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Turbine Powered Electric Hydraulic Fracturing

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Hydraulic Fracturing Challenges

- Safety
  - # of Personnel
  - Exposure
  - Noise
  - Hot Fueling
- Economics
  - Capital
  - R&M
  - Fuel
- Environment
  - EPA Tier IV
  - Footprint
  - Lighting
- Efficiency
  - MORU
  - Pumping
  - Technology

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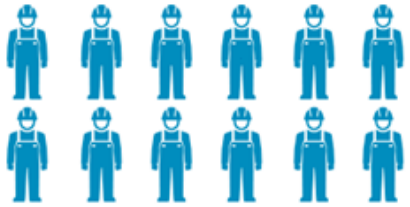
Safety – Personnel

Turbine Powered Electric Fleet



60% less

Turbine powered electric fracturing operations reduce required personnel utilizing electric equipment and enhanced automation

VS

Conventional Fleet

The average conventional fraturing operation is crewed by 20+ personnel.

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Safety – Exposure

- All Equipment is Controlled from Inside a Tri-Level Data Van
  - **Less personnel exposure around high pressure iron and silica dust**
  - **Camera footage on all moving parts**
  - **Birds eye view for operators on top level**

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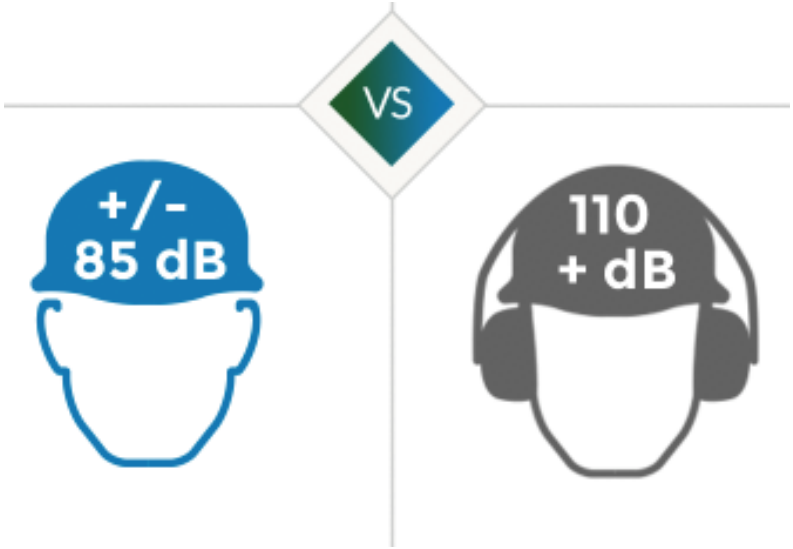
Safety – Noise



- Noise Reduction
  - **Eliminates the need for hearing protection**
  - **Significantly eases disruption to neighboring areas**

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Safety – Hot Fueling

Turbine Powered Electric Fleet

VS

Conventional Fleet

- No Hot Fueling Required
  - **Cause of multiple location fires during fracturing operations**

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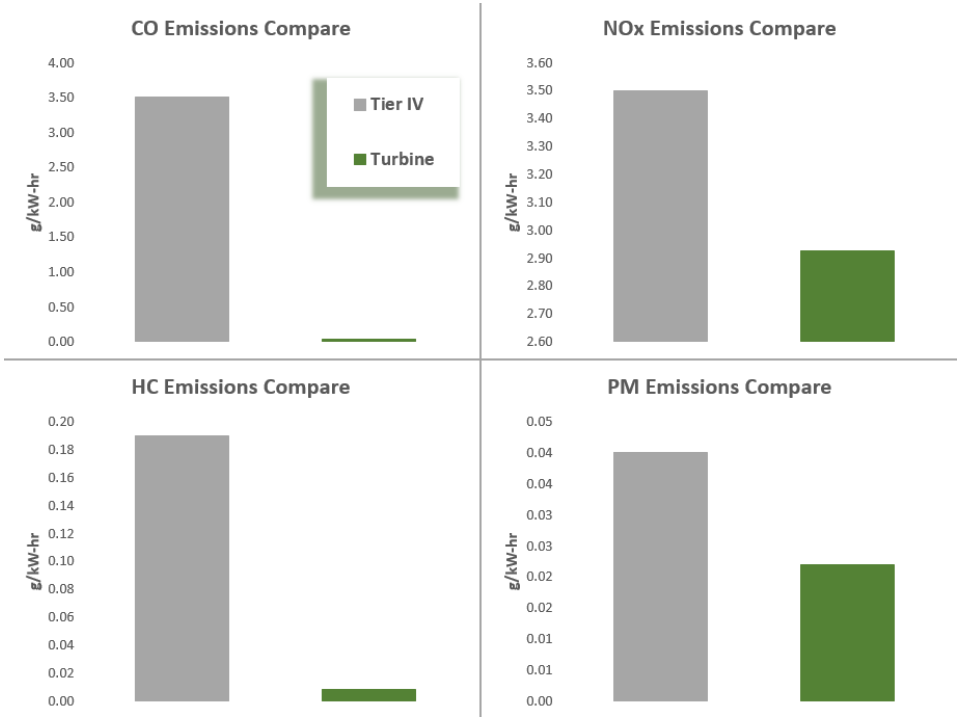
Environment – EPA Tier IV



