Jupiter Oxygen Corporation

High Flame Temperature Oxy-Fuel Combustion Carbon Capture

Transitional Technology for a Zero Emission Future

Introduction – "The Energy Mix"

The energy mix is the total combined *primary sources* that provide energy needs, primarily electricity for heat, air conditioning, water filtration, manufacturing, etc. The primary sources in the energy mix also provide fuel for transportation needs. Globally, fossil fuels dominate the energy mix accounting for anywhere from 20% - 80% of the total mix – depending on the individual country or region.[1] Fossil fuels are – in order of usage - natural gas, coal and oil (petroleum liquids and coke) as well as other gases.

Other primary sources that make up the energy mix include – in order of usage - nuclear, hydropower, wind, biomass including wood, landfill gas, municipal solid waste (biogenic), solar and geothermal.

Any strategy to reduce Greenhouse Gas Emissions (GHG) from the atmosphere must include data about the **global energy mix** that include statistical trends and individual nation's economic capabilities. From these, an efficacious strategy of **global** climate change mitigation can be crafted and executed.

A growing population continues to exert pressure on the global energy market and energy mix. UN, in consideration of the world's population trends, estimate that global material use, with fossil fuels as the primary material, could reach 180 billion tonnes by 2050[2] absent substantive climate mitigation gains.

Complicating the growing demand for energy is the global consensus that dependence on fossil fuels must decrease. Adoption and efficacy of cost-effective processes for electricity sourced by alternative and natural resources is increasing. The cost of doing nothing is considerable.

Growing Use of Fossil Fuels in the Energy Mix

Global fossil fuel use *will* continue to rise with the rising demands of Africa, India and China as well as other countries currently experiencing energy poverty. Over a billion people in the world today either cannot afford or have no access to electricity[3]. According to IMF's World Economic Outlook, global electricity from coal alone is expected to grow by 8.6% to 2040 even as its overall share decreases relative to other fuels.[4]

[1] IPCC, IEA, UN, US Energy Information Administration. The factors underlying the variance are those countries identifying as MEDC and LEDC.
[2] UN Environment Program, International Resource Panel
[3] World Bank, UN, Duke Energy, Rice University
[4] IMF

To meet these needs, the International Energy Agency estimated that non-ODCD country (LEDC countries) will need to double their investments in electricity across the value chain from US$240 billion to US$495 per year. That is equivalent to US$13 trillion a year to 2040. The obvious challenge is these many countries have substantive economic hurdles already – just providing basic services like clean water can be Herculean.

Further, consider the global trends to urbanization. Today, 55% of the world's population lives in metropolitan areas.[5] By 2050 between 65% - 69% of the world's population is projected to live in metropolitan areas. Increased urbanization leads to substantial increases in energy consumption and a decrease in the efficiency of energy use.[6] Energy inefficiencies are also increased in times of growing GDP.

Until the electrification gap is filled with renewable energy like wind, photovoltaic, geothermal, and bioenergy and off-grid technology like mini-grids, the value climate change mitigation technology like carbon capture cannot be overstated.

There are two paths to reducing CO_2 in our atmosphere: Lower the amount of CO_2 from the anthropogenic source. And/or, removing greenhouse gases from the atmosphere that have already been emitted.

Will Carbon Capture Change the Energy Mix?

No. The energy mix is comprised only of primary energy sources. However, carbon capture will make fossil fuel utilization a less volatile component of the energy mix. Fossil fuels with carbon capture technology can be used with *Near Zero Emissions.*

Gernot Wagner, Associate Professor at the Department of Environmental Studies at New York University wrote in, *Climate Shock*[7]. "It's always been wishful thinking but more recently it's become more imminently clear that there's simply no way to decrease CO_2 emissions without capturing CO_2 that's part of the fossils fuel supply chain. It should objectively be part of the equation because of how late in the game we are."

[5] UN, Pew Research, US Census Bureau, WHO, Yale University
[6] Yale, University of Michigan, University of Arizona, IPCC, World Bank
[7] Gernot Wagner & Martin L. Weitzman, 2016. "Climate Shock: The Economic Consequences of a Hotter Planet," Economics Books, Princeton University Press, edition 2, number 10725, March

