Direct-Drive Turbine Technology Powers Eco-Conscious Hydraulic Fracturing

As the energy industry continues to explore Environmental, Social, and Governance (ESG) models to improve business holistically, eco-conscious improvements are at the heart of these change initiatives. Today's frac operators are faced with numerous challenges in an ever-evolving landscape to overhaul business practices and implement technological innovations. The constant demands to lower costs, boost profitability, and increase efficiency often impede environmentally friendly objectives.

The Case for Innovation

The U.S. Energy Information Association (EIA) reports that the reliance on hydraulic fracturing will increase natural gas production "from 342 billion cubic feet per day (Bcf/d) in 2015 to 554 Bcf/d by 2040…Shale gas is expected to account for 30% of world natural gas production by the end of the forecast period." As the U.S. continues to be a global leader in oil and gas production, technological innovation is essential to reducing capital expenditures (CAPEX) and operation expenses (OPEX). More importantly, the right drilling and hydraulic fracturing technology can help the energy industry achieve a cleaner future by reducing emissions and waste.

Standard hydraulic fracturing equipment uses diesel-powered engines. They produce emissions that the Environmental Protection Agency (EPA) identified as negatively impacting human health, our environment and global climate. According to the EIA, "Diesel fuel (refined from crude oil) produces many harmful emissions when it is burned, and diesel-fueled vehicles are major sources of harmful pollutants, such as ground-level ozone and particulate matter." The impact on health can result in "eye, nose, throat and lung irritation, coughing, sneezing, runny nose and shortness of breath," says the New York State Department of Health.

To address the harmful side-effects of diesel, fracing operators are turning towards new technologies, including eFrac, dynamic gas blend (DGB), bi-fuel tech, and direct-drive turbine technology.

Lower Emissions

Conventional hydraulic fracturing Tier 2 and Tier 4 diesel-based technologies release carbon dioxide, nitrous oxide, carbon monoxide, volatile organic compounds and other greenhouse gas equivalent emissions into the atmosphere. The U.S. EIA estimated "diesel fuel consumption in the U.S. transportation sector [alone] resulted in the emission of about 432 million metric tons of carbon dioxide (CO_2) [in 2020], a greenhouse gas. This amount was equal to about 26% of total U.S. transportation sector CO_2 emissions and equal to about 9% of total U.S. energy-related CO_2 emissions in 2020."

With growing emissions concerns fueling the need for change across the energy industry, Catalyst Energy Services has introduced Vortex Prime™—the first-of-its-kind fleet in the hydraulic fracturing sector using natural-gas powered, direct-drive turbine technology. By using local natural gas from the Permian Basin, VortexPrime eliminates the dependency on natural resources to be transported across Texas to refineries and then brought back to the Permian Basin to support operations. This minimizes transportation wear-and-tear on highways as well as truck emissions, including carbon dioxide.

Compared to the fuel burn of Tier 2 and Tier 4 frac fleets, VortexPrime's natural gas technology reduces emissions equivalent to removing nearly 79,000 cars from roads annually. When measured against Tier 4 diesel technology, VortexPrime decreases CO_2 equivalent greenhouse gas emissions up to 40%. As energy operators eye eco-conscious solutions, VortexPrime delivers lower emissions without sacrificing production output.

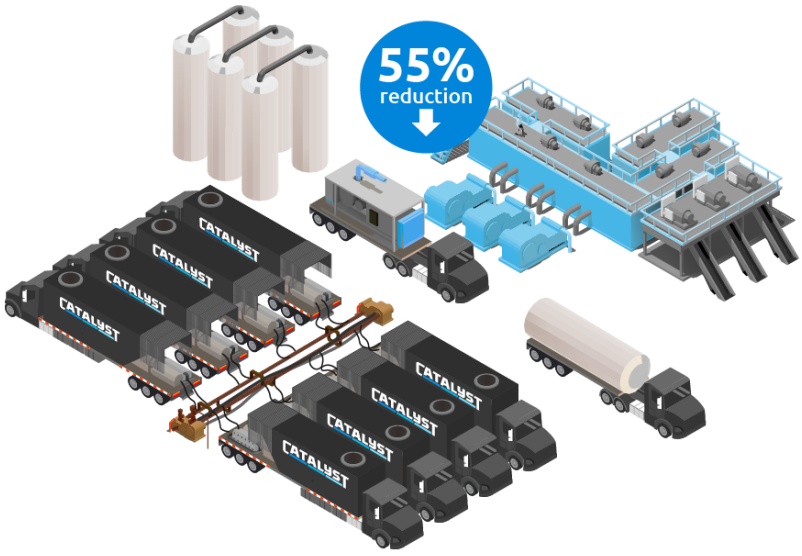
VortexPrime™ decreases CO_2 equivalent Greenhouse Gas emissions vs. Tier 4 diesel technology.

