, as well as ensuring the diversification of its energy mix, portfolio of suppliers and transit routes. Second, Turkey also wants to generate geopolitical and geo-economic leverage in its international relations through hosting as many energy infrastructure projects on its territory as possible, including pipelines. In this context, Turkey's insistence on furthering its position from being a transit country, mainly confined to a passive role as merely a route for the flow of energy resources from producers to consumers hosting the infrastructure necessary to do so, to becoming an energy "hub" [1], an active contributor to the dynamics of the international energy markets, should be understood going beyond securing domestic needs. Turkey'conceptualisation of an energy hub as both a transit and transition center, with includes enhanced infrastructure including storage, processing and conversion facilities, as well as pipelines, combined with a trading center, where diversified resources and routes meet to enable the country to form a complex mechanisms of pricing and trade[2] with opportunities to re-export.

Turkey's role as a major consumer, as well as its geographical location, could serve as a critical factor in enabling it to become a transit country. Today Turkish decision-makers feel that Turkey's priority to secure energy for its own market coincides with the aim of becoming a regional energy hub. It is believed that these two factors, in combination with relatively lower hydrocarbon prices, commodification of natural gas through improvements in LNG technology, and meticulous efforts to establish new contracts by exploiting the need with the existing and emergent producers and consumers in its wider neighbourhood, might enable Turkey to reach its objectives.

Growth in natural gas demand is driven mainly by gas-fired power plants, residential and industrial consumption. Turkey's long-term contracts with all its current suppliers –Russia, Azerbaijan and Iran– are due to expire in the 2020s, bound to affect some 40 bcm/year, or 80 percent of current gas demand. Extension of these contracts depends both on commercial and political issues. LNG imports could mitigate the problem, but the limited capacity of regasification terminals, and the capabilities of BOTAS storage and transmission system, especially during peak winter seasons, represent a critical bottleneck.

What are the options for Turkey then for the next two decades?

Currently, Turkey i) may renew already existing contracts; ii) may transport additional volumes of natural gas from alternative suppliers iii) may channel the next wave of production in Azerbaijan, iv) improve its LNG infrastructure and import more LNG from oversees suppliers on spot or longer-term contract basis; v) diversify more by accommodating gas deals with alternative neighboring suppliers like Northern Iraq (KRG) and Eastern Mediterranean (Israel).

Amidst these alternatives, most of which are being pursued at varying degrees of development and success by Ankara, the most important project at hand remains to be the realization of TurkStream.

TurkStream is a new natural gas pipeline project running 900 km across the Black Sea from the Russian port of Anapa to Kıyıköy, in Turkish Thrace, and then as an underground pipe to the Turkish-European border. The project will be developed by the South Stream Transport BV, a subsidiary of Gazprom registered in the Netherlands and is composed of two parallel strings or lines each with annual capacity of 15.75 bcm/year for a total of 31.5 bcm. Of this capacity, one string would serve the Turkish market. The first string's capacity is sufficient to replace the current volume of Russian natural gas to Turkey of the Trans-Balkan pipeline after the termination of the transit agreement between Russia and Ukraine. The remaining 15.75 bcm/

1- Turkey's aspiration to become an "energy transition center (hub)" is repeated on more than one occasion by successive energy and foreign ministers, as well as being included in various official strategy and policy documents such as: *Strategic Plan 2015 – 2019*, BOTAŞ, Ankara, 2015, p. 30; *Strategic Plan 2015 – 2019*, Ministry of Energy and Natural Resources, Ankara, 2015; *Turkey's Energy Profile and Strategy*, Ministry of Foreign Affairs, 2015 (online) http://www.mfa.gov.tr/turkeys-energy-strategy.en.mfa, accessed April 4, 2017; *Turkey's Energy Strategy*, Ministry of Foreign Affairs, January 2009, p. 1.

2- In this context on 18 March 2015 Energy Exchange Istanbul (EXIST) was established; "in order to lead development of energy market through managing it in an effective, transparent and reliable manner. Its operations are expected to expand beyond electricity to include natural gas, oil and derivatives in the forthcoming period." "Turkey's Energy Profile and Strategy", Turkish Ministry of Foreign Affairs, (online) www.mfa.gov.tr/turkeys-energy-strategy.en.mfa, accessed 21 June 2017. However, it is hard to argue that all aspects of Turkey's energy markets and investment environment is liberalized in a way that would facilitate prospects of becoming an "energy hub" as said to be desired.

year destined for European customers. Although TurkStream might at a first glance be seen as just another project increasing the dependence on Russsian gas it also minimizes risks of interruptions in gas flows due to disruption of relations between Russia and Ukraine. Also, the project represents a direct link with Turkey's historically proven most dependable and reliable supplier, with an energy relationship that has proved to be resilient to political shocks in the past. TurkStream can also be viewed as a project for improving EU's energy transport security.

So far, TurkStream project has essentially been reviewed by international observers from a geo-political angle highlighting its impact on the Turkey-Russia energy relationship and regional energy supply dynamics, while analysis on the economic impact of TurkStream for Turkey has remained limited. The aim of this report is to address this gap and provide an overall economic assessment of this pipeline project. The economic assessment will explore two different questions that have not been fully addressed in the national debate. The first one is whether Turkey will actually need the natural gas to be supplied via TurkStream in the future. The methodology will be to provide a detailed examination of Turkey's portfolio of natural gas purchasing commitments with a view to estimate the approximate guaranteed supply quantities over a time horizon extending to 2035. The next step will be to estimate the domestic demand for natural gas over the same time horizon. A bottom-up energy Modelling Platform developed by Bogazici University will be utilized for this purpose. The Bogazici University Energy Modelling Platform is based on a sectorally disaggregated demand model that projects the evolution of Turkey's natural gas consumption pattern over a period extending to 2035. The sectors included in this bottom-up estimation of natural gas demand are the Power Industry, Manufacturing, Residential, Commercial/ Retail, Agriculture & Transport sectors. The outcome of the supply and demand analysis will then be used to assess the potential contributions of TurkStream to Turkey's energy supply security. Secondly, an additional section will provide an estimation of the economic benefits linked to the construction phase of this project.

2 The Supply Dimension

This chapter aims to examine the supply dimension of Turkey's natural gas equation. A detailed analysis of Turkey's portfolio of natural gas import agreements will be undertaken. The long-term outlook will also include scenarios of additional imports from other new and old regional suppliers like Iran, Azerbaijan and the KRG. A discussion of the LNG import trends will also be provided.

2.1 An overview of Turkey's Natural Gas History

Between 2003 and 2013, Turkey was surpassed only by China in terms of growth in natural gas and electricity demand. The share of natural gas in the total energy demand stands above 30 percent. As such, Turkey does not want to remain vulnerable with regards to gas supply security for its domestic market. Despite not being a producer country, the fact that the country is surrounded by 63 percent of the world's gas reserves, compels Turkey to play an increasingly "proactive role" in energy and natural gas markets, both in geopolitical and geo-economical terms.

It is worth noting for instance that in its 2015 report the Institute for 21st Century Energy ranks Turkey's energy security at more than 20% lower than the OECD average of the 25 countries listed[3]; in fact, Turkey ranks near the bottom at 23rd for natural gas import exposure.[4] However, the situation might be seen actually even worse for Turkey since natural gas is far more important for Turkey for meeting its energy demand than the only two countries ranking lower, i.e. France and Spain.[5] As a matter of fact, in 2016 Turkey ranked 22nd.[6] However, according to BP's Statistical Review of World Energy, the only country apart from France and Spain that scored worse than Turkey was South Korea with natural gas consisting only around 14 percent of its primary energy consumption versus Turkey's 27.5 percent.[7]

As such, Turkey has been pursuing an assertive foreign policy approach in energy for the last decade and a half. The alacrity with which Turkey has been negotiating alternative gas pipeline projects that would cross its territory is seemingly a function of the national decision-makers' perception of such projects as potential trump cards in its international relations. Utilizing its geography, Turkey's decision-makers are in pursuit of capitalizing on the country's well-recognized geopolitical importance and further leveraging it by a geo-economic variable, that would hopefully be introduced by becoming an "energy hub" between the energy producers and consumers. It is possible to take this as a clear sign of the perceived strategic link between foreign policy, geopolitics, geo-economics and energy projects in the minds of Turkish decision-makers. As such, Turkey's medium- to long-term energy strategy is an act of optimization aimed at decreasing its foreign dependence by utilizing domestic resources, increasing supply security through resource diversification, enhancing its flexibility by boosting the share of LNG, improving energy efficiency, and introducing nuclear into its energy mix.

In this framework, Turkey's eagerness for diversified natural gas deals is underpinned by a vision to potentially reverse the vulnerability caused by foreign dependency. To the extent that Turkey can enhance its own energy security through increased diversification (both of resource and source) and flexibility, it can also secure more favorable contracts from exporters. Hence, if successful, the outlined strategy may not only diminish Turkey's energy dependency, vulnerability and exposure, but also might potentially turn it into a viable and sustainable energy hub. This would require an integrated and holistic approach to Turkey's energy needs, infrastructure and environment. In this vein, Turkish Ministry of Energy and Natural Resources Strategic Plan's SWOT analysis sees the success of Turkey's future as a hub contingent on the attainment of "relevant infrastructure, market formation and regional effectiveness".[8]

3- *International Index of Energy Security Risk: Assesing Risk in A Global Energy Market*,2015 Edition, Institute for 21st Century Energy, US Chamber of Commerce, Washington, 2015, p 9.
4- *Ibid.*, p 16.
5- Jude Clemente, "Turkey's Rising Natural Gas Demand Needs US LNG", *Forbes*, Feb. 7, 2016, (online) https://www.forbes.com/sites/judeclemente/2016/02/07/turkeys-rising-natural-gas-demand-needs-u-s-lng/#60cb93682e53, May, 7, 2017.
6- *International Index of Energy Security Risk: Assesing Risk in A Global Energy Market*, 2016 Edition, Institute for 21st Century Energy, US Chamber of Commerce, Washington, 2016, p 9.
7- BP's Statistical Review of World Energy June 2017, BP, p.9.
8- *MENR Strategic Plan 2015 – 2019*, p. 23.

2.2 A Brief Look at Turkey's Natural Gas History

Turkey got acquainted with natural gas in late the 1980s. Turkish decision-makers' understanding of energy security was largely molded by air pollution, the oil crisis of 1973, and by successive economic and political crises, the latest of which culminated in the crisis of 2001 that led to a landslide change in Turkey's political landscape and witnessed a negative growth of 6.1 percent. Amidst these influences the share of natural gas in Turkey's energy mix increased rapidly to reach a share of 31 percent in Turkey's primary energy consumption for 2016.[9] Currently 28.2 percent of the installed capacity for electricity production is based on natural gas.[10] The volume of natural gas the is consumed is likely to increase in the years to come.[11] The general trend on the import dependency of the country in its primary energy consumption, increasing from 51.6 percent in 1990 to 75 percent in 2014, confirms this observation.[12]

Turkey has concluded its first ever agreement on natural gas with the Soviet Union in February 1986. Since then, Turkey's northern neighbor has assumed a key role on issues pertaining to the country's energy security and resource diversification. As a result of the 25-year agreement accorded between Turkey's BOTAS and USSR's Soyuzgazeksport, the construction of a pipeline that would be called Western Line (Trans-Balkan Pipeline) started in 1986 and the gas reached Ankara in August 1988. According to the agreement, Turkey started to buy 6 bcm/year of natural gas from the Soviet Union and then from Russia from 1991 onwards. Following the expansion of the pipeline, gas imports through the pipeline reached a capacity of 14 bcm/year.

During the first half of the 1990s, Turkey's discourse on energy strategy has been centered on the terms "energy terminal" and "energy center". In line with the perspective of becoming a gas center and a main transit country as reflected in the above-mentioned discourse, Turkey started to pursue a more active and engaged role in regional energy policy. In 1996 Turkey reached an agreement with Iran[13] with a view to the construction of the Eastern Anatolia Natural Gas Pipeline. In 2001 Iran started gas deliveries over this pipeline, which has a capacity of 10 bcm, with a yearly volume of 3 bcm, boosted up to 8.9 bcm in 2014.

In 1997, Ankara and Moscow agreed to build a second pipeline, named Blue Stream, creating a direct route for gas trade between Turkey and Russia, without having to rely on another transit country and avoiding associated fees.

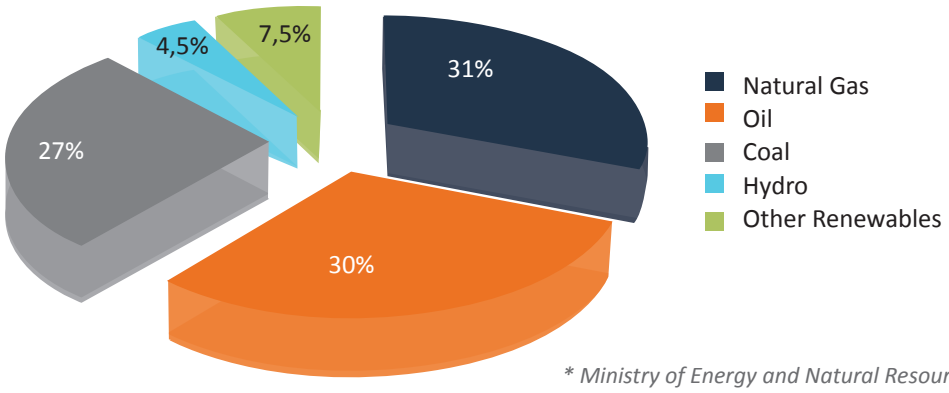
The process of moving Caspian gas resources to Western markets through Turkey has also been regarded as one of the priorities of Turkey during this period. Gas deliveries from Azerbaijan were initiated with the newly built Baku-Tbilisi-Erzurum Natural Gas Pipeline in 2007. This pipeline transports 6.6 bcm/year of Shah Deniz Phase-I gas to Turkey. It was, and still has, not been possible to tap the resources located east of the Caspian as originally envisaged.

Turkey's signed its first LNG shipping agreement with Algeria in 1988 in order to increase resource diversity and supply security. In this context, the Marmara Ereğli LNG Terminal was commissioned in 1994. This was followed by a 22-year LNG purchase contract with Nigeria in 1995. The first gas from here was delivered to Turkey in 1999. In 2009 EgeGaz Aliağa LNG Terminal became operational as an additional LNG import and supply facility. Currently the total re-gasification capacity of EgeGaz and Marmara Ereğli LNG terminals is 12.2 bcm/year.

Following its inclusion in Turkey's energy mix in the second half of the 1980s, natural gas has quickly turned into a primary and reliable source of energy. Owing to Turkey's geographic proximity to suppliers and location between supplier and consumer countries, coupled with opportunities brought about by the end of the Cold War, natural gas agreements have gone beyond Turkey's own energy security. Turkey assumed a stance that incorporated its policies to adequately meet its energy demand with an economic-political vision that actively sought trading opportunities, utilizing both north-south and east-west transit and trade potentials.

9- *Türkiye Genel Enerji Görünümü*, TMMOB Makine Mühendisleri Odası Enerji Çalışma Grubu, March 25, 2017, (online) https://www.mmo.org.tr/sites/default/files/TURKIYE%20ENERJI%20GORUNUMU_2017_ %28 25.03%29.pdf, accessed April 25, 2017.
10- Türkiye Elektrik Enerjisi İstatistikleri, TMMOB Elektrik Mühendisleri Odası, (online) http://www.emo.org.tr/ genel/bizden_detay.php?kod=88369#.WRc2LbyGOCQ, accessed May 10, 2017.
11- *Türkiye Elektrik Enerjisi 5 Yıllık Üretim Kapasite Projeksiyonu (2016-2020)*, Türkiye Elektrik İletim A.Ş. Genel Müdürlüğü Planlama ve Stratejik Yönetim Dairesi Başkanlığı, Ankara, Eylül 2016.
12- *Ham Petrol ve Doğalgaz Sektör Raporu*, Türkiye Petrolleri, Ankara, Mayıs 2016, p. 26.
13- First delivery of the Iranian gas has been made in December 2001.

Figure 1 Turkey's Primary Energy Mix 2015*



** Ministry of Energy and Natural Resources*

2.3 An Assessment of Turkey's Natural Gas Strategy

Turkey's natural gas demand increased exponentially since late 1980s. At its peak, annual imports reached 49.2 bcm in 2014, not only because of the expansion of gas transmission and distribution networks, but also due to the increasing share of gas in electricity generation and industrial use. Turkey imports almost all of its gas and is only able to store approximately 8.2 percent of its consumption as of 2016, following the start of operations of the storage in Salt Lake. Higher storage capacity necessitates intensive investment, especially if Turkey plans to benefit from potential lower spot prices and processes relating to the commodification of natural gas.

Table 1 2006-2016 Natural Gas Imports (Mcm)

Country	Russia		Iran		Azerbaijan		Algeria		Nigeria		Other*		Total	% change yoy
Year	Volume	Share (%)	Volume	Share (%)	Volume	Share (%)	Volume	Share (%)	Volume	Share (%)	Volume	Share (%)	Volume	
2006	19.316	63,92	5.594	18,51	0	0	4.132	13,67	1.100	3,64	79	0,26	**30.221**	-
2007	22.762	63,51	6.054	16,89	1.258	3,51	4.205	11,73	1.396	3,89	167	0,47	**35.842**	**18,60**
2008	23.159	62,01	4.113	11,01	4.580	12,26	4.148	11,11	1.017	2,72	333	0,89	**37.350**	**4,21**
2009	19.473	54,31	5.252	14,65	4.960	13,83	4.487	12,51	903	2,52	781	2,18	**35.856**	**-4,00**
2010	17.576	46,21	7.765	20,41	4.521	11,89	3.906	10,27	1.189	3,13	3.079	8,09	**38.036**	**6,08**
2011	25.406	57,91	8.190	18,67	3.806	8,67	4.156	9,47	1.248	2,84	1.069	2,44	**43.874**	**15,35**
2012	26.491	57,69	8.215	17,89	3.354	7,3	4.076	8,88	1.322	2,88	2.464	5,37	**45.922**	**4,67**
2013	26.212	57,9	8.730	19,28	4.245	9,38	3.917	8,65	1.274	2,81	892	1,97	**45.269**	**-1,42**
2014	26.975	54,76	8.932	18,13	6.074	12,33	4.179	8,48	1.414	2,87	1.689	3,43	**49.262**	**8,82**
2015	26.783	55,31	7.826	16,16	6.169	12,74	3.916	8,09	1.240	2,56	2.493	5,15	**48.427**	**-1,70**
2016	24.540	52,94	7.705	16,62	6.480	13,98	4.284	9,24	1.220	2,63	2.124	4,58	**46.352**	**-4,28**

* Representing spot LNG purchases

Source: *2017 Natural Gas Sector Report*, EMRA, Ankara, 2017, p. 9.

As the second largest buyer of Gazprom after Germany in Europe[14] the main pillars of Turkey's natural gas strategy is, inevitably, based on its sizable demand and its geographic location. Being a large consumer provides Turkey with a paradox to manage. On the one hand its domestic need creates a continuous pressure to secure significant volumes of supply. However that "curse" has the potential to turn into a blessing if and when global supply is high and gas prices are low. In order to leverage its bargaining power, Turkey's recent energy strategy also focuses on increasing the share of domestic resources and renewables in its primary energy consumption. As such, Turkey's strategy on natural gas builds upon three priorities:

1. *Achieving and Strengthening Supply Security:* To diversify resources by purchasing gas in as many different sources and routes as possible and via long- and short-term agreements with more flexible pricing methodology, while providing effective service to both domestic and foreign markets, especially by increasing underground storage capacity;

2. *Access to Natural Gas Supplies on More Economical Terms*: Using the advantage of being the closest sizable consumer to the source countries, effectively securing access to gas at the most convenient prices to help lower the current account deficit – probably the biggest structural vulnerability of the country's economy;

3. *Leveraging Trade and Transit Opportunities*: Becoming a gas re-exporter able to re-price natural gas as well as generate transit income, effectively translating the advantages of its geographic proximity to resources, geographic location between large consumers and producers, possibility of easy access to global trade routes over the Mediterranean, and sizeable domestic consumption for transforming its position from transit country into a central country, or a "hub".[15]

Price uncertainty, concerns with ongoing market liberalization, existing LNG infrastructure bottlenecks, the emergence of potential new suppliers compound Ankara's supply strategy. The most important component of Ankara's strategy is to import gas from multiple sources in order to reduce dependency on any one supplier. This policy is driven mainly by considerations for avoiding any single supplier's quasi-monopolistic power, as well as serving as an insurance policy against actual or potential deteriorations in bilateral relations with the supplier countries. The overall goal is to reduce energy supply sensitivity and vulnerability through reducing the share of natural gas in Turkey's energy mix. Turkey thus aims to reduce the share of natural gas in power generation mix by increasing the share of domestic coal and renewables. This is potentially consequential as currently the biggest consumer of natural gas is the power generation industry.[16] A related objective is the diversification of suppliers so that no one supplier would have more than 25 to 30 percent share in Turkey's imports.

