Status Review on Gas Network Infrastructure and Security of Supply in the MEDREG Region

Final Document

Ad hoc Group on GAS

Doc Med12-13GA-3.3d

June 2012

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Table of Contents

EXECUTIVE SUMMARY 4

1. Introduction 6

1.1. Background of the Review 6

1.2. Aim of the Review 6

1.3. Methodology and Limitations 6

2. Natural Gas Network Infrastructure in the MEDREG Region 7

2.1. Gas Figures and Trade 8

2.1.1. Basic Natural Gas Figures of the MEDREG Region 8

2.1.2. Intra and Inter-regional Gas Trade 10

2.2. Gas Infrastructure and Trade in the Mediterranean 12

2.2.1. Western Mediterranean 12

2.2.2. Central Mediterranean 14

2.2.3. Eastern Mediterranean 15

2.2.4. Complete Pipeline and LNG Map of the Mediterranean 16

3. Security of Supply 17

3.1. Security of Gas Supply Risks: 17

3.1.1. Share of Import Gas in Consumption 18

3.1.2. Diversification of Sources 18

3.1.3. Resilience Capacities 19

3.2. Overall Analysis of Security of Supply Conditions of MEDREG Countries. 22

3.3. Export Countries and Security of Supply 24

4. Overall Analysis of Gas Network Infrastructure and Security of Supply in the Mediterranean 25

APPENDIX 1 Applying security of supply indicators to countries 28

APPENDIX 2 Infrastructure and Security of Supply Questionnaire 29

LIST OF TABLES

TABLE 1 RESPONSE TO QUESTIONNAIRES 7
TABLE 2 MEDREG NATURAL GAS CONSUMPTION IN THE WORLD 8
TABLE 3 GAS TRADE AMOUNTS IN THE MEDITERRANEAN (BCM) 11
TABLE 4 IMPORT CAPACITIES 20
TABLE 5 UNDERGROUND STORAGE (BCM) 22
TABLE 6 SECURITY OF SUPPLY INDICATORS 22
TABLE 7 RESERVES TO PRODUCTION RATIO 24
TABLE 8 EXPORT DIVERSIFICATION OF NET GAS EXPORTERS (BCM/YEAR) 24

List of Figures

FIGURE 1 NATURAL GAS CONSUMPTION OF MEDITERRANEAN COUNTRIES (BCM) 8
FIGURE 2 GAS CONSUMPTION PER PERSON (M3/Y) 9
FIGURE 3 GAS INTENSITY (EXPORT+CONSUMPTION BCM/$1000 OF COUNTRY GDP) 10
FIGURE 4 GAS TRADE LINKS AROUND MEDITERRANEAN 12
FIGURE 5 GAS INTERCONNECTION CAPACITIES AND TRADE IN THE WESTERN MEDITERRANEAN 13
FIGURE 6 GAS INTERCONNECTION CAPACITIES AND TRADE IN THE CENTRAL MEDITERRANEAN 14
FIGURE 7 NEW GAS NETWORK INFRASTRUCTURES IN THE MEDITERRANEAN 15
FIGURE 8 GAS INTERCONNECTION CAPACITIES AND TRADE IN THE EASTERN MEDITERRANEAN 16
FIGURE 9 COMPLETE MAP OF GAS NETWORK INFRASTRUCTURE 17
FIGURE 10 HHI OF MEDITERRANEAN COUNTRIES 18
FIGURE 11 MARKET SHARES OF EXPORT COUNTRIES 19
FIGURE 12 ANNUAL IMPORT / IMPORT CAPACITY (%) 21
FIGURE 13 COUNTRY-BASED SECURITY OF GAS SUPPLY SITUATIONS OF MEDITERRANEAN COUNTRIES 23

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EXECUTIVE SUMMARY

The gas consumption levels of Mediterranean countries hugely vary across the region. We can mainly group countries into two: countries consuming high amount of gas (more than around 30 BCM/year): Italy, France, Turkey, Egypt, Spain and Algeria; and countries with less gas consumption (around 5 BCM/year and below). The average gas consumption (excluding countries of non-consumers), appears to be 13 BCM that separates these two groups. The heavily unbalanced figure regarding gas consumption populations becomes smoother when per person and gas intensity figures are considered.

Mediterranean energy markets can be geographically divided into Western, Eastern and Central Mediterranean regions. Gas trade links are vertical not horizontal, making three separated zones in the region. For the western Mediterranean, the vertical link creates a regional market stretching from Algeria, through Spain and France, to the Netherlands. In the central Mediterranean, Italy is the main figure along with producer countries Algeria and Libya. Interconnections with Slovenia and Croatia are very critical for these countries to get chance of diversifying their resources. The trade links are not complete in Eastern Mediterranean, notwithstanding. In the South-East Mediterranean, Egypt is the main actor as it exports gas to three of the regional countries. Turkey on the North-west is critical in terms of its potential for serving as a hub and a transit country. However, there is no interconnection between Syria and Turkey that completes the missing link in this region.

Main risks for security of gas supply are the external dependence of import countries. At this point, following points define the dimension of the risk: Share of import gas in gas consumption, diversification of sources and gas intensity. Accordingly, greater share of imported gas in consumption, lesser diversification of sources and higher share of gas in Gross Domestic Product (GDP) raise the security of supply concerns. Gas diversification is an important problem, especially for countries having relatively smaller gas consumption. Seven countries depend on a single import supplier. Only three countries, Italy, Spain and France have largely diversified imports. The single supplier problem is more critical for countries that don't have indigenous production; case for Jordan, Morocco and Bosnia Herzegovina.

The risks to the security of supply can be alleviated through resilience capacity of a country. These mechanisms include number of border transmission entry points, maximal technical capacity (MTC) of entry points, number and capacity of LNG terminals, working gas capacity and withdrawal rate of storage facilities. For exporting countries, these mechanisms include maximum technical production capacity as well as reserves to production ratio. Only six countries have underground storage facility. However, Turkey and Portugal's capacity, in the face of their annual consumption, is quite low. Another problem for Turkey is that the daily withdrawal capacity is low, taking daily consumption amounts into account. Spain's storage capacity (currently amounting 13 percent of the annual consumption), is expected to increase in such a way to highly diminish short term security of supply concerns. Another noteworthy point is that six of regional countries depend on single interconnection without any LNG terminal or any storage facility. Supply disruption in these countries would lead to serious consequences.

The security of supply concern is also valid for gas exporting countries as gas exports play part in their economy. Any risk in the continuity of supply also poses threat to the exporters. Main risk factors include production capacity, reserves to production ratio, export capacities and facilities as well as diversification of routes and importers.

Security of supply in the Mediterranean Region will best be maintained by mutual cooperation and harmonization of trading rules. Establishment of a common regulatory understanding and level-playing field among the trading partners would institute a common market and increase the elasticity in the face of gas supply disruption.

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1. Introduction

1.1. Background of the Review

The Ad-Hoc Group on Gas (GAS AG) was established in order to seek cooperation opportunities among MEDREG members, to create level-playing field through Mediterranean and to function as a platform of best practice-sharing regarding the regulation of gas markets. One of the first comprehensive fruits of these works was the Benchmarking report which was prepared in 2008. The benchmarking report well provided a clear portrait of status of gas markets in the Mediterranean.

During the 7th Gas Ad hoc Group meeting, held in Madrid, September 2010, it was agreed to set up task forces in the fields of transparency, third party access and infrastructure and security of supply. The task on preparing a review of infrastructure and security of supply was assigned to Energy Market Regulatory Authority (EMRA) of Turkey. EMRA has initiated the task by preparing a questionnaire (see Appendix 2). The questionnaire was circulated among the members during the first half of 2011 and, initial findings of the study were shared during the 8th General Assembly as well as 9th Gas Ad hoc Group meeting.

The review is finalized by sharing its final version with Gas Ad hoc Group members and after approving during the 10th Gas Ad Hoc Group meeting.

1.2. Aim of the Review

The review aims at providing an updated picture of gas network infrastructure and security of supply situations of the Mediterranean countries. By doing so, the review would enable MEDREG members to visualize the “Mediterranean gas market”. On the other hand, the review allows members to compare and analyze their security of supply situations among other members.

The review also questions the feasibility of creating a Mediterranean ring and discusses possible problems in setting path for a level playing field. It sets a basis for works on cooperation opportunities on supply security both for gas-importing and gas-exporting countries.

1.3. Methodology and Limitations

The review is mainly based on the questionnaire circulated in the first half of 2011 among MEDREG gas AG members. As Table 1 shows, not all members have responded the call for filling the questionnaire. In this case, we used the data submitted for the 2008 benchmarking report questionnaire where possible. For some other data, BP Statistical Review, International Energy Agency Statistics and European Network of transmission network operators for gas (ENTSOG) sources were used. The data laid in the Tables, figures and maps is based on compilation of these sources; and they are separately noted in the relevant table, figure or map. As a consequence of this compilation, reference years are not noted in the tables/figure etc, as different sources are used. However, the review is revised by the MEDREG members and values are updated with their comments. This makes the review to be based on the most updated information (final recirculation was made in May, 2012).

