Cedigaz Insights n° 22
July 2017

Underground Gas Storage in the World – 2017 Status

Report prepared by Sylvie Cornot-Gandolphe for CEDIGAZ

The Underground Gas Storage & LNG Storage Market in the World 2015-2035

SIXTH EDITION OF CEDIGAZ'S REFERENCE REPORT (JUNE 2016)

49 countries surveyed - 500 pages, 104 tables, 103 charts & figures, 46 country maps.

Since its first publication in 1990, "**Underground Gas Storage in the World**" has been the industry's reference on underground gas storage (UGS). The updated 2016 edition includes for the first time the coverage of **LNG storage in the world**. The report includes detailed analyses of the latest developments and trends in the storage industry, CEDIGAZ's Outlook to 2035 at regional and global levels, and extensive country analyses with complete datasets including current, under construction and planned UGS and LNG import facilities for 49 countries.

MAIN FINDINGS INCLUDE:

€100 billion to €170 billion Investment Needed in Underground Gas Storage to 2035

Global UGS capacity is expected to increase from 413 bcm in 2015 to between 547 bcm and 640 bcm in 2035. This wide range reflects the uncertainties surrounding the evolution of global gas markets plus the uncertainties specific to the gas storage business, such as challenging geology and the competition from other sources of flexibility. New storage markets which include, Asia-Oceania, the Middle East, and potentially Central and South America are expected to drive the growth. Conversely, the growth in working capacity should be limited in mature markets, and could even be negative in the EU.

UGS Profitability Challenged in the Wider Flexibility Market

In liberalized markets the traditional roles of gas storage in dealing with seasonal or short-term demand variation, providing security of supply and allowing optimization of the whole gas chain have been expanded to the financial sphere where storage is used for seasonal or short-term price arbitrage. In this context, the seasonal spreads become the main drivers of storage valuation, ignoring the many other values of physical storage. In an increasingly competitive flexibility market, gas storage profitability comes under increasing pressure, especially in Europe.

FSRUs Allow a Growing Number of Countries to Access the LNG Market

The number of LNG importing countries has grown rapidly over the past ten years, from 18 in 2005 to 35 in 2015. This trend is expected to continue, with 20 new countries planning to import LNG from now to 2025. With lower costs than traditional onshore plants and shorter lead time, FSRUs are playing a central role by facilitating access to the LNG markets for new importers. At the beginning of 2016, 118 LNG import terminals (including 17 FSRUs) and 429 LNG storage tanks existed worldwide, with 16 new terminals under construction, of which four FSRUs and 12 terminals being expanded. In addition, CEDIGAZ has identified more than 100 projects at different stages of planning.

COUNTRIES SURVEYED

Comprehensive analysis of UGS/LNG storage in 49 countries:

North America: Canada, Mexico, United States.

Europe: Albania, Austria, Belgium, Bosnia&Herzegovina, Bulgaria, Croatia, Czech Republic, Denmark, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Netherlands, Poland, Portugal, Romania, Serbia, Slovakia, Spain, Sweden, Turkey, United Kingdom.

CIS: Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Russia, Ukraine, Uzbekistan.

Asia/Oceania: Australia, China, India, Japan, New Zealand, Pakistan, South Korea, Taiwan

Rest of the World: Argentina, Brazil, Iran

CEDIGAZ

PRICE

Report price (PDF format):

	One user licence	Five user licence*
CEDIGAZ Full & Corporate Members	**€ 2 000**	**€ 4 000**
CEDIGAZ Associate & Corresponding Members	**€ 2 800**	**€ 5 600**
Non members	**€ 4 000**	**€ 8 000**

* for more than 5 licences, please contact us

Order Before June 30 to Benefit from the 10% Early Bird Discount

ABOUT CEDIGAZ

CEDIGAZ is an international association dedicated to natural gas information. Since its creation in 1961, CEDIGAZ has been recognised by the gas industry as one of the most reliable and independent sources of information on the whole gas chain.

CEDIGAZ products include a **comprehensive service dedicated to LNG**, the annual survey "Natural Gas in the World", databases and news reports. CEDIGAZ' **Underground Gas Storage Database** is the only worldwide storage database to be updated every year.

ABOUT THE AUTHOR

Sylvie Cornot-Gandolphe is an independent consultant on energy and raw materials, focusing on international issues. She is the author of the 2013 report on Underground Gas Storage in the World. She also works with the Energy Centre of the French Institute of International Relations (IFRI), the Oxford Institute for Energy Studies (OIES), and with CyclOpe, the reference publication on commodities. Sylvie Cornot-Gandolphe has a long and proven experience in global gas and energy markets, gained during her past positions at IFPEN/CEDIGAZ, the UN/ECE, the IEA and ATIC Services.

OUR MEMBERS

CEDIGAZ has members in more than 25 countries among which leading Oil & Gas Companies (BP, Cheniere Energy, Chevron, CNPC, ENI, Gazprom, Repsol, Saudi Aramco, Sempra Global, Sinopec, Sonatrach, Statoil, Total, YPFB, Wintershall...), international and national energy organisations (International Energy Agency, Gas Exporting Countries Forum, OPEC, US Department of Energy...), utilities (EDF, Engie, Gas Natural Fenosa, Kogas, Tokyo Gas...), oil and gas industry contractors (Saipem, Technip...), banks and consulting companies (Barclays Bank, Bloomberg, The Boston Consulting Group, McKinsey, Mizuho Corporate Bank, Thomson Reuters...).

