PRAXAIR

Making our planet more productive

Energy

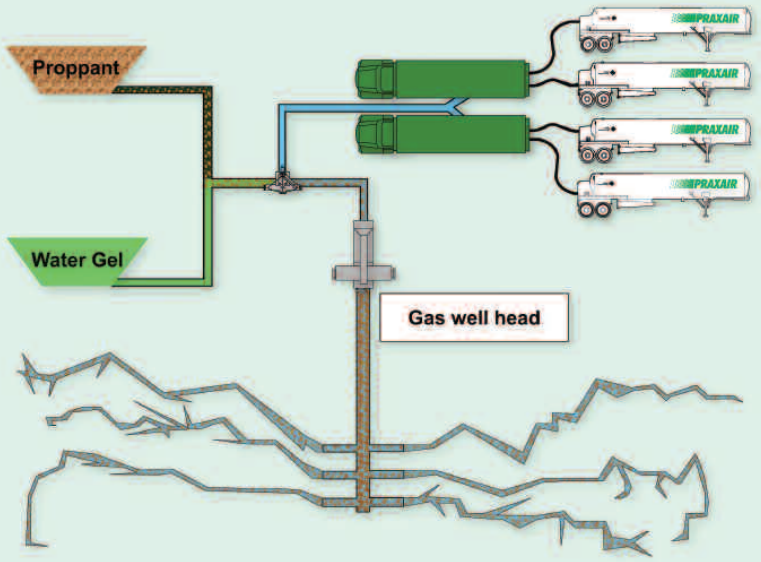
Economical, Efficient, Effective

Using Carbon Dioxide for Well Fracturing

Well Fracturing

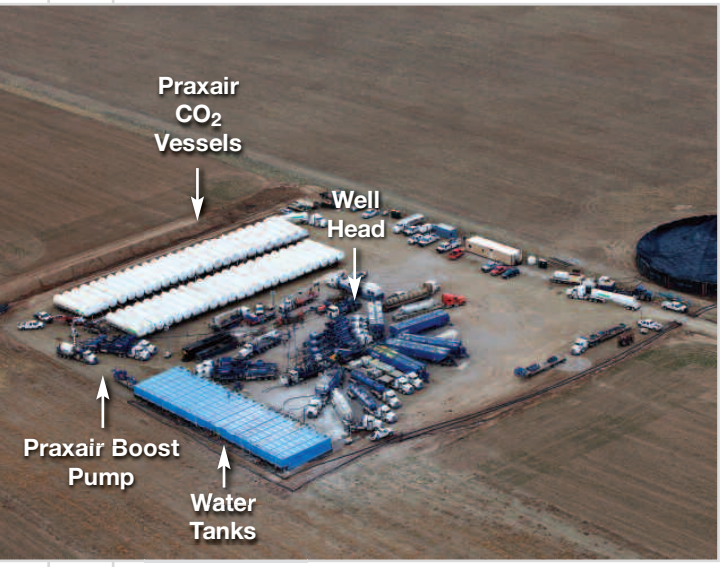
The ability to develop a wider array of hydrocarbon reservoirs has become central to meeting today's energy needs. This has become critically important as we not only exploit historic conventional fields, but also move into unconventional hydrocarbon deposits (coal bed methane, tight sands, and shale oil and gas). To facilitate unlocking of these unconventional deposits, energy companies are dependent on hydraulic fracturing.

Praxair has been serving the oil & gas markets for over 30 years. We offer targeted products and services to the well services industry to support fracturing throughout the world. We supply liquid CO_2, transportation and logistic services, and primary pressure pumping. We also operate a number of strategically located plants, a specialized fleet of vehicles, and dedicated pumping equipment. Depending on your geography, Praxair is able to provide complimentary nitrogen services to meet your oilfield needs through an extensive network of subsidiary and joint venture partners.



Fracturing Simulation

The Benefits of Using Carbon Dioxide



Solubility and Viscosity – Used extensively since 1962 as an additive to acid fracturing, CO_2 is very soluble with oil and water. Due to its solubility, it greatly reduces viscosity (especially of oil) during a fracturing treatment.

Less Damaging – An advantage of using CO_2 is its low pH (4.5 to 5.0). In formations where clays are usually found, using CO_2 with the frac fluid minimizes the swelling of these clays, allowing the sand laden fluid to penetrate farther into the fractures. Less gel pumped means less unbroken gel left in the rock pore space and less on the fracture walls.

Easier Cleanup – When using CO_2 fracture treatments far less water is introduced into the formation compared with traditional frac treatments. This results in significantly less liquid to clean up and less liquid trapped in the formation by capillary forces. Additionally, the high percentage of CO_2 lightens the fluid column in the well bore reducing the energy required to remove the frac fluids. The expanding CO_2 also provides much of the energy needed to remove the fracture fluids and excess sand.

This results in faster, more thorough, and more economical cleanup as well as accelerated well production startup.

No Special Equipment Required – The use of CO_2 can be an added advantage for service companies and well operators because, with very limited modif ications, the same equipment can be used to pump the high pressure CO_2 as they would use to pump water.

