Automated Landfill Gas Collection Increases Landfill Gas Flow and Quality at Oklahoma City Landfill

White Paper

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Abstract

Aria Energy (“Aria”) is the market leader and one of the largest companies in the North American Landfill Gas sector. Aria has developed or constructed more than 50 projects over the last 25 years and has successfully integrated four acquisitions since 2008.

Loci Controls (“Loci”) is the leader in automated landfill gas collection. Loci’s products and services provide remote wellfield control through cloud-based software applications that maximize landfill gas collection. Loci products have been installed at over 20 sites, including landfill gas-to-electricity projects and landfill-gas-to-high-BTU operations.

This paper highlights a case study where Loci provided automated landfill gas collection to Aria at the Oklahoma City Landfill. From project inception in October 2017, through January 2018, Loci Controls’ automated gas collection has resulted in an average increase in methane flow of 55% relative to the prior year. Over this same period, the percent methane content of the gas rose by 2.4% to 56.6%, and plant uptime increased by 3.7% to 99.5%. Decreased variability in gas quality, rapid troubleshooting of emerging issues, and improved visibility into site operations all contributed to significant improvements in operations and increased revenue for the operator that more than offset the cost of the system. For a representative landfill gas to high BTU project, where the project operator generates $20/mmBTU in RIN revenues and an additional $3/mmBTU in natural gas revenues, and where the operator’s share of the project revenue is 70%, automation with a 55% gain in gas production would increase net revenues by over $250,000 per month with a return on the incremental cost of the Loci service of more than 800%.

Background

Landfill gas automation

Loci Controls is the first company to provide automated landfill gas collection and was founded in 2013 by MIT engineers. Loci uses patent-pending technology and control algorithms to monitor and control the landfill gas collection process. Through continuous monitoring and control of landfill gas collection systems, Loci maximizes methane collection, gas quality, and profits. The landfill wellfield is an integrated and interconnected system. Loci's ability to continuously monitor all collection wells and simultaneously tune each collector maximizes the collection of methane from the whole wellfield. While each landfill has a unique operating environment, our system has been proven to increase gas collection by 20% or more on installed wells — all while decreasing fugitive emissions and operating costs.

Loci's product and services consist of wellhead and header line mounted hardware connected via cellular networks to our WellWatcher® online portal and analytics platform. Loci's internal analytics team provides remote oversight of the landfill gas collection process and our in-field service technicians provide on-call support, together optimizing the overall gas collection process. Loci provides automation through the use of "Controller" devices which are wellhead mounted products with an onboard sensor package that remotely monitors pressure, temperature, oxygen, carbon dioxide, methane, system vacuum, and flow — all while calculating balance gas. The product includes an automated vacuum control valve that regulates the extraction pressure at each individual well based upon the Loci gas collection algorithm, which maximizes methane flow within operator established gas composition set points. Loci also uses Sentry devices which are mounted on individual header lines to provide aggregate gas composition from sectional areas of the landfill.

Oklahoma City Landfill

Oklahoma City Landfill began accepting waste in May 1981, is an open site, and has over 10 million tons of waste in place. The landfill is owned by Waste Connections. Aria Energy owns the gas rights and 2015 Aria commissioned a landfill gas to high BTU pipeline injection project. This project generates Renewable Identification Numbers (RINs), as part of the Renewable Fuel Standards Program, from the methane injected into the pipeline.

The OK City landfill has 129 collection wells, with an average LFG collection of 2,200 SCFM. The landfill has been manually tuned historically, with typical gas composition of the landfill gas of 55% methane, 42% CO_2, and less than 3% combined O_2% and % balance gas.

To meet pipeline injection requirements, a minimum of 950 BTU is required.

The LFG to high BTU operation uses a membrane process to remove CO_2, O_2 and H_2O, supplied by Air Liquide, but this process does not include nitrogen rejection. As a result, to meet pipeline injection standards, it is necessary to tune the gas collection wellfield to maintain balance gas below 3%.

Historically, maintaining the gas quality required for this project has been especially challenging during the winter months, when dramatic swings in barometric pressure and rapid changes in weather patterns can have significant impacts on landfill gas generation and quality. Before use of Loci's automated gas collection, it was not uncommon to have to flare gas resulting in lost revenue and plant shutdowns, during periods when the pipeline's BTU requirements could not be met.

Project

In late 2017, Loci and Aria collaborated to deploy automated landfill gas collection at the Oklahoma City Landfill. Loci deployed 50 Controller units on wells which were selected because they historically produced 80% or more of the total gas flow from the landfill. One Loci monitoring only product, a Sentry-H, was installed at the header before the gas processing plant.

Photo 1: Loci Controller which provides real-time gas composition monitoring and algorithm based well tuning, installed on a gas collector at Oklahoma City Landfill.

