LMOP Webinar

Landfill Gas Control System Best Practices

November 4, 2020

LANDFILL METHANE OUTREACH PROGRAM

Welcome and Agenda

Agenda
The Importance of Training: Safe and Effective Landfill Gas Systems Matt Lamb, Senior Scientist, Smith Gardner
Automated Landfill Gas Collection Nicole Neff, LFG Collection Project Manager & Sales, Loci Controls and Mark Messics, Director – Field Optimization & Development, Energy Power Partners
Questions and Answers
Wrap Up

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The Importance of Training

Safe and Effective Landfill Gas Systems

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November 4, 2020

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Topics

- Introduction
- Safety First
  - o Training to recognize and mitigate hazards
  - o Case study and lessons learned
- Gas Collection and Control System (GCCS) Design
- Construction Phase Considerations
- GCCS Operation and Maintenance (O&M)

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Introduction

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The Value of Training

"The only thing worse than training an employee and having them leave, is to not train them, and have them stay." *(Hilary Hinton Ziglar)*

- Objectives of effective training:
  - Teaching, learning, developing skills, knowledge, competencies
  - Related to specific defined tasks
  - Developing the ability to overcome unforeseen challenges

Health and Safety

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Training to Recognize Landfill-Related Hazards

- 2019 statistics (Solid Waste Association of North America)
  - At least 58 fatalities in the solid waste industry, including
    - 11 at landfills, and
    - 4 at material recovery facilities (MRFs)
  - Both increased from 2018
- Some of the hazards at landfills:
  - Vehicles and equipment
  - Hazardous gases, oxygen-depleted environments
  - Trenching, excavations, and boreholes
  - Environmental conditions (heat stress, cold, sun exposure…)
  - Ticks, biting insects, animals

Training to Mitigate Hazards

- OSHA Hazardous Waste Operations and Emergency Response (HAZWOPER)
  - Covers risks including and beyond those encountered in landfills
  - Intensive: 24- and 40-hour initial trainings, annual 8-hour refreshers
  - Common in the industry
- Health and Safety Plan (HASP) focuses on hazards associated with a specific project and covers:
  - Job Hazard Analysis
  - Personal Protective Equipment
  - Safe Operating Procedures

Case Study: Okeechobee Landfill Fatality

- Feb. 19, 2004: Contractors making final tie-in to GCCS
  - Shallow excavation (< 3 feet) to connect to leachate cleanout
  - Gas chain saw could not work in oxygen depleted trench
  - Work continued despite warning signs (odor)
  - Three workers were overcome, one died in transit to hospital
  - Autopsy showed asphyxiation by "**acute hydrocarbon (methane) inhalation**"
- Lessons:
  - Recognize warning signs
  - Wear PPE (gas meter)
  - Cease work until safe to resume

Landfill Gas Collection and Control System Design

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Take Advantage of Available Resources

- §60.759 provides basic design parameters
- LMOP LFG Energy Project Development Handbook (PDH) addresses system design best practices
- Conferences and webinars
  - Currently most training is online
  - LMOP has an extensive library of proceedings
  - SWANA offers several courses related to LFG management
  - LMOP Partners, vendors, engineering firms

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Initial Steps

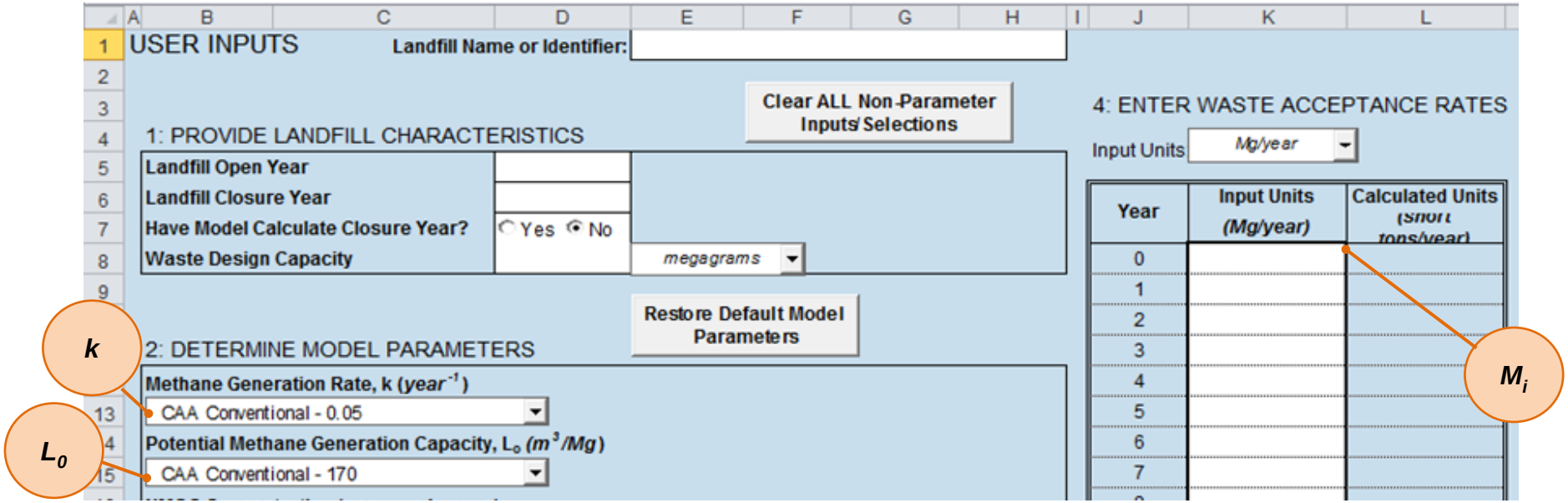
- Review and assess landfill characteristics
  - Active landfill or facility in post-closure care?
  - Cover soils may create zones of perched leachate
  - Leachate handling/recirculation practices
  - Waste types affect system design
    - Areas of sludge acceptance
    - Reactive waste types create special considerations
  - Design system to be compatible with the local climate
  - Condensate management creates many design challenges

Additional Design Considerations

- Determine primary objectives
  - o Regulatory compliance
  - o Odor control
  - o Beneficial use projects
  - o Greenhouse gas emission reductions
- Provide capacity for the future
  - o Build for maximum generation rate anticipated through closure
  - o Size header and lateral piping to accommodate peak flow and distribute vacuum at full build-out
  - o Account for operational range limitations when selecting control devices
  - o Turndown limitations typically require modular blower/flare installation

Landfill Gas Emissions Model (LandGEM, U.S. EPA)

- Model and User's Guide available for download from EPA



o Understand limitations
  - Assumes uniform conditions across the landfill
  - Does not account for changing conditions over time
  - Factors that increase LFG generation often hinder collection

