SOUTHERN GAS CORRIDOR, MILESTONES AND OTHER TURKMEN GAS EXPORT OPTIONS (VIA TURKISH STREAM)

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"EU is the biggest energy importing structure in the world and Russia is her major supplier. EU energy security troubled by increasing political conflicts with Russia rushes EU to diversify her energy supplies. One of the most popular candidates for EU's future energy supply is the Caspian resources."

"According to the information giving on the map, there is an unbalanced gas equation due to total high demand and insufficient total supply potential from the Caspian (except Iran)."

ABSTRACT

EU is the biggest energy importing structure in the world and Russia is her major supplier. EU energy security troubled by increasing political conflicts with Russia rushes EU to diversify her energy supplies.

One of the most popular candidates for EU's future energy supply is the Caspian resources placed in between Russia, Azerbaijan, Turkmenistan, Iran and Kazakhstan, however, as of today (due to political reasons) only Azeri and Turkmen natural gas resources have the priority for EU's future energy security strategies. These strategies under the forth corridor concept by EU were partly realized through southern gas corridor (SGC) initiated by Azerbaijan. In such a corridor Azerbaijan is planned to be the main supplier country and to a greater extent Turkmenistan and others as well. While Azerbaijan and Turkey will be the transit countries and EU and also Turkey will be the markets in demand.

As there are no important political obstacles for Azerbaijan as the supplier, demand market or transit countries however; unreconciliated political situation of the Caspian Sea is one of the most important milestones for potential supplier Turkmenistan to flow its gas through Caspian to Azerbaijan stepping forward with the corridor since early 2000. Moreover, the political encouragements and support of EU and US, and related parties have not been enough to take tangible steps to resolve the problem.

However, in any case, even if the linkage of Turkmen gas to Azerbaijan flowing through the demand market is assumed politically possible, another important matter will be the economic fundamentals as a determining factor for consideration.

In this paper, initially by assuming the political conflicts on Caspian is resolved, success rate and future of Southern Gas Corridor will be evaluated from the view of capacity point through assessing potential shippers, and of economic parameters, then the place of Turkmen gas in SGC will be evaluated. In addition, for Turkmen gas exportation to EU, other two possible roots: through Iran & Turkey and Russia & Turkey (through new popular line Turkish Stream) will be analyzed in terms of economic parameters affecting the end market competition.

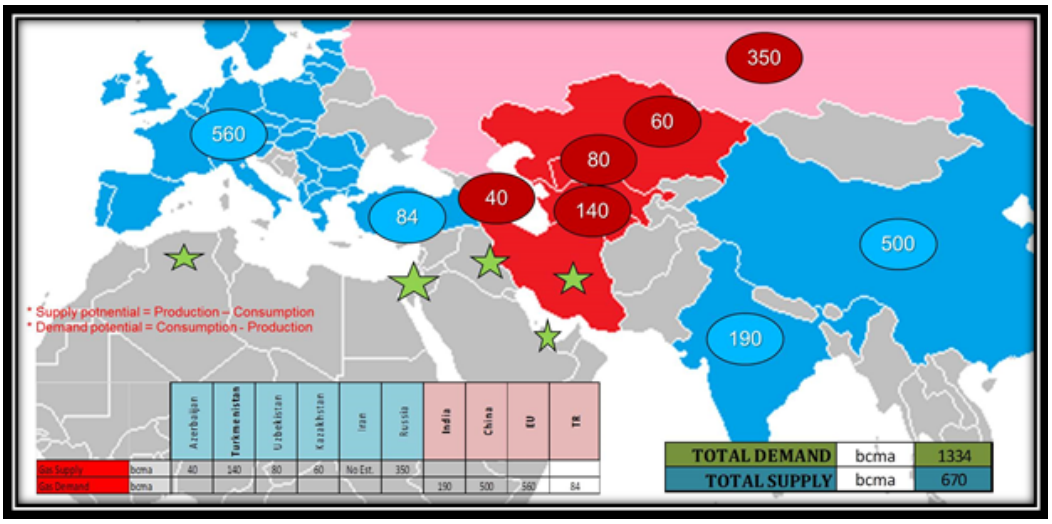
INTRODCUTION

Caspian, involving Russia, Turkmenistan, Kazakhstan, Uzbekistan, Azerbaijan, Iran, is the most important region according to the proved gas reserves potential in the world (46,3% of the world share[1]). Moreover, due to the geographical properties (being located in the middle of the important consumers; China-India-EU & Turkey), importance of Caspian region for world gas politics is increasing.

