Technology Box – Underground Natural Gas Storage
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Most types of natural gas storage facilities are located underground. These underground natural gas storage facilities serve two basic types of service requirements: base load and peak load. Typically, the months of November through March is called the heating season, the time when the US gas storage facilities are the most important. These are the coldest months and the months that experience the greatest usage of stored supply. April through October is called the refill season and is when companies try to replace the gas in storage that was used during the winter.

Base load storage (over 70 days) has the capability of holding a large enough volume of gas to provide the bulk of customer requirements beyond long haul pipeline deliveries. This storage provides one long withdrawal season and one long injection season. On the other hand, peak load storage (5 to 20 days) deliver gas at high rates to meet urgent needs for a short period of time. These storage facilities can be both depleted and replenished quickly.

Types of Stored Gas

A gas storage reservoir can be thought of as a pressurized container. As gas is pumped in, the pressure in the container rises, and as gas flows out of the container, the rate of flow decreases as does the pressure, and thus the energy is depleted. The rate of flow is also dependent on the degree of pressure differential between the reservoir and the wellhead, for example, a lower wellhead pressure means that more gas can flow out of the reservoir. The total volume of gas in a storage reservoir can be segmented into three parts: physically unrecoverable gas, cushion gas (base gas), and working gas.

The physically unrecoverable gas is gas that is trapped by physical forces in the pores of the rock. It cannot be removed regardless of how low the wellhead pressure is dropped. Cushion gas or base gas, is the permanent volume of gas needed to fill the reservoir to a point where the pressure in the reservoir will provide significant flow of gas when needed and finally, working gas is the volume of gas that is injected and produced during the storage cycle.

Storage Capacity in the US

The bulk of the nation's storage is located in either the consuming or producing regions, as would be expected. Most of the proposed capacity increases are also located in these regions. About 70% of the nation's capacity is operated by interstate pipeline companies and about 28% by local distribution companies (LDCs). The remaining 2% is owned and operated by independent storage service providers, however the largest number of development projects are being proposed by private operators. If the facility serves the interstate market it is subject to Federal Energy Regulatory Commission (FERC) regulations, otherwise, is it State-regulated. Owners and operators of storage facilities are not necessarily the owners of the gas held in storage. In fact, most of the working gas held in storage facilities are under lease with shippers or end users who own the gas.

As of July 2002, thirty states had underground storage capacity, with Michigan leading the way with 12.99% of US storage capacity and Illinois coming in a close second, storing 10.90% of US natural gas. Texas and West Virginia are also big natural gas storage states, with 8.49% and 8.90% of the US market respectively. See table below for States with largest storage capacities.

States with the largest underground natural gas storage capacity

State	Number of Active Fields	Capacity (Bcf)	Percent of US capacity
Michigan	49	1,071	12.99
Illinois	30	899	10.90
West Virginia	36	733	8.90
Texas	35	699	8.49
Pennsylvania	58	685	8.31
Ohio	24	574	6.96
Louisiana	13	569	6.91
California	9	388	4.71
Oklahoma	13	378	4.59
Montana	5	372	4.51

Source: Energy Information Administration/Natural Gas Monthly April 2002.

Storage Reservoirs

Most existing gas storage in the US is in depleted natural gas or oil fields that are close to consumption centers. Conversion of a field from production to storage duty takes advantage of existing wells, gathering systems and pipeline connections. Depleted oil and gas reservoirs are the most commonly used underground storage sites because of their wide availability.

In some areas, most notably the Midwestern US, natural aquifers have been converted to gas storage reservoirs. An aquifer is suitable for gas storage if the water-bearing sedimentary rock formation is overlaid with an impermeable cap rock. While the geology of aquifers is similar to depleted production fields, their use in gas storage usually requires more cushion gas and greater monitoring of withdrawal and injection performance.

A third and very common formation used in gas storage is salt caverns. Salt caverns provide very high withdrawal and injection rates relative to their working gas capacity and cushion gas requirements are often low. The large majority of salt cavern storage facilities have been developed in salt dome formations located in the Gulf Coast States. Salt caverns have also been leached from bedded salt formations mainly in the Northeast and Midwest US.

Finally, there have been efforts to use abandoned mines to store natural gas, with at least one facility having been in use in the US in the past. Further, the potential for commercial use of hard-rock cavern storage is currently undergoing testing. None are operational as natural gas storage sites at the present time.