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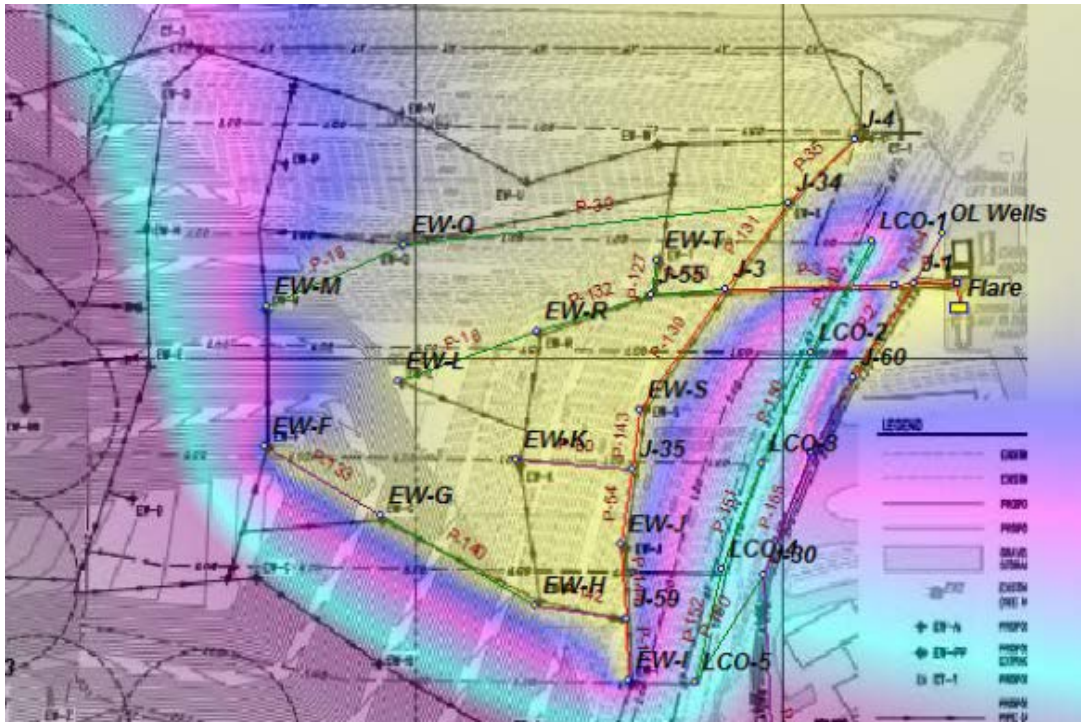
KYPipe (University of Kentucky)

- Vendor provides a variety of training courses
  - o Designed to model water and sewer systems
  - o Commonly used during GCCS design to model vacuum loss
  - o Does not account for losses due to condensate blockages

Node Pressure Case 0		Pipe Diameter	
	= -50		<= 4
	= -40		<= 6
	= -30		<= 8
	= -25		<= 10
	= -20		<= 12
	= -10		<= 18
	= -5		<= 24
			> 24



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Construction and Installation

Ensure a Safe Working Environment

- Confirm that contractors and their staff all have required training, such as:
  - o 30-hour construction (trenching & excavation)
  - o Current HAZWOPER certifications
  - o Confined space
  - o Lockout/tagout
  - o Asbestos Accreditations?
- Project-specific HASP development
  - o If developed by the contractor, the landfill owner/operator should review ahead of time
  - o Conduct daily safety reviews prior to commencing work

Changes to Design Based on Current Conditions

- Determine the bottom of waste/top of liner when developing well schedules
  - As-built liner surveys certified by a Registered Land Surveyor or Professional Engineer (PE) are ideal
  - Design or construction drawings are less reliable
  - Historic topographic information should only be used in pre-Subtitle D landfills
- Changes in slope and differential settlement
  - May require additional excavation to maintain condensate drainage
  - Field well location adjustments should be PE-approved

GCCS Operation and Maintenance (O&M)

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Multiple Tasks to Accomplish One Goal

- Consistent collection system operation is the key to optimizing production and maintaining compliance
- In addition to safety, training is required to:
  - Operate gas analyzers
  - Tune wellheads to optimize collection without stressing the system
  - Operate and maintain pumps
  - Identify and repair leaks
  - Maintain blowers in good working order
  - Operate and maintain control device components
  - LFG sampling and analysis
  - Monitoring wellfield, total flow rates, and control devices to demonstrate regulatory compliance

Available Resources

- LFG system O&M training offered by SWANA and various LMOP Partners (https://www.epa.gov/lmop/about-partners-landfill-methane-outreach-program)
- Specific training offered by equipment vendors on site or online
- Service contracts for specific equipment may be available from the vendor
- General service firms to service range of system components
- LMOP PDH at https://www.epa.gov/lmop/landfill-gas-energy-project-development-handbook

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PDH Ch. 7: Design & Installation Best Practices

- Review your facility (e.g., site conditions, climate, goals)
- Decide well type(s), casings and seals, wellheads
  - o Comparisons of vertical/horizontal wells, wellhead designs
- Lateral and header piping: placement, material, size
- How will you manage condensate?
- Blowers and compressors: sizing, type, placement
  - o Plan for future development and growth
- Installation/Construction – construction quality assurance (CQA), surveying and documentation
  - o Best practice ideas for documentation

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PDH Ch. 8: O&M Best Practices

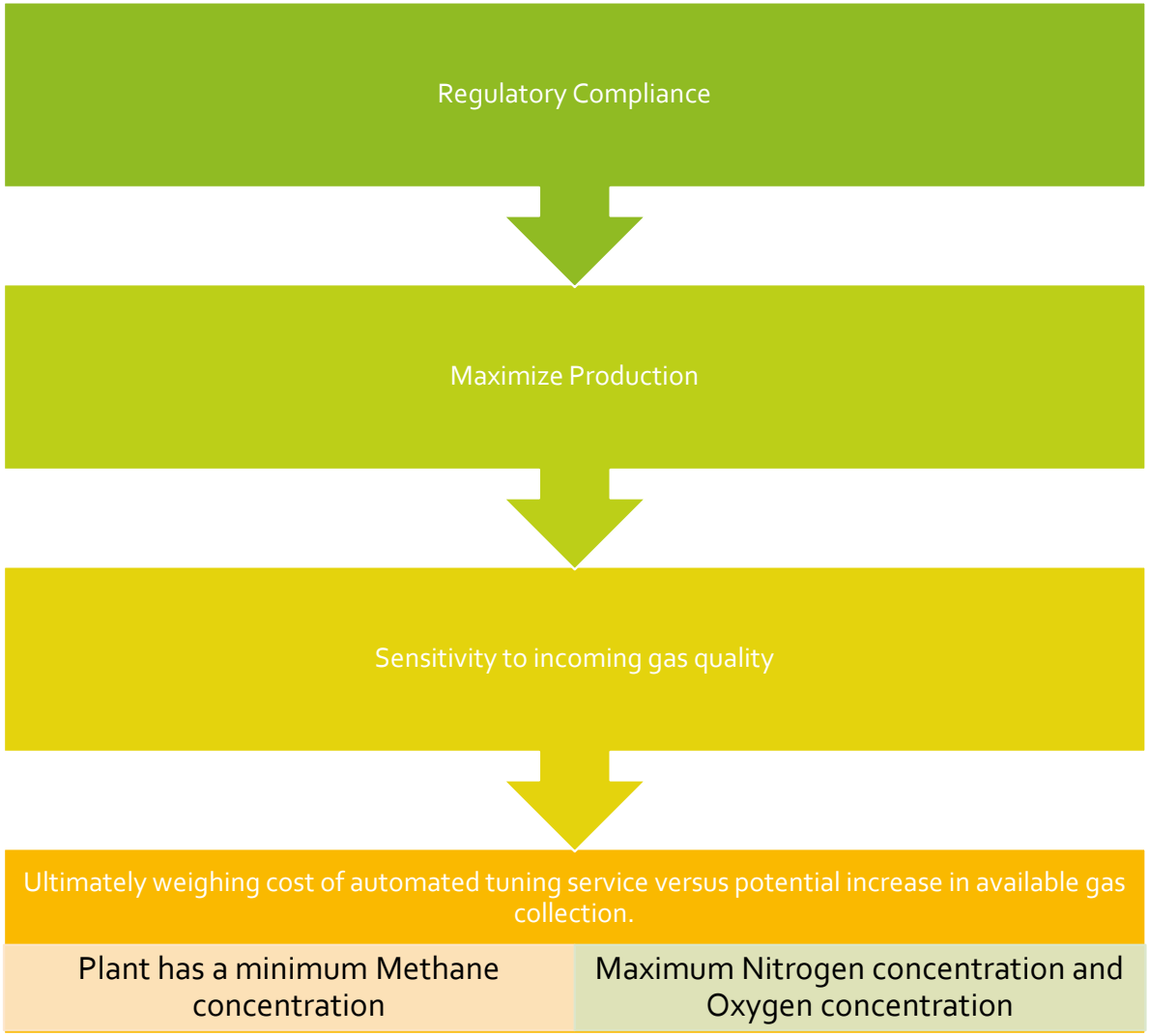
- Proactive O&M can minimize air leaks & system downtime
- System vacuum stability
  - o Set control system goals – vacuum control, flow rate control, or heat content control?
  - o Well tuning to achieve steady vacuum while avoiding air intrusion
- Identifying and correcting air leaks
- Finding and managing excess liquids
  - o Pumps, air compressors
- Robust monitoring and data analysis system can detect problems early
  - o Flowcharts of typical wellhead monitoring procedures