- The Turbine Emissions Exceed EPA Tier IV Standards
  - **Visual evidence on silos from electric crew vs. diesel crew**

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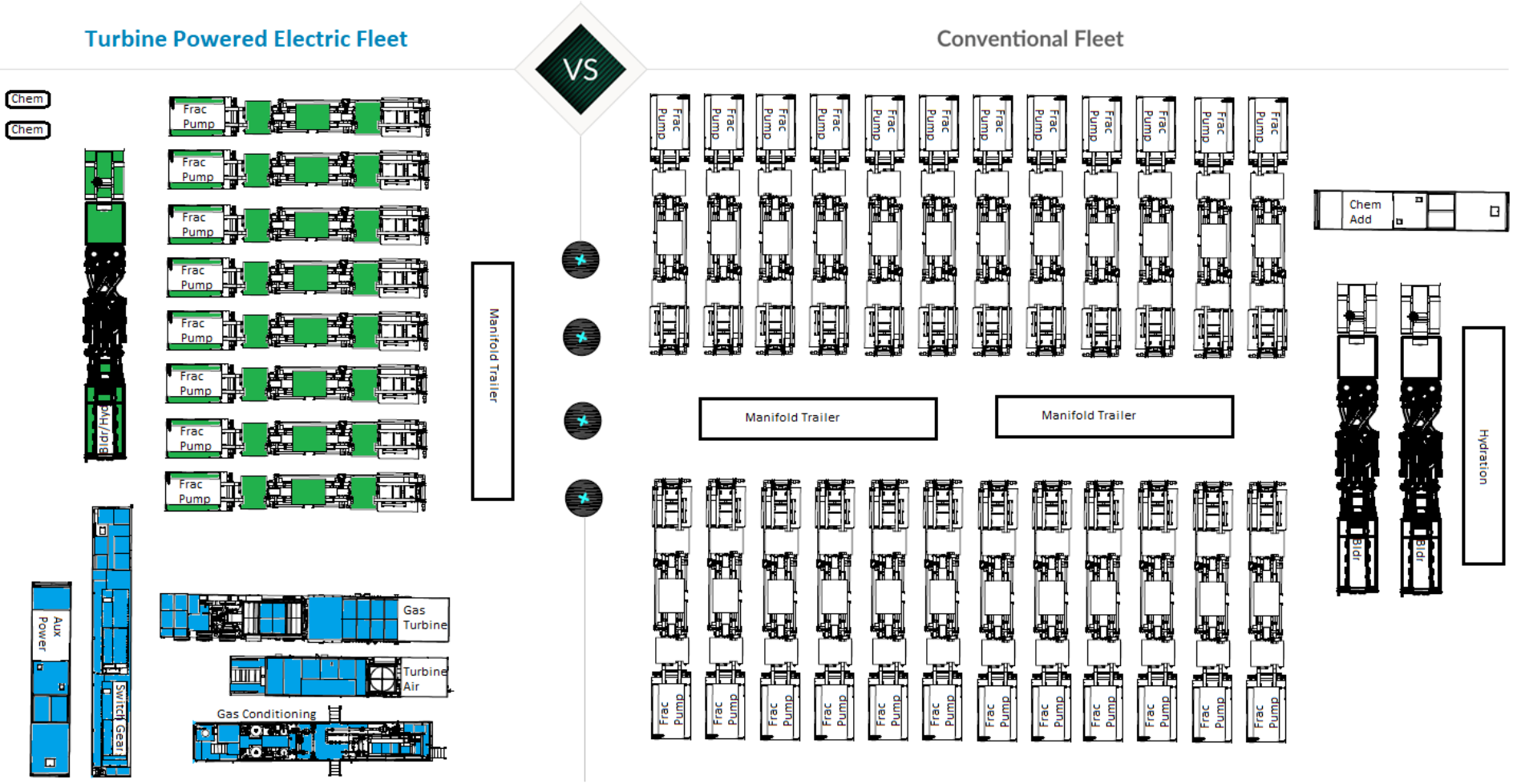
Environment – Footprint



