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If another gas dispute breaks out between the Ukraine and Russia, would Europe now be equipped to deal with it?

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In January 2009, the supply of natural gas from Russia via the Ukrainian pipeline system was interrupted for nearly two weeks. Particularly the countries in Southeastern Europe were ill-prepared for such an event. Disputes regarding both the payment of natural gas supplies and transit rights between Russia and Ukraine have recently flared up again, which gives rise to the question of whether the EU is now better prepared if a similar scenario to that of January 2009 were to happen again.

A number of measures have been introduced since the beginning of the year aiming to overcome any delivery shortfalls, but only a few of them have actually already been implemented, e.g. the creation of technical requirements to reverse the flow of natural gas. Therefore, supply shortages in some Southeastern European countries can not be fully excluded.

Russia currently supplies about one-third of the EU's natural gas imports pipelines running through the Ukraine, thus covering about 20 percent of Europe's natural gas consumption. Russia is the EU´s most important natural gas supplier followed by Norway.[1]

In 2008, the working gas capacity of storage facilities in the EU amounted to more than 80 billion cubic meters, which equates to about 15 percent of primary energy consumption. Theoretically, this would be enough to cover any supply disruptions from Russia via the Ukraine for up to eight months. Despite the short interruption in supply (13 days) at the beginning of 2009, there were a number of supply disruptions in various Southeastern European countries because supplies available within the EU could not be transported there. This shows that an evaluation of the available storage capacities alone is not enough to guarantee a sufficient supply of natural gas. In addition, the following measures need to be discussed:[2]

- Regional diversification of imports.
- Expansion and improved interconnection of the networks.
- Expansion of the landing stations for liquefied natural gas (LNG).

1 However, Russia's share of the European natural gas market has dropped over the last years due to increased imports from both Norway and African countries.

2 The EU Commission analyzed various instruments and their effects together with their current usage in the form of a working document (SEC(2009) 978 Final).

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- Reversal of load flows against the main direction of flow.
- Change of fuel at short notice and contracts with discontinued supply (interruptible contracts).
- Expansion of storage capacities.

Regional diversification in Eastern Europe is making slow progress

European Union's member states depend to very different extents on natural gas imports (Table 1). Denmark and the Netherlands supply natural gas to their neighboring countries. Both new EU member countries (Bulgaria, Estonia, Slovakia and Slovenia) and some older ones (Belgium, Finland, Greece, Sweden, Portugal and Spain) were almost completely dependent on imports in 2008. The UK and Romania were largely independent on imports within the same year, as they sourced around two-thirds to three-quarters of their natural gas requirements from their own supplies. Within the EU, Germany is one of the countries with relatively high level of indigenous production. Despite this, its net import rate, which is in excess of 80 percent of its natural gas requirements, is still very high.

Russia is the main natural gas supplier for most Eastern and Central European countries, with Bulgaria, Romania, Estonia, Latvia, Lithuania and the Slovak Republic importing nearly all of their natural gas from Russia. And Russia is still the main supplier to the remainder of the Eastern European countries as well. However, Slovenia, Poland and Hungary in particular are making substantial progress in regionally diversifying their imports. Among Western European countries, particularly Austria and Germany are still relying strongly on Russian natural gas.

Table 1

Production, consumption and net imports of natural gas 2008

	Production	Consumption	Net imports	Net imports	Imports from Russia
	in billion cubic meters			in percent[1] relating to consumption	
Belgium	0.0	17.3	17.4	100.5	5.2
Bulgaria	0.2	3.5	3.5	98.7	98.7
Denmark	10.1	4.6	–5.5	–120.2	0.0
Germany	16.4	95.8	79.2	82.7	42.5
Estonia	0.0	0.9	0.9	100.0	100.0
Finland	0.0	4.7	4.7	99.3	100.1
France	0.9	45.9	43.9	95.7	14.1
Greece	0.0	4.2	4.2	99.9	66.9
Ireland	0.4	5.2	4.7	90.1	0.0
Italy	9.3	84.9	76.7	90.3	26.2
Latvia	0.0	1.7	1.4	84.8	84.8
Lithuania	0.0	3.3	3.1	96.0	96.0
Luxembourg	0.0	1.3	1.3	103.6	0.0
Netherlands	84.7	48.3	–36.4	–75.3	0.0
Austria	1.5	8.7	7.2	83.4	77.5
Poland	5.7	16.5	11.2	67.4	47.0
Portugal	0.0	4.8	4.8	100.2	0.0
Romania	11.4	14.4	4.5	30.9	39.2
Sweden	0.0	0.9	0.9	98.6	0.0
Slovakia	0.1	6.3	6.1	96.9	99.3
Slovenia	0.0	1.0	1.0	100.0	51.3
Spain	0.0	38.2	38.6	101.1	0.0
Czech Republic	0.2	8.7	8.6	99.0	86.0
Hungary	2.6	13.2	11.5	87.2	66.9
United Kingdom	73.4	99.0	25.8	26.1	0.0
EU total	217.0	533.3	319.4	59.9	24.4

