

## New system for detecting, mapping, monitoring, quantifying, and reporting fugitive gas emissions

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## Who is Picarro?

- Leading provider of solutions for trace gas concentrations and stable isotopes across many scientific applications & energy market.
- Over 45 patents owned by Picarro or exclusively licensed from Stanford University
- Global HQ, including R&D and manufacturing in Santa Clara, California
- 100 employees including 35+ STEM PhDs
- Over 2,000 Picarro instruments in 60+ countries world-wide





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## Who is SGS?

- SGS is a leading sampling, inspection, testing, verification and certification company.
- SGS employs over 90,000 people globally and operates a network of more than 1,650 offices and laboratories globally.
- Core activities of the SGS Group include consultancy, inspection and monitoring services to a range of industries including petroleum.
- Offices in Brisbane and Chinchilla to provide vehicles, resources and support.



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## **Instrumentation: Picarro Surveyor**





- Advanced emission detection system.
- Detect emissions at hundreds of metres.
- Gear attached to the vehicle.
- Analyser is fitted inside the vehicle.



# Gas analyzer: Cavity Ring-Down Spectrometer (CRDS)





With Sample

Without

Sample

Time (µs)

- Highly sensitive (<1 ppb)</li>
  - -Measure from the road
- Low drift (3 ppb over 1 month)
  - -No in-field calibrations
- Continuous measurements (2 Hz speed)

## **Picarro Surveyor™: Mobile Methane Sensor**

P-Cubed<sup>™</sup> is Picarro cloud-based computational software



## P-Cubed displays actionable methane data





## "Curtain View" visualization for background methane monitoring



**Concentration is not reliable indication of emission rate** 



## **Example of emission rate** *≠* **concentration**

## 6.1 ppm > 4.3 ppm





## Emissions: 3.29 SCFH ~ Emissions: 3.54 SCFH

ppm = parts per million SCFH = standard cubic feet hour

## To measure emissions, use a vertical sampling system

- Plume is measured along its entire height and width by passing through the "flux plane" created by multiple inlets on moving mast
- By measuring the amount of gas passing through the flux plane from the entire plume, the emissions rate can be determined
- Repeated measurements of the same plume refine precision

←	Wind direction
<image/>	Mathematical Action

## **Picarro Surveyor performance**

- Compared instrument performance by releasing methane at a controlled rate in a natural gas training facility
- Agreement between Picarro Surveyor and controlled release rate on 13/16 measured sources located within 100 m away



# An example of the emission reports produced after surveying

Color-coded LISA indication markers indicate both measurement location and emissions
 SCFH



## **Survey or Measurement Protocol**



- Start a survey using tablet
- Drive around all the infrastructure of interest
  - –To quantify well pads' emissions, drive around it at least 4 times
  - As long as driving forward and less than 65 kph, instrument is measuring
  - -Survey speed = Driving speed
- In 3 days, surveyed and quantified emissions of 137 well pads and associated infrastructure

## **Driver View as surveying**



### Add field notes for other sources



### Infrastructure with no emissions



### **Emissions report of the same area**





## **Emissions report of entire field**



## Easily determine which field emits more compared to



#### **Surat Basin compared to Barnett Shale in Texas**

Caveat: Barnett Shale data skews towards higher emitters because

- Limited to public-road access
- Barnett Shale infrastructure significantly older

	Surat Basin, Australia	Barnett Shale, USA
Number of well pads sampled	137	115
Highest emission	10.3 lpm	1,210 lpm
Median emission	2.0 lpm	16.0 lpm
Lowest emission	0.2 lpm	0.7 lpm

#### **Surat Basin compared to Barnett Shale in Texas**

Surat Basin emission distribution is significantly narrower



## Putting the emissions in context

Compared to cattle output:

- Average emission = 2.4 lpm ~ 11 head of cattle
  - EPA emission factor for a mature non-diary Australian female cow: 63.2 kg/head/yr



## Investigating methane sources using Picarro Mobile View



- Mobile webpage app
- Past survey's LISAs overlaid on map
- Optional: pipeline GIS information overlaid on map (shown in purple). Pipelines within LISAs that are most likely to be emitting are highlighted in yellow
- Google Map directions provided to take user to LISA location
- Once leak found, notes can be added that is stored on P-Cubed server for administrators/supervisors to view
- Blue dot shows users' current location based on phone GPS

## **Example of methane source locating**

- Survey with Picarro Surveyor indicates a methane source
- Emission = 11 lpm

 Curtain View used to visualize plume location





## Locating and recording methane source with Picarro Mobile View

 Picarro Mobile View guided user to methane source and record GPS position of leak source once identified (blue dot)





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## **Potential applications**

- Pinpointing hard-to-find methane sources
- Rapid, emergency survey, post-disaster evaluation (earthquakes, cyclones, wild fires, landslides, floods, etc.)
- Prioritization of infrastructure replacement
- Due-diligence for asset acquisition
- Monitoring high-risk infrastructure
- Routine regulatory compliance leak survey
- Quantifying fugitive emissions from infrastructure
- Risk-based assessment surveys

## Thank you!

- SGS Field team: Kristian Hansen, Damien Todor, and Lesley Kirstenfeldt
- Picarro: Johnathan Dang and Adolfo Aguirre



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Back up



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## **CRDS: time, not absorbance**

- CRDS utilizes the unique infrared absorption spectrum of gas-phase molecules to quantify the concentration of (and sometimes isotopes of) H<sub>2</sub>O, CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O, CH<sub>2</sub>O, NH<sub>3</sub>, etc.
- Measure decay rate, rather than absolute absorbance



- Small 3-mirrored cavity ~ 35 cc
- Long effective path-length (> 10 km)
- Time-based measurement
- Laser is switched on and off, and scanned across wavelengths

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#### Increasing concentrations, faster ring-down