Table 2 Turkey's Natural Gas Purchase Contracts Towards 2020s

Agreements	Volumes (bcm/year)	Expiry Date	Status
LNG - Algeria - Nigeria	4 1.2	Oct 2024 Oct 2021	In Operation In Operation
Iran - EAP	10	Jul 2026	In Operation
Russian Fed. - Blue Stream - Western Line[17]	16 4 +10	End of 2025 End of 2021* (Depending on Agreements)	In Operation In Operation (Private Contractors)
Azerbaijan - SDPhase-I (BTE) - SWAP Agrm.	6.6 0.15	Apr 2021 2046	In Operation In Operation

14- http://www.gazpromexport.ru/en/statistics/

15- USA's concept of East-West Energy Corridor concept paved the way for the adoption of the role in the future. The East-West Energy Corridor generally refers to the energy version of the Silk Road in the 21st century and was first introduced to the Turkish Ministry of Foreign Affairs by US officials in December 1997.

16- Gulmira Rzayeva, *Turkey's Gas Demand Decline: Reasons and Consequences*, The Oxford Institute for Energy Studies, Energy Insight 11, April 2017, p. 5

17- It is reported that the contract of the Western Line will be terminated when the TurkStream becomes operational, which is targeted for 2019. See "Türk Akımı nedeniyle Batı Hattı devre dışı kalacak", Milliyet, March 15, 2017.

As the overall goal is to reduce energy supply sensitivity and vulnerability, it should be expected that Turkey will continue to invest in infrastructure. However, particularly if the current market trend of marked down prices is to continue as expected, combined with the goal of market liberalization, these contracts shall potentially be renewed by lower-priced private industry contracts. These renewed contracts would also mainly utilize the existing infrastructure, primarily when it comes to pipeline gas. Also due to the existing Natural Gas Market Law of 2001, a series of restrictions has been imposed on BOTAS in order to shed its monopoly position in the market and create a more competitive and efficient market. In this context, the Energy Market Regulatory Authority (EMRA) has imposed limitations barring any single company importing more than 20 percent of national consumption. BOTAS has not been exempted. Given its current share of almost 80 percent in Turkey's natural gas imports, it can transfer some of its import contracts to private players in the future. BOTAS is also barred from signing any new import contracts with the exception of LNG imports, unless the Council of Ministers identifies a risk to supply security. Yet the transfer of gas supply contracts to private companies has proceeded much too slowly for a real competitive landscape to emerge. To date, only a volume of 10 bcm/year from Turkey's Western Line contracts with the Russian Federation, amounting to 20 percent of the total, has been successfully transferred to the private sector in 2011. The current volume of private sector contracts is 11.2 bcm, 21.6% of total imports. However, the private companies face both domestic and international obstacles. Domestically, it has a competitive disadvantage given that its lack of access to the leverages of BOTAS-style subsidies. Ultimately the authority to accept or deny the transfer of existing contracts lies with the supplying party, rendering this a highly politicized issue that necessitates government intervention. In this context, a long-awaited change in the Natural Gas Law 4646 is due, and if realized, such a change will more likely soften the existing, though unenforced, limitations on BOTAS. But the Turkish government is duly concerned about leaving Turkey's natural gas contracts, which are deemed strategic not only by its own virtue but also as a potential factor of leverage in Turkey's foreign policy, to private parties with weak negotiation powers and limited public and political responsibility.

In addition, most of the existing BOTAS/Turkish contracts will be expiring during the next decade. In this context, Turkey's existing contracts with the Russian Federation, Azerbaijan and Iran will have expired by 2020s. This will create a need to replenish 40 bcm/year of gas purchases. Today almost 53 percent of Turkey's existing need, totaling 24.5 bcm/year, is supplied by Russia. Turkey's second largest supplier is Iran, with a current contract of approximately 10 bcm/year. The third supplier, Azerbaijan, has had a limited export capacity until recently. However, the Trans-Anatolian Pipeline Project emerges as a very important opportunity and hence a priority during the coming half decade. Iraq/KRG and the Eastern Mediterranean prospects are hostage to geopolitical developments.

If Turkey can ensure its own energy security through increased diversification (both of resource and source), it may also secure more favorable contracts from the producers, granting it the ability to offset its domestic consumption and, perhaps more importantly, creating the possibility of re-exporting the available gas. Whether the country can achieve this vision will first and foremost depend on its ability to implement its current strategies that rely on its initiatives on the LNG front, its ability to introduce nuclear in its energy mix and the level of utilization of domestic resources: coal as well as renewables. But it will also depend on guaranteeing natural gas supplies from existing and potential suppliers. Given the political and economic uncertainties that have in the past affected the ability of many potential suppliers to overcome their supply constraints, an assessment of different natural gas supply scenarios over the next two decades would be useful.

2.4 Turkey's Prospective Gas Projects and Potential: An Asssessment on the Basis of Partners

As mentioned above, Turkey imports gas from Russia, Azerbaijan, and Iran over pipeline systems, and LNG from the world market, primarily from Algeria and Nigeria over long-term contracts. Turkey's existing suppliers, especially the Russian Federation, are expected to have formative roles in Turkey's energy future. At present, Turkey already has four new projects on the table; TurkStream, TANAP, Eastern Mediterranean/Israeli and Northern Iraqi/Kurdish gas and is also working towards strengthening its LNG infrastructure.

Table 3 Turkey's Prospective Gas Projects and Potential

Agreements	Volumes (Bcm/Year)	Status
LNG - Other	10	Potential
Russian Fed. - Turkstream (Turkey imports)	15,75	Contracted/Under Construction
Azerbaijan - SD Phase - II (TANAP)	6	Contracted/Under Construction
Northern Iraq (Kurdish)	10	Forecast
East Med (Israeli)	8-10	Forecast

2.4.1 Russia

Russia has by far been Turkey's largest and most reliable gas supplier for almost two decades. Russia supplies approximately 28-30 billion cubic meters of gas (some 55 percent of the total demand) to Turkey each year. Turkey currently receives Russian gas via Trans-Balkan (or Western) pipeline and Blue Stream. The TurkStream pipeline is set to be a new addition to this existing infrastructure.

Figure 2 TurkStream Map

The TurkStream natural gas pipeline is set to have an offshore section running 900 km across the Black Sea from the Russian port of Anapa to Kıyıköy, in Turkish Thrace, and then as an underground pipe to the Turkish-European border with a total annual throughput capacity of 31.5 bcm/year delivered over two strings of pipelines.[18] The South Stream Transport BV, a subsidiary of Gazprom in the Netherlands, signed two contracts to build both offshore strings, each with the capacity of 15.75 bcm/year.[19] The construction

18- Turkey and Russia signed an IGA on the construction of two strings of TurkishStream on 10 October 2016.
19- See "Construction contract signed for first string of TurkStream's offshore section", December 8, 2016 (online) www.gazprom.com/press/news/2017/february/article304093/, accessed May 27, 2017;and "Construction contract signed for second string of TurkStream's offshore section", February 20, 2017, (online) www.gazprom. com/press/news/2017/february/article304093/, accessed May 27, 2017.

of the first string's offshore section has commenced on May 7, 2017.[20] This string will serve the Turkish market as an alternative to the Trans-Balkan pipeline coming to Turkey via Ukraine. The remaining amount of 15.75 bcm/year will be delivering gas to southern and southeastern Europe through the planned second string.[21] The offshore sections of both pipelines will be contracted and owned by Gazprom, while the onshore section of the first string will be contracted and owned by BOTAS and the second string will be jointly contracted and owned by BOTAS and Gazprom through a joint venture.

The first string's capacity is sufficient to replace the current volume of Russian natural gas delivered to Turkey through the Trans-Balkan pipeline if the transit agreement between Russia and Ukraine is not extended beyond 2019. Russia exports 14 bcm gas annually to Turkey through this line. TurkStream therefore has a potential for enabling Russia to by-pass Ukraine and redirect its export route via Turkey, without affecting the current volumes.

In addition to allowing Moscow to by-pass Ukraine, Moldova, Romania and Bulgaria, TurkStream will also help Russia to maintain its share in European gas markets by being able to ship gas to Europe from the Turkish border. TurkStream will therefore position Turkey at the front-end of a complex delivery system that will deliver natural gas to Europe, rather than the last destination; and hence will potentially enhance the strategic positioning of the country as a gateway for European energy security – a position that is in line with Turkey's energy strategy. It will also allow Gazprom to address its concerns over the long term contracts to Europe. Many of those contracts will begin to expire after 2020 with potentially sizeable consequences for overall deliveries. This might translate into significant losses in contract volumes and take-or-pay contracts by that time, should these contracts are not renewed. Such a scenario would also impact the European market in the form of increased LNG sales and a gradual switch away from Russian gas.

As for Turkey, the security of gas supply is the main motivation for supporting TurkStream. As demand in Turkey is likely to grow in the coming years, interruptions in flows through the Trans-Balkan line could create serious supply shortages, especially in the industrial western regions that are the most intense consumers of natural gas. The objective of ensuring a new supply alternative with competitive pricing has been another factor shaping Turkey's decision making. Russia has always been a reliable energy supplier and partner to Turkey even during the politically tense periods, such as the crisis that followed the downing of a Russian Air Force Su-24M by Turkey in November 2015. The renewed Turkish-Russian relations reflect a broader geopolitical change where regional integration and bilateral relations may become more important.

2.4.2 Azerbaijan

Azerbaijan is currently the third main supplier (in terms of gas volume) for Turkey after Russia and Iran. The importance of Azerbaijan in Turkey's energy strategy is likely to increase with the realization of Trans-Anatolian Pipeline (TANAP). Currently Azerbaijani gas from Shah Deniz I (SD1) remains as the commercially most preferable source for Turkey, albeit with a very small margin compared to Russian gas. This is due to the price structure and BOTAS's ownership of the existing natural gas pipeline between the two countries. The possibility of unhindered land connection between the two countries and relatively shorter transportation distance compared to alternatives also positively influence the investment decisions. The gas deliveries are also perceived to be politically more secure by at least the Turkish public opinion, given the overall state of the bilateral relationship. Currently, Turkey imports gas from Azerbaijan via the South Caucasus Pipeline (or Baku-Tbilisi-Erzurum-BTE) and has a contract for purchasing 6.6 bcm/year gas from Azerbaijan's SD1 and condensate field annually. The existing BTE pipeline is owned by BOTAS and no transportation fees are involved in the contract.

As a new project, Azerbaijani gas from the Shah Deniz 2 (SD2) field will flow through the Southern Gas Corridor (SGC). This project consists of three consecutive pipelines the South Caucasus Pipeline (SCP) from Baku to Erzurum, TANAP which will cross Turkey from east to west and, Trans-Adriatic Pipeline (TAP) which will start from Greece to bring gas to Italy through Albania under the Adriatic Sea. TANAP project was initiated officially on 17 March 2015. The official groundbreaking ceremony for TAP took place on 17 May 2016 and as of the end of May 2017, 72 percent of TANAP and 10 percent of TAP is complete.[22]

Both TANAP and TAP rely on gas from the Shah Deniz II (SD2) field development. It is expected that SD2 will

20- http://www.gazprom.com/press/news/2017/may/article329932/
21- "Construction of TurkStream gas pipeline's offshore section commenced", *Gazprom*, May 7, 2015, (online) www.gazprom.com/press/news/2017/may/article329932/, accessed May 27, 2017.
22- "TANAP'ın yüzde 72'si tamamlandı", *Milliyet,* May 31, 2017.

add 17 bcm/year to the 9 bcm/year produced from SD1 of this field after 2018.[23] The gas from SD2 has already been contracted for the Turkish market with 6 bcm/year, and 1 bcm/year each for Bulgaria and Greece, with the remaining 8 bcm/year supplying Italy. The transport capacity, initially 16 bcm/year, is aimed to increase gradually, first to 24 bcm and then to 31 bcm. According to SOCAR, the first gas from SD2 will be in the Turkish market in 2018. TANAP will be completed in the same year, and Azerbaijan gas will reach Greece and Italy in 2020 with one or two year delay.

Azerbaijan plans to increase TANAP's capacity from 16 to 31 bcm/year in three stages with additional gas supplies from the Caspian. With these new resources Azerbaijan may have unallocated gas above SD1 and SD2 volumes by the 2020s and 2030s and potentially produce additional 15 bcm/year from three fields – Absheron, Umid/Babek, and Azeri-Chirag-Guneshli, plus a possible extra 15 bcm/year if Shah Deniz 3 is implemented. TANAP will play a crucial role for Turkey both in covering its own demand and in becoming an energy hub. Nevertheless, there are a number of issues such as financing and capacity that the parties will need to overcome.

These pipelines will be built on the basis of project finance, which means that the developers will need to tap international debt financing. Although having the State Oil Fund of Azerbaijan (SOFAZ) will help as a backer, finding additional funders will be difficult as low oil prices have made financial institutions very cautious in financing new major energy projects. Secondly, the project size is not enough to play a game changer role in European markets. The main question is how to enhance the project as to become an alternative to Russia through adding extra gas from new sources. Azerbaijan's continental shelf has other prospective middle-sized fields. But in the Caspian Sea there is a serious dearth of deep-sea drilling rigs, which delays prospecting and development of the fields. Only one new Azerbaijani field, i.e. Absheron with a capacity of 5 bcm/year, will start to produce gas in the next ten years. It is not certain whether this gas will be directed for export, given Azerbaijan's growing domestic consumption. As such, parties need to find some new alternatives to support projects, be it gas from East-Mediterranean, Iran, Iraq or Turkmenistan. However, the realities of all those alternatives dictate that there will be little or no gas from Iraq, Iran or Turkmenistan until 2025 at the least, and thus in the short- and medium-term Azerbaijani gas will be the backbone of the project.

Finally, one would need to consider Russia's economic, political and security perspectives as another decisive limitation. Disagreements on the status of the Caspian Sea and Russian military stance in the Caucasus and Caspian regions are the real and potential limitations deserving a crucial element for risk assessment. Russia also holds the ability to offer more competitive prices, if it chooses to do so, rendering any project less attractive for consumers. TANAP is not immune to this either.

Some industry insiders in Turkey are also anxious about the fate of SD-1 after the completion of SD-2 (TANAP) and the possible termination of the SD-1 contract. The critics argue that SD-1's advantage for Turkey, as reflected in its status as the cheapest gas resource, was partly due to the fact that transportation was not a cost element as the ownership of the line belonged to BOTAS. This is not the case with TANAP, Turkey will be paying considerable transport fees despite the fact that it is the transit country. As a result, in addition to the fact that the contract price of TANAP is higher than that of SD-1, this additional cost item will increase the cost of Azerbaijani gas to Turkey. What is more, even though the chances are slim, if the SD-1 contract is not renewed at the time of the completion of TANAP, Turkey might be left in a position in which it is only able to get the pricier SD-2 gas and the existing SD-1 pipeline could be left idle. Alternatively, SD 1 contract could be renewed either on terms closer to that of SD-2, and as such could become less beneficial for Turkey. It is hard to say that these questions looming in the background of TANAP are properly addressed by authorities at the time of writing.

2.4.3 Iran

With enormous offshore and onshore fields, Iran owns the third largest gas reserves in the world. Nevertheless, Iran has not been able to make full use of its natural gas capacity as a big actor in the international gas markets because of EU and US sanctions. Thus, Iran, as a potential big gas player,

23- The Government of the Republic of Turkey and the Government of the Republic of Azerbaijan signed the Memorandum of Understanding between the State Oil Company of Azerbaijan Republic (SOCAR) within the framework of the TANAP Natural Gas Transmission Company on 24 December 2011. The TANAP Project was established and the design, construction and subsequent operation of the project was authorized. The "Intergovernmental Agreement concerning the Trans-Anatolian Natural Gas Pipeline System between the Government of the Republic of Turkey and the Government of the Republic of Azerbaijan" and the "Host Government Agreement" which constitute the legal basis of the project, were signed in Istanbul on 26 June 2012. The Host Government Agreement was amended and signed on 26 May 2014. The revised agreement was ratified by the Grand National Assembly of Turkey on 10 September, 2014.

could become a substantial global gas exporter when uncertainties over the future of the sanctions are fully overcome.

Following the nuclear deal and a softening of the sanctions regime, Iran has begun to revive its oil and gas production and export capacity. The field Iran shares with neighboring Qatar is being developed in 24 phases. About half of the phases have been completed, and Iran hopes that the fields, including those centered on oil, will be fully operational in 2018. Located over 60 miles offshore, South Pars holds nearly 40 percent of Iran's gas reserves. Nevertheless, Iran's energy sector requires massive investments and these are not on the horizon in the short term. Iran contributes just 1 percent to the total global natural gas trade, with almost 90% of exports going to Turkey. It is not quite possible for the moment to detect the market priorities of the Iranian decision makers. But the European market is likely not to be a priority destination for export from the main Iranian gas fields. Iran has officially stated that gas transportation to Europe is no longer a priority because of low gas prices, which have made the construction of pipelines economically unviable. A huge buildup in infrastructure, on the other hand, signals that India, Pakistan, Kuwait, and UAE could all become targets for Iran's gas. Planned reductions in subsidized pricing, which will help reduce wasteful usage, will free up more of Iran's gas for exports.

Currently, Turkey is the only commercially viable market for Iranian gas. A Gas Sales and Purchase Agreement was signed between Turkey and Iran in 1996. The maximum capacity in the Iran Gas Trunk Line I (IGAT1) that exports gas to Turkey is 16 bcm/year depending on compressor stations, currently the discharge capacity is 14 bcm/year, which leaves little space for additional volumes. In addition to this, Iranian gas is the most expensive pipe gas Turkey procures. Increasing Iran's share in Turkey's energy mix through additional gas flow with infrastructure development projects could be a possible scenario for Turkey. Nonetheless, the historical rivalry between the two countries and ongoing differences on regional issues continues to hinder the implementation of large-scale projects between Ankara and Tehran. In addition, Iranian gas supplies have been prone to disruption in the past, especially in winter times when domestic demand reaches its peak.

2.4.4 Iraq

Despite the presence of significant reserves, Iraq currently does not produce natural gas in marketable quantities. Similar to Iran, the Iraqi government has to attract foreign investment for development of new natural gas fields for its own use and export excess volumes. Turkey's future projections in terms of gas trade with Iraq include large and undeveloped natural gas fields located in northern Iraq or the Kurdistan Regional Government (KRG) territories. The region holds as much as 200 trillion cubic meters natural gas reserves. This volume is in fact higher than Algeria or Nigeria and represents about 3 percent of the world's total deposits according to the website of the KRG Ministry of Natural Resources.[24]

The main issues in the development of those fields are security/stability in Iraq and the available technical know-how. The KRG region enjoyed better security conditions and more effective local governance than the rest of the country in the last decade.[25] This has encouraged Kurdish and Turkish hopes for a rapid expansion of Iraqi gas exports to Turkey and Europe. Yet, major political, legal, and constitutional questions stand in the way of progress. The KRG claims authority to negotiate contracts on energy exploration and development projects. This has caused tensions with the central government in Baghdad, which wants to link future gas exports with meeting urgent domestic electricity-generation needs. Article 111 of the Iraqi Constitution affirms that "oil and gas are owned by all the people of Iraq in all the regions and governorates." The KRG views the oil and gas issue as a domestic one that concerns Kurds alone, and insinuates intention to bypass Baghdad. To this end it holds international conferences with international companies, including Turkish firms, and calls for international investments. On the surface, KRG appears to be a strong option for new supply to international markets, especially to Turkey. KRG hopes to start exporting 10 bcm/year to Turkey by 2019-2020 and double the amount afterwards.[26]

Nevertheless, it seems that this target is not a realistic as far as at least two main issues are concerned:

24- "The Kurdistan Region could hold as much as 200 Tcf (5.67 Tcm) of natural gas reserves, representing between 1.5 percent and 3 percent of the world's total reserves. This positions Kurdistan for a prominent role in regional gas markets." http://mnr.krg.org/index.php/en/component/content/?view=featured. Also see https://www.bloomberg.com/news/articles/2016-01-15/iraq-s-kurds-to-start-natural-gas-exports-to-turkey-in-2019-2020

25- We should keep in our mind that PKK opposes KRG-Turkey natural gas agreement. A PKK sabotage operation against a Kurdistan region oil pipeline in Turkey temporarily halted oil exports to Turkey in mid-August 2015. It cost the KRG around $250 million in lost revenue and wasted crude oil.