THE LEADER IN AUTOMATED LANDFILL GAS COLLECTION

Energy Power Partners

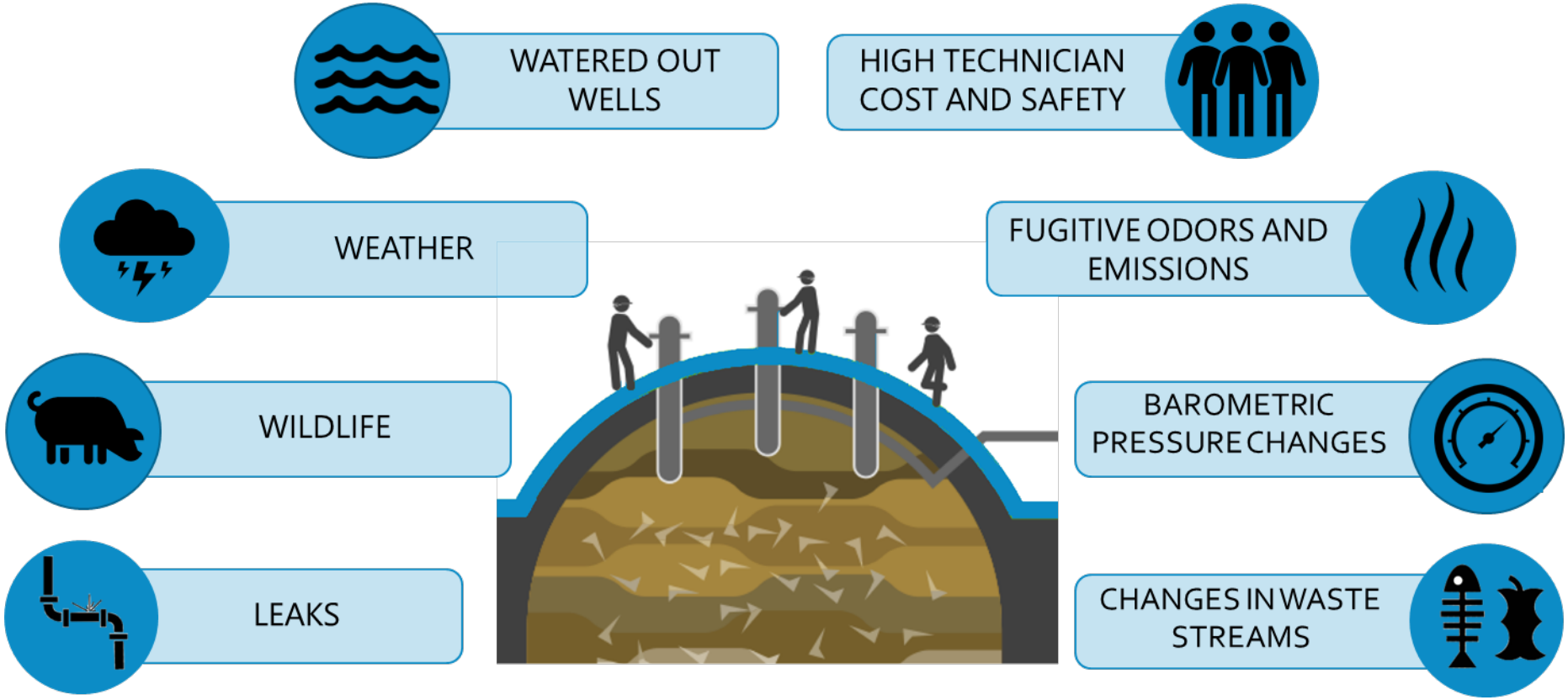
Renewable Investments With Sustainable Results

Landfill and Energy Project Considerations



Several Challenges Involved In LFG Collection

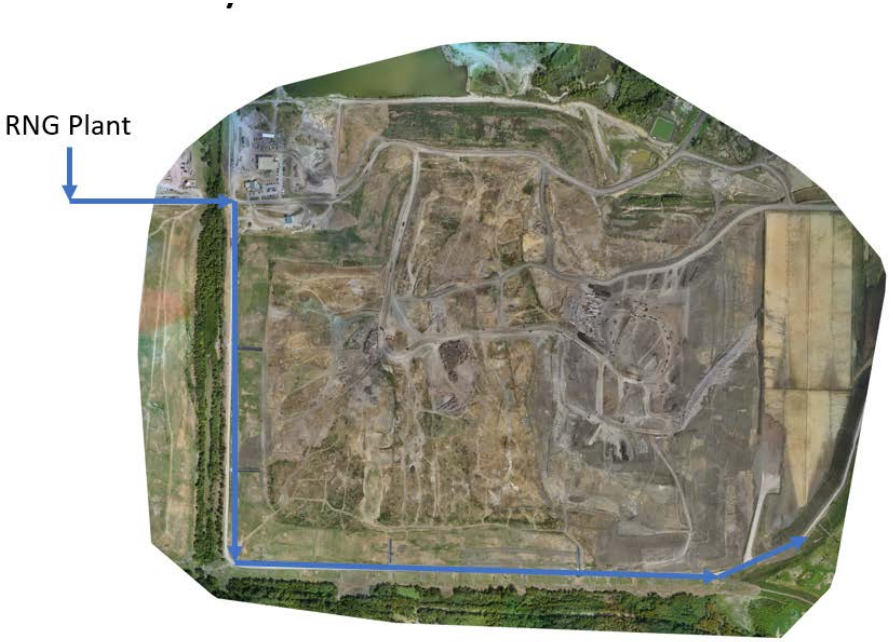
From high technician costs, to a constantly changing environment, even the best operators have trouble optimizing collection when landfill gas is managed manually.



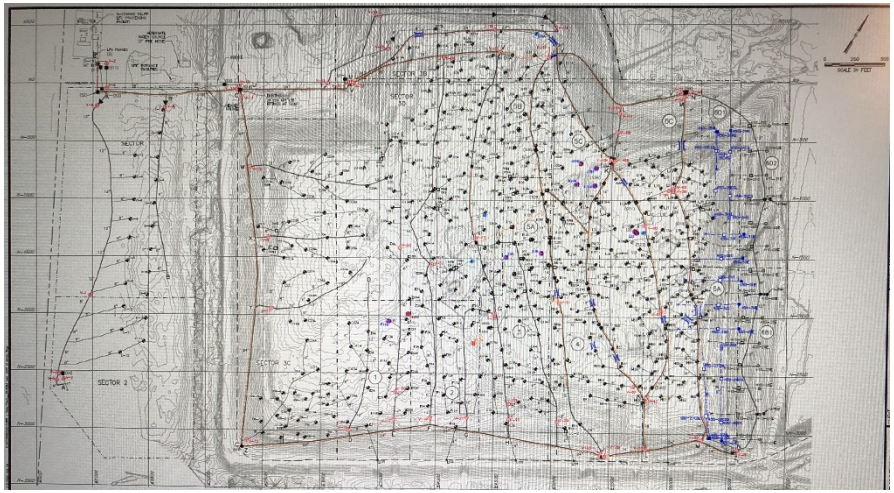
Real Life Examples

Logistics of McCommas Bluff Landfill

- Furthest portion of gas collection system is two miles away from RNG plant



- There are 500 gas collection points spread out over 500+ acres



Increases Landfill Gas Collection By 15% or More

Loci Controls increases revenue through improved gas flow and quality and decreases costs and reduces risks through more efficient operations.