Table 1 Response to Questionnaires

MEMBERS	2008 Questionnaire	2011 Questionnaire
Bosnia	√	√
Croatia	√	√
France	√	√
Jordan	√	√
Portugal	√	√
Slovenia	√	√
Spain	√	√
Turkey	√	√
Algeria	√	no answer
Greece	√	no answer
Israel	√	no answer
Italy	√	no answer
Tunisia	√	no answer
Morocco	√	no answer
Egypt	no answer	
Lebanon	not member	
Libya	not member	
Syria	not member	

Main limitation of the Review was that not all data for security of supply was available and cannot be reached via the over-mentioned sources. Though some members have provided some data, it was not enough to make a cross-country analysis. At this point we benefitted from the most relevant available data. Another noteworthy point is that the study only focuses on the Mediterranean countries having gas network.

2. Natural Gas Network Infrastructure in the MEDREG Region

This section provides basic figures of the MEDREG countries in terms of their natural gas consumption, the role of gas in their economies and gas trade in the region.

2.1. Gas Figures and Trade

Establishment of Mediterranean scale gas market and development of cooperation opportunities in the region mainly aims to foster gas trade among the member countries. However, natural gas is not a must-use energy resource and some of the regional countries do not have gas consumption; and some have relatively less dependence on gas. The following sections outline the role of gas in the members' economies.

2.1.1. Basic Natural Gas Figures of the MEDREG Region

Figure 1 shows the gas consumption levels of Mediterranean countries. We can mainly group countries into two: countries consuming high amount of gas (more than around 30 BCM/year): Italy, France, Turkey, Egypt, Spain and Algeria; and countries with less gas consumption (around 5 BCM/year and below). The average gas consumption (excluding countries of non-consumers), appears to be 14 BCM that separates these two groups.

Figure 1 Natural Gas Consumption of Mediterranean Countries (bcm)

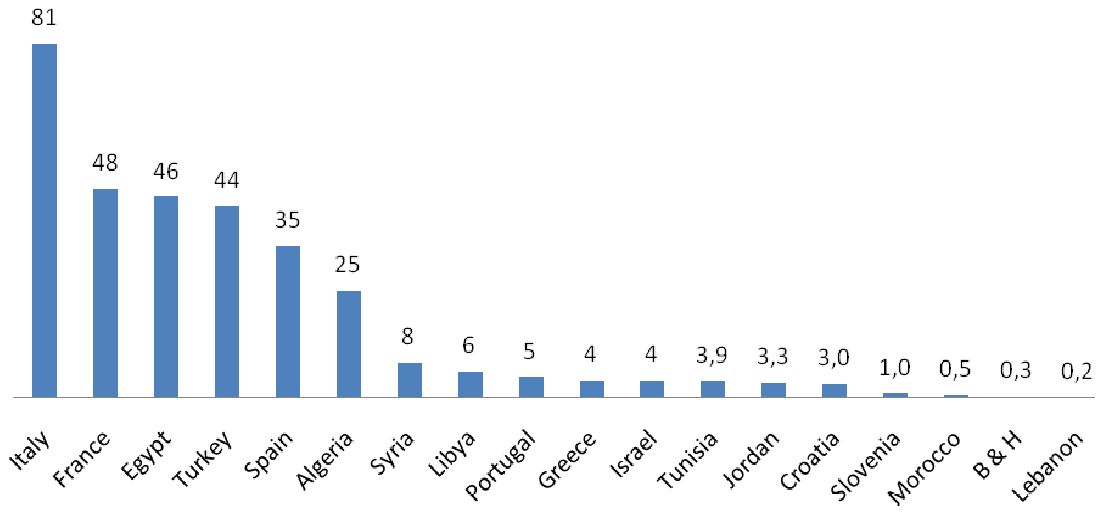


Table 2 MEDREG Natural Gas Consumption in the World

	Amount (bcm/y)	Share	Average by Country (bcm/year)	Gas Consumption (m3/y) per Person
Total World	3193	100%	16	425
European Union	492	16%	18	918
OECD	1546	50%	44	1.206
MEDREG	**308**	**9%**	**14**	623

Gas consumption in MEDREG as it is shown in Table 2, around 300 BCM/year, is relatively low compared with the EU and OECD figures. The average gas consumption per country is also even below world averages.

Mediterranean countries vary across their GDP from 16 million $ to 2 000 billion $. This huge variation also exists in terms of the population. While Slovenia has the population around 2 million, Egypt tops the population list with 78 million citizens. A more plausible analysis regarding the role of natural gas in each member economy should regard these variations by using relative numbers.

Figure 2 Gas Consumption per person (m3/y)

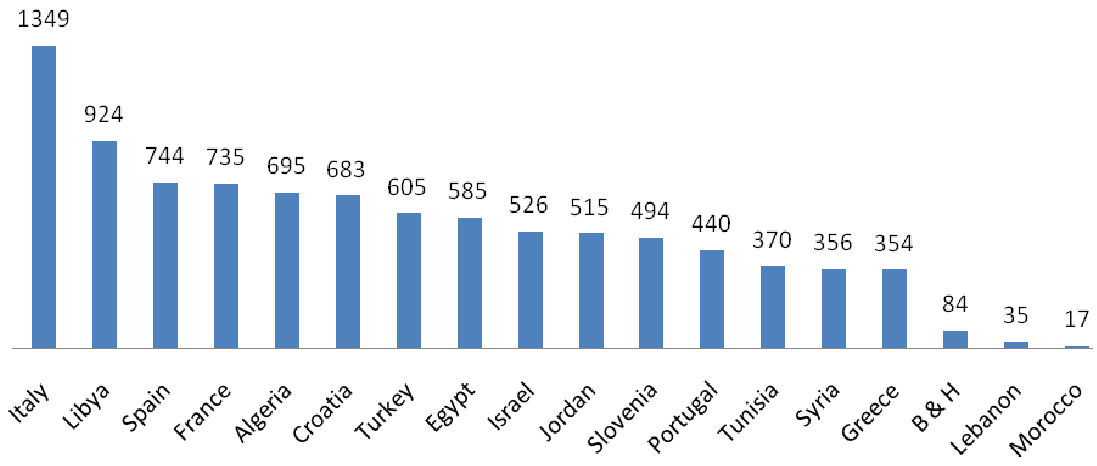
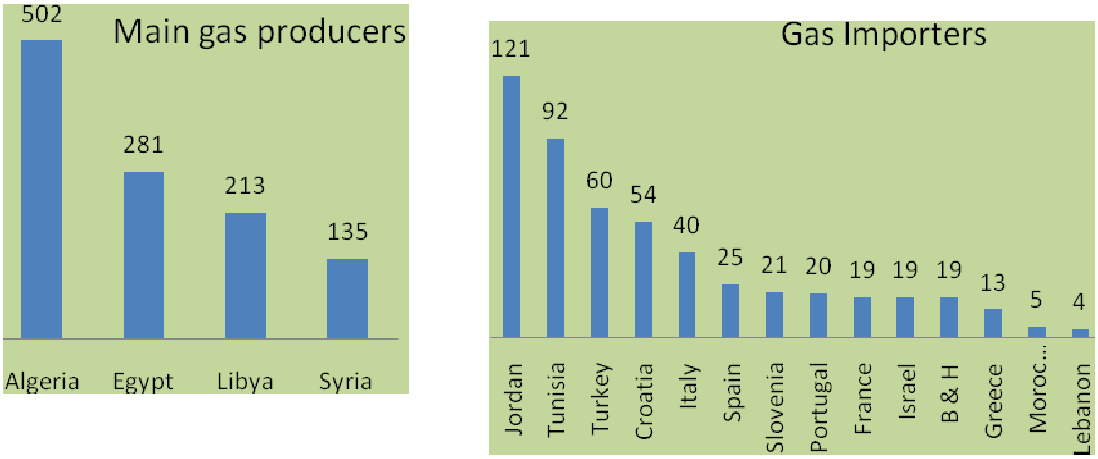


Figure 2 demonstrates natural gas consumption per person among MEDREG countries. The heavily unbalanced figure regarding gas consumption populations becomes smoother when per person figures are considered. Gas consumption per person does not hugely diversify excluding outliers Italy, Lebanon, Bosnia and Morocco; 13 of the Mediterranean countries consume around 400 to 800 cubic meters per person. In terms gas consumption, then, gas is much more important for Italy than any other member. For Bosnia, Lebanon and Morocco, natural gas consumption is highly lower than world averages. Croatia, on other hand, has high per person level of consumption despite its low ranking of absolute amounts shown in Figure 1.

Figure 3 Gas Intensity (export+consumption bcm/$1000 of country GDP)



Despite the population figures give some clues about the role of gas in MEDREG countries, they lack insights into fragmentation among power generation, household and industry consumption. Another perspective could be developed by the gas usage (consumption and export) per unit of GDP. As it is shown in Figure 3, natural gas producer countries are heavily dependent on gas in their economies overall. Jordan, Syria and Tunisia, albeit being net-importers also show high levels of gas usage per unit of GDP, which is less likely a result of house-hold consumption considering warm climates of these countries. Turkey, for its part, has also highly gas intense economy for a country that has negligible gas production. For Morocco and Lebanon, natural gas has minor role in the overall economy. The rest of the countries have closer appearances in terms of the gas usage per unit of GDP and also around world average.