26- Hurriyet Daily News, "KRG Plans 10 bcm in Natural Gas Exports to Turkey in Two Years," Hurriyet Daily News, November 20, 2015, http://www.hurriyetdailynews.com/krg-plans- 10-bcm-in-natural-gas-exports-to-turkey-intwoyears.aspx?p

obstacles concerning security and issues on the development of fields - i.e. production process and the transportation of natural gas to international markets - especially to Turkey. The KRG's first priority is to satisfy domestic demand in order to fuel the region's power stations with gas, replacing expensive diesel, which costs billions of dollars a year in imports.[27] The current gas production in the region stands at around 3–4 bcm/year, and is currently entirely for domestic use. The addition of Kirkuk to KRG's control adds about 2.5 bcm annually, which could increase if more gas that is currently flared is captured. However, most of this gas is required for local power generation. Miran and Bina Bawi could produce about 11 bcm between them, with 5 bcm from an expansion of Khor Mor and 6 bcm from Chemchemal. Flared gas from Khurmala could add another 2 bcm. The development of Miran and Bina Bawi fields gas reserves, with a capacity of 350-400 bcm, is underway by the Anglo-Turkish company Genel Energy, with an estimated cost of $2.9 billion.

Challenges in developing the infrastructure to increase production is the major impediment to the access of Kurdish natural gas to the global market. As noted, KRG's oil and gas exports to Turkey have been an issue of contention between the KRG and the Iraqi federal government. KRG and Turkish authorities signed a gas sales agreement in November 2013. The agreement included 4 bcm of Kurdish gas exports by 2017, 10 bcm by 2020, and a possible increase to 20 bcm by 2025. There were also discussions about the possibility of the connection of the KRG natural gas exports to the Trans-Anatolian pipeline (TANAP) in the future.[28] But the parties have failed to implement the agreement to date due to geo-political uncertainties. Genel Energy plans to export up to 20 bcm of natural gas per year from the fields located at some 300 km (186 miles) from Turkey. Given the geographic proximity, insiders to the project note that the pipeline could be built in 6 months with an initial throughput capacity of 4 bcm/year. Genel Energy representatives have stated that they expect the fields to take around three years to develop and to start production in early 2020. In line with that, Turkish officials have said that "the national gas company, BOTAS, would open a tender for the construction of a 185km pipeline from Silopi, on the Iraqi-Turkish border, to connect with the Turkish grid at Mardin."[29] There were also discussions about the possibility of connecting KRG natural gas exports to the Trans-Anatolian pipeline (TANAP) in the future.[30]

Given that the Iraqi federal government has been uneasy about the KRG's independent exportation of oil via/to Turkey, Baghdad would possibly adopt the same recalcitrant position in relation to potential gas exports from KRG to Turkey.

2.4.5 Eastern Mediterranean and Israeli Gas

The discovery of a significant volume of natural gas in the Eastern Mediterranean reignited debates about the relationship between regional geopolitics and energy. The territorial waters of Israel, the Gaza Strip, Lebanon, Syria, and Cyprus, might contain as much as 122 Tcf of natural gas and 1.7 billion barrels of oil.[31] Even though these figures are relatively large for the region, they represent less than 1.5 percent of the global proven reserves. What is more, regional production in 2014 was under 2 percent of global production, while consumption was over 3 percent.[32] Hence the region, as of today, remains a net importer. In a global

27- Build it better: the path forward for the Kurdistan Region of Iraq", December 17, 2014,http://www.theoilandgasyear.com/interviews/build-it-better-the-path-forward-for-the-kurdistan-region-of-iraq/

28- "The Kurdistan region is about 570 kilometers from the closest TANAP station in Erzurum. In order to connect with TANAP, a new pipeline would need to be built, stretching from Zakho to Erzurum. Therefore, Kurdish natural gas could be considered as the most affordable, sufficient, closest and safest supply source for the Trans Anatolian Pipeline." *Darwn Rahim,* "Kurdish natural gas could enhance chances of Trans Anatolian Pipeline (TANAP) success", 3/7/2016, http://www.rudaw.net/english/analysis/03072016.

29- John Roberts, "Row with Russia Forces Turkey to hunt for New Energy Partners," Financial Times, December 15, 2015, http://www.ft.com/intl/cms/s/0/03025db8- 99aa-11e5-9228- 87e603d47bdc.html#axzz414gVCgef. "A 176-kilometre pipeline already takes gas from the Khor Mor field to power generation plants in Erbil and Suleimaniah and to Khurmala. A 30-kilometre interconnector pipeline from Summail field to Duhok power plant is under construction, so that the plant, which is currently running on diesel/light fuel, will run on gas by early 2014.By 2016, large volumes of gas are expected to flow through a Kurdistan Region export pipeline to Turkey, at the Fish Khabur border." see http://mnr.krg.org/index.php/en/gas/gas-pipeline.

30- "The Kurdistan region is about 570 kilometers from the closest TANAP station in Erzurum. In order to connect with TANAP, a new pipeline would need to be built, stretching from Zakho to Erzurum. Therefore, Kurdish natural gas could be considered as the most affordable, sufficient, closest and safest supply source for the Trans Anatolian Pipeline." *Darwn Rahim,* "Kurdish natural gas could enhance chances of Trans Anatolian Pipeline (TANAP) success", 3/7/2016, http://www.rudaw.net/english/analysis/03072016.

31- Simon Henderson, *Seismic Shift: Israel's Natural Gas Discoveries*, Policy Watch 1736, January 2011 (online)www.washingtoninstitute.org/policy-analysis/view/seismic-shift-israels-natural-gas-discoveries accessed May 3, 2017.

32- Michael Ratner, *Natural Gas Discoveries in the Eastern Mediterranean*, U.S. Congressional Research Service Report, August 15, 2016, p. 3.

environment of low hydrocarbon prices, and given the geopolitical situation in the Eastern Mediterranean region and the viability of infrastructure, countries are in actual competition, seeking to attract operating companies. The agreements the individual country would offer, their intended contribution to the costs, the size of domestic markets, and governmental and regulatory stability are all factors contributing to the equation. Despite the obstacles, many observers opine that this amount of resources has the potential to play a significant role as a new game-changer even in the resolution of long-standing conflicts in the region. The countries that were previously dependent on energy imports have an opportunity to develop gas fields, achieve energy independence, and earn money by exporting gas to others. In this framework, even though the Israeli market is small and the domestic debate on its gas policy creates ambiguity at times, with the economies of scale that recent discoveries created, the relatively small geographical distances helping to reduce the development costs, and the relative political (albeit not yet regulatory) stability that it provides to potential investors, Israel arguably has some competitive advantage vis-a-vis the rest.

The first two largest discoveries of hydrocarbons were made at Tamar and Leviathan off the coast of Israel in 2009-2010. These two fields are seen as an opportunity for Israel to become a major energy player in the Middle East. The third largest discovery was "Aphrodite field-Block 12''. Located offshore the island of Cyprus, the field was discovered in 2011. Cyprus Block 12 field covers approximately 40 square miles and will require additional exploratory drilling prior to development.[33] The field is generally claimed to hold a gross resource range of 5 to 8 Tcf, although, latest assessments put the field at 4.1 Tcf.[34] The largest gas reserves called Zohr was discovered in Egypt's shores in the Eastern Mediterranean in 2015. This discovery contains an estimated 850-900 bcm of natural gas, almost doubling Egypt's gas reserves. Lebanon has some potential to be listed in this new gas-rich countries list in the East Mediterranean. These countries have lagged behind in the discoveries and drilling in their territories for obvious reasons.

Challenges related with the development of the Eastern Mediterranean gas fields and the export capacity might be categorized as follows:

1. Commercial challenges (capacity, competition for new remote markets, and transportation),
2. Competitive disadvantages (total cost of development phase and building the offshore pipeline exceeds the average price in the region, including Turkey)
3. Domestic policy and regulatory issues (attracting strong international operators, technical difficulties in building the infrastructure for gas exports),
4. Security and stability related geopolitical challenges.

2.4.6 Israeli Gas and Turkey

Israel has already made natural gas supply deals with Egypt, Jordan and Palestine. However, with Israel's consumption also rising, and with what some industry experts call "zigzags" in its energy policies, including retroactively enforced regulatory changes, the collapse of the Leviathan-Woodside deal and its accompanying consequences, coupled with the fact that Israel is still not a member of the Energy Convention, and the domestic debate in Israel on the utilization of its gas resources for export purposes, Israel's advantages in the Eastern Mediterranean equation can be said to be real but not as solid as one should expect. In this regard, regulation in Israel introduces a price ceiling of roughly USD 5.4 /MMBtu. It also enforces an export peg: if the gas companies offer cheaper export prices, then they will also have to lower their domestic price to the more competitive export price level. Israeli regulation also enforces an export limit of around 40 percent, i.e. companies can only export that share of the gas that they extract. This scheme is based on a de-escalatory model depending on the size of the field, i.e. as the field gets larger, the amount earmarked for exports decreases. In this framework, Noble Energy estimates the Leviathan field, that would be supplying to Turkey should Turkey–Israel gas agreement becomes a reality, holds 622 bcm of gas and half of this volume can be licensed for exports under Israel's new "Gas Framework" which seriously limits the producer companies' ability to compete in the international arena.

These factors make an Israel-Turkey pipeline a complicated issue, even though the Turkish route

33- Cyprus owns 12 Blocks, which all appear to be promising in gas and oil reserves, and the exploration activity in the Cypriot exclusive economic zone will continue in the summer of 2014 (The ENI – KOGAS consortium has signed a contract for hydrocarbons exploration in blocks 2, 3 and 9 within Cyprus' EEZ, while Total has signed a contract for blocks 10 and 11).
34- "Gas reserve estimates at Cyprus' Aphrodite lowered to 4.1 tcf", Reuters, Dec. 1, 2013. (online) www.reuters.com/article/cyprus-natgas-aphrodite-idUSL5N0JG0GW20131201, accessed May 8, 2017.

is clearly more advantageous than the alternatives. Despite that, Turkey seems to be the most reasonable and cost-effective line for eastern Mediterranean natural gas, both in terms of commercial and market opportunities, as well as the feasibility and competitiveness of the infrastructure. At the same time, bringing Israeli gas to Turkey within a framework that also includes a re-export option to Europe, probably through TANAP, would be compatible with Turkey's policy of becoming an energy hub. It should also be noted that at least some Turkish industry insiders opine that if seen as alternatives, they would expect Israeli gas to arrive in Turkey faster than Northern Iraqi gas, despite the crossover of interests for gas companies with dual interests in both Israeli and Cypriot fields and the obvious geopolitical (Cyprus issue) and foreign policy obstacles (the frailty of Turkish–Israeli relations). Within this framework, if realized, Turkish–Israeli pipeline might feed 8 to 10 bcm/year to the Turkish grid. Turkish companies Zorlu Group, Turcas – Enersa Consortium and ENKA are the three companies that have negotiated gas sales and purchase agreement from the giant Leviathan field to the Turkish mainland. Although a scenario involving Turkish companies' participation in the short term seems unlikely due to political obstacles, such examples serve to demonstrate Turkey's pragmatic approach in the energy field. In this vein, Turkish Minister of Energy Berat Albayrak declared Turkey's interest in Israeli gas, citing energy as a "resource fostering cooperation".[35]

Turkish MENR Strategic Plan states; "Diversification of import countries and routes shall be provided by adding new source countries and routes into natural gas import portfolio" as a main objective (Objective 7) under its goal of achieving optimum resource diversity and as a Performance Indicator (G2.PI.7.1). The Plan lists "Iraq, Qatar, Algeria, Turkmenistan, Eastern Mediterranean, Africa and other potential countries" as countries where to the prospect of procuring natural gas by private sector should be studied.[36] The same document also declares that in order to achieve the strategic goal of integrating Turkey with regional markets "to make Istanbul a finance center, an energy center with price formation capacity shall be established in Black Sea and Mediterranean, where Ceyhan and Aliağa delivery products will be processed" (Objective 9).[37] Eastern Mediterranean gas, (in effect, Israeli gas, as the possibility of Cyprus gas also getting into the mix is slim), with its geographic proximity to Ceyhan, might prove to be a cornerstone in the realization of these objectives. In fact, Ankara's resilient economic relationship with Israel is reason to be optimistic about future cooperation in the field of energy, despite bilateral relations reaching a historic low on a political level. The trade between Israel and Turkey in 2014 reached an all-time high of USD 5.44 billion despite the fragility of relations, and in 2016, a year that witnessed a rapprochement between the two countries, bilateral trade was USD 3.9 billion.

Yet, even if investment decisions were finalized today, it would take at least 3-4 years for the gas to be ready for export. Until then, a dozen rival projects (as well as a large number of FSRU / LNG facilities), such as Shah Deniz-2 in Azerbaijan, as well as Kurdish, Iran, Tanzania, Mozambique, Australia, USA options, will be initiated. Therefore for the Eastern Mediterranean energy to fulfill its promise, it is necessary for Tel Aviv and Ankara to have sound relations with each other, as well as with Cyprus, Egypt and Lebanon. However with Cyprus reunification talks stalled once again with no apparent solution on the horizon, and with the current state of Egypt-Turkey and Turkey-EU relations, this is not an easy proposition.

However geopolitical concerns might override these very real issues. In fact; "The notion of 'economic peace', loosely defined as using the development of economic relations to break political impasses and urge the parties towards peace, has informed much of the diplomatic agenda of the US State Department in the Eastern Mediterranean."[38] Furthermore, the United States also does see the Eastern Mediterranean gas as an opportunity to de-leverage Russian gas dominance in Europe, as professed by relevant US officials on various occasions.[39] In fact, the synergy that the Israeli-Turkish energy cooperation can create may attract other states to the fold and might appeal to international investors.

All in all, for the Eastern Mediterranean gas to find its way to international markets, the Turkish route remains as the most viable alternative. Israeli Energy Minister Yuval Steinitz stated for instance that Turkey is to be the route of natural gas to Europe: "Israel wants to have the opportunity to export natural gas through Greece and Turkey. Building a pipeline to

35- Berat Albayrak, Minister of Energy, Budget Speech 2017 p.73.
36- *Strategic Plan…*, p.39
37- *Strategic Plan…*, p.78.
38- Tareq Baconi, *Pipelines and Pipedreams: How the EU can support a regional gas hub in the Eastern Mediterranean*, ECFR Policy Brief, April 2017, p. 2.
39- See *Testimony by Amos j. Hochstein, US Special Envoy for International Energy Affairs*, *Bureau of Energy Resources*, Committe on Foreign Affairs's Subcommittee on the Middle east and North Africa and the Committee on Science and Space and Technology's Subcommittee on Energy, Washington DC, September 8, 2016

Turkey is much cheaper than building it to Cyprus and Greece."[40] On another occasion, Steinitz, who is known to be close to Israeli Prime Minister Benjamin Netanyahu, again went on record to say that he "wants two pipelines," one to Turkey and one to Egypt. However analysts do suspect that there might not be enough gas to supply both routes.[41] The energy company Noble also seems to think that a pipeline to be built in Turkey may be more feasible, both technically and financially, than the Israel–Cyprus–Crete–Greece Mainland–Europe option.

2.4.7 LNG

The advent of technology to cool natural gas into liquefied natural gas (LNG) in the 1960s now allows natural gas to be shipped by a tanker. Despite the fact that this process of liquefaction, transport, and regasification is relatively costly and requires large upfront investments in massive LNG supply chains, LNG is a game changer and will probably set the future trends in the conventional pricing, contracting and financing in natural gas markets. The new LNG technologies (notably floating storage and regasification technology – FSRU) make the gas market more flexible. The startup of several large-scale LNG projects over the last couple of years, in particular in Qatar, Australia and the US will grow the volume of gas available to trade on this market. Experts are expecting: "UBERization of LNG trade with buyers dispatching LNG cargoes from a liquid global market whenever they need one", leading to a "much more efficient and liquid market[42]." As a result, the financial risks of natural gas projects "will increasingly shift toward the gas producer, and not, as historically has been the case, predominantly rest with the buyer[43]." It is exactly this trend that Turkey, already the world's 14th largest LNG consumer,[44] currently tries to capitalize on.

The share of LNG in total natural gas consumption in Turkey is around 15 percent. The import of LNG started in 1994 from Algeria, seconded by LNG supplies from Nigeria in 1999. Today, LNG is also imported via spot markets from Qatar, Norway and Trinidad-Tobago. MENR Strategic Plan states that "Considering annual demand projections in electricity and natural gas, implementation of existing electricity and natural gas transmission investments shall be provided with, taking into consideration technological advances such as smart grid, storage in electricity and investment regarding storage and LNG terminal in natural gas."[45]

The Strategic Plan also stipulates "adding at least two countries to the countries supplying pipe gas or LNG form natural gas either in spot or long term basis" as a performance indicator "until the end of the plan period", and "Development of various alternatives such as; operation of spot pipe gas, TAP pipeline in reverse flow basis, usage of LNG facilities of other countries, if necessary."[46] In this context LNG is seen as the most important factor to contribute to the liberalization of the market.

Turkey already has two onshore LNG terminals: one at Aliağa/EgeGaz with a capacity of 6 bcm/year and one at Marmara Ereğlisi with equivalent capacity. Another step to turn LNG into a more important factor in Turkey's energy strategy is the decree numbered 2016/8670 of the Council of Ministers, dated March 21, 2016. The decree, titled "Assignment of BOTAŞ General Directorate in Order to Ensure Natural Gas Supply Safety and Resource Diversity" has tasked BOTAS with "making the necessary investments and other necessary works and transactions for the connection of the natural gas to the floating LNG storage and gasification units and to the domestic natural gas transmission system.

The main obstacle for wider room for LNG in the energy mix is the cost of establishing the necessary facilities and infrastructure including storage facilities. On the other hand, LNG is the most open area to private sector activity and competition due to the regulation on the access of the third parties to LNG terminals published by EMRA and approved by the institution in 2010. In this context, and in line with the above mentioned decree, since December

40- "İsrail`den Türkiye`ye gaz mesajı", *EnerjiGünlüğü*, January, 29, 2016, (online) www.enerjigunlugu. net/icerik/17065/israilden-turkiyeye-gaz-mesaji.html, accessed April 4, 2016.
41- David Wainer and Yaacov Benmeleh, "Israel's geopolitical quandary on exporting gas", Bloomberg Markets, September 6, 2016 (online) www.bloomberg.com/news/articles/2016-09-06/quicktake-q-a-israel-s-geopolitical-quandary-on-exporting-gas, accessed February 19, 2017.
42- Tim Boersma and Tatiana Mitrova, A Changing Global Gas Order", Columbia Center on Global Energy Policy, 21 March 2017.
43- Ibid
44- "Türkiye'nin İlk LNG Depolama ve Gazlaştırma Terminali Hizmete Girdi", *Deniz Haber*, (online) www.denizhaber.com.tr/turkiyenin-ilk-lng-depolama-ve-gazlastirma-terminali-hizmete-girdi-haber-71 727.htm accessed May 3, 2017.
45- *MENR Strategic Plan 2015 – 2019*, p.30.
46- *MENR Strategic Plan 2015 – 2019*, p. 39.

