**Jupiter Oxygen Corporation : For Distribution (1)**

## The Simple and Chilling Reality of Climate Change

Climate change is making the planet warmer and is pressuring all sectors, public and private, to come to a common understanding of the short- and long-term implications. No longer an existential or theoretical assessment, the rising concentration of greenhouse gasses in Earth's atmosphere has affected every geophysical system on which human beings depend; the hydrosphere and its cycles, the atmosphere and its conditions, and the lithosphere including ice caps, oceans, forest, mountains, and arable lands.

The menace of climate change unquestionably affects human systems including food supply, health, security, property, business, jobs, markets, and economies. Climate related events have increased specifically, severe weather events. These have resulted in droughts, crop failures and pest infestation leading to population displacement and conflict. The global mega-trends of population growth, human migration, urbanization, and continued technological development are factors in the growing peril of climate change. *(climate.nasa.gov)*

Climate change is one of the most labyrinthine issues facing us today. Expanding into aspects of economics, politics, society, and ethics, it is an issue that we, as a global community, will be addressing for centuries given the half-life of excess $CO_2$ in the atmosphere ranges between 30 – 50 years. The 2019 levels of atmospheric concentration of $CO_2$ was 410ppm, an increase of almost 50% from pre-industrial levels (1850). The range of atmospheric $CO_2$ from the Last Glacial Maximum (20,000 years ago) to 1850 was 185ppm to 280ppm. *(climate.nasa.gov)* Environmental and climate scientists estimate than an atmospheric concentration of 350ppm will *stabilize* the effects of climate change. *(e360.yale.edu)*

For those who see today's climate change as part of a normal trend in geophysical systems of the earth it is important to note that the last time $CO_2$ levels were as high as they are today was in the Pliocene Epoch or five million years ago predating evolved humans by 4,685,000 years. *(climate.nasa.gov)* NASA scientists have concluded that previous cycles of moderate climate change, measured by glacial advance and retreat, were caused by very small variations in Earth's orbit that changes the amount of solar heat on the planet. These variations or eccentricities happen approximately every 100,000 years and cannot be identified as the source for the severe climate changes and climate events happening now.

## $CO_2$ is the Primary Driver for Climate Change

The cause is anthropogenic. We did this.

The industrial activities upon which modern society depends are the primary sources of greenhouse gases and, by extension, climate change. Human activity since the mid-20th century has contributed greenhouses gases into the atmosphere that is unparalleled to any time in human history.

$CO_2$ has been identified as the key component in greenhouse gases. In oceans, $CO_2$ acidifies the water. In plant and human organisms, $CO_2$ can result in disturbances of life-sustaining processes. The historical legacy and continued release of $CO_2$ and other greenhouse gases by industrialized countries, combined with increasing emissions from the unchecked combustion of fossil fuels in developing countries will result in a trajectory of atmospheric concentrations of $CO_2$ and other greenhouse gases that will likely exceed 2°C above pre-industrial levels. An MIT report from 2013 projected that 9.1 million people will die annually from uncurbed climate change effects by 2100.

There are compelling environmental, economic, and social reasons to invest in mitigation efforts. The urgency in implementing climate change mitigation efforts are highlighted by the very nature of climate change itself. The distribution of extreme weather occurrences are rapidly shifting. The socioeconomic impact of climate change grows disproportionately and catastrophically disproportionally affects the most vulnerable populations and subpopulations of the world.

**The Technologies Available to Mitigate Climate Change**

The solution to climate change must transcend the binary discord of fossil fuels or renewables. The solution will be a conglomeration of technologies executing multiple scenarios requiring broad coalitions with varying adaptabilities.

The costs and efficiencies of renewable technologies are improving. But there are not enough renewable alternatives currently eligible to replace fossil fuels in every corner of our global energy system. The challenges to sustainable renewable energy production are significant and include re-engineering the grid, providing large-scale consistent generation, supplying low reactive power to re-charge from blackouts. These are just a few issues that underscore the necessity of fossil fuels during the transition to renewable and clean energy technologies.

For full implementation, renewables must improve their value chain, optimizing activities from engineering to commercial capabilities. Renewable technologies must improve economies of scale and skill. Finally, renewables must establish a more agile operating model to cope with fluctuating development cycles to help drive down costs.

Across the globe, it is the energy sector that accounts for over two-thirds of greenhouse gas emissions.  And it is a US$25 trillion global energy infrastructure that must be replaced to eliminate all $CO_2$ emissions by 2050.  If the goal were only to meet 2/3 of the Paris goals from 2015, oil production must be reduced by 50% and coal usage must end.  Neither of these scenarios address the one billion people across the world who currently have no access to a reliable energy source and depend on fossil fuels to provide the most basic energy needs.

Cheap energy resources will always be the preferred source.  And, until renewable energy alternatives can address the challenges on a global scale, the continued use of fossil fuels will remain essential to sustaining the energy supply, worldwide.