2.1.2. Intra and Inter-regional Gas Trade

There are 3 net gas exporters in the region: Algeria, Egypt and Libya, having annual production amounts of 80 bcm, 61 bcm and 16 bcm respectively. Main net importers are Italy, 73 bcm/y, France 48 bcm/y, Turkey 44 bcm/y and Spain 35 bcm/y, while the rest of the imports are totally around 17 bcm/y. There is nearly a balance between the total production, 181 bcm/y, and total imports, 203 bcm/y. Arguably, trade pattern in the region diverse and gas trade is also made out of the regional countries.

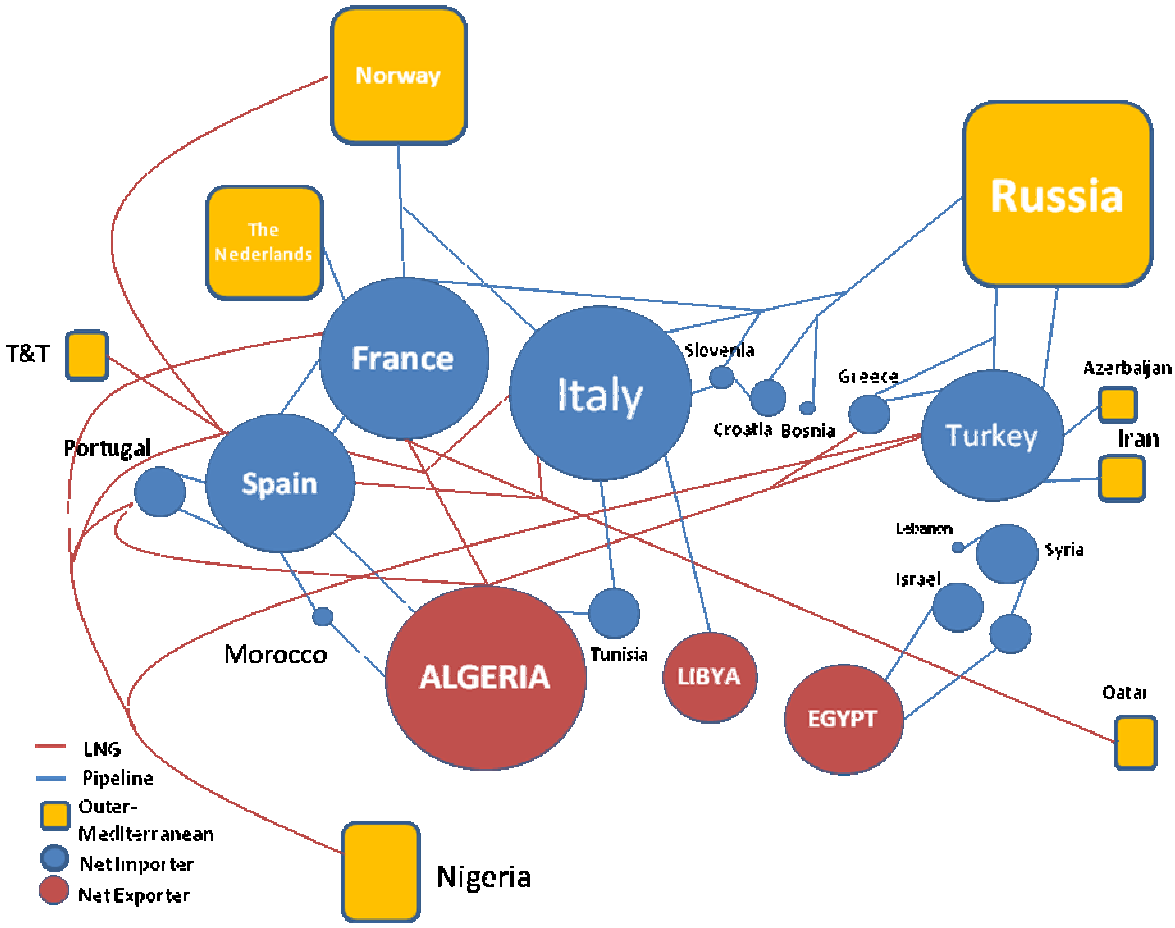
Table 3 outlines the trade links in the region. As it is pointed out above, 14 of the MEDREG countries are net importers of natural gas. There are 18 different sources of these imports from highly divergent geography.

Table 3 Gas trade amounts in the Mediterranean (bcm)

	Norway	Algeria	Russia	Qatar	Egypt	T&T	Oman	Nigeria	Yemen	France	Italy	Spain	ND	Libya	Turkey	AZ	Iran	Austria	TOTAL
Italy	5,8	28	14	6,2	0,7	0,3							8,1	9,4					**72,5**
France	16,2	8,1	8	2,4	0,7	0,4		3,60	0,1			0,7	8,1						**48,3**
Turkey		4,2	25	1,2	0,4			1,20								3,8	8		**43,8**
Spain	3,3	12		5,5	2,6	3,3	0,2	7,80	0,2	0,2				0,3					**35,4**
Syria					0,7														**0,7**
Israel					2,1														**2,1**
Portugal		2						3											**5,0**
Tunisia		1,3																	**1,3**
Greece		1	2		0,1	0,1									0,7				**3,9**
Jordan					2,5														**2,5**
Croatia			1,04								0,1								**1,1**
Slovenia		0,3	0,49															0,2	**1,0**
Morocco		0,5																	**0,5**
Bosnia			0,2																**0,2**
Lebanon					0,15														**0,2**
TOTAL	**25,3**	**57,4**	**50,7**	**15,3**	**9,95**	**4,1**	**0,2**	**14,6**	**0,3**	**0,2**	**0,1**	**0,7**	**16,2**	**9,70**	**0,7**	**3,8**	**8**	**0,2**	**218,5**

Focusing on the regional trade, Figure 4 charts the trade links among Mediterranean countries. Size of the figures represents the share of the indicated country's gas in the MEDREG region. While Algeria is topping the list with 57 bcm export, both via pipelines and in LNG form, Russia almost twice next-comer with 50 bcm. Other big suppliers are Norway, The Netherlands, Nigeria, Egypt, Libya and Qatar.

Figure 4 Gas Trade Links around Mediterranean



2.2. Gas Infrastructure and Trade in the Mediterranean

As the Figure 4 depicts, Mediterranean energy markets can be geographically divided into Western, Eastern and Central Mediterranean regions, enabling us to develop a more straightforward analysis.

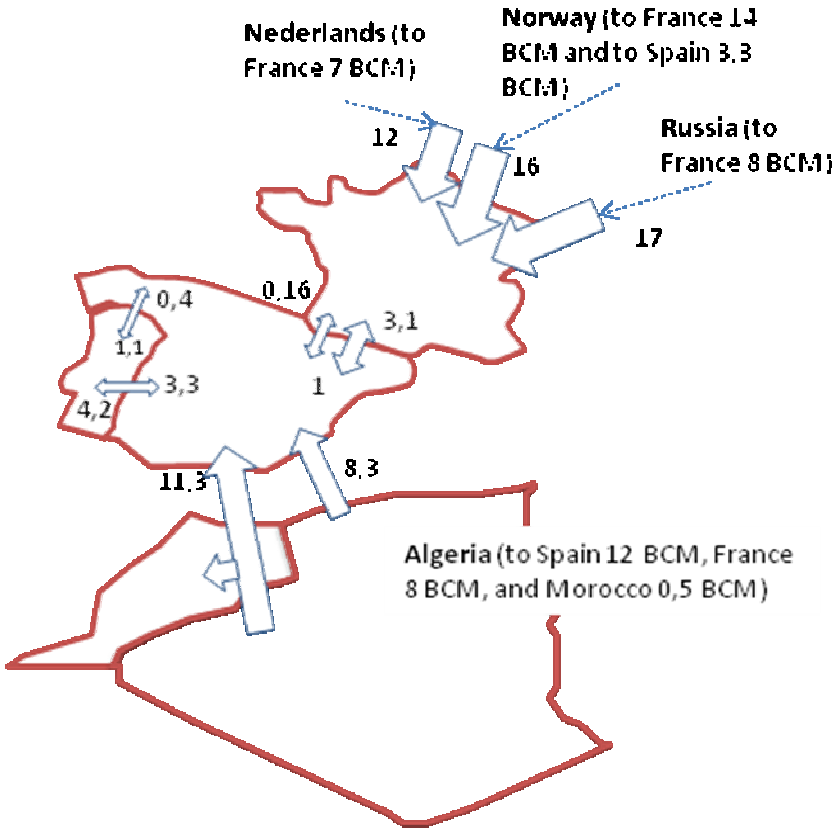
2.2.1. Western Mediterranean

Five MEDREG countries have established closer trade binds in the western Mediterranean. While Algeria is the major regional gas supplier, Spain and France are significant and Portugal and Morocco are relatively smaller gas-importer countries.

