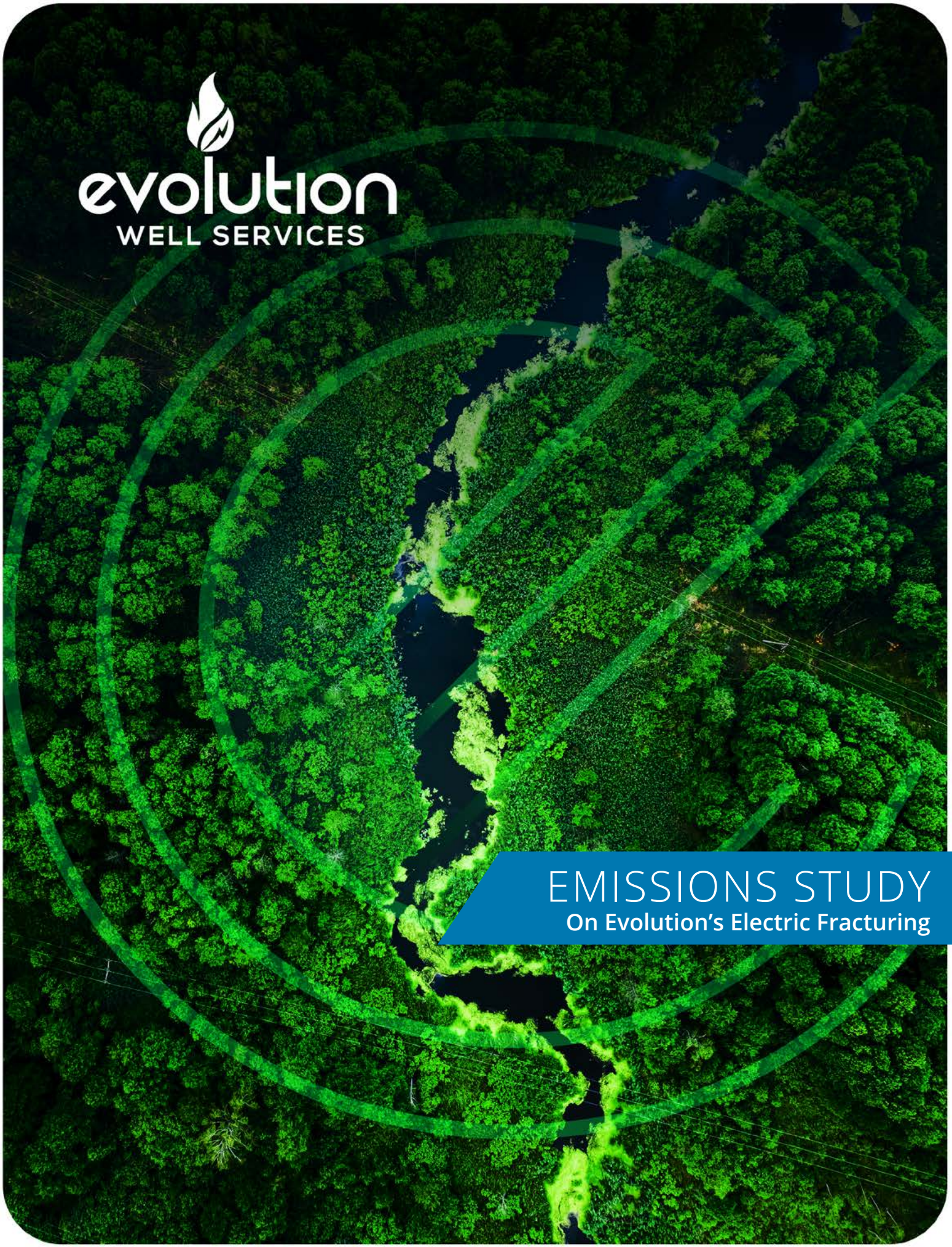


EMISSIONS STUDY

On Evolution's Electric Fracturing

Importance of Emissions Data Transparency

Evolution Well Services (Evolution) has grown sevenfold in the last four years becoming the leader in electric hydraulic fracturing. With this growth comes immense challenges & opportunities, but through all of this growth, one foundational trait has been constant – transparency. When deploying a new technology, this truly is the only path to success, and it has paid dividends with our great E&P partners to date. With the shale industry under pressure to improve its environmental standing, Evolution sees a great opportunity to expand its transparent, industry leadership yet again. In recent months, pressure pumping suppliers & service companies created substantial confusion by advocating their technology as the leader in low emissions hydraulic fracturing. But, how can multiple different technologies all be the leader in emissions? They can't. There should be zero confusion, and this confusion does not benefit an industry attempting to navigate both low commodity prices & environmental pressure. Due to this, Evolution decided to invest the resources to provide fully transparent emissions data on our electric frac equipment – actually measured in the field.

Our goal was to remove all possible subjectivity, and enable E&P companies to make data-driven decisions on how to best complete new wells.

Our Objective Approach

We began by going to the emissions experts. We partnered with Air Hygiene, Inc. who is accredited by the Accredited Air Emissions Testing Body & the Texas Commission on Environmental Quality to perform emissions testing in accordance with the ISO/IEC 17025:2017, ASTM D7036, EPA Method 1, EPA Method 3A, EPA Method 7E, EPA Method 10, EPA Method 19, and EPA Method 32 standards for emissions testing[1,2]. In accordance with the governing standards, a wide spectrum of emissions data was collected from the field to provide a transparent view of Evolution Well Services emissions across numerous operating conditions & designs.

