1 October 2015
15GSE102

Paper on the GSE Investment database 2015-2025

About GSE

Gas Storage Europe (GSE) represents the interests of 31 Storage System Operators with around 110 storage sites in 16 countries in Europe, representing approximately 84 bcm, i.e. 87% of EU technical storage capacity. GSE is one column of Gas Infrastructure Europe (GIE), the European association of the Transmission, Storage and LNG terminal Operators.

GSE is committed to improving the regulatory and investment framework for storage activities in order to help its members to continue providing secure, efficient and valuable storage services to the market.

1 Introduction

GSE updated its investment database in May 2015.[1] The investment database allows for seeing the potential future development of gas storage capacity. The information is also incorporated in the database accompanying the GSE map.[2] This report aims at giving an explanation of the information in the databases and an overview of the existing and the planned capacity, including the investment planned to enter in operation in a period of 10 years (2015-2025) and the investments which either have a commissioning date beyond 2025 or do not have a defined commissioning date, which are classified as "Other projects".

The European storage business witnessed in the past years a successful history of investments from the SSOs which allowed the gas storages to develop along the years in parallel to the transmission grid in order to serve the growing needs of the gas market and which resulted in a total amount of about 108 bcm[3] of total technical maximum volume of working gas in 2015 for the EU28.

Data collected covers EU28 and non-EU28 countries (Albania, Belarus, Serbia, Ukraine and Turkey) and has been provided by GSE members as well as by the use of open sources (e.g. company websites, Ten-Year Network Development Plan 2015).

The investment projects are classified into 3 different categories:

- ***operational****:* existing capacities;
- ***under construction***: construction/ procurement phase started, major permits acquired, for the vast majority of these projects financial investment decision (FID) has been taken;
- ***planned***: FID not yet taken.

2 The storage activity

Underground gas storage provides benefits along the whole gas value chain from production (also for the power) through transmission network to end-user supply.

[1] http://www.gie.eu/index.php/maps-data/gse-investment-database
[2] http://www.gie.eu/index.php/maps-data/gse-storage-map
[3] Operational at –the time of data collection. Data from GSE investment database

These benefits are well explained in the GSE paper "The value of gas storage – Questions and answers"[4].

The graphs below show that underground storages have generally been well exploited and are an important tool for covering the seasonal swing, in different scenarios of gas demand and gas prices.

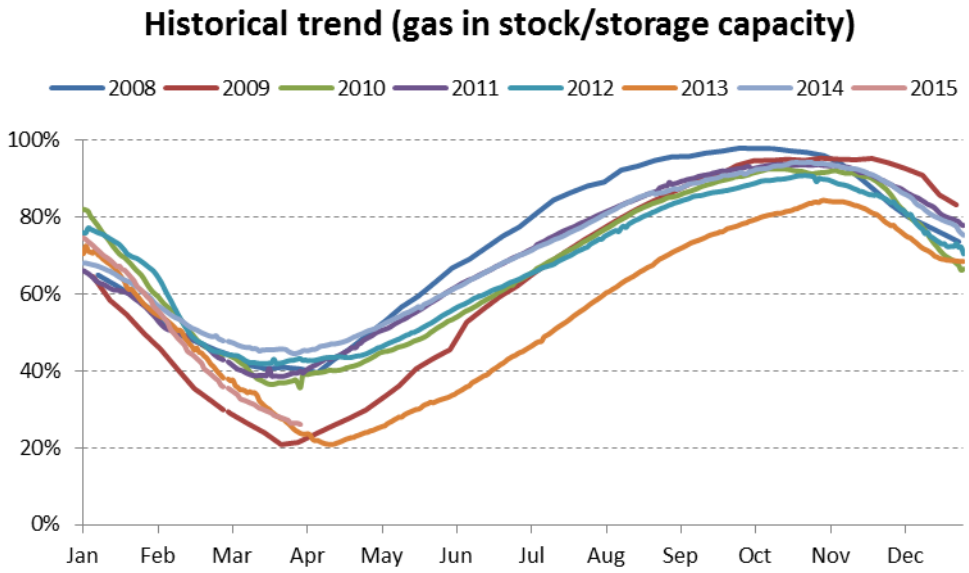

Fig.1: yearly detail of gas in stock in the period 2007-2015 (data from GIE AGSI+)

