The Oil Drum: Europe
DISCUSSIONS ABOUT ENERGY AND OUR FUTURE

Goodbye Helium, Goodbye Brainscans

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Some of the great things that make human live much easier are dependent on rare non-renewable resources. Helium is one of these, a noble gas with remarkable qualities due to its inert state. It is used for example to cool metals needed to create superconductivity. This process is applied in the medical industry to make Magnetic-Resonating-Image(MRI) scans, a technique to produce images of body tissue, making accurate diagnosis of health problems without surgery possible. But Helium is also applied in nuclear magnetic resonance spectroscopty (NMR), for the arc welding of various metals amongst which are titanium, magnesium and aluminium, to reduce high-pressure risk in deep-sea breathing systems, to purge and pressurize liquid-hydrogen rocket propulsion systems, to find leaks in pipelines, as a coolant in certain nuclear reactor types, possibly for superfluid gyroscopes and last and for me definetly the least, to let balloons float.

Can Helium be substituted? The answer is no for applications which need cooling below a temperature of minus 210 degrees centigrade since that is the temperature at which the next best thing, liquid nitrogen, freezes. Helium on the other hand only liquifies at minus 272 degrees centigrade and stays in that state even down to absolute zero. Making it the most precious element for cooling at very low temperatures. For MRI scanning this means the available substitutes can only offer much higher temperatures at which the scanner can operate, implying less conductivity and therefore a less effective scanner.

The availability of Helium is thus quite important as long as no substitutes for these processes have been developed. So how long will this resource last?

Introduction

Helium is a gas that over time came into existence mainly from the radiogenic decay of uranium and thorium in the earth's mantle. As it migrated to the surface it has remained trapped in underground fields combined with other gasses and in the earth's atmosphere. The forming rate is too slow to be of any relevance in the timescale of a few human generations. Interestingly, very few studies are being done on the limitations of this resource. Only one research group in the entire world is currently studying the topic. The number of people who know a great deal about the future supply can be counted on one or maybe two hands. One of these is Phil Kornbluth, executive vice president of Matheson Tri-Gas Global Helium. For some background information on Helium I suggest listening to this interview with Kornbluth.

Types of Helium reserves

The sources of Helium on earth can be broadly divided into three categories; 1) Helium rich resources from natural gas fields with a helium concentration of 0.3% or higher; 2) Helium lean resources from natural gas fields with a concentration below 0.3% which mostly is uneconomical to extract; 3) Atmospheric Helium which will likely never be produced because it is too energy intensive to do so. For the two sources of Helium from natural gas, there is little known about the energy costs of production since Helium has so far been produced as a by-product of natural gas production. In this case only produced when the lifetime of the natural gas field and the gas resources warrant the construction of infrastructure to produce Helium for 20 years or longer.

How much Helium is there?

The expected ultimate extractable amounts of Helium are estimated at 40,000 million Sm3 as of 1 January 2007 by the United States Geological Survey (Sm3 = standard cubic meters). Of this amount 93% is endowed in six countries, the United States, Algeria, Canada, China, Qatar and Russia. This ultimate extractable reserve base has been identified using an economic classification, not a geologic one. The reserve classification here includes currently economic, marginally economic and some of the identified currently subeconomic reserves. Of this ultimate extractable amount 7,030 million Sm3 has been classified as reserves that are extractable using existing technology under current economic conditions. However, for Canada, China and Qatar this data is not available which makes the actual figure likely to be much higher. The countries for which figures are available are the United States (3,500 million Sm3), Algeria (1,850 million Sm3) and Russia (1,680 million Sm3).

Since Helium is a by-product of natural gas production, and the discoveries of natural gas fields peaked in the ‘70s of the 20th century and have been on a declining trend ever since, it is unlikely that much more Helium reserves will be discovered. The earth’s endowment of Helium is therefore quite well known although the figures are not very precise. This is due to a lack of a universal methodology to measure Helium reserves. Whether these figure are on the upside or downside is unknown. For reasons of political nature, governments worldwide normally have a tendency to exaggerate reserve figures and as a result it is likely that the expected ultimate amount of Helium in reality is lower.

The consumption & the lifetime of Helium

Figures for worldwide helium consumption are not available since there is no agency that tracks this data. As there only is one storage for helium in the entire world, the Cliffside field in the United States managed by the federal bureau of land management, it can be inferred that world production statistics plus net stock drawdowns or minus net stock intakes in the United States roughly match consumption figures. From these figure it can be concluded that Helium consumption has been rising steadily over time especially since the mid 80’s of the 20th century.