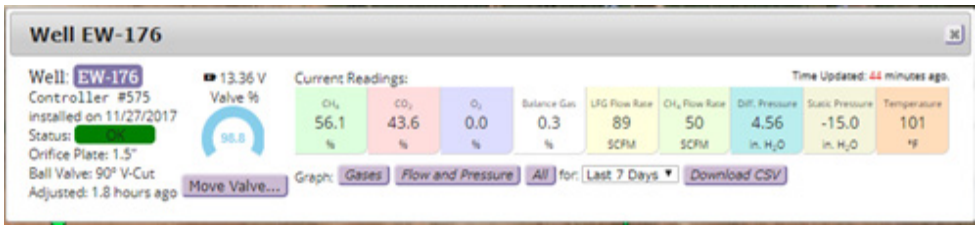


Photo 2: WellWatcher® user interface, with representative gas composition, flow, valve position; as well as 7 days of historical data on gas collector EW-176, at the Oklahoma City landfill.

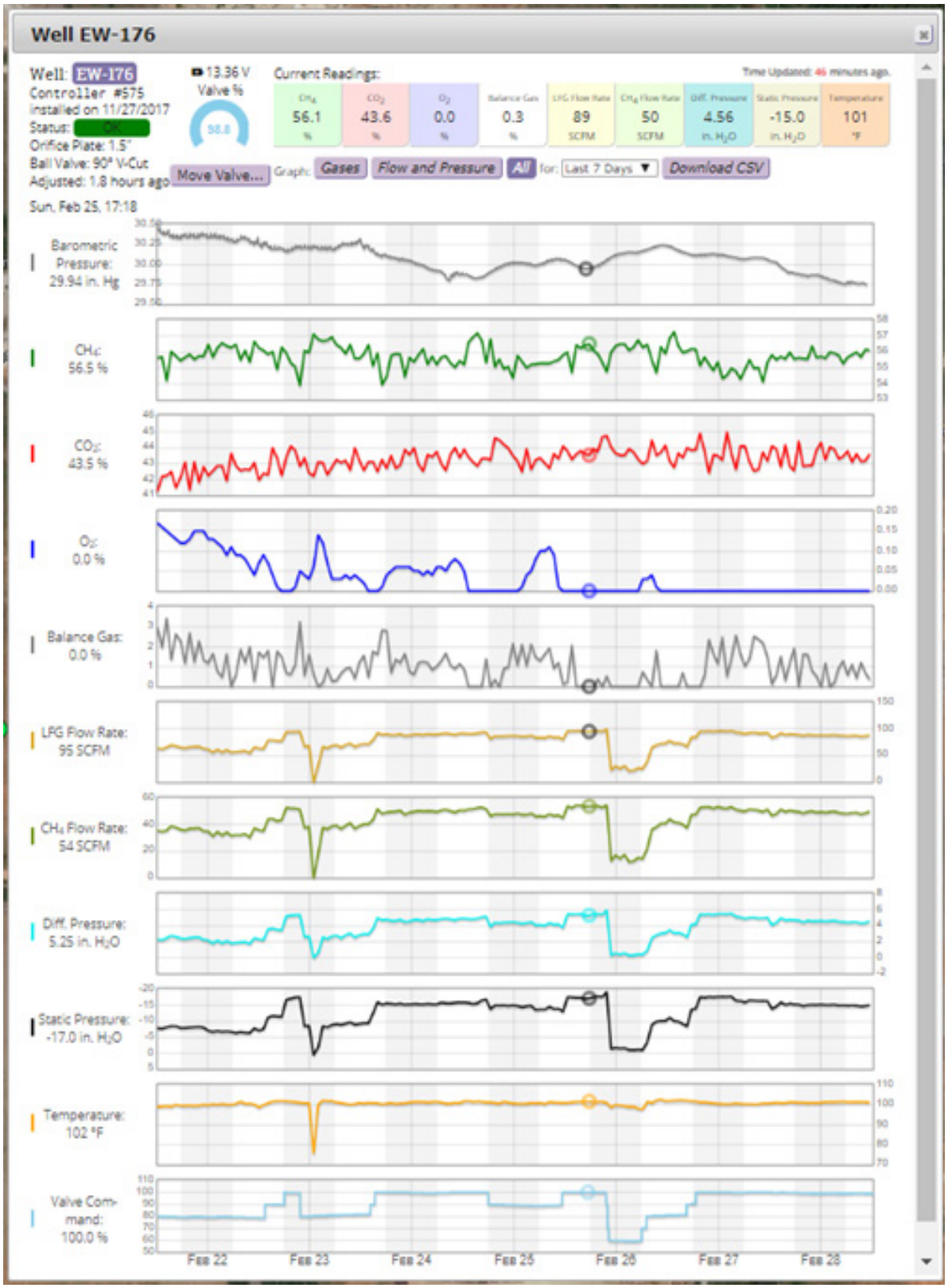
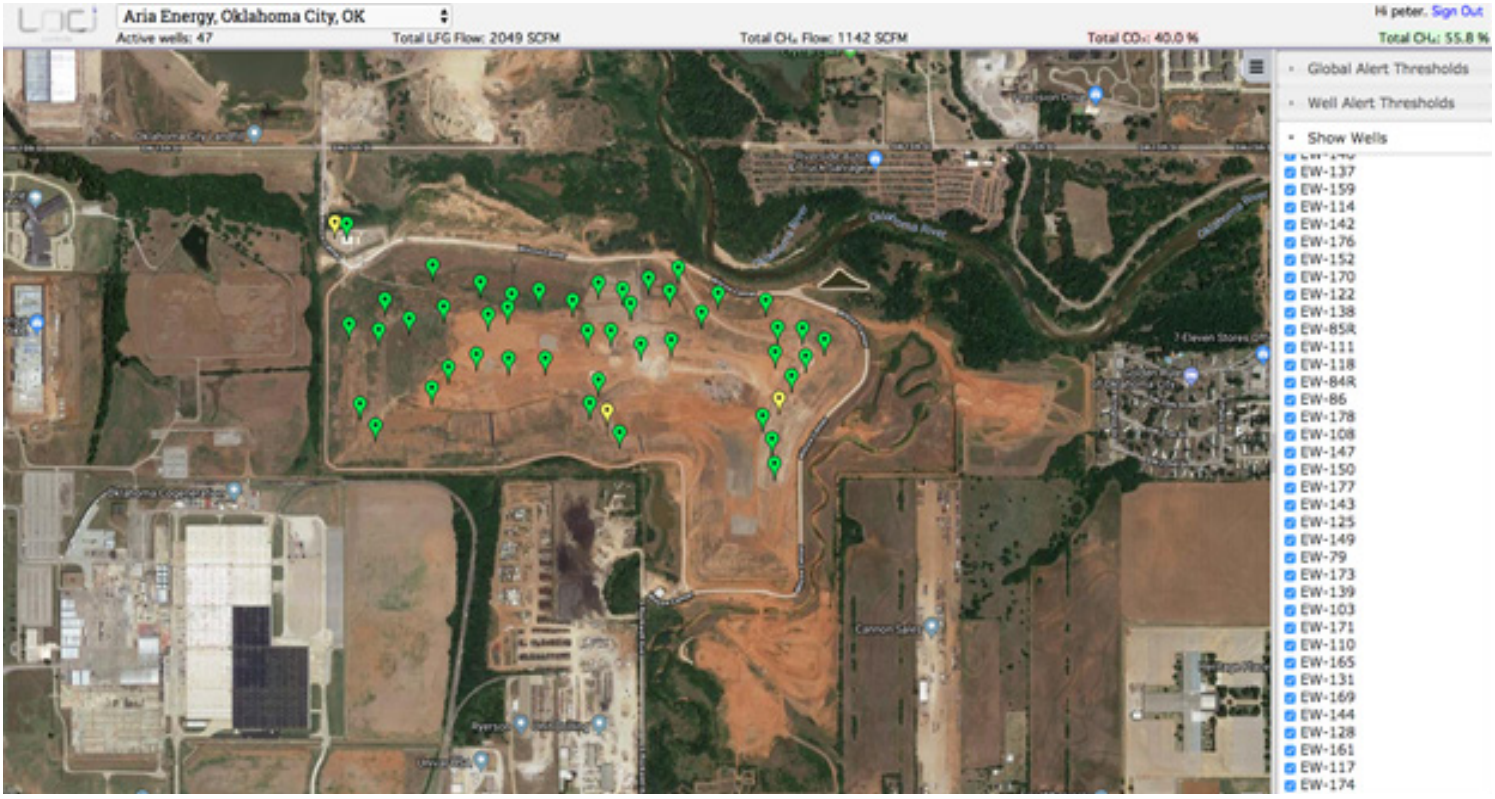