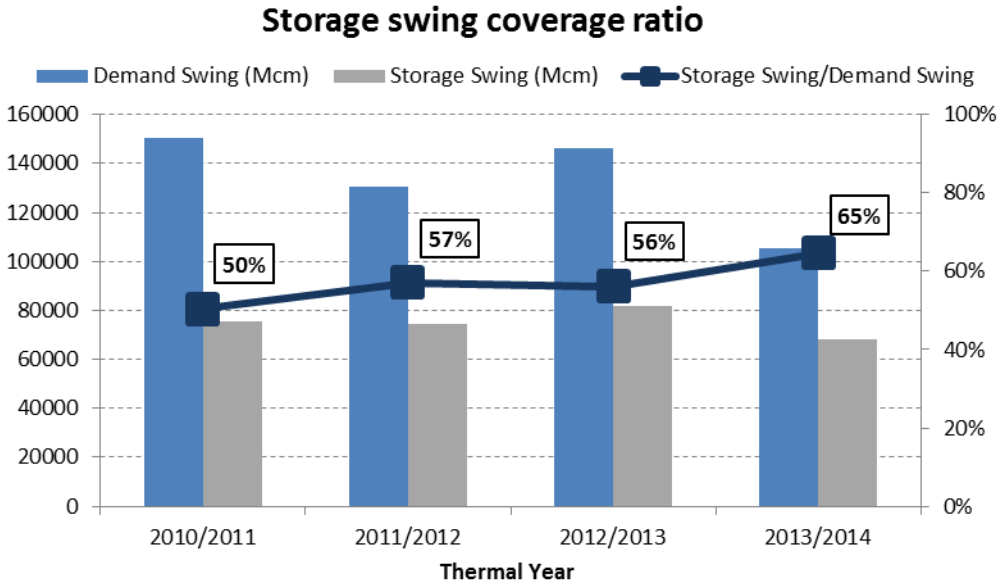

Fig.2: share of storage on winter-summer demand (data from GIE AGSI+ and yearly winter summer outlook from ENTSOG[5])

[4] http://www.gie.eu/index.php/publications/gse/doc_download/22412-gse-the-value-of-gas-storage-brochure-june-2014

[5] Note that the storage swing takes into account AGSI+ data. Please note that the AGSI+ database is continuously being improved and new and existing operators have been added in the past years. The AGSI+ database now covers over 90% of total capacity in the EU28

In addition, the availability of stored gas was an important tool to face geopolitical crisis during past years, also considering the decreasing domestic production and the increasing dependency of the gas supply by non-EU countries. (see Fig. 3)

