Leak Detection Practices & Demonstration of Optical Imaging

1st Asia Pacific Global Methane Initiative Oil & Gas Sector Workshop

September 23, 2011
Jakarta, Indonesia

Milton W. Heath III
Director, Environmental Services
Heath Consultants Incorporated

Global Methane Initiative

Agenda

- Remote Sensing – Detection over a path
  - Gas Plume Imaging – Active vs. Passive
  - Optical – TDLAS, ALMA, ANGEL, LDAR, OP-FTIR, UV-DOAS
- Examples of Commercially Available Aerial Leak Detection Products & Services Today
  - Heath Consultants Incorporated, PERGAM, Lasen, ITT-ANGEL, New Era Technology, Inc.
- OPGAL Eye-C-Gas Imaging Camera
- Gas Imaging Demonstration
- Contacts and Further Information

Global Methane Initiative

Why Is Infrared Gas Imaging & Laser Technology Needed?

- Gas leaks pose several problems for producers, processors, transporters and distributors of refined petroleum and natural gas products:
  - SAFETY – undetected gas can cause explosions or toxic poisoning of employees and neighbors
  - ENVIRONMENTAL – GHG and regulatory compliance
  - LOST REVENUES – material lost into the open air can not reach the market for sell

Gas leaks are invisible, odorless, and go unnoticed

Global Methane Initiative

Why Thermal Infrared Imaging

- Actual practice - utilize a gas detector with a wand-like probe and physically "sniffing" every component at a regulated facility called TVA (Toxic Vapor Analyzer). Highly time and human resource consuming.
- Thermal infrared imaging - identify many more leaks much more quickly and given that any detected leak, regardless of the size of the leak (volume) must be repaired, also allows the operator to perfectly localize the source of the leak.

Global Methane Initiative

Technology Overview – Plume Imaging

Technology	Capabilities	Limitations	Demonstrated Field Applications
Passive Plume Imaging	•Detects Leaks •Expedites Emission Detection •Simultaneously Detect Multiple Sources •Mobile System	•Qualitative, not quantitative •Requires radiance difference between gas and background •Some units are not intrinsically safe and require a hot work permit	•Emission Leak Detection •Pipeline Leak Detection
Active Plume Imaging	•Imaging •Detects leaks •Expedites emission detection •Mobile system	•Qualitative, not quantitative •Steam could appear as leak •Requires a background within close proximity to emission source •Some units are not intrinsically safe and require a hot work permit	•Sources Emission leak detection •Pipeline leak detection

Sources: Environ, 2005b. Survey and Demonstration of Monitoring Technology for Houston Industrial Emissions (project H31. 2004).
EPA, Technology Innovation Program website. www.clu-in.org/programs/21m2

Global Methane Initiative

Technology Overview – Infrared Optical & Laser

Technology	Capabilities	Limitations	Demonstrated Field Applications
TDLAS (Tunable Diode Laser Absorption Spectroscopy)	•One of the highest spectral resolutions of any method •With the use of fiber optics, a number of measurements can be performed at remote locations simultaneously	•Separate diode laser must generally be used for each gas •Pipelines Under Water, Lakes & Rivers •Pipeline Inspections in Deep Snow with Ice Cap.	•Pipeline transmission right of way and distribution gas pipeline compliance leak surveys •All above ground piping •Mobile Leak Surveys
LIDAR (Light Detection and Ranging)	•Maps the location of chemicals over a wide region up to 80 km •Time resolution allows good spatial resolution	•Tuned to evaluate one pair of wavelengths at a time, not multiple components •Complex, large, expensive systems, which require highly skilled personnel •Can be impacted by meteorology	•Industrial processes •Mobile source emissions •Airport Emissions •Urban air quality •Ambient air quality
OP-FTIR (Open Path Fourier Transform Infrared)	•Indentify, measure, and speciate 100+ compounds simultaneously from 500 to 1000 meters •Good for VOC idenfication. •No spectral losses due to dispersion or reflection, since it uses an interferometer	•Requires a large number of calibration runs •Technical savvy operator needed. •Presents poor sensitivity for aromatic compounds due to water vapor interference •Impacted by water/water vapor	•Urban air pollution •Industrial fence line •Airport monitoring •Traffic monitoring •Stack monitoring •Ambient air quality

Global Methane Initiative

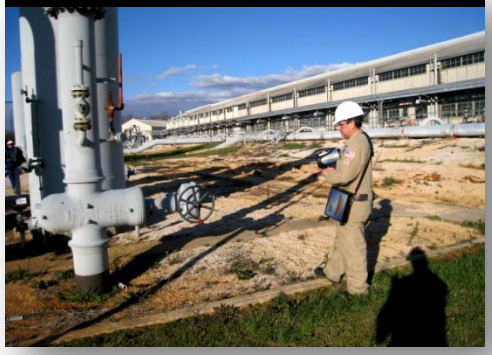
What does Active Plume Imaging Look Like?

