Deployment of New Technologies for Leak Detection and Quantification at PG&E

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CH_4 Connections

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Together, Building a Better California

Company Profile

- Pacific Gas and Electric Company, incorporated in 1905, is one of the largest combination **natural gas and electric utilities** in the United States.
  - The company provides natural gas and electric to approximately 15 million people throughout a 70,000-square-mile service area in northern and central California.
  - Service area stretches from Eureka in the north to Bakersfield in the south, and from the Pacific Ocean in the west to the Sierra Nevada in the east.

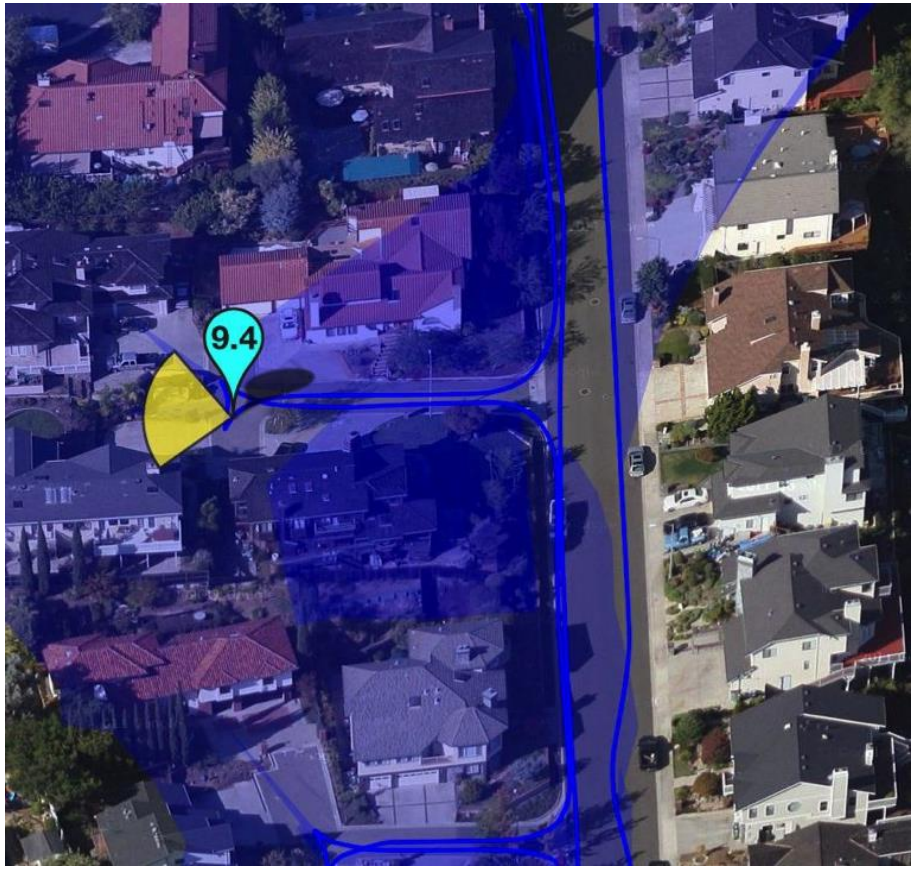
- <u>Gas Operation Key Statistics</u>
  - **5,800 miles** of gas **transmission** pipeline
  - Approx. **42,000 miles** of gas **distribution** main
  - 4.3 million natural gas customer accounts.
  - Deliver 820 BCF/year (2.62 CF/daily average)

Mobile Leak Detection

- PG&E was the first gas utility in the USA to use high-sensitivity mobile leak detection system
- It is today deployed as part of PG&E's safety leak survey process

Re-inventing the process

- Compliance survey:
  - Redefined the leak survey process around mobile technology
    - Driving protocol
    - Investigation around methane indications
    - Coverage and gap investigations
    - The “5 foot rule”
  - Adapted resources to leak found rate
    - Leak investigation
    - Leak repair