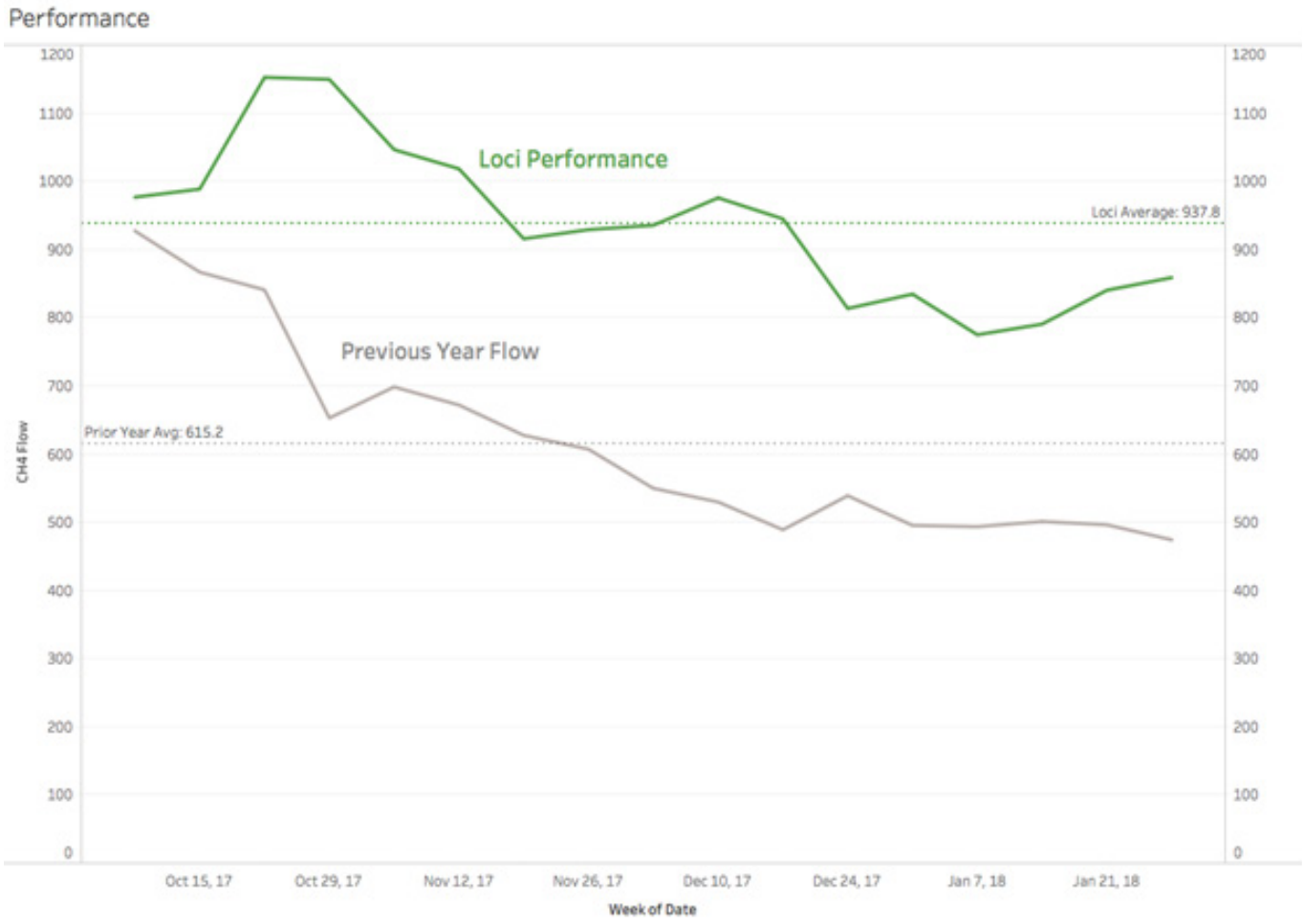
Photo 3: WellWatcher® user interface, with field level gas collection data. Green icons indicate collection wells that are operating within Aria Energy gas composition requirements, yellow icons indicate wells that are trending towards limits of gas composition.