Figure 5 shows the interconnection capacities and gas trades in the western Mediterranean. As it is seen from the trade amounts (mostly 2010 values), Algeria has largest shares in Spain and France, and it is the unique gas supplier of Morocco. In the Figure 5, relative capacities of the interconnection points are shown with the size of arrows with numbers in bcm/year. There are two bidirectional interconnection capacities between Portugal and Spain as well as between Spain and

France. These capacities are limited comparing to the interconnection points from Algeria to Spain and other import points to France. These weak capacities (especially the ones between Spain and France) don't allow greater amounts gas flow among northern Algeria to France and from northern Europe to Spain/Portugal.

Figure 5 Gas Interconnection Capacities and Trade in the Western Mediterranean[1]



On the other hand, cross-border capacities between France and Spain are being developed: Up to 5,5 bcm/year in Larrau as of 2013 (in both flow senses) and up to 2 bcm in Irún-Biriatou as of 2015 (from Spain to France). This would serve to the further diversification of resources in both sides of the border. A similar process is underway in the France – Belgium border. The Belgium-France Open Season organised in 2008 led to the decision to develop new capacities at the entry point of Taisnières H (+300 GWh/d by the end of 2013).

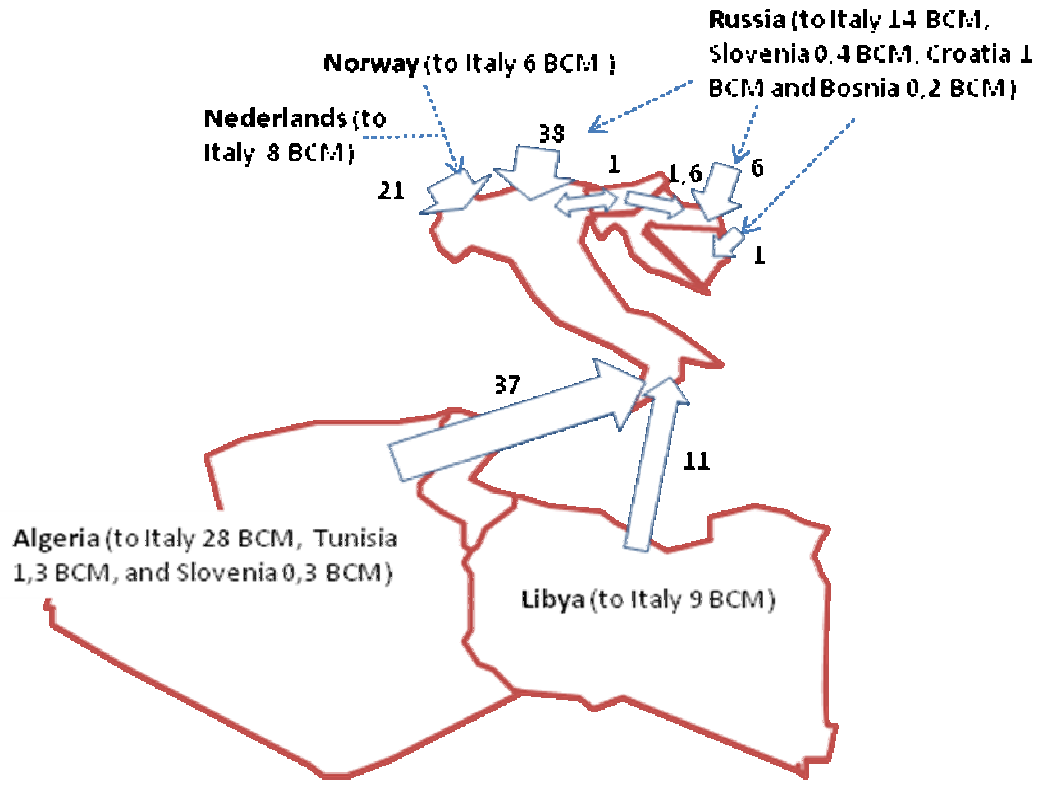
[1] In-parentheses amounts show the yearly traded gas amounts, numbers next to the arrows show annual capacity of the interconnection pipeline. This is also valid for Figure 6 and Figure 7.

2.2.2. Central Mediterranean

There are two main regional supplier countries in the central Mediterranean, Algeria and Libya; and one main consumer country: Italy. Tunisia, Bosnia, Croatia and Slovenia consume smaller amounts of gas. Algeria supplies around 18 bcm gas to Italy via undersea pipeline with the capacity of 37 bcm/y.

Italy imports gas from highly diversified routes with 5 interconnection points. Slovenia and Croatia also benefit from two interconnection points, while Slovenia-to-Italy connection provides bidirectional flow. There appear two main captive countries, Bosnia with one interconnection Russia and on the supplier side, Libya to Italy. Tunisia also has single interconnection (with Algeria), but it indigenous production provides some degree of diversification.

Figure 6 Gas Interconnection Capacities and Trade in the Central Mediterranean

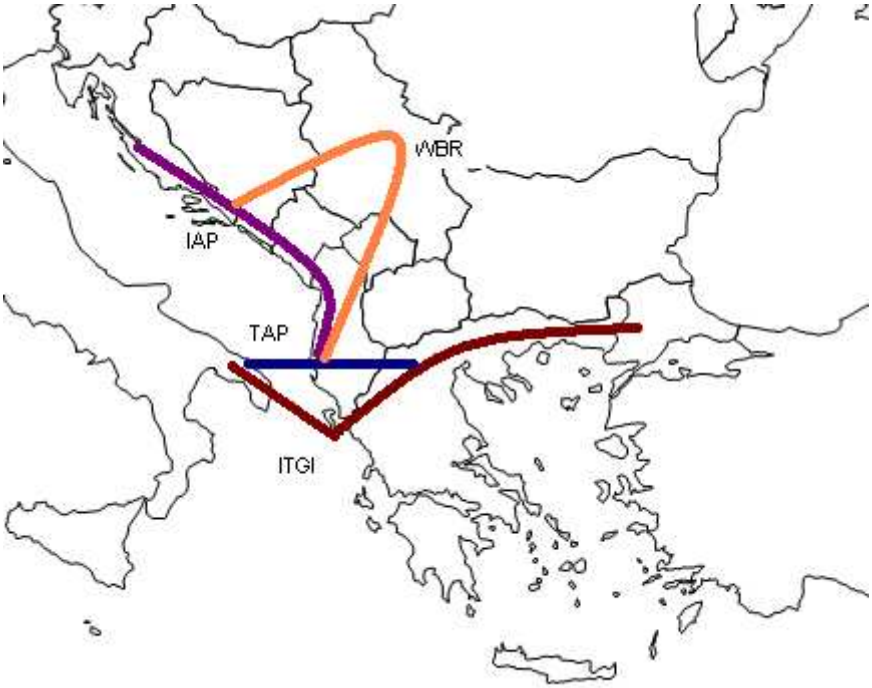


The first step of Interconnector Turkey-Greece-Italy (ITGI) project has been completed in 2007 and Greece has started receiving gas from Turkey. The connection between Greece and Italy is expected to be completed in 2018, and so Italy will start to receive gas from another source to ensure security of supply via further diversification.

The continuing infrastructure construction in the Balkan region is going to provide gas to Albania and Montenegro as well as help Bosnia and Croatia to diversify the import routes. The gas transmission pipeline Bosiljevo - Split - Ploče with capacity of 7.5 bcm/year is planned at the southern part of Croatia (Dalmatia region) and it would allow the link with Ionian Adriatic Pipeline (IAP). The ongoing Ionian - Adriatic Pipeline (IAP) will enable the connection of the Croatian gas pipeline system

with the planned Trans Adriatic Pipeline (TAP). With the objective of the IAP Project realization, a Ministry Declaration was signed by the representatives of the relevant ministries of the Republic of Albania, Montenegro and the Republic of Croatia in 2007. In December 2008, Bosnia and Herzegovina signed the Ministry Declaration. Preliminary and research work, preceding the full feasibility study is in progress, as well as the forming of a Interstate Committee, as a coordination and supervision authority of the IAP project, consisting of representatives of the relevant ministries of the Republic of Albania, Montenegro, Bosnia and Herzegovina and the Republic of Croatia. The financing of the project will be both public and private (Plinacro, EGL Switzerland and possibly KfW).