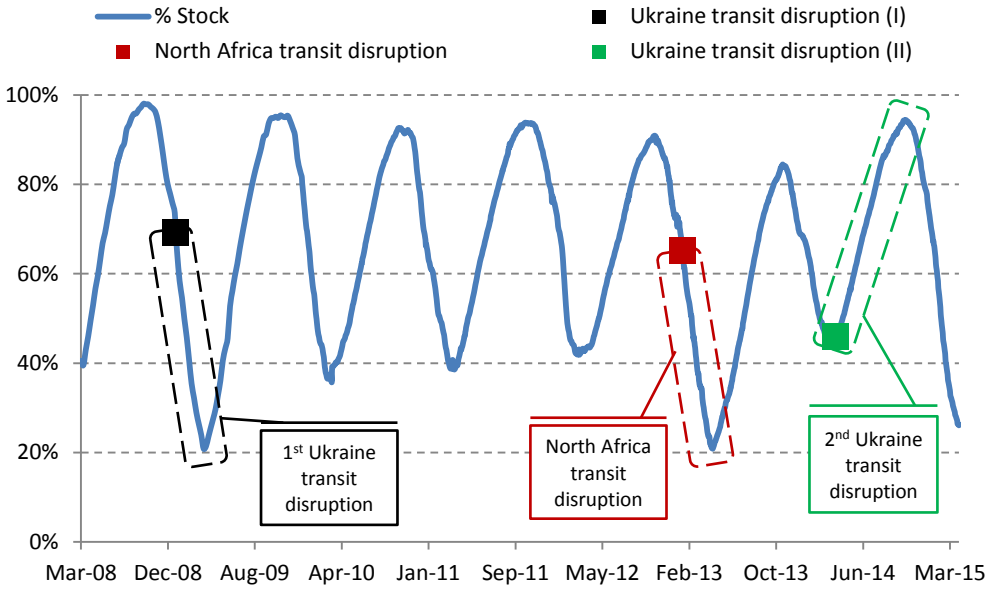

Fig.3: gas in stock from 31st March 2008 to 31st March 2015 (data from GIE AGSI+)

3 Market scenario

The European energy market is facing big challenges in the short and medium term. More requirements in terms of clean and cheap energy must take into account the increasing imports in the EU supply mix from non-EU countries (with the increasing share of Russian supply) resulting from declining indigenous production.

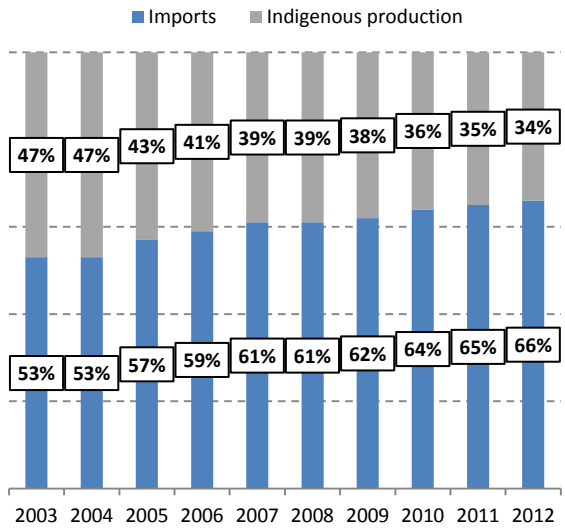

Fig.4 Evolution of indigenous production vs. import 2003-2012. (Source: Eurostat - ENTSOG TYNDP 2015-2025)

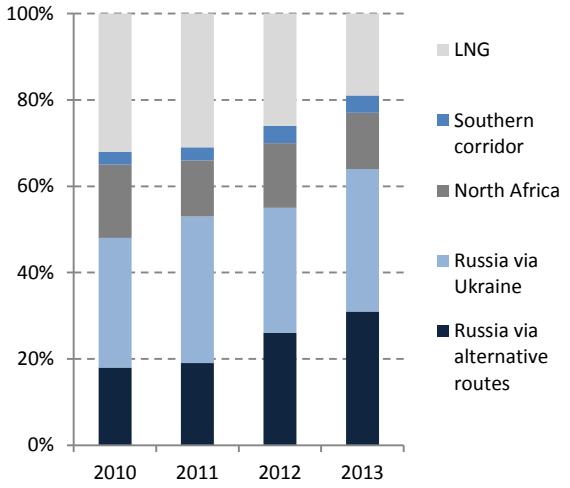

Fig.5: European natural gas imports by source. (Source: IEA 2014)

These aspects are considered in the current EU energy policy which is focusing, through different energy policy initiatives, on the convergence of three different targets sometimes conflicting (the so-called trilemma): competitiveness, security of supply and sustainability. Storage can fully contribute to the fulfilment of all the three targets, also considering the future trends.

Some market projections foresee an increase of the European gas demand in the next 20 years and a simultaneous reduction of indigenous gas production at an average rate of 3 – 3.4 % in the period 2015-2035[6]: these two factors are expected to trigger an increase of natural gas imports from non-EU28 countries which will enlarge the dependency of Europe in terms of gas supply and consequently they could strengthen the role of storage as an element to ensure security of supply.

The above mentioned need of the storage for security of supply, along with the need of flexibility rising from the more integrated and competitive energy market and the growing importance of storage as a support to renewables will enlarge the role of storage further.

