

Quantifying Intermittent Bleed Device Emissions

By Activation Count



Company Overview

Largest natural gas producer in the United States



- **EQT Corporation is a leading independent natural gas production company**

- Operations focused in the cores of the Marcellus and Utica Shales in the Appalachian Basin
- Dedicated to responsibly developing our world-class asset base
- By leveraging a culture that prioritizes operational efficiency, technology and sustainability, we seek to continuously improve the way we produce environmentally responsible, reliable and low-cost energy.
- We have a longstanding commitment to the safety of our employees, contractors, and communities, and to the reduction of our overall environmental footprint.
 - Our 2019 ESG Report, *Future Focused*, was published on October 21, 2020 and provides a detailed framework on how we think about our business, and how all the pieces – from how we manage human capital to how we empower our employees with technological capital – are aligned to execute a cohesive operational, corporate and ESG strategy that drives sustainable value creation

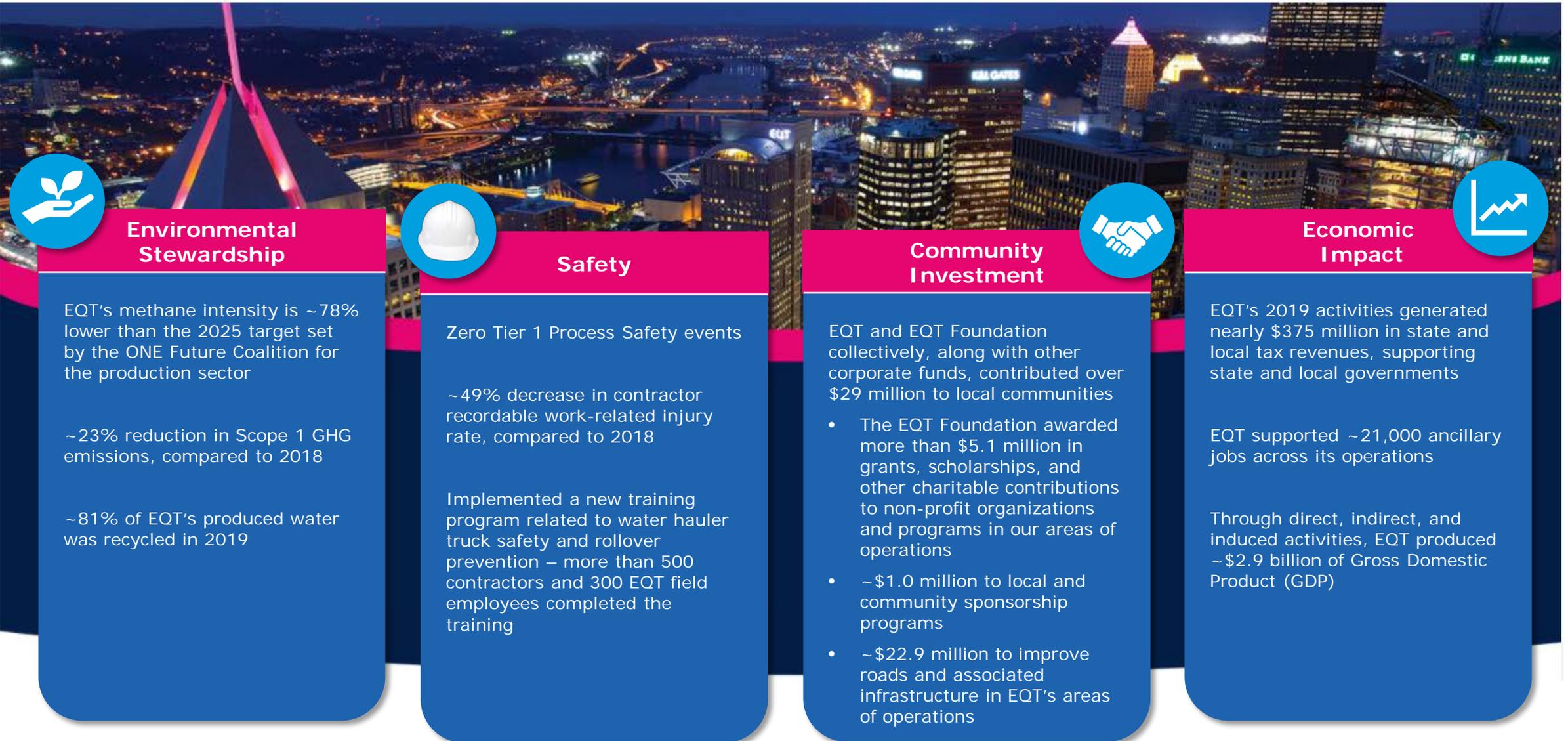
- **Mission, Vision and Values**

- Mission: Realize the full potential of EQT to become the operator of choice for all stakeholders
- Vision: Evolve EQT into a modern, connected, digitally-enable organization that has vision and purpose
- Our values are evident in the way we operate, how we interact each day and are at the center of all we do.
 - Trust, Teamwork, Heart and Evolution



Future Focused Highlights

For calendar year 2019



Purpose

Motivation for Shift to Alternate Methods of Calculation



- **EQT's commitment to responsible gas production requires evolution in our use of new technologies as well as review of our past practices.**
- **Accuracy and better understanding of emissions inventories based on improvements in methodology can drive better results for actual emissions reduction and further refinement of best practices.**
- **EQT is proposing a change to EPA approved calculation methodology of green house gas inventories based on well production and equipment configuration based on application.**

Outline of Current Methodology

Based on EPA Guidance



- **Generic guidance that covers all “intermittent bleed” devices**
 - 13.5 SCFH per component
- **EQT estimates total GHG emissions based on this factor multiplied by 8,760 hours per year for continuous operation**
- **Intermittent bleed devices only emit gas when activated**
 - In the case of a liquid level controller (LLC), when a signal is required to move the position of the valve open or closed
- **Current methodology doesn’t account for the action-based nature of intermittent devices in favor of a simplified time-based factor**
 - Results in potential over-estimation



