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SPECIFIC FEATURES OF NATURAL GAS SUPPLY IN SOME EU COUNTRIES

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Abstract: The monthly gas balances for Hungary and for five other EU Member States were investigated between 2008 and 2017. For the analysis, monthly data available in the EUROSTAT database [nrg_103m] was used to ensure that the data for the different countries are comparable. Time charts for each country were used with a three-figure set of figures. For each country studied, the first member of the graph group shows the seasonal changes in the use of natural gas for the period 2008-2017. The timely changes in the liability side of domestic production and net imports, the domestic user's use of the user's page, are time-consuming, and the storage activity is illustrated by the quantities extracted from the containers. In the second graph of the group of figures, the monthly opening and closing stock of the gas stored in the given country / country group, as well as the change in the net import, are shown. Finally, the third figure illustrates the change in inventory variability for the gas year from 1 April to 31 March. The authors conducted the analysis for the EU-27, Hungary, Austria, France, Italy and the Czech Republic, and their findings were formulated for the listed countries.

1 Introduction, seasonality, opportunities and risks of natural gas supply

Natural gas, which is more favorable to GHG emissions than other fossil fuels, is transmitted to end-users via a pipeline power supply network. In most countries, the bulk of this energy carrier is used by the household, industry and service sectors. In many countries there is also a significant amount of natural gas used for electricity generation. Over the past two decades, new perspectives have also emerged, from which the transport sector has to be highlighted.

The European Union's firm commitment to reducing GHG emissions has led to the gradual shift from coal to natural gas in the field of electricity production from the statistical data. There is also evidence of improved efficiency in the use of natural gas in the household and service sectors [1,2].

From the point of view of natural gas use it is favorable that natural gas can be stored in exhausted oil and gas fields and in underground water reservoirs (aquifers). In some European countries, it is possible to store in artificial salt domes. In the past decades, commercial and strategic (supply security) storages have been set up in several European countries. The authors present, through the example of some countries, the seasonal changes in the supply of natural gas and the role of storages in this process [3-7].

The changes in the storage strategy of the EU-27 and other EU Member States during the period 2008-2017 were further examined. EUROSTAT monthly data was used to present and analyze monthly gas balances.

2 Natural gas supply in the EU

Figure 1 shows the change in the EU's monthly gas consumption from January 2008 to March 2018. From the gross domestic consumption curve it can be seen that the lowest monthly consumption of natural gas was 857.9 PJ, the largest being 2666.3 PJ. The figure also shows that the gas demand exceeded 2600 PJ in 2010 (January and December) and 2017 in the coldest winter months. The biggest gas demand was in January 2010 with 2666.3 PJ. The lowest gas demand was registered in August, August, with a value of 857.9 PJ.

Figure 2 shows that net imports between 2009 and 2012 were changing in wider, but after 2013, they were changing in a narrower range. From 2015, a moderate growth trend can be seen. During the period 2008-2013, the monthly opening and closing stock of stored gas changed in the range of 1000-2500 PJ but no relevant growing or decreasing trend occurred. After 2013, there was a clear and significant increase in the amount of gas stored, especially in the maximum values. From a financial point

of view, the inventory of winter-end (remaining) stocks is interesting, as this is a "frozen cost" for the traders.

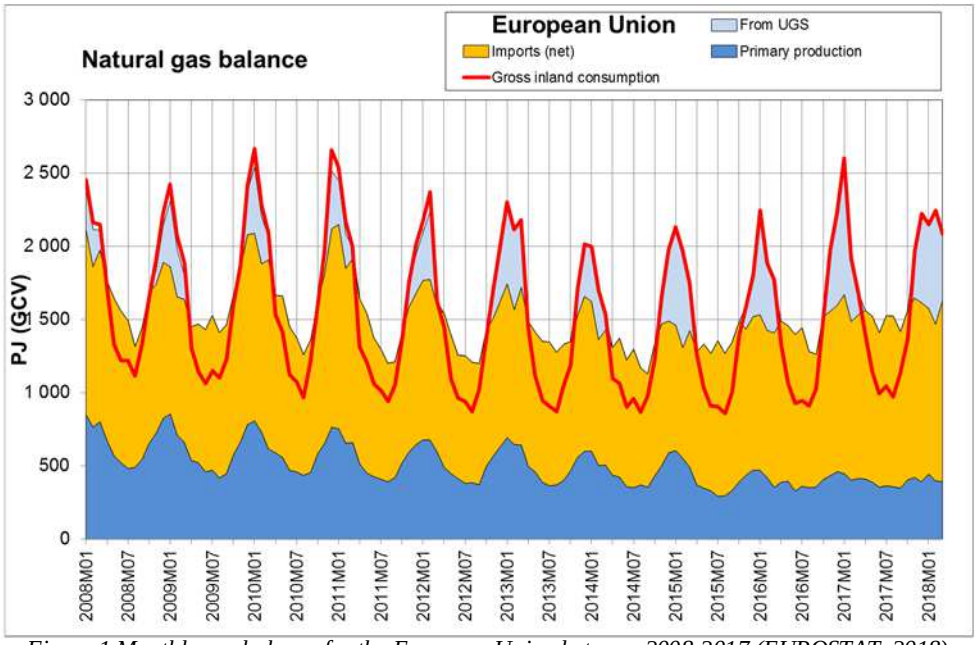

Figure 1 Monthly gas balance for the European Union between 2008-2017 (EUROSTAT, 2018)