2016, Turkey's first private FSRU is active at Aliağa by Kolin and Kalyon consortium.

According to the Energy Minister Berat Albayrak, BOTAS will also launch a similar facility with 20 mcm send-out capacity. This terminal is planned to be stationed at Hatay/Dörtyol, close to Turkey's Eastern Mediterranean port of Ceyhan. Reportedly other parties are also interested in this niche of the gas market, including Turkey's largest industrial enterprise, the Koç group with its ADG Energy for a facility with 14.1 mcmpd send-out and 5 bcm/year total capacity. The other applicant for an FSRU license is Maks Project Development Inc. for a platform with a send-out capacity of 17 mcmpd and 6 bcm/year[47]. When completed, the combined daily send-out capacity of Turkey's FSRU infrastructure will be equal to 71.1 mcm and 26 bcm/year.[48] However while calculating the yearly capacity one should be aware that the FSRU facilities will not be working around the year and their most active period will be approximately 130 to 150 days – the peak consumption periods during the winter.

Also in this framework BOTAS and EgeGaz Inc. signed a Terminal Service Agreement for a maximum period of 5 years starting from 01 January 2017 for EgeGaz/Aliağa to supply LNG services for the national grid[49]. The Terminal Service Contract for service acquisition for 6 years starting from 1 December 2016 from the Etki FSRU was signed between BOTAS and Kalyon-Kolin. These agreements are intended to bring more predictability for these private industry players. In this context, EgeGaz now has increased its send-out capacity from 16.5 mcmpd to 24 mcmpd. It is targeted for this capacity would reach 40 mcmpd by the end of 2017, an assertive target by any standard, which, if realized, will increase the yearly capacity to approximately 15 bcm on a year around basis. This will enable the LNG terminal to be able to "meet 18 percent of Turkey's daily gas consumption" according to the company's General Manager.[50] Moreover, efforts continue to increase the production capacity of BOTAS' Marmara Ereğli LNG Terminal. The aim of the project is to increase the daily gas send-out capacity of the facility from 18 mcmpd to 27 mcmpd, increasing the total capacity from 6.2 bcm/year to approximately 9.8 bcm/year.[51]

In order to make sense of Turkey's moves on the LNG front, one has to understand that the primary concern driving Turkey's LNG surge is the country's peak gas consumption. Turkey's daily peak gas consumption record was 243 mcm in February 2017. Some industry insiders claim that this figure has actually reached 260 mcm, between December 2016 and January 2017. In fact BOTAS "issued a directive for natural gas power plants that produce electricity to reduce their injection capacity by 50 percent starting from December".[52] Under the circumstances MENR aims to increase Turkey's daily send-out capacity from 190 mcmpd to 300 mcmpd in the short term and to 400 mcmpd by 2019. The storage capacity target for 2023 is stated as 11 bcm.[53] The short-term send-out capacity target level is 107 mcmpd for LNG.[54]

The LNG dimension of Turkey's national gas strategy is expected to enhance Turkey's energy security by making it possible for the country to supply its grid with spot purchases, presumably with more agreeable prices, depending on the global supply-demand dynamics and prices of natural gas. It is also important for the country to become a trade center for gas. However, for this vision to materialize, Turkey also has to improve its natural gas storage capacity.

2.4.8 Storage

At present Turkey has two storage facilities: Silivri and Salt Lake. BOTAS acquired Silivri Natural Gas Storage Facility as of 01 September 2016 from Turkish Petroleum Corporation according to High Planning Council Decision No 2016/T-12 dated 20 May 2016. Necessary revisions were made in the Usage Procedures and Principles of this establishment. This revision is aimed to make the system more efficient to operate. Silivri Facility has a 2.84 bcm/year total capacity with the send-out capacity of 20 mcmpd. It

47- "LNG'de FSRU dönemi ve Türkiye arz güvenliği", Türkiye Enerji Vakfı, Dec. 28, 2016.
48- *Ibid.,* "Türkiye'nin ilk FSRU Tesisi Açıldı", Enerji ve Tabii Kaynaklar Bakanlığı, (online) www.enerji.gov.tr/tr-TR/Bakanlik-Haberleri/Turkiyenin-Ilk-FSRU-Tesisi-Acildi, accessed May 5, 2017.
49- Berat Albayrak, Minister of Energy, Budget Speech 2017 p. 47.
50- Murat Temizer, Tolga Albay, Nuran Erkul, "Turkey's capacity to re-increase in six months", *Anadolu Ajansı*, Dec. 28, 2016, (online) aaenergyterminal.com/newsSub.php?newsid=10517138 accessed May 18, 2017.
51- *Bütçe Sunuş Kitabı*, p.46-47
52- Temizer, *Ibid.*
53- "Bakan Albayrak Dogalgaz Iletim Sebekemizin Gunluk Tasima Kapasitesini Iki Yil Icinde 400 Milyon Metrekupe Cikaracagiz ", Enerji Bakanlığı, July 10, 2017, http://www.enerji.gov.tr/tr-TR/Bakanlik-Haberleri/Bakan-Albayrak-Dogalgaz-Iletim-Sebekemizin-Gunluk-Tasima-Kapasitesini-Iki-Yil-Icinde-400-Milyon-Metrekupe-Cikaracagiz,
54- "Türkiye'nin ilk FSRU Tesisi Açıldı", Enerji Bakanlığı, Dec. 23, 2016.http://www.enerji.gov.tr/tr-TR/Bakanlik-Haberleri/Turkiyenin-Ilk-FSRU-Tesisi-Acildi,

is planned to be increased to a total capacity of 4.6 bcm/year with a send-out capacity of 75 mcmpd by the end of 2019.

In addition to Silivri Natural Gas Storage, Tuz Gölü Natural Gas Underground Storage Project has come into operation in February 2017. Phase 1 of the project as completed entails 0.5 bcm/year storage capacity in 6 underground caves. When phase 2 is completed the facility will have 1.2 bcm/year storage capacity with mcmpd send-out capacity in 12 caves. The revised plan for the project foresees the overall capacity to be increased to 5.4 bcm/year with a send-out capacity of 40 mcmpd. Eventually the target is to increase the send-out capacity to 80 mcmpd.[55] Tianchen Engineering, a Chinese company, serves as the contractor of the Phase 1 & 2 and funding has been provided by the World Bank.

In order to ensure effective use of seasonal supply-demand balance and supply security, these projects are attributed utmost importance by the Turkish government. The target is to bring the storage capacity to a level that corresponds to 20 percent of the consumption. Industry experts think that Turkey might even have to go higher than that level to 25 to 30 percent by the next decade if it is going to be able to realize the vision of becoming an energy hub. What is more, Turkey also eyes LNG-bunkering in the Mediterranean and already uses CNG in transportation, making the storage issue all the more critical for the country to address.

55- Doğal Gaz, Enerji ve Tabii Kaynaklar Bakanlığı, (online) www.enerji.gov.tr/tr-TR/Sayfalar/Dogal-Gaz, accessed April 23, 2017.

3 Turkey's Natural Gas Supply Scenarios

This section summarizes the geo-economic analysis of section 2. It provides for estimates of natural gas supply to Turkey under three different scenarios over the 2017-2035 period.

Core Assumptions

1. The scenarios below take into consideration natural gas destined for and bought by Turkey only. Hence, the possible increases in TANAP volumes, or TANAP gas for European destinations, and TurkStream String 2 volumes are not included in the overall calculations.
2. We also assume the continuation of political and economic stability in Turkey.
3. For all scenarios, the amount of gas is calculated on the basis of gas designated for Turkey plus Turkey's offsetting capability.
4. We do not anticipate any Turkmen gas to arrive through a Trans-Caspian arrangement during the scenario period, except under the Gas Glut Scenario.
5. We assume that TurkStream will be completed by 2019 as planned and therefore Western Line supplies will be halted by that date.
6. All scenarios should be understood as static displays of what might be securable in terms of readily available resources for Turkey under certain conditions and limitations, rather than an anticipation of Turkey's policy responses to certain developments concerning specific gas resources, state policies, and contracts that might considerably alter the existing scenarios.

3.1 Most Likely Scenario: Business As Usual

1. Turkey will continue to buy gas from Azerbaijan Shah Deniz 1 (6.6 bcm/ year) until 2021.
2. TANAP will offer a supply of 6 bcm/year of its 16 bcm/ year capacity.
3. Iranian deliveries of 10 bcm/year will also be sustained through 2035.
4. Blue Stream deliveries will continue at 16 bcm/ year.
5. Western Line deliveries will cease following the completion of TurkStream.
6. LNG supply will continue to increase even though Algerian and Nigerian contracts might be terminated.

Table 4 Business As Usual Scenario Natural Gas Supply Estimated Quantities

Business As Usual Scenario		2017	2020	2025	2030	2035	Notes
Source / Country	Project / Country						
Russian Federation	Western Line	8	-	-	-	-	
	Blue Stream	16	16	16	16	16	
	Turkstream	-	15.75	15.75	15.75	15.75	
Azerbaijan	BTE (Shah Deniz I)	6.6	3	-	-	-	Assuming termination of BTE contract by 2021
	TANAP (Shah Deniz II)	-	6	6	6	6	
	Trans Caspian (Turkmen)	-	-	-	-	-	
Iran	Iran - Turkey	10	10	10	10	10	Iran's NG exports to Turkey never exceeded 9 bcm
Northern Iraq	Kurdish	-	-	-	-	-	
Eastern Med	Israeli	-	-	-	-	-	
LNG	Algerian	4	4	2	-	-	
	Nigerian	1.2	1.2	-	-	-	Under lenient prices TR will turn to Spot markets
	Other (Spot)	2.5	5	12	15	16	
	TOTAL (Bcm/Year)	**48.3**	**60.95**	**61.75**	**62.75**	**63.75**	

3.2 Least Likely Scenario: Gas Scarcity

1. Supplies from Azerbaijan Shah Deniz 1 are replaced by supplies from Shah Deniz II by 2030.
2. For the purposes of this scenario, we assume that TANAP will not be finished before 2030, or the geopolitical rivalries and intractable conflicts in the Caucasus will evolve in such a way that the gas flow will be terminally interrupted.
3. Iranian supply contract of 10 bcm/year will not be rolled over beyond 2030 because of either a conflict on gas prices between the parties or geopolitical problems.
4. Western Line will not be able to be operated due to Russian - Ukranian issues.
5. We assume continuation of Blue Stream contract with the Russian Federation for 16 bcm/year of natural gas through the existing Blue Stream pipeline.
6. We assume that despite global developments and hurdles TurkStream will be fully operational as planned, becoming the main pillar of Turkey's natural gas supply.
7. Disintegration of global trade and/or geopolitical issues and unfavorable spot prices wil hinder Turkey's ability to purchase spot LNG, also disrupting Turkey's Algerian and Nigerian contracts even though these contracts are renewed. However, total LNG supply is expected recover between 2020 to 2035.

Table 5 Gas Scarcity Scenario Natural Gas Supply Estimated Quantities

Least Likely Scenario: Gas Scarcity		2017	2020	2025	2030	2035	Notes
Source / Country	Project / Country						
Russian Federation	Western Line	8	-	-	-	-	
	Blue Stream	16	16	16	16	16	
	Turkstream	-	15.75	15.75	15.75	15.75	Frozen at the project phase.
Azerbaijan	BTE (Shah Deniz I)	6.6	6.6	6.6	-	-	Assuming termination of BTE contract by 2021
	TANAP (Shah Deniz II)	-	-	-	6	6	Assuming TANAP will not be fully operational before 2030
	Trans Caspian (Turkmen)	-	-	-	-	-	
Iran	Iran - Turkey	9	7	4	1	-	Turkish and Iranian relations will rift apart becasue of geopolitical factors
Northern Iraq	Kurdish	-	-	-	-	-	Unconducive geopolitical environment and/or worsening bilateral relations.
Eastern Med	Israeli	-	-	-	-	-	Unable to take off.
LNG	Algerian	4	4	2	2	2	Disintegrating global trade.
	Nigerian	1.2	1.2	1.2	-	-	Political unrest and the impact of disintegrating global trade.
	Other (Spot)	2.5	4	4	4	4	Disintegrating global trade and/or geopolitical issues and unfavourable spot prices.
	TOTAL (Bcm/Year)	**47.3**	**54.55**	**49.55**	**44.75**	**43.75**	Fluctuating market conditions and political unrest coupled with a disintegrating global trade.

3.3 Overshoot Scenario: Gas Oversupply

1. Turkey will continue to buy gas from Azerbaijan Shah Deniz 1 (6.6 bcm/ year).
2. We assume that TANAP will also be readily available by the time and will offer Turkey 6 bcm/year of its 16 bcm/ year capacity. However Turkey might choose to buy, at least some of, the additional amount of 10 bcm/ year slated for Europe. Gas Glut scenario assumes Iranian contract of 10 bcm/year to be sustained untill 2035. This scenario envisages that Iran would target European markets via Turkey, possibly with reexport option available for Turkey, and will largely renew and develop its infrastructure. As such Iran might go as high as supplying Turkey with 12 bcm/ year.
3. Blue Stream contract, will be renewed with the Russian Federation for 16 bcm/year.
4. Northern Iraqi (Kurdish) gas will be available (10 bcm/ year).
5. Eastern Mediterranean (Israeli) gas will be available (10 bcm/ year).
6. Turkey would treat Northern Iraqi and Eastern Mediterranean resources as not mutually exclusive.
7. Turkey will invest heavily on LNG infrastructure to enable an offsetting capability to allow efficient energy trade and diplomatic bargaining.

Table 6 Gas Oversupply Scenario Natural Gas Supply Estimated Quantities

Gas Oversupply Scenario		2017	2020	2025	2030	2035	Notes
Source / Country	Project / Country						
Russian Federation	Western Line	8	-	-	-	-	
	Blue Stream	16	16	16	16	16	
	Turkstream	-	15.75	15.75	15.75	15.75	
Azerbaijan	BTE (Shah Deniz I)	6.6	6.6	6.6	6.6	6.6	Assuming Turkey and Azerbaijan find an agreement to continue supplies fm SD1
	TANAP (Shah Deniz II)	-	6	6	8	10	Additional supplies becomes possible as capacity grows and European demand remains low
	Trans Caspian (Turkmen)	-	-	-	15	15	Turkmen gas reaches European markets through Turkey with re-export option
Iran	Iran - Turkey	10	10	10	12	12	Assuming Iran will target EU markets via Turkey
Northern Iraq	Kurdish	-	-	10	10	10	
Eastern Med	Israeli	-	-	10	10	10	
LNG	Algerian	4	4	-	-	-	
	Nigerian	1.2	1.2	-	-	-	Under lenient prices TR will turn to Spot markets
	Other (Spot)	2.5	7	11	13	17	Theoretical offsetting capability is 37 - 40 Bcm/year
	TOTAL (Bcm/Year)	**48.3**	**67**	**85.35**	**106.35**	**112.35**	

4 The Demand Dimension

This chapter of the study aims to develop a sector-based demand model that projects the evolution of Turkey's natural gas consumption pattern over a period extending to 2035[56]. The targeted sectors to be considered for natural gas demand are the Power, Industry, Residential, Commercial/Retail, Agriculture & Transport sectors. The following sections explain the sector-based structure of the model outcomes.

56- Technical information about the model is provided as Annex I

4.1 Residential Natural Gas Demand

4.1.1 Method

In the bottom-up modeling, 2015 is taken as the "base year" as it is identified as the most recent year for which reliable data is available with no extraordinary economic or political shocks. The planning horizon runs until 2035. The main parameters used for modelling residential gas demand are:

- Number of Subscribers (Number of Households with access to gas)
- Annual natural gas consumption per subscriber
- Future expectation of trends in the development of the number of subscribers (official gas infrastructure expansion plans)
- Efficiency gain trends in technology

4.1.2 Data Characteristics and Assumptions

The data set for the above mentioned parameters is the official report by GAZBIR (Union of Natural Gas Distributors) for 2016[57] (which comprises 2015 data as well). Accordingly it was highlighted that:

- There were 11.6 Million subscribers in 2015 and almost 12.5 million in 2016[58].
- Current Natural Gas Penetration statistics (of districts) as of 2016 are as follows:
  - Turkey has 81 cities with 919 districts in total,
  - As of 2016, 76 cities and 339 districts have access to natural gas,
  - Natural gas penetration in 146 districts is around 80%,
  - Natural gas penetration in 46 districts is between 60% - 80%,
  - Natural gas penetration in 43 districts is between 40% - 60%,
  - Natural gas penetration in 38 districts is between 20% - 40%,
  - Natural gas penetration in 51 districts is around 20%,
  - In 16 districts, linking subscribers to the gas network is ongoing.
- Top 10 cities in terms of Consumption Per Household (2016, sm3):

Ardahan	*1544,00*
Karabük	*1413,53*
Kars	*1395,00*
Van	*1388,19*
Gaziantep	*1355,72*
Gümüşhane	*1304,86*
Bayburt	*1273,35*
Kırklareli	*1189,23*
Erzincan	*1188,02*
Kastamonu	*1179,49*

It can be said that per household consumption is highly correlated with climate conditions and that a high level of usage is observed where temperature is relatively low compared to other cities.

- Lowest 6 cities of Consumption Per Household (2016, sm3)

Antalya	*701,14*
Mersin	*750,64*
Yalova	*794,40*
Hatay	*807,81*
Osmaniye	*827,18*
Kırşehir	*834,69*

It is seen that high temperature is also inversely correlated with gas consumption. Table given above comprises cities with annual (and summer) high temperature, i.e. cities that have relatively low heating demand.

- Consumption Per Household in the top six cities connected to the natural gas grid (2016, sm3):

Ankara	*1082,03*
Eskişehir	*1028,97*
Sakarya	*1007,34*
Bursa	*890,67*
Kocaeli	*869,22*
İstanbul	*856,95*

57- There is also a report available for 2015 which was developed by the Energy Market Regulatory Authority (EMRA), but it is worth mentioning that the data between two sources are approximately 5% different from each other. EMRA uses the data supplied by members of GAZBIR as well, but also considers the billing information supplied for calendar year. It is important to express that billing period is between 25th and 5th day (of next month) so that the actual consumption values were not taken into account for the December period. Therefore, usage of GAZBIR data is more adequate for the purpose of this study.

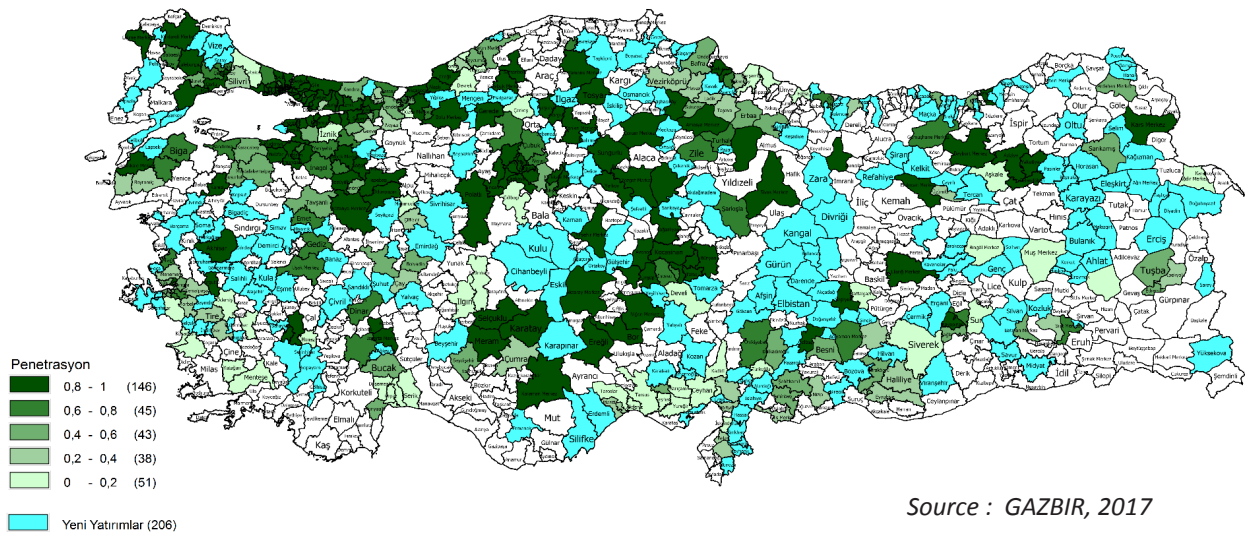
58- Data obtained from GAZBIR is further discussed with their chief scientist Ömer Doğan.