1 Values above 100 percent may be due to storage effects or statistical differences.

Source: IEA. **DIW** Berlin 2009

Additional investments in gas networks are required

The European domestic market for natural gas requires sufficient transport capacities with a high level of interconnection within the network in order to function effectively. However, both the import pipelines and the connecting pipelines currently in place in certain regions of the EU—especially in Southeastern Europe—are insufficient in terms of preventing supply shortages in the event that the main natural gas suppliers fail to be able to provide supplies. If currently planned projects are realized in due time, such shortages could be overcome in the next few years.

The declining level of natural gas extraction in the EU coupled with increasing natural gas consumption levels represent new challenges.[3] The natural gas networks must both accommodate increasing consumption levels and regional gas flow displacements. According to Gas Infrastructure Europe (GIE), starting in 2014 the drop in domestic natural gas production levels will be larger than the growth in the capacities for providing imports.[4] If only the plans that are currently being developed by companies are implemented, the available capacities within the European gas network in 2018 will be lower than they are today. During a cold winter, this could lead to shortages in natural gas transport between Denmark and Sweden, as well as between the successor states of the former Yugoslavia. Restrictions may even occur in Central and Western Europe. In contrast to this, due to increasing LNG capacities

3 The EU anticipates natural gas consumption levels to increase by up to 200 billion cubic meters by 2030. Cf. Engerer, H., Horn, M.: Erdgas für Europa: Die Importe steigen deutlich (Natural Gas for Europe: Import Levels are Increasing Drastically). DIW Berlin Wochenbericht No. 17/2009.

4 Gas Infrastructure Europe (GIE): GTE + Demand Scenarios vs. Capacity Report. Brussels, 31 July 2009.

and natural gas supplies from North Africa, certain regions—particularly in Southern Europe—have surplus supply capacities. This implies that further additional efforts beyond the scope of companies' current plans are required to ensure long-term natural gas supply throughout Europe.

LNG regasification capacities to double by 2016

In mid-2009, the European Union had LNG import terminals with a total capacity of 108 billion cubic meters of natural gas per year (Table 2). Of this total, about half is attributable to Spain and one-third to France and England. The remaining capacity is borne by Belgium, Portugal, Greece and Italy. Many of these countries are in the process of increasing their capacities over the next few years. The Netherlands, which has had no LNG capacities until now, is currently building corresponding facilities in Rotterdam. According GIE, the European Union's LNG landing capacities are set to double to a total of 207 billion cubic meters by the year 2016. Until now, Germany, Greece, Ireland, Croatia, Lithuania, Poland, Romania, Sweden and Cyprus have all come up with few specific projects to set up capacities to import LNG. Plans in Germany to build an LNG terminal in Wilhelmshaven have been postponed several times already.

To ensure that LNG can make an increased contribution to Europe's energy supply in the future, LNG export capacities also need to be created in the supplier countries. Corresponding plans are already in place. The International Energy Agency (IEA) projects that global LNG capacities reached in 2008 will increase by 150 billion cubic meters to 400 billion cubic meters in 2012. Qatar, Malaysia, Algeria and Nigeria currently supply LNG to Europe. Qatar already has plans to vastly increase its capacities, and Angola, Equatorial Guinea and Yemen are set to get involved in the future as well. Iran too has major, long-term potential.

