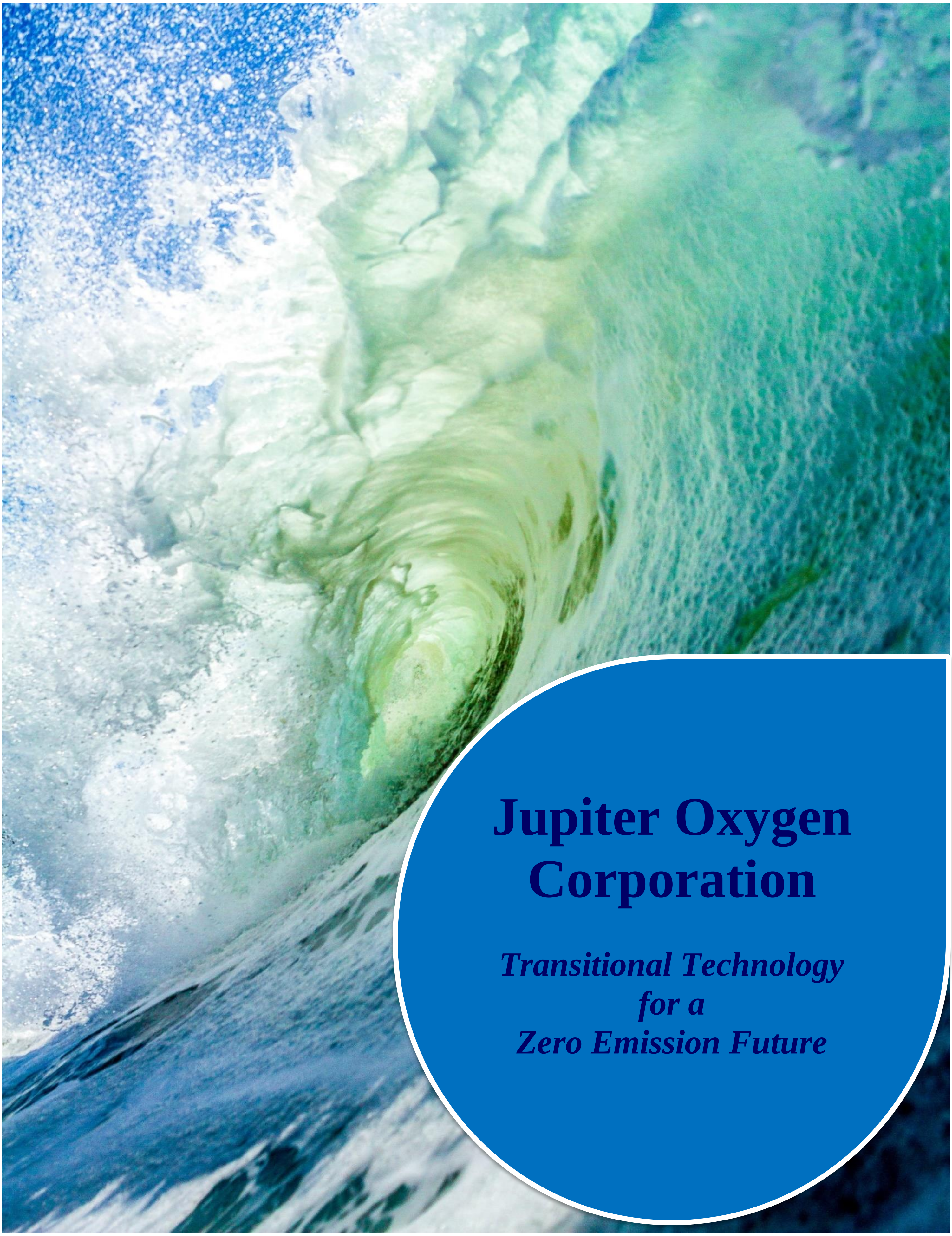

Jupiter Oxygen Corporation

Transitional Technology for a Zero Emission Future

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 it's 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 such as increased and more severe weather events resulting in droughts, crop failures and pest infestation have led 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.

The entirety of scientific information about climate change is substantive and dynamic given the inherent social, economic, and technological factors. So too, the breadth and depth of response options and the framework within which those options are considered. The political context in which climate change options has also changed.

The Primary Driver of Climate Change

Anthropogenic emissions.

The industrial activities upon which modern society depends is the primary source of greenhouse gases and, by extension, climate change. Human activity since the mid-20^{th} 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 coal and other 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 annually will die from uncurbed climate change effects by the year 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.

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.