- 56,000 HHP vs 48,000 HHP

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Environment – Lighting

- Direct Focused LED Lighting
  - **Does not flood light into the surrounding areas**
  - **Allows safe, quiet operations, 24-hrs a day**

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Economics – Capital

- Less Capital Required than Building a Conventional Fleet
  - **Dollar per HHP basis**
  - **All in cost including power generation equipment**
  - **Applies to larger fleets for shale operations**
- Breaks the Myth of Electric Fleets Being Expensive
  - **Competitively priced in any shale-type market**

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Economics – R&M

- Less R&M Required than a Conventional Fleet
  - **No diesel engines, transmissions, radiators, or tractors (3rd party moving)**
  - **Very little added R&M due to electrical and turbine equipment**
    - 25,000 operating hours for the turbine's first hot section PM
- 100,000+ Data Points Tracked Continuously
  - **Ability to predict and learn fosters predictive maintenance**

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Economics – Fuel

Injection Rate (BPM)	90
Treating Pressure (PSI)	9500
Per Stage Pump Time (HRS)	2
Time Between Stages (HRS)	2.38
Frac Stages Per Well	37
Wells Per Pad	4
Pads Per Year	12
Diesel Cost (GAL)	2.75
Field Gas Cost (MCF)	1.85
BTU/SCF of Field Gas	1200

	Turbine Powered Electric Fleet	VS	Conventional Fleet
Consumption **Per Stage**	350 NAT GAS (MCF)		2,935 DIESEL (GAL)
Cost **Per Stage**	$648 (USD)		$8,071 (USD)
Consumption **Per Well**	12,959 NAT GAS (MCF)		108,592 DIESEL (GAL)
Cost **Per Well**	$23,975 (USD)		$298,627 (USD)
Consumption **Per Pad**	51,838 NAT GAS (MCF)		434,367 DIESEL (GAL)
Cost **Per Pad**	$95,900 (USD)		$1,194,508 (USD)
Consumption **Per Year**	622,052 NAT GAS (MCF)		5,212,399 DIESEL (GAL)
Cost **Per Year**	$1,150,796 (USD)		$14,334,098 (USD)

- Burn Rate Under Load of 150-200 mcf/hr
  - **Idle burn rate of ~40 mcf/hr**

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Efficiency – MORU

- High Power Density – 56,000 HHP in 8 Pump Trailers
  - **Far less pumps trailers and iron on the ground**
- Medium Voltage Platform
  - **Higher voltage means less power cables, ~15 main cables**
- Build for Purpose Turbine Package
  - **No crane lifts or need to decouple the turbine from the generator**
  - **Two trailers operational and transportable**

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Efficiency – Pumping

- High Power Density – 56,000 HHP in 8 Pump Trailers
  - **Excess reserve HHP allows for long term, high efficiency pumping**
  - **7,000 HHP per pump trailer, compared to 2,200 HHP**
- Blending Equipment
  - **2 blenders and 1 hydration unit combined into 1 trailer**
  - **100% redundant blending with ambidextrous suction and discharge**
- Very Low Rate Applications
  - **Electric motors and VFDs allow for optimum control**
  - **Pumping capabilities of less than 1 bpm**
    - Conventional pumps have transmission limitations

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Efficiency – Technology

- Advanced Automation Ensures Steady Job Execution
  - **Compensates for changes in any piece of equipment**
  - **Pump-by-pressure capability**
- IOT-Enabled Equipment
  - **Unique ID of all end devices, centralized database**
- Remote Monitoring
  - **Remote visibility of process parameters and all end devices**
  - **All instrumentation is cloud-connected**
  - **CCTV, fiber-optic communications**

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Conclusions

- Turbine powered, electric hydraulic fracturing is fundamentally different and inherently eliminates most of the challenges currently faced in hydraulic fracturing
  - **Safety, environment, economics, & efficiencies are all greatly improved when utilizing electric hydraulic fracturing**
- Efficient turbine power is both economical and an effective way to power electric frac fleets
  - **A single 36 MW turbine can generate enough electricity to power 30,000 HHP in nearly any conditions**
- Turbine powered, electric hydraulic fracturing opens the door for a new generation of technological advances within the hydraulic fracturing market

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Thank You For Your Time

Questions?

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