Evolution removed the inherent bias that engine or turbine manufacturers have as vendors, and we relied on the objective experts.

To ensure further transparency, we factored in additional bias towards Tier IV diesel fleets by including high-end technologies like engine idle reduction systems that are not commonly deployed on fleets today. For the turbine emissions analysis, we did not consider any "best case scenarios", and instead, we used our actual operating data.

Digging Deeper into the Data

To fully understand the emissions profile of a hydraulic fracturing fleet it is important to consider all types of EPA regulated emissions and compare these to the standards. In our industry, we typically use EPA 40 CFR Part 1039 which is the EPA Tier based emissions standard for nonroad compression-ignition engines[3]. The first chart considers CO_2e, or "CO_2 Equivalent" which is a method to convert all greenhouse gas emissions to an equivalent CO_2 number by factoring in the individual "global warming potential" of each emitted compound or element. Here is an example of how this works: Carbon Dioxide (CO_2) has a global warming potential of 1, Methane (CH_4) has a global warming potential of 28, and N_2O has a global warming potential of 298 – meaning methane is 28 times and N_2O is 298 times more detrimental to global warming than CO_2[4, 8].

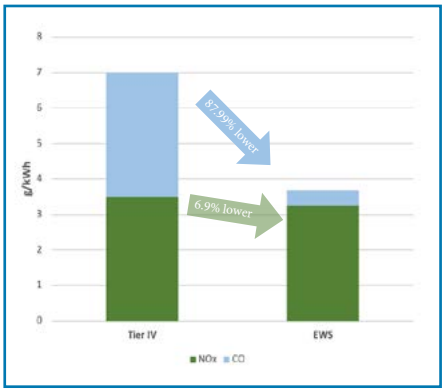
EXAMPLE CALCULATION:

$$CO_2e = (1* CO_2 \text{ emissions}) + (28*CH_4 \text{ emissions}) + (298*N_2O \text{ emissions}) + \ldots etc$$

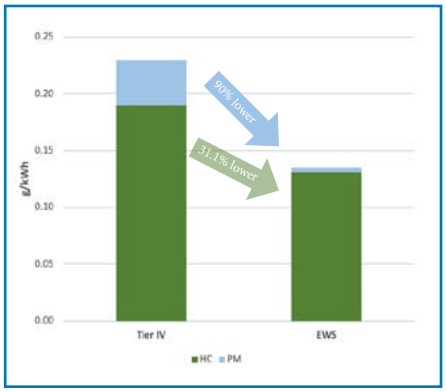
The CO_2e measurement is commonly used to easily compare emissions profiles of different companies or equipment, and it is becoming increasingly popular. While CO_2e is effective in normalizing emissions for comparisons, it is not all-inclusive of every form of EPA emissions. The other two charts show the carbon monoxide (CO), nitrogen oxides (NO_x), particulate matter (PM), & hydrocarbons (HC). Even though these types of emissions are not directly greenhouse gas emissions, each has a negative impact on the environment when emitted. For this reason, we also included the data showing these emissions in relation to a Tier IV fleet.