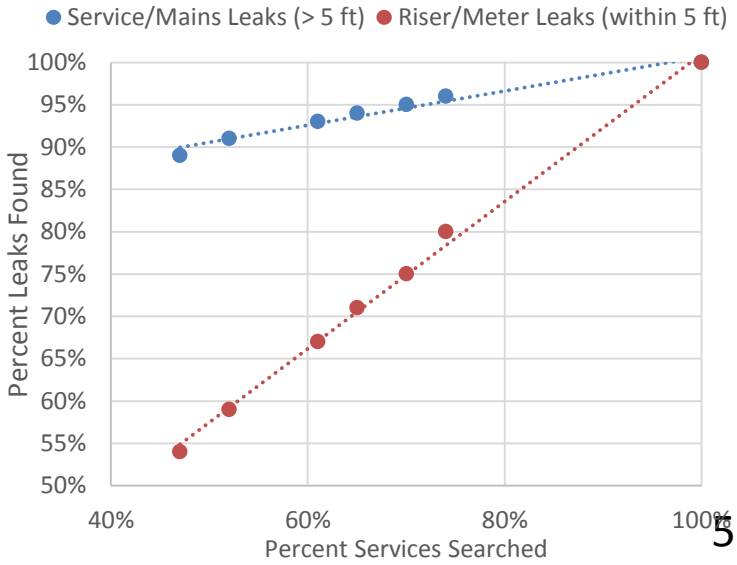


Asset coverage with mobile leak detection, indication of higher methane concentration, coverage gaps

Continuous Improvement

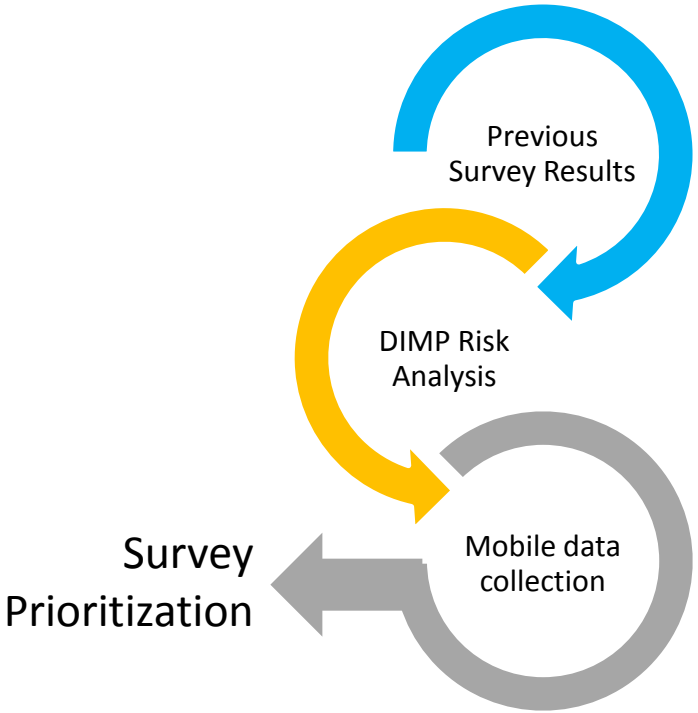
Coverage gaps are surveyed by foot using traditional technologies

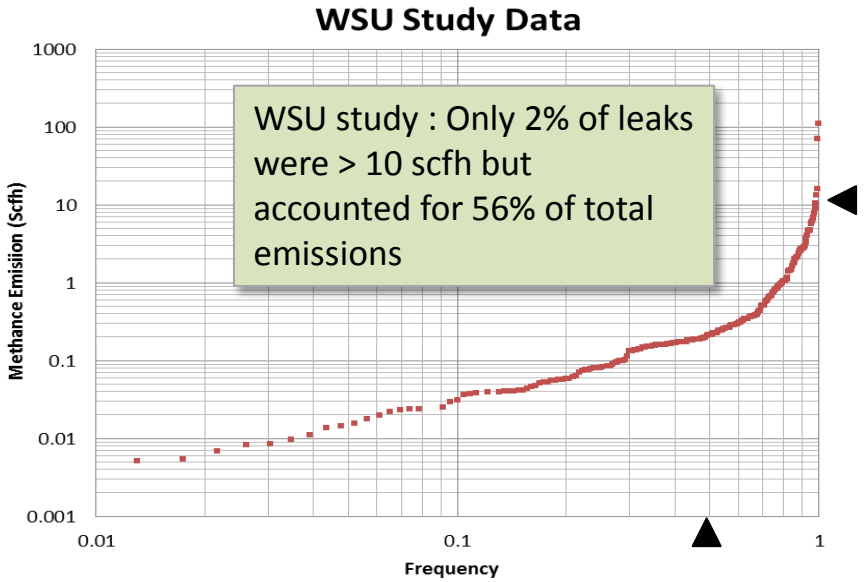
- Data collected through mobile survey and leak repair are systematically analyzed to optimize:
  - Leak indication filtering
  - Coverage modeling
  - Investigation areas