Table 2

LNG import capacities in the EU in mid-2009

In billion cubic meters of natural gas per year

	Existing capacities	Under construction or in planning	
		Extensions	New capacities
Belgium	9.0	–	–
France	17.0	6.5	8.3
Greece	5.3	–	–
Italy	3.4	4.6	19.0
Netherlands	–	–	16.0
Portugal	5.5	–	–
Spain	54.4	22.5	11.0
United Kingdom	13.4	7.4	13.8
EU total	**108.0**	**41.0**	**68.0**

Source: Gas Infrastructure Europe. **DIW** Berlin 2009

Reversal of gas flow in the pipeline

In the event of supply interruptions, pipeline capacities that are freed up as a result can be used to transport supplies in the opposite direction. To achieve this, however, both cross-border transfer stations and compressor stations would need to be technically modified. Cooperation involving various network operators would also most likely be required. Technical facilities that can be used to reverse the gas flow were already in place at various cross-border transfer points within the European gas network, e.g. on the border between Germany and the Czech Republic, and from there to the Slovak Republic. During the crisis in January 2009, natural gas was successfully transported from Greece to Bulgaria by reversing the flow of gas in the GMS Strimonohori pipeline, thus helping to reduce the consequences of the crisis in Bulgaria.[5]

A number of projects are currently being developed that aim to both increase capacities for reverse flows and to further integrate previously poorly connected areas by means of additional connecting pipelines.[6] Such technical facilities would also make it possible for Germany and Italy to provide additional supplies to Southeastern member states of the EU. To ensure that supplies within the European natural gas system can be maintained in the event of an emergency, other critical shortages within the current natural gas transport network—such as the one between Spain and France—need to be addressed and resolved.

Substitution and consumption limits

If a natural gas supplier does not deliver for whatever reason, it can partially be compensated for by reactions taken in terms of demand, e.g. substituting natural gas for heating oil or coal when it comes to producing electricity or by switching to heating systems that are powered by wood or electricity. A temporary production shutdown or the halting of electrolysis processes is also possible. Since nondelivery by a major supplier is generally associated with price increases on spot markets, to some extent such reactions are triggered automatically. However, the spot markets currently have limited

5 2.5 million cubic meters could be imported from Greece per day. Kovacevic, A.: The Impact of the Russia-Ukraine Gas Crises in South-Eastern Europe. Oxford Institute for Energy Studies, NG29, March 2009.

6 www.gie.eu.com/publications/indexframe_plus_reverse.html.

Box 1

Types of natural gas storage facilities

Natural gas can be stored in both underground and surface storage facilities as well as in pipelines. Furthermore, tankers can be used to store liquefied natural gas as long as their capacities exceed that which is required to cover consumption at that particular point in time.

Natural gas (in gaseous form) can be stored pressurized in tanks above the ground (surface storage facilities) or in caverns under the ground (underground storage facilities). Smaller surface storage facilities are often located near local distribution networks, so that a storage instrument is available to the end distributors of natural gas, e.g. municipal utility companies.

Operators of long-distance natural gas pipelines can also store natural gas in the transport system, in the event of brief demand fluctuations, by increasing the pressure in one section of a pipeline, thus supplying larger energy quantities.[1]

In Europe, the majority of storage capacities are located in underground storage facilities.[2] The pressure in these storage facilities increases the volume that can be stored as well as the potential withdrawal volume per unit of time. If the pressure within the chamber drops below that of the well-head, no more gas can be withdrawn. This implies that there must always be a certain amount of cushion gas in each underground storage facility, in order to maintain the required pressure level. Only the working gas volume present in a storage facility can therefore be used for withdrawal.

There are various types of underground storage facilities. Pore storage facilities serve to store natural gas between the porous layers of naturally occurring limestone and sandstone formations. Pore storage facilities also include former natural gas and crude oil fields as well as aquifers.[3] Due to natural flow directions, both the injection and withdrawal into and from aquifers is generally slow, and injected quantities can only be re-extracted some time later. A high volume of cushion gas, 50 to 80 percent of the total volume, is also required. Pore storage facilities are highly suited to balance seasonal demand fluctuations on account of their characteristics.

Salt caverns are artificial caverns washed out from salt domes. Salt caverns, which only require 20 to 30 percent cushion gas, have high injection and withdrawal rates, making them a highly attractive option for handling demand fluctuations at short notice. Salt caverns do, however, require much higher levels of investment than pore storage facilities.