- Real-time detection of methane leaks
  - Quicker identification & repair of leaks
  - Screen hundreds of components an hour
  - Screen inaccessible areas simply by viewing them

Pipe Connectors

Mobile Leak Detection

Valve Stem Packing



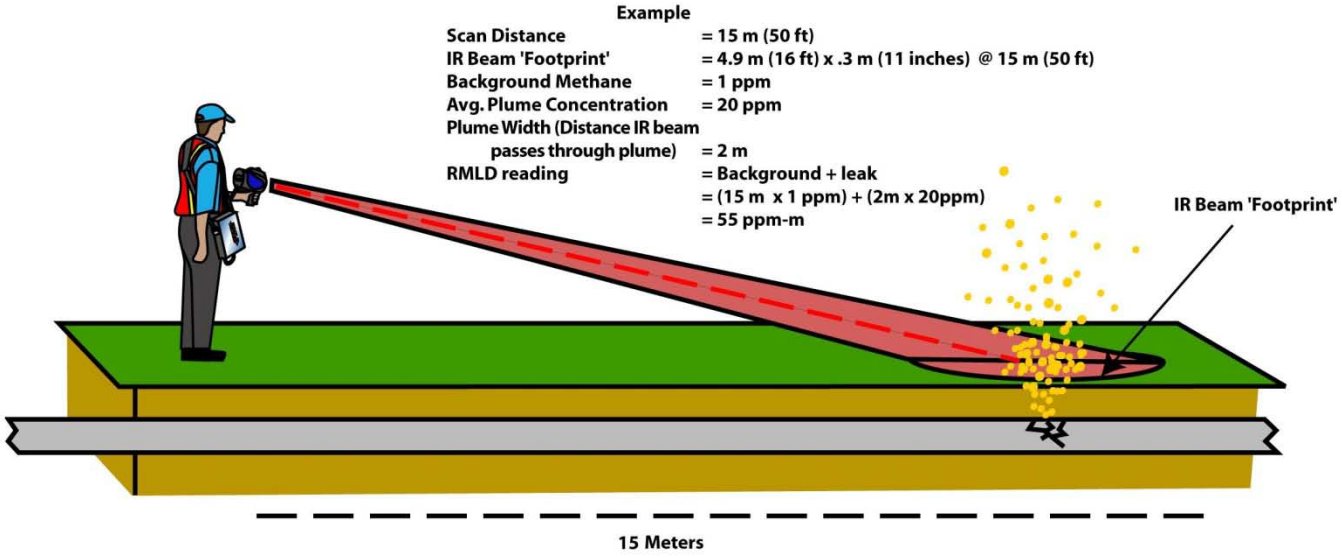
RMLD
Remote Methane Leak Detector

Source: Heath Consultants

Global Methane Initiative

Remote Methane Leak Detection

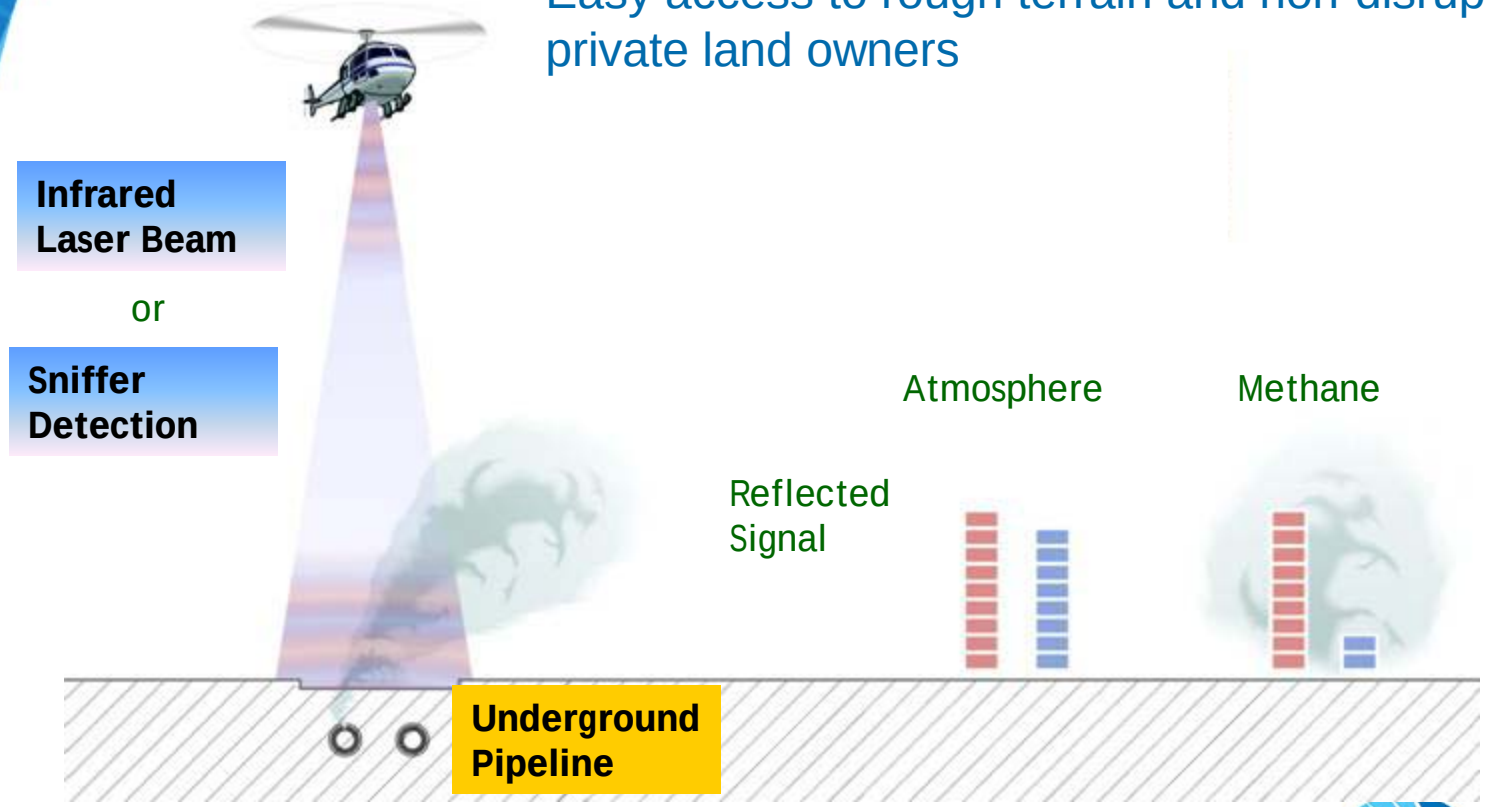
- Works using Tunable Diode Laser Absorption Spectroscopy (TDLAS)
- Specific to methane gas only
- Displays gas reading in parts per million metered



Global Methane Initiative

Aerial Pipeline Surveys

- Over 10 times faster than ground surveys
- Full coverage of the right-of-way
- Easy access to rough terrain and non-disruptive to private land owners



Global Methane Initiative

DI&M - Aerial Leak Surveys

- Aerial leak surveys with infrared leak detection devices can aid in leak identification over large sections of pipelines
- Aerial surveys can be conducted in helicopters or fixed wing aircrafts using both active and passive IR detection devices