Results

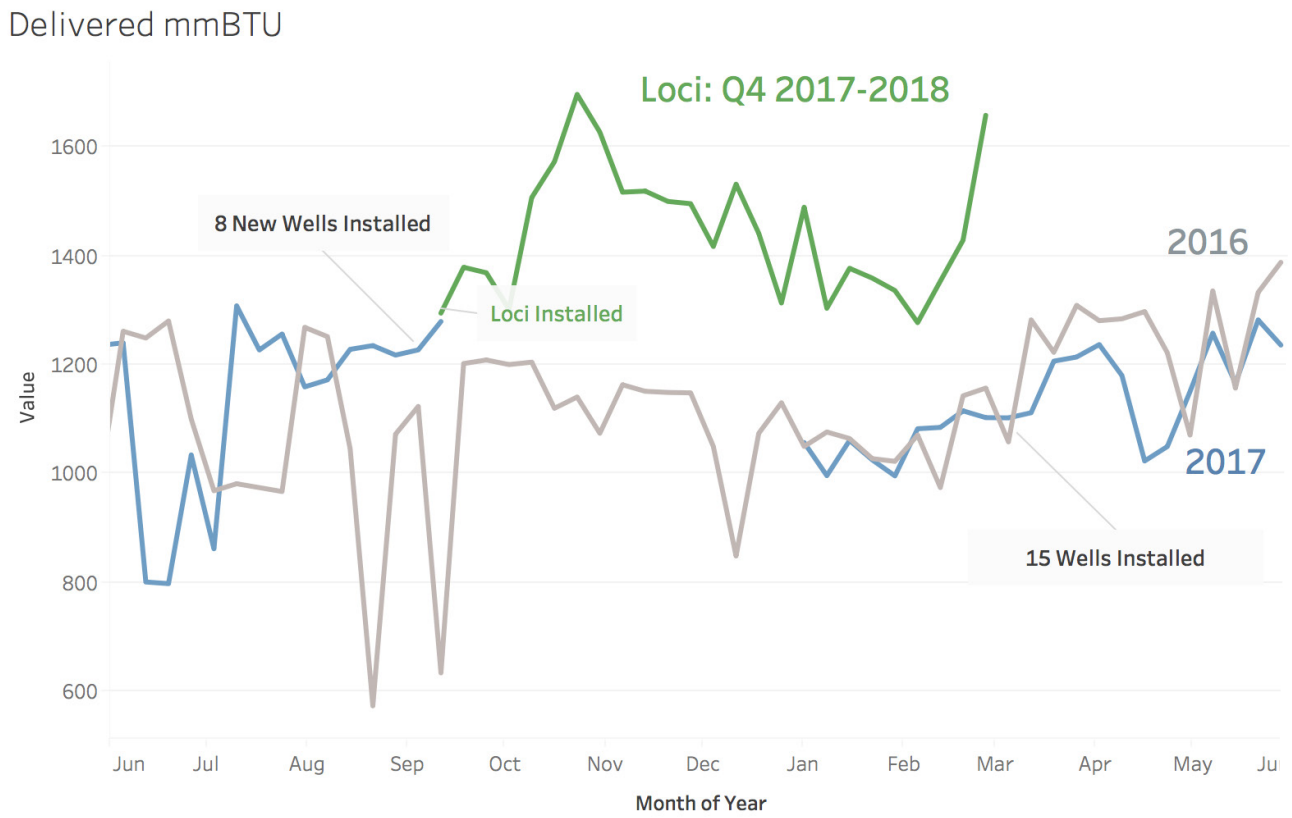
Automated gas collection at the OK City landfill began in mid-October 2017 and continues to be in place. Results here are shown through the end of January 2018. Relative to October 2016 – January 2017, when manual well tuning was practiced, automation increased methane flow by 55%, as shown in Figure 1. Landfill gas collection at this site historically experiences significant seasonal decline during the winter months, but with automation, the site experienced a step increase in production.

Figure 1: Weekly average flows since optimization by Loci started, showing a 55% improvement.



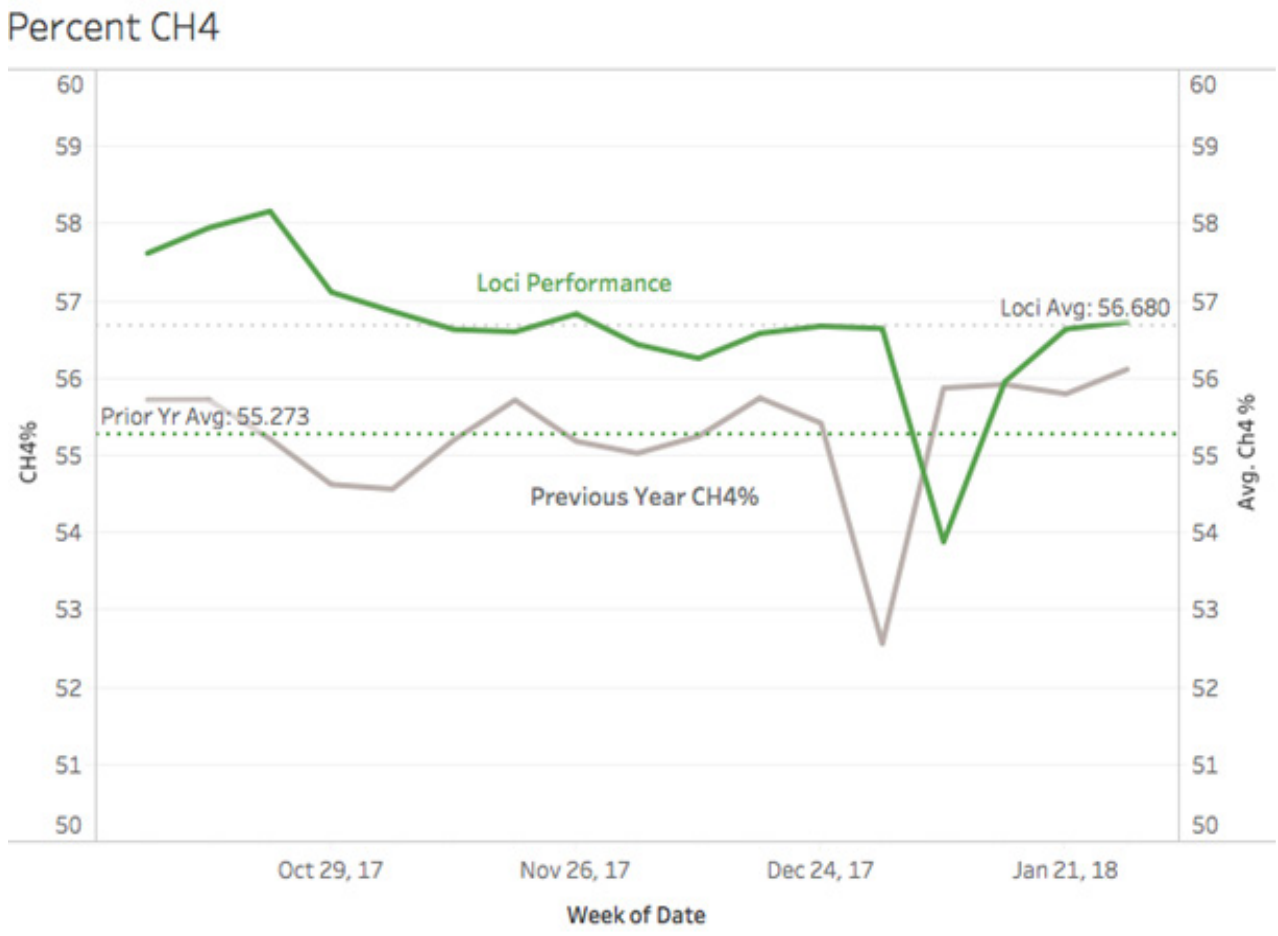
The incremental increase provided by the Loci units provides a mmBTU boost at the plant, and translates to revenue for the operator. The data from the plant is shown below. The 8 wells drilled just prior to the Loci installation provided a temporary gas flow increase that was sustained with automated landfill gas collection. As shown in Figure 2, the Loci system performance is substantially higher than historical flows, during the lowest performance season.

