

Regional Methane Monitoring Networks

Presented to:

Gas STAR Technology Transfer Forum

Transmission and Storage: Partner Experience in Methane Emissions Management

Presented by:

Ted Weaver, CEO

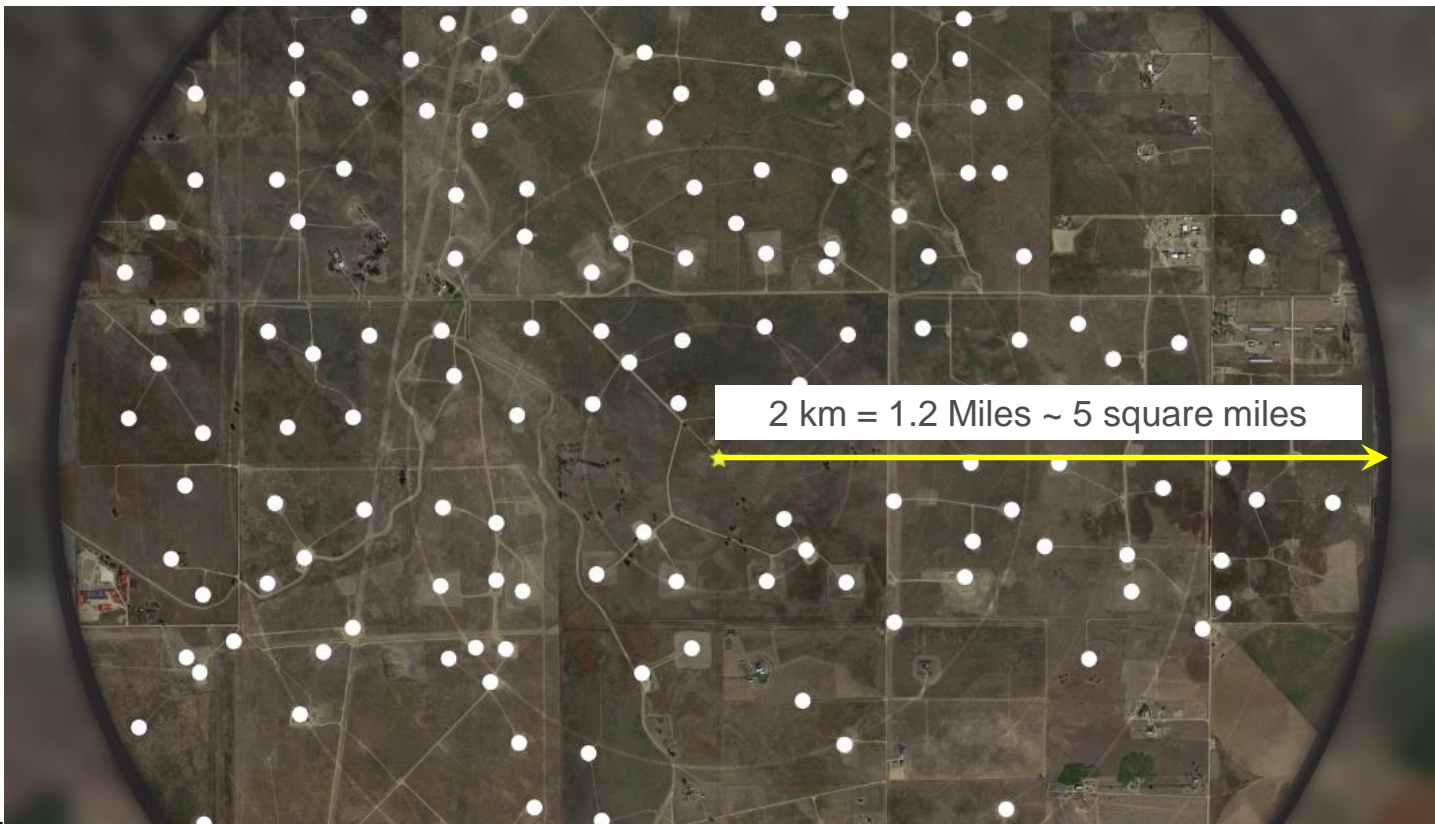
June 7, 2018



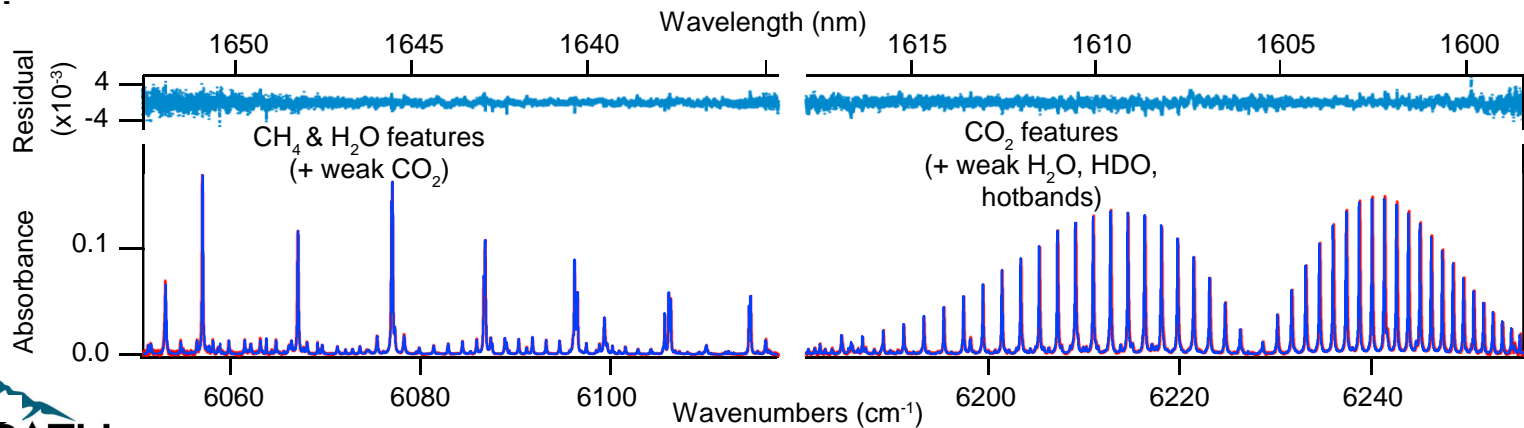
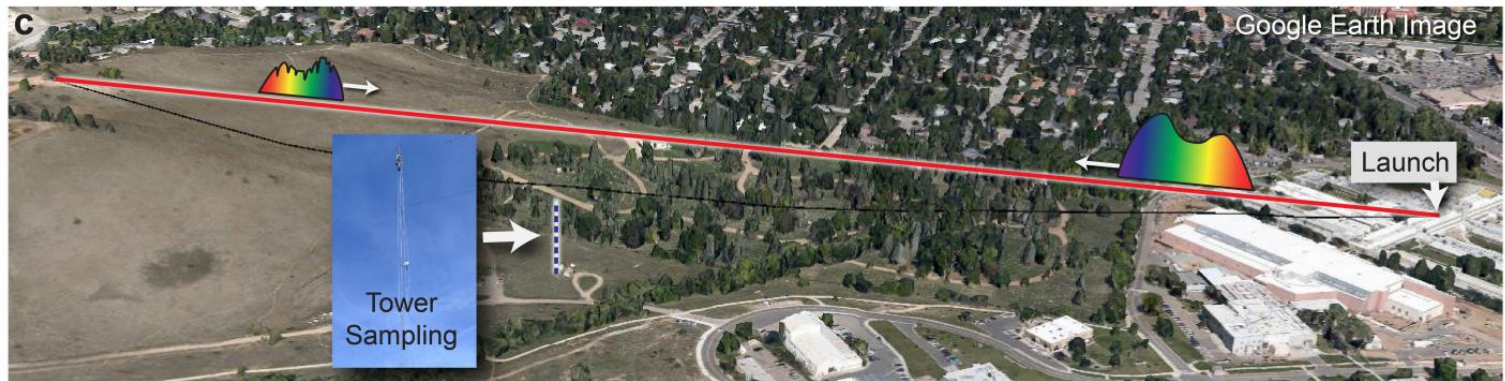
Our Solution: Regional Detection Networks