Fortunately, there is a carbon negative technology capable of reducing fossil fuel emissions to *near zero.*  It is the *only* technology capable of dealing directly with emissions from fossil fueled processes.  It is also the only technology capable of supporting supply for rising demand as well as meeting climate mitigation targets.  Carbon Capture.

**Carbon Capture Offers Immediate and Measurable Mitigation**

Carbon capture technologies reduce $CO_2$ emissions from the atmosphere by "capturing" carbon dioxide.  The simplest explanation of carbon capture is that $CO_2$ is separated from other elements and compounds and "captured".  Following "capture" or the acquisition of $CO_2$ it is compressed, contained, and then transported for either storage or further commercial utilization.

The International Energy Agency projects that by 2040, 60% of primary energy generation will still be sourced to fossil fuel use.  Taking into consideration the stark climate change conditions, carbon capture is a critically important technology to achieve climate mitigation goals given this estimate of continued fossil fuel use.  The Global Carbon Capture and Storage Institute has estimated that large-scale deployment of 2,000 carbon capture sites are needed to be in operation by 2040 to meet Paris Agreement goals.   The Great Plains Institute estimates that there are more than 400 near- and medium-term carbon capture opportunities in the U.S. alone today.  These projects are increasingly important in delivering the required reductions in carbon emissions domestically, further restraining global carbon emissions

Multiple sources have underscored the necessity of the deployment of carbon capture projects, sufficient to put global carbon emissions on a path consistent with long-term stabilization of atmospheric $CO_2$ concentrations providing progressive reductions in atmospheric carbon intensity.

In consideration of both economic and environmental realities and constraints, it is necessary to apply efficient and suitable technology for carbon capture with low operating cost and energy consumption. Carbon capture technologies have progressed by leaps and bounds in recent years with credit going to innovators and support from multiple governmental agencies worldwide. Carbon capture has been receiving increasing policy and legislative attention primarily because of its climate mitigation features. As commercial viability becomes reality, the transformative value creation and subsequent market opportunities provide critical impetus to make carbon capture a mature industry.

## The Distinctive Types of Carbon Capture Technologies Available

### Direct Air Carbon Capture

Direct Air capture is the removal of $CO_2$ directly from the atmosphere and not from an industrial source (e.g., emissions from commercial plants). This technology captures $CO_2$ directly from the air using large fans that act as a giant vacuum, literally sucking ambient air into the fan, through a physiochemical process whereby the $CO_2$ is pulled through a filters, adsorbed by chemicals producing a stream of $CO_2$ which is then contained.

The benefit to DACC is that the fans are easily transportable. This system can be set up virtually anywhere. The disadvantages include the substantial water input that is required raising questions of the sustainability of long-term use DACC. There is a high amount of energy required to run this process. The substantial energy requirements raise serious questions of downstream environmental challenges. Should DACC utilize renewable energy sources to run its operations, the land usage for that energy would be massive. The high cost of energy utilized in the operations of DACC is a primary reason why it is the most expensive of the carbon capture technologies. Most important, unless renewable sources (including back-up energy) is used through the entire value chain of DACC it is net $CO_2$ additive into the atmosphere.

### Post Combustion Carbon Capture

The most mature of the carbon capture technologies, post combustion carbon capture (a "point source" carbon capture) technology is utilized in relation to the combustion process in power plants and industrial facilities that use fossil fuels. When fossil fuels are burned for energy to run the plants the additional substances created include water, carbon dioxide, particulate matter, heavy metals and acidic gasses. These substances are the emissions vented into the atmosphere as flue gasses.

PCCC removes $CO_2$ from the flue gasses; after burning (post-combustion) the fossil fuels. $CO_2$ is scrubbed out of the flue gasses by either membranes or solvents. Most carbon capture technologies operating today are post combustion. And most of the PCCC technologies are "retrofit" which means they have been added to existing power or industrial facilities as opposed to "new build" power or industrial facilities. While “point source” carbon capture technologies are more efficient than DACC this “end-of-pipe” process, PCCC – like DACC – is energy intensive giving it a high efficiency penalty and making it less efficacious and more costly when additional fuel is taken into consideration.

Another challenge is the high cost for that technology. Unless massive financial supports are put in place across the globe, this technology will face implementation difficulties.

**Oxy-Fuel Combustion Carbon Capture**

Also a “point source” carbon capture technology, oxy-fuel combustion carbon capture applies a relatively simple concept in which substantially pure oxygen is substituted (in the combustion process) in the place of ambient air. Near pure oxygen is used to oxidize the fossil fuel. The resulting flue gas contains primarily $CO_2$ and water vapor with smaller amounts of oxygen, nitrogen, sulfur oxides and nitrous oxides. Oxy-fuel combustion provides a more concentrated stream of $CO_2$ than other carbon capture technologies. And the more concentrated the stream of $CO_2$, the higher the efficiency and the lower the cost of capture.

Oxy-fuel has been used in industrial furnaces since the early 1990’s with success primarily because this process decreases the volume of fossil fuel required. The industrial furnaces run at much higher efficiencies and generating ultra-low emissions. Transformation to a sustainable energy system with low greenhouse gas emission is far less challenging with oxy-fuel combustion carbon capture because of these lower costs and efficacy improvements.