Due to the nature of the development procedures of huge gas projects, long term planning is vital for logical estimations. Therefore, at least 2035 supply and demand potentials with the economic fundamentals have to be studied.

Map 1 is giving brief information about the 2035 supply and demand potentials estimations of Caspian and related regions.

According to the information giving on the map, there is an unbalanced gas equation due to total high demand and insufficient total supply potential from the Caspian (except Iran). So, minimum additional 600 bcma volume of gas will be demanded annually in the region. This shows the increasing importance of Caspian resources and from the sight of huge demanders; "First comers will get much from the cake.". Moreover, current sit-



Map 1: 2035 Estimations (Demand – Supply potentials).[2]

uation shows that due to the previous agreements and existing infrastructures EU will get the greatest part.

From the general sight; videlicet, middle world (including Asia & Europe) also needs Iran, Iraq, North Africa, East Mediterranean, Persian Gulf & some Pacific resources for their future gas security (So, LNG will play a key role).

After showing the unbalanced gas supply-demand potentials in the region and the struggles growing up, to focus on EU's main energy security targets related with Caspian gas resources:

- For political reasons and diversity of resources, Caspian gases have to be transported to EU.
- Initially, Azeri gas and then Turkmen gas will be transported.
- For additional supply potentials and decreasing the transportation costs, Iran – Iraq and West Mediterranean resources will be able to be adapted to the supply system.
- All transportation will be through Turkey via pipelines.

These ideas are called popularly as Southern Gas Corridor (SGC). In order to have a more coherent analysis, SGC will be divided and investigated in four stages.

SGC IN FOUR STAGES

In general, resources and planned infrastructures for SGC can be studied in four stages according to their tangibility;

SGC STAGE 1

The first stage of SGC is the delivery of Shah Deniz Stage 2 gas to EU. It is continuing. In that concept, capacity expanded SCP (SCPX), TANAP and TAP is planned to transport 10 bcma Azeri gas to EU/Italy Hub after 2018. The view of SGC Stage 1 is given in Table 1.

SGC STAGE 2

The second stage; future Azeri gas (mainly from Umid/Babek and Absheron) is planned to be transported to EU via SCPFX, TANAPX and TAPX after 2025. (Note: TAP capacity is with the maximum expandable 10 bcma, and it can be 20 bcma. So, for additional gas flow above maximum capacity, new infrastructures have to be constructed). The view of SGC Stage 2 is given in Table 2

SGC STAGE 3

The third stage as on the table projects; Iraq – Iran – Eastern Mediterranean gas is to be transported through Turkey to EU via:

- Free capacity of TANAP or TANAPX
- Possible expanded capacity of TANAPX (TANAPFX)

"The first stage of SGC is the delivery of Shah Deniz Stage 2 gas to EU as it is continuing. The second stage; future Azeri gas (mainly from Umid/Babek and Absheron) is planned to be transported to EU via SCPFX, TANAPX and TAPX after 2025."

"The third stage as on the table projects; Iraq – Iran – Eastern Mediterranean gas is thought to be transported through Turkey to EU.

Time Period To Start	After 2018
Related Countries / Political Structures	AZ (Supplier), GEO & TR (Transit), EU/ITALY (Market)
Resource	No risk (Existing proved resources in Shah Deniz Gas Field waiting to be developed. Very low reserve risks, those can be negligible.)
Finance	No risk (All shareholders have necessary finance.)
Infrastructures / Production	No risk (All are in the construction period)
Infrastructures/ Transportation	No risk (SCPX (through AZ & GEO), TANAP (through TR), TAP (in EU). All are in the construction period)
Market	No risk (Enough market capacity in Italy Hub, completed sales agreements)
Economics	Low level risk (Transportation costs, decreasing oil & oil effected energy prices.)
Political Support	No risk (Full political support from AZ, GEO, EU)
Agreements	No risk (All related agreements are signed)
Related Legislations	No risk (Legislative structures are clear and defined.)
Result	Successful
Volume (bcma)	10
Effect on EU 2035 Gas Demand (%)	Less than 2%
Future Risks & Weak Points	Due to increasing competition in EU, gas sale price might go down to unexpected levels. This decrease in sale prices may make the project uneconomic due to transportation costs.

Table 1: SGC Stage 1 analysis.

- Revival of NABUCCO

The view of SGC Stage 3 is given in Table 3.

SGC STAGE 4

The fourth stage: Turkmen gas is to be transported to EU via Trans Caspian Pipeline (TCP) and forward infrastructures in Turkey and EU.