Figure 7 New Gas Network Infrastructures in the Mediterranean



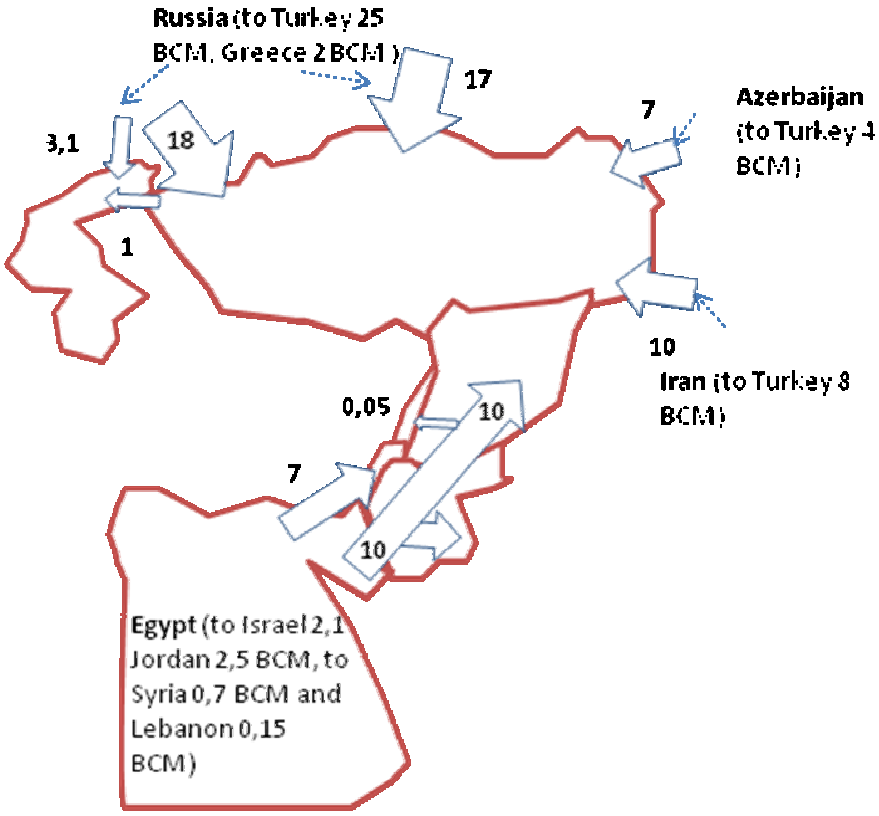
Aside from IAP, Western Balkan Ring (WBR) is of critical importance for Balkan States. Bosnia, for example, will benefit from two other interconnections, one with Croatia and the other with Serbia. These new investments would relieve Bosnia's one route and one resource dependence.

2.2.3. Eastern Mediterranean

Eastern Mediterranean has one big importer and one big exporter: Turkey and Egypt, respectively. Nevertheless there exists no gas trade among these countries. While Egypt provides gas to Jordan, Syria, Israel and Lebanon, Turkey imports gas from Russia, Azerbaijan and Iran. A missing link between Turkey and Syria sets a barrier in completing gas ring in the eastern Mediterranean. A bilateral link in this bottleneck may serve to the interest of regional countries.

While Turkey has large interconnections in its import points, the interconnection between Turkey and Greece is small, and currently does not suffice for the huge amounts of gas transit in east-west direction. In overall, Eastern Mediterranean has important bottlenecks that limit gas trade in east-west and north-south directions.

Figure 8 Gas Interconnection Capacities and Trade in the Eastern Mediterranean



Turkey has recently signed a transit agreement, Trans-Anatolian Pipeline (TANAP), with Azerbaijan which transports Azeri gas to Europe via Turkey. 16 BCM amount (of which six bcm is for Turkey and ten bcm for transit) is contracted to be carried out through this pipeline. Turkey is also planning to import gas from Iraq, and connect to the Arab pipeline in Syria border. These new interconnections will enable Turkey to gain a hub position, and bridge the eastern side of the Mediterranean gas ring.

2.2.4. Complete Pipeline and LNG Map of the Mediterranean

Figure 9 adds LNG terminals to the complete infrastructure picture of the Mediterranean. As it is seen from the map, there are 14 LNG regasification and 4 liquefaction terminals in the region. Spain has benefit from 6 facilities, while Italy, France and Turkey own two and Greece and Portugal one. Spain is continuing to invest in LNG terminals. According to the Planning document 2008-2016, regasification capacity is planned to increase by 71% and LNG tank capacity to 142%. France is also building new LNG terminals in Dunkirk and Fos Faster. Other LNG regasification terminals are projected to be built in Croatia, Albania, and Greece along with Turkey.

Figure 9 Complete Map of Gas Network Infrastructure

When it comes to the pipeline interconnections, we can see that western and central Mediterranean is highly interconnected. Eastern Mediterranean, in the other hand has some missing links discussed above.

3. Security of Supply

This part analyses the exposed risks as well as resilience capacities of MEDREG countries. Risks include the import dependence ratios and diversification of sources and/or routes. Resilience capacities, on the other hand, mainly include technical capabilities and number/capacity of entry points, storage facilities along with LNG ports.

3.1. Security of Gas Supply Risks:

Following points define the dimension of the risk:

- Share of import gas in gas consumption
- Diversification of Sources
- Gas Intensity

Arguably, greater share of imported gas in consumption, lesser diversification of sources and higher share of gas in GDP raise the security of supply concerns.

3.1.1. Share of Import Gas in Consumption

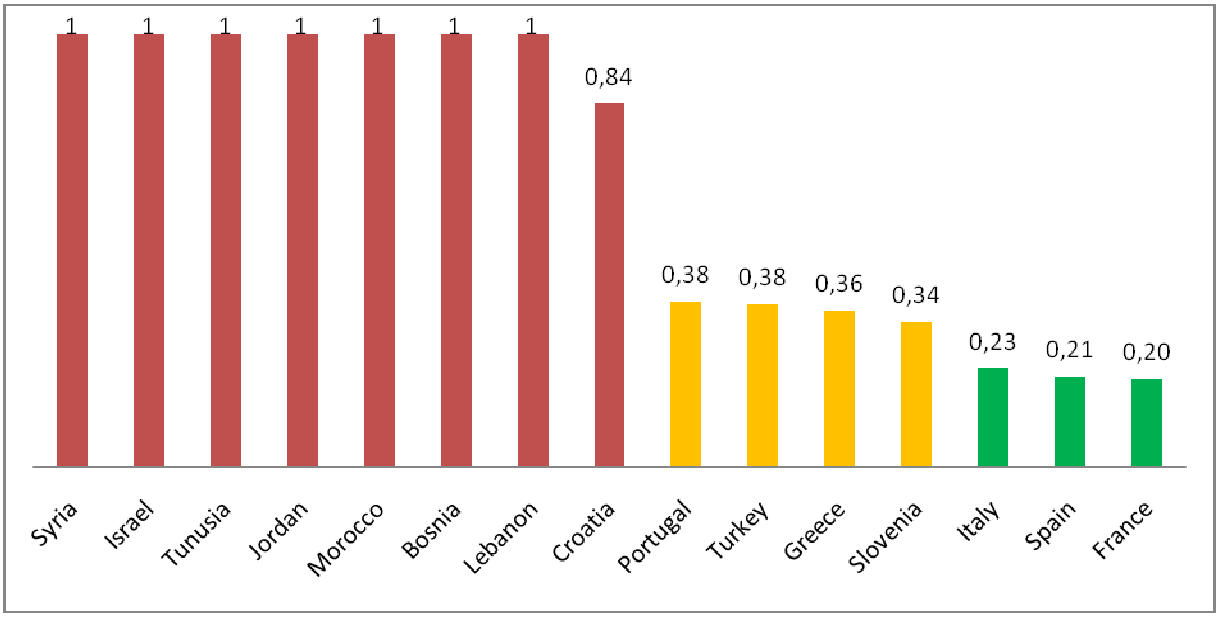
As it is pointed out in section 2.1.2, only three net exporting countries exists in the region (Algeria, Egypt and Libya) while the rest are net importers. Among gas importing countries only Syria has considerable production for its own consumption. All the other countries, especially including the four big consumption countries (Italy, France, Spain and Turkey) are heavily dependent on import gas with small production in Italy and negligible indigenous production in the other three.

3.1.2. Diversification of Sources

Diversification of sources helps the import country to manage possible problems with the source country by balancing with other sources. As far as the market is heavily dominated by single source the security of supply concern grows. A much referred way of calculating market dominance is Herfhindal-Hirchman Index (HHI) which aggregates the squares of the individual market shares[2].

HHI indexes of MEDREG countries are as follows:

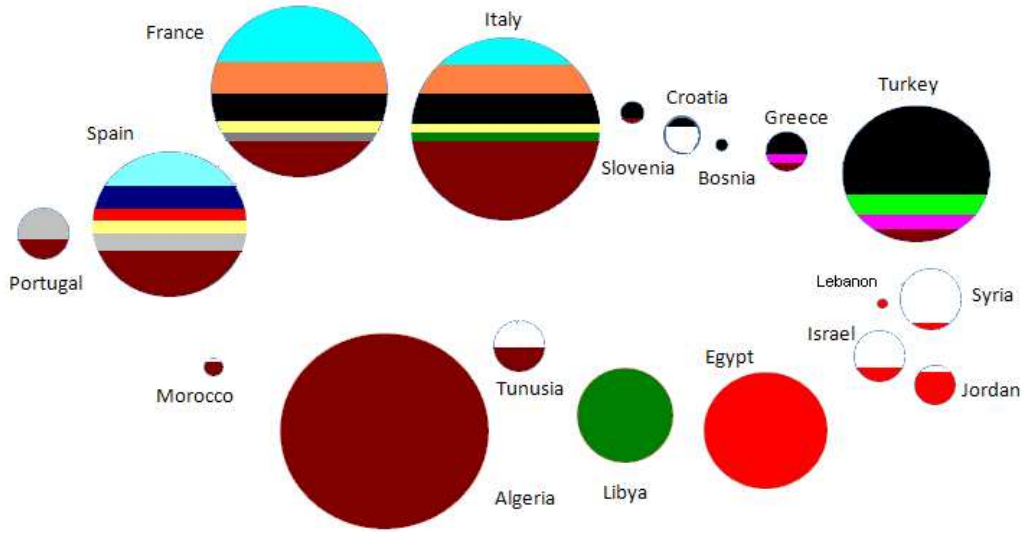
Figure 10 HHI of Mediterranean Countries



As the Figure 10 depicts six of the regional countries are under the absolute dominance of a single exporting country. While Tunisia and Morocco are under Algerian monopoly, Israel, Jordan, Syria and Jordan are dominated by Egyptian gas. Bosnia, on the other hand, is supplied by gas by a non-regional country: Russia. Croatia is not dominated by a single source but their HHI is still high. France, Italy and Spain are the three regional countries having HHI below 0,3 and with a desired level of market concentration ratio.

