ANNEX 4: Common Risk Assessment – North African Risk Group – Libya

Member States

The Libyan Risk Group is composed of: Austria, Croatia, Italy, Malta and Slovenia.

Gas Storage Capacity in Member States

	Working gas volume in TWh	**Share of capacity in risk group in %**
AT	97,64	32,81%
HR	4,77	1,6%
IT	195,20	65,59%
MT	0,00	0,00%
SI	0,00	0,00%
Total	**297,61**	**100,00%**

Source: AGSI+, 16.08.2023

Summary of the Common Risk Assessment

The Libyan gas supply risk group, after taking into account infrastructure and supply standards, protected customers definition for each involved Member State and the results of JRC analysis on the Russian supply disruption risk, found the following conclusions.

1 Infrastructure and supply standards, even if are theoretically sufficiently covered at a group level, may result into a situation where new infrastructures are needed in order to guarantee security of supply to the involved MSs considering the changing situation related to the geo-political risk of the Russian gas supply routes.

2 Risk scenarios analysis conclusions are the following.
   - The non-cooperative context when assuming a short-term storage management strategy (i.e. storages could be used as much as possible during winter 2022-2023) leads to 0.4 bcm of unserved gas in the RG on average, however it varies between 0 and 1.3 bcm depending on the demand scenario. In relative terms, gas curtailment in Italy and Austria remain at 0%, while, while it amounts to 1% in Croatia and only Slovenia exhibits the highest value (52%).
   - The cooperative approach when assuming a short-term storage management strategy increases the curtailment to approximately 0.7 bcm. Austria is the country of the RG bearing in absolute terms the highest gas curtailment with 0.4 bcm on average, but there is a probability of 1/6 that the unserved gas for Austria is slightly higher than 1 bcm. In relative terms, unserved gas demand is kept at 15% for Slovenia, 3% for Croatia and 8% for Austria.
   - Assuming a long-term storage management strategy prevents the exhaustion of storages during the upcoming winter. Consequently, the average curtailment in the RG increases to 8.1-8.2 bcm under both cooperative and non-cooperative approaches (slightly lower in the cooperative one). However, the maximum curtailment achieved under a non-cooperative strategy is close to 15 bcm, much higher than under a cooperative approach (around 10 bcm in the worst-case demand scenario). In absolute terms, the highest curtailment is identified in Italy (6.5 bcm on average over the winter) followed by Austria (1.1 bcm), Croatia (0.3 bcm) and Slovenia (0.1 bcm) in the cooperative context. In relative terms, unserved gas demand is kept at 20% for all countries belonging to the RG except Italy (15% of its demand is curtailed). In the non-cooperative scenarios, the curtailment distribution across countries is different, being higher in Austria (4 bcm on average) and followed by Italy (3.6 bcm), while Slovenia amounts on average to 0.5 bcm and Croatia to 0.1 bcm. Under the non-cooperative scenarios, unserved gas demand is around 96% for Slovenia and 70% for Austria, with lower shares for Italy (8%) and Croatia (5%).
   - Peak gas curtailment is around 74-79 mcm/d (19-20% of its peak demand) in Italy in the cooperative contexts, where lower values refer to the short-term storage management strategy, and the higher ones to the long-term storage management. However, in a non-cooperative strategy, this peak may increase for Italy up to 114-161 mcm/d (around 41%). In general, the remaining countries under the cooperative strategy keep their peak curtailments at 20%. Under the non-cooperative scenarios the highest relative curtailment can be observed in Slovenia (98%). It should be noted that this peak curtailment is the one happening in the worst-case demand scenario with a probability of 1/6.