CONTACT US

Contact: info@cedigaz.org
+33 1 47 52 67 20
Website: www.cedigaz.org

CEDIGAZ
1 et 4 Avenue de Bois-Préau
92852 Rueil Malmaison - France

MORE ON OUR WEBSITE:
www.cedigaz.org/products/underground-gas-storage/underground-gas-storage-2016.aspx

Contents

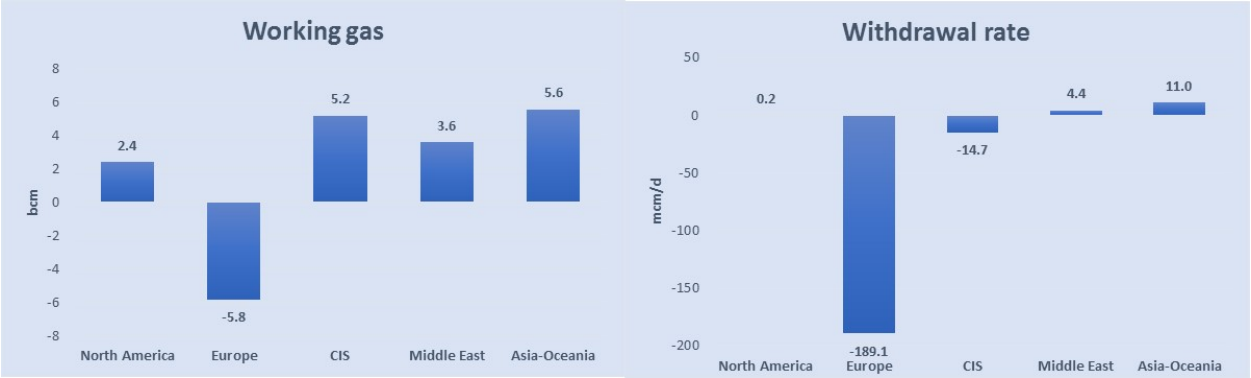
1. Current capacity of underground gas storage in the world

No significant changes compared with 2015, except in Europe

As of end 2016, there were 672 underground gas storage (UGS) facilities[1] in operation in the world, representing a working gas capacity of **424 billion cubic meters** (bcm), or 12% of 2016 world gas consumption. The number of storage facilities has decreased (680 UGS in 2015), mainly due to closure/mothballing of UGS in the United States and Europe. However, the global working capacity has slightly increased (+11 bcm) driven by expansions in the Commonwealth of Independent States (CIS), the Middle East and China. In Europe, storage capacity has continued its decline. Working gas capacity decreased by 5.8 bcm due to the closure of storage facilities in Germany, Ireland and the UK. The temporary closure of the Rough depleted field was confirmed as a permanent one in June 2017. This sharply reduces the UK storage capacity, and especially its seasonal storage capacity.

Global peak deliverability rates slightly decreased to 7,126 million cubic meters per day (mcm/d) as of end 2016, down 2.6% from 2015. The decline is linked with the closure of European UGS.

Figure 1: Major changes in working capacity and withdrawal rates (2016 vs. 2015)



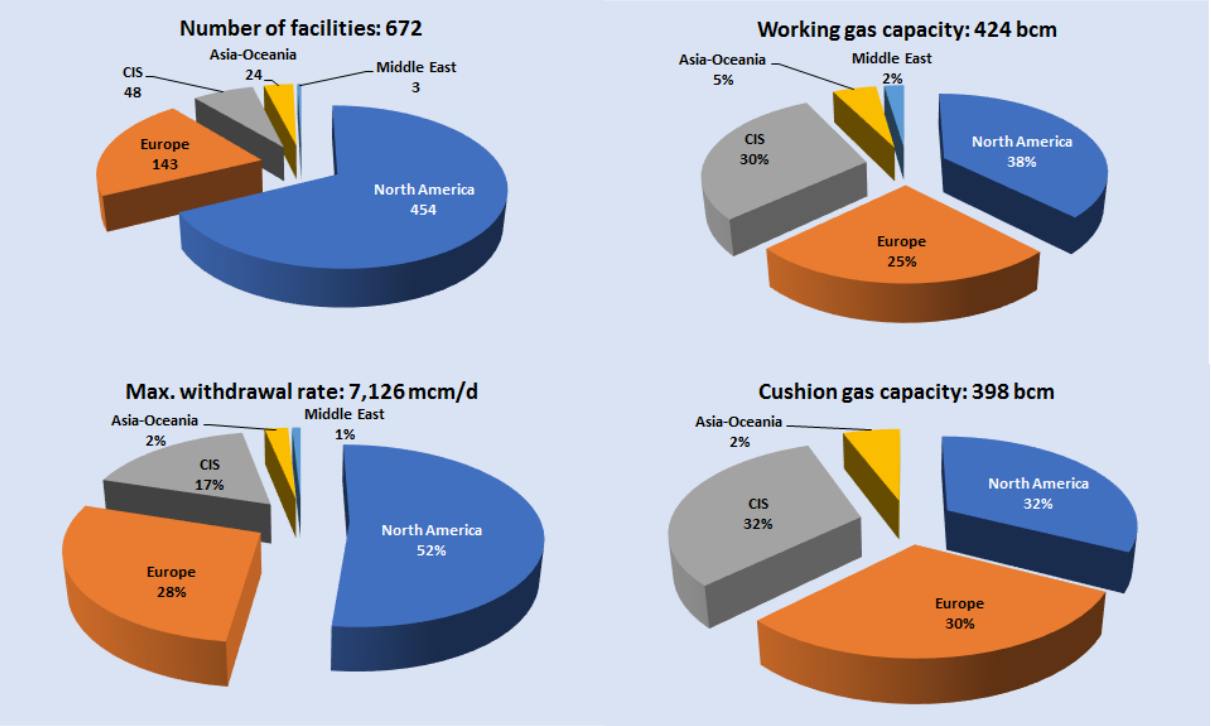
Source: CEDIGAZ

North America leads the market

Underground gas storage has been developed in five regions: North America, Europe, the CIS, Asia-Oceania, and recently the Middle East (Iran). **North America concentrates more than two thirds of the sites**, with 392 active storages in the US, and 62 in Canada, a combined working capacity of 160 bcm (38% of the world total), and 3,697 mcm/d of peak withdrawal rate (52% of the world total). **There are 143 facilities in Europe** (107.5 bcm, 1,999 mcm/d), **48 in the CIS** (125.1 bcm, 1,201 mcm/d), **23 in Asia-Oceania** (21.8 bcm, 168 mcm/d), and **3 in the Middle East** (9.9 bcm, 61 mcm/d). There is also one small site in Argentina.

