The changing face and perception of CO2

By **Sam A. Rushing** on Apr 02, 2014

Carbon dioxide is ever more a green-natured agent when applied in a growing number of industries.

It is often difficult to think of carbon dioxide as a green chemical or gas, when at first blush, CO2 is indeed the greatest greenhouse gas by volume; not the worst of all heat trapping gases, but the greatest (by volume) when emitted.

All of this is relevant to the industries which produce a CO2 by-product or flue gas; as well as those gas companies which recover, refine, and sell the product to the merchant markets.

By many accounts, atmospheric levels of CO2 are near 400 parts-per-million (ppm), a record by modern standards, while noting that CO2 levels have steadily risen since the beginning of the industrial revolution. However, these have accelerated during the last number of years and decades in particular. In the end, it is clear to see the often dire effects which climate change can take, as evidenced by melting glaciers and the shrinking arctic ice.

Perhaps the most daunting image happens to be the drowning of, and unlikely relocation of, polar bears. It is important to note that since the 1960s, over some 40 years, CO2 atmospheric content has increased by a factor of 20%. This is indeed, truly unsustainable.

However, there is hope to turn the tide, or at least arrest the accelerated growth of carbon emissions, via many small steps and

major steps toward CO2 emissions reduction schemes. This can start with green CO2 applications from planting more green life, trees, and even more commercial greenhouse crops, to large ventures such as enhanced oil recovery (EOR) projects, which can truly sequester and recycle CO2.

Many green CO2 applications are essentially well proven and are now essentially old technologies, which continue to work well. So, ahead we go toward developing additional green and environmentally friendly carbon dioxide uses in industry, as well as improved methods of sequestering the product.

Changes in perception

The problem with CO2 sequestration and carbon reduction schemes is the lack of economic return for many purely sequestration projects, unless government funding or subsidies are guaranteed.

The challenge is to find projects which are truly green from a sequestration perspective, while they weather the test of economic returns. With this in mind, EOR may be on the top of the list, in terms of receiving potential and real economic returns from the application of carbon dioxide which achieves carbon sequestration as well. This represents incremental returns from the rather long-term investment in EOR, often running from years to many decades in duration.

Otherwise unobtainable oil is recovered, plus CO2 is actually sequestered in the geological formations. Therefore, in some ways, CO2 emissions are essentially 'taken off the table'.

Then we also have the ongoing arguments surrounding absolute removal of carbon by-product into various modes of sequestration compared with only displacing the CO2 into various markets via a wide range of uses in industry. Sequestration rather than displacement of CO2 via applications is perhaps a matter of perception; however, some of this is quite clear.

It is truly clear to see applications which replace harmful, carcinogenic, and toxic agents such as various halogenated hydrocarbon compounds (such as 'perc' in dry cleaning environments) instead of carbon dioxide, which is an excellent solvent, without the terrible legacy associated with dry cleaning operators developing cancer – which is common in the industry.

When thinking in terms of economic gains received via certain green applications, perhaps the greatest example of this would be EOR applications, which have proven to be effective in the recovery of oil as well as sequestering CO2 – all dependent upon the geology of the well

Green applications

A number of common and proven green applications exist in industry today.

All of this is important to the readers of this article, particularly to the gas company professional, where markets can be enhanced by more use of 'green-related' CO2 applications; both in terms of gaining more CO2 market share, and increasing revenues.

Further, many of these new developments in industry essentially create new CO2 business from otherwise applications of solvents and chemicals of a noxious nature.

Supercritical extraction: Supercritical extraction of essential oils has both food-related and cosmetic applications. Flavouring agents, essential oils, and of course caffeine removal from coffee and tea are among the major applications for supercritical extraction. This has the benefit of eliminating sometimes hydrocarbon-based solvents from the process in lieu of a food grade CO2 which has no residue, and is harmless to the consumer. Products of this process can then be labelled 'natural'.

Dry cleaning industry: It has been said that many of the dry cleaning industry's long-term workers who have used 'perc' for years often end up with a variety of diseases, including cancer and organ damage. However, when applied in specially designed machines, CO2 is an excellent solvent for a truly healthy dry cleaning environment, which also yields outstanding cleaning results from the process.

Water treatment and Ph reduction: This is a long-lived and well proven application, which in many world markets dates back half a century; but has a long way to go in terms of use in public and private industrial settings.

The application of CO2 is sometimes found in municipal water treatment plants. Many such municipal treatment plants in places like the US Midwest and Southwest have particularly hard water. Often such plants use lime as one of the basic chemicals for the softening process, and CO2 is then the logical and natural option for Ph reduction in place of using other agents.