- Italy and Croatia have LNG terminals. LNG send-out flows are kept around 7.2-8.1 bcm over the winter regardless of the assumptions. Temporal patterns of the send-outs are quite stable all over the time span, while some differences can be noted comparing the storage management, with higher LNG send-outs in the case of long-term storage management. It also emerged how the utilisation rates are higher under the cooperative scenarios, as LNG remains a crucial option for mitigating undesirable impacts in the other neighbouring countries.
- All countries in this RG except Slovenia have underground gas storage facilities. When assuming a short-term storage management strategy, the aggregated filling level at the beginning of the heating season is slightly higher than 80%, however the storages are depleted over the winter thus arriving at 8% on 1 April 2023 on average. There are demand scenarios in which storages are exhausted and other scenarios in which filling level is kept just below 20% (cooperative strategy). Long-term storage management leads to higher curtailments, as stated previously, in order to prevent the use of gas in storage. In this case, the average filling level is kept around 40% on average on 1 April 2023 (cooperative strategy). However, there is a wide range of possible filling levels at the end of the heating season depending on the demand scenarios, in a range between 30 and 50%. A non-cooperative strategy may lead to lower filling levels at the end of the winter.
- Cooperation implies more intense use of transmission capacities especially in the case of the Eastern interconnection points. Per se, interconnection transmission capacities do not affect substantially the impact on curtailment. Moreover, it can be seen that higher flows go to countries with storages when assuming a long-term security of supply perspective.
- Regarding the sensitivity analysis on demand reduction, it can be concluded that 5% reduction over the winter is enough to mitigate completely gas curtailments when storages could be used as much as possible during winter. On the other hand, if security of gas supply in the long-term (next winter) were prioritised, the needed demand reduction would be 15%. Note that this reduction factor has been applied throughout the simulation horizon.

Regarding the additional risk events, the total disruption of Algeria’s supplies is the event leading to the worst gas curtailment (3.4 bcm on average for the RG). The unserved demand under such adverse event is 5.8 bcm with a 1/6 probability, but there is another probability of 1/6 to have a milder winter without negligible curtailments. Among the other adverse events, the Transmed disruption is the most relevant (2.5 bcm).

Description of the System

Croatia

Croatian gas transmission network has a total length of 2.694 km of transportation pipelines. The natural gas transmission network has cross-border interconnections with Slovenia (Rogatec) and Hungary (Dravaszerdahely) usually utilised to import gas. There are also 7 entry points from production plants and one interconnection with the underground storage facility of Okoli.

The upstream pipelines in the Adriatic Sea are used to export Croatian natural gas from the production platforms to Italy. Panon gas fields are connected by upstream pipelines to the transmission network and to the underground gas storage facility at the Okoli site.

The Okoli gas storage infrastructure (553 million cubic meters) is located at Okoliand and it is part of the Underground Gas Station d.o.o..

In 2020 Croatia completed the construction of the LNG terminal on the island of Krk, with a storage capacity from up to 265.000 m3 of LNG; nominal regasification capacity of 8 billion m3 of gas per year.

There were 33 companies for natural gas distribution in the Republic of Croatia in 2020. In total, the gas distribution network in Croatia is 18,429 km long. In 2021 natural gas consumption amounted to 31,70 TWh, against a domestic production of 8,08 TWh; total storage capacity amount to 5,22 TWh.

Italy

Italian gas transmission network extends for more than 32.000 km. Snam Rete Gas (SRG), part of the Snam Group, is Italy’s main gas Transmission System Operator (TSO). SRG operates a nationwide pipeline network and supplies around 95% of the Italian market. All pipelines have reverse flow capability.

The national network has cross-border interconnection points with Austria (Tarvisio/Arnoldstein), Slovenia (Gorizia/Sempeter) and with Switzerland (Griess Pass). Italy is also supplied through three offshore interconnectors: Transmed (with Tunisia and Algeria – entry point in Mazara del Vallo), Greenstream (Libya – entry point in Gela) and Trans Adriatic Pipeline (Azeri gas from Caspian Sea Region to Italy at Melendugno entry point). There are four entry points from the regasification terminals (Panigaglia, Livorno, Cavarzere and the newly operational Piombino), as well as another new point under construction in Ravenna, where the FSRU BW Singapore is expected to moor and become operational within the beginning of 2024.There are also twelve entry exit point from storage plants. Stogit, controlled by Snam, is the most significant operator of natural gas storage in Italy. Local production shows a historical decreasing trend due to the decline of domestic sources, not sufficiently offset by new production developments.

Natural gas is a critical energy source, accounting for almost half of electricity generation. It will continue to play a central role in power generation in the coming decade, particularly as coal-fired capacity is being phased out. Currently nearly 44% of gas consumption comes from the distribution network demand, 38% from power generation demand and 18% from the industrial demand.