For evaluation of all steps, political support, resources, finance, market potentials, economics, related infrastructures and related legislations (on the related period) have to be considered jointly. The view of SGC Stage 4 is given in Table 4.

All these criteria will be evaluated shortly on a standard table for each stage.

OVERALL CRITICS FOR ALL FOUR STAGES

"Only the Turkmen and Iranian gas export to EU via forth corridor may be impossible due to economic reasons."

Notes about the Table 5:

- Overall expectations are taken into consideration.
- "OK" means; there is no risk or no high risk or possible.
- "Successful" means; will be completed successfully.
- "POTENTIAL" means; there is potential for being successful.

As seen on Table 5, only the Turkmen and Iranian gas export to EU via forth corridor may be impossible due to economic reasons. This table also shows that economics is the most important item in addition to political support for such gas project to be successful.

When generally estimating the netback prices and tariffs of each stage on the Table 6, Iranian and Turkmen gas economic risks can be

Time Period To Start	After 2024 (In best case)
Related Countries / Political Structures	AZ (Supplier), GEO & TR (Transit), EU (Market) (Note for EU Market: With preference due to existing infrastructure Italy or Balkan markets can be selected)
Resource	Medium Level Risk (Hence being in appraisal stage, proven reserves is not clear yet.)
Finance	Low Level Risk (Low oil prices may make contractor or AZ government to delay some investments on development projects.)
Infrastructures / Production	Low Level Risk (No risks for technology, know-how, equipment supply but risks for infrastructures completion time. Hence being in the appraisal stage, a delay in infrastructures will delay the first gas)
Infrastructures / Transportation	Low Risk (Extension of related pipelines is on the table projects and has to be studied more. SCPFX (through AZ & GEO), TANAPX (through TR), TAPX (in EU to Italy), other options to Balkan countries are planned to be used for transportation.)
Market	No Risk (Price computation will determine the end point)
Economics	Medium Level Risk (Transportation costs, decreasing oil & oil effected energy prices, competitive end market price will determine the economy)
Political Support	No risk (Full political support from AZ, GEO, EU)
Agreements	Low Risk (Market and economics will determine the risk factor, if the project is economic then there will be only some delay risks for the agreements hence the projects are in the appraise stage)
Related Legislations	No risk (Legislative structures are clear and defined.)
Result	Potential For Being Successful
Volume (Estimated) (bcma)	4-6
Effect on EU 2035 Gas Demand (%)	1%
Future Risks & Weak Points	Due to increasing competition in EU, gas sale price might go down to unexpected levels. This decrease in sale prices may make the project uneconomic due to transportation costs.

Table 2: SGC Stage 2 analysis.

observed.

Note: EU Gas price for 2018 is estimated as 400 USD/1000 m^3, all values are in USD/1000 m^3 unit. All tariff estimations are for the time period after 2018, netback values are without tax, Sta4 Turkmen gas to TR tariff value includes (75 USD for Trans Caspian pipeline and 85 USD for AZ to TR related pipeline for 1000 m^3)[3].

From another strategic view, even if all the steps are to be successfully completed (including the assumption that Turkmen gas option is possible), the total volume is lower than the 10% of EU's 2035 demand. This also shows the success rate of EU's energy diversification plans.

For Turkmen gas to be able to be exported to EU, which seems the greatest volume in the concept of SGC, hence the problem is mainly economic, other options have to be studied for better economics.