Increase Revenue

- ✓ Maximize methane gas flow
- ✓ Control N2 in the wellfield
- ✓ Automated valve adjustments
- ✓ Better collection efficiency
- ✓ Reduce plant downtime

Increase Productivity

- ✓ For both plant and employees
- ✓ Lower labor cost for wellfield tuning and O&M
- ✓ Reduce plant maintenance costs

Reduce Environmental, Health & Safety Risks

- ✓ Reduce man hours spent in wellfield
- ✓ Reduce fugitive LFG emissions
- ✓ Reduce odors

Products & Services

Depending on your project, we can help you select the optimal configuration of Controllers and Guardians for automated control and Sentrys for monitoring.

	CONTROLLER	SENTRY	GUARDIAN
Mounting location	Vacuum Riser	Header	Vacuum Riser
Measures P, Av Vac, T, flow	✓	✓	✓
Measures gas composition (CO_2, CH_4, O_2, Balance Gas)	✓	✓	✓
LFG automation with actuated valve adjustments	✓		✓
Precision	10ths of a percent	10ths of a percent	Percentage point

Automated Landfill Gas Collection with Loci

Our collection well mounted products make continual, automated adjustments to valve position based on measurements to respond to the constantly changing environment.

CONTROL

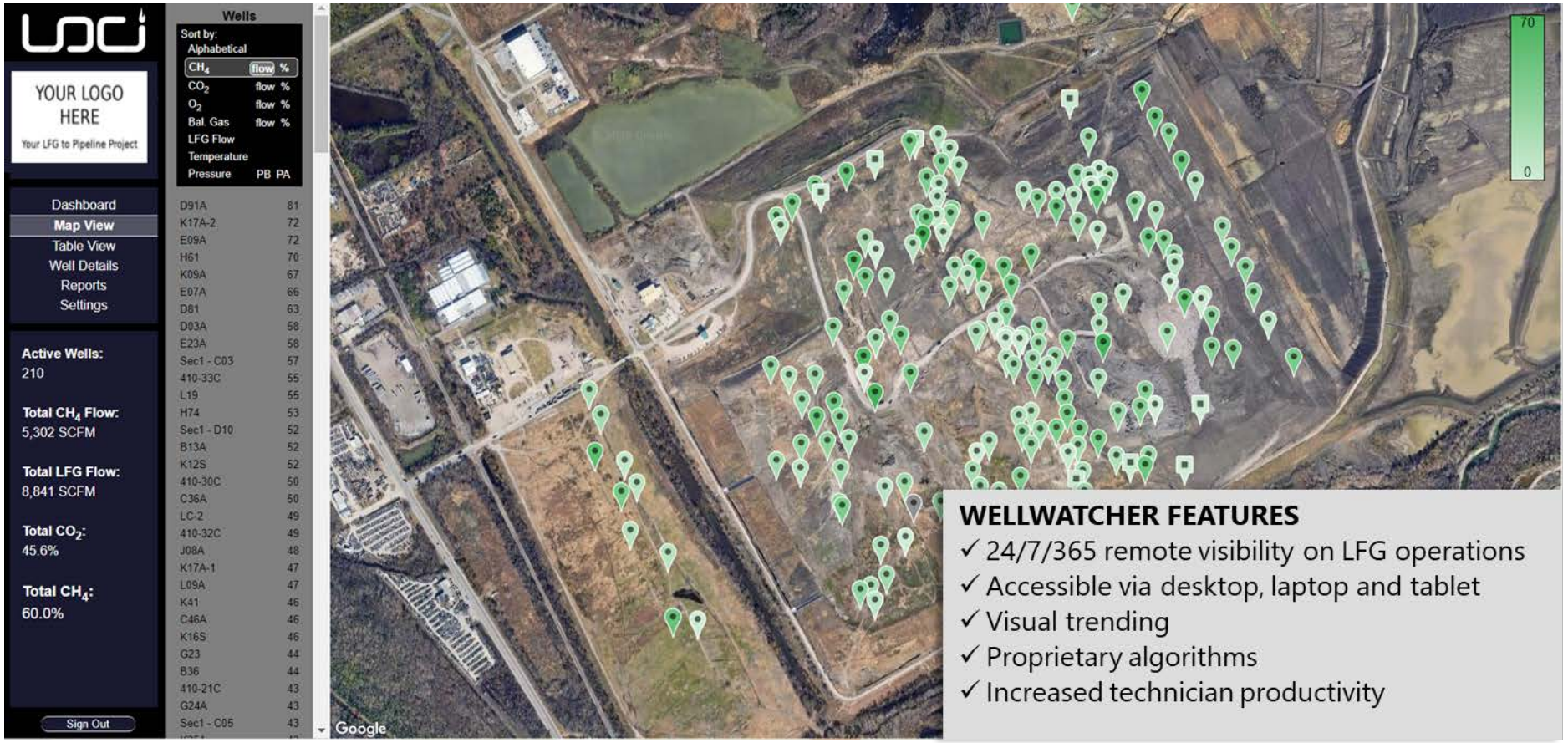
Automated tuning through control algorithm
User gas composition thresholds