Annual natural gas consumption per subscriber in Turkey is 934 sm3 in 2016. The cities depicted in the table above account for an average annual gas consumption value of 955 sm3 per subscriber. As these six major cities are densely populated and are considerably above the average of national economic figures, it can be said that those six cities are the main drivers of residential gas consumption in Turkey.

· Official plans indicate that the natural gas infrastructure coverage is to be expanded to all 81 cities in Turkey, and 206 new districts are on the implementation agenda. In accordance with the stated gas network growth plans, the expansion in number of subscribers is expected to increase about 1 million per year till 2020, half a million a year till 2030, and in gradually decreasing trend afterwards.

Current natural gas penetration and new investments can be seen below:

Figure 3 Natural Gas Distribution Network Penetration and New Investments Map

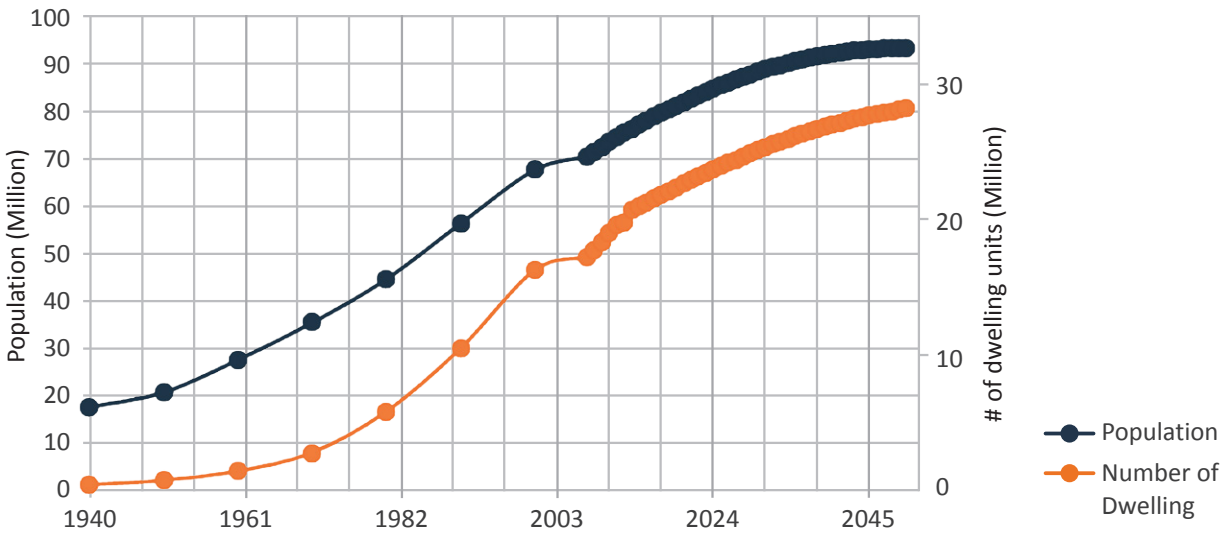


Source : GAZBIR, 2017

It was surmised that the addition of new districts will have a decreasing effect on the "national annual consumption per subscriber" values. The main reasons backing this observation are the locations of new districts (an indicator of annual temperatures that is above-country average for expansion districts) and the economic environment of the expansion region (an indicator for fuel switching decisions in heating and cooking), as well as building insulation investment.

The development of number of dwellings and population growth, based on data from the Turkish Statistical Institute, is as follows:

Figure 4 Dwelling stock change w.r.t. population growth for the period 1940-2052



Based on all these considerations and assumptions, the number of subscribers is assumed to grow as shown in the table below.

Figure 5 Forecast for number of natural gas subscribers

YEAR	Subscribers	
2011	9,200,000	Historical
2012	9,350,000	
2013	9,484,324	
2014	10,758,400	
2015	11,636,400	
2016	12,496,400	
2017	13,596,400	Expected
2018	14,596,400	
2019	15,546,400	
2020	16,446,400	
2021	17,296,400	
2022	18,096,400	
2023	18,846,400	
2024	19,546,400	
2025	20,196,400	
2026	20,796,400	
2027	21,346,400	
2028	21,846,400	
2029	22,296,400	
2030	22,696,400	
2031	23,046,400	
2032	23,346,400	
2033	23,596,400	
2034	23,796,400	
2035	23,946,400	

For the distribution of natural gas demand with respect to heating and cooking appliances in households, results obtained from a scientific study performed at Boğaziçi University (Işık, 2016) have been used.

4.1.3 Model Outcomes

- The model is calibrated such that 2016 Residential Natural Gas Demand is computed as 11.559 million sm3 which is exactly the same value as actual realization.
- The model outcomes are in the form of energy units and are Petajoules (1 Million Gigajoules) in this case.
- The model considers the abovementioned data insight in its calculations:
  - Annual additions of districts (growth in subscriber numbers in accordance with official plans)
  - Decreasing effect of new districts (discussed with GAZBIR for expansion region, annually supplied to the model in accordance with expansion plans) on "countrywide per subscriber consumption average"
  - In addition efficiency gain (comprising cumulative effects of efficiency expectations in heating and cooking technologies and building insulation) is considered as 1% annually which is also considered as a pertinent gain in EPA database of technology.

The model forecasts are as follows:

Figure 6 Natural Gas Residential Energy Demand Final Units

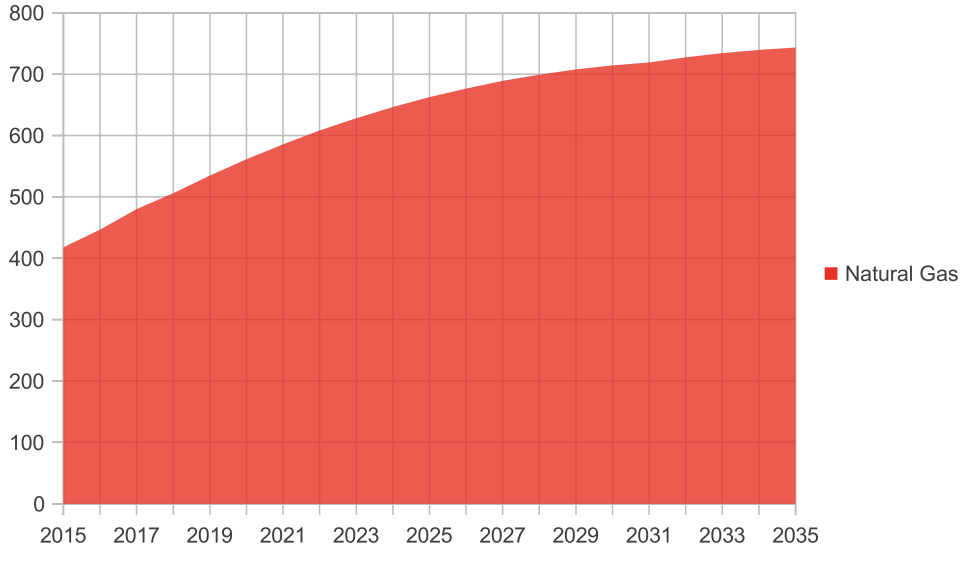
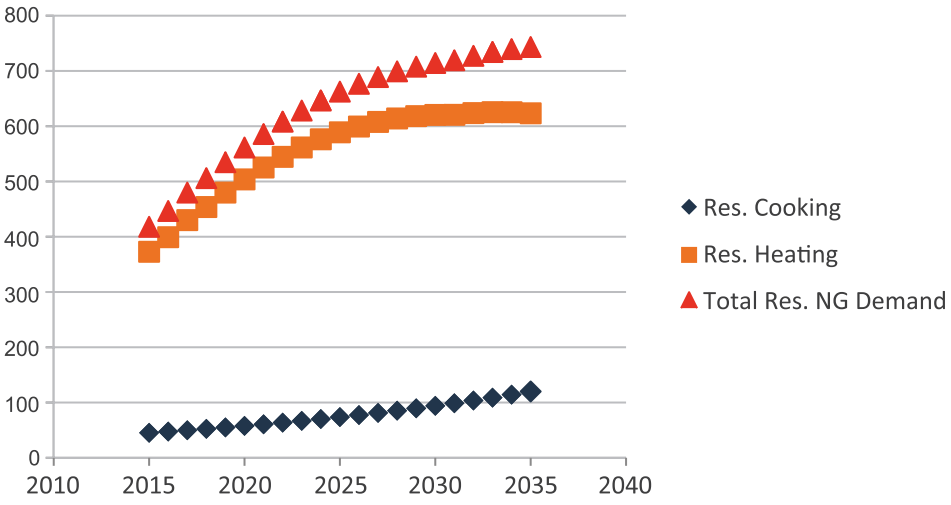


Figure 7 Residential Natural Gas Demand Breakdown (PJ/YEAR)



The model forecast points out that the residential natural gas demand will increase from 418 PJ in 2015 to 743 PJ in 2035 as a reflection of the expansion of the gas distribution network in Turkey. The new districts to be added to the gas network after 2025 are mostly from high temperature regions. Therefore their impact on heating gas demand is expected to be relatively low compared to ones in 2016-2025 period. Due to the increase in number of subscribers, cooking gas demand draws a permanent increase trend throughout the whole modeling interval.

4.2 Industry Natural Gas Demand

4.2.1 Method

Just like the residential gas demand, the base year is taken as 2015 and the planning horizon runs until 2035 for the bottom-up modeling of the industrial sector. The main parameters used for modeling industrial gas demand are:

- Per unit gas consumption for individual sectors
- Sector-based growth characteristics in terms of production quantities (historical trends, expert estimations and so on, in accordance with the nature of the related sector)
- Sector-based gas consumption (derived from Turkey Energy Balance Sheet for the base year)
- Efficiency gain trends in technology (adopted from the Boğaziçi University Energy Modeling System (BUEMS) framework)

4.2.2 Data Characteristics, Assumptions and Modeling Approach

Industrial gas demand modeling effort covers the following sub-sectors of the Turkish Industry, to be explained in detail in the following sections:

1. Chemicals
2. Fertilizers
3. Pulp and Paper
4. Cement
5. Glass and Ceramic
6. Iron and Steel
7. Non Ferrous Metals
8. Automotive
9. Food (including Drink and Tobacco)
10. Textile
11. New Industrial Zones
12. Other Industries

In accordance with the model parameters listed above in the method section, the initial approach was to establish the link between sub-sectoral production quantities and the amount of gas consumed for the respective industry. TURKSTAT (TURKSTAT a,b,c,d , 2016) databases were used as the primary source of base year and historical data, comprising not only production statistics but also economic indicators. After obtaining the base year production quantities, per unit gas consumptions were derived from the World Energy Council (WEC-TR) Energy Balance Sheets. To identify the growth structures of the industry sub-sectors, the following three main approaches were adopted:

i. Develop an econometric growth model by estimating the relation between industry-specific GDP, i.e. Industry Value Added, and sector-specific production (historical). The most reliable Industry Value Added series that can be extracted from TURKSTAT dates back to 1995 and cover the interval till base year 2015. The forecast of Industry Value Added is derived as an expert estimation based on the interpretation of Industrial Production Index (2005-2017) published by TURKSTAT (TURKSTAT, e, 2010). The value for 2016 forecasts a 1.9% growth, yet a gradual recovery is foreseen in the light of 2023 national economic targets. After 2023, the forecast depicts a leveling off trend, and average growth for the whole period appears to be 4.7%. With the intention of obtaining relevant parameters for the growth model regarding each sub-sector, the next step is taken to formulize the mathematical relations between the Industry Value Added series and the historical production series.

ii. Whenever the abovementioned econometric approach does not yield reasonable findings, growth trends from the "Bottom-Up Electricity Demand Model" which has been developed in late 2015 for the electric utilities industry, have been adopted. At the time of development of the stated model, the data was collected by way of comprehensive interviews with sectoral representatives and state authorities.

iii. The third approach is to conduct interviews for the sectors that were not included in the previous electricity modeling study and/or cannot be formulized through econometric approach. This approach was particularly helpful in the "fertilizer" industry.

4.2.3 Model Outcomes and Sub-Sector Details

Chemicals

Chemicals Industry covers production of basic chemicals, pharmaceuticals, and plastic/rubber goods. Base year gas consumption of the Chemicals industry is 62.74 PJ regarding 1.41 million tons of production. The growth model is derived through econometric modelling, and the Compound Annual Growth Rate (CAGR) for the model period appears to be approximately 2%. Natural gas consumption reaches to 90.7 PJ by 2035. Also, 1% of annual efficiency gain is taken into account.

Fertilizers

Fertilizer industry was not included in the energy model, and the econometric model outcomes were not reasonable. Therefore the matter was thoroughly discussed with the senior representatives from the industry. Mr. Sebahattin Emul, the Secretary General of "The Fertilizer Manufacturers, Importers and Exporters Association" mentioned that gas is used only in chemical fertilizer production process, and pointed out that there are two major barriers in growth of the sector. The first one was said to be the low prices of import fertilizers attracting the local market. The second barrier is addressed as the precautionary limitations of the government due to the possibility of use of fertilizers as explosives by terrorist organizations. Both Mr. Emul and the head engineer of IGSAŞ (the dominant fertilizer production company in the market) mentioned that they do not foresee any expansion in this industry, nor any improvements in the technology they currently operate with. The growth strategy is to increase the annual operational duration to 330 days a year, from its current level of 300 days a year. In this regard, the modelling strategy has been structured on the operational duration increase, and model outcomes depict that the gas demand rises from 3.57 PJ to 3.92 PJ in modelling period.

Pulp and Paper

The Pulp and Paper Industry Foundation (SKSV) foresees 2% CAGR for the 2015-2035 period. They expect an annual efficiency gain of 1%. The 2015 production is slightly over 8 million tons requiring 8.4 PJ. In light of these statements, model output for the gas demand from pulp and paper industry is obtained as 10 PJ by 2035.

Cement

Natural gas is not being used for clinker production but essentially for heating purposes in the manufacturing plants. Annual efficiency improvements of around 1% is expected. Cement production growth is derived from the econometric model structured by adopting 1995-2015 series of production and Industry Value Added records. The model outcome points out that the production will grow from 71 million tons to 90 million tons for the 2015 – 2035 period which reflects a rise in gas demand from approximately 9.4 PJ to 12 PJ.

Glass and Ceramic

The trend obtained through "Electricity Demand Growth Model- BU-ELC" has been adapted to gas model following a confirmation obtained from Turkey Ceramic Federation (TSF). CAGR of 2.5% was foreseen throughout the modeling period. Efficiency

gain estimated at 1% annual. Accordingly, production rises from 201 million tons in 2015 to 323 million tons in 2035. In return, gas demand rises from 32PJ to 82PJ for the same interval.

Iron and Steel

In interviews with representatives of the Iron and Steel Manufacturers Association, it was highlighted that Turkish steel production showed a drop in 2015 for the third year in a row. Global steel production also fell for the first time in 2015 after the sharp drop during the global financial crisis in 2009. According to the World Steel Association data, in 2015 world crude steel production fell 2.8% from 1.67 billion tons to 1.62 billion tons. While production dropped in all the regions, among all the 15 steelmaking countries, only India's steel production grew. Aside from India, the other 14 steelmaking countries experienced decrease in production, however, Ukraine's production rates suffered the most declining by -15.6%, followed by the USA at -10.5%. After Ukraine and USA, Turkey was the third country to have largest decline in steel production with a rate of -7.4%. Because of the sharp decline in production, Turkey has dropped to 9th rank from 8th in the world's largest steelmaking countries list. In interviews, the association highlighted that iron and steel industry is highly affected by the fragile price structure in international markets, but even under those conditions, due to strength of this sector within the structure of national economy, they estimate that CAGR would not fall below 2.5% in the long run. When the model is run in accordance with these statements, the production is expected to rise from 67 million tons to 110 million tons within the model interval. Natural gas consumption is expected therefore to rise from 58 PJ to 77.5 PJ.

Non Ferrous Metals

Non Ferrous Metals industry is forecasted via the development of econometric model for the production growth. Production is estimated to be on a rising trend from 1.9 million tons to 3.4 million tons between base and end years of the model, which corresponds to a gas demand rise of approximately 20PJ to 35PJ.

Automotive

Another industry that has been forecasted via the adoption of econometric model approach is the Automotive industry. The outcome of the model points out a production increase in the number of manufactured vehicles from 1.4 million to approximately 2.5 million vehicles within the modelling period. Natural gas demand corresponding to the given production figures rises from 6.7 PJ to 9.7 PJ.

Food (including Beverages and Tobacco)

The food industry mainly comprises food, beverage, and tobacco production and processing. The highest level association of the industry, The Federation of Food Associations of Turkey, was contacted regarding the data for the industry growth model. Capacity use of food and beverages industry in Turkey stood at 74% in 2012, while 48% of total production was exported. The Federation representatives stated that the food industry growth is strictly related to GDP and population. Taking into consideration the potential for exports, the initial trend in electricity demand by the food industry was foreseen at slightly higher than twice the population growth till 2023. Post-2023, the growth rate was reduced to reach around 0.28% by 2035. In the light of this information, model results estimate an increase in the gas demand from food industry from 3.7PJ in 2015 to 10.6 PJ in 2035.

Textiles

The textiles industry, which also includes ready-made clothing, leather products, carpets, and other textile products, has been modelled under the electricity demand modelling study based on sector reports of Ministry of Development analyzing export/ import trends and market dynamics (Ministry of Development, 2014). The growth rate is taken as 10% for the periods of 2015-18, and the same trend is applied as GDP expectations thereafter. The production is expected to rise from 4.6 billion sqm of textile products to 9.1 billion sqm for the modeling interval. The corresponding increase in gas demand is 45 PJ to 85 PJ. Annual efficiency gain is considered as 1%.

New Industrial Zones

According to the Board of Organized Industrial Zones, the number of operational industrial zones are due to increase by another 40% in the future (OSBUK, 2015). In other words, an additional 40% increase in demand is to be expected as part of the overall gas demand of industrial zones. The new zones will be operational by 2018, and the growth rates foreseen for the following "other industries" section is applied to new zones thereafter. The model output estimates gas demand for Organized Industrial Zones at approximately 19 PJ in 2018 and 43 PJ by 2035.

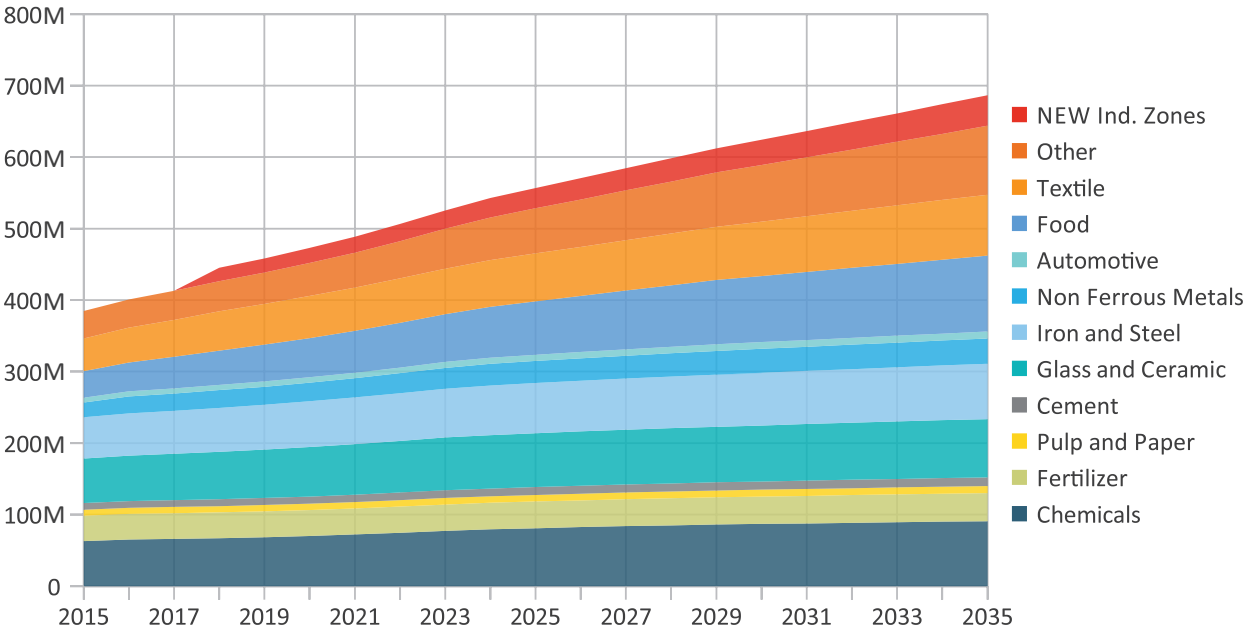
Other Industries

The other industries section comprises present industrial zones, mining industry, wood industry, machinery/electronics industry, furniture industry and construction industry. The Board of Organized Industrial Zones states that their expectancy of demand growth is 3% annually by 2025, and 2.5%

thereafter till 2035. The model outcome for natural gas demand for the "other industries"group ranges from 39PJ to 96 PJ for the modelling period.