Pneumatic Level Controller



Actuated Dump Valve

Proposed Method for Quantifying

Shift to Action-Based Emissions



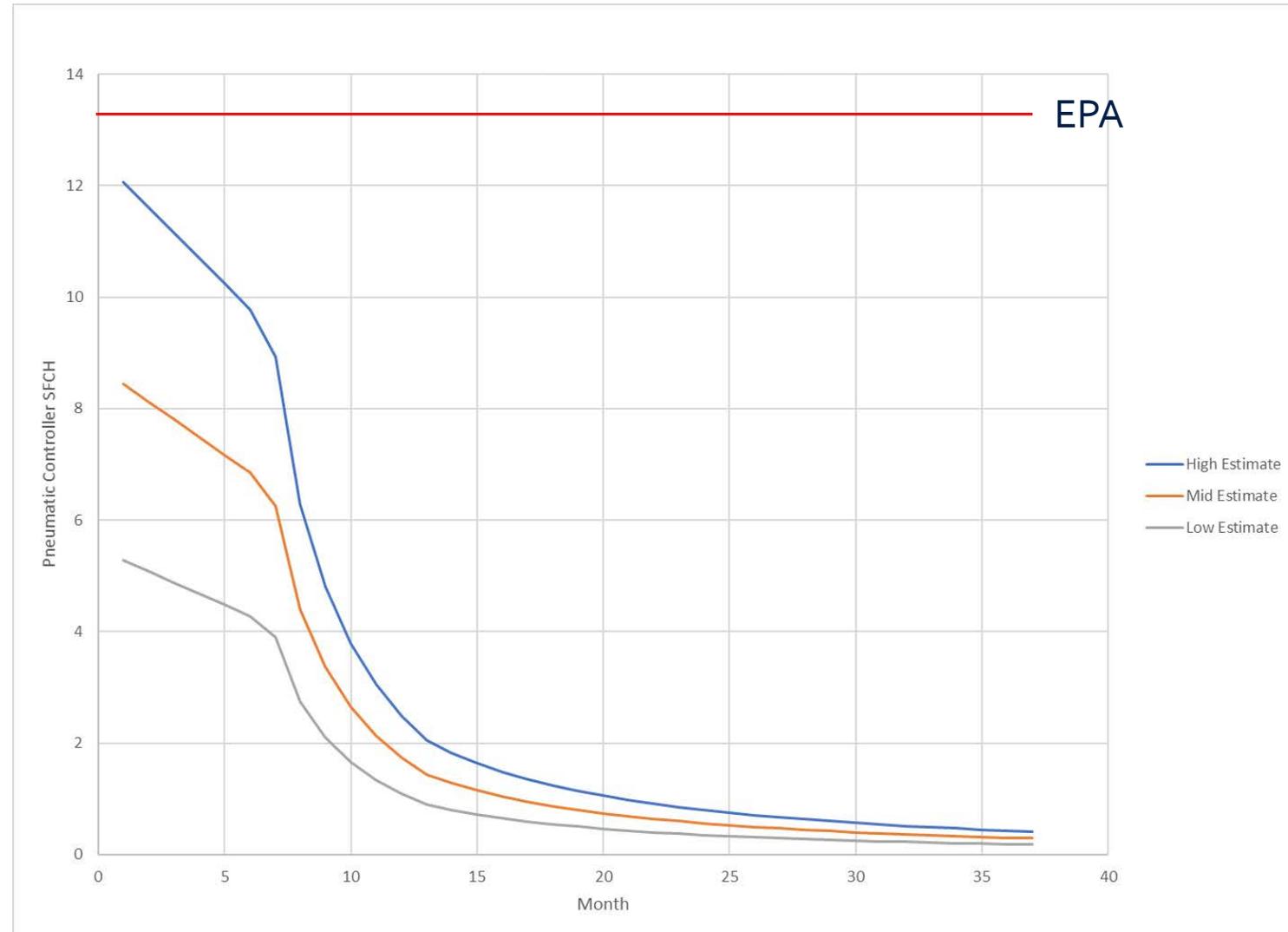
- **Gas vents only during valve actuation – estimate gas vented per cycle and tie to production data to refine GHG emissions estimates:**
 - Calculate volume of water dumped during each cycle
 - Measure the dump span on a sample set of GPUs to determine level change when valve opens
 - Calculate associated volume of liquid based on level change using separator geometry
 - Calculate gas emitted during each cycle
 - Estimate gas vented from equipment during dump cycle by calculating gas held in actuator and tubing at set pressure
 - Calculate total gas emitted
 - Divide water production by dump volume to determine number of dump cycles per day and multiply by gas volume vented per cycle
- **Total GHG emissions can be estimated based on actual well production**
- **Future GHG emissions can be projected on well type curves**
- **Note - Malfunctioning controllers could be emitting at higher levels. EQT's in house LDAR program works to identify malfunctioning controllers to remediate**
 - Malfunctions can be logged for inclusion in bifurcated quantification method
 - Utilize various existing studies for emissions factors

Results of Proposed Methodology

Case – EQT Standard Vertical Separator



- **Following previously outlined methodology and applying results to generic 12,000' dry gas type curve for water production**
- **Results show actual GHG estimates significantly below current guidance**
- **Factors can be created and applied to actual production data from per well water measurement**
- **Emissions decline hyperbolically with well production**
- **Assumes leak-free system and regular LDAR inspection**