Figure 2: Plant data from the last 2 years shown on a monthly basis.



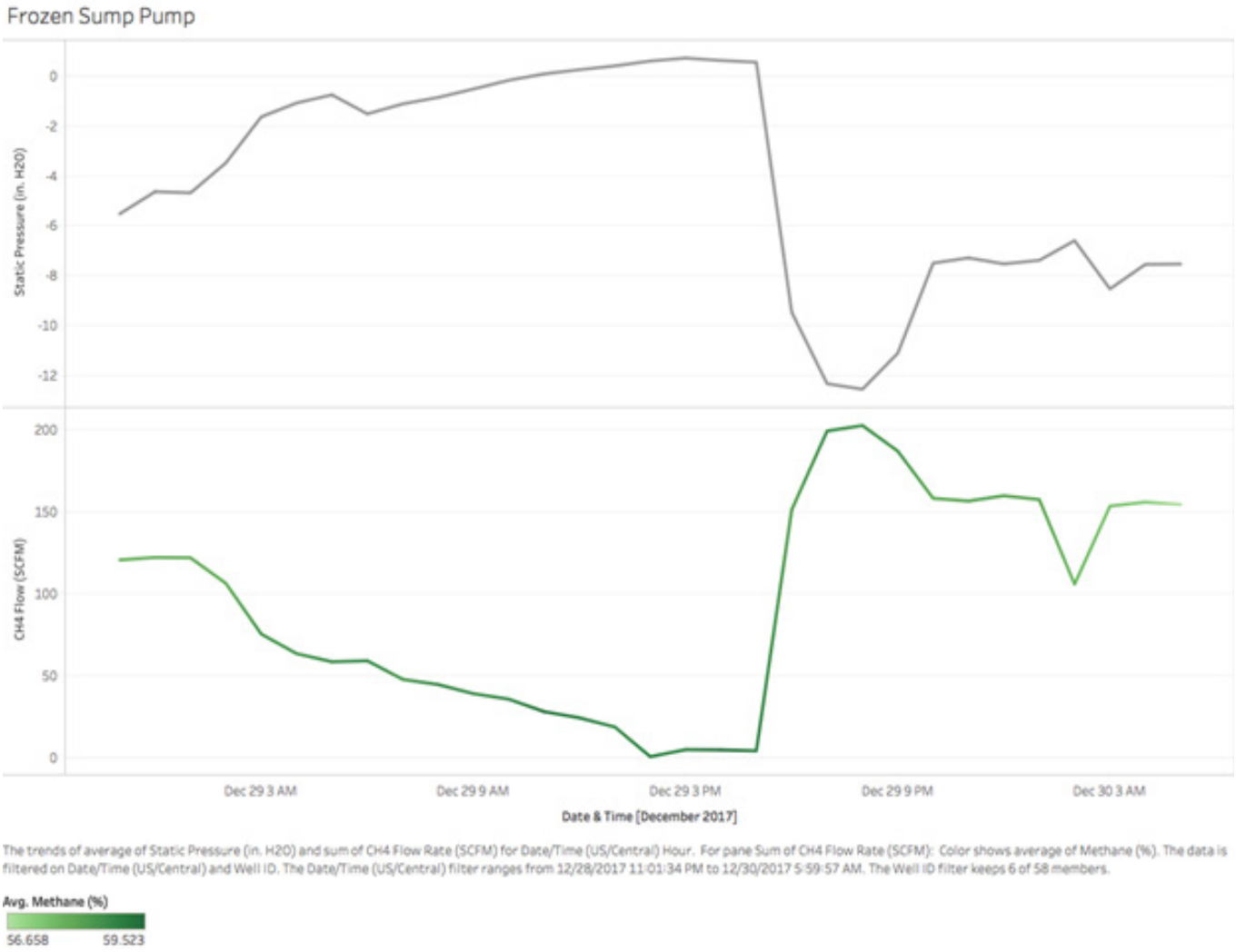
Over this same period, gas quality also improved by 1.3% to 56.6%, as shown in Figure 3. The anomalies in gas quality relate to weather events with extremely low temperatures, concurrent with rapidly rising barometric pressure. Improved methane quality translates directly to reduced balance gas, and because pipeline companies have strict thresholds for pipeline injection, this improved quality has important implications for operator revenue.