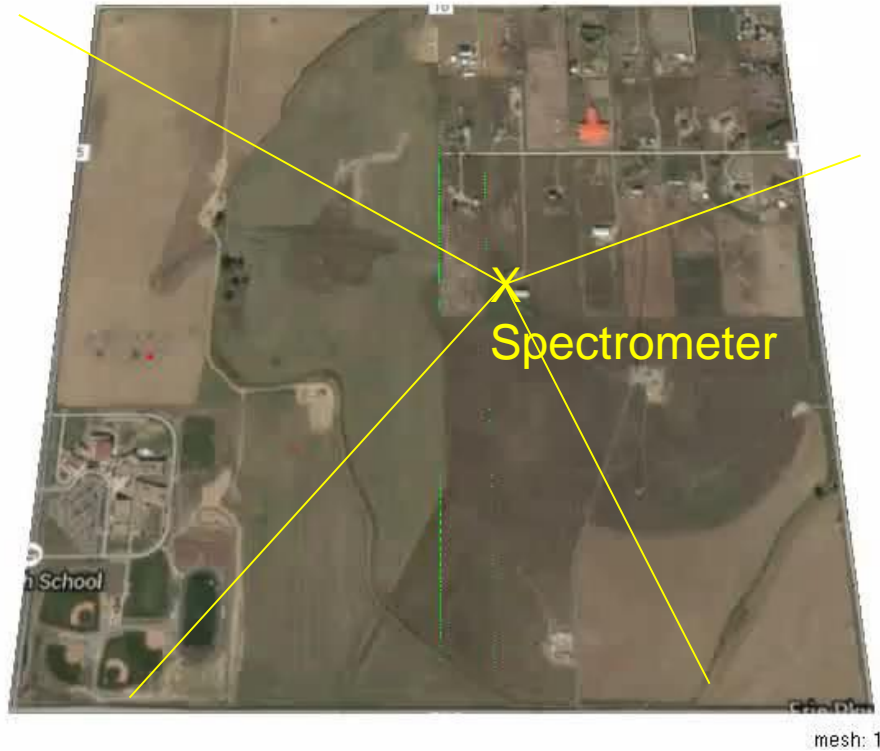
Regional Methane Monitoring Networks



Invention 1: Dual Comb Laser Spectrometer

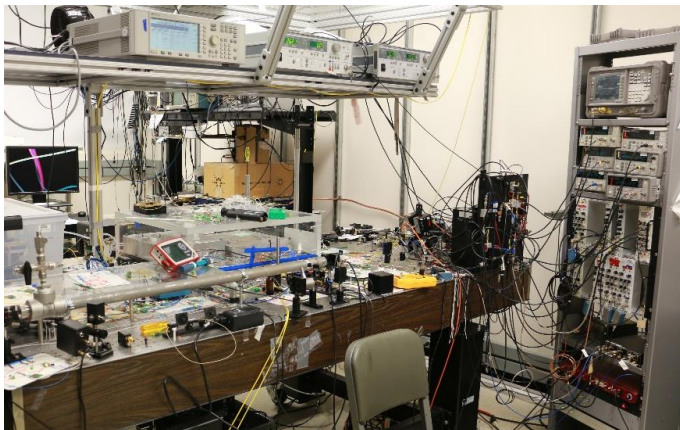


Invention 2: Atmospheric Inversions



Frequency Comb Laser Spectrometer

Proof-of-Concept Spectrometer



- Room-sized
- Sensitive to...everything



Robust, Portable System

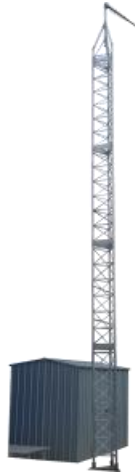


- Portable 19 inch rack mounting
- Robust against vibration and temperature change
- 10X reduction in size
- 10X reduction in cost