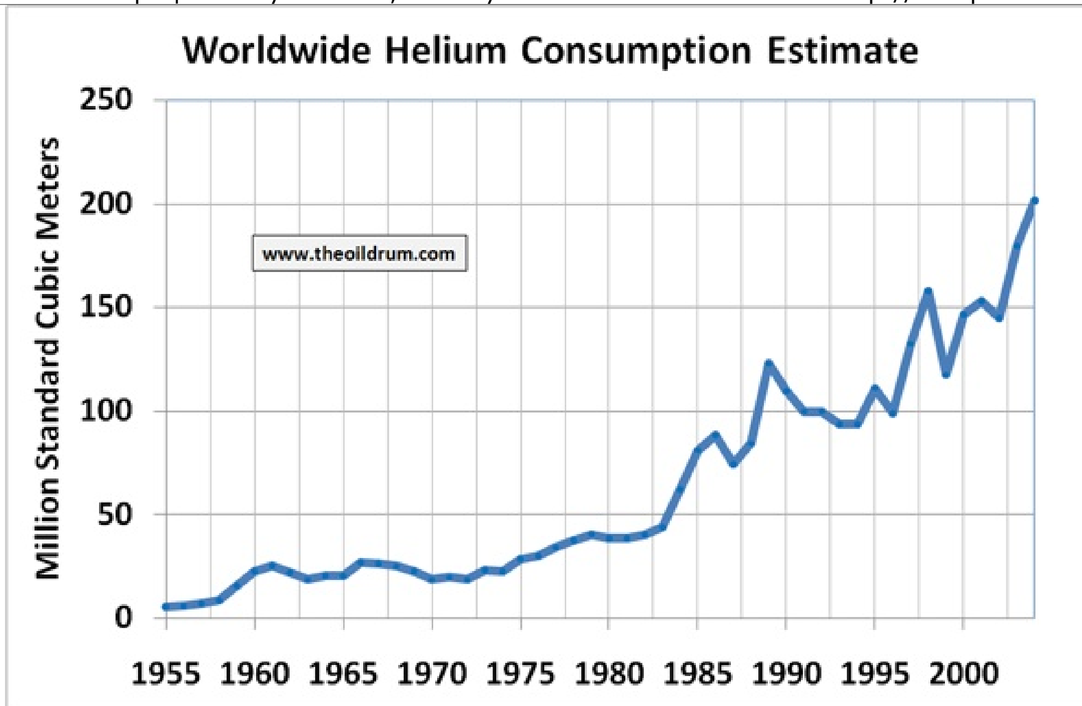

Figure 1 - Worldwide Helium Consumption from 1955 until 2004

With this methodology a world consumption number of 202 million Sm3 can be derived as of the year 2004. A static approach in which the expected ultimate extractable amounts are divided over present consumption gives a lifetime expectancy of 200 years for Helium. Using a more dynamic approach, in which the average consumption growth from 1990 to 2004 namely 5 percent is continuously extrapolated, gives a resource lifetime of approximately 48 years.