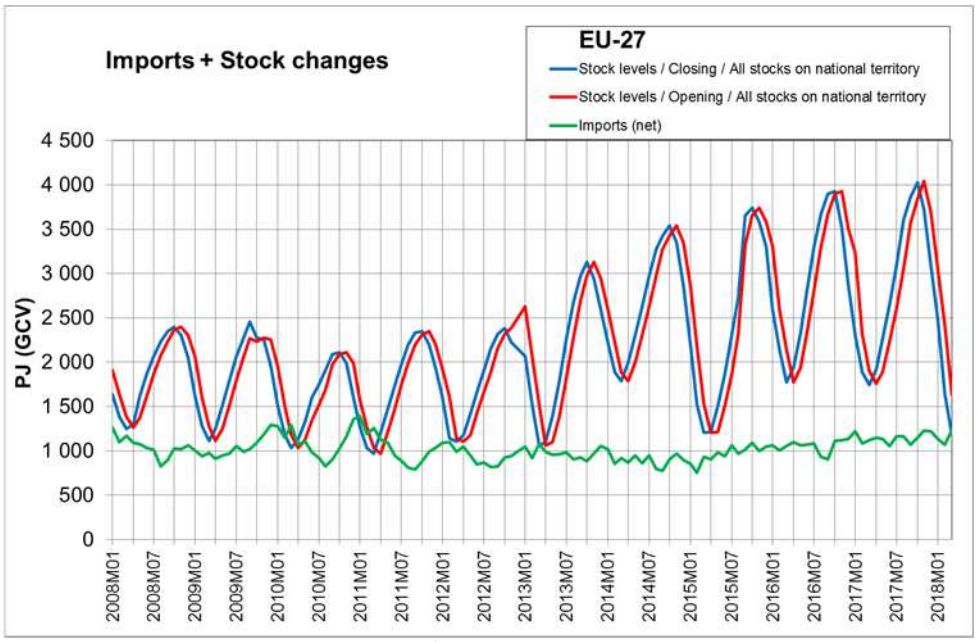

Figure 2 Net import and changes in storage reserve for the European Union between 2008-2017 (EUROSTAT, 2018)

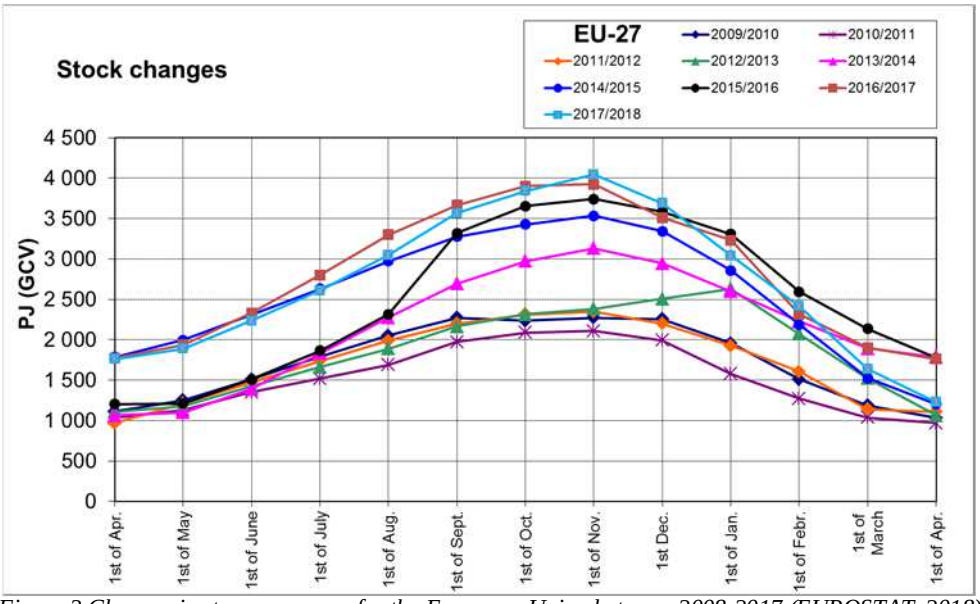

Figure 3 Changes in storage reserve for the European Union between 2008-2017 (EUROSTAT, 2018)

In Figure 3, the inventory changes of gas storage are shown for the "storage" gas year, i.e. from 1 April to 31 March of the following year. In various winters the amount of gas stored varied at different rates during the winter months. The maximums of curves fall at the end of October. Subsequently, the loss of storage stocks can be observed due to the higher gas demand in the cold winter months.

3 Natural gas supply in Hungary

Figure 4 shows Hungary's monthly gas consumption from January 2008 to March 2018. From the gross domestic consumption curve it can be seen that the lowest monthly gas consumption was 12.8 PJ in the month of August 2014 and the highest was 71.7 PJ in January 2008. It can be seen from the figure that in the years 2008-2011, winters with almost the same cold temperatures were successive years with significant natural gas consumption. The figure clearly shows that domestic gas production decreased slightly during the period under review, but its monthly / seasonal fluctuation was small. Monthly net import volumes have changed significantly, sometimes due to international conflicts that are independent of Hungary.

Figure 5 shows the changes in the net import and the underground storage inventory. During the period under review, there have been several years of considerable gas remaining underground storage after mild winters. Based on the figure, it is likely that, after the fall of 2013, the estimation of storage stocks reflects an increasing experience. The net monthly import rate changed in the 6.7 to 51.9 PJ interval.

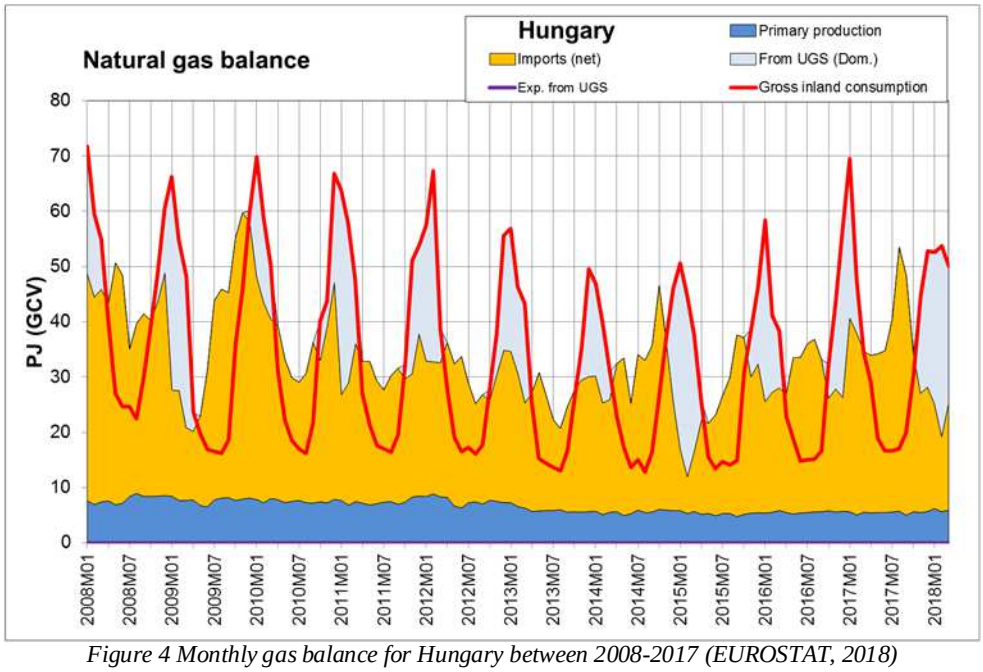

Figure 4 Monthly gas balance for Hungary between 2008-2017 (EUROSTAT, 2018)