[1] Some individual storage sites are grouped into storage clusters (for instance in China and Russia). If counted as individual sites, there are 687 storage sites worldwide. Some storage facilities are inactive or mothballed (20 UGS). If added, the world total is 707 UGS.

Figure 2: Global underground gas storage as of end 2016 – by region



Source: CEDIGAZ

Box 1: China's underground gas storage

Actual data on UGS in China are not readily available. Official figures refer to design capacity and not actual capacity (Table 1: Main UGS in China). China's actual working gas capacity is largely below design parameters, as many storage facilities are still under development. Hence, data on UGS in China are estimated based on CNPC and PetroChina reports and published UGS information. Actual working gas capacity at end 2015 was 5.5 bcm (of which 5.2 bcm for CNPC/PetroChina) and reached 7.4 bcm in November 2016. Two large storage facilities were commissioned in December 2016 (Shuang 6 and Suqiao).

Despite a rapid development since 2012, the construction of UGS in China still lags behind the growth of gas demand and behind investment in long-distance gas pipelines. UGS accounts for only 4% of gas consumption. Investment in storage is therefore not only necessary; it has to be made rapidly. This was again demonstrated in January 2013 when a very cold snap led to gas shortages in the central and eastern provinces of the country. The situation improved in the past two winters due to the commissioning of new infrastructure (storage, pipeline and LNG terminals), the slowdown in economic activity which has reduced the rate of growth of Chinese gas demand, and better preparation for dealing with emergency situations before winter time. Before winter, gas producers are asked to boost production while LNG importers are requested to fully utilize their import capacities. Large industrial consumers along major pipeline routes are also interrupted in case of shortages. The lack of underground gas storage is partly offset by storage capacity at LNG import terminals, as well as by seasonal LNG imports.

Table 1: Main UGS in China (existing and under construction) - Design capacity

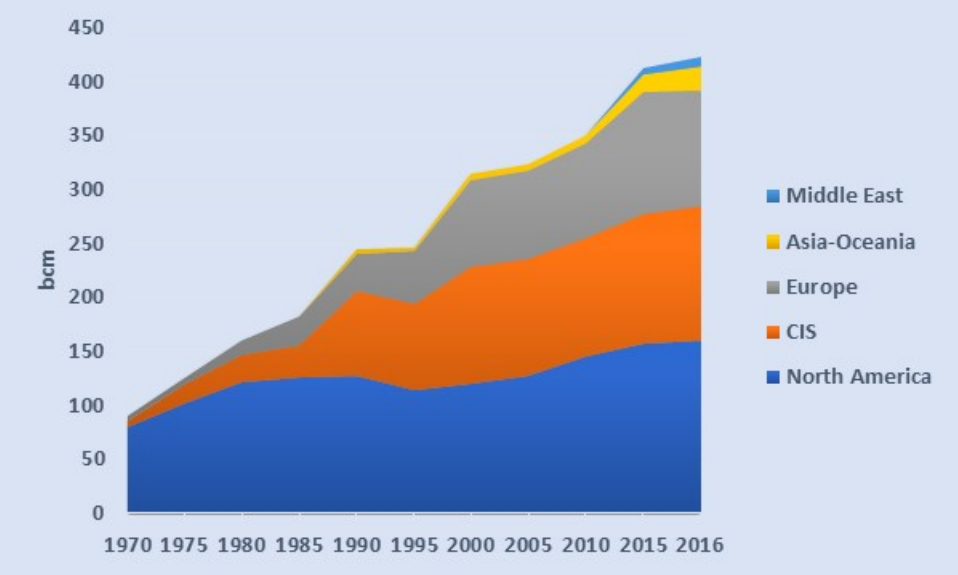
UGS	Max working gas capacity (bcm)	Cushion gas volume (bcm)	Total capacity (bcm)	Peak withdrwal rate (mcm/d)
Dagang cluster (Banqiao)	3.03	3.93	6.96	34
Jing 58 Group	0.75	0.79	1.54	6
Bannan	0.43	0.58	1.01	4
Wen 96	0.29	0.30	0.59	5
Liuzhuang	0.25	0.21	0.46	2
Jintan	1.71	0.93	2.64	15
Shuang 6	1.60	2.53	4.13	15
Suqiao	2.33	4.41	6.74	21
Hutubi	4.50	6.20	10.70	28
Xiangguosi	2.28	1.98	4.26	14
Shaan 224	0.50	0.54	1.04	4
Total	17.67	22.40	40.07	**148**

Source: CNPC, CEDIGAZ

Historical evolution: the growth decelerated in 2016

Working gas capacity has increased significantly since 2010 (+74 bcm, or +21%), mainly under the impetus of Europe which added almost 19 bcm of capacity (net growth) in the past six years. However, the increase occurred before 2015 and the trend has reversed since that date. European working gas capacity (and net growth) declined in 2016. The growth over the period 2010-2016 was pronounced and stable in the other regions: CIS: +15.7 bcm, Asia-Oceania: +15.1 bcm, and North America: +14.3 bcm. One additional region, the Middle East[2], took part in this development (+9.8 bcm). The annual growth in working capacity averaged 3.4% per year between 2010 and 2015. However, the increase slowed down in 2016 at only 2.6%.