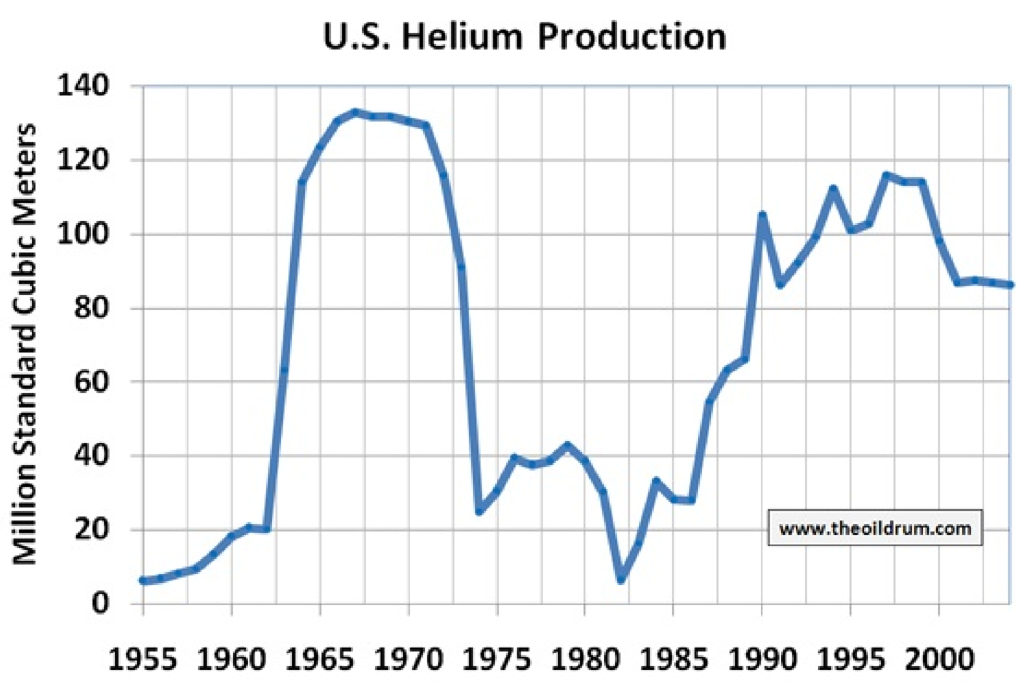

Figure 2 - Helium Production in the Untied States from 1955 until 2004

Natural gas peaks, Helium peaks?

However, this does not take into account that the production of a resource never follows a peak and then suddenly drops to near zero. In reality resource production roughly follows a more smooth bell shaped curve due to the physical and economic conditions of extraction. This is also true for natural gas fields and its associated helium.To gain insights into the lifetime of a non-substitutable resource before it runs into its phase of scarcity no matter what technology or investment takes place, it would therefore be better to estimate the maximum possible rate of extraction.For natural gas it has been estimated by independent scientists such as Jean Laherrère that the point of maximum production will be reached somewhere in the period of 2020-2030. Does that imply that Helium will become scarce somewhere in that period? Not necessarily because the number of Helium rich natural gas fields is very small. If some of the natural gas fields are not developed on a speedy basis then the helium production curve will be much smoother and shortages will appear earlier.

Politics and economics come into play

Interestingly, these shortages are already here to a certain extent. The price of Helium rose significantly in the past few years. From a range of 1.5 to 1.8 dollars per Sm3 in the period 1995-2002 to a price of 3 dollars per Sm3 in 2006. The rise in prices occurred due to a scarcity of Helium as a result of production in the United States being in decline since 1999. Being the largest producer of Helium in the world this has led to a gap between supply and demand. This gap is being filled up by stock drawdowns from the United States Helium Reserve. This stock has declined from 985 million Sm3 in 1999 to 696 million Sm3 in 2006.

