TRANSFORMING GAS DETECTION & MONITORING

- new remote sensing technologies
- advances in science & methods
- cutting edge gas mapping
Challenges with Gas Detection & Monitoring

Facilities lack affordable, timely, & quantifiable ability to proactively detect and monitor landfill gas

Subjective - Human nose is inaccurate
Lengthy - Lab testing can take weeks
Inefficient - Inability to target AOI’s
Tedious - Continual re-certification
Costly - Perimeter monitoring is expensive
Safety - Dangerous environments
Lack of Regulation - No clear standards and policies for H₂S (Odor)

Fugitive gas emissions can lead to odor issues, public complaints, operational shutdowns, and loss in gas to energy revenues
Needs & Requirements

Typical Facility Needs

- Develop high resolution survey maps and volumetric measurements
- Proactively quantify landfill gases
  - $\text{H}_2\text{S}$ (Odor), $\text{CH}_4$ (Methane)
- Overlay gas infrastructure & wellheads for context
- Assess locations of leaking wellheads
- Layer cell topology & wind data to determine gas migration patterns

Assessment of Available Solutions

- Drone-Based Imagery Collection
- Handheld Gas Measurement
- Drone-Based Gas Measurement
- Drone-Based Air Sample Capture
- Perimeter Mitigation Systems
- Odor Control Spray Applications
BeamIO’s End-To-End Solution

CUSTOM SENSOR

Sensor Modules - H₂S (Odor), CH₄ (Methane), CO₂, NOₓ, SOₓ (Air quality)

Small, Portable, GPS enabled, Automated Logging

Mobile - Handheld, Vehicle, Drone

CAPTURE

Baseline Scans - Perimeter & Area

Temporal Monitoring - Temporal & Trend Analysis

End-to-End Service - Flight Planning, Sensor Integration, Data Collection*

* Self-Service Options available

ANALYZE

GasMaps delivered by TileDriver

Identify Leaks

Quantify Mitigation
Interactive Results

- High Resolution Survey Map
- 3D Visualization
- Volumetric Measurement
- H₂S (Odor)
- CH₄ (Methane)
- CO₂ / NO₂ / SO₂ (Air Quality)
- GIS Layers (gas collection system, etc)

> TileDriver Demo
Results & Discussion

New sensor technologies can produce results that agree with traditionally used equipment.

Drones must be used carefully to produce accurate results:

- Understanding of how landfill gas moves throughout the landscape is required.
- Some gas types may require ground based measurement ($\text{H}_2\text{S}$).

Performing on a recurring basis critical to answering certain questions:

- How much did my odor shield help?
- Where should I spray?
- Are any wellheads leaking?
Thank You. Please Visit Us!

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ADDITIONAL
Volumetric Measurements

![Graph showing volumetric measurements over time](image)

- **Volumetric Measurements**
- **Graph**
  - **Y-axis**: Fill (cy) in Thousands
  - **X-axis**: Date from 5/6/13 to 9/22/17
  - **Legend**: Ground Survey (blue) and Drone (orange)

![Phase 2 detail](image)

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**Note**: The image depicts a graph of volumetric measurements over time, comparing data from ground surveys and drones. The graph shows a significant increase in fill volume from 5/6/13 to 9/22/17, highlighting the effectiveness of drone technology in monitoring and measuring construction sites.
Human Perception vs Sensor
Sensor Performance

![Graph showing percent ability to detect odor and annoyance by odor against H2S (PPB).]