Forecast by Cedigaz[7] shows that compared with underground gas storage capacity in operation in 2015, a further need for 40 bcm is expected in 2035 at European level, however this seems not be reflected in the current market prices. The increasing needs for storage are based on the following drivers:

- reinforced commercial role of storage due to market liberalisation (development of market hubs/gas trading, market-based pricing, more network balancing needs, greater interconnectivity of the European network require more flexibility from the storage, mainly close to the market and the interconnection);
- more seasonal storage needed for strategic purposes considering a significant increase in gas imports;
- more storage for operational purposes considering a decrease in domestic production (even with shale gas);

[6] ENTSOG, TYNDP 2015-2025

[7] Cedigaz at "Gas Storage in Europe, recent developments and outlook to 2035", European Gas Conference, 27-29 January 2015, Vienna, estimates an UGS need of 120 bcm at 2025 and of 147 bcm at 2035

- potential for significant development of highly-flexible gas-fired power plants after 2020 to back-up renewable power.

4 Investment survey

The survey conducted by GSE gathers data from 27 countries (22 EU countries and 5 non-EU countries: Albania, Belarus, Serbia, Turkey and Ukraine) and amounts to 85 projects with overall storage volume of **41.052 bcm** (36.872 bcm in EU28 and 4.180 bcm in non-EU28), of which the capacity planned to enter into operation by 2025 is 22.619 bcm (19.829 bcm for EU28 and 2.790 bcm for non-EU28), with about **544 mcm/d** in terms of deliverability.

The figures 6 and 7 below show the foreseen development of underground storage capacity (working gas and deliverability rate) from 2015 on. It is important to note that about one-half of the foreseen volume is part of the "Other Projects" where FID has not been taken yet.

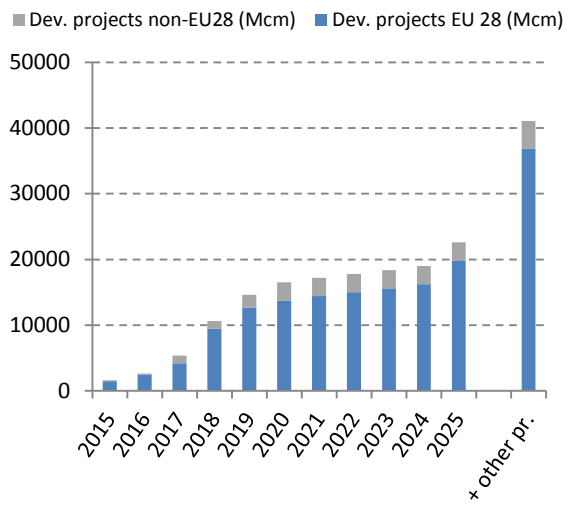

Fig.6: Total foreseen storage capacity for EU28 and non-EU28 countries

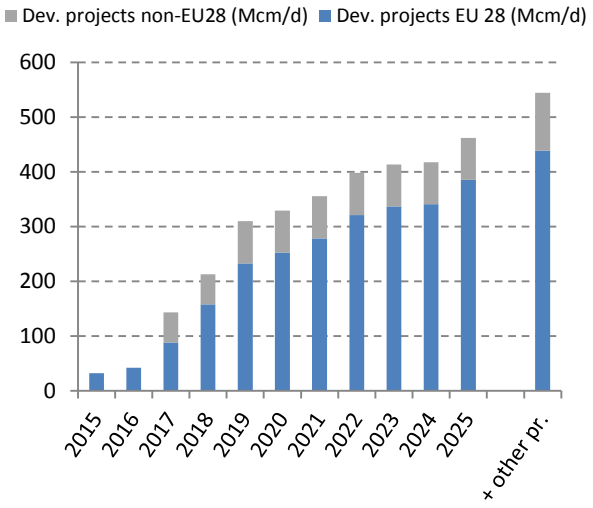

Fig.7: Total foreseen withdrawal capacity for EU28 and non-EU28 countries[8]

It's interesting to note that the 3 countries with the higher existing/planned storage capacity (fig.8) are placed in the European South-North axis (the UK, Germany and Italy).