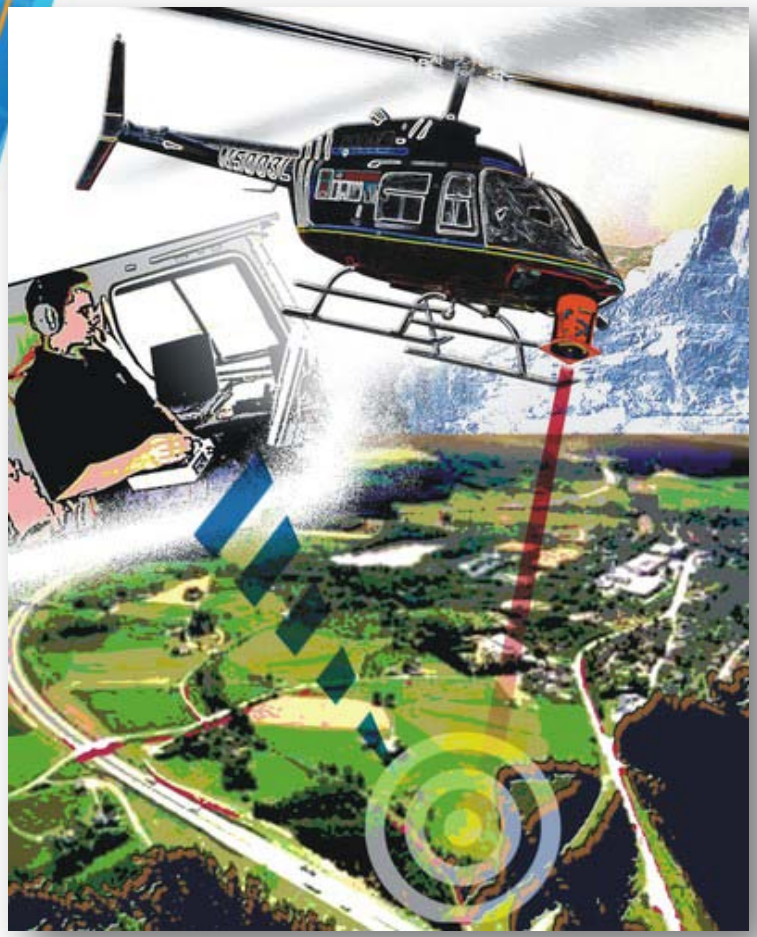
Source: LaSen Inc.

Source: New Era Technology, Inc.