TURKMEN GAS EXPORT OPTIONS TO EU

Turkmenistan has the third biggest proved

Time Period To Start	After 2020 (In best case) (Assumed that sanctions on Iran are removed)
Related Countries / Political Structures	IRAN & IRAQ & ISRAEL (Supplier), TR (Transit), EU (Market) (Note for EU Market: With preference due to existing infrastructure Italy or Balkan markets can be selected, but not confined to)
Resource	No Risk (No geological and reserves risks, there are proven reserves but risks exist in available future export volumes)
Finance	Low Level Risk (Low oil prices may make Iran & Iraq governments to delay some investments on development projects.)
Infrastructures / Production	Low Level Risk (No risks for technology, know-how, equipment supply but risks for new infrastructures completion time. Hence some of the projects are being in the appraisal stage, a delay in infrastructures will delay the first gas)
Infrastructures / Transportation	Medium Risk (Possible Pipelines for Transportation: Free Capacity of TANAP according to time period / TANAPX / TANAP FX / new NABUCCO (through TR), TAPX / new standalone pipelines according to volume of gas / ITGI (in EU to Italy), other options to Balkan countries and further EU states All these projects are on the table but as distinct from the second stage, these suppliers are not the shareholders of the existing pipeline projects.)
Market	No Risk (However, price competition will determine the end point)
Economics	Low Level Risk for Iraq and Israel (Transportation costs, decreasing oil & oil effected energy prices, competitive end point price will determine the economy) Medium to High Level Risk for Iran (Production costs, transportation costs and market (end point) sales prices which makes net back value questionable do not let Iran gas to be economic for EU sale)
Political Support	No Risk (Assumed as sanctions on Iran are removed)
Agreements	Low Risk (Market and economics will determine the risk factor, if the project is economic then there will be only some delay risks for the agreements hence the projects are in the appraise stage)
Related Legislations	No Risk for Iran & Iraq, Low Risk for Israel (Antimonopoly & tax issues should be should be solved for Israel.)
Result	Potential For Being Successful (Except Iran gas via pipeline in current conditions.)
Volume (Estimated) (bcma)	Not Clear (As a general estimation: Israel: 4 bcma, Iraq: 3 bcma, Iran: only via LNG export to EU is possible and production capacity and internal consumption scenarios are not clear to be able to make estimation)
Effect on EU 2035 Gas Demand (%)	Not Clear (From Israel & Iraq 1.2%)
Future Risks & Weak Points	Due to increasing competition in EU, gas sale price might go down to unexpected levels. This decrease in sale prices may make the project uneconomic due to transportation costs.

Table 3: SGC Stage 3 analysis.

Time Period To Start	After 2025
Related Countries / Political Structures	TURKMENISTAN (Supplier), AZ & GEO & TR (Transit), EU/ ITALY or BALKANS (Market)
Resource	No Risk (No geological and reserves risks, there are proven reserves but risks exist in available future export volumes)
Finance	No Risk (According to Turkmen fiscal policy but project economics will be determining factor since all finance should be met by contractor.)
Infrastructures / Production	Low Level Risk (No risks for technology, know-how, equipment supply but risks for new infrastructures completion time. Hence some of the projects are being in the appraisal stage, a delay in infrastructures will delay the first gas)
Infrastructures / Transportation	Medium Risk (Possible pipelines for transportation: Trans Caspian Pipeline (through Caspian Sea), SCPFX or new standalone pipeline (from AZ to TR), Free Capacity of TANAP according to time period / TANAPX / TANAP FX / new NABUCCO (through TR), TAPX / new standalone pipelines according to volume of gas / ITGI (in EU to Italy), other options to Balkan countries and further EU states. All these projects are on the table but as distinct from the second stage, Turkmenistan as a supplier is not a shareholder in the existing pipeline projects.)
Market	No Risk (Price computation will determine the end point)
Economics	High Level Risk (Production costs, transportation costs and market (end point) sales prices which makes net back value questionable do not let Turkmen gas to be economic for EU sale)
Political Support	No Risk (By assuming the conflicts in the situation of Caspian Sea are solved.)
Agreements	Low Risk (Market and economics will determine the risk factor, if the project is economic then there will be only some delay risks for the agreements hence the projects are in the appraise stage)
Related Legislations	No Risk
Result	Not Possible to be Successful (Hence being uneconomic in current situations, after assuming Caspian conflicts are solved)
Volume (Estimated) (bcma)	30
Effect on EU 2035 Gas Demand (%)	5.3%
Future Risks & Weak Points	Due to increasing competition in EU, gas sale price might go down to unexpected levels. This decrease in sale prices may make the project uneconomic due to transportation costs.

Table 4: SGC Stage 4 analysis.

gas reserves in the region (after Iran & Russia), with 9.4% of the world share of 17.5 tcm1. Moreover, in 2035 she is estimated to be able to have a 140 bcma gas export potential. Therefore, she is an important strategical supplier for the huge demanding markets in the nearby region, such as China – India & EU.

From this view, EU is making plans and continuing negotiations to export Turkmen gas for more than 10 years. However, in addition to conflicts in the Caspian status, economics is the key factor for these plans to be successful.

As observed in the sections above; Turkmen

"Turkmenistan has the third biggest proved gas reserves in the region (after Iran & Russia), with 9.4% of the world share of 17.5 tcm. Moreover, in 2035 she is estimated to be able to have a 140 bcma gas export potential."