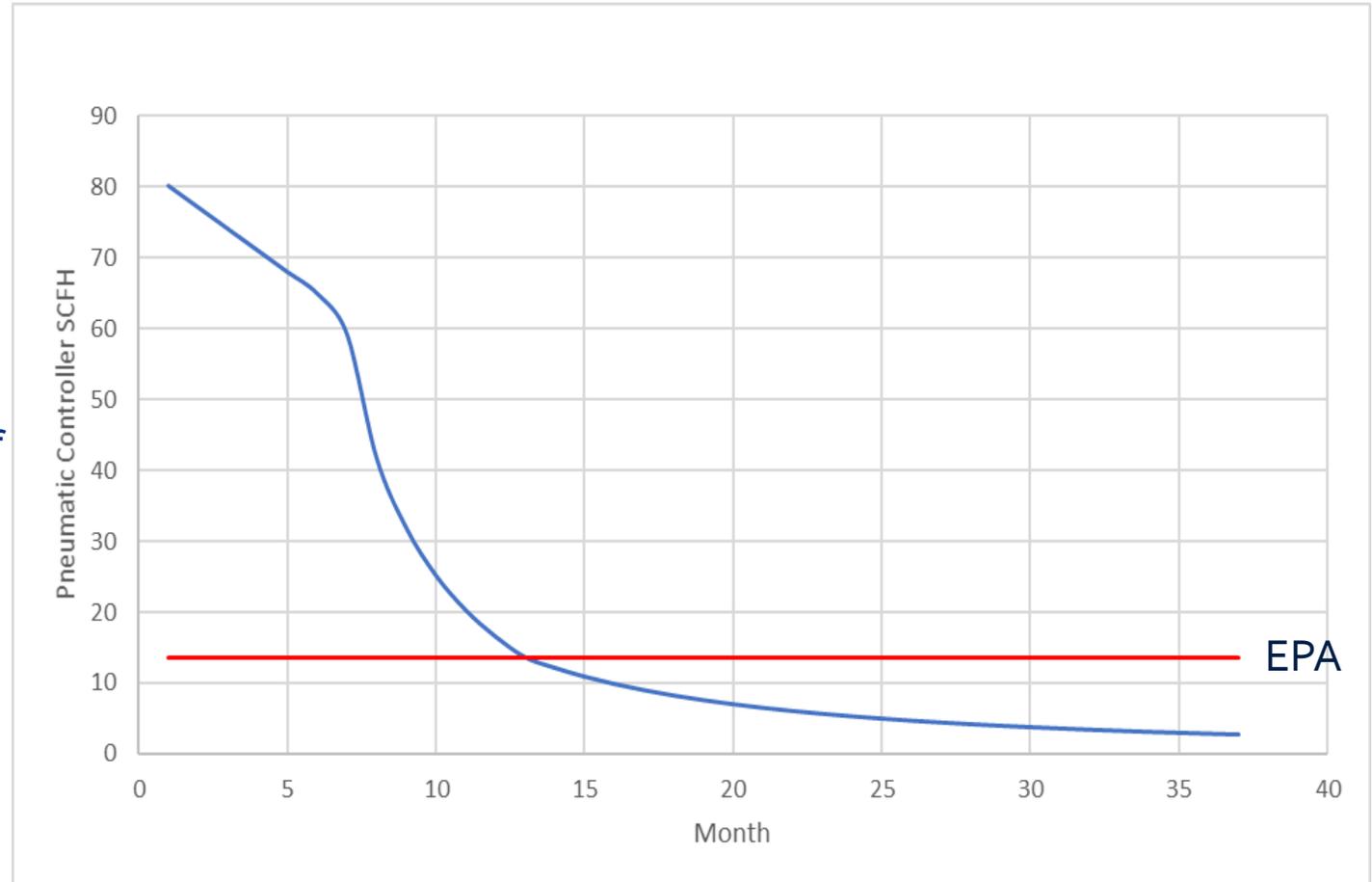


Results of Proposed Methodology

Case – EQT Standard Horizontal Separator



- **Same Methodology as Vertical**
- **Dump span is smaller on horizontal level controllers**
- **Results show higher GHG emissions during first year**
- **Later life emissions are drastically below current methodology level**
- **Methodology incentivizes removal of intermittent bleed devices during initial production to reduce GHG emissions**