GHG Emissions - CO_2e

EPA Emissions - NO_x and CO



EPA Emissions - HC and PM[7]



Represents emissions normalized over a complete day of hydraulic fracturing operations with a job design of 100bpm & 10,000psi. Conservatively assumes the diesel fleets have engine idle reduction systems (no idle), but the Evolution electric fleet idles in between stages.

Summary of Results

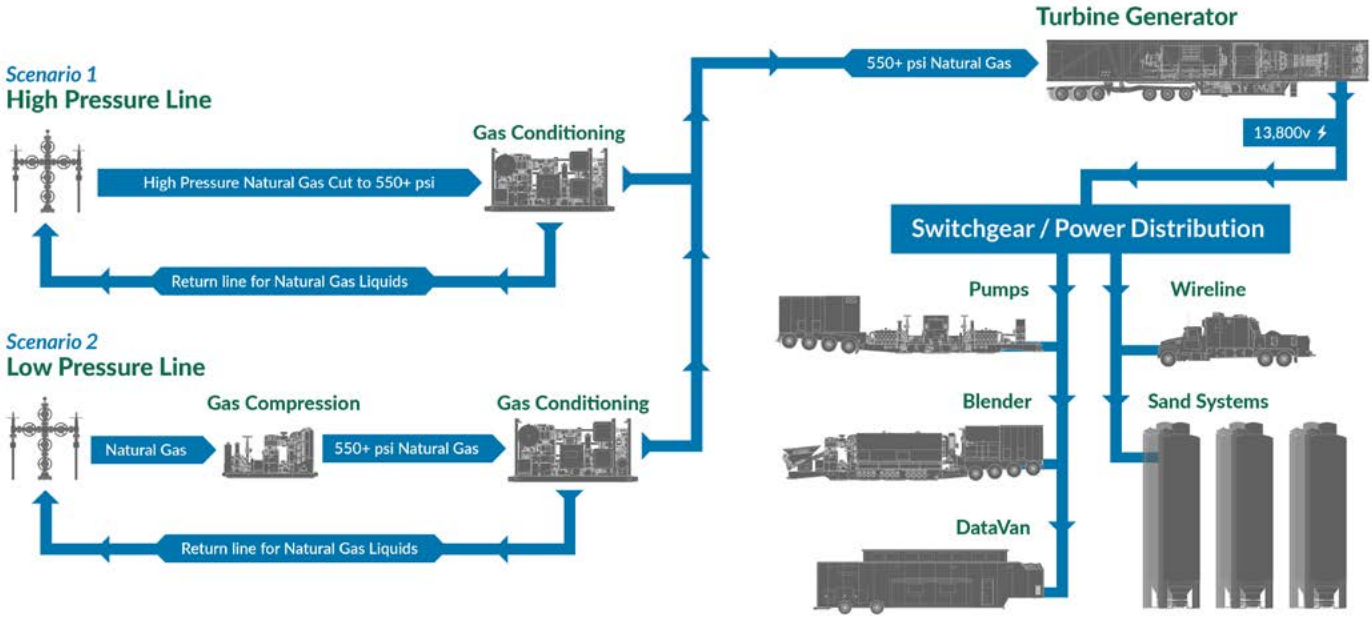
The EPA method study shows the Evolution electric frac fleet has an 18.1% lower greenhouse gas emissions profile than the EPA's Tier IV standard. When looking at today's hydraulic fracturing market, the majority of fleets are actually Tier II which makes the emissions reduction impact even greater. We applaud the industry for shifting to Tier IV fleets from Tier II fleets, and we especially look forward to the industry continuing to push towards technology like the Evolution electric frac fleet which further reduces emissions and helps our industry produce energy more responsibly. In an industry aiming to change its environmental standing, eliminating upwards of 5,000,000 gallons of diesel consumption per fleet per year and reducing emissions by 18.1% is certainly a great step forward.