[8] Note that for other projects often the withdrawal capacity data was not provided by the source

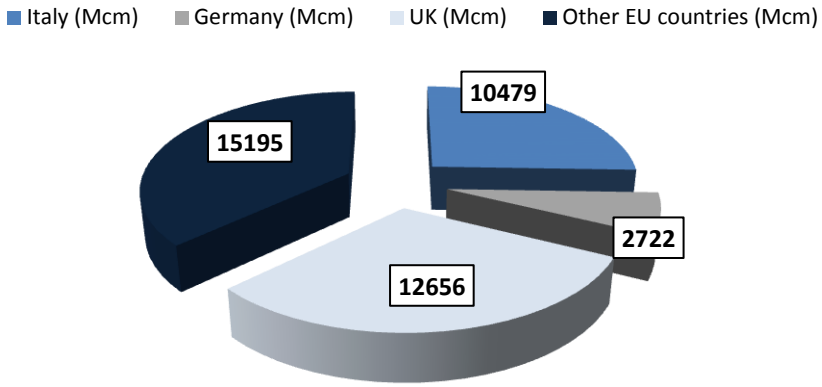

Fig.8: Incremental capacity per country (EU28 and non-EU28)

Projects already **under construction**, account for 21% of all projects (**8.523 bcm** – 7.013 bcm in EU28 and 1.510 bcm in non-EU28) while **planned projects**, i.e. those that may or may not be built, account for the remaining 79% (**32.529 bcm -** 29.859 bcm in EU28 and 2.670 bcm in non-EU28). Figure 9 below shows that the UK and Italy together account for the majority of new projects. In general the main drivers for new gas storage capacity are import dependency and security of supply concerns in combination with the decline in domestic production and the increase in intermittent sources such as wind and solar. . However, it is almost certain that many of these projects will not be developed.[9]
.

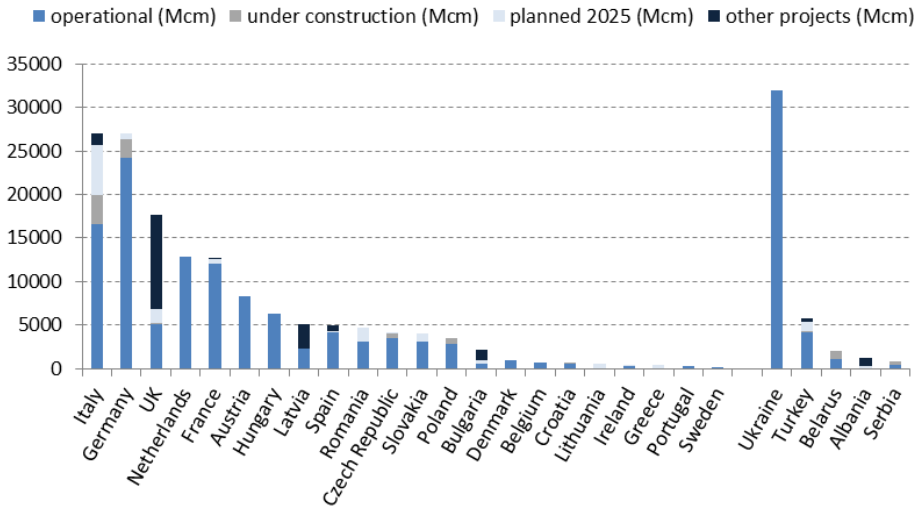

Fig.9: Existing and incremental capacity per country and investment status (planned or under construction) (EU28 and nonEU28)

Fig. 10 below details if the changes in underground storage capacities (for the period 2015-2025) are referred to new facilities, expansion of already existing facilities, decommissioned capacities and existing facilities.

[9] See also presentation Michael Kohl (RWE) during GIE annual conference on 12 June 2014, http://berlin2014.devsite.be/public/uploads/snip_435/files/2-3.%20Michael%20Kohl%20(RWE%20GS)%20140606%20Kohl_Investing%20in%20storage%20facilities_GIE%20AC%202014_4-3.pdf