Global Methane Initiative

Airborne Laser Methane Assessment (ALMA) by PERGAM-SUISSE

PERGAM-SUISSE AG

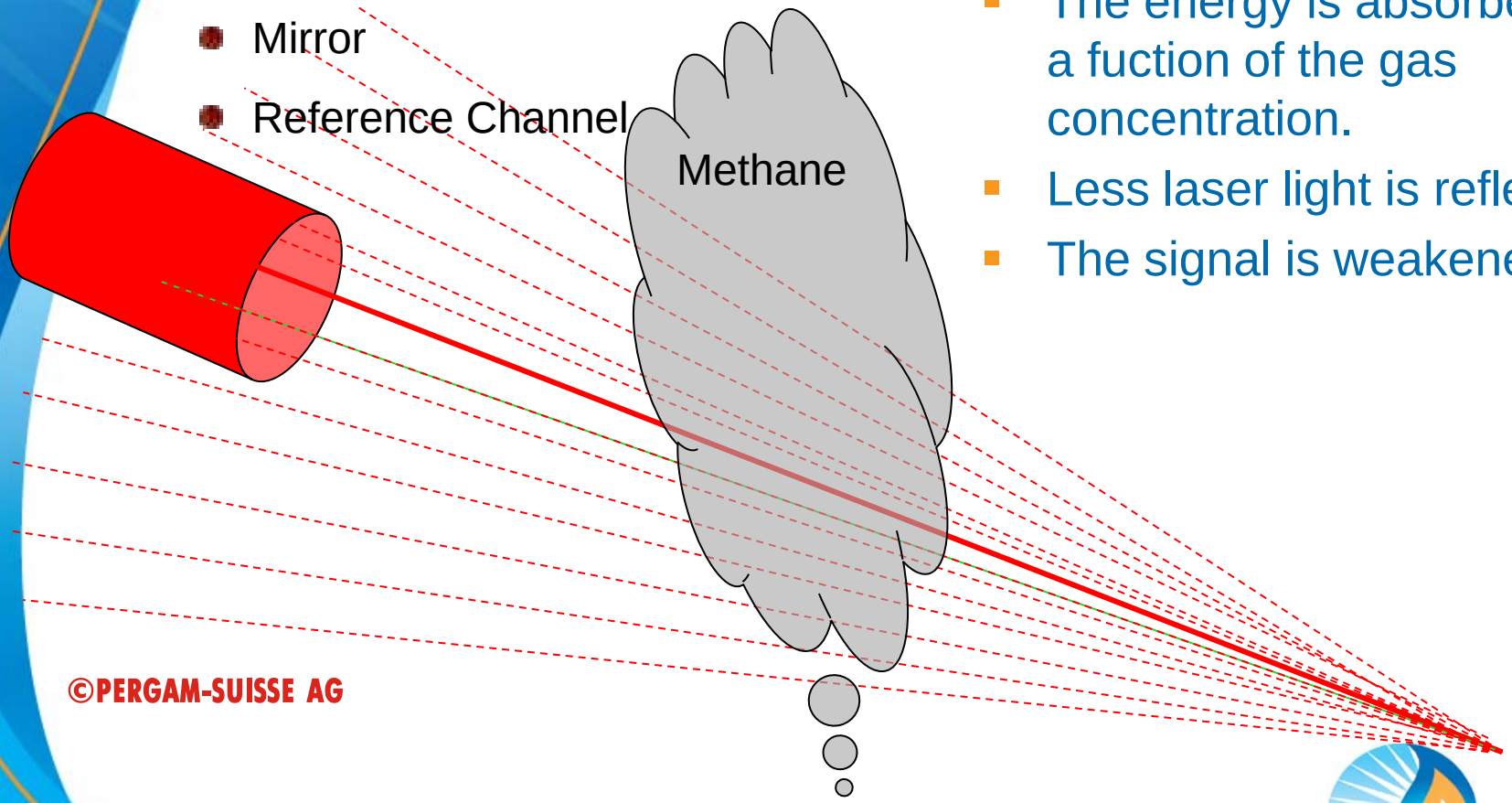


Global Methane Initiative

The Basic Principle

Optical Unit:

- Laser