[2] To avoid misunderstanding, this figure illustrates HHI on source country basis not on the importer company basis.

Figure 11 Market Shares of Export Countries



	Algeria	26%		Egypt	5%
	Russia	23%		Libya	4%
	Norway	12%		Iran	4%
	Nederland	7%		T&T	2%
	Nigeria	7%		Azerbaijan	2%
	Qatar	7%			

3.1.3. Resilience Capacities

The risks to the security of supply can be alleviated through resilience capacity of a country. These mechanisms include number of border transmission entry points, maximal technical capacity (MTC) of entry points, number and capacity of LNG terminals, working gas capacity and withdrawal rate of storage facilities. For exporting countries, these mechanisms include maximum technical production capacity as well as reserves to production ratio.

Table 4 gives an idea regarding the resilience capacities of Mediterranean countries. Annual import capacity is very high in Italy, France, Spain and Turkey. But the import capacity should be considered in terms of the annual consumption amounts. The ratio is still high in France and Spain, but not in Italy and especially Turkey has lower rankings. Turkey has the lowest ratio of import amounts to import capacity. The excessively high import capacity to consumption ratios of Morocco, Tunisia and Jordan should not be misleading as heavy amounts of transit gas pass through these countries. Another noteworthy point is that import capacity alone is not enough to get grips of the technical constraints. Transport capacity is also crucial in securing gas supply considering bottlenecks within a country could pose a risk. Due to lack of data, however, the review doesn't put forward an analysis on this subject.

Table 4 Import Capacities

Country	Border/LNG	Name of the point	*GWh/d*		
Italy	Border Entry	Passo Gries	*637*	3210,9	**3648,4**
		Tarvisio	*1136*		
		Gorizia	*28*		
		Mazara Del Vallo	*1088*		
		Gela	*323*		
	LNG	Panigaglia	*147*	437,5	
		Porto Levante	*291*		
France	Border Entry	Taisnieres (H)	*590*	2015	**2795**
		Taisnieres (B)	*230*		
		Obergailbach	*620*		
		Biriatou	*5*		
		Dunkirk	*570*		
	LNG	Montoir De Bratagne	*370*	780	
		Fos Tonkin / Cavaou	*410*		
Spain	Border Entry	*Tarifa*	*355*	848	**2763,4**
		Almería (2011)	*266*		
		Badajoz	*105*		
		Tuy	*12*		
		Irún	*10*		
		Larrau	*100*		
	LNG	Barcelona	*544*	1915,4	
		Sagunto	*279*		
		Cartagena	*377*		
		Huelva	*377*		
		Mugardos	*115*		
		Bilbao	*223*		
Turkey	Border Entry	Malkoçlar	*547*	1554,2	**1960,198**
		Durusu	*504*		
		Gürbulak	*304*		
		Turkgözü	*199*		
	LNG	Aliağa	*171*	406,0	
		M. Ereğlisi	*235*		
Portugal	Border Entry	Valença do Minho	*122*	145,2	**331,7**
		Campo Maior	*23*		
	LNG	Sines	*187*	186,5	
Greece	Border Entry	Kipi	*30*	139	**286,5**
		Kula	*109*		
	LNG	Revythoussa	*148*	147,5	
Croatia	Border Entry	Zabok	*46,7*	224,5	**224,5**
		Donji Miholjac	*178*		
Slovenia	Border Entry	Sempeter	*28*	27,9	**103**
		Ceršak	*75*	75	
Bosnia	Border Entry	Sepak	*25,2*	25,2	**25,2**
Syria	Border Entry	Rehab	*292*	292	**292**
Jordan	Border Entry	Aqaba	*292*	292	**292**
Israel	Border Entry	Ashqelon	*204*	204	**204**
Tunisia	Border Entry	Qued es Saf Saf	*794*	794	**794**
Morocco	Border Entry	Morocco	*330*	330	**330**

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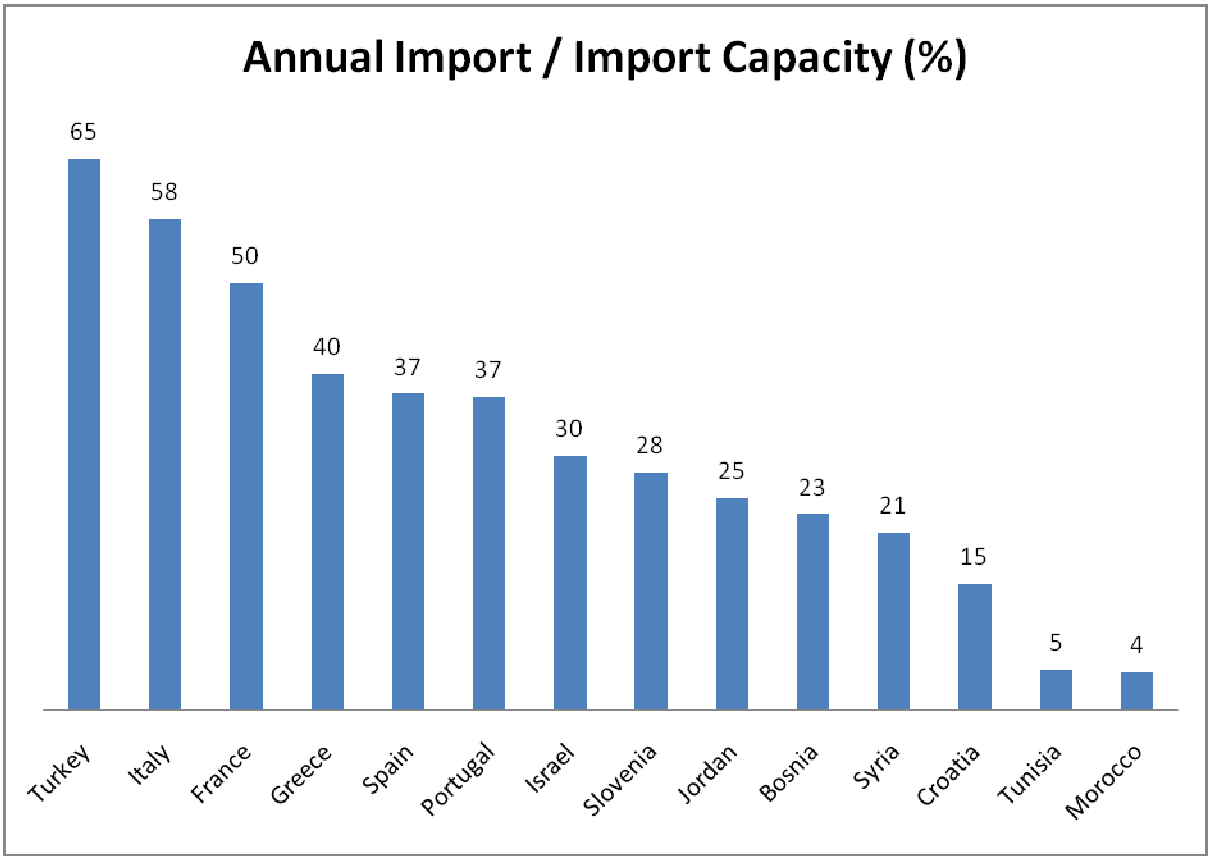
The LNG import capacity is also a significant relief mechanism for security of supply as it allows gas importing countries to easily diversify sources. At this point, Spain has great advantage in terms of number and send-out capacities of LNG terminals: 6 LNG terminals provide the opportunity of nearly 2000 GWh daily gas send-out. Italy, France and Turkey with two, Portugal and Greece with one LNG terminal, also benefit from the reliance factor of LNG facilities.

Figure 12 Annual Import / Import Capacity (%)



Storage capacity is another resilience mechanism for alleviating security of supply risks. As Table 5 demonstrates only six Mediterranean countries have storage facilities. Despite having underground facilities, Turkey, Spain and Portugal's reservoir withdrawal capacities fall short of their gas demand profile. Turkey can store 6 percent of its annual consumption and its daily withdrawal capacity can meet around one fifth of its average daily consumption; short reservoir withdrawal capacity in Portugal is compensated by the new LNG reservoir which allows a better withdrawal capacity. Relatively better in daily withdrawal capacity, Portugal cannot fully rely on underground storage facilities.