Figure 3: Evolution of global working gas capacity, 1970 -2016



Source: CEDIGAZ

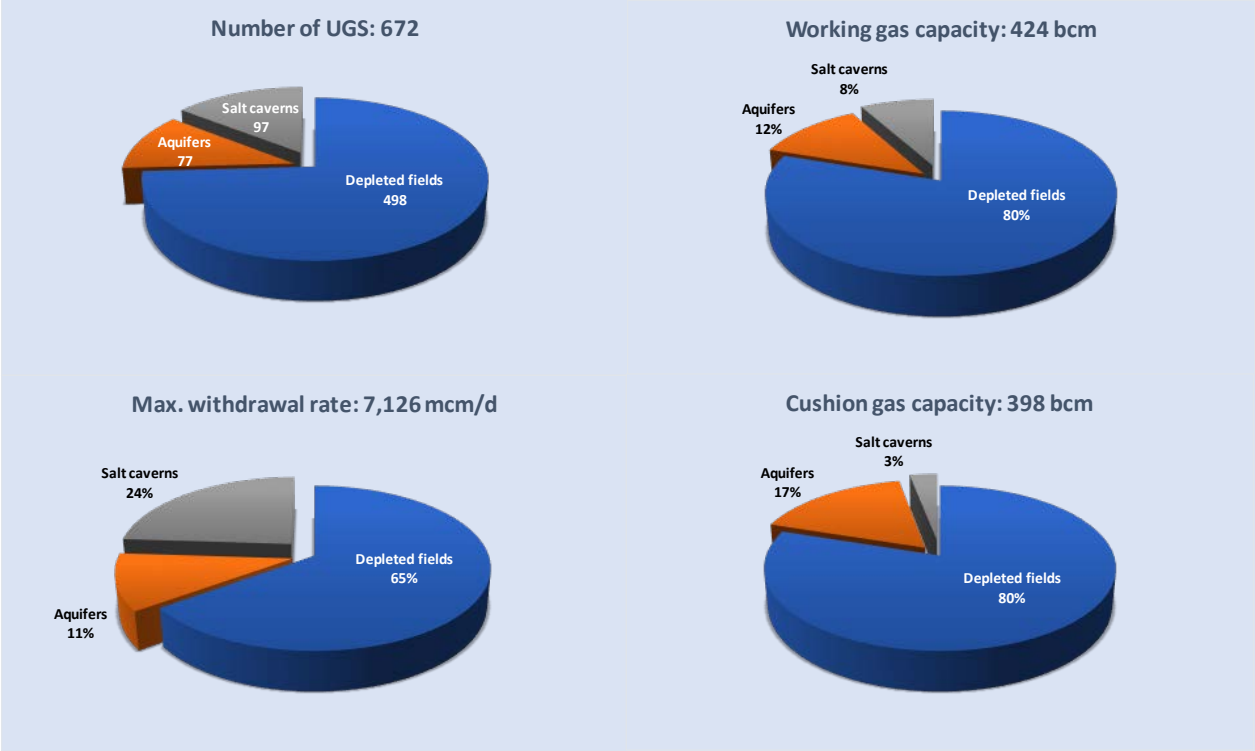
[2] The updated database has been corrected and includes a storage facility built in Abu Dhabi in the 1990s.

Depleted fields dominate, but UGS in salt caverns is growing faster

The breakdown of underground gas storage by type of storage shows the **dominance of depleted fields**, which allow storing large volumes of gas and are mainly used to balance seasonal swing in gas demand. With 498 facilities in the world, depleted fields represent 74% of the total number of sites and 80% of working gas volumes.

However, market liberalization has brought some important changes in the gas storage market. Today, storage is also used as a financial tool to optimize gas portfolios at short term. This trend can be seen in the **growing importance of salt cavern storage** in North America and Europe. This type of storage allows high injection and withdrawal rates, and the working gas can be cycled several times per year. As of end 2016, **97 salt caverns facilities are in operation in the world** (76 in 2010), representing 14% of the world total. **Although salt caverns account for only 8% of global working gas capacity, they can be rapidly cycled and they deliver up to 24% of global deliverability.**

Figure 4: Global underground gas storage as of end 2016 – by type



Note: Salt caverns include two rock cavern facilities and one abandoned mine.

Source: CEDIGAZ

A closer look on the type of facilities in operation in the world reveals important disparities from one region to another. Even if porous reservoirs (depleted fields and aquifers) largely dominate the total number of storage facilities in all regions, their share falls to 67% in Europe, where salt caverns represent a higher proportion than in other regions. Conversely, the CIS holds only three salt cavern facilities, Asia-Oceania only one and the Middle East none.

Table 2: Distribution of UGS facilities by region

Regions	Number of UGS facilities		Working gas capacity		Max. withdrawal rates	
	Salt caverns	Porous reservoirs	Salt caverns	Porous reservoirs	Salt caverns	Porous reservoirs
North America	10%	90%	9%	91%	26%	74%
Europe	33%	67%	17%	83%	36%	64%
CIS	6%	94%	1%	99%	3%	97%
Middle East	0%	100%	0%	100%	0%	100%
Asia-Oceania	4%	96%	2%	98%	1%	99%
WORLD TOTAL	**14%**	**86%**	**8%**	**92%**	**24%**	**76%**