High Flame Temperature Oxy-Fuel Combustion Carbon Capture

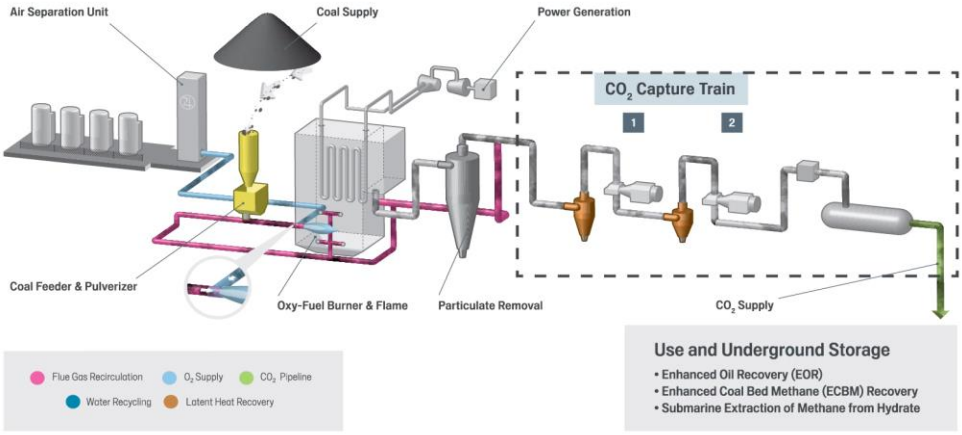
Headquartered in The City of Big Shoulders, Jupiter Oxygen Corporation has patented a technology; high-flame temperature oxy-fuel combustion carbon capture that shown substantial promise for reducing pollutants and greenhouse gasses in new and existing fossil fueled electric power generation plants.

In the 1990's, Jupiter Oxygen conducted experiments with the use of oxygen in industrial melting furnaces. Knowledge from these experiments led to a new technology for combustion and burner systems for the oxy-fuel combustion process that had been used in plants for decades. The results of this technology are dramatic; a 78% reduction of natural gas fuel and a waste oil fuel usage reduction up to 68%.

The unique oxy-fuel technology was then transferred from industrial melting furnaces to fossil fuel steam generators and power plants, focusing on efficiency and emissions benefits. Cooperation was received from the Energy Task Force, the Department of Energy and its National Energy Technology Laboratory.

Jupiter Oxygen Corporation has kicked off a Front-End Engineering and Design Study for the application of its technology on an existing coal-fired power plant.

Jupiter Oxygen's High Flame Temperature Oxy-Fuel Combustion Technology



Key Barriers and Uncertainties

Cost: Today the market does not provide any substantial incentives for companies to gain a full return on investment in CCUS. While the development of lower-cost advanced low-carbon technologies is a singular focus of tens of thousands of people around the world, a standard techno-economic process is not being currently employed. This results in

Further, sound cost engineering and analysis is difficult because of a lack of good basic equipment cost data in the public domain. Additionally, a high level of experience with economics and cost engineering is required as well as an understanding of process and equipment design issues. This is an extremely small population who are the surrogates for a global industry.

Further Expansion of Policy Decisions Supporting Carbon Capture Utilization and Storage: While there are tax incentives like IRC Code Section 45Q Tax Credit, initially passed in 2008 and significantly updated in 2018, that provide a tax credit on a per-ton basis for CO_2 that is sequestered, placed in service or utilized in a serviceable manner, there is a need for expansive policies that fully support investments in carbon capture and storage. There **is** movement in some quarters promoting mandatory CCUS deployment.

Lack of global consensus on CCUS: The support of CCUS technologies are conditional based on special interests of local, regional and national politics. In the coal-heavy economies of China, India, Canada and the U.S. governments promote CCUS in their emissions-reduction promises, but they have been reluctant to mandate the technology. The stance of "No Fossil Fuels" indicates some lack of serious consideration to the trends on population growth etc.

Conclusion & Key Takeaways

For the next few decades, oil, gas and coal will continue to be the dominant players in the global energy mix. Population growth will be the primary driver for the increased global demand for energy. There is no single solution for the solution to resolving our world's energy supply issues. The proliferation of investment in renewable energy technologies will help gradually shift the energy mix away from its heavy dependence on fossil fuels. However, sole reliance on renewable energy technologies to mitigate climate change will push measurable recovery into the twenty-second century.

Technologies that can be applied immediately to plants that utilize fossil fuels are critical. Carbon capture technologies in the energy mix including Jupiter Oxygen's High Flame Temperature Oxy-Fuel Combustion will give the energy sector a selection of solutions for environmentally sound energy production while fulfilling the growing demand of the expanding world population.

With the initiation of a Front-End Engineering & Design Study (FEED) study in Qu. 1, 2020, Jupiter Oxygen is poised for rapid commercial introduction and widespread deployment of its energy-efficient and capital-effective technology for carbon capture.