Operations & Savings

Employees, equipment and material resources are necessary yet malleable financial factors in operations. A typical Tier 4 hydraulic fracturing operation requires about 20 pumps for production. Averaging about 28 field employees to run shifts

around the clock supported by teammates in the yard office, the personnel costs and increased risk associated with the number of employees onsite impact OPEX and reduce profitability.

VortexPrime is a fully self-contained pump that reduces the hydraulic fracturing footprint of twenty Tier 4 pumps to eight, taking up to 55% less space onsite, which yields a 30% savings in employee overhead.* With less pieces to move, less staging, and less move days, VortexPrime delivers more production days.



VortexPrime™ reduces fleet footprint up to 55% vs. Tier 4 technology.

The "Trends in U.S. Oil and Natural Gas Upstream Costs" report states that the average drilling and completion costs per well range from $2.9 million to $5.6 million. Considering the volatility of the current fuel market, VortexPrime delivers significant savings up to approximately $1,785,600 by running eight pumps on natural gas ($13/MCF) vs 20 pumps on diesel ($4/gallon) for 400 hours per month.

According to Seth Moore, chief operations officer at Catalyst Energy Services, "We can burn six to seven tanker loads of diesel a day in normal [Tier 4] operations. If we use locally sourced field gas, we can reduce that to almost none by requiring less fuel trucks that move through cities and across the country. The rising cost of diesel paired with its emissions make natural gas an optimal replacement."

In addition to savings, VortexPrime minimizes downtime and fuel burn when idled to optimize efficiency and reduce emissions. It features automated software and a built-in kill switch that shuts-down and starts-up operations in under five minutes compared to other technologies, which can take up to four hours. VortexPrime also makes efficient operations possible in remote, tough-to-reach areas such as tight urban or mountainside sites due to its concentration of hydraulic horsepower and fully self-contained design with a small footprint.

Reduced Waste

Fracing operations have come a long way in nearly 80 years. However, today's environmental focus on lowering emissions goes hand-in-hand with waste reduction. A typical Tier 4 diesel engine uses lubricants, coolants, filters, and replacement parts that contribute to both waste and emissions. As the energy industry eyes a more sustainable future, the materials destined for recycling or the landfill must be reduced.

VortexPrime reduces 72.3% to 99.9% of waste materials. This is the equivalent of keeping 170,755 (16.9 oz) single-use water bottles from the landfill. By using fewer pumps than Tier 4 technology, VortexPrime has fewer expendables and increased service life.

Waste	Tier 4 Diesel	VortexPrime™	Reduction
Filter - Cubic Feet	30,186	18	**99.9%**
Filter - Pounds	188,024	614	**99.7%**
Gallons of Fluids	35,120	9,712	**72.3%**

VortexPrime™ reduction of waste vs. Tier 4 diesel technology

VortexPrime™: Changing the Face of Fracing

Strategically based in the Permian Basin, Catalyst Energy Services is a stimulation service company specializing in hydraulic fracturing treatment with the equipment, people and technology to get energy industry investments online as soon as possible. From pre-job design to post-job analysis and reporting, Catalyst Energy Services delivers safe, custom-made, and efficient service, every well, every time. They collaborate and innovate with client partners to improve production enhancement strategies that maximize returns.

Through their natural gas, direct-drive turbine technology, VortexPrime, Catalyst Energy Services exceeds accepted standards in the field by innovating

hydraulic fracturing technology to lower emissions, reduce waste and improve cost-effective fuel consumption.

As the energy sector continues to explore environmentally friendly solutions, the path to a sustainable future requires inventive thinking, design and engineering today. For details, visit https://catalystenergymarketing.com/WorldOilPaper.

VortexPrime™: The eco-conscious alternative to traditional frac technology

** A Tier 4 fleet requires 14 people per shift, 28 people per 24 hours. A turbine fleet requires a total of 22 people per 24 hours. 28 vs. 22 people results in a 20%+ savings.*