- Mirror
- Reference Channel

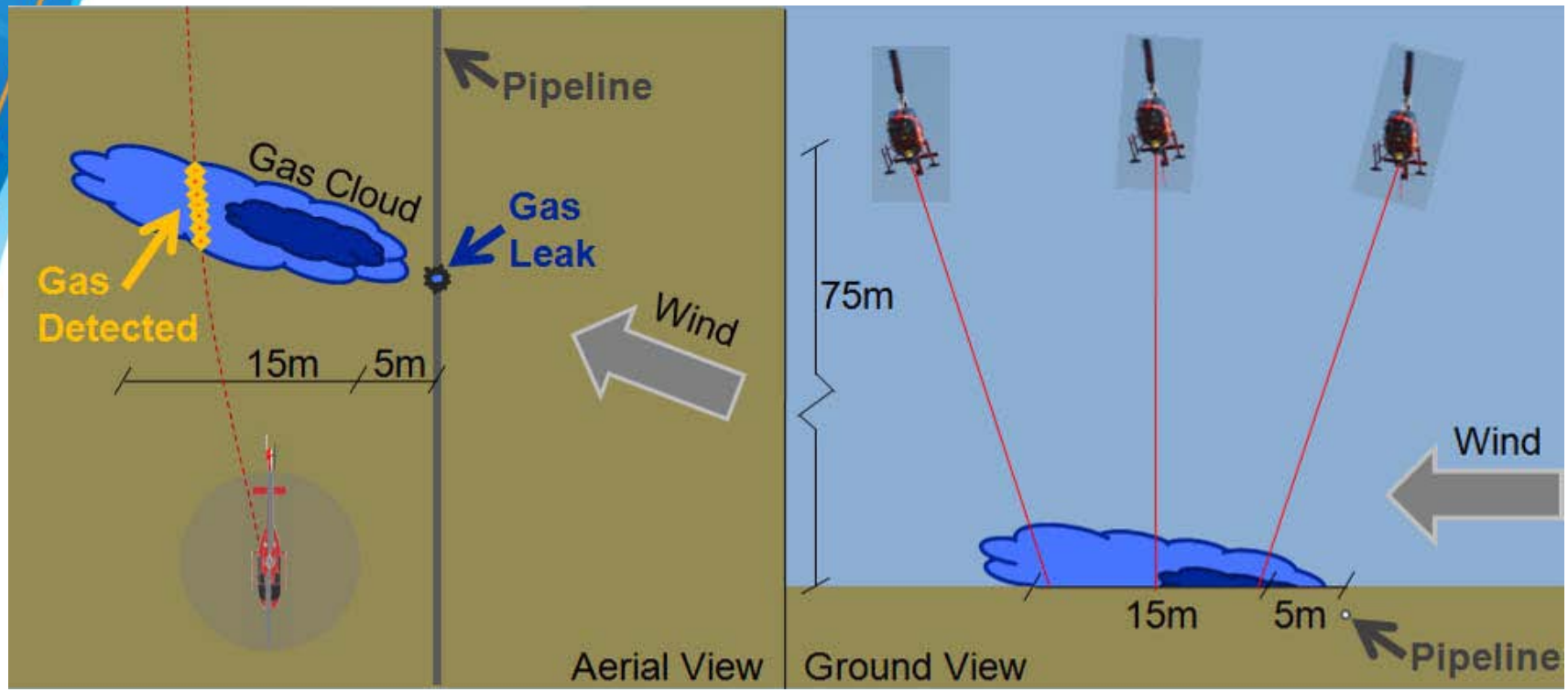


- The laser hits a gas cloud
- The energy is absorbed as a fuction of the gas concentration.
- Less laser light is reflected
- The signal is weakened