	STAGE 1	STAGE 2	STAGE 3	STAGE 4
Resource	OK	OK	OK	OK
Finance	OK	OK	OK	OK
Infrastructures	OK	OK	OK	OK
Market	OK	OK	OK	OK
Economics	OK	OK	OK (except Iran)	NOT ECONOMIC
Political Support	OK	OK	OK	OK
Agreements	OK	OK	OK	OK
Result	SUCCESSFULL	POTENTIAL	POTENTIAL	NOT POSSIBLE

Table 5: SGC Stages overall critics.

gas export to EU through Caspian Sea – AZ – TR option is not economic. Therefore, other options have to be studied.

In this section, from the economical view, three Turkmen gas export options to EU through; Caspian – AZ – TR, Iran – TR and Russia – TR will be evaluated.

Note: Turkmen gas export to TR market is not included in calculations.

THROUGH CASPIAN – AZERBAIJAN – TURKEY OPTION3

"1442 km pipeline has to be constructed with a cost of 16 billion USD and expected tariff is 180 USD/1000 m3 for 30 bcma Turkmen gas that will be transported from Turkmen border to TR border."

	EU GAS PRICE	GAS UNIT COST	TO TR	TR-EU	E U INSIDE	NETBACK
ST1 AZ SD2	400	125	60	100	80	35
ST2 AZ ADDITIONAL	400	120	60	120	80	20
ST3 ISRAEL	400	100	40	120	80	60
ST3 IRAQ	400	70	50	120	80	80
ST3 IRAN	400	150	60	120	80	-10
ST4 TURKMEN	400	120	160	100	60	-40

Table 6: SGC Stages netback analysis.

Assuming that political conflicts on the Caspian status are solved: Turkmen gas will be transported to EU initially through a new standalone pipeline called "Trans Caspian Gas Pipeline". From AZ to TR (again assuming SCPX or SCPFX will not have enough free capacity for 30 bcma), a new standalone pipeline will be constructed, then through Turkey with a new Nabucco or a similar pipeline will be in demand.

As a result of this option, netback in Turkmen border (excluding the gas transportation cost inside Turkmenistan), after sale of gas to EU is 110 USD/1000 m^3.

Technical properties' cost, tariff analysis of the pipelines, and other related assumptions can be found in the 3rd reference given.

THROUGH IRAN – TURKEY OPTION3

In this option, transportation of Turkmen gas through Iran and Turkey is evaluated. According to this evaluation, for 30 bcma Turkmen gas, from Turkmen border to TR border, a 1442 km pipeline has to be constructed (as shown on Map 2) with a cost of 16 billion USD and expected tariff is 180 USD/1000 m^3. By adding the other transportation costs Table 7 is prepared.

Technical properties cost and tariff analysis of the pipelines and other related assumptions can be found in the 3rd reference given.

	EU GAS PRICE	GAS UNIT COST	TO TR	TR-EU	E U INSIDE	NETBACK
TURKMEN GAS VIA IRAN & TR	400	120	180	100	60	-60

Table 7: Turkmen gas via Iran to EU netback analysis.

	EU GAS PRICE	GAS UNIT COST	TO RU	RU- TS	TS	E U INSIDE	NETBACK
TURKMEN GAS VIA RUSSIA & TR	400	120	20	60	100*	60	40

Table 8: Turkmen gas via Russia to EU netback analysis.

THROUGH RUSSIA – TURKEY OPTION

In this option, Turkmen gas thought to be exported to EU via:

- Initially the existing CAC & Bukhara – Urals Pipelines (From Turkmenistan to Russia, through Uzbekistan and Kazakhstan)
- Then 30 bcma Turkmen gas will be transported through Russia inside gas pipeline system up to the start of Gazprom's new popular project "Turkish Stream (TS)"
- Through TS (Assumed as TS will successfully be completed) or the expanded versions of TS, gas is transported via Black Sea and Turkey to the EU border.

Tariff estimations of this root are given on Table 8.

This option (in the case of realization) might make Turkey a medium size trading hub together with Russian gas in terms of source and liquidity.[4]

Note: Political issues between related countries, the situations of the existing old pipelines, free capacities of gas pipeline network inside Russia (after 2020) is not taken into consideration for the tariff estimations above.

Additional Note: For the tariff estimation of TS, by using the IHS QUESTOR software for such a 30 bcma gas transportation, with 54" pipe diameter and middle quality thermal isolation material, pipeline capex is estimated as 10.1 billion USD (including the compressor stations). Then the tariff is estimated as 100 USD/1000 m^3. This cost and tariff estimation is for a standalone pipeline in the same root of ST. So, for an already existing ST, tariffs will be cheaper. However, as a worse case tariff of ST for 30 bcma Turkmen gas is assumed as 100 USD.