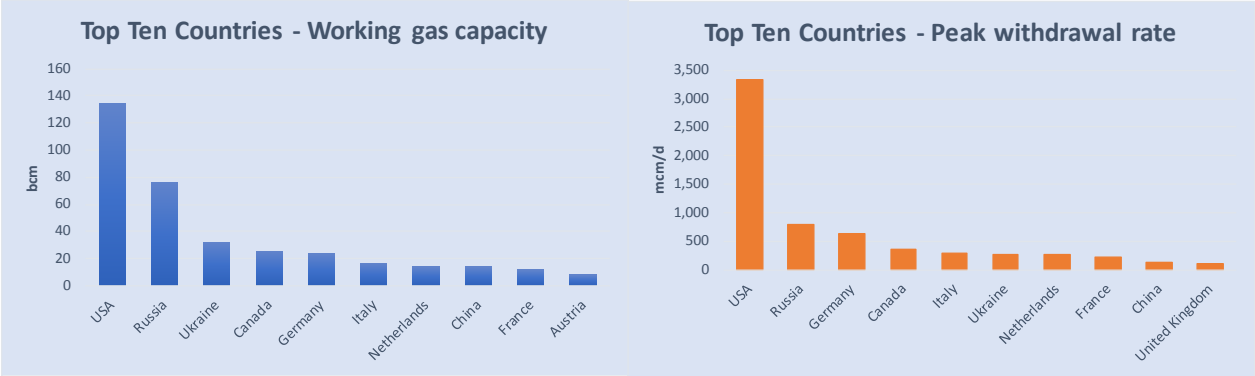
Note: Porous reservoirs include depleted fields and aquifers.

Source: CEDIGAZ

Top Ten league

As of end 2016, the **United States** is by far the most important country in terms of installed working capacity, with almost 134 bcm out of a global volume of 424 bcm. Together with **Russia** and **Ukraine**, with respectively 76 bcm and 32 bcm of working capacity, **Canada** and **Germany** (26 bcm and 24 bcm respectively), **these five countries concentrate 69% of the worldwide capacities**. Major changes have occurred since 2010: The Netherlands, China and Austria have entered in the Top Ten league. The Netherlands entered the league in 2015, following expansion of storage sites associated with the Groningen field and the commissioning of a large seasonal field (Bergermeer). China also entered the league in 2015 as several new storage facilities were commissioned in 2014 and 2015, following the policy adopted in 2012 favoring the development of storage. Austria is also among the Top Ten storage-holders thanks to the completion of the Haidach expansion and the commissioning of the 7Fields UGS in 2013. Italy, with 17 bcm of working capacity, remains in the sixth place, while France was outpaced by China in 2016. In terms of deliverability, the US and Russia remain the leading countries with withdrawal capacities of respectively 3,331 and 784 mcm/d. Germany ranks third with 642 mcm/d.

Figure 5: World Top Ten storage countries, as of end 2016



Source: CEDIGAZ

Table 3: Overview of underground gas storage in the world – Storage in operation as of end 2016

	Number of UGS facilities				Working gas capacity (bcm)				Max. withdrawal rate (mcm/d)			
	Salt caverns (a)	Depleted fields	Aquifers	Total	Salt caverns (a)	Depleted fields	Aquifers	Total	Salt caverns (a)	Depleted fields	Aquifers	Total
NORTH AMERICA	**46**	**364**	**44**	**454**	**14.5**	**132.7**	**12.5**	**159.6**	**944**	**2,486**	**267**	**3,697**
Canada	9	53		62	0.7	25.0		25.7	19	347		366
United States	37	311	44	392	13.8	107.6	12.5	133.9	925	2,139	267	3,331
CENTRAL AND SOUTH AMERICA		**1**		**1**				**0.1**		**2**		**2**
Argentina		1		1				0.1		2		2
EUROPE	**47**	**75**	**21**	**143**	**18.3**	**74.2**	**15.7**	**107.5**	**738**	**1,047**	**282**	**1,999**
Austria		9		9		8.4		8.4		97		97
Belgium			1	1			0.7	0.7			15	15
Bulgaria		1		1		0.6		0.6		4		4
Croatia		1		1		0.6		0.6		6		6
Czech Republic	1	6	1	8		3.3	0.2	3.5	6	49	5	60
Denmark	1		1	2			0.6	1.0	14		11	25
France (b)	3		10	13	1.1		11.3	11.7	77		200	210
Germany	31	12	6	49	14.4	8.9	0.5	23.9	484	140	17	642
Hungary		5		5		6.3		6.3		79		79
Italy		12		12		17.2		17.2		296		296
Latvia			1	1			2.3	2.3			30	30
Netherlands	1	4		5		14.0		14.3	26	231		257
Poland	2	7		9	0.7	2.4		3.2	28	23		51
Portugal	1			1				0.2	7			7
Romania		7		7		3.2		3.2		30		30
Serbia		1		1		0.5		0.5		5		5
Slovakia		3		3		3.4		3.4		45		45
Spain		3	1	4		2.5	0.1	2.6		13	4	16
Sweden	1			1				0.0	1			1
Turkey		1		1		2.66		2.66		20		20
United Kingdom	6	3		9	1.0	0.4		1.4	94	9		103
CIS	**3**	**33**	**12**	**48**	**0.9**	**102.5**	**21.7**	**125.1**	**41**	**909**	**251**	**1,201**
Armenia	1			1				0.1	9			9
Azerbaijan		2		2		4.8		4.8		15		15
Belarus	1	1	1	3	0.5	0.6	0.4	1.5	20	6	5	31
Kazakhstan		1	2	3		4.0	0.7	4.7		27	7	34
Kyrgystan		1		1		0.1		0.1		1		1
Russia	1	14	7	22		57.3	18.8	76.4	12	547	224	784
Ukraine		11	2	13		30.4	1.8	32.2		257	14	271
Uzbekistan		3		3		5.4		5.4		56		56
MIDDLE EAST		**3**		**3**		**9.9**		**9.9**		**61**		**61**
Abu Dhabi		1		1		3.3		3.3		4		4
Iran		2		2		6.6		6.6		56		56
ASIA-OCEANIA	**1**	**22**		**23**	**0.5**	**21.3**		**21.8**	**2**	**166**		**168**
Australia		7		7		6.1		6.1		30		30
China	1	8		9	0.5	13.8		14.3	2	129		130
Japan		5		5		1.1		1.1		5		5
New Zealand		1		1		0.3		0.3		3		3
Taiwan		1		1								
WORLD TOTAL	**97**	**498**	**77**	**672**	**34.2**	**340.6**	**49.8**	**424.0**	**1,724**	**4,671**	**799**	**7,126**

Notes:

(a) Includes one abandoned mine and two rock caverns

(b) Total working gas and withdrawal rate differ from the sum of working gas and withdrawal rate by type of storage. As Storengy provides information by storage groups and not by storage facilities, the total figures have been adjusted to reflect published data for all storage groups.