Two Deployment Strategies

- **Fixed Tower**

- Stationary
- Continuous monitoring
- Advanced monitoring program
- Better environmental performance

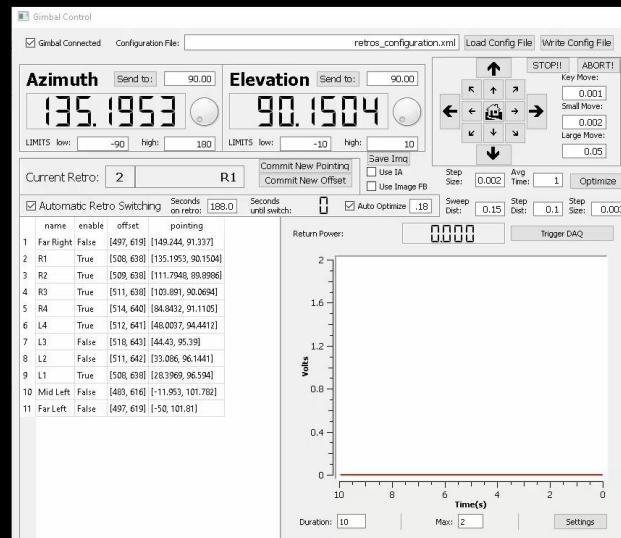
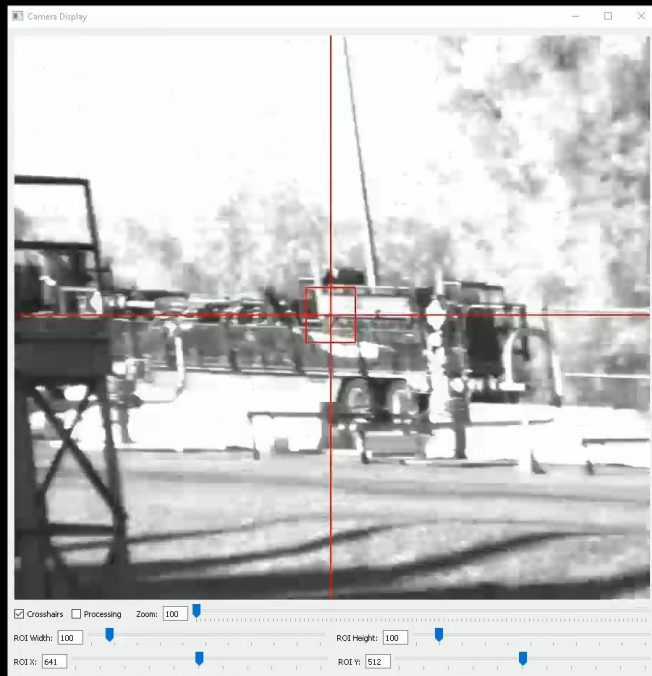