Overall Industry

Figure 8 Gas Demand of Turkish Industry (GJ)



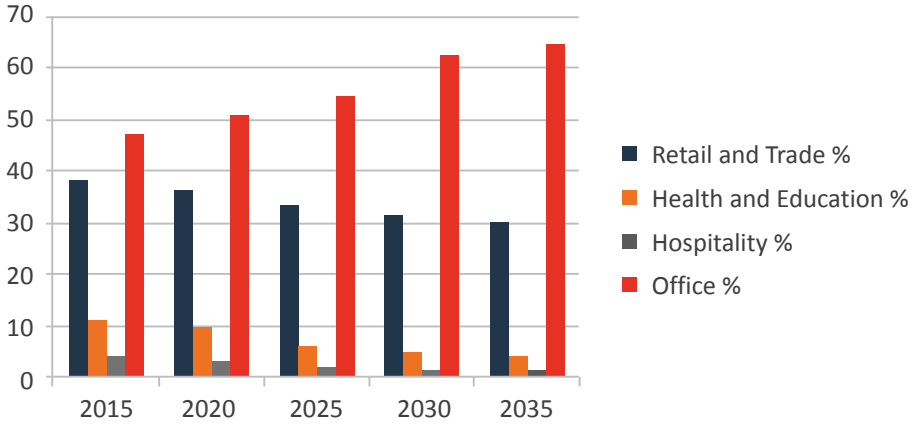
The overall demand in 2015 is 387 PJ. By 2035, the gas demand is modeled to reach to approximately 690 PJ, which corresponds to 18.07 bcm.

4.3 Natural Gas Demand in Commercial and Service Sectors

4.3.1 Scope, Data Structure, and Model Insight

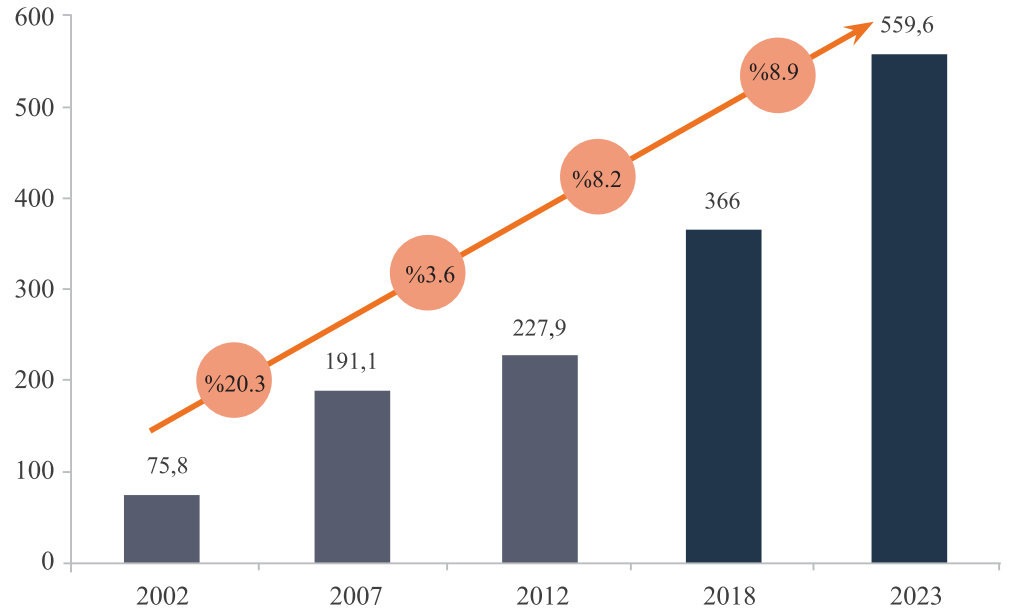
The commercial and service sectors comprises the following subsectors: Wholesale and Retail Trade, Health, Education, Hospitality and Office Buildings. Future gas demand estimates for these service industries have been collected through interviews with the relevant government authorities.

Figure 9 Share Decomposition of Natural Gas Demand in Services Industries



Accordingly, gas demand from office buildings is to increase its share within the commercial sector, while at the same time the other subsectors will gradually decline in terms of percentage share of gas use. This decomposition is used as a reference point whilst developing scenarios for gas demand modeling for the commercial and service sectors in Turkey. The commercial and service sectors are elaborated in the 10th Development Plan of Turkey (2014), and Special Working Committee on Services Sector (2014) officially foresees the following growth trends:

Figure 10 Growth Projections of the Services Sector



These figures correspond to a compound annual growth rate of more than 8% for the period 2015-2023[59].

4.3.2 Sector Growth and Model Outcome

The following table sets out the growth rates for the commercial and services sectors obtained from interviews:

Table 7 Growth rates indicating the trend in Commercial and Services Sectors

Period	CAGR
2015:2023	7%
2023:2030	6%
2030:2035	4%

Considering the growth expectancy for the services sector and applying the model efficiency database, the model results for 5-year intervals are summarized below:

Table 8 Commercial and Services Sector

YEAR	NG Consumption by Services Sector (bcm)
2015	120
2020	168
2025	231
2030	310
2035	377

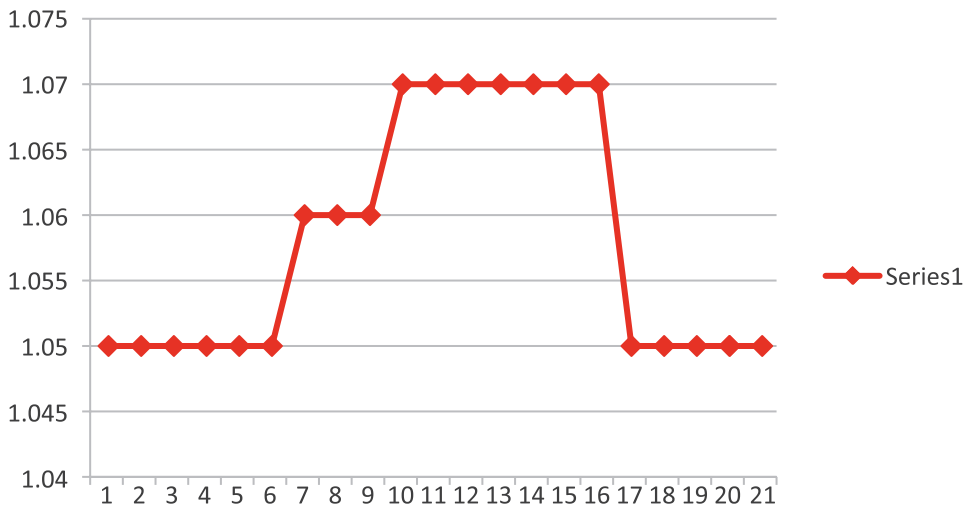
59- As there is a trend in transition to high value added products and services in domestic market, the trend given above is further discussed with the officials from Ministry of Development and the Central Bank in order to obtain a measure to link with the growth in magnitude of the services and commercial sector which can be used as a physical gas demand indicator.

4.4 Natural Gas Demand for Transport

4.4.1 Natural Gas Demand for Transport

Energy Market Regulatory Authority (EMRA) statistics indicate that that natural gas used as fuel for vehicles in 2014 and 2015 was 82.55 million Sm^3 and 85 million Sm^3 respectively, which corresponds to an increase of some 4% (EPDK, 2016). Although it is observed that natural gas consumption as fuel in vehicles has a share of 0.18% by 2015, there is an obvious interest in the transition to Natural Gas Vehicles (NGV) fueled by Compressed Natural Gas (CNG) and Liquified Natural Gas (LNG), as NGVs offer increased economic and environmental benefits. Currently, there are 4000 NGVs present in operation in Turkey, of which 1850 are passenger cars and light duty vehicles, 2000 are busses, and 150 are trucks (NGV Journal, 2016, and NTV, 2017). As of 2015, NGV numbers were 3850, implying an annual increase of approximately 4%. Accordingly, the growth trend depicte d in Figure 10 is assumed for NGVs[60].

Figure 11 NGV Growth Coefficient



4.5 Natural gas demand of pipeline transport

As gas flows through a long pipeline, the friction of the gas on the pipe wall causes the pressure to decrease. The change in static pressure implies a friction loss. Natural gas pipelines consume an average of 2-3% percent of throughput to overcome frictional losses. In modeling frictional losses, the yearly extension of the pipeline network is assumed to be 1 percent annually till 2019, afterwards growth continues at 1% p.a. onwards till 2035.

As a result, the following gas demand projections given in Table 9 are obtained for the transport sector, which combines the demand for natural gas for pipelines and for NGVs:

60- After discussing the matter with Berkan Bayram, the director of TEHAD (Turkish Association of Electric and Hybrid Cars), as an experienced manager in the field of transportation for many years, he shared his expert estimation. He highlighted that, he sees the CNG and other NGVs in the same disadvantaged position with Electric Vehicles (EV) in terms of market acceptability. The problem with EVs is the lack of charging infrastructure, which he thinks is mimicking the fuel station problem of NGVs. But as a last comment he would not be surprised to see 5% annual growth (the fuel consumption increase in 2015) as a BAU scenario in the long term.

Table 9 Natural Gas Demand in the Transport Sector (PJ)

	Pipelines	NGVs	TOTAL
2015	12.81	3.23	16.04
2016	12.93	3.39	16.33
2017	13.06	3.56	16.62
2018	13.19	3.74	16.93
2019	25.08	3.93	29.01
2020	25.33	4.12	29.45
2021	25.58	4.37	29.95
2022	25.84	4.63	30.47
2023	26.10	4.91	31.01
2024	26.36	5.25	31.61
2025	26.62	5.62	32.24
2026	26.89	6.01	32.90
2027	27.16	6.44	33.59
2028	27.43	6.89	34.32
2029	27.70	7.37	35.07
2030	27.98	7.88	35.87
2031	28.26	8.28	36.54
2032	28.54	8.69	37.24
2033	28.83	9.13	37.96
2034	29.12	9.58	38.70
2035	29.41	10.06	39.47

4.6 Agriculture Natural Gas Demand

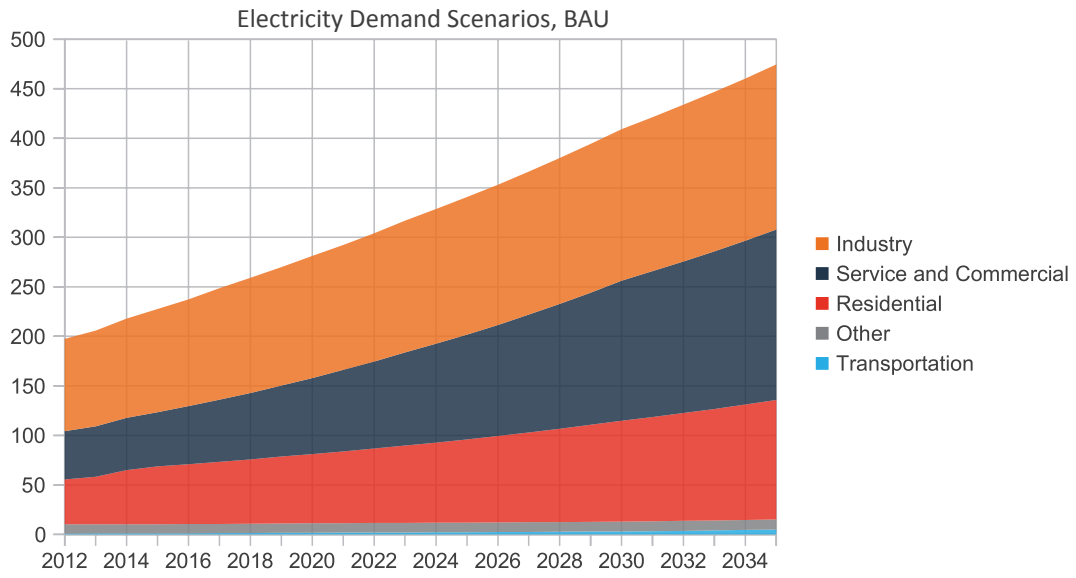
As fertilizer industry has very strong links with the agricultural activities, agricultural growth estimates has also been discussed with Mr. Sebahattin Emul (the General Secretary of Fertilizer Industry Association). Mr. Emul confirmed foresees low growth, as he does not expect either the fertilizer industry or the agriculture sector to take a major leap forward unless fundamental policy actions are taken. Accordingly long-term energy requirements will be assumed to be growing very slowly, in this case with a CAGR of 0.35%. The model output envisages natural gas demand to slowly rise from 5 PJ to 5.4 PJ from 2015 to 2035.

4.7 Electricity Sector Natural Gas Demand

4.7.1 Scope, Data Structure, and Model Insight

Natural gas has been an important input for the power industry in Turkey. In return, the foremost generator of demand for natural gas have been power plants for electricity generation. This is also why estimations of natural gas projections have generally been linked to electricity projections, not only in official studies but also the private sector led studies. In this study as well, estimations for natural gas utilization have been linked to electricity demand projections. The long term electricity demand projection (2012-2035) model for Turkey previously developed by Bogazici University team indicates that electricity demand in Turkey rises from 227.5 TWh in 2015 (of which 37% is supplied via gas) to 474 TWh in 2035 which accounts for approximately 3.75% CAGR (note that the results are derived from 2012-2035 model). Stated Electricity Demand trend is depicted in the figure below:

Figure 12 Electricity Demand Projection



Government plans indicate that the share of natural gas is to be gradually brought down to a level of 30% in electricity generation by 2023 (SPO, 2009; Mahmutoglu and Ozturk, 2015) for enhancing the security of supply and by supporting the utilization of low-carbon power generation technologies such as renewable energy. This ceiling has been adopted for the model as well: the share of natural gas has been limited so as not to exceed 30% of overall electricity generation by 2023 and beyond. However, due to rapidly increasing demand for electricity, while the share of natural gas in electricity generation declines, the volume consumed can still increase. The natural gas demand by the power generation industry in 2015 was approximately 875 PJ (23.032 bcm). For future demand, three alternative projection tendencies are considered:

Decreasing Natural Gas Demand Trend – Scenario UNLIKELY

Throughout the interviews carried out with GAZBIR, it is concluded that they foresee a decline in natural gas demand for electricity generation. It is mentioned that internal studies carried out among their members considering the current economic and investment climate as well as the renewable energy developments have resulted in a decrease. It is worth mentioning that GAZBIR projections might have an influence on official expectations. In this scenario, the expected trend line depicts a decrease from 875 PJ (base year value) to 730 PJ by 2035. It should be noted that this scenario implies a conversion of gas-fired power plants to other technologies (i.e. coal) and/or shutdown and/or carrying out operations below current levels. Therefore, this tendency is considered to be rather unlikely.

Constant Natural Gas Demand Trend – Scenario POLICY

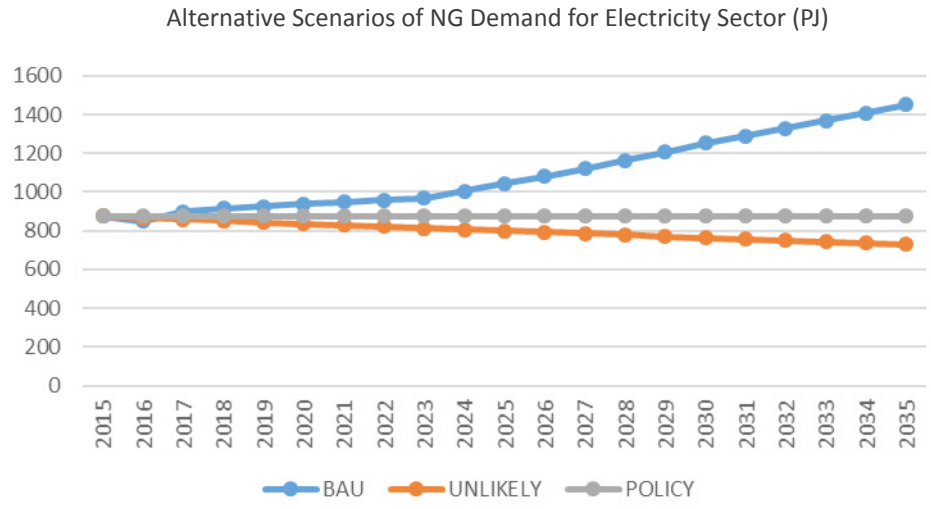
In this alternative path, the policy priority to reduce import dependence is assumed to be made effective with new policy instruments and/or regulations so as to fully prevent the installation of new gas-fired power generation capacity. Based on targeted policies towards an accelerated utilisation of renewables and coal as domestic energy sources, and introduction of nuclear in the Turkish power sector, it is assumed that no new capacity is added to the current natural gas power plant portfolio, while the operation of existing power plants is assumed to continue at current utilization level. In this POLICY scenario, the base year consumption value of 875 PJ is taken as fixed throughout the modelling horizon.

Increasing Natural Gas Demand Trend– Scenario BAU

According to this alternative scenario, Business is assumed to continue As Usual so that market forces are effective allowing new investment into natural gas power plants. However, the share of gas-fired power in total electricity generation (37.7% in 2015) is capped at 30% beyond 2023, based on projections for electricity demand as depicted in Figure 9. For the natural gas utilization efficiency of new power plant installations, an annual efficiency gain of 0.25% (derived from US Energy Information Administration datasheets, 2016) has been assumed. Under this scenario, the base year consumption value of 875 PJ is forecast to reach 1450 PJ (38.2 bcm) by 2035.

Abovementioned trends of natural gas demand in power sector are depicted in the following figure:

Figure 13 Natural Gas Demand in Power Sector



4.7.2 Electricity Sector Summary and Model Output

From the three trajectories presented in Figure 10, the POLICY scenario assuming constant natural gas demand (875 PJ p.a.) for power generation is chosen as the reference scenario. This scenario reflects the assumption of no long-term capacity increase in total gas powered plants. In other words under this scenario no new natural gas power plants are to be constructed. It therefore reflects a most restrictive view on natural gas use for electricity generation and requires more targeted government policies and regulations to be designed. It provides scope for the ongoing deployment of new renewable power generation technologies as well as the nuclear power program under implementation. However, it should be noted that this reference assumption, implying essentially a hard ceiling on new natural gas power plants, is still different from GAZBIR projections - which typically influence official estimates – that foresee a gradual decrease in the overall capacity of natural gas fired power plants. This scenario entails either the conversion of natural gas power plants to coal or the decommissioning of these plants. But against a backdrop of a rising electricity consumption, we believe that imposing a hard ceiling on the capacity of natural gas fired power plants would be a more realistic assumption than an outright estimate of falling natural gas power plant capacity. Furthermore it is rather likely that actual natural gas demand for power generation turns out to be higher than the POLICY scenario estimates. In summary, the POLICY scenario assumptions being employed in the reference run can be considered as a most conservative way forward for the electricity sector entailing an upside risk on forecast error.

4.8 Summary of Natural Gas Supply Modeling

The model output is decomposed and summarized in Table 10. Accordingly Turkey's demand for natural gas starting from a level of 50.7 bcm in 2017, reaches 55.6 bcm in 2020, 62.2 bcm in 2025, 67.5 bcm in 2030 and finally 71.8 bcm by 2035. The final estimates are based on the POLICY scenario results for the power industry which, as discussed above, keeps the capacity of natural gas fired power plants constant over the years.