The table excludes mothballed or inactive storage facilities as well as strategic reserves (in Russia).

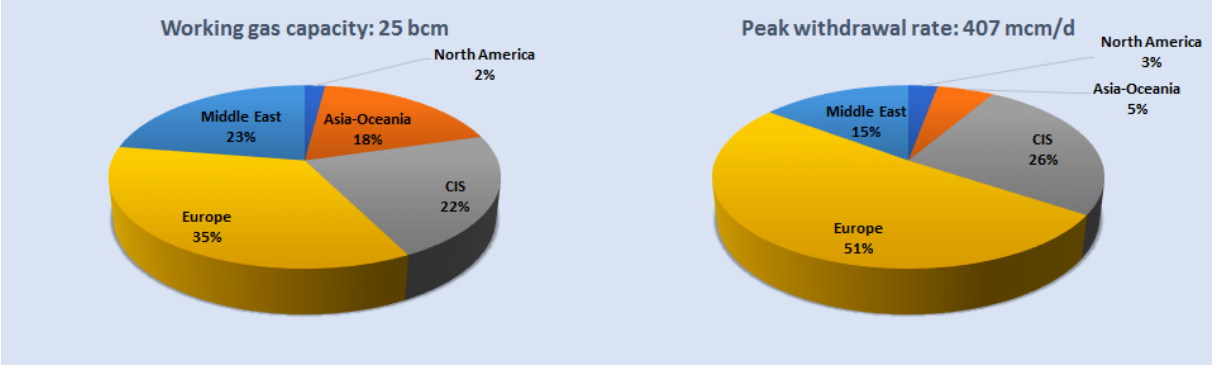
Source: CEDIGAZ

2. Storage projects

Only 25 bcm of working capacity is under construction

The capacity currently under construction is limited. **At worldwide level, there are 48 storage projects[3] under construction adding 25 bcm of working capacity**. This includes only 15 new storage sites (12 bcm) and 33 expansions (13 bcm). Again, this is lower than last year's report (58 projects adding 36 bcm of working capacity) and previous ones. This is partly due to the commissioning of storage facilities in 2016, but also to cancellations of projects. Most of the projects under construction will be completed by 2020/25. All regions, but Central and South America, participate in the additions to storage capacity currently under construction. It is worth noting that Europe ranks first, but capacity under construction is concentrated in Italy, where the storage regulation is much more favorable than in other European countries. The CIS ranks second with expansions and new facilities built in Russia. **The Middle East and Asia-Oceania account for 23% and 18% of the world additions**. The shift of storage investment to new emerging and growing gas consuming countries started at the beginning of the 2010s and is expected to dominate the next 20 years. The additions to withdrawal capacity are dominated by Europe reflecting the focus towards highly flexible storage in the region.

Figure 6: Storage under construction by region



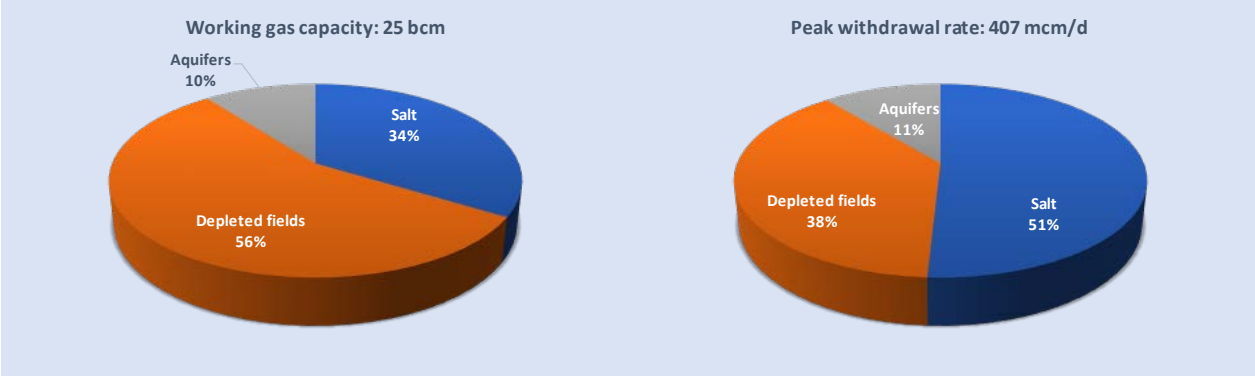
Source: CEDIGAZ

By type of storage, **salt caverns projects dominate in mature markets**, while all types of UGS are developed in emerging markets. One significant exception is UGS developed in aquifers, which have almost disappeared from the list of new projects (only two UGS under construction). Environmental issues make their construction more difficult and their relative low flexibility makes them less suitable to current market needs in liberalized markets.

Salt caverns projects represent almost half of the total number of projects under construction (22 projects). Most of them are built in Europe, but emerging markets (China, Iran) are also building this type of UGS. The working capacity (8.4 bcm) of salt caverns projects accounts for 34% of the total capacity under construction and their combined withdrawal rate for 51% of the total deliverability.