As seen from the Table 8 above, this option is the only economic option that can be successful.

Map 2: Trans Caspian & Trans Iran Pipelines from Turkmenistan.[3]

RESULTS & ADDITIONAL BENEFITS OF 3rd OPTION

As seen from the general economic views, according to the netback values (without tax), only the through Russia – Turkey option is coherent for Turkmen gas to be exported to EU. The other two options might be considered following the solution of Caspian conflicts and Iran sanctions but the future of those acts are unforeseeable.

This option, as an idea, has to be studied and improved and taken into consideration as a new route for SGC, although Russia will be an arbiter as a transit (pipeline owner) country. Besides, future estimations show that Russia will continue to be the most important exporter for EU. As written in BP Energy Outlook 2035 – EU & Global Reports: "EU (via pipelines) remains the largest importer of natural gas and imports from Russia that has an important remaining source of supply, growing by 15% and maintaining a market share of around 31% by 2035.". Therefore, if EU really needs Turkmen gas resources, she has to act more political.

"EU (via pipelines) remains the largest importer of natural gas and imports from Russia that has an important remaining source of supply, growing by 15% and maintaining a market share of around 31% by 2035."

In addition, with such a new gas corridor from Turkmenistan – Russia – TR to EU, possible future gas exporters such as Uzbekistan and Kazakhstan may also be added to the system as the gas suppliers to EU.

Besides, this will be the most beneficial option for Turkey, increasing importance of being a gas trading hub strategy. By this way, this hub concept will be at reach.

SUMMARY

SGC's popularity for EU and the related regions is increasing due to increasing demand of EU and other huge demander competitors such as China and India. In the concept of SGC, initially Caspian resources and additionally Iran, Iraq and Israel gases are planned to be transported to EU.

The focus on the Caspian resources states that Azeri step will be completed successfully in late 2018. However, as for the other Caspian supplier options Turkmenistan, there are no tangible steps have been taken.

Although some EU authorities claim: "after the solution of the Iranian sanctions, Turkmen gas will be exported to EU via both Azerbaijan and Iran"[5], hence being uneconomic in the current situations, these are not coherent notions.

For gas politics to be successful, although all the milestones in reserves, markets, legislations, and technics are progressed, if the projects are uneconomic, then no investor, finance and agreement steps can be taken. Therefore, in order for SGC plans to be consistent, in addition to political steps, economics have to be considered.

As described in the paper, in current situations, gas export option of Turkmenistan via Azerbaijan and Iran to EU may not be commercially possible. In addition, Iran gas export to EU, via pipeline through Turkey, is in the same situation. Thence, other commercially possible and coherent options and solutions have to be considered.

Turkish Stream, which is the changing face of Gazprom's gas export politics with the pros and cons for EU may also have positive sides with new strategic targets. Assuming TS to be completed and capacity expanded, Turkmen gas and additionally Uzbek and Kazakh gas will be able to find a chance to be transported to EU economically (through Russia and TR). Then, this option will also be profitable for EU, Russia, Turkey, Turkmenistan, Uzbekistan and Kazakhstan.

To sum up, in this paper, after giving brief information about the SGC, mainly economic concerns of the SGC stages are explained and a new approach for Turkmen gas to be exported to EU is described.

From the sight of Turkish energy policies; hence having Turkey an extended resource diversified gas market and trading hub, this approach might be a strategic energy target for Turkey to put an effort on.

Note: Special thanks to Dr. Tayfun Yener

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ABBREVIATIONS

EU: European Union

RU: Russia

TR: Turkey

AZ: Azerbaijan

SCP: South Caucus Pipeline

SCG: Southern Gas Corridor

TS: Turkish Stream Pipeline

TANAP: Trans Anatolia Pipeline

GEO: Georgia

TAP: Trans Adriatic Pipeline

TCP: Trans Caspian Pipeline

ITGI: Interconnector Turkey – Greece – Italy Pipeline

"X" after pipeline name: Means extension of the related pipeline (Ex: SCPX: Expansion of SCP)

"FX" after pipeline name: Means forward extension of the related extended pipeline (Ex: SCPFX: Expansion of SCPX)

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"Assuming TS to be completed and capacity expanded, Turkmen gas and additionally Uzbek and Kazakh gas will be able to find a chance to be transported to EU economically (through Russia and TR)."