1 The total volume of the German network buffer is only 0.8 terawatt hours, of which two-thirds are attributable to transport and one-third to distribution networks. Federal Network Agency: Monitoring Report 2008, pursuant to §63 (4) German Energy Industry Act (EnWG) together with §35 German Energy Industry Act (EnWG), Bonn 2008.

2 A detailed overview of underground storage facilities in Germany can be found in Sedlacek, R.: Untertage-Erdgasspeicherung in Deutschland (Underground Natural Gas Storage in Germany). Erdöl Erdgas Kohle (Crude Oil Natural Gas Coal), Vol. 124, No. 11, 2008, 453–465.

3 If water was found in the caverns before injecting natural gas into them, then they are known as aquifers.

importance in Europe. The link between natural gas prices and oil prices that still exists in a number of long-term agreements prevents gas prices from reflecting shortages on the natural gas markets and from utilizing savings and substitution potential for natural gas.

Information regarding potential short-term savings or the potential substitution of natural gas by other energy sources is only sporadically available for individual EU countries. According to information provided by the EU, in Germany 10 to 14 percent, in France 6 percent, and in Italy 9 percent of the total gas consumption can be substituted at short notice, in Belgium 15 percent of the industrial gas consumption.[7]

In order to realize this potential, interruptible agreements can be reached alongside price increases on the spot markets. Within the scope of longer-term agreements, major customers would declare themselves prepared, if the need should arise, to not consume any natural gas for a certain number of days each year, for which they would receive significant price reductions. Corresponding agreements cover about a quarter of the natural gas used to generate electricity in Germany, France, the Netherlands and Spain; in Italy such agreements only cover one percent. Within industry, this amount reaches five percent in Spain, ten percent in both Germany and Italy, up to 25 percent in France and 30 percent in Belgium.

7 Stern, J.: Continental European Long-term Gas Contracts: Is a Transition away from oil-product Linked Pricing Inevitable and Imminent? Oxford Institute of Energy Studies, NG 34, September 2009.

Storage expansion for 90-day reserves

At the end of 2008, the European Union had in excess of 80 billion cubic meters (Box 1) of natural gas (working gas) storage capacity. Of that, roughly two-thirds were attributable to exhausted oil and gas fields. About 20 percent of storage capacity is covered by aquifers and some ten percent by caverns. Other types of storage (incl. LNG storage) only make up a small share (Table 3). In 2008, Germany, Italy and France had storage capacities with a working volume of 20, 13 and 12 billion cubic meters respectively, which constitutes more than half of the EU's working gas storage capacity. The remaining storage capacity is relatively evenly distributed across the other member countries involved.

Within the EU, there are still nine countries with no natural gas storage facilities,[8] while Sweden only has negligible cavern capacities. Natural gas is not used at all as a source of energy in Malta and Cyprus. Ireland and Luxembourg, which border member countries that export natural gas, see no need to build storage facilities as a form of risk provision.

The contribution made by natural gas storage facilities to supply security is best determined using the relationship between its working volume and natural gas consumption. Figure 1 shows the corresponding data for EU countries in 2008. Italy and France, who, together with Germany, have the largest storage capacities by far, can store 15 and 26 percent of their natural gas primary energy consumption respectively. In Germany, the figure stands at around 21 percent. The best ratio by far is achieved by little Latvia, with a value of almost 140 percent. Austria and the Slovak Republic with 40 and 44 percent respectively also record positive figures that are more than double the figure in Germany.

According to current plans, natural gas storage capacities are due to increase by two-thirds based on July 2009 figures (Table 4). The United Kingdom is planning an increase of roughly nine billion cubic meters, which is triple the capacities in place in 2009. Spain and Austria are planning an expansion of six and five billion cubic meters respectively, with the aim of more than doubling their storage capacities. Italy wants to increase its capacities by eleven billion cubic meters (80 percent). With almost ten billion cubic meters, Germany has the second-largest expansion plans after Italy. Nevertheless, an almost fifty percent increase in storage capacity is expected as a result of this. Together with existing capacities,

8 Finland, Greece, Ireland, Luxembourg, the Baltic states of Estonia and Lithuania as well as Slovenia, Malta and Cyprus.