Global Methane Initiative

11

We always fly downwind from the pipeline



New Era Technology, Inc.
Aerial Leak Detection & Surveys

Option to Purchase the Plane and Detection Platform or Purchase the Service.

NEW ERA TECHNOLOGY, INC.

Global Methane Initiative

Partner Experience – Chesapeake Energy

- Sept. 2008 flight covered 616 miles
- To cover the same area with ground patrol:
- 4 men: 2 men on 2 crews 2 vehicles and fuel
- 6 hours / day
- 6 miles / day
- Result: 100 days, 3,200 man hours, 5 months of detection
- Flight time was 65 hours
- Real savings in man hours, time, and vehicle fuel

Global Methane Initiative

Partner Experience -DCP Midstream

- DCP Midstream faced with surveying their 66,000mile “spaghetti” like pipelines
- Contacted LaSen Inc. to use their laser remote sensing application on DCP’s gathering lines.
- DCP reported LaSen’s surveys cover 50 to 100 miles per day
- Since working with LaSen, DCP has reduced it’s unaccounted emissions by 50 %

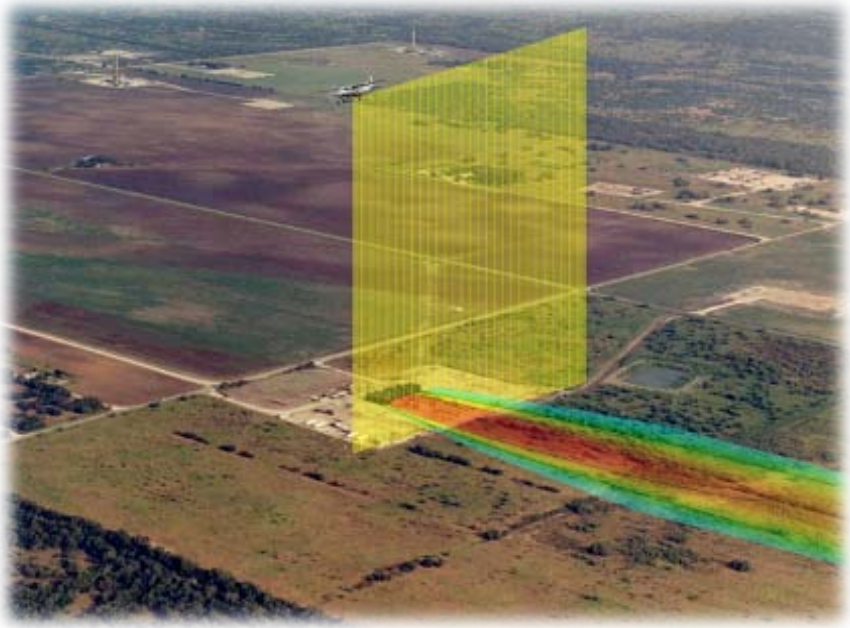
Global Methane Initiative

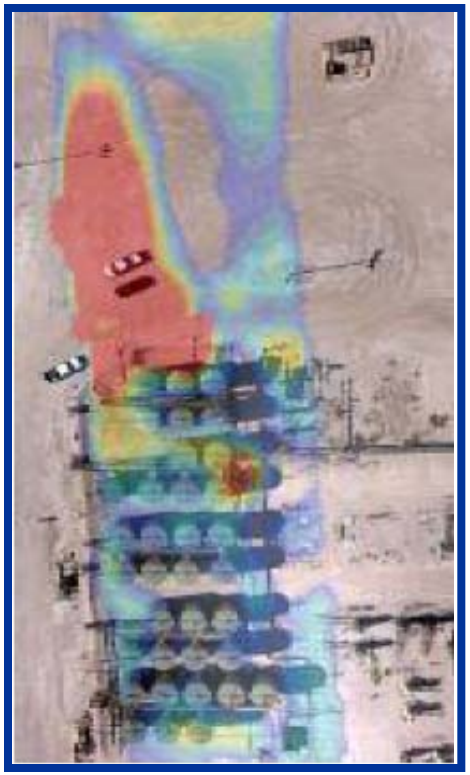
ITT's Aerial Leak Detection Lidar (ANGEL) Service