This technology is quite advanced and presents the attractive benefit of being the most affordable solution today. The very first financial analysis present a ratio 2 to 3 times cheaper than the post-combustion technology.

**Jupiter Oxygen Corporation has developed a Transitional Technology for a Zero Emission Future**

Jupiter Oxygen Corporation, based in Chicago, has patented an innovative carbon capture technology to capture $CO_2$ emissions at the source. With *near zero* emissions, our technology offers a viable solution to address emissions control from fossil fueled power generation sources. We are leading the application of oxy-fuel carbon capture technology worldwide.

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

The unique oxy-fuel technology was then transferred from industrial melting furnaces to fossil fuel steam generates and power plants, focusing on efficiency and emissions benefits in cooperation with the U.S. Department of Energy and its National Energy Technology Laboratory.

Our technology features significantly in every low carbon scenario resulting in an economically efficient and carbon neutral energy supply. Our pragmatic and practical approach will augment the environmental benefits at Near Zero emission power plants. Positioned to be first-of-a-kind carbon capture in Wyoming, Jupiter Oxygen has a valuable role in unlocking the profitability of carbon capture.

**Our Advantages**

- The technology provides capabilities to generate energy from fossil fuels with near zero emissions providing 99+% decarbonized electrical generation. Virtually emission free power production.

- The increased heat in our combustion process with near pure Oxygen allows for the capture of not only $CO_2$ but Nitrous Oxides, Sulfur Oxides, Mercury, and Particulate Matter.

- The technology creates more efficient heat transfer for industrial furnaces with moderate process temperatures. Improved efficiency is due to elimination of airborne nitrogen, more radiant heat transfer, and longer gas residence time.

- The high flame temperature oxy-combustion technology offers fuel efficiency gains in the boiler and latent heat recovery for additional efficiency, as well as process water reuse.

- Parametric studies performed to determine the optimal performance conditions and to generate the necessary technical data required to demonstrate our technology substantiate the technology is viable technically and economically at levels not yet achieved by other carbon capture technologies.

- Jupiter Oxygen Corporation’s technology is, in general, at a higher level of maturity and is a simpler concept compared to other more novel technologies suggesting a buffer against the growing divestment from fossil fuel investing.

- We are targeting smaller scale fossil fueled units to retrofit with our technology. This will significantly lower the overall capital cost expenditures, reducing financial hurdles that would be found in new build fossil fueled power plants.

- Jupiter Oxygen's timeline represents one of the fastest to market of the low-carbon advanced coal technology allowing it to capitalize on the existing 45Q $CO_2$ tax credits.

- The cost of capture and EOR application offers price efficacies far superior to membrane, solvent, or direct air carbon capture technologies.

- Given the nascent state of development of many renewable energy technologies, our speed to market provides an immediate solution for climate change mitigation and offers a competitive advantage in the growing low-carbon economy.

- Jupiter Oxygen is partnering with some of the most progressive engineering and energy companies with a combined focus of meeting the rising energy demand with our innovative technologies.

- This innovation and the scaling up of our decarbonization technology has led to major reductions in the cost of our technology, the primary challenge in any carbon capture demonstration project.

**Milestones**

- Jupiter Oxygen is the project owner, director, and technologist for the High Flame Temperature Oxy-Fuel Combustion carbon capture project at PacifiCorp's Dave Johnston Power Plant in Glenrock, Wyoming.

- Our patented technology has undergone rigorous testing at our Hammond, Indiana Pilot Plant while working with the U.S. Department of Energy over a ten-year period. Our technology is ready for full scale demonstration at an operating coal-fired plant (TRL 6).

- Our nimble operations have fast-tracked our carbon capture technology through Feasibility Study to FEED Study of Retrofit of a Coal-Fired Electric Power Generating Unit with a vital $CO_2$ off-take market.

- A Feasibility Study was completed in 2018. A Front-End Engineering and Design study began in February 2020 and is scheduled to be completed in June 2021. This FEED study will ultimately lead to a complete plan to build the largest oxy-combustion $CO_2$ capture facility in the world and to demonstrate a viable cost-effective strategy for retrofitting existing coal-fired power plants with low-carbon, poly-generational technology.

- The proposed demonstration project involves the engineering and construction of a carbon capture utilization and storage (CCUS) facility involving the retrofit of PacifiCorp's Dave Johnston Unit 2 to oxy-fuel combustion with carbon capture for delivery of $CO_2$ to a nearby oil field for $CO_2$-EOR long term operations.

- Our demonstration project will capture the power plant emissions, purify, and deliver the $CO_2$ to an oil field approximately 10 miles away. The $CO_2$ will then be injected in the oil field for enhanced oil recovery, a proven means of producing residual oil from older and depleted oil fields that would otherwise be stranded when using convention oil production techniques

- Following successful deployment of demonstration, Jupiter Oxygen's plan is to further deploy its oxy-combustion carbon capture technology as a retrofit to existing fossil-fueled units throughout Wyoming, the U.S. and abroad.