Figure 3: Weekly average percent methane composition figures since optimization by Loci started, showing a 1.3% improvement.



In addition to the continuous performance improvement in flow and quality, there were several operational benefits realized from continuous data availability. For example, on December 29, 2017 and January 16, 2018, Loci identified and alerted site personnel to a reduction and near total loss of system pressure on the east side of the landfill due to a frozen sump pump, reducing flow by 200+ SCFM. In Figure 4 below, the data from several affected wellheads is shown for this event in December 2017. On this day, the problem was identified on a Friday and the resolution of the issue that day prevented lost flow throughout the weekend.

Figure 4: Loss of static pressure due to a frozen sump pump and resulting loss of flow. Rapid resolution of the issue minimized losses.



In addition to rapid resolution of issues, the site has also gained new insights into the optimal management of the wellfield during barometric pressure events. For example, the site now reduces overall applied vacuum during increasing barometric pressure events because Loci has documented significant improvements to quality and uptime using this approach. During rapidly changing barometric pressure events, automation has also been able to adjust vacuum in real-time to maintain BTU specifications for pipeline requirements while adjacent landfills experiencing similar issues without automation were forced to divert gas to flare.

Economic Benefits

Prior to automation, the Oklahoma City landfill was generating 1,160 SCFM per month from the 50 wells where Loci Controllers were installed, such that an average well was generating ~23 SCFM of flow. For an operator generating 70% of the project revenue, with $23 mmBTU (RIN + natural gas price), assuming 55% methane content, each collection well would generate $8,700 per month of revenue for the project operator, or $104,000 per year per collection well.

With the use of Loci's automated gas collection service, these same 50 collection wells increased flow by 55%, translating to an average flow on those wells of over 35 SCFM. The incremental revenue to the operator from this additional landfill gas collection is $4,540 per collection well per month, or $54,500 per collection well per year. This compares to an annual per well Loci Controls automated gas collection service cost of $6,000.

The following provides an overview of the overall financial benefits to the landfill gas project operator, taking into account the Loci automated gas collection service costs, along with the value to the project operator of increased gas collection, reduced plant downtime, and reduced labor costs. Economics presented here are representative and are not specific to Aria Energy's economics at the Oklahoma City landfill.

For an operator making $23/mmBTU (RIN + natural gas price), who captures 70% of the revenue generation, the 55% increase in gas flow from this project would translate to $219,000 per month in increased revenue, or $220,000 in net profit inclusive of labor and maintenance savings, less the Loci automated gas collection service monthly expense. For the full methodology for this economic model, please see Appendix A. For assumptions for this analysis, see Table 1.

Figure 5: Net profit per month for example operator with Oklahoma City performance characteristics.