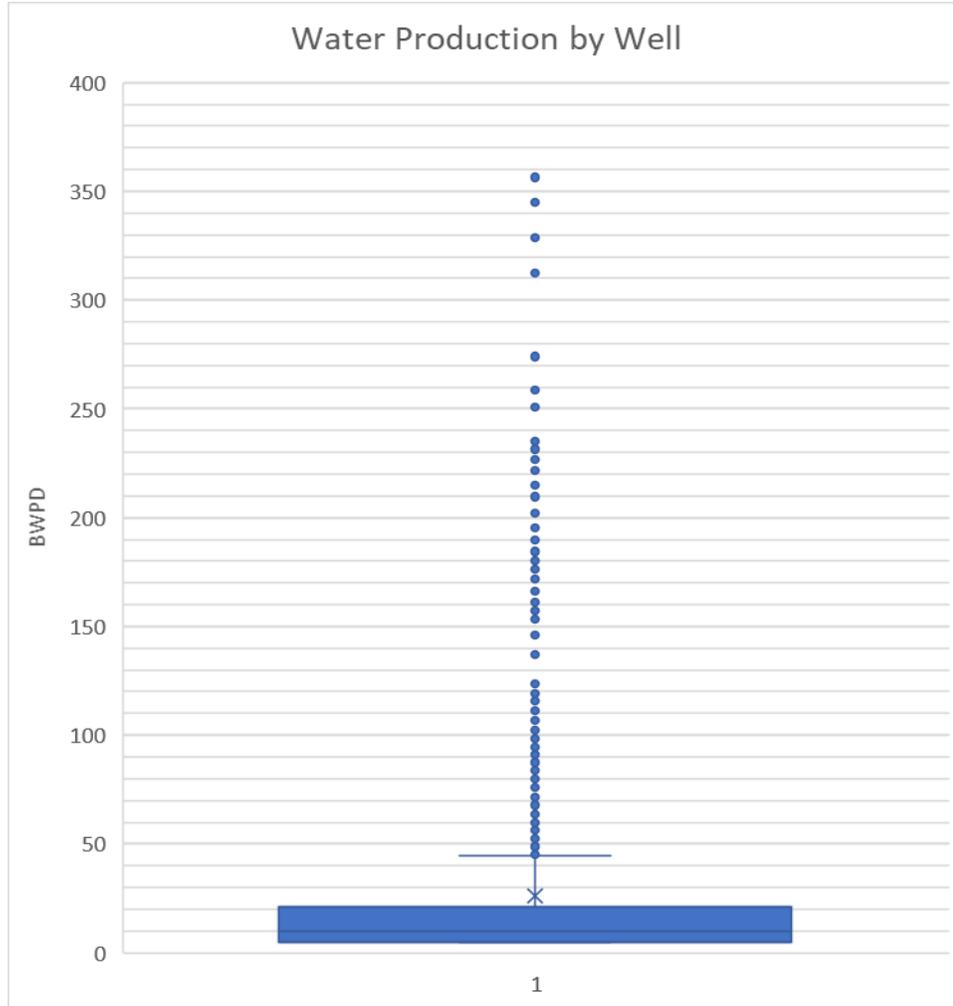
- **Initial Evaluation:**

- Average EQT well in PA currently produces ~20-25 bbl/d
 - 1545 Wells and approx. 32,000 bbl/d total production
- Assume LLCs operating under parameters evaluated in Horizontal GPU analysis
- Yields average emissions rate of 6.9 SCFH, 49% lower than current 13.5 SCFH guidance

- **Possible to further refine with additional field measurement and LLC adjustment**