Table 5 Underground Storage (bcm)

	Reservoir Capacity	Daily withdrawal Capacity	Reservoir Capacity / Annual Demand (%)	Average Daily consumption / Daily withdrawal capacity (%)
Italy	15,500	0,275	21	138
France	12,900	0,274	30	233
Turkey	2,666	0,020	6	17
Spain	2,400	0,013	11	13
Portugal	0,124	0,007	3	53
Croatia	0,553	0,006	50	89

France has been trying to increase storage capacity as the existing storage facilities are planned to increase by 1.9 bcm in the next ten years. Furthermore, two projects for new storage facilities with an estimated capacity of 0.2 bcm have reached the building phase. Another significant capacity increase is ahead in Spain with an expected storage capacity increase by 238%. Bosnia, Croatia, Portugal (one reservoir planned to 2012 and two other with no determined date) and Turkey are also constructing new underground storage facilities. A storage facility in Bosnia would make a fundamental contribution to its security of gas supply. A new directive was adopted in Turkey that outlines the procedures for new storage construction. After newly built capacity underground reservoir capacity is expected to excess 4 bcm, still a low figure projected consumption levels considered.

3.2. Overall Analysis of Security of Supply Conditions of MEDREG Countries.

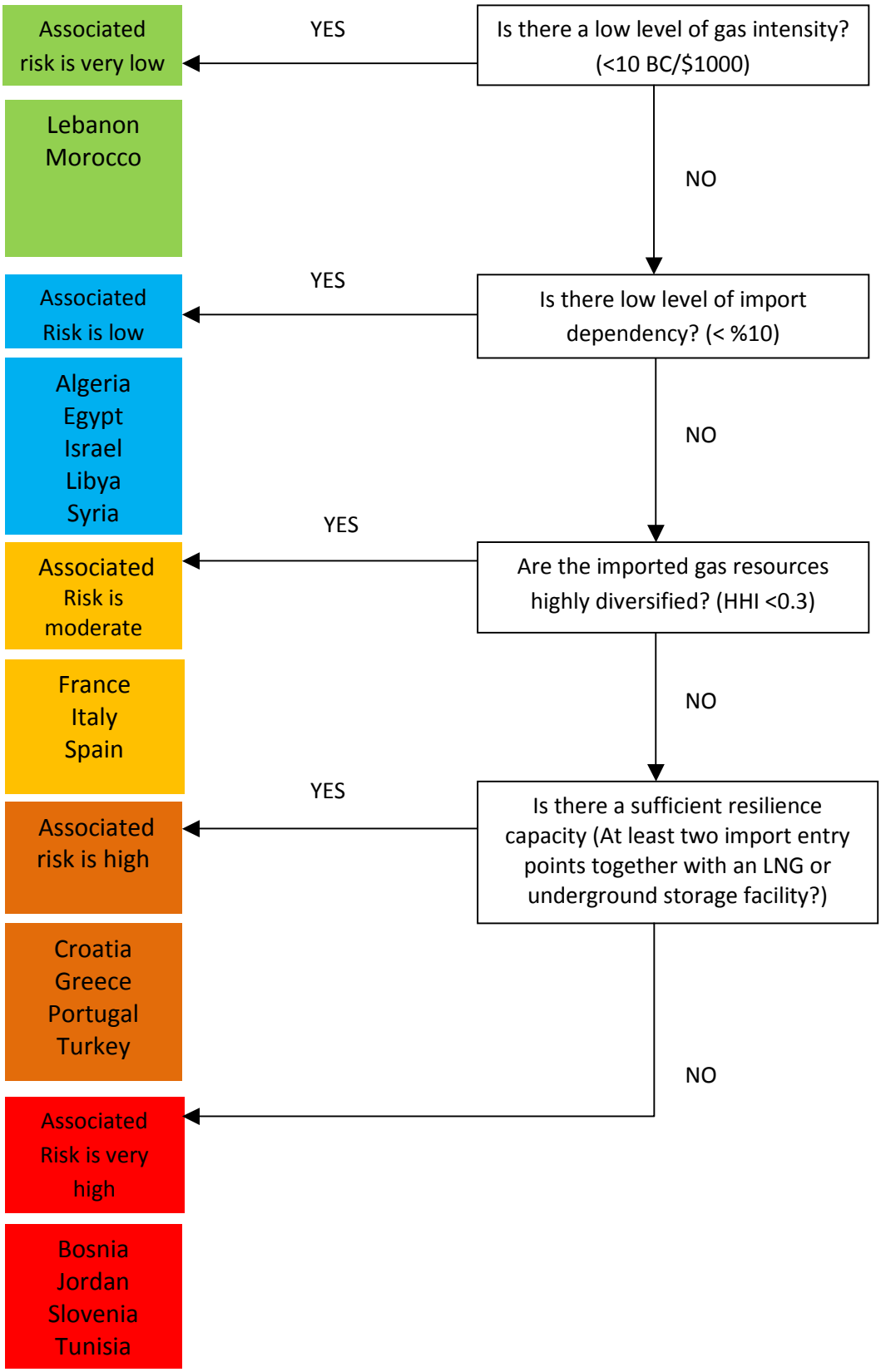
Table 6 Security of Supply Indicators

Indicator	Low	Medium	High
Gas Intensity BCM/$ 1000	< 10	10 – 60	> 60
Gas Import dependency (%)	< 10	10 – 70	> 70
Diversification of Sources (HHI)	< 3000	3000 – 6000	> 6000
Number of Border Entry points	>= 5	3 – 4	= < 2
Annual import capacity / Annual consumption (%)	< 25	25 – 75	> 75
Number of LNG Regasification Terminals	>= 3	1 – 2	0
Underground Storage Reservoir Capacity / Annual Demand (%)	> 10	1 – 10	0
Average Daily consumption / Daily withdrawal capacity	> 1	1	0

Basing on the criteria[3] outlined in Table 6 and results in Appendix 1, we can draw the below chart outlining the country-based security of gas supply situations of Mediterranean countries.

[3] The Security of Supply Criteria outlined in the Table 6 is based on a similar study of International Energy Agency on short term modeling of energy supply security. For details see: http://www.iea.org/Papers/2011/moses_paper.pdf

Figure 13 Country-based security of gas supply situations of Mediterranean countries



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3.3. Export Countries and Security of Supply

The security of supply concern is also valid for gas exporting countries as gas supplying plays a key role in their economy. Any risk in the continuity of supply also poses threat to the exporters. Main risk factors include production capacity, reserves to production ratio, export capacities and facilities as well as diversification of routes and importers.

Table 7 Reserves to Production Ratio

Qatar	>100
Nigeria	>100
Iran	>100
Libya	98,0
Azerbaijan	84,2
Russian Federation	76,0
Algeria	56,0
Egypt	36,0
Syria	33,2
Norway	19,2
Netherlands	16,6
Italy	11,1

As it is demonstrated in Table 7, main supplier countries of Mediterranean region (Algeria, Egypt and Libya) secure their long term production with high reserves-to-production ratio. On the other hand, other main gas consumer country, Italy will exhaust its gas resources in the medium term; European suppliers, Nederland and Norway will tap their reserves in short-to-medium term.

Table 8 Export diversification of net gas exporters (bcm/year)

	Algeria	Egypt	Libya
Slovenia	0,38	-	-
Morocco	0,50	-	-
Tunisia	1,25	-	-
Israel	-	2,10	-
Jordan	-	2,52	-
Lebanon	-	0,15	-
Syria	-	0,69	-
Italy	27,56	0,72	9,41
Spain	12,05	2,62	0,34
France	6,27	0,73	-
Greece	0,98	0,08	-
Turkey	3,87	0,27	-
Portugal	2,03	-	-
Other Spot LNG	0,25	5,24	-
Pipeline exports	**36,48**	**5,46**	**9,41**
LNG exports	**19,9**	**9,71**	**0,34**
Total exports	**56,4**	**15,17**	**9,75**

Table 8 indicates that Algeria has largely diversified its export routes with five pipeline exports and six LNG trading partners. Egypt also benefits from LNG and pipeline trade. Libya, however, has limited pipeline interconnection also highly limited LNG export.

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4. Overall Analysis of Gas Network Infrastructure and Security of Supply in the Mediterranean

Mediterranean region countries have divergent features between northern and southern and between western and eastern parts. This divergence also heavily exists in the structure of gas markets, and specifically in the gas trade patterns. While the South consumes gas mainly in power generation, the consumption patterns in Northern countries are relatively balanced and flat. Southern countries are producers of natural gas which give them the opportunity to subsidy the prices. Northern countries, on the other hand, are big gas customers and pricing is crucial part of gas market regulation. Institutional factors, such as the European Union, play an important part in the structuring and regulation of gas markets. In non-EU countries these institutional effects are indirect and less influential.

Gas consumptions, in absolute terms, are varying through the region between 81 bcm in Italy to 0.2 bcm in Lebanon. However, an insight into population and GDP of countries shows that consumption is not very unbalanced in the region. Basing on this fact, we set up our security of supply conditions of the region on gas intensity. As the gas intensity is higher in a country, it will be more vulnerable to supply disruption. Among gas importing countries, the three most vulnerable countries are Jordan, Tunisia and Turkey. The risk could be tolerable for Jordan and Tunisia as long as they have enough reserve capacity for power generation. However, gas consumption in Turkey highly realizes in residential heating making this country more vulnerable to disruption.