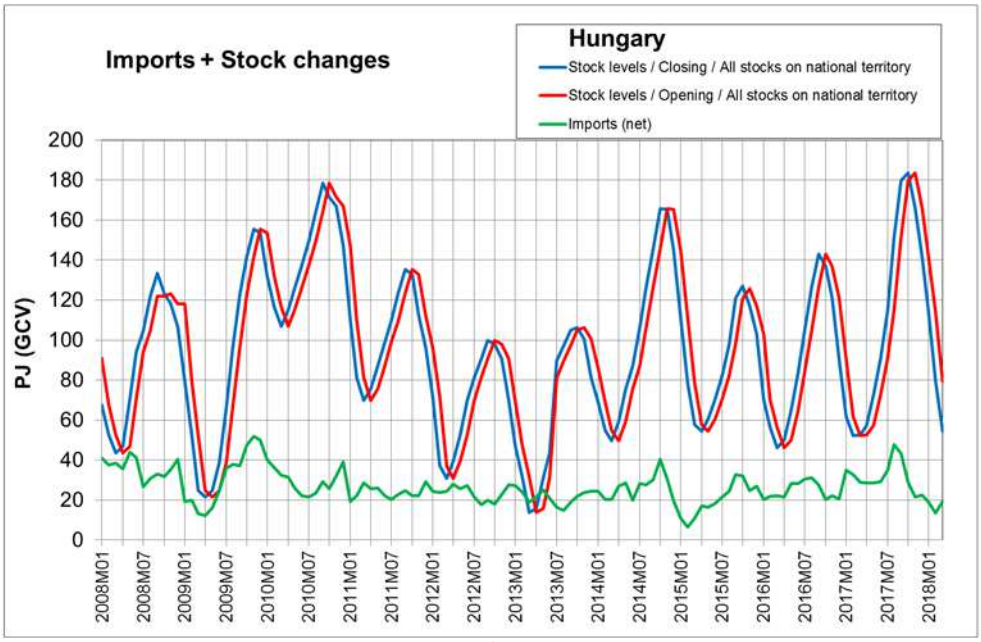

Figure 5 Net import and changes in storage reserve for Hungary between 2008-2017 (EUROSTAT, 2018)

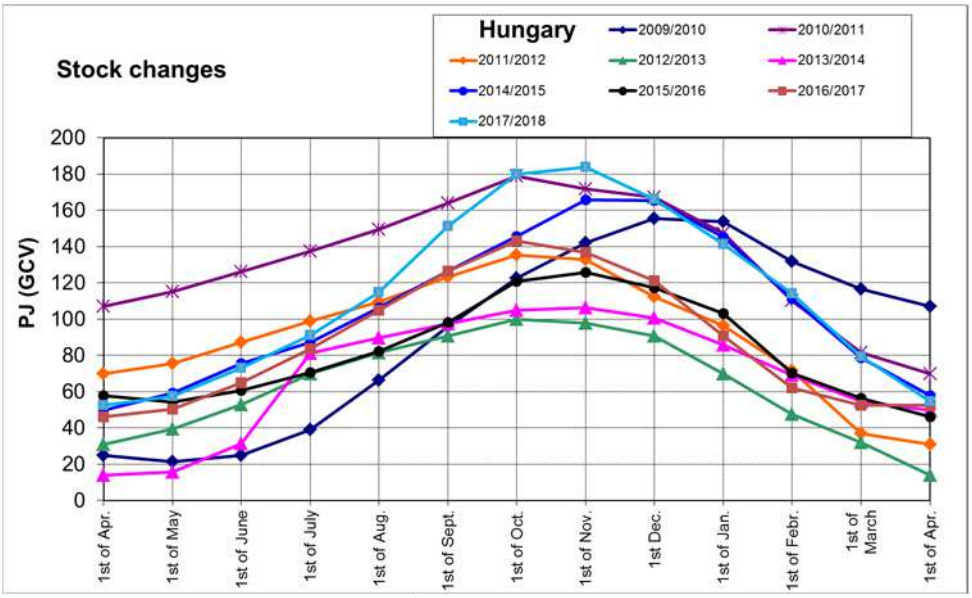

Figure 6 Changes in storage reserve for Hungary between 2008-2017 (EUROSTAT, 2018)

Figure 6 shows the storage reserve changes over the investigated gas years. In differently cold winters the quantities of gas stored were different, these changes are different in magnitude and in their pace in the winter months. It can be seen that the volume of natural gas that was stored began to decrease in early October in some years, and in other years it only occurred only in November or December.

4 Natural gas supply in Austria

Figure 7 shows Austria's monthly gas consumption from January 2008 to March 2018. From the gross domestic consumption curve it can be seen that the lowest monthly gas consumption was 12.8 PJ in July 2013 during the period under review and was highest with 59.5 PJ in January 2017. It can be seen from the figure that domestic production was continuous but its size was considerably lower than gas demand. The amount of natural gas stored in the underground storage facilities played an important role in satisfying gas demand.

The figure shows (violet line) the special shape of the "area" of the stored gas quantities and its passage to the negative range. This phenomenon is related to the activities of the Central European Gas Hub (CEGH). In Austria, the role of the underground gas storage facilities are considerably wider than in other countries in the region. In addition to satisfying the seasonal gas demand of the country, it is necessary to meet the temporary storage needs of CEGH. Figure 7 clearly shows that significant storage capacity is a prerequisite for the operation of an international gas trading center in Austria.