In 2022 natural gas consumption amounted to 724,49 TWh, against a domestic production of 35,05 TWh; total storage capacity amount to 197,52 TWh.

Slovenia

The Slovenian transmission network has cross-border interconnections with Austria (Murfeld/Ceršak interconnection point), with Italy (Gorizia/Šempeter) and with Croatia (Rogatec).

Slovenian gas system has no storage facilities nor any local gas production. The gas network was put into use 1978 and further developed over its lifetime. Slovenia uses approximately between 0.9 and 1 billion cubic meters of natural gas annually, accounting for about 13 percent of the country's final energy consumption. Most of gas was supplied on a short-term basis from Central European Gas Hub. A minor portion was supplied through a long-term contract from Russia until early 2022. Slovenian companies depend on infrastructure in Austria, Italy and Croatia. Slovenia has expressed interest in securing LNG sources via terminals in Krk, Croatia, or Rovigo, Italy, to diversify its supply away from Russia. Various projects and investments are planned to develop the gas network. Two corridors are envisaged, one of them Croatia – Slovenia – Austria, which would enable gas transport from enlarged LNG terminal at Krk. In Slovenia this project requires investments into both interconnectors, Rogatec and Ceršak, and an enlargement of Kidričevo compressor station. The second corridor connects Hungary – Slovenia – Italy. The pipeline would run from Kozármisleny to Nagykanizsa, Tornyiszentmiklós, Lendava, Kidričevo, Ajdovščina, Šempeter, Gorizia. It is listed in 10-year natural gas development plans for Slovenia and Hungary. In Slovenia the gas interconnector consists of two sections: repurposing of Šempeter-Vodice Gas Pipeline and building a new gas pipeline Pince-Lendava-Kidričevo. Both corridors would be hydrogen ready.

In 2021, the total natural gas consumption amounted to 10,13 TWh, out of which 8,20 TWh by the non-household customers, i.e. industry and services which are not protected customers. Protected customers consumed 1,95 TWh of gas. Household consumption was 1,31 TWh. The structure of gas consumption in the year 2021 is representative.

Use of gas in the electricity mix is very specific. Both larger gas-fired power plants are only used for peak power production and auxiliary services for the electricity system. In addition, they both have fuel switching capability which they efficiently utilise. They play a very important role for the operation of electricity, system, for which they consume very small gas volumes. The largest gas power plant consumed only 4,63 mcm of gas in that year, the others even less.

Malta

Natural gas in Malta is used solely for the generation of electricity and currently constitutes the largest share of Malta's electricity generation mix. The only source of natural gas in Malta is imported LNG. Malta does not have gas distribution networks or any district heating networks and there are no end-use gas customers apart from two electricity producers at the Delimara Power Station. Currently, Malta does not form part of the EU internal gas market as it is not interconnected via a gas pipeline. Malta's gas infrastructure consists of an LNG facility with import and offloading capability; a Floating Storage Unit (FSU); LNG jetty, pipework and other services; and a regasification facility with ancillary services. The regasification facility provides natural gas to two centrally dispatched electricity generation units. All gas infrastructure is within the Delimara Power Station complex. Should Malta become interconnected via a gas pipeline, the risk to Malta in the context of regional risk groups would change and the risk to gas security of supply would need to be reassessed.

In January 2017, Malta began its gas supply thanks to the new floating storage unit (FSU) and regasification facility at Delimara, which supplies gas to two electricity producers. The terminal has a total LNG storage capacity of 125,000 m3 while the regasification plant has a maximum send-out capacity of 20 GWh/d. Since the beginning of its operation in 2017, the Delimara LNG terminal has not received Algerian gas, so it would not be directly affected by a hypothetical curtailment in the Algerian LNG supply. Up until now, Malta has purchased LNG from the following countries of origin: Netherlands, USA, Equatorial Guinea, Egypt, Trinidad & Tobago, Peru, Norway, Nigeria. From 2017 to 2021, from a regional perspective Malta has sourced its LNG primarily from South America (69%), followed by the United States (16%), Africa (14%) and then Europe (1%).