Evolution Well Services Electric Frac Fleet

% Reduction vs Tier IV			
Emission Type	Baseline	Add Refining & Trucking	Add Diesel Idling
CO_2e	18.1%	26.2%	30.9%
NO_X	6.9%	n/a	n/a
CO	87.9%	n/a	n/a
HC	31.1%	n/a	n/a
PM[7]	90.0%	n/a	n/a

Impact of Holistic Analysis

When an E&P or any company analyzes their supply chain for environmental improvements, it is important to take a holistic & lean operational view of the entire environmental footprint. A primary goal of lean operations is to remove all waste from a process. Within the hydraulic fracturing industry, we have been doing this for years by removing equipment, people, & complexity out of the completions process. When using an Evolution electric fleet, there is a great opportunity to further remove waste from the supply chain – using field gas.



If the goal of a lean operation is to eliminate waste, think about the wasted energy & processes of using diesel to fuel a frac fleet. Using Midland as an example, crude is extracted in Midland, sent to the gulf coast, refined, sent back to Midland, and finally sent to a wellpad to power a frac fleet. Imagine eliminating all of this waste by using wellhead or infield gas? These are the types of analyses that Evolution is performing to help E&P companies legitimately reduce their overall carbon footprint and create a lean supply chain. **While it might seem minor, the EPA estimated emissions from this diesel process adds an extra 11.1% CO_2e into the hydraulic fracturing process**[5,6]. If you include the potential of eliminating natural gas flaring, the emissions reduction is increased even further.

Next, it is important to look at the entire pad to eliminate additional waste. With the 36MW turbine package on pad, why wouldn't you eliminate every ounce of diesel on pad? This is exactly what Evolution is now doing in partnership with its customers – electrifying proppant systems, wireline, pumpdown, water transfer, lights, and essentially the entire pad. While not quantified in this brief report, Evolution has the data & expertise to help your completions team fully understand the impact of a nearly silent, low emitting, and fully electric well pad.

What's Next?

Evolution has plans to introduce a new tool to help our industry – an emissions calculator. To further remove the subjectivity of job designs, pumping hours per day, etc., this calculator will enable E&P companies to input operational data from their specific completions program to calculate the emissions impact – all based on legitimate, measured data. Coupled with our Evolution Fuel Savings Calculator, we aim to enable E&Ps to make data-driven, unbiased decisions on how to best operate acreage.

Have Questions?

Evolution is an open book. If you are considering next-generation hydraulic fracturing technology or reducing emissions in your completions program, please contact us, and we will help you better understand where your emissions stand today, and how this compares to an Evolution electric frac fleet. Our industry needs transparent innovation, and we hope this environmental leadership is a step in the right direction.

References

1. *Air Hygiene - Accreditation. (n.d.). Retrieved from https://www.airhygiene.com/accreditation*
2. *Graham, T. K., Tsotsoros, L., & Page, T. (2020). Stack Emissions Study for...Evolution Well Services, LLC (pp. 1-119, Rep.). Broken Arrow, OK: Air Hygiene International.*
3. *Nonroad Compression-Ignition Engines: Exhaust Emission Standards (Rep. No. EPA-420-B-16-022). (2016). United States Environmental Protection Agency - Office of Transportation and Air Quality.*
4. *Metrics for Expressing Greenhouse Gas Emissions: Carbon Equivalents and Carbon Dioxide Equivalents (Rep. No. EPA420-F-05-002). (2005). United States Environmental Protection Agency - Office of Transportation and Air Quality.*
5. *Serpa, D. (2008). CO2 Emissions from Refining Diesel (Rep. No. REV 1.0 08-28-2008). After Oil EV.*
6. *Average Carbon Dioxide Emissions Resulting from Gasoline and Diesel Fuel (Rep. No. EPA420-F-05-001). (2005). United States Environmental Protection Agency - Office of Transportation and Air Quality.*
7. *Emissions Factors - Chapter 3: Stationary Internal Combustion Sources (Publication No. EPA AP 42, Fifth Edition, Volume I). (n.d.). United States Environmental Protection Agency.*
8. *Understanding Global Warming Potentials. (2017, February 14). Retrieved from https://www.epa.gov/ghgemissions/understanding-global-warming-potentials*