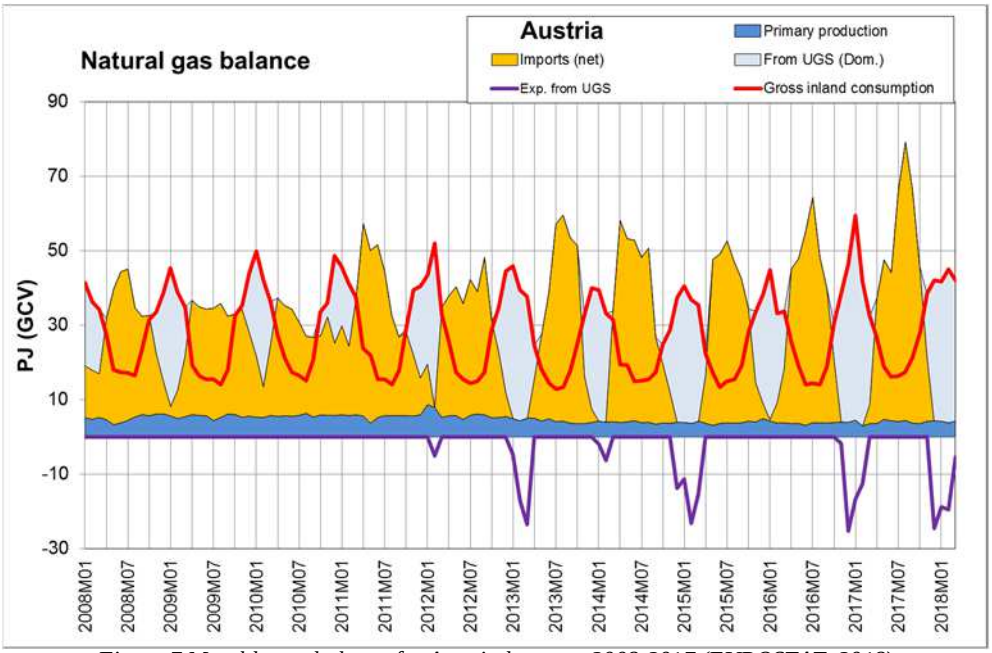

Figure 7 Monthly gas balance for Austria between 2008-2017 (EUROSTAT, 2018)

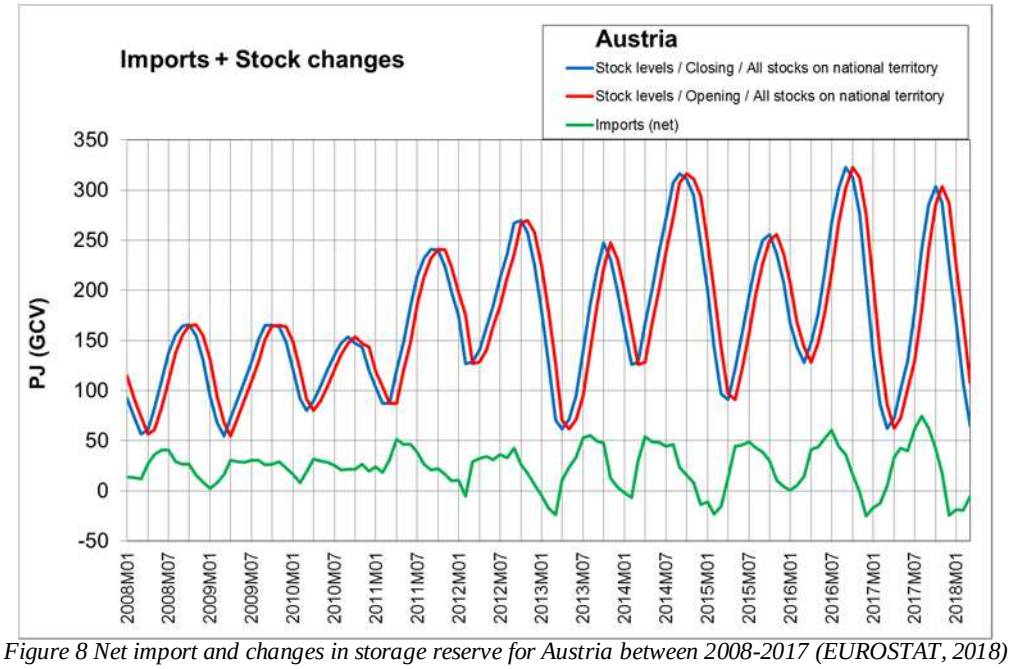

Figure 8 Net import and changes in storage reserve for Austria between 2008-2017 (EUROSTAT, 2018)

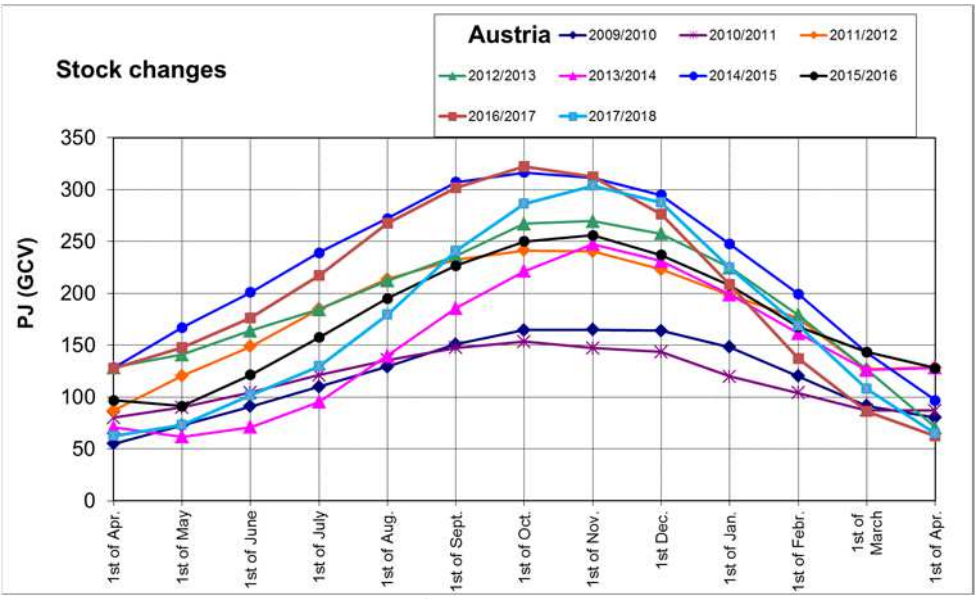

Figure 9 Changes in storage reserve for Austria between 2008-2017 (EUROSTAT, 2018)

Figure 8 shows the changes in the net import and the underground storage reserve. During the period under review, there have been several years since, after mild winters, significant amounts of gas has remained in underground storage, which is unfavorable to traders. The figure suggests that after the fall of 2013 gas traders have become more experienced, the estimation of storage reserves reflects an increasing experience. It can be seen in Figure 9 that the storage reserve in Austria during the period under consideration changed from 67 to 308 PJ. Net imports changed between the 74.8-25.1 PJ interval.