[3] Each phase of a multi-phase storage expansion is considered as one UGS project (when such information is available).

Figure 7: Storage under construction by type



Source: CEDIGAZ

Table 4: Storage projects under construction, as of end 2016

	Number of UGS facilities				Working gas capacity (bcm)				Max. withdrawal rate (mcm/d)			
	Salt caverns	Depleted fields	Aquifers	Total	Salt caverns	Depleted fields	Aquifers	Total	Salt caverns	Depleted fields	Aquifers	Total
NORTH AMERICA	**3**			**3**	**0.5**			**0.5**	**11.7**			**11.7**
Canada	1			1	0.2			0.2				
United States	2			2	0.3			0.3	11.7			11.7
EUROPE	**12**	**15**		**27**	**3.5**	**5.3**		**8.7**	**141.6**	**65.6**		**207.2**
Croatia		1		1						1.0		1.0
Czech Republic		2		2		0.5		0.5		9.2		9.2
France	2			2	0.2			0.2	32.0			32.0
Germany	3			3	1.5			1.5	22.0			22.0
Italy		7		7		4.0		4.0		43.1		43.1
Poland	2	1		3	0.4			0.4	15.6	0.5		16.1
Portugal	1			1	0.1			0.1	3.1			3.1
Romania		2		2		0.2		0.2		1.8		1.8
Serbia		1		1		0.4		0.4		5.0		5.0
Turkey	2	1		3	1.0	0.2		1.2	40.0	5.0		45.0
United Kingdom	2			2	0.3			0.3	28.9			28.9
CIS	**3**	**4**	**1**	**8**	**0.9**	**2.6**	**2.0**	**5.5**	**25.0**	**40.4**	**40.0**	**105.4**
Armenia	1			1	0.1			0.1				
Azerbaijan		1		1		1.0		1.0				
Belarus	1			1	0.5			0.5				
Kazakhstan		1		1				0.0				
Russia	1	2	1	4	0.4	1.5	2.0	3.9	25.0	40.4	40.0	105.4
MIDDLE EAST	**1**	**2**	**1**	**4**	**2.0**	**3.0**	**0.6**	**5.6**	**15.0**	**40.0**	**4.8**	**59.8**
Iran	1	2	1	4	2.0	3.0	0.6	5.6	15.0	40.0	4.8	59.8
ASIA-OCEANIA	**3**	**3**		**6**	**1.5**	**3.1**		**4.6**	**13.5**	**9.2**		**22.7**
China	3	3		6	1.5	3.1		4.6	13.5	9.2		22.7
WORLD TOTAL	**22**	**24**	**2**	**48**	**8.4**	**13.9**	**2.6**	**24.9**	**206.8**	**155.1**	**44.8**	**406.7**

Source: CEDIGAZ

Identified projects would add 52 bcm, but remain uncertain

At worldwide level, there are **106 identified projects at different stages of planning (planned and potential)**. If all built, these projects would add 52 bcm of working capacity.

Data given in Table 5 and Table 6 are only relevant for the three traditional storage regions (Europe, CIS and North America). Data on working gas capacity are missing for several announced projects in emerging gas countries. Therefore, it is not possible to evaluate the shift of storage activity to emerging gas countries based on identified planned projects.

Table 5: Planned storage projects

	Number of UGS facilities				Working gas capacity (bcm)				Max. withdrawal rate (mcm/d)			
	Salt caverns	Depleted fields	Aquifers	Total	Salt caverns	Depleted fields	Aquifers	Total	Salt caverns	Depleted fields	Aquifers	Total
NORTH AMERICA	**9**	**1**		**10**	**1.1**	**0.1**		**1.2**	**34.7**	**3.4**		**38.1**
Mexico	1			1								
USA	8	1		9	1.1	0.1		1.2	34.7	3.4		38.1
CENTRAL AND SOUTH AMERICA		**2**		**2**		**2.2**		**2.2**				
Brazil		2		2		2.2		2.2				
EUROPE	**16**	**29**	**4**	**50**	**10.9**	**15.7**	**1.0**	**27.6**	**209.8**	**167.7**	**13.0**	**390.5**
Bulgaria		1		2		0.5		0.5		4.6		4.6
Croatia		1		1						2.4		2.4
Czech Republic	1			1	0.2			0.2	23.6			23.6
Germany	2			2	2.1			2.1				
Greece		1		1		0.4		0.4		4.0		4.0
Italy		13		13		5.5		5.5		65.9		65.9
Latvia			3	3			0.5	0.5			5.0	5.0
Lithuania			1	1			0.5	0.5			8.0	8.0
Netherlands	1			1	0.1			0.1				
Poland	2	2		4	0.9			0.9	17.9	5.3		23.2
Portugal	1			1	0.1			0.1				
Romania		5		5		1.6		1.6		13.3		13.3
Slovakia		2		2		0.9		0.9		13.8		13.8
Spain	1			1	0.2			0.2	13.7			13.7
Turkey	3	1		4	5.5	1.5		7.0	57.6	50.0		107.6
United Kingdom	5	3		8	1.9	5.4		7.3	97.0	8.5		105.5
CIS	**3**	**2**	**3**	**8**	**1.3**	**0.9**	**5.0**	**7.2**	**5.0**	**0.0**	**50.0**	**55.0**
Azerbaijan	1			1	0.3			0.3				
Georgia		1		1		0.3		0.3				
Russia	2	1	3	6	1.0	0.6	5.0	6.6	5.0		50.0	55.0
MIDDLE EAST		**3**		**3**								
Iran		3		3								
ASIA-OCEANIA	**6**	**10**		**17**	**2.9**	**5.2**		**8.1**		**3.0**		**3.0**
Australia	1	4		5		0.2		0.2		3.0		3.0
China	5	5		11	2.9	5.0		7.9				
South Korea	0	1		1								
WORLD TOTAL	**34**	**47**	**7**	**90**	**16.2**	**24.0**	**6.0**	**46.2**	**249.5**	**174.1**	**63.0**	**486.6**

Note: The number of total projects differs from the sum of salt caverns and porous reservoirs projects as some countries do not specify which kind of storage they plan to develop.