Table 10 Total and Disaggregated Model Results

YEAR	INDUSTRY	TRANSPORT	AGRICULTURE	SERVICE	POWER	RESIDENTIAL	TOTAL PJ	TOTAL BCM
2017	413.12	16.62	5.09	137.52	875.22	479.93	1927.51	50.72
2018	445.46	16.93	5.11	147.15	875.22	506.09	1995.95	52.53
2019	458.21	29.01	5.13	157.45	875.22	534.89	2059.89	54.21
2020	472.78	29.45	5.14	168.47	875.22	561.47	2112.54	55.59
2021	488.77	29.95	5.16	180.26	875.22	585.89	2165.25	56.98
2022	506.68	30.47	5.18	192.88	875.22	608.17	2218.60	58.38
2023	525.66	31.01	5.20	206.39	875.22	628.35	2271.82	59.78
2024	542.77	31.61	5.22	218.77	875.22	646.49	2320.07	61.05
2025	556.89	32.24	5.23	231.89	875.22	662.61	2364.09	62.21
2026	570.64	32.90	5.25	245.81	875.22	676.76	2406.58	63.33
2027	584.65	33.59	5.27	260.56	875.22	688.97	2448.26	64.43
2028	598.38	34.32	5.29	276.19	875.22	699.29	2488.68	65.49
2029	612.36	35.07	5.31	292.76	875.22	707.76	2528.48	66.54
2030	624.24	35.87	5.33	310.33	875.22	714.41	2565.38	67.51
2031	636.38	36.54	5.34	322.74	875.22	719.29	2595.52	68.30
2032	648.82	37.24	5.36	335.65	875.22	727.37	2629.65	69.20
2033	661.16	37.96	5.38	349.08	875.22	734.26	2663.05	70.08
2034	673.79	38.70	5.40	363.04	875.22	739.59	2695.74	70.94
2035	686.73	39.47	5.42	377.56	875.22	743.34	2727.74	71.78

It should be noted that there is a discrepancy between official projections and model results at the very beginning in 2017. The Energy Market Regulatory Authority (EMRA) has declared Turkey's official gas demand forecast for 2017 as 46.03 bcm (EMRA decision 6884; dated 26/01/2017) which is 0.36 bcm less than the actual demand realized in year 2016. On the other hand, our reference scenario forecast for 2017 amounts to 50.7 bcm. In other words, at the very beginning of the planning horizon the natural gas consumption is estimated to be 10% higher than official predictions. The reason for this discrepancy relates to the bottom-up methodology of our model which captures the impact of sub-sectoral developments and provides more accurate estimates. In fact, when actual realizations for the first 6-month period of 2017 are compared to the same period of the previous year, it is found that natural gas demand has increased by 3.8 bcm. A major decrease in demand after July 2017 (compared to the same periods of the previous year) would be needed in order to match the official forecast for the whole year.

5 Economic Impact Assessment

Economic impact is a measure of the employment, spending and economic activity associated with a sector of the economy or a specific project (such as the construction of new infrastructure). In this case, economic impact refers to the economic contribution associated with the construction of the onshore section of the TurkStream natural gas pipeline. Economic impact is most commonly measured in several ways, including employment, income, and contribution to Gross Domestic Product (GDP).

EMPLOYMENT	Number of individuals working in the construction of the pipeline.
INCOME	Wages, salaries, premiums, social aids and other payments earned by people related with the pipeline construction operations.
CONTRIBUTION TO GDP	A measure of monetary value of final goods and services produced by the construction activity.

There are three distinct types or categories of economic impact associated with the construction phase of the TurkStream pipeline.

Direct Economic Impact

This is the employment, income and GDP associated with the construction of the pipeline.

Indirect Economic Impact

The employment, income and GDP generated by downstream industries that supply and support the construction activities. For example, these could include: suppliers of construction materials, companies providing professional advisory services etc.

Induced Economic Impact

This captures the economic activity generated by the employees of firms directly or indirectly connected to the construction work spending their income in the national economy. For example, an engineer at the work site might spend his/her income on groceries, restaurants, schooling and other items which, in turn, generate employment in a wide range of sectors of the national economy.

5.1 Direct Impact

5.1.1 Employment

In order to derive an estimate of the employment that is directly linked to the land construction phase of the TurkStream project, we will use employment estimates derived for other pipeline construction projects. The approach will be to estimate the total employment per kilometer of pipeline construction. In its recent report entitled "The Economic Impact of Crude Oil Pipeline Construction and Operation" IHS Economics[61] has estimated this figure at 4.8. In other words, according to IHS Economics, $1 million of spending on pipeline construction leads to 4.8 jobs. The economic impact study by Oxford Economics for the Albania section of the Trans Adriatic Pipeline – TAP estimates the direct employment gains of a $1 billion construction investment at 11400. In other words, according to Oxford Economics, $1 million of spending on pipeline construction in Albania would lead to 11.4 jobs[62]. The TurkStream project is composed of an offshore segment of 910 km and an onshore segment on Turkish land of 225 km . According to a recent analysis published by the Oil and Gas Journal[63] the average cost of 1 km pipeline was estimated at $ 4.7 mn. Accordingly the project budget linked to onshore construction can be estimated at $1 billion leading to an on-shore construction linked direct employment estimate of 4800 jobs per year if we are to use the lower labor ratio estimate used by IHS Economics. But some of these jobs will be held by non-Turkish nationals. A sound estimate for the number of local jobs per year for the on shore construction of the pipeline would be around 4000. The following economic impact assessment will rely on this employment estimate.

5.1.2 Income

A distinction shall be made among employment groups in order to calculate the income obtained in return for the above given employment. The reason is that white collar employees like civil engineers and controllers (income group A) and pipeline construction workers (income group B) fall into different fixed income categories. Based on interviews with pipeline construction companies, we shall also assume that 30% of the labor force is composed of white collar employees. According to the 2015 statistics of TURKSTAT[64], annual average net income of employees falling into in the income group A (engineering services NACE Code 71.12) is found as 24,921 TL. Annual average

61- IHS Economics. "The Economic Impact of Crude Oil Pipeline Construction and Operation". http://www.nam.org/Issues/Energy-and-Environment/Crude-Oil-Pipeline-Impact-Study.pdf
62- Oxford Economics (2013). "The Economic Impact of the Trans-Adriatic Pipeline on Albania A report for TAP AG". http://www.oxfordeconomics.com/Media/Default/economic-impact/economic-impact-home/Economic-Impact-trans-Adriatic-Pipeline.pdf
63- Oil & Gas Journal. "Pipeline construction plans shrink". February 6, 2017

net income of pipeline construction workers falling into in the income group B (NACE Code 42.21) is found as 11422 TL. Accordingly, average income earned by the people working in this pipeline construction project is found as (0.30 x 24.921) + (0.70 x 11.422) = 15,471 TL or $ 5.300 as a result of calculation of the two income groups together. Total labor income is found as 62 million TL or $21 million.

5.1.3 Value Added

Average labor productivity indicators shall be utilized to find value added generated by the economic activities related with pipeline construction. Using the revised GDP figures for 2015 published by TURKSTAT, average labor productivity namely the contribution of each employed person to GDP exclusive of taxes and subsidies is obtained as 113.000 TL or about $ 40000. The total contribution to national income of the direct employment generated by the project can hence be obtained as (4000 x 113000) = 452 mn TL or $ 155 million.

Table 11 Direct Impact

Employment	Income		Value Added	
	Mn TL	$ Mn	Mn TL	$ Mn
4000	62	21	452	156

5.2 Indirect Impact

The estimation of indirect impacts requires the calculation of employment, income and value added arising from business activity supporting the onshore construction of the pipeline. For this purpose, input-output schemes of Turkish economy published by TURKSTAT can potentially be used. But unfortunately, the Turkish economy's input-output tables recently updated by TURKSTAT to reflect the structural dynamics of the economy for 2012 fail to distinguish the activity of pipeline construction. This activity is subsumed under the category of "Land transport services". Therefore we need to rely on other studies that have investigated the economy-wide impact of pipeline construction. IHS Economics has for instance published a report in 2016 outlining these linkages for the US economy[65].

Table 12 Estimates for US

U.S. Economic Impacts of Construction Spending for Crude Oil Pipelines in 2015

Impact Measure	Total Change in Economic Activity	% in the Mfg. Sector	Impact/$1 Billion of Construction Spending
Employment (Number of Jobs)	164,111	13.3%	14,185.8
Direct	55,136	17.6%	4,766.0
Indirect	47,260	19.7%	4,085.2
Induced	61,714	4.5%	5,334.6
Labor Income (Millions of US$)	$ 10,250.3	16.7%	$ 886.0
Direct	$ 3,819.1	20.2%	$ 330.1
Indirect	$ 3,265.1	22.1%	$ 282.2
Induced	$ 3,166.1	6.8%	$ 273.7
Output (Millions of US$)	$ 32,267.9	31.9%	$ 2,789.3
Direct	$ 11,602.4	31.0%	$ 1,002.9
Indirect	$ 10,990.3	44.7%	$ 950.0
Induced	$ 9,675.1	18.3%	$ 836.3
Contribution to GDP (Million of US$)	$ 15,584.1	19.1%	$ 1,347.1
Direct	$ 4,641.0	26.0%	$ 401.2
Indirect	$ 5,283.6	25.5%	$ 456.7
Induced	$ 5,659.5	8.2%	$ 489.2

Note: The total construction spending figure used to derive the impacts was $11.57 billion.

64- The figures given in this study are expressed in fixed 2015 prices for TL and USD
65- IHS Economics. "The Economic Impact of Crude Oil Pipeline Construction and Operation". http://www.nam.org/Issues/Energy-and-Environment/Crude-Oil-Pipeline-Impact-Study.pdf

The findings of IHS Economics suggest that each million dollar spent in the construction of the pipeline, indirectly creates 4 additional jobs in the economy.

Another possible set of references are provided by the Oxford Economics economic impact study of the Albania on shore section of the Trans Adriatic Pipeline. According to the estimates of Oxford Economics each million dollar spent in the construction of the pipeline, indirectly creates 12.4 additional jobs in the economy.

Figure 14 TAP Economic Impact Assessment for an investment spending of $1 billion

Project's economic impact						
			Construction			
Impact	Metric	Unit	2015	2016	2017	2018
Direct	GDP	€mns	27	54	57	19
	Employment	Jobs per year	1,900	3,900	4,200	1,400
	Wages	€mns	13	23	25	8
	Tax revenues	€mns	7	14	15	5
Indirect	GDP	€mns	21	37	39	13
	Employment	Jobs per year	2,300	4,200	4,400	1,500
	Wages	€mns	8	15	16	5
	Tax revenues	€mns	5	8	8	3
Induced	GDP	€mns	18	37	40	12
	Employment	Jobs per year	2,600	5,400	5,800	1,800
	Wages	€mns	6	13	15	4
	Tax revenues	€mns	4	8	9	3

Source: Oxford Economics/TAG AG/Albanian Institute of Statistics

For this study, we shall be using an average of those two estimates. Given the estimated spending of $1bn for the onshore part of TurkStream, the indirectly promoted jobs in the economy can be estimated at 8000.

In 2015 according to TURKSTAT, the net average annual salary in Turkey was 24169 TL. Therefore we can estimate the indirect additional labor income linked to the onshore section of TurkStream at 8.000 x 24.169 = 193 million TL or $67 million. In order to estimate the GDP impact, we can use the average labor productivity figures for the Turkish economy in 2015, which was calculated as 113000 TL per worker. Accordingly, indirect GDP impact of the initial spending on pipeline construction can be calculated as 8000 x 113000= 904 million TL or $ 312 million.

Table 13 Indirect Impact

Employment	Income		Value Added	
	Mn TL	$ Mn	Mn TL	$ Mn
8000	193	67	904	312

5.3 Induced Impact

This category relates to the economic activities arising from consumption within the national economy of people employed in enterprises directly connected with pipeline construction-based activities. It is seen in the direct impact analysis that some additional household income amounting to 62 million TL or $21 million is generated from the said activities. The additional employment, income and value added generated as a result of consumption of this income in the national economy in other sectors need to be identified in order to calculate the overall induced impact. The concept of marginal consumption propensity shall be used for this purpose. The marginal consumption propensity of an economy indicates the ratio of each unit additional income that

is turned into spending by households. Econometric studies show that this ratio is considerably high for the Turkish economy. The marginal propensity to consume is given as 0.73 in a research published by the Central Bank[66]. In other words, households turn 73% of each unit of additional income into spending. Its reflection on the economy occurs with a multiplier effect that is calculated as 1/(1-0.73) and corresponds to 3.7 given that the marginal consumption trend is 0.73. Therefore, spending of an income amounting to 62 million TL in the economy triggers some second wave consumption amounting to 230 million TL or $79 million.

The growth elasticity of employment in Turkish economy should be considered to calculate the additional employment generated by this consumption. According to a calculation made for 2002-2014, 1% increase in employment is obtained for every 3.6% increase in growth[67]. Therefore the employment to be generated by an additional spending of 230 million TL or $79 million shall be equal to 1.494. If we consider that the said employment shall receive a wage/salary in Turkey's average, there is an additional household income amounting to 36 million TL or $12.5 million created by the said consumption.

Table 14 Induced Impact

Employment	Income		Value Added	
	Mn TL	$ Mn	Mn TL	$ Mn
1494	36	12.5	230	79

The economic impact analysis for the onshore section of the TurkStream pipeline demonstrates that the project based on an investment spending of $1 bn will lead in total with its direct, indirect and induced impacts to:

- 13500 additional jobs,
- $ 100 million of additional household income and
- $ 546 million of additional national income.

The total economic impact can be tabled as

Table 15 Total Economic Impact

	Total Employment	Income	Value Added
		$ Million	$ Million
Direct Impact	4000	21	155
Indirect Impact	8000	67	312
Induced Impact	1494	12.5	79
Total	13494	100	546

66- Ceritoğlu,E. (2013). Household Expectations and Household Consumption Expenditures: The Case of Turkey. TCMB Çalışma Kağıdı No 13/10

67- Caner Timur ve Zehra Timur Doğan (2015). İstihdam yaratmayan büyüme: Türkiye Analizi. Ardahan Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi, Sayı: 2, Ekim 2015, ss. 231-247

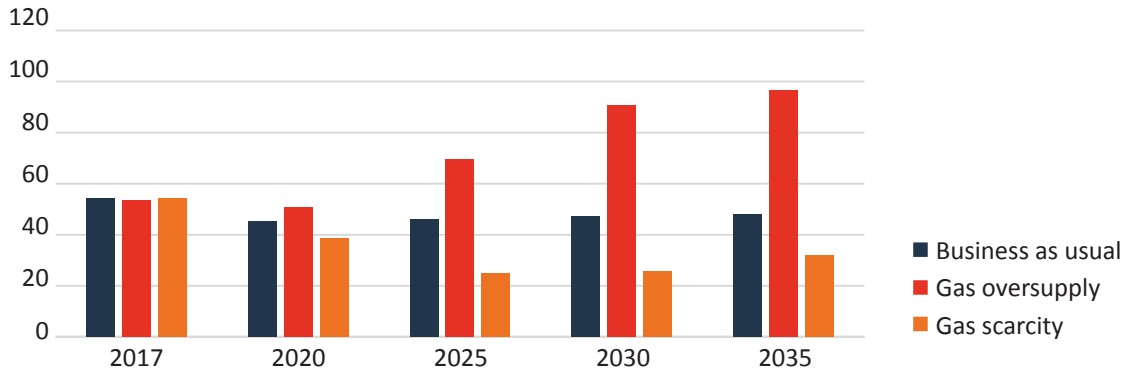
6 Conclusion

The first aim of this study was to estimate the need for the TurkStream project based on a modelling of Turkey's natural gas demand and supply scenarios. The natural gas demand was obtained with the support of an energy model calibrated for Turkey. Supply estimates were obtained by a comprehensive analysis of Turkey's existing and potential natural gas purchasing contracts. The results were summarized in previous sections.

This concluding section will address the same issue from a different perspective. Namely the two workstreams – demand and supply parameters – will be combined to determine the potential natural gas supply gap according to the different scenarios. In order to focus on TurkStream particularly, the supply tables have been re-formatted to exclude the potential supply from TurkStream.

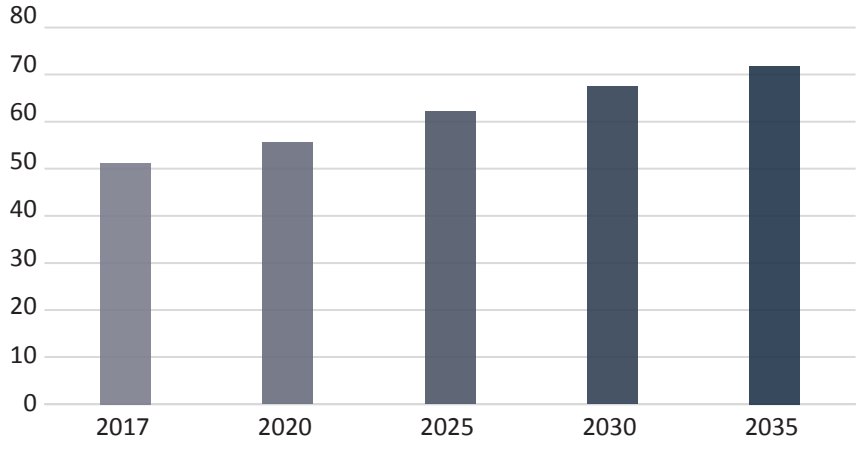
Accordingly the different natural gas supply quantities for each scenario can be described as follows.

Figure 15 Natural gas supply scenarios in bcm (excluding TurkStream)



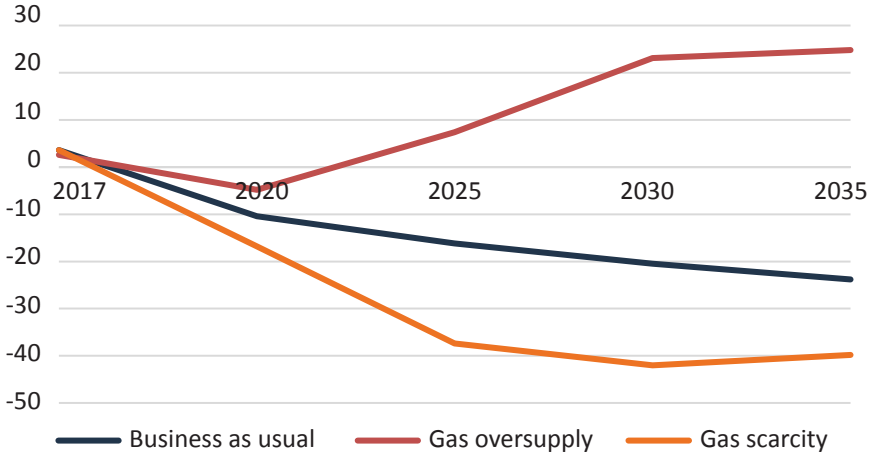
The model generated domestic demand for natural gas is given here below.

Figure 16 Estimates for natural gas domestic demand in bcm



Combining this two different set of data allows us to determine the shortfall or the overhang in supply for natural gas.

Figure 17 The supply-demand balance



The combination of the supply and demand curves demonstrates that with the exception of the "Gas Oversupply" scenario which reflects optimistic conditions regarding regional developments and the evolution of Turkey's bilateral relations with neighbouring countries, Turkey will be in need of additional sources of natural gas supply after 2020 that exceeds the additional supply of TurkStream. By 2025, the shortfall – if potential supplies from TurkStream are to be excluded - will be around 16 bcm under the business as usual scenario and 37 bcm under the gas scarcity scenario. For 2035, the shortfall will have reached 24 bcm under the business as usual scenario and more than 40 bcm for the gas scarcity scenario. It is clear that under these circumstances, Turkey will greatly benefit from the 15.75 bcm to be supplied from TurkStream. Turkey may even want to augment its purchasing commitments from TurkStream in the years following 2025.