Table 3

Storage capacities for natural gas (working gas) at the end of 2008

In million cubic meters

	Total	Exhausted oil and gas fields	LNG peak storages	Aquifers	Caverns[1]
Belgium	655	–	55	600	–
Bulgaria	350	350	–	–	–
Denmark	1001	–	–	560	441
Germany	19866	10998	–	1414	7454
France	12142	–	–	11234	908
Italy	12870	12870	–	–	–
Latvia	2300	–	–	2300	–
Netherlands	5078	5000	78	–	–
Austria	4249	4249	–	–	–
Poland	1660	1280	–	–	380
Portugal	124	–	–	–	124
Romania	3162	3162	–	–	–
Sweden[2]	9	–	–	–	9
Slovakia	2770	2770	–	–	–
Spain	2726	2726	–	–	–
Czech Republic	2501	2260	–	177	64
Hungary	4190	4190	–	–	–
UK	4523	3736	260	–	527
EU total	**80176**	**53591**	**393**	**16285**	**9907**

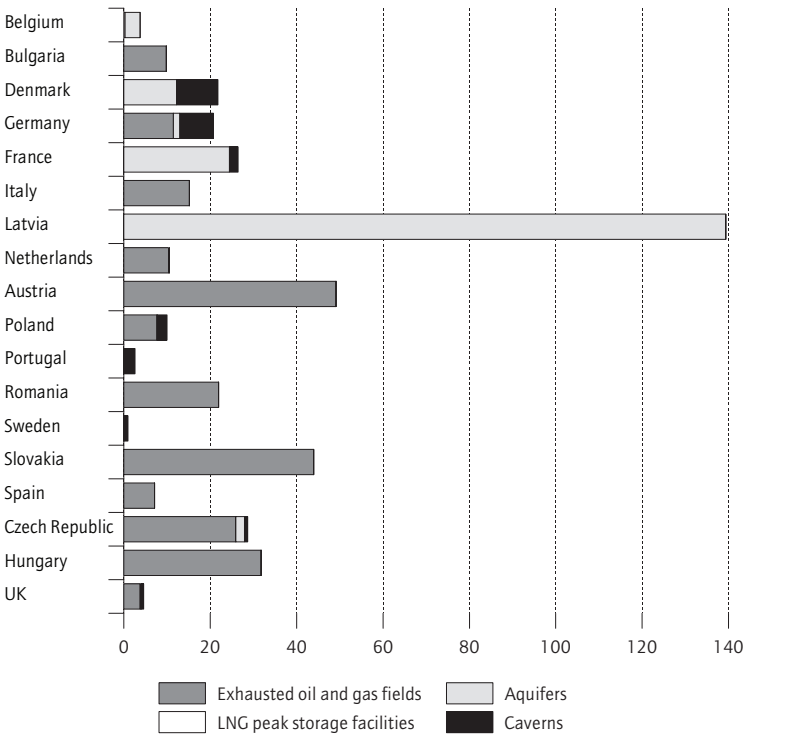
1 Salt, granite and other types of stone.
2 Data from the end of 2007.

Source: IEA: Natural Gas Information 2009. Paris 2009. **DIW** Berlin 2009

Figure 1

Natural gas storage capacity in the EU at the end of 2008

In percent of primary energy consumption



1 Data from end of 2007.

Source: IEA. **DIW** Berlin 2009

the average natural gas consumption for 2008 could theoretically be covered for around 90 days.

EU pushes towards security of supply

The EU used the Russian-Ukrainian conflict at the beginning of 2009 as an incentive to present a draft Directive in July 2009 on the subject of crisis prevention within the natural gas sector. This draft aims to oblige member states to ensure within just a few years that, should the respective main natural gas supplier in each individual member state fail to provide supplies during extremely cold winter periods, they will be able to handle the situation. The member states are free to choose which measures they will implement to achieve the prescribed standard (Box 2).

In case of a crisis, the EU Commission will above all ensure that national measures taken by a member state do not limit flow of natural gas within the Community. The allocation of limited gas supplies should, also in the event of a crisis, take place on a market principles. The EU is not granted permission to force solidarity of the member states in the event of a crisis. The EU's crisis mechanism in the natural gas sector is therefore not only behind the IEA's crisis mechanism for oil[9] in terms of reserve capacity level requirements (natural gas: ten percent

9 Pursuant to Article 7 of the Agreement on an International Energy Program, countries disproportionately affected by a lack of oil imports can be forced into solidarity with member states in cases where the crisis leads to a severe shortage of oil products.