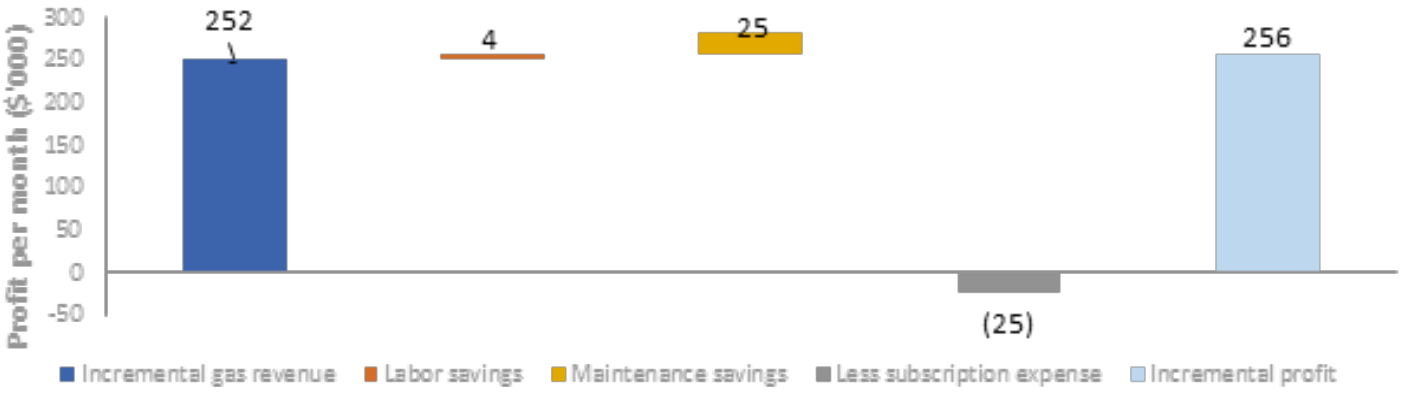


Table 1: Summary of assumptions

Value driver	Assumptions
Capacity of landfill (SCFM)	1,166
Number of wells	50
Increase / controller	55%
Landfill revenue share	70%
Total gas revenue with RIN and natural gas price ($/mmBTU)	$23
Flaring reduction	27%
Labor force efficiency factor	33%

Conclusion

The use of automation to improve landfill gas flow, quality, and operational efficiency has provided significant value for the Oklahoma City Landfill. With improved visibility into the overall landfill gas collection process through real time data and automated control, the variability of the system is reduced, resulting in improved quality and fewer shutdown events which add to the topline value proposition of increased flow. We show results through winter months in some of the most extreme and variable conditions, which highlights the value of automation in complex environments. In this case, automation provided significant value above the recurring incremental service costs and demonstrates exceptional benefits and results. Even if substantially reduced performance or economic factors are assumed based on the specifics of the landfill gas to energy project, the value proposition for automated gas collection can be compelling.

About the Authors

Peter Britton, Aria Energy, Corporate Gas Processing Manager

Peter Britton is the corporate gas processing manager for Aria Energy responsible for the management, oversight, and direction of Aria's gas processing facilities. Mr. Britton has been involved in the landfill renewable natural gas industry since 2009 and instrumental in the expansion of Aria's RNG portfolio from one to eight plants during the past six years. Mr. Britton came to Aria with more than 30 years of petrochemical operations experience. He has used this experience to improve existing operating performance and implement new technologies used in the processing of landfill gas into RNG.

Bill Bingham, Loci Controls, Vice President of Business Development

While finishing his undergraduate studies in biochemistry at Stanford University, William Bingham founded the country's first medical waste company that became the recognized leader in the industry. After selling the business to Browning Ferris Industries, Mr. Bingham was given divisional responsibility to help build BFI Medical Waste Systems to national acclaim. Subsequently, he held several senior leadership roles in BFI, and after leaving the organization, became the CEO of multiple companies, including Red Sky Interactive, where he was nominated as a finalist for the coveted Ernst & Young Entrepreneur of the Year. Prior to joining Loci Controls, Inc., Mr. Bingham was employed by Waste Management, Inc., where he held responsibility for all of Waste Management healthcare solutions operations in the eastern United States. Today, as the Vice President of Business Development for Loci Controls, Mr. Bingham has responsibility for all sales and business development activity for the company.

Appendix A

Methodology - Economic Benefit Model

We estimated the impact that our technology has on the profitability of high-BTU landfill gas operators by quantifying the economic value of our product and service offering. We include increased revenue, labor savings, and decreased downtime, and then compare these benefits to the cost of subscription. Revenue from incremental gas collection captures the primary benefit of our product, where the automated landfill gas collection drives 20% or more increases in landfill gas flow. Decreased costs from labor savings captures savings from reduced tuning by landfill gas technicians, freeing up labor for higher value-add tasks. Revenue from decreased downtime captures of early identification of problems at the plant which can reduce plant shutdowns.

Incremental profit
= Revenue from incremental gas collected + Labor savings
+ Revenue from decreased downtime - Subscription expenses

where:

Revenue from incremental gas collected
*= Average gas production (pre-Loci) * increase post Loci*
** methane composition * (Price of natural gas + RIN credit)*

$$\textit{Labor savings} = \frac{\textit{Number of wells in field}}{\textit{Wells tuned per technician per year}} * \textit{Annual cost per technician} * \textit{Percentage reduction in technician workforce}$$

Revenue from decreased downtime
*= Reduction in flaring * Average duration in flaring*
** Average gas collection (pre-Loci) * (Price of natural gas + RIN credit)*

Subscription expenses
*= Number of Wellhead hardware * Monthly price of well head hardware*
** Number of months of installation*

To estimate the incremental gas revenue, we assumed 55% methane content in the landfill gas, and a 55% increase in CH_4 collection. We have assumed $23/MMBTU for gas revenue, with $20/mmBTU from RIN credits and $3/mmBTU from natural gas prices, with an operator share of incremental revenue of 70%, or net incremental revenue for the operator of $16.10/mmBTU.

To estimate cost savings, we assumed that our devices could achieve a minimum 33% reduction in labor. We further applied a factor for increased uptime from 95.8% to 99.5%, or an increase of 26 hours per month.