Finally, in addition to the contributions that TurkStream is set to provide for Turkey's energy supply security, it should be underlined that the project will also generate other economic benefits, during its construction and operation phase, for the Turkish economy. This study analyzed the economic impact of the on shore construction part of the project. It was demonstrated that based on an investment expenditure of around $ 1 bn, this task will generate close to 13500 direct, indirect and induced jobs, around $100 million of additional household income and a contribution to Turkey's GDP of around $ 546 million. These positive economic impacts are due to be augmented by the yearly economic benefits derived from the operation of the pipeline[68].

68- The study did not detail the economic impact of the operational phase as many of the parameters necessary for the methodology are yet to be shared with the public.

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Appendices

A1

The model developed in a "Bottom Up" manner, and is constructed under the Bogazici University Energy Modeling System (BUEMS) framework as an extension to BUEMS. The stated extension is named BU-GAS. BUEMS framework, which has a bottom-up systematic approach accompanied by a technology-rich structure, encompasses entire value chain of the energy sector. BUEMS is designed to represent energy sector as realistically as possible by using minimum level of data. Hence, it aims to diminish the time spent on gathering and compilation of the data. Being developed as an extension to BUEMS, BU-GAS model considers the structural, social, economic and technological changes affecting the medium and long term gas demand, and it is structured in a way that it depicts the Business As Usual (BAU) case, and enables assessing other scenarios in order to monitor the variations that are likely to happen.

BU-GAS model has been developed and run by Prof. Dr. Gürkan Kumbaroğlu and Dr. Zafer Öztürk of Bogazici University Energy Systems Modeling Lab, and BOUN Energy Policy Research Center.

Method, Data Sources and Assumptions

The model follows the accounting framework approach to generate a consistent view of energy demand based on the physical description of the energy system. It also relies on the scenario approach to develop a consistent storyline of the possible paths of energy system evolution. Thus for the demand forecasting, the model does not optimize or simulate the market shares but analyses the implications of possible alternative market shares on the demand.

The analysis in BU-GAS model environment is carried out at a disaggregated level where the structure of energy consumption is organized as a hierarchical tree, where the total or overall activity is presented at the top level. For each subsector, the drivers of energy demand are identified. The distribution of these activities at the disaggregated level following the hierarchical tree is also developed. The product of activity and the energy intensity (i.e. demand per unit of the activity) determines the demand at the disaggregated level.

The demand relationship is as follows: E = A x I, where A = activity level and I = final energy intensity.

In addition, considering efficiency gains, Useful Energy is also a modeling methodology in BU-GAS approach.

Useful Energy Analysis: e = a ´ (u / n)

Where u=useful energy intensity, n = efficiency

Throughout the project framework, BU-GAS is also paired up with BU-ELC (bottom-up electricity demand extension to BUEMS) whenever the data requirements necessitate deriving Natural Gas forecasts from electricity demand. In addition, sector growth projections of BU-ELC are also taken into account in some sub-sector projections whenever the stated database emerges as the most up to date data resource.

BU-GAS model adopts 2015 Energy Balance Sheet of Turkey (General Directorate of Energy Affairs, 2015) as the baseline for constructing the bottom-up approach.

Balance sheet has also been compared with reports of Natural Gas Associations (GAZBIR,2017) , and 2015 Natural Gas Market Sector Report published by Energy Market Regulatory Authority EMRA (EPDK, 2015).

Historical data regarding the sector related growth, capacity, manufacturing, Value-added GDP growth rates ad so on are adopted and/or derived from official datasets published by Turkish Statistical Institute (TÜİK, 2016).

Sector growth trends are obtained in the following ways:

- *Through interviews with officials and sector related market prominent*
- *Through Sector reports from ministries, official institutions, and private reports from the industry and funding institutions*
- *By developing macroeconomic growth models*
- *By coupling BU-GAS and BU-ELC models*

A2. Industry Production Index Used for deriving Industry Value Added GDP Growth (from TURKSTAT)

Sanayi üretim endeksi, 2005 - 2017
Industrial production index, 2005 - 2017
[**Arındırılmamış endeksler**- Gross indices]
[2010=100]

İktisadi faaliyet (NACE Rev. 2)	**Yıl**	**Ocak**	**Şubat**	**Mart**	**Nisan**	**Mayıs**	**Haziran**	**Temmuz**	**Ağustos**	**Eylül**	**Ekim**	**Kasım**	**Aralık**	**Yıllık ortalama**	
Economic activity (NACE Rev. 2)	Year	January	February	March	April	May	June	July	August	September	October	November	December	Annual average	
Toplam sanayi Total industry	2005	72.1	74.1	84.8	81.8	85.4	88.1	86.1	86.0	93.9	96.0	87.9	97.3	86.1	
	2006	72.9	80.6	95.3	90.3	96.1	97.5	94.2	91.6	98.2	92.2	100.5	99.8	92.4	7.3%
	2007	86.9	87.8	101.1	95.7	103.2	102.2	99.9	98.9	102.4	101.6	108.8	98.2	98.9	7.0%
	2008	96.7	95.9	104.7	102.9	106.3	104.6	104.3	95.5	98.3	95.2	94.8	81.1	98.3	-0.6%
	2009	75.9	72.9	82.2	83.5	88.1	94.2	95.0	89.3	88.8	101.1	92.0	100.5	88.6	-9.9%
	2010	85.6	85.4	100.0	97.7	101.7	103.9	105.0	100.5	97.2	108.6	98.6	115.9	100.0	12.8%
	2011	101.9	97.7	111.7	107.1	111.6	114.1	112.4	106.2	111.0	119.9	107.2	120.1	110.1	10.1%
	2012	104.5	102.9	115.8	110.0	118.2	116.5	116.1	103.4	116.4	112.3	121.4	116.7	112.9	2.5%
	2013	106.8	104.4	116.0	115.3	120.5	120.0	122.9	102.1	123.9	111.7	127.0	124.8	116.3	3.0%
	2014	114.9	109.7	121.3	120.9	122.7	122.0	117.4	115.0	129.4	116.7	125.5	130.3	120.5	3.6%
	2015	112.4	110.6	127.2	125.5	123.1	130.2	118.9	124.5	119.2	134.0	130.1	136.2	124.3	3.2%
	2016	116.4	120.2	133.2	126.4	131.9	131.8	108.9	128.0	114.3	134.3	136.2	137.9	126.6	1.9%
	2017(r)	121.3	118.2	136.9											

A3. Econometric Model Parameters for Non Ferrous Metals Industry

Non-Ferrous

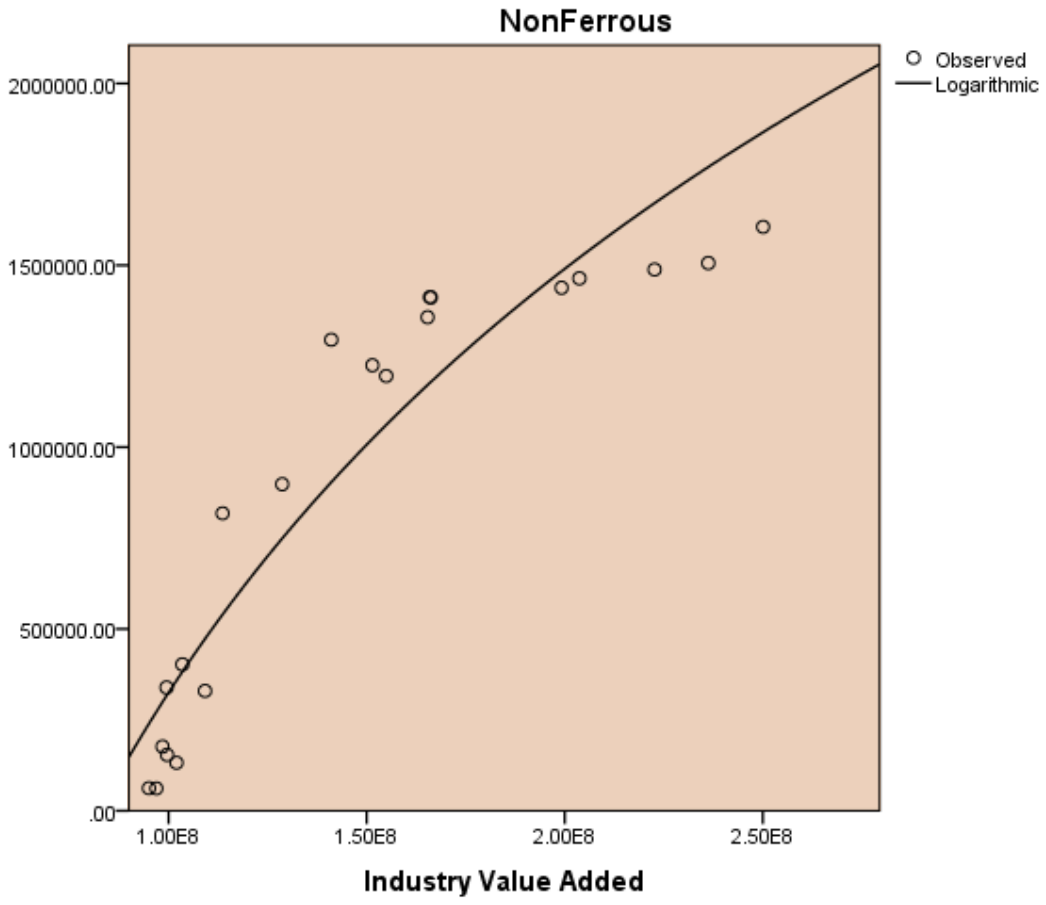
Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
.938	.880	.874	208172.244

The independent variable is Industry Value Added.

Coefficients

	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
ln(Industry Value Added)	1681434.867	142342.406	.938	11.813	.000
(Constant)	-30648310.933	2670606.473		-11.476	.000



A4. Econometric Model Parameters for Chemicals Industry

Chemicals

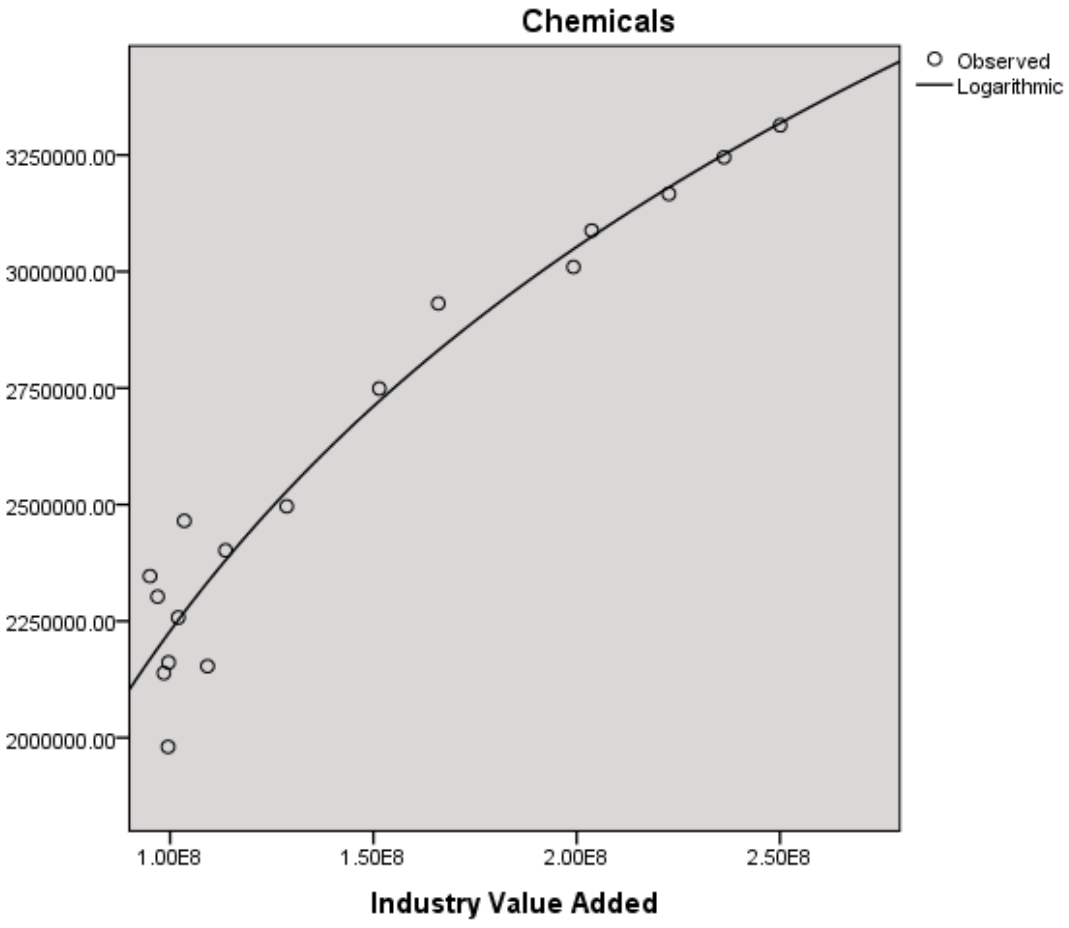
Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
.968	.937	.932	114576.391

The independent variable is Industry Value Added.

Coefficients

	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
ln(Industry Value Added)	1189005.591	79795.646	.968	14.901	.000
(Constant)	-19673533.388	1495094.132		-13.159	.000



A5. Econometric Model Parameters for Cement Industry

Cement

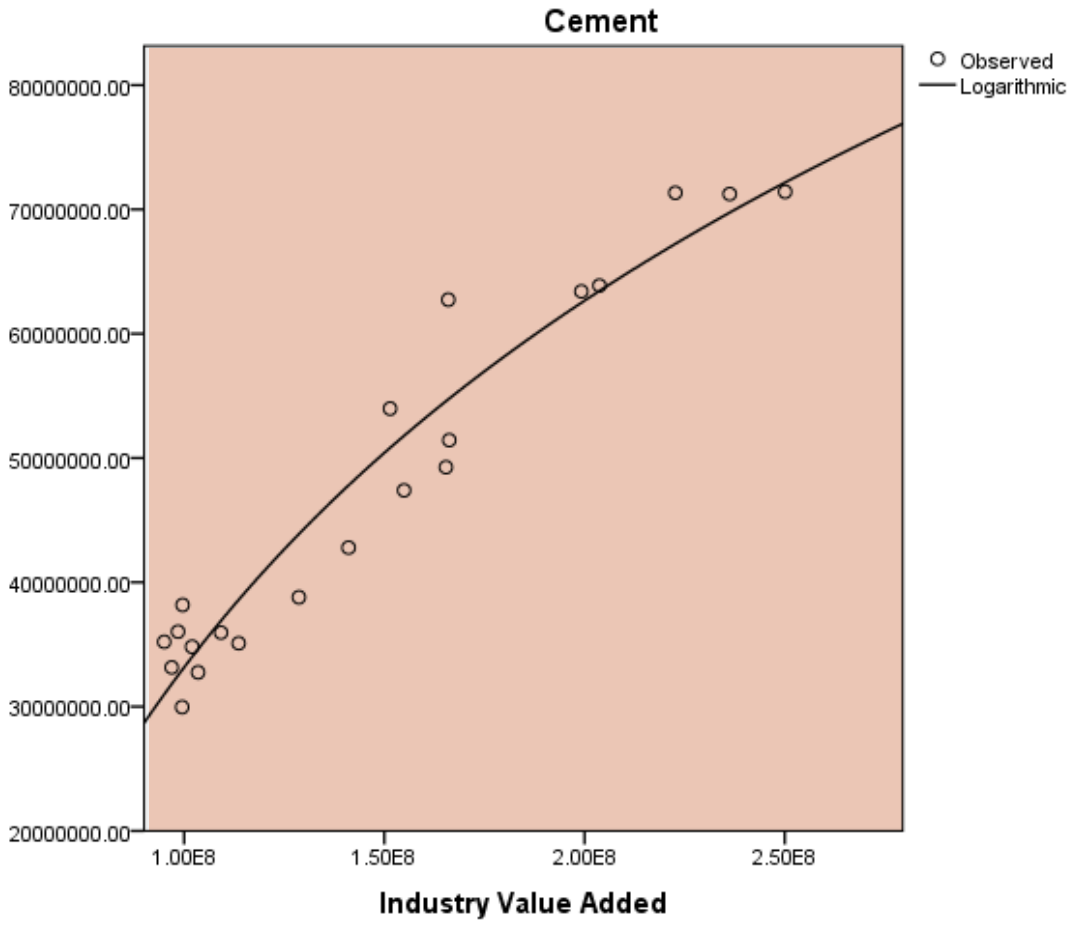
Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
.965	.930	.927	3905267.396

The independent variable is Industry Value Added.

Coefficients

	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
ln(Industry Value Added)	42559839.819	2670313.522	.965	15.938	.000
(Constant)	-750822892.153	50100014.256		-14.986	.000



A6. Econometric Model Parameters for Automotive Industry

Automotive

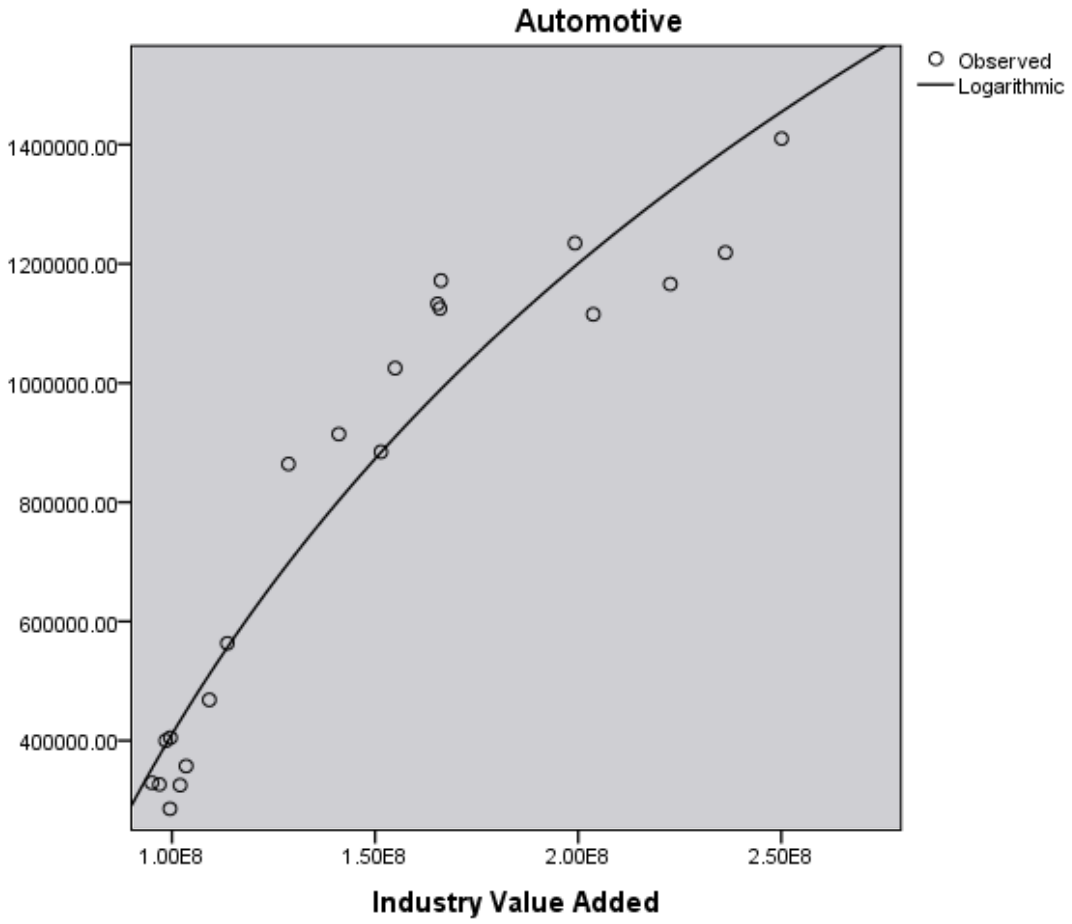
Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
.960	.922	.918	111347.338

The independent variable is Industry Value Added.

Coefficients

	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
ln(Industry Value Added)	1139494.327	76136.221	.960	14.967	.000
(Constant)	-20579565.133	1428456.146		-14.407	.000



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