Table 4

Existing and planned storage capacities as of mid-2009

In billion cubic meters

	Existing	In planning	In planning as a percentage of the
	capacity		
Belgium	None	None	–
Bulgaria	0.35	–	0.0
Denmark	1.001	–	0.0
Germany	19.595	9.524	48.6
Estonia	None	None	–
Finland	None	None	–
France	12.255	1.79	14.6
Greece	None	–	–
Ireland	None	None	–
Italy	14.335	11.1	77.4
Latvia	–	–	–
Lithuania	None	None	–
Luxembourg	None	None	–
Malta	None	None	–
Netherlands	5.078	4.5	88.6
Austria	4.3	5.2	120.9
Poland	1.675	1.225	73.1
Portugal	0.15	0.03	20.0
Romania	2.694	2.3	85.4
Sweden	–	–	–
Slovakia	2.75	None	–
Slovenia	None	None	–
Spain	4.14	5.594	135.1
Czech Republic	3.077	0.755	24.5
Hungary	3.72	2.3	61.8
United Kingdom	4.31	8.939	207.4
Cyprus	None	None	–
EU total	**79.43**	**53.157**	**66.9**

Source: GIE.

DIW Berlin 2009

Box 2

Draft EU Directive to ensure natural gas supplies

The draft EU Directive of July 2009 to provide for crises in the natural gas sector obliges the member states to present a risk analysis within six months of the Directive coming into force and then every two years thereafter. A three-step emergency plan (early warning, alarm and emergency) must also be drafted, which governs the interplay between supply companies and the authorities, in the event of supply interruptions. Within three years of the Directive coming into force, but by March 31, 2014 at the latest, every member state should be in a position to supply both private and other protected consumers, such as schools and hospitals for at least 60 days (Article 6) in the event of key gas infrastructure components - (N-1) criterion – failing, or in the event of an extremely cold period. Should more than ten percent of the Community's daily natural gas imports from third countries be halted, the EU can declare a Community-wide emergency. This is also possible if more than one national authority declares a national emergency (Article 10, No. 1). In this case, the commission coordinates the national regulatory authorities. Should the commission be of the opinion that the national authorities are implementing unreasonable measures or are posing a major threat to the situation in another member state, the commission can demand that the responsible national authority changes its course and follow its instructions (Article 10, No. 4).

of imports for 60 days, crude oil: seven percent of imports for 90 days), but also in terms of intervention options.

This could result in countries that are highly dependent on Russian natural gas supplies seeking solo domestic strategies to improve the security of their supplies, which may be far more expensive than expanding the remainder of the EU's natural gas network. However, companies may see it as an incentive to invest in ensuring gas supplies beyond the minimum requirement, insofar as their calculations prove this to be economically viable.[10] This does, however, require that all associated costs are taken into consideration when regulating gas transport tariffs.

Conclusion

There was enough natural gas present within the European Union to replace the shortfall during the interruption to natural gas supplies from Russia at the beginning of 2009. It was not possible, however, to transport a sufficient amount of natural gas to where it was required. Some countries in Southeastern Europe were therefore faced with shortages. A number of projects to expand storage capacities are currently in planning alongside plans to build new natural gas pipelines and modify existing pipelines so that they can deliver in reverse flow direction. However, most of the projects will not be initiated until 2010 at the earliest. The member state obligation drafted by the EU Commission, according to which protected consumers (private households, schools, hospitals, etc.) must be supplied with natural gas for 60 days, in the event of supply interruptions, would only come into force in 2014. Despite the fact that natural gas consumption levels in Europe sank drastically in 2009 on account of the financial crisis, another prolonged interruption to supplies during the winter season could lead to shortages in some Southeastern European countries.

Overall, the EU—and Germany in particular—is well prepared for such temporary crises. The natural gas storage facilities are sufficiently filled, in some countries domestic production can be temporarily increased, and LNG is currently abundant on the global market.

10 This could also be contributed by investment in storage or additional pipelines/gas flow modifications leading to additional profitable markets (e.g. for storage services).

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