Why Choose Praxair

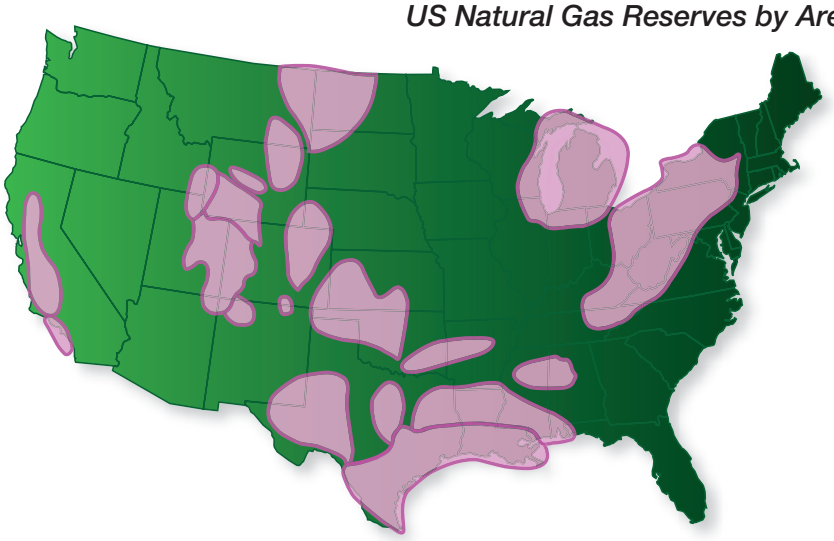
Excellent Supply Positions

Praxair has one of the largest supplies of CO_2 in the US. We are based where you need us and can be there with the necessary volumes.

The Leader in Delivery and Portable Storage

Praxair has added almost 3,500 tons of portable storage to handle the increase oil and gas service demand for liquid CO_2 we currently have approximately 200 portable storage tanks available (ranging in size from 34 to 60 tons each in capacity), as well as 1,080 tons worth of skid mounted tanks.

US Natural Gas Reserves by Area



To fill these portable vessels, we have over seventy 20 ton transport trucks in service. Our fleet includes two special CO_2 trucks that can haul 10 tons apiece up mountainous roads or other areas of limited maneuverability. These two trucks can also be used on location to provide the boost pressure to the high pressure pumps used to pump CO_2 down hole.

We have a number of skid mounted plants, rated at 300 tons per day. These plants are portable and can be set up in days in conjunction with skid mounted tanks.

Another valuable resource is our substantial network of railcars. With over 350 in operation, each capable of transporting 80 tons of CO_2, we are able to expand far beyond the normal reach of using trucks alone.

The Leader in Logistics and Onsite Pumping Services

Praxair provides portable storage and CO_2 on the jobs sites, and can manage the boost pump operations as well. In order for service companies to pump the liquid down hole at a steady rate, small boost pumps with capacity ranging from

10 barrels per minute to 100 barrels a minute must be used. Praxair can provide this service, along with the necessary experienced technicians to help ensure reliable fracture treatments and to prepare the infrastructure.

Our newest boost pumps are automated so the operator can be at a safe distance from the high pressure lines when operating this piece of equipment. With the new pumps we can also capture boost pressure and flow rate digitally for later computer analysis.

A Frac Story

In one of our more complex assignments, we recently performed a frac job within the Appalachian basin in Alabama.

We were able to move and pump 2700 tons of CO_2 in four days. We initially filled 1450 tons of portable storage from the Loudon, TN, Decatur, AL, and Brandon, MS plants. We also were able to obtain an additional 1200 tons of storage within railcars placed 20 miles from the location. Each railcar was capable of hauling 80 tons. In one day, we moved 720 tons of product, enabling us to pump the next day's stage of 600 tons.

Physical Properties of Carbon Dioxide

	BBL LIQ	BL GAS	LBS	SCF GAS	GAL LIQ	CF LIQ
1 BBL LIQ	1	560.9	366.5	3,151	42	5.616
1 TON LIQ	5.45	3.057	2,000	17,168	229	30.64
1 GAL LIQ	0.0238	13.4	8.72	75.02	1	0.1337
1 CF LIQ	0.178	99.6	65.27	559	7.481	1

SCF GAS MEASURED @ 14.7 PSIA & 60°F (1 lb of LCO_2=8.569 SCF OF GCO_2) LIQUID CO_2 MEASURED @ 250 PSIG & -10°F

Typical Properties of Carbon Dioxide

Density Liquid	65.3 Lb/Ft³ @ -10°F, 250 PSIG
Density Gas	44.7 Lb/Ft³ @ -170°F, 4000 PSIG
Triple Point (Forms Dry Ice)	-69°F, 60.43 PSIG
Critical Temp (Exists As Gas)	87.8°F
Critical Pressure (Exists As Gas)	1051.6 PSIG
Critical Density	29 Lb/Ft³
Latent Heat Of Vaporization	125 Btu/Lb @ -10°F
Solubility In H_2O	170 Scf/Bbl @ 170°F, 4000 PSIG
Viscosity Gas	0.015 Centipoise @ 0°F
Viscosity Liquid	0.085 Centipoise @ 0°F

A Global Leader in Industrial Gases

Praxair, Inc. is the largest industrial gases company in North and South America, and one of the largest worldwide, with 2011 sales of $11 billion. The company produces, sells and distributes atmospheric, process and specialty gases, and high-performance surface coatings. Praxair products, services and technologies are making our planet more productive by bringing efficiency and environmental benefits to a wide variety of industries, including aerospace, chemicals, food and beverage, electronics, energy, healthcare, manufacturing, metals and others. More information on Praxair is available on the Internet at www.praxair.com.

To learn more about Praxair's CO_2 gas well fracturing services, go to **www.praxair.com** or call **1-800-PRAXAIR**.

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