- **Mobile Solution**

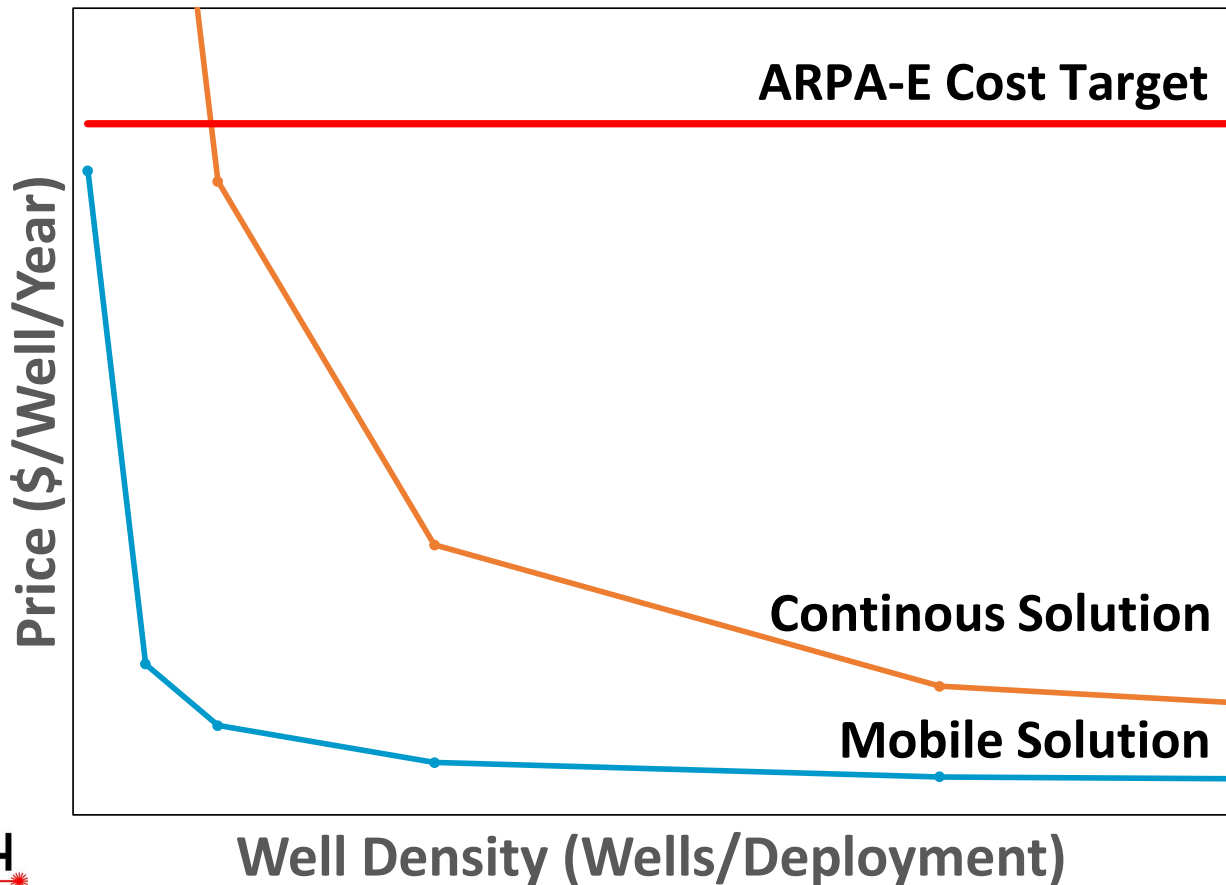
- Trailer mounted
- Periodic monitoring
- Match current regulatory schedules



Autonomous Operation



Service Pricing: Exponential Scale Economy



ARPA-E METEC Field Test Results

- **Range:**

- 1 km range

- **Detection:**

- 17 of 17 leaks
- Detected “zero leak” case
- Smallest leak was 3 scfh

- **Attribution**

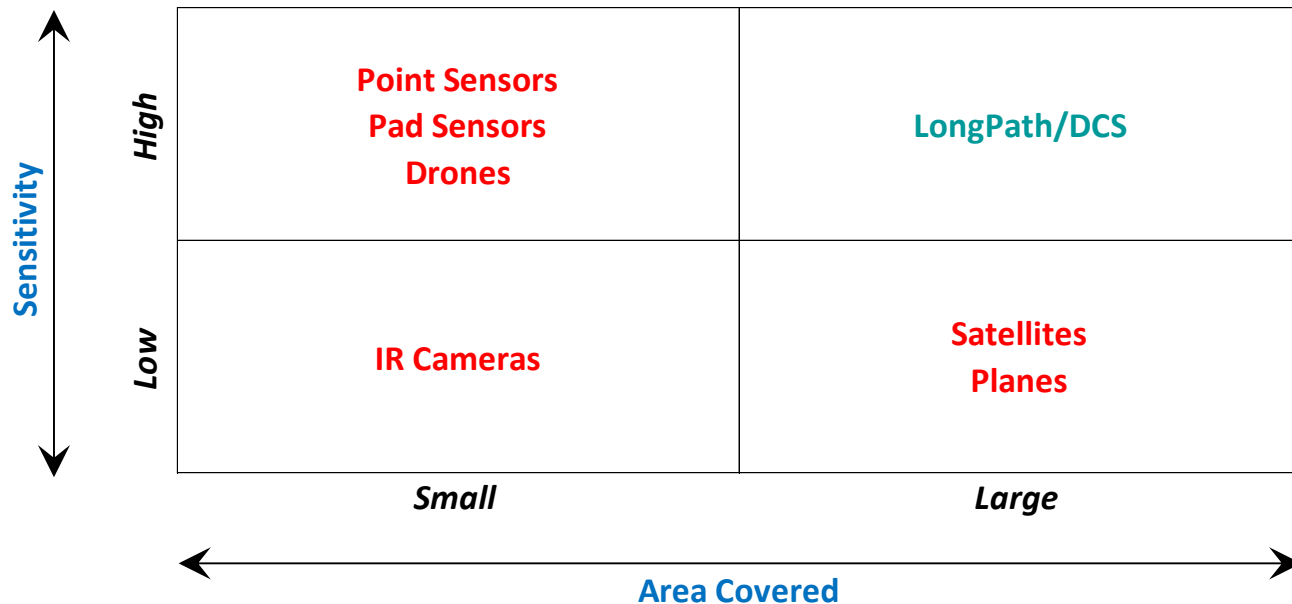
- Correct pad for all multi-pad leaks
- Within 5+ meters for 14 of 17 leaks