Further, the application can be sought to help reduce calcium carbonate scale within the distribution system, where literally calcium scale can fully plug up the water lines. Then, the application is an environmentally friendly alternative to mineral acids (hydrochloric, sulfuric, and nitric), where CO2 by-products are benign carbonates and bicarbonates rather than sulfur compounds from sulfuric, for example.

In the end, this application should be explored fully in all industries which have effluent, or a need to reduce the Ph, which are otherwise being treated by other agents such as mineral acids, and of course evaluate opportunities in municipal treatment systems. How much greener can we get than naturally purifying and reducing the Ph in the water we drink?

In a gaseous form for agricultural uses: Perhaps another very 'natural' form of CO2 usage in a 'literally' green (flower and plant growing) format would be the application of CO2 for greenhouse plant growth enrichment. In this context, of course, photosynthesis is enhanced with the CO2 content elevated from our current levels near or at 400 ppm to 1,000 ppm; the plant growth factor is estimated to be enhanced by up to 50% with this treatment.

Overnight, the application occurs and in the years and decades past, greenhouses often used fossil fuel combustion flue gas to obtain some boost in CO2 content, though not very concentrated, with a noxious mix of gases instead of pure CO2. Various projects worldwide have evaluated the use of CO2 by-product streams from traditional source production, such as ethanol. Also, during the high development days of US cogeneration projects, greenhouses served as a 'thermal sink' for the cogeneration flue gas.

Insect fumigation: In lieu of using various chemical agents for insect control in grain storage facilities, CO2 maintained at around 50% by volume in the atmosphere, for 4-7 days and generally in warmer climates over 60°F, is an excellent means of eliminating chemical agents and controlling insects in a very green way.

This application would be particularly interesting to buyers of grain products labelled as 'natural' or in language relating to being processed in a 'green' manner.

Algae farms: As algae is an area which is being embraced more readily for applications in biodiesel, such as extraction of algae oil for biodiesel projects, CO2 is of course one of the raw ingredients required for algae growth. Everything from power project flue gas to merchant CO2 deliveries have been used in algae projects, which remain in the early stages of development when thinking of commercialisation for large biodiesel projects.

As a small usage requirement, CO2 is used for micro-bulk storage of algae growth; and algae can serve as a foodstuff for shrimp and seafood farms, which then ends up on our dinner tables. This is green CO2 usage found in an everyday food industry context.

Dry ice blasting: This, of course, has been promoted for some years as the logical, clean, and safe alternative to various forms of cleaning, from a menu of solvents, to sand, for example. Dry ice blasting inquiries from independent gas producers in developing countries continue to grow, where this has been the basis of new CO2 producer start-ups in some cases.

Even though this represents a small percent of total CO2 sales, it is a means of selling and supplying a greater service which entails the use of the CO2. It represents far more than the price of the commodity as a unique and clean form of removing a wide variety of materials from many surfaces. The lack of leaving behind a mess is perhaps the greatest advantage found.

Enhanced fossil fuel yield:

Under this heading, the most obvious, perhaps, is EOR, which achieves various tasks, primarily enhanced recovery and revenues from oil and secondly, a viable form of sequestration.

EOR project interest has literally exploded in North America. Numerous ethanol projects in the US have their CO2 by-product delivered to EOR projects by pipeline, and many more such projects are under evaluation for possible development.

Since oil and gas production in North America is significantly on the rise, and the potential and true need to recover as much oil from otherwise depleted wells is now fostered more than ever, there is pressure to sequester ever more CO2 due to climate change, while some industry and political influence in favour of EOR is also underway. In short, more EOR developments will occur.

One such project of interest in Saskatchewan is Sask Power, which will take and sequester over one million metric tons of CO2 from a coal-fired power plant, – its 140 MW unit 3. The ultimate goal is to expand the currently operating Weyburn oil field, which will deliver (through a 40 mile pipeline) CO2 recovered via MEA technology. The pipeline is being built by Cenovus Energy, the oil company expanding the EOR project. This represents real change from a greenhouse gas emitted from power production, both to enhance oil recovery and achieve CO2 sequestration all in one.

When looking at this, as well as other applications, isn't all of this representative of change for the greater good, in favour of a green economy and environment while using a gas which (by volume) has been the greatest offender?

It is important for the gas companies to focus on green technologies, some of which will take business from 'competing' chemical agents used in industry rather than only using CO2, and expand markets. This is more than perception alone; it is truly green in nature.

About the author

Sam A. Rushing is President of Advanced Cryogenics, Ltd, and a major CO2 consultant throughout the Americas and internationally.

Rushing is a chemist by background, with a massive merchant and comprehensive consulting background covering all subjects and sources of CO2, from source types, to production, purity, markets, applications, expert witness work, and everything else.

Telephone: +1 305 852 2597

E-mail: **rushing@terranova.net**

www.carbondioxideconsultants.com