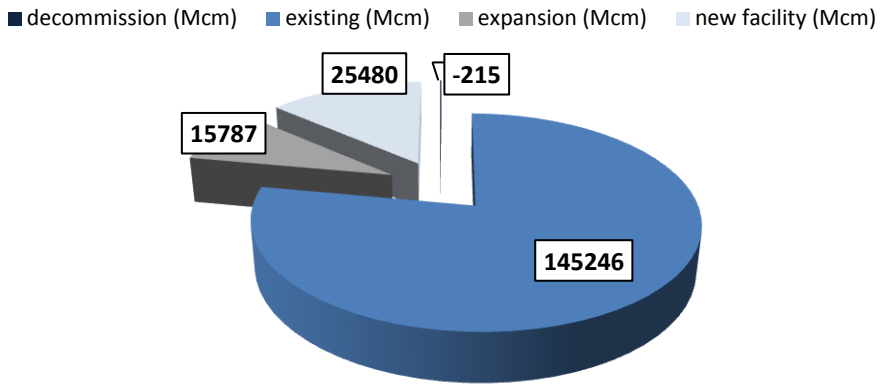

Fig.10: Total volume (EU28 and non-EU28 (see figure 9)) of storage capacity projects (all) including volume that will be decommissioned

The current market conditions are unfavourable and the total capacity decommissioned or mothballed between 2010 and 2015 amounts to approx. 2.7 bcm.[10] It is unclear how much additional capacity will be taken offline in the period 2015-2025. It is important to note in this respect that planned projects are usually announced in an early stage and can be cancelled before reaching the FID stage (and this is likely to happen if market conditions are not favourable), whilst information about decommissioning will only be disclosed after FID. Therefore, the decisions that will be taken by gas storage operators are unknown in the coming years, namely if the current market conditions and the lack of adequate investment signals from stakeholders and policy makers persist. It should be noted that decommissioning is irreversible and in the case of mothballing huge investments are needed to get a gas storage facility operational again.

5 Conclusions

The latest data from AGSI+ highlight the crucial role of underground storage in the European gas market in spite of declining gas demand and a historically low summer-winter spread, with very intensive utilization in the last thermal year (from 92.2 bcm of gas stock in October 2014 down to 24.3 bcm at the end of March 2015).

The new storage projects included in the GSE survey would, if realized, could bring a total of **41 bcm** of additional capacity to the market, with over 22 bcm expected to enter into operation by 2025. Most of the foreseen capacity is located in Italy, Germany and UK. However, **only 8.5 bcm** of the foreseen capacity is **under construction**. Given the length of planning and permitting in complex projects like storage facilities, the vast majority of these projects have been approved five to ten years ago, i.e. before the dramatic fall of the summer-winter spread and of demand for gas in the EU in general. A total of 2.7 bcm of capacity has been decommissioned in the past five years.

Some future scenario and estimates indicate an even more important role of the storage, expecting the incremental storage needs at European level of about **40 Bcm** at 2035.[11] The result of the above comparison between the forecast of storage capacity needs and foreseen storage capacity of the GSE investment database shows that the demand for storage capacity demand could be met by a corresponding storage volumes offered by foreseen projects, assuming that all the capacity shown by the GSE investment database would enter into force in due time. Conversely, in case of

[10] RWE Gasspeicher analysis, see annex (figure 16)

postponement or deletion of some projects, the need for additional gas storage capacity could not be met. It is important to highlight that the right measures and clear investment signals should be put in place by policy makers in order to create a favourable investment climate which could incentivize the SSOs not only to invest in new storage infrastructure taking the FID for those projects still in the "planned" status but also to keep under operation their current capacity. In addition, one should keep in mind that when existing gas storage facilities have to reinvest, mothballing is in many cases a realistic option given the current market conditions for operators of gas storage facilities.

Current gas market conditions give weak investment incentives for new investment in gas storage. Investments in gas storage facilities can only occur if investors are confident about recovering totally their investment costs and securing a return on their investment. This is due to the amount of sunk costs involved and the lead times to develop a new gas storage facility.

Investors in gas storage facilities require that investment costs would be recovered with their future expected income. In those cases where storage prices are market-based, market valuation predominantly reflects the seasonal spread, which currently stands at around 1.50 €/MWh, well below the costs required to operate and maintain underground storage facilities in the EU. Such prices thus essentially rule out any new investment in gas storage sites. On the contrary, they incentivize decommissioning and mothballing of existing facilities.