- **Quantification**

- 17 of 18 leaks within 20 scfh
- No false positives; no false negatives



How Do We Compare to Other New Entrants?



Demonstration Partners

Upstream Production

Anadarko Petroleum

- 10th largest oil & gas company in US



CMC Research Institutes

- Early stage technology demonstrator for Canadian oil & gas industry



Natural Gas Storage

- Confidential California Storage Field Operator

• Xcel Energy

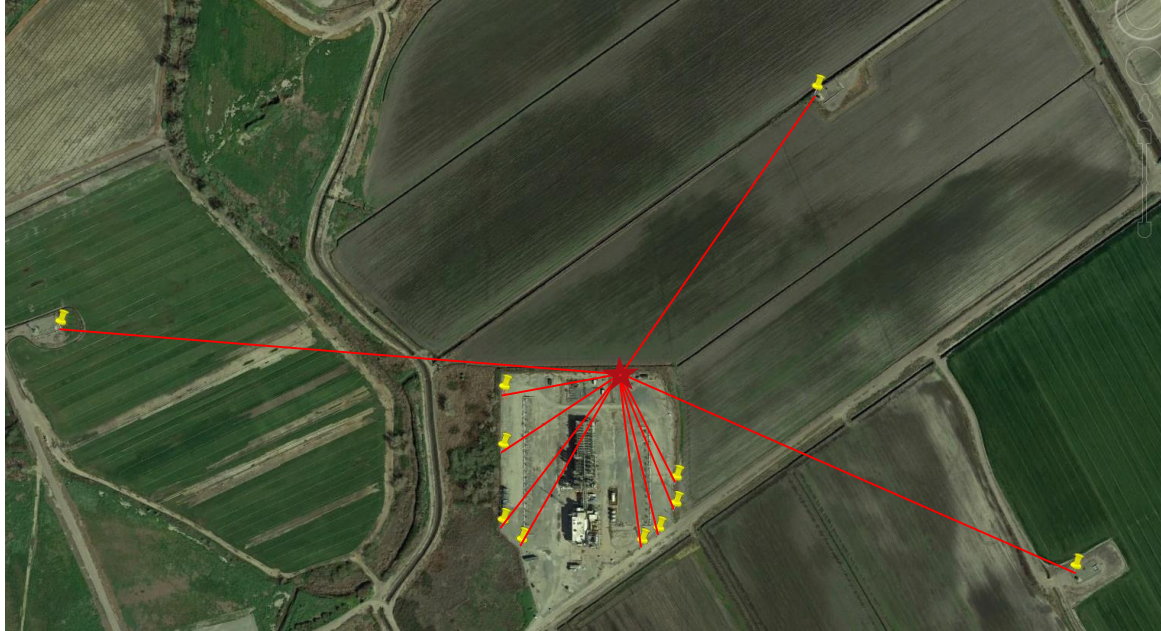
- 2 million customers in 7 US States



Storage Deployment: Approach 1

Focus on injection wells

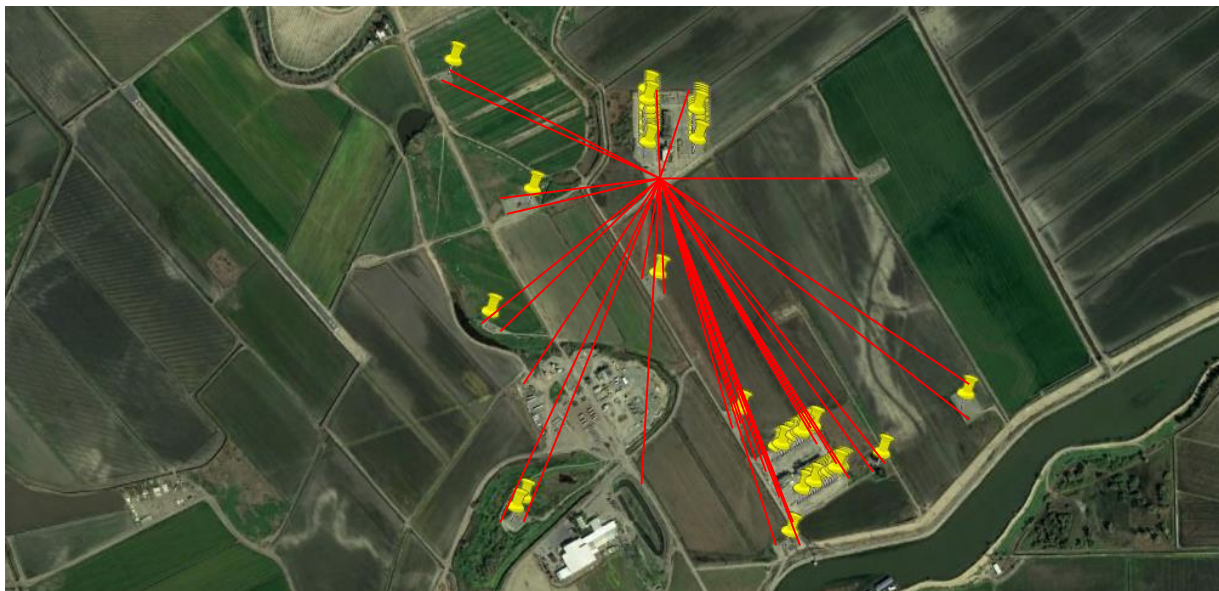
- 8 on platform (distances between 140 and 230 meters)
- 3 outside “background” retros (400 to 670 meters)



Storage Deployment: Approach 2

Expand to entire facility

- Source attribution for all well heads and gas handling platforms
- Total facility flux measurement



LongPath Team



Ted Weaver, CEO

- 35+ years, energy industry
- 2 service startups, w/exits
- 5 Fortune 500 internal startups
- BS, MIT



Greg Rieker, CTO

- PI for original work
- PI for DOE, DOD grants
- Co-Founder, Fluence, LLC
- PhD, Stanford



Robert Wright, Engineer

- Lead: optics design
- Extensive optics background
- 2 early stage companies
- MS, Rochester



Sean Coburn, Scientist

- Lead, deployment
- Extensive laser monitoring experience
- PhD, CU



Caroline Alden, Scientist

- Lead, Analytics
- Extensive atmospheric modeling background
- PhD, CU
- Post-doc, Stanford



Robert Gill, Board

- Ex-President, Ball Corp
- Ex-CEO, 5 Startups
- Founder, Vantage Point VC
- Ex-Chair, Deming Center, Boulder Innovation Center



Merc Mercure, Advisor

- Founder, Ball Corp
- Founder, 2 Optical Startups
- Board, Multiple Companies
- Ex-Director, CU TTO
- PhD, CU



Bill Roberts, Advisor

- Corporate Attorney
- Extensive startup experience
- Advisor, Silicon Flatirons
- BA, CU
- JD, Harvard