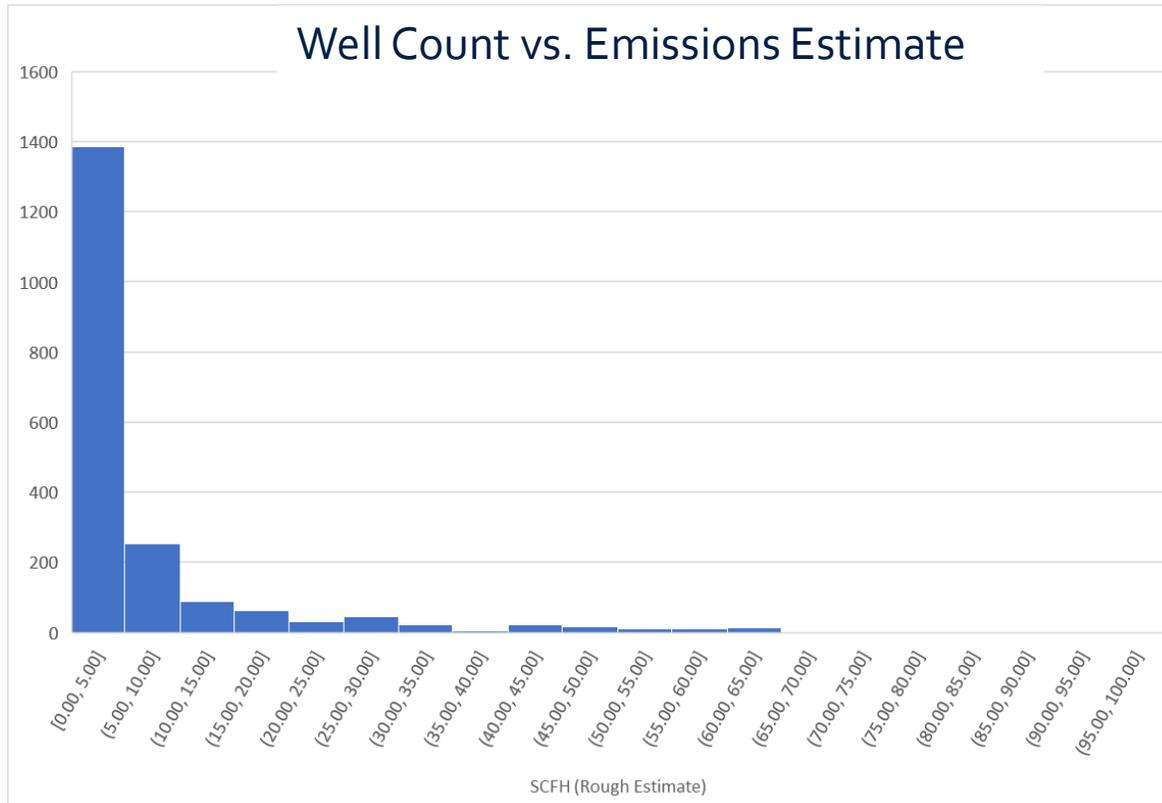
- Expand sample set of dump span measurements
- Evaluate additional GPU designs for additional factors

- **If methodology is acceptable, can build out per well emissions calculations based on specific equipment used and water production data**



- **Chart of Water Production by Well**
- **1,974 wells have water production forecasts**
- **Average 29 bbl/d**
- **Median 10 bbl/d**

Well Emissions Estimate Based on Water Production



- Assume minimum water production of 5 bbl/d
- Estimated 86% of wells fall below EPA 13.5 SCFH guidance



- **Changing to action-based methodology can lower GHG emissions reported to more accurate levels based on specific pneumatic application**
 - Other applications, such as devices to monitor for upset conditions, rarely actuate which would show even higher percentage reduction in emissions
 - Better quantification of actual GHG emission will drive better decision making by operators promoting further reduction
- **Accurate quantification can help serve as a bridge while industry pursues use of other technologies to replace venting devices**
- **Understanding periods of increased GHG emissions, such as early well life, will incentivize:**
 - Higher focus on improved operation of intermittent devices to drive actual emission reduction
 - Replacement of intermittent devices with other technologies to eliminate emissions
- **Guidance is requested from EPA on next steps to approve recommended methodology**