Gas intensity is also important for gas producer countries. The gas intensity in Algeria is almost four times higher than Jordan (the most-gas intense regional country importing gas). Even if Algeria is the biggest supplier in the region, this doesn't make it safe from supply disruption risks considering its dependence on gas in its overall economy. We can reach a similar conclusion for Egypt and Libya in relatively lesser extent. These figures make us conclude that some sort of interdependence exists in the region.

When the trade patterns are considered, we can see that gas trade links are vertical not horizontal, making three separated zones in the region. For the western Mediterranean, the vertical link creates a regional market stretching from Algeria to the Netherlands. In the central Mediterranean, Italy is the main figure with producers countries Algeria and Libya. Interconnections with Slovenia and Croatia are very critical for these countries to get a chance of diversifying their resources. The trade links are not complete in Eastern Mediterranean, notwithstanding. In the south-East Egypt is the main figure as it exports gas to three of the regional countries. Turkey on the North-west is critical in terms of its potential for serving as hub and transit country. However, there is no interconnection between Syria and Turkey bridging the missing link in this region.

LNG trade has also great share in the region gas market. Algeria, by no doubt dominates the LNG market, having two LNG terminals and four regional customers. Egypt also bridge pipeline gap with LNG transport and delivering gas to five countries in the region. Libya, on the other hand, has negligible LNG exports; only to Spain with amount of less than 0.5 bcm. LNG importer countries are those which already consume over 30 bcm annually with the exception of Portugal and Greece. LNG terminals are very helpful for these two countries to diversify the gas imports.

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Gas diversification is an important problem, especially for countries having relatively smaller gas consumption. Seven countries depend on a single import supplier. Only three countries, Italy, Spain and France have largely diversified their imports. The single supplier problem is more critical for countries that don't have indigenous production; case for Jordan, Morocco and Bosnia Herzegovina.

A similar picture also is valid for the resilience capacities of regional countries. Only six countries have storage facility. However, Turkey and Portugal's capacity in face of their annual consumption is low. Another problem for Turkey is that the daily withdrawal capacity is low taking daily consumption amounts into account. Spain's storage capacity (currently amounting 13 percent of the annual consumption) is expected to increase in such a way to highly diminish short term security of supply concerns. Another noteworthy point is that six of regional countries depend on single interconnection without any LNG terminal or any storage facility. Supply disruption in these countries would lead to serious consequences.

When it comes to the country based analysis, we can argue that four countries are in critical condition in terms of security of gas supply: Bosnia, Jordan, Slovenia and Tunisia. Among these four Bosnia and Jordan are the most critical as Tunisia at least owns indigenous production and Slovenia has two interconnection import points and less market concentration ratio. Bosnia has a single supplier, imports gas via single route and gas intensity is in the medium range. Risks posing treat to Jordan is higher as it is almost the same with Bosnia in terms of gas import source and dependence on a single route, but having higher gas intensity ratio. Jordan, indeed, is the most gas intense country among gas importer countries, excluding Syria who has considerable indigenous production. Jordan, then, is the country with most critical condition in the MEDREG region.

Continuing investment will alleviate certain risks in the region and help to enlarge the sub-regional markets into the whole Mediterranean. To begin with the planned capacity increase in the interconnection points between Spain and France, we can argue that diversification will further grow in Spain, France and possibly in Portugal. This will also allow Algeria to penetrate into continental Europe. On the other hand, Algerian-Italy undersea pipeline project (Galsi) will secure the bind between Algeria and Italy and serve as another anchor connecting the two sides of the Mediterranean. One of the most crucial infrastructure constructions is underway in the Balkans. The projected Trans-Adriatic and Turkey-Greece-Italy pipelines in addition to already being built Ionian and Western Balkan Rings, will introduce gas to Albania and Montenegro, relieve route dependency for Bosnia and Croatia and diminish the market concentration ratio of all regional countries considering that connections from Turkey and Italy provide non-Russian gas to the Balkans. At this point it is noteworthy that, enrichment of gas supply in the western Mediterranean very much depends on the possible routes passing through Turkey. Turkey is already planning to build interconnections with Syria and Iraq, and has brokered and agreement with Azerbaijan to import and transport the gas to Europe and Middle East (via Syria). New interconnections will also relieve Turkey's high dependence on Russian gas. A bidirectional flow between Syria and Turkey will have two-pronged effect in the region. It will close the Eastern part of the Mediterranean Gas Ring; allow Turkey use Egyptian gas and Syria & Jordan use gas already imported to Turkey from Iraq and Azerbaijan.

A last comment should be made on Libya. Unlike neighboring Egypt and Algeria, Libya's gas resources are untapped and local consumption levels does not put an obstacle to its exporting potential. Highly isolated today, Libya could serve to the security of supply in the region. Horizontal connections with Tunisia and Egypt could be quite helpful in completing the Mediterranean Ring. Similarly, increasing the capacity of LNG terminal or building new liquifaction capacity would truly introduce Libya to the regional gas market.

As a final conclusion, security of supply in the Mediterranean Region will best be maintained by mutual cooperation and harmonization of trading rules. Establishment of a common regulatory understanding and level-playing field among the trading partners would institute common market and increase the elasticity in the face of gas supply disruption.

APPENDIX 1 Applying security of supply indicators to countries

Countries	Gas Intensity BCM/$ 1000	Gas Import dependency (%)	Diversification of Import Sources (associated risk)	Number of Border Entry points	Number of LNG Regasification Terminals	Annual import capacity / Annual consumption	Underground Storage Reservoir Capacity / Annual Demand (%)	Average Daily consumption / Daily withdrawal capacity
Algeria	High	Non	NA	NA	NA	NA	NA	NA
B & H	Medium	High	High	High	High	Low	High	High
Croatia	Medium	Medium	High	High	High	Low	Low	Medium
Egypt	High	Non	NA	NA	NA	NA	NA	NA
France	Medium	High	Low	Low	Low	Medium	Low	Low
Greece	Medium	High	Medium	High	Medium	Medium	High	High
Israel	Medium	Low	High	High	High	Medium	High	High
Italy	Medium	High	Low	Low	Low	Medium	Low	Low
Jordan	High	High	High	High	High	Low	High	High
Lebanon	Low	High	High	High	High	Medium	High	High
Libya	High	Non	NA	NA	NA	NA	NA	NA
Morocco	Low	High	High	High	High	Low	High	High
Portugal	Medium	High	Medium	High	Medium	Medium	Medium	Medium
Slovenia	Medium	High	Medium	High	High	High	High	High
Spain	Medium	High	Low	Low	Low	Medium	Low	Low
Syria	High	Low	High	High	High	Low	High	High
Tunisia	High	Medium	High	High	High	Low	High	High
Turkey	High	High	Medium	Medium	Low	Medium	Medium	Medium

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APPENDIX 2 Infrastructure and Security of Supply Questionnaire

1. Please complete the following tables and fill in the blanks[i]:

A- Import and export capacities for each interconnection point	Point 1 (Name)	Point 2 (Name)	Point 3 (Name)	…
Import / Export[ii]				
Countries of Origin(for imports)				
Target Countries (for export)				
Countries of Transit				
Maximum Technical Capacity (GWh/d)				
Reserved Capacity (GWh/d)for 1 year or less				
Reserved Capacity (GWh/d) for more than 1year				
Available capacity (GWh/d)for 1 year or less				
Available capacity (GWh/d) for more than 1year				

B- Total LNG Import Capacity (GWh/d**)**

a. Maximum Technical Capacity: _____

b. Reserved Capacity (GWh/d)for 1 year or less: _____

c. Reserved capacity (GWh/d) for more than 1year: _____

d. Available capacity (GWh/d)for 1 year or less: _____

e. Available capacity (GWh/d) for more than 1year: _____

C- Storage Figures:

a. LNG gas storage capacity (Nm3): _____

b. Underground Gas Storage – Working Gas volume (Nm3): _____

c. Underground Gas Storage – Maximum withdrawal capacity (Nm3/h): _____

D- Degree of interconnection:

a. Total entry capacity (GWh/d): _____

b. Total production capacity (GWh/d): _____

c. Daily peak demand historically registered (GWh/d): _____

d. Ratio import capacity / peak demand (% with 1 decimal): _____

e. Ratio production capacity / peak demand (% with 1 decimal): _____

E- Degree of source diversification and Import dependency (2009):

YEAR 2009	BCM/Y	% of Total consumption	% of total Imports
Imports (Total)			
Country 1			
Country 2			
Country 3			
…			
Spot/Others			
Storage capacity			
Total consumption			

2. **Are there any transit flows in your country? If so, please indicate the amount of transit gas passing through your territories and destinations of the flow. Please also describe the rules (exemptions etc.) regulating the transit flow.**

Please identify planned or continuing cross-border gas infrastructure, LNG or underground storage facility constructions in your country.

[i] Please refer to the most updated data unless a specific period is referred.
[ii] If a Point is used both for import and export please show this by adding new column to the table.