Source: CEDIGAZ

Table 6: Potential storage projects

	Number of UGS facilities				Working gas capacity (bcm)				Max. withdrawal rate (mcm/d)			
	Salt caverns	Depleted fields	Aquifers	Total	Salt caverns	Depleted fields	Aquifers	Total	Salt caverns	Depleted fields	Aquifers	Total
EUROPE	**3**	**1**		**4**	**2.3**	**0.1**		**2.3**	**22.1**	**0.5**		**22.6**
Albania	1	1		2	1.2	0.1		1.3	6.0	0.5		6.5
Bosnia & Herz.	1			1	0.1			0.1				
Turkey	1			1	1.0			1.0	16.1			16.1
CIS	**4**	**1**	**1**	**11**	**0.6**		**3.0**	**3.6**	**30.0**			**30.0**
Russia	4	1	1	11	0.6		3.0	3.6	30.0			30.0
AFRICA				**1**								
Morocco				1								
WORLD TOTAL	**7**	**2**	**1**	**16**	**2.9**	**0.1**	**3.0**	**6.0**	**52.1**	**0.5**		**52.6**

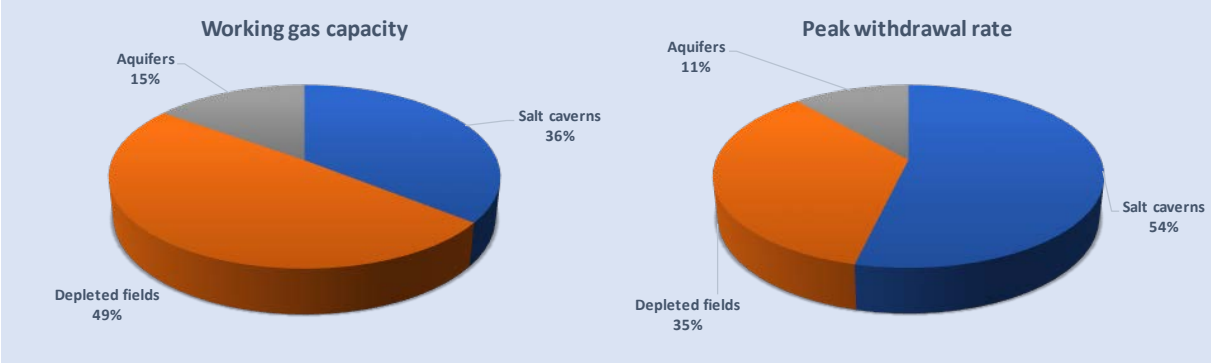
Note: The number of total projects differs from the sum of salt caverns and porous reservoirs projects as some countries do not specify which kind of storage they plan to develop.

Source: CEDIGAZ

Overall, **there are 154 projects under construction, planned or potential, representing 77 bcm of working capacity**. This figure shows the readiness of the storage industry to continue investing in this key asset to support the expansion of the global gas market and accompany the trend towards more

intermittent energy sources. However, the figure is much lower than in 2013 when 236 projects totaling 153 bcm of working gas capacity were either under construction or identified. This is due to two factors: in mature markets, numerous projects have been put on hold or even cancelled. In new and growing markets, the storage market is still in its infancy and projects are not identified precisely in several countries.

Figure 8: Storage under construction, planned and potential - Working gas capacity and withdrawal rates



Source: CEDIGAZ

Annex: Methodology

CEDIGAZ UGS database compiles the existing and future Underground Gas Storage facilities in the World (under construction, Planned and Potential). The indicators have been selected to provide a database as close as possible from the reality of the market. You will find below some details about the chosen classification:

Type of data	Comments
Name of UGS facility	- Some facilities are known under different names or belong to a storage complex: this information is listed next to the common name in order to give the clearest view of the UGS name - Expansions and their different phases are listed on separated lines so they can be clearly identified from the existing part of the storage.
Class	- E (existing), N (new facility), or X (expansion of existing storage:additional caverns, new phase of development, increase of working gas capacity,...)
Type of storage	- Depleted field, Aquifer, Salt cavern, Abandoned mine, Rock cavern. - Adjustment: An adjustment has been added to reconcile data published by Storage groups with data from individual sites
Status	- In operation: UGS commissioned or technically ready (filling phase) - Under construction: physical works on the facility have begun - Planned: the project is referenced with at least a minimum of information though it may never be constructed - Potential: under consideration for a possible development - Other Status: * for existing facilities: Closed / Inactive / Mothballed * Strategic reserves * for projects: Cancelled / On hold * Unknown
Year UGS commissioned	- Indicates the year of commissioning of the initial site. The year of commissioning of an expansion of an existing site is given separately, when known
WGC	- The maximum working gas capacity has been selected for the facilities in operation. Concerning the projects, this indicator reflects the designed working gas capacity, and can be adjusted once the storage is put in operation.
Cushion gas	- Can include working gas being kept as strategic storage, like in Russia where more than 40 bcm of cushion gas are being stored as long term reserves and could be technically considered as working gas
Peak withdrawal rate	- Maximum delivery rate recorded for the facilities in operation. - Expected maximum delivery rate for the projects.

CEDIGAZ UGS Excel file allows you to make your own research and tables, by country, region, type of storage, status (existing, under construction, planned, mothballed, closed, etc.), working capacity, withdrawal rates, year of commissioning, etc.

List of Tables and Figures

Tables

Figures