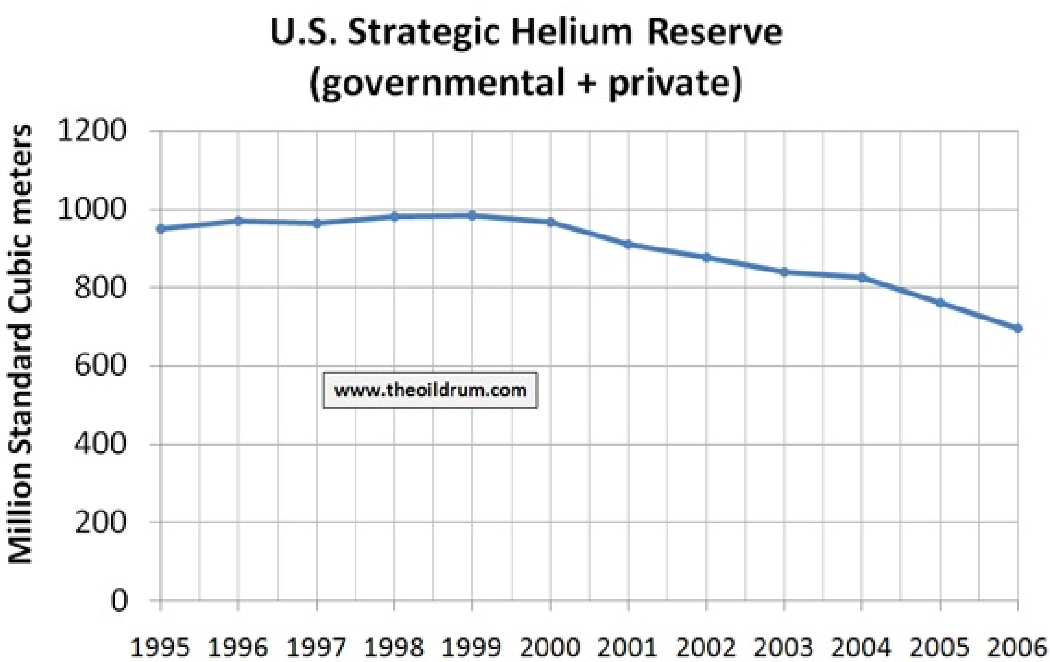

Figure 3 - Helium in the United State Helium Reserve from 1995 until 2006

While sufficient reserves exist to scale up production in other countries these have been slow in response to the decline in production in the United States. This is primarily due to the fact that Helium is a by-product of natural gas fields and operators make a decision not based on the availability of Helium but based on the need to develop Natural Gas Fields. Some new production capacity is coming online in Qatar and Algeria in 2007/2008, but this will not alleviate the situation to sustain a growth rate of 5%. For the near term future therefore, Helium prices will remain high until a large new source of production comes on-stream. The Helium industry recognises this and is forecasting a tight demand-supply balance until at least 2011.

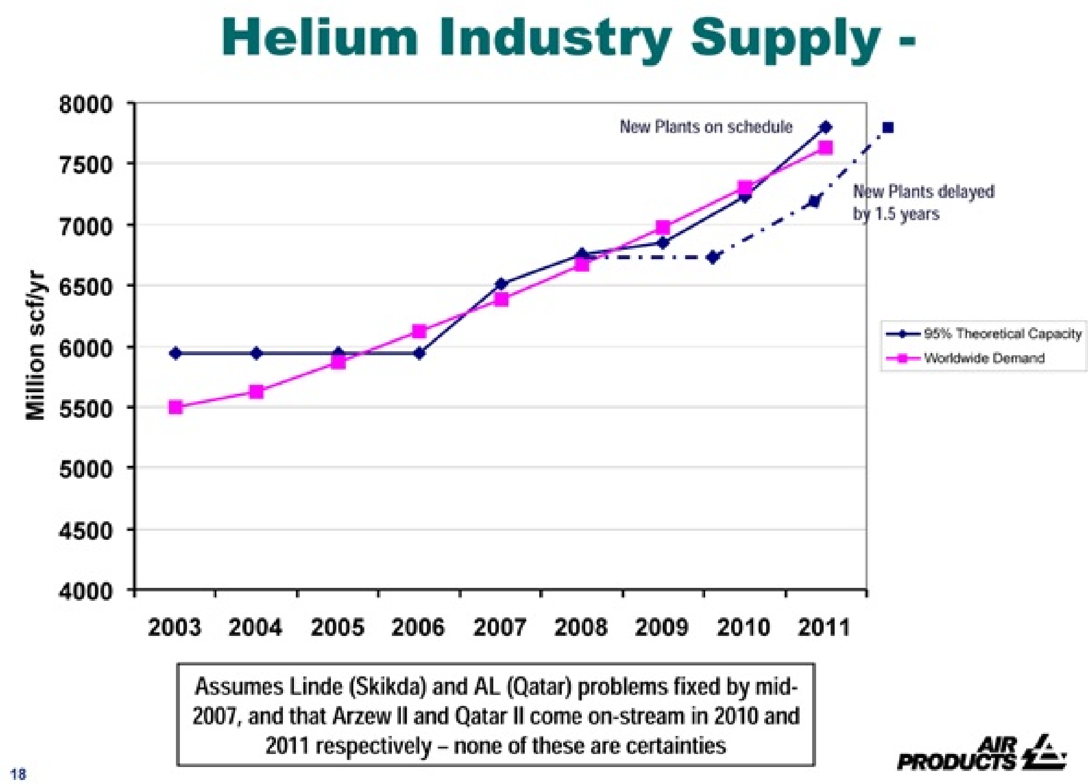

Figure 4 - Expected Supply and Demand Balance up to 2011 according to Airproducts, one of the big Helium Supply companies in the world.

So how long will this tightness last? The first natural gas field that will bring sufficient quantities online that is being spoken about is Kovykta, which lies in Eastern Siberia in Russia. This field contains 40% to 50% of the Russian Helium reserves and is intended to be developed to provide natural gas for China and to provide Helium supplies to the world. Startup is expected to be 2015 at the earliest. So we can expect the present constrained Helium supply to persist until at least 2015, by which the federal helium reserve in the United States will be nearly depleted. If the production of Kovykta is delayed much further beyond 2015 it could lead to severe worldwide Helium shortages.