Figure 9 shows the storage inventory changes for the period under review for the years concerned. Comparing Figure 4 and 7 and Figure 6 and 9, it is clear that in Austria, significantly lower storage capacities and storage rates would be sufficient than those shown in Figure 9 to equalize seasonal fluctuations in Austria. However, it can also be seen that the changes of the gas loading and gas removal curves from the storages are very similar to the curves shown in Figure 3 and 6.

5 Natural gas supply in France

Figure 10 shows France's monthly gas consumption from January 2008 to March 2018. From the gross domestic consumption curve it can be seen that during the period under review, the lowest monthly gas consumption was 44.8 PJ in August 2012 and the highest was 307.9 PJ in January 2010. It can be seen from the figure that the size of gas production was not significant in the first half of the examined period, and decreased by 0.1-0.2 PJ after 2013. Because of the high import share and the minimal domestic production, underground storage plays an outstanding role in the country's natural gas supply. It should be noted that in France, most of the underground gas storage facilities are aquifer, i.e. deep gas storages in artificial water reservoirs.

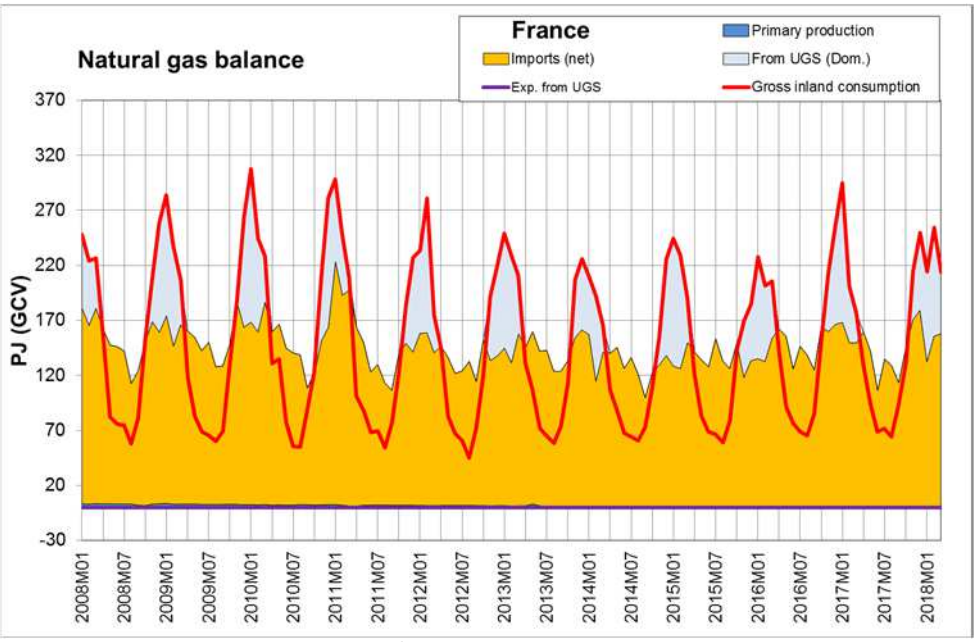

Figure 10 Monthly gas balance for France between 2008-2017 (EUROSTAT, 2018)

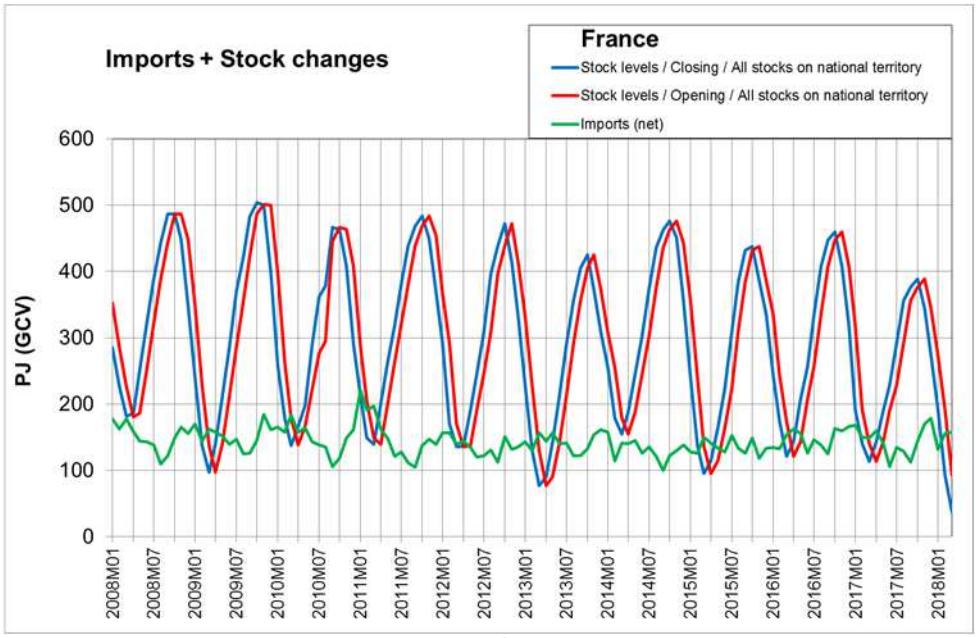

Figure 11 Net import and changes in storage reserve for France between 2008-2017 (EUROSTAT, 2018)