Therefore the regulatory framework should be conducive to storage use and commercial innovation, also taking into account that the value of storage should not only be related to the seasonal spread, but also to other factors that the market currently does not value enough. An adequate return on investment together with a stable and a predictable regulatory framework are essential elements to trigger new investment initiatives.

Annex

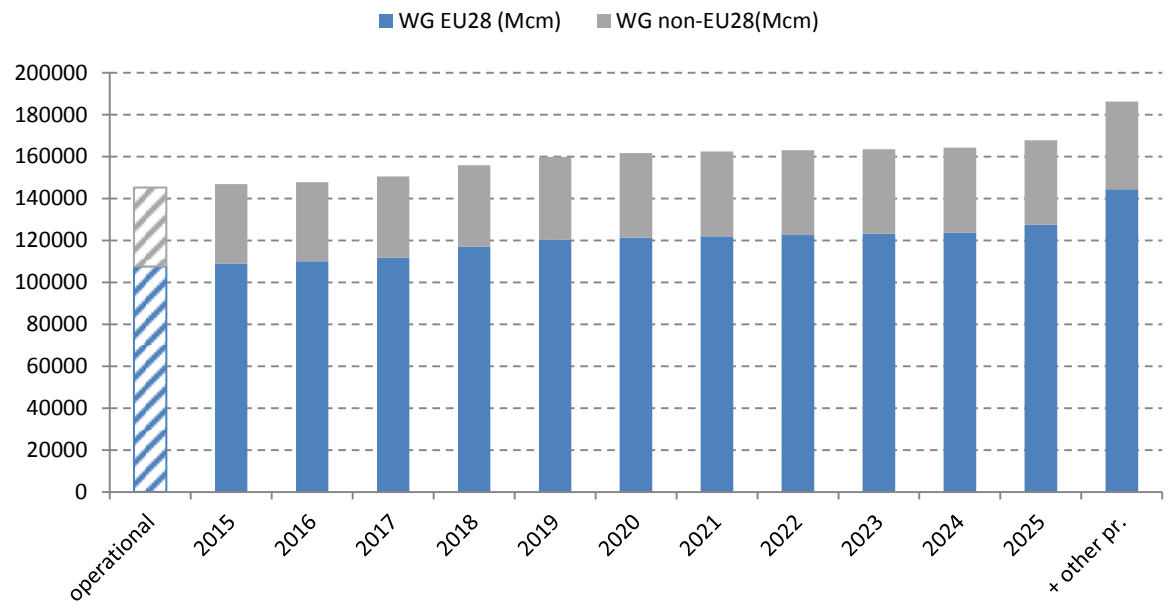

Fig.11: cumulated underground storage capacity development for EU28 and non-EU28 countries