SERVICE

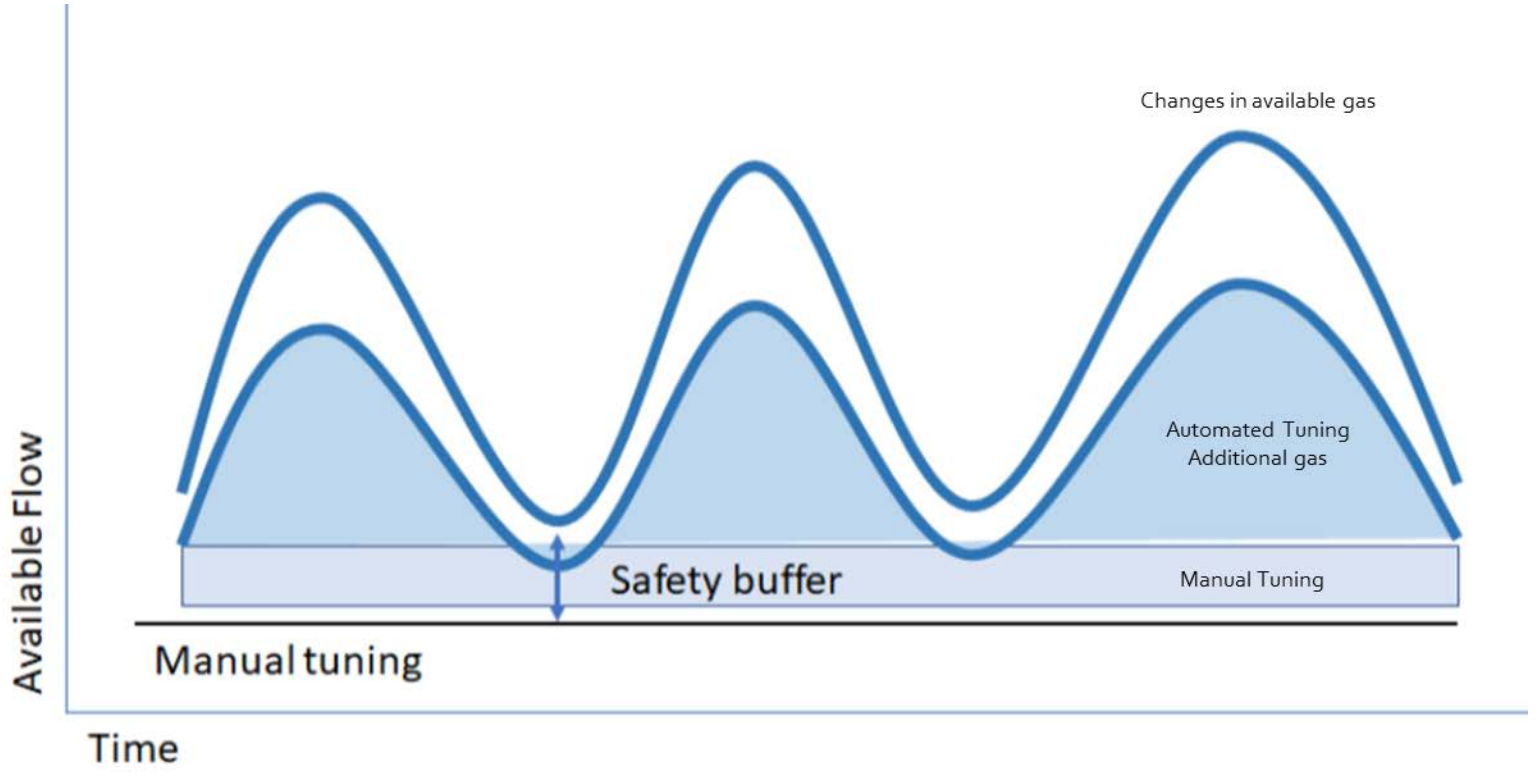
Automated calibration
Routine maintenance
Rapid troubleshooting leveraging field technicians

WellWatcher Platform

Our cloud-connected online platform displays live data from each well and allows users to view historical data through our user interface.



Automated Tuning Concept



- The Concept is:
  - Composition fluctuates in-between well tuning
  - Tuning once or twice a month = Conservative (flat) set-points to account for fluctuations and a safety buffer
  - Loci Automated tuning = fast reaction to changing conditions and tighter safety buffer → **more gas captured**

Loci uses Plant GC, Wellfield Data to Optimize Collection

Loci's fine-tuning algorithm is like having a technician at each well 100% of the time.

Loci's threshold algorithm makes adjustments to many wells at the same time based on changes in overall gas quality measured at the plant, something which can not be done manually.

Fine-Tuning Algorithm

1. The Loci system takes hourly individual collection well readings (gas, composition, flow, LFG temp, ambient pressure, temperature, valve position, and pressure above/below Loci's automated valve).

2. Automation is used to make small incremental valve adjustments (<1% open or close) every 2-3 hours based on last measurement. Finds optimum for each collection well.

Individual Well Control

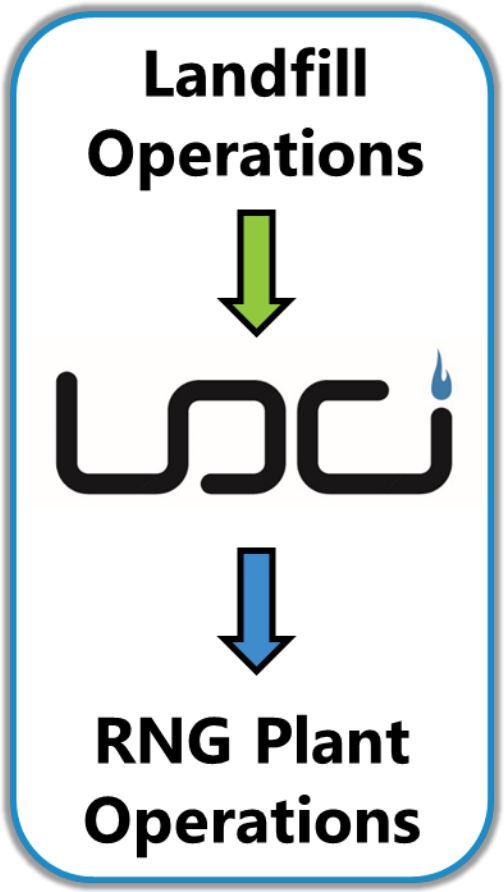
Valve adjustments for individual collection wells are weighted by gain factors. The gain factors reflect how responsive each collection well is to changes in gas composition based on valve position.

Aggregate Gas Composition Algorithm

Loci's automated system makes batch valve adjustments, changing multiple collection wells at the same time. Uses aggregate gas composition thresholds with top-level control variables: BTU, 0_2, and N_2 as measured by plant Gas Chromatograph or Precision 0_2 meter. There is a direct connection to plant measurement equipment via serial port to Loci Sentry.

Loci Support for Landfill & RNG Plant Operations

Operational Support



Site Wide Operating Set-Points
- Established at a site wide level, to ensure aggregate gas composition meets plant spec.

Individual Collector Set-Points
- Established with Landfill and RNG Plant operator

Loci Analyst
- As required, communication between Loci's remote analyst, Landfill site personnel, and Loci field service representatives supporting gas collection operations

Service
- Loci has field personnel within 4 hr. drive of any RNG installation, so will be able to provide extensive support to ensure operation meets landfill and RNG operator objectives

Reporting
- Monthly or as-required review meetings with operating personnel from Landfill Operations and RNG Plant Operations Teams

Overview – LFG Composition vs Barometric Pressure and Ambient Temperature Changes

Based on review of data from many landfills, using aggregate landfill gas composition data, as well as individual collector data, some general observations can be made:

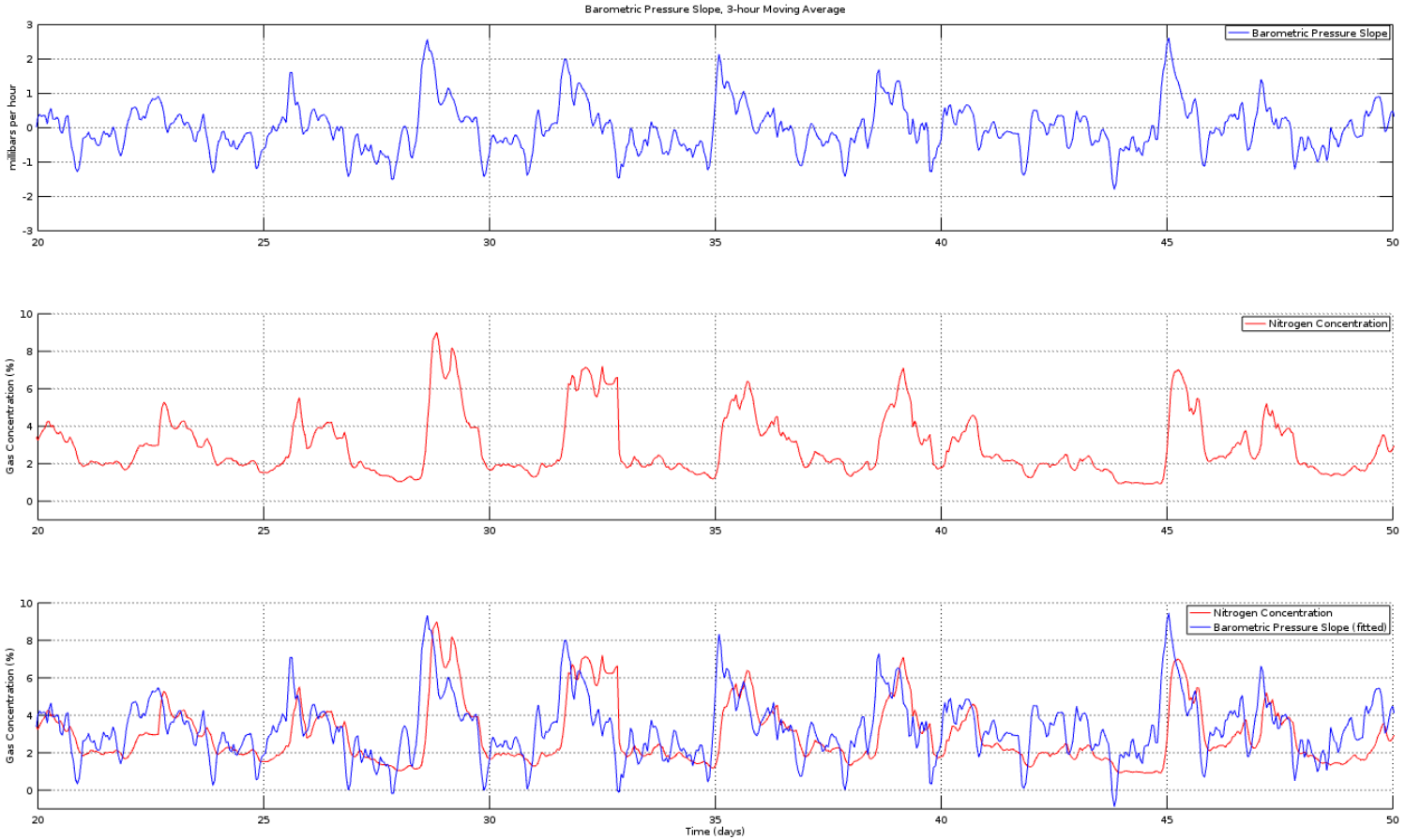
1. The landfill gas collection process and gas composition are strongly impacted by changing ambient weather conditions:
   A. Changes in barometric pressure
   B. Daily fluctuation/changes in ambient temperature
   C. Freezing/thawing transitions which affect landfill cover permeability

2. Barometric pressure changes are often a dominant factor influencing gas composition and quality, but daily changes in ambient temperature also have a significant impact on gas composition. This relationship is highly dependent on the cover integrity and if the site has a final cap installed.

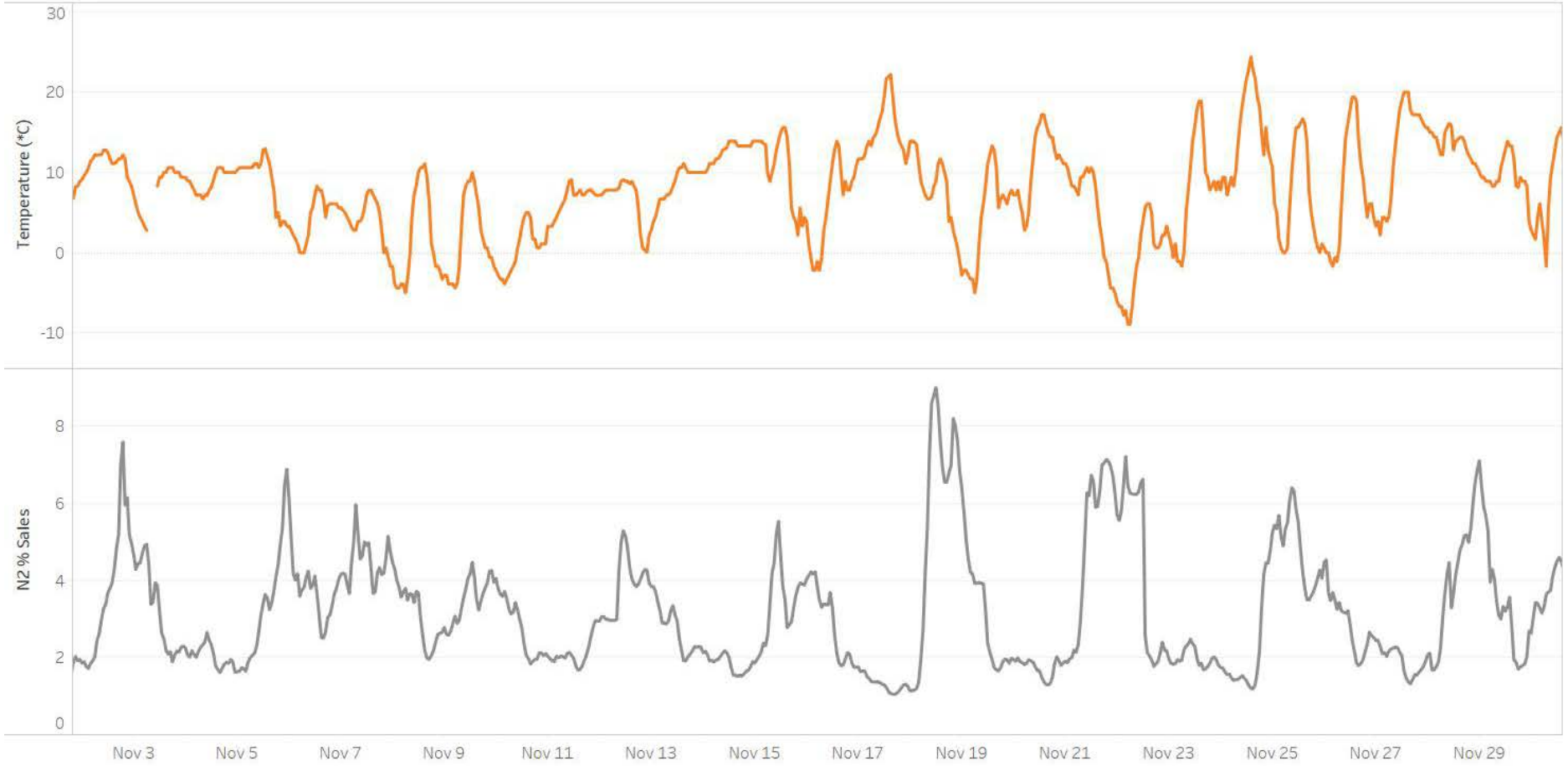
3. There is also a substantial relationship between changing ambient temperature and gas composition. Strong daily fluctuation in temperature results in daily fluctuations of landfill gas energy content – but it is likely that this effect can be obscured by impact of changing barometric pressure.

4. The effect on gas composition from changing barometric pressure or ambient temperature is seen in 1–4 hours generally – in other words, changing atmospheric conditions result in near constant changes to the gas collection process.