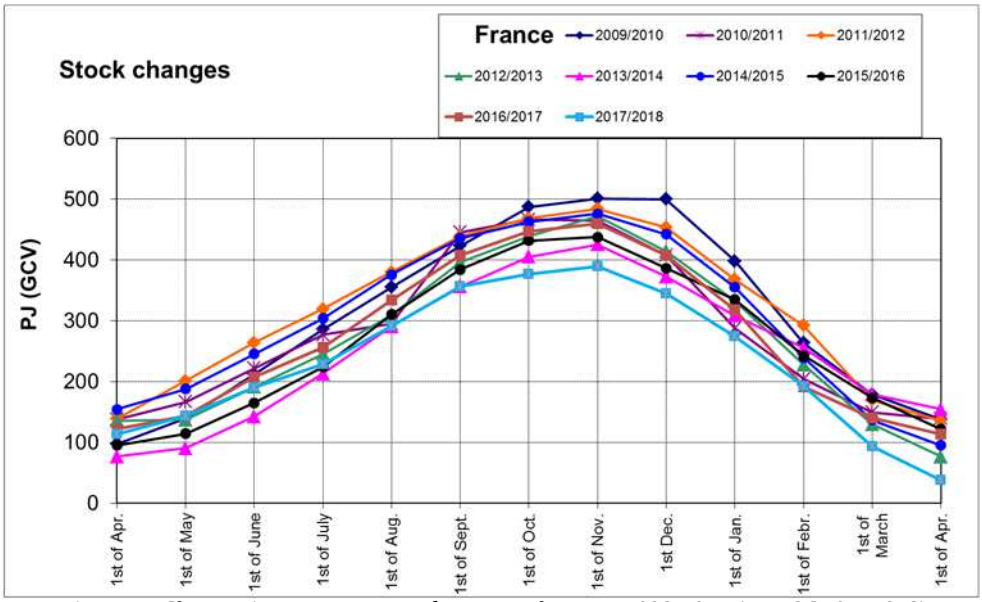

Figure 12 Changes in storage reserve for France between 2008-2017 (EUROSTAT, 2018)

Figure 11 shows that during the period under review, the storage opening volume ranged between 76.7 and 500.9 PJ. Net imports, in particular in the first half of the investigated time interval, changed in a broader range of 99.7 to 221.7 PJ intervals.

Figure 12 shows the storage reserve changes for each gas year. It is conspicuous that in some gas years the storage reserve has changed very narrowly.

6 Natural gas supply in Italy

Figure 13 shows Italy's monthly gas consumption from January 2008 to March 2018. The gross domestic consumption curve shows that the lowest monthly gas consumption was 115.6 PJ in the month of August 2014 and the highest was 424.5 PJ in January 2017. It can be seen from the figure that the volume of domestic production in the months of 2008 has exceeded 30 PJ, but gradually decreased over the following years. Due to the high share of imports, underground storage plays an important role in the country's natural gas supply.

Figures 13 and 14 show that, in the first half of the investigated period, the volume of imports in Italy was significantly higher in the coldest months of the year than in the rest of the year. However, this practice changed after 2014, and the monthly net import became much more even.

Figure 15 shows that during the period under review the storage opening volume in Italy was between 264.1 and 771.5 PJ. Net imports, in particular in the first half of the investigated period, changed in a broader range of 134.7-310.6 PJ.

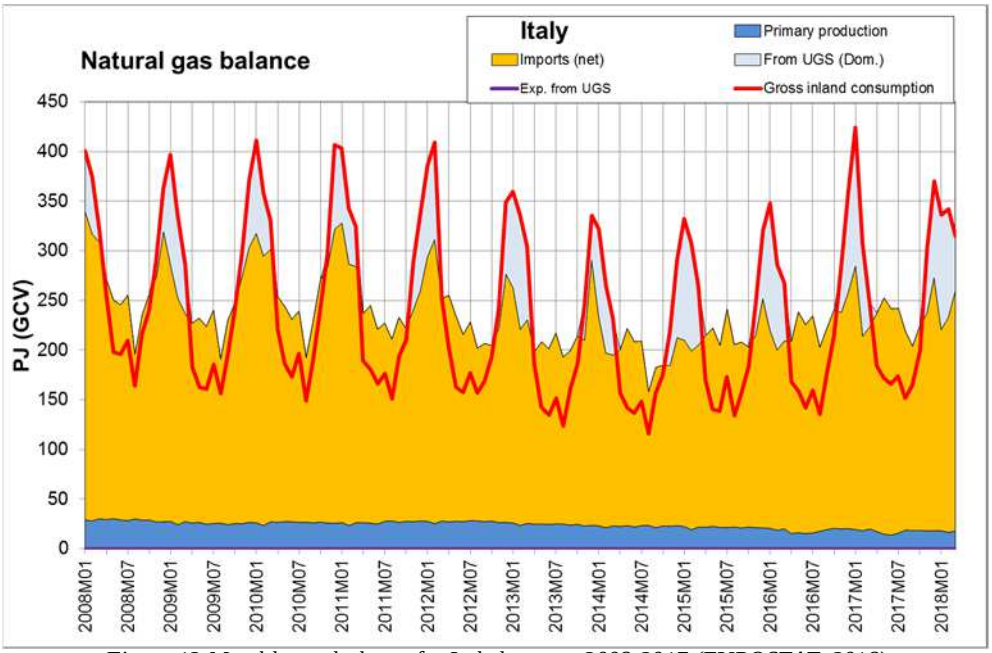

Figure 13 Monthly gas balance for Italy between 2008-2017 (EUROSTAT, 2018)

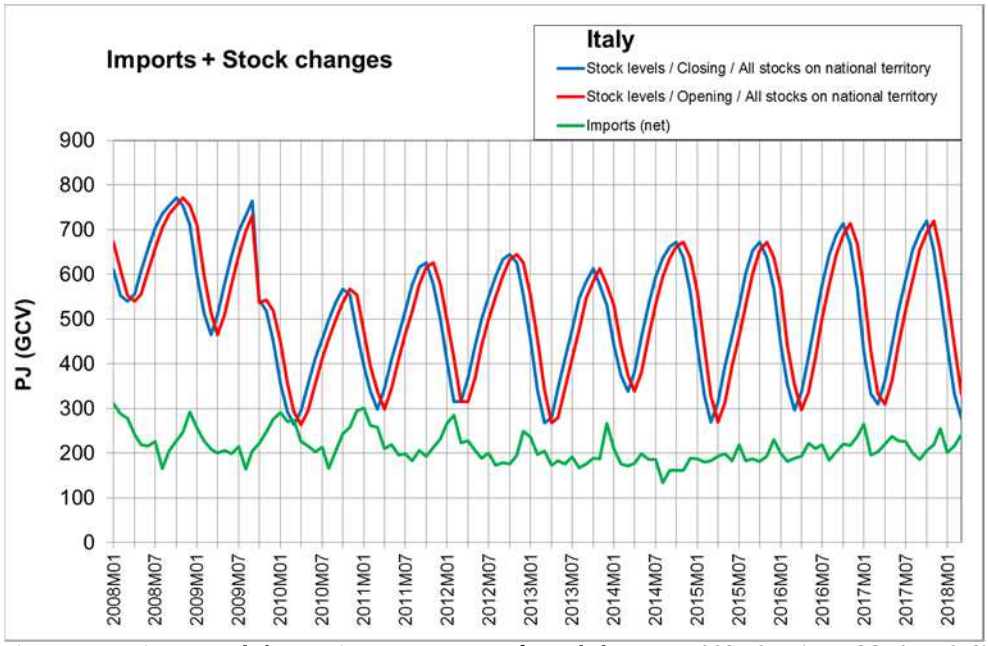

Figure 14 Net import and changes in storage reserve for Italy between 2008-2017 (EUROSTAT, 2018)