Key data 2021

PRODUCTION	*Maximum Production (GWh/d)*	
POWER GENERATION	*Installed gas-fired capacity (Mwe)*	358
DEMAND	*Total 2021 (GWh)*	2
	Summer (GWh)	1,063.8
	Winter (GWh)	833
	Max. Day (GWh/d)	8.1
	Min Day (GWh/d)	0

Total 2021
1 Jan 2021 to 31 Dec 2021
Summer
1 Apr 2021 to 30 Sep 2021
Winter
1 Oct 2021 to 31 Mar 2021

Infrastructure Standard

N-1 formula calculation

As provided for by article 5.5 of the Regulation, the competent authorities of relevant Member States may agree to provide the calculation of the N – 1 formula at regional level in the common risk assessment (art. 7), following the provisions of point 5 of Annex II of the Regulation.

The N – 1 formula describes the ability of the technical capacity of the gas infrastructures to satisfy total gas demand in the calculated area in the event of disruption of the single largest gas infrastructure during a day of exceptionally high gas demand occurring with a statistical probability of once in 20 years (D_{max}).

As provided for by Annex II of the Regulation, for the calculation of the "N – 1 formula at regional level", the single largest gas infrastructure of common interest shall be used; the single largest gas infrastructure of common interest for the Risk group Libya is Baumgarten interconnection point.

The formula used for the calculation of the "N – 1 formula at regional level" is the one provided by the point 4 of Annex II "*Calculation of the N – 1 formula using demand-side measures*":

$$N-1[\%] = \frac{EP_m + P_m + S_m + LNG_m - I_m}{D_{\max} - D_{eff}} \times 100, N-1 \geq 100\%$$

The terms of the formula have been calculated as follows:

EP_m	*Technical capacity of entry points (in GWh/d), other than production, LNG and storage facilities covered by Pm, LNGm and Sm, means the sum of the technical capacity of all border entry points capable of supplying gas to the calculated area.*
P_m	*Maximal technical production capability (in GWh/d) means the sum of the maximal technical daily production capability of all gas production facilities which can be delivered to the entry points in the calculated area.*
S_m	*Maximal technical storage deliverability (in GWh/d) means the sum of the maximal technical daily withdrawal capacity of all storage facilities which can be delivered to the entry points of the calculated area, taking into account their respective physical characteristics.*
LNG_m	*Maximal technical LNG facility capacity (in GWh/d) means the sum of the maximal technical daily send-out capacities at all LNG facilities in the calculated area, taking into account critical elements like offloading, ancillary services, temporary storage and re-gasification of LNG as well as technical send-out capacity to the system.*

I_m	*Technical capacity of the single largest gas infrastructure (in GWh/d) with the highest capacity to supply the calculated area. When several gas infrastructures are connected to a common upstream or downstream gas infrastructure and cannot be separately operated, they shall be considered as one single gas infrastructure.*
D_{max}	*The total daily gas demand (in GWh/d) of the calculated area during a day of exceptionally high gas demand occurring with a statistical probability of once in 20 years.*
D_{eff}	*The part (in GWh/d) of Dmax that in the case of a disruption of gas supply can be sufficiently and timely covered with market-based demand-side measures.*

Tables below are calculated taking into account the hypothesis of the interruption of Baumgarten entry point as the single largest infrastructure (I_m) as requested by the SOS regulation.

As provided by the Regulation, the N-1 formula has been computed taking into account the 100% of underground storage working gas volume.

Even If in each case the index results far above the 100%, given the actual rerouting of the main gas supply flows following the February 2022 invasion of Ukraine by Russia, the result doesn't mean that regional gas infrastructures are properly dimensioned in order to cover maximum demand of the involved Member States.

However, N-1 index doesn't take into account possible existence of internal bottlenecks or problems induced by malfunctioning of internal interconnection points or due to lack of available capacity to attract gas. All these risks are evaluated in the following risk analysis.

The following tables summarise the data set used for N-1 formula calculation.

	2022	**2022-09**
N-1	**154,8%**	**155,0%**
D_{max}	5111,93	5111,93
EP_m	4701,30	4711,40
P_m	134,69	134,69
S_m	4021,52	4021,52
LNG_m	627,70	627,70
Im	1570,40	1570,40