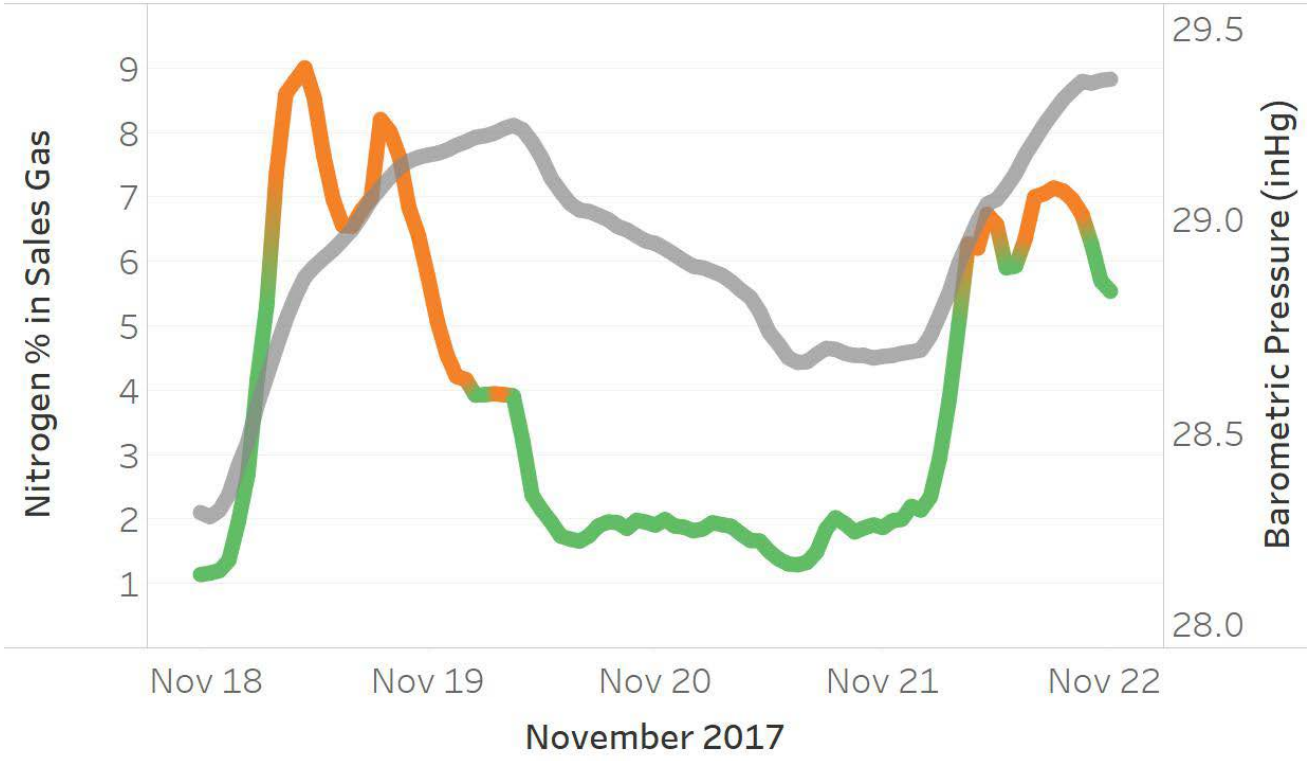
Barometric Pressure vs. Nitrogen Concentration