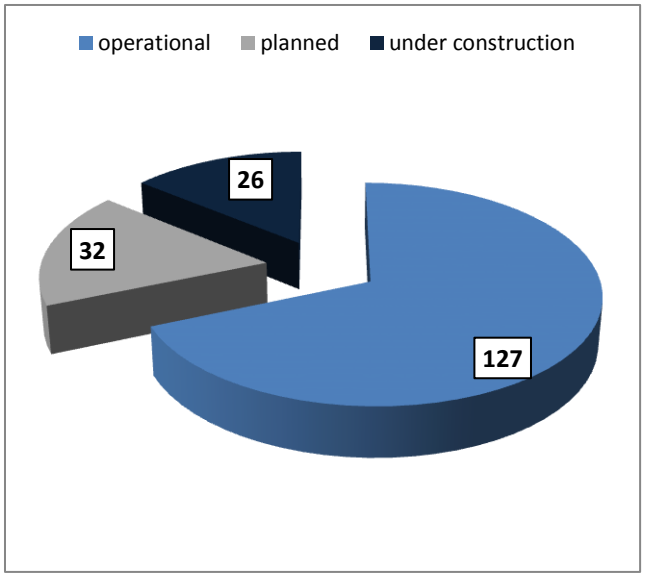

Fig. 12 : n° of projects of storage capacity development within 2025 for EU28

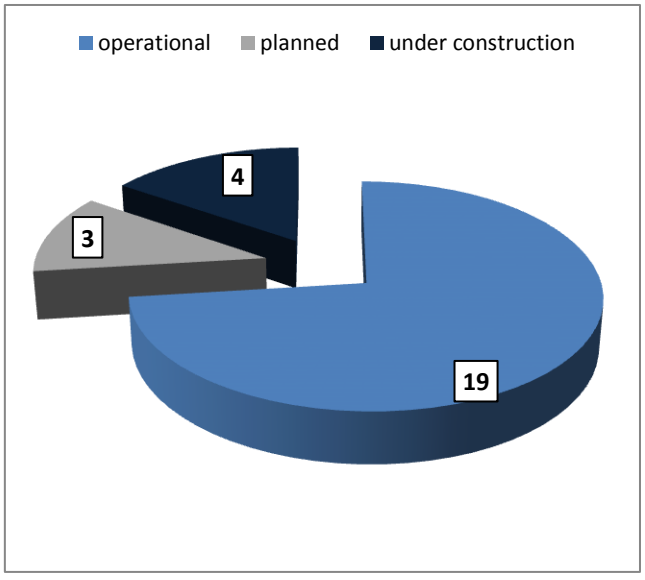

Fig. 13 : n° of projects of storage capacity development within 2025 for non-EU28 countries

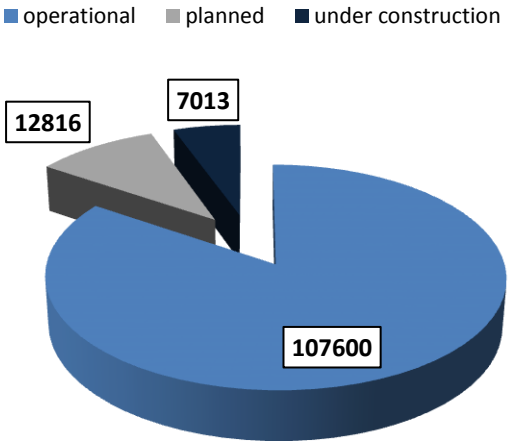

Fig.14: volume of storage capacity projects within 2025 for EU28 countries

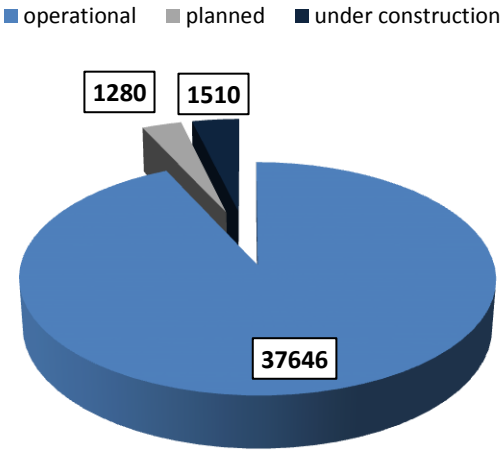

Fig.15: volume of storage capacity projects within 2025 for nonEU28 countries

year	country	storage name	storage type	gas type	company	WGV (Bcm)
2010	B	Zeebrügge	LNG peak shaving	H-Gas	Fluxys	0,115
2011	D	Dötlingen	depleted gas field	H-Gas	Exxon Mobil / BEB	1,065
2011	UK	Partington	LNG peak shaving	H-Gas	National Grid	0,095
2011	UK	Glenmavis	LNG peak shaving	H-Gas	National Grid	0,043
2011	D	Nievenheim	LNG peak shaving	L-Gas	RWE Gasspeicher	0,014
2012	F	Trois Fontaine	depleted gas field	H-Gas	Storengy	0,080
2012	F	Soings-en-Sologne	aquifer	H-Gas	Storengy	0,220
2013	D	Lehrte	depleted oil field	H-Gas	E.ON Avacon	0,035
2014	D	Reitbrook	oil field with gas cap	H-Gas	Storengy	0,350
2014	F	Saint-Claire-sur-Epte	aquifer	H-Gas	Storengy	0,485
2015	D	Buchholz	aquifer	H-Gas	VNG Gasspeicher	0,175
2016	D	Kalle	aquifer	H-Gas	RWE Gasspeicher	0,215
Sum						**2,892**

Fig.16: gas storage facilities that were abandoned or mothballed (source: RWE Gasspeicher analysis)