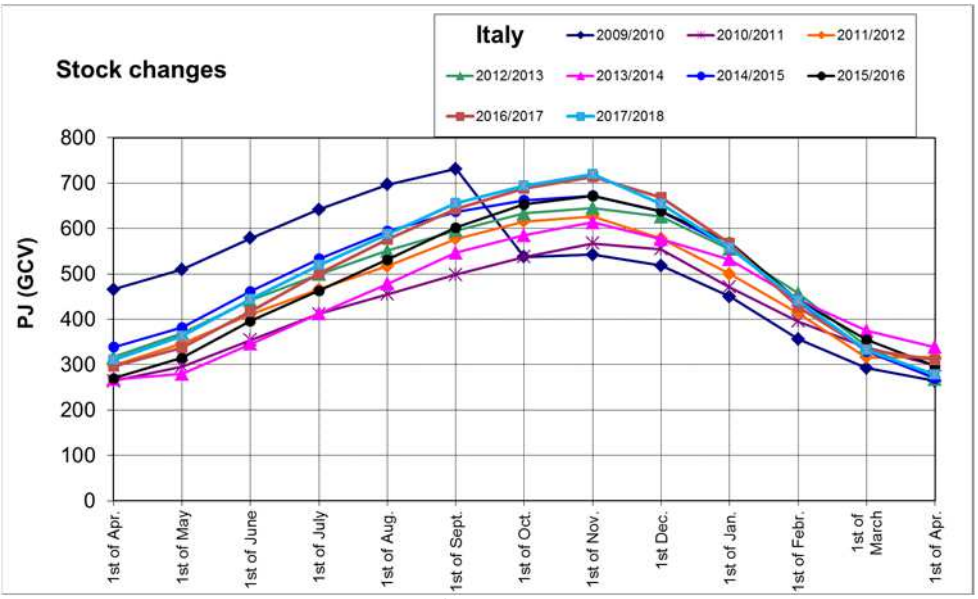

Figure 15 Changes in storage reserve for Italy between 2008-2017 (EUROSTAT, 2018)

7 Natural gas supply in the Czech Republic

Figure 16 shows the change in the monthly gas consumption in the Czech Republic from January 2008 to March 2018. From the gross domestic consumption curve it can be seen that the lowest monthly gas consumption in the period under review was 10.7 PJ in August 2009 and the highest was 56.8 PJ in January 2017. It can be seen from the figure that the size of the domestic production during the period under investigation did not change significantly between 1.0 and 0.4 PJ. Because of the high import share, underground storage has played a prominent role in the country's natural gas supply.

Figure 17 illustrates the changes in the size of the storage opening capacity between 118.4 and 10.5 PJ during the investigated period in the Czech Republic. The net import in varied a broader range between 44.3-10.2 PJ.

Figure 18 shows changes in gas storage capacity for the investigated period. It is conspicuous that in the individual gas years, the storage capacity in charged state varied at a reduced rate compared to the greater changes in months with almost depleted storages.

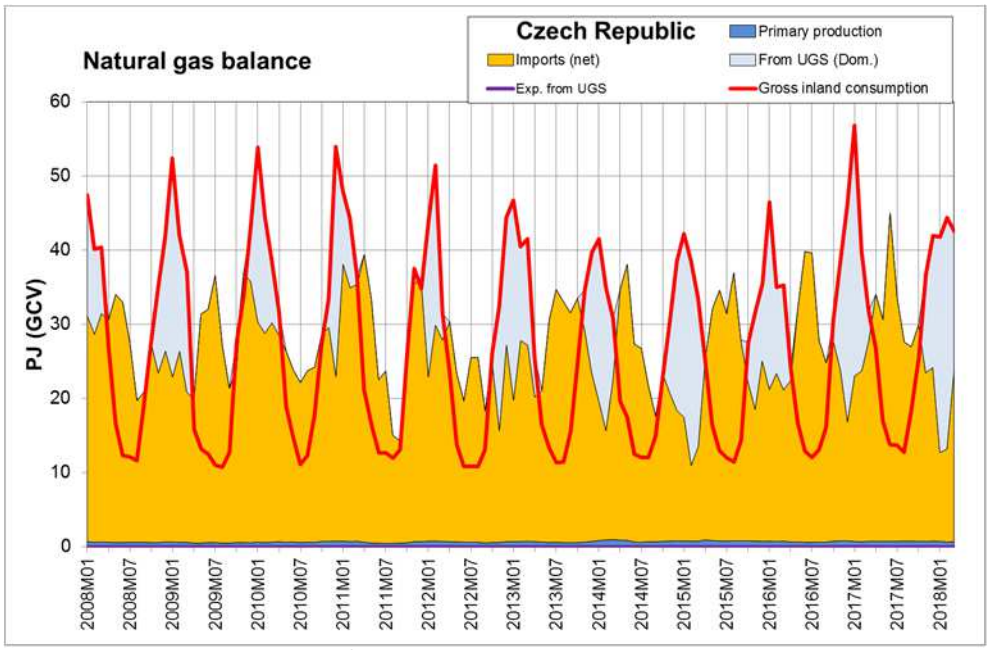

Figure 16 Monthly gas balance for the Czech Republic between 2008-2017 (EUROSTAT, 2018)