One Month – Ambient Temperature vs. Nitrogen %

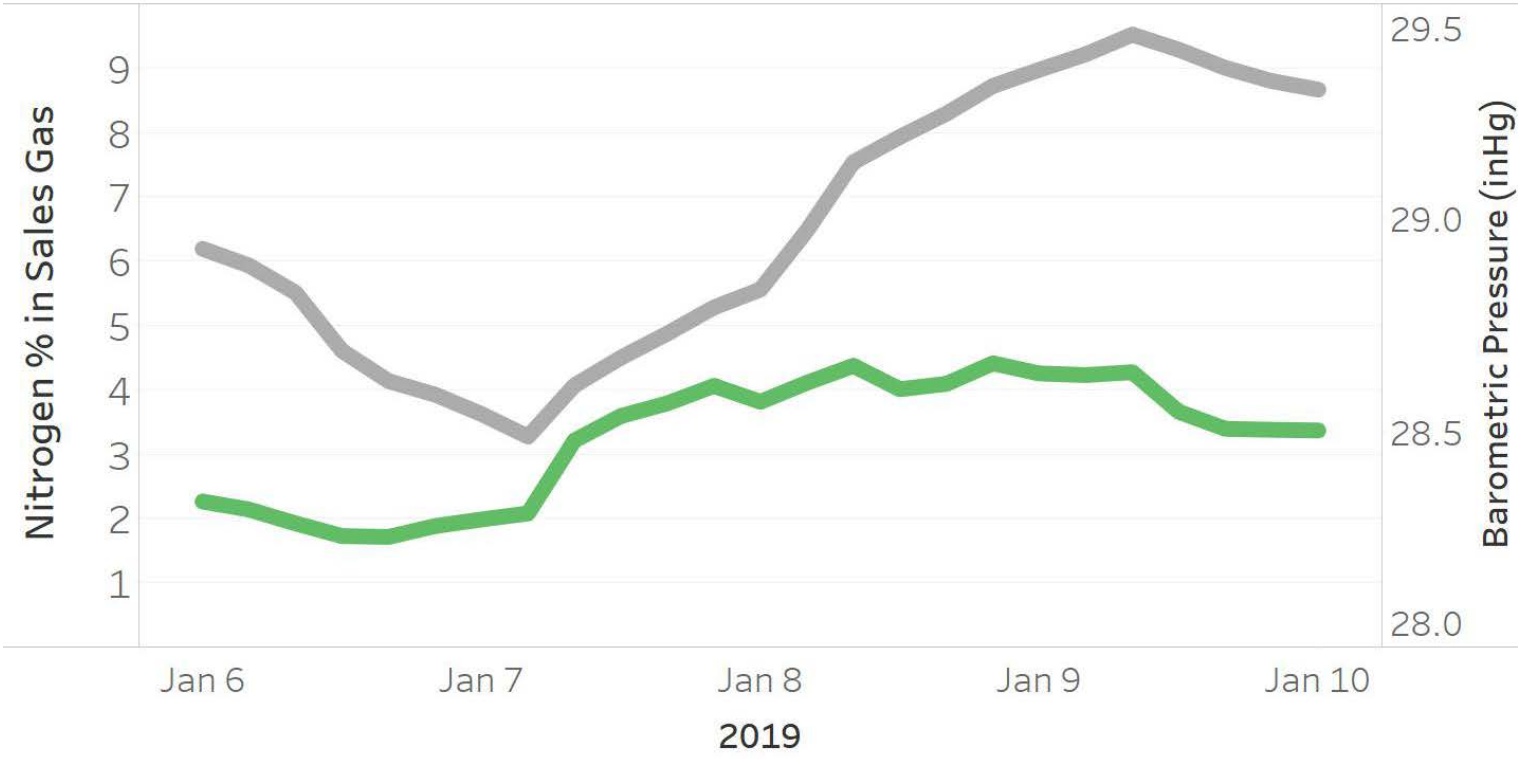


Rapidly rising barometric pressure event



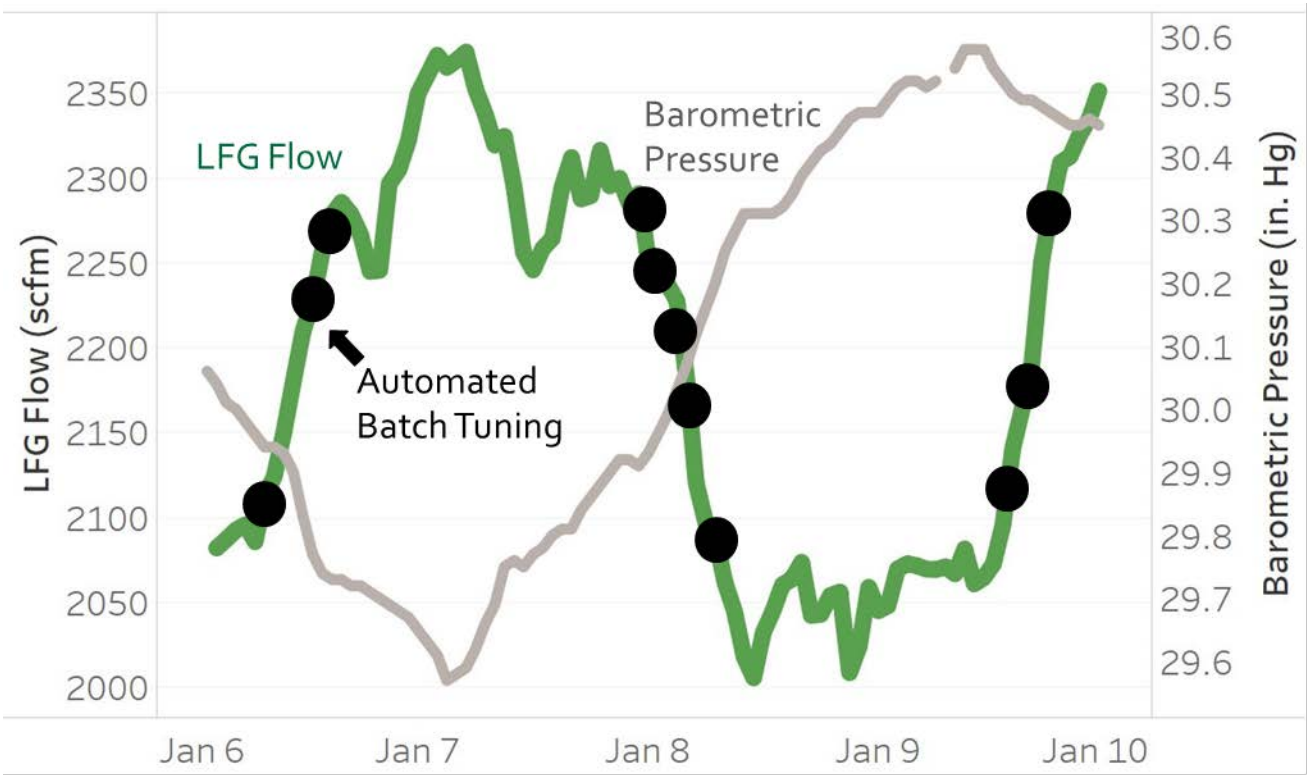
Green/Orange is Nitrogen % in Sales Gas
Grey is Barometric Pressure

Rapidly rising barometric pressure event



Green is Nitrogen % in Sales Gas
Grey is Barometric Pressure

Batch valve adjustment during barometric pressure event



Green is LFG flow (scfm)
Grey is Barometric Pressure

WellWatcher 2.0 and WellWatcher 3.0

- Loci has two different Automated Landfill Gas Collection systems
- WellWatcher 2.0
  - Designed for Automated Landfill Gas Collection Process Control - (does not take compliance measurements/data)
    - Measures CH4, and CO2 – 0 – 100% concentration
    - Measures O2 – 0 – 2.5% concentration
    - Measures Pa, and Pb (Pressure above and below Loci valve – which is installed on vacuum riser side of collection well)
    - Measures LFG Temperature once per month for purposes of gas composition measurement temperature
    - Compliance measurements taken, and recorded independent of Loci system
- WellWatcher 3.0
  - Designed for Automated Control and Compliance
    - Measures CH4 and CO2 – 0% - 100% concentration
    - Measures 02 – 0% - 25% concentration
    - Measures Pa, and Pb for process control
    - Measure Static Pressure, and LFG Temperature 1x per month or to cure an exceedance
    - All calibration and confirmation readings and data storage per NSPS reporting
    - Includes alerting function to more quickly mobilize on site support if required to cure an exceedance
    - Most exceedances closed via automation within 24 hours
    - Audited by a third party engineering firm to meet/exceed the requirements of NSPS reporting/testing requirements

THE LEADER IN AUTOMATED LANDFILL GAS COLLECTION

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Thank you

Questions

Q&A

Wrap Up

Contact Information

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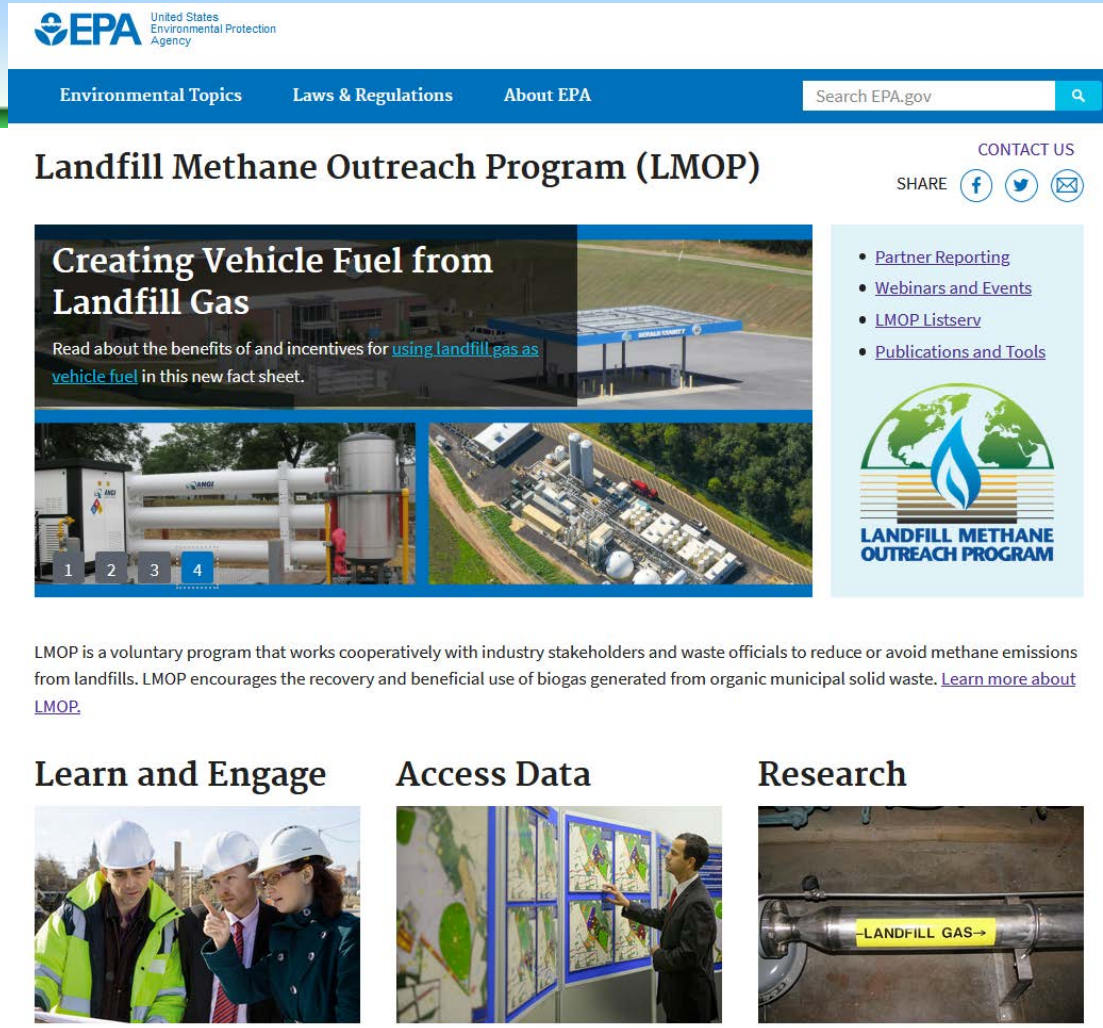
Wrap Up

- The slides and recording from today's webinar will be posted on the LMOP website
- To learn more about LMOP or LFG energy, visit our website at epa.gov/lmop
- Have a webinar idea? Drop us a note with your email in the Questions box or email lmop@epa.gov



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Thank You

Please reach out with any questions or comments

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