A Suite of Solutions

The aggressive decarbonization goals targeting 2030, even 2050 require the solution transcend the binary discord of fossil fuels or renewables. These climate goals require a planned transition; economic, technological, and political. The solution will be a conglomeration of technologies executing multiple scenarios requiring broad coalitions with varying adaptabilities.

Renewable energy technologies are experiencing cost reduction and improving operational efficiencies. However, the challenges that remain include re-engineering the grid, large-scale and consistent generation, and low reactive power to re-charge from blackouts. Most significant is the use of rare earth and other key metals in all renewable energy technologies. Under a 100% renewable scenario for energy and transportation by 2050 – an ambitious scenario - rare earth demand will rise appreciably. Many new mines are currently in development and projections include significant expansion of existing mines. Rare earth mining increased 99.5% between 2014 and 2019 raising concerns of a structural scarcity. Finally, transparency in the supply chain of key and rare earth metals is a challenge because of its global dimension complicated by current political and geopolitical relations

Despite aggressive development of renewable energy alternatives, the continued use of fossil fuels will remain essential to sustaining the energy supply, worldwide as the pressing challenges to renewable technology development continue to be addressed.

We are in a transition and, at least for the short term, fossil fuels and renewable technologies will co-exist. The solution requires more than either one can provide, separately. Effective implementation will be a synergistic set of both fossil fuel and renewable technologies.

Aiding this transformation are the vast amounts of data on the measurable economic effects of climate change. While all segments, sectors and industries measure and estimate future damages differently, there are fewer uncertainties and more common ground on the potential economic cost as well as potential returns of investing in transitional technologies.

The traditional utilities industry is amid a fundamental shift how energy is produced, used, stored, and traded. Methodologies for climate impact assessments on energy planning and operations are increasing significantly within the sector. High on a list of priorities for the energy sector includes carbon capture with its technological readiness. Energy efficiency improvements can reduce carbon emissions competitively but cannot lead to deep decarbonization on their own. In any energy transition scenario carbon capture is the *only* technology capable of supporting supply for rising demand as well as meeting climate mitigation targets.

Carbon Capture

There is a suite of technologies that reduce CO_2 emissions from the atmosphere by "capturing" carbon dioxide. Every carbon capture technology consists of the separation of CO2 from a source including industrial, energy-related, and direct from the air. The simplest explanation of carbon capture is that CO_2 is separated from other elements and compounds and compressed.

Within the quaternary industry of carbon capture, oxy-fuel combustion carbon capture is uniquely suited to advance the pathways of climate change mitigation with its cost, technological, and performance primacy.

Essentially, near pure oxygen is used in the combustion process instead of ambient air. The products of Jupiter Oxygen's high-flame temperature oxy-fuel combustion are primarily carbon dioxide and water vapor. The net flue gas – after cooling to condense water vapor - contains CO2 which can be compressed, dried, and further purified before being delivered to our pipeline for industrial use.

Globally, the power sector is the largest emitter of CO2. The International Energy Agency's "best case scenario" projects electricity demand will double by 2060 with CO2 emissions reaching 15 billion tons per year from power generation alone. Decarbonizing the power sector with high flame temperature oxy-fuel carbon capture, upgraded grid controls and demand management can reduce carbon emissions by half by 2040 *(Energy Transition Commission, 2018)*

What Happens with CO_2 After "Capture"?

Following the acquisition of CO2 from its source it is transported to either a storage location for long term isolation from the atmosphere (sometimes called 'mineral carbonation' or 'mineral sequestration'). Alternatively, it is transported for a broad variety of industrial utilization from feedstock to technical fluids to enhancing productivity of a depleted oil field (Enhanced Oil Recovery). The destinations of anthropogenic carbon emissions are known as "Utilization and Storage' in the carbon capture process. A more accurate phrase would be Utilization or Storage as CO2 emissions are not used and then stored or stored and then used.

Carbon Capture Utilization and Storage (CCUS) is perceived as anthropogenic. However, CCUS has its origins in the Cambrian period – 500 million years ago. The confluence of land plants, soil, forests, oceans, and coasts created a natural carbon-absorbing capacity; a nature-based carbon sink. With current carbon capture and storage technologies, the U.S. could potentially store 500 years of current CO2 emissions.

Put to industrial use, the resulting revenues make carbon capture not only environmentally attractive but profitable. **Carbon Capture with Enhanced Oil Recovery (CCUS-EOR)** is a way to amortize the expense of carbon capture technology making it an economically valuable contribution downstream as well as producing more oil in the U.S. reinforcing energy security.

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Jupiter Oxygen Corporation is a privately held company in Chicago that 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 manufacturing 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

We provide 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.

Our 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.

Our 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.

Our 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.

Our 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-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.