Global Methane Initiative

Aerial Leak Detection – Emission Rate Quantification

- Airborne Differential Absorption Lidar (DIAL)





- Consider a “fenceline” 100-ft high by 100-ft wide (10,000 ft2)
- At a wind speed of 2 mph = 10,560 ft/h, 1.056 E8 Std-ft3/hr of air flow across that fenceline under standard conditions
- If the air contains 1000 ppm of methane on average (0.1%), then the methane flow is 105,600 SCFH = 2545 MSCF/D

Global Methane Initiative

OPGAL: EYE-C-GAS
Fugitive Emissions Detection Camera

- A design formed by the demands of the industry.
- Specially designed for the applicative market of natural gas, oil and petrochemical industries.
- Design for intrinsically safe, allowing the inspection at hazardous places in the plant.

Global Methane Initiative

How The Eye-C-Gas Camera Works

- The leaking gas temperature differs from the background temperature,
- The EYE-C-GAS™ camera spectral band coincides with the emissivity (absorbance) spectra of the leaking gas,
- The sensitivity of the EYE-C-GAS™ camera enables the measurement of the difference in signal value, caused by the leaking gas
- EYE-C-GAS™ produces images of infrared energy and display it on a screen, similar to how a camcorder displays video.

Global Methane Initiative

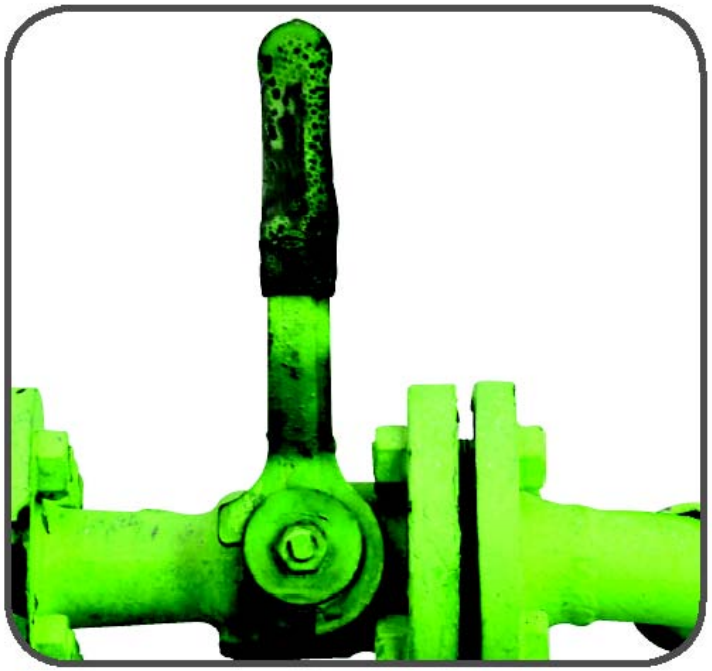
What the Eye-C-Gas Camera Does

- Detects smaller leaks or leak sources that have minimal temperature contrast with enhanced imaging mode of operations
- Implements an internal video and audio recording device.
- Features a large color LCD display for image and text display.
- Rugged and durable by design to be used as a tool in the field.
- The EYE-C-GAS™ includes a digital CCD camera for fast recognition of the components being inspected or leaking for video recording.

Global Methane Initiative

EYE-C-GAS™

INVISIBLE GAS INTO VISIBLE DISPLAY



What you see

EYE-C-GAS™

Global Methane Initiative

What does passive plume imaging look like

Source: Heath Consultants Incorporated

Global Methane Initiative

Infrared Methane Leak Detection

Video recording of fugitive leaks detected by various infrared devices

Global Methane Initiative

23

Contacts and Further Information

- More detail is available on these practices and over 80 others online at: epa.gov/gasstar/tools/recommended.html
- For further assistance, direct questions to:

Scott Bartos
EPA Natural Gas STAR Program
bartos.scott@epa.gov
+1 (202) 343-9167

Milton W. Heath III
Heath Consultants Inc.
Milt.heath3@heathus.com
+1 (713) 844-1304

Global Methane Initiative