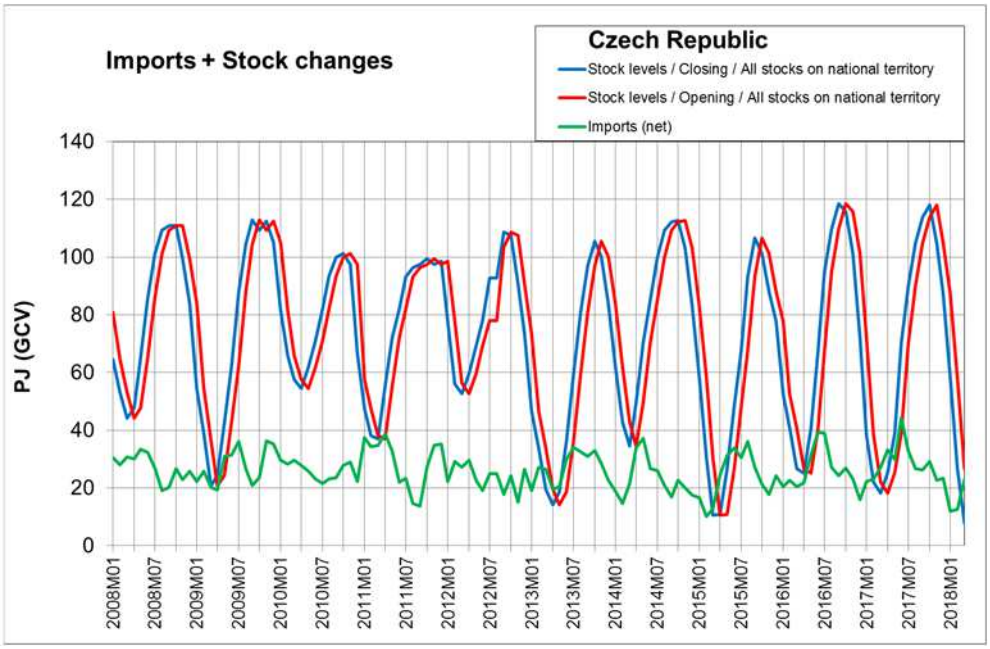

Figure 17 Net import and changes in storage reserve for the Czech Republic between 2008-2017 (EUROSTAT, 2018)

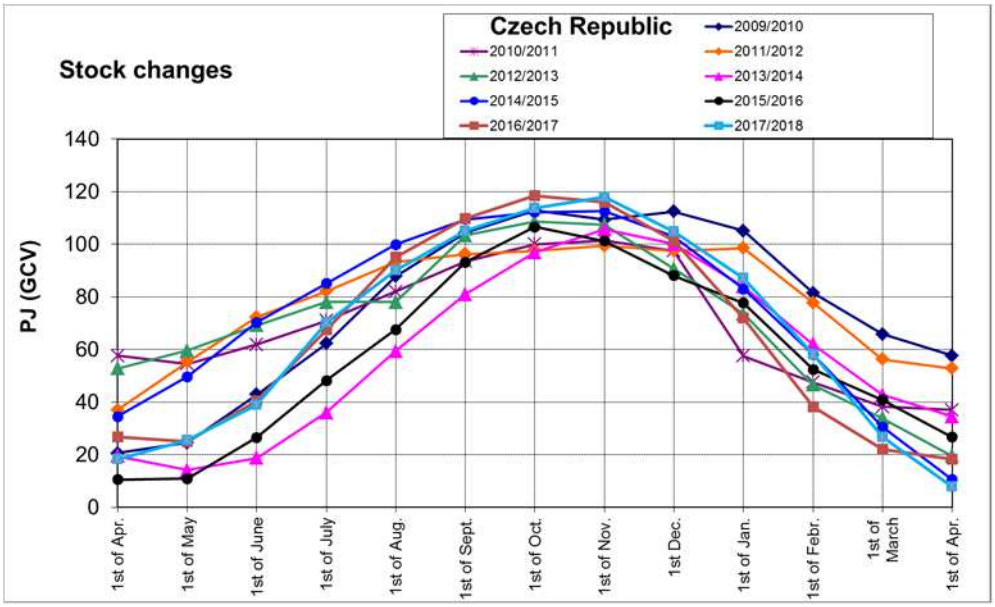

Figure 18 Changes in storage reserve for the Czech Republic between 2008-2017 (EUROSTAT, 2018)

8 Summary, conclusion

The magnitude and timely changes of natural gas consumption and storage reserves were investigated for five EU Member States for 2008-2018 on the basis of the EUROSTAT database monthly data.

From the comparative analysis the following conclusions can be drawn:

- For economic reasons during the investigated period in the countries studied, the monthly volumes of natural gas and imported gas fluctuated within narrow limits;
- Natural gas was used in some countries for end-use purposes and partly for electricity generation;
- It was shown in the surveyed countries that the monthly volume of natural gas consumption showed significant seasonal fluctuations due to the significant gap in heating usage;
- In order to compensate for seasonal fluctuations in the examined countries, natural gas transmission pipeline systems have different gas storage types with different capacities;
- The primary task of storages is the balancing of narrow gas sources and seasonally changing gas

requirements, which are necessary for supply and national security;

- Depleted oil and gas fields are used primarily for the storage of large quantities of natural gas, but aquifers, artificial salt caves are used seldomly;
- In European countries where regional gas trading centers operate, storage facilities are also essential for international gas commerce;
- It can be stated that the storage strategy has changed in the countries under investigation after 2010, that more and more import gas is stored in the summer months and, the volume of imports is reduced in the winter months when possible.

Analysis made to the EU member states surveyed highlighted ways to balance the resource side and the seasonal fluctuations of the user side under significantly different conditions.

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References

[1] Underground Gas Storage in the World – 2017 Status, CEDIGAZ_July, 2017, http://www.cedigaz.org/documents/2017/Overview%20of%20underground%20gas%20storage%20in%20the%20world%202017%20v1.pdf, 2017.
[2] Ten major trends in the European gas market: Executive summary – CEDIGAZ http://www.cedigaz.org/documents/2018/Executive%20summary.pdf, 2018.
[3] The role of gas storage in internal market and in ensuring security of supply, Directorate-General for Energy, Internal Energy Market, 2015.
[4] Towards the Paris Agreement with Gas Infrastructure https://www.gie.eu/conference/USB/GIE/GIE_Brochure_Towards_the_Paris_Agreement_March2018.pdf, 2018.
[5] Position Paper – The Storage Market in Transition – What needs to be done? https://www.gie.eu/index.php/gie-publications/position-papers, January 16, 2018.
[6] Gas Balances in European Underground Storages https://naftogaz-europe.com/article/en/GasBalances, August, 2018.
[7] Gas Balances in European Underground Storages https://naftogaz-europe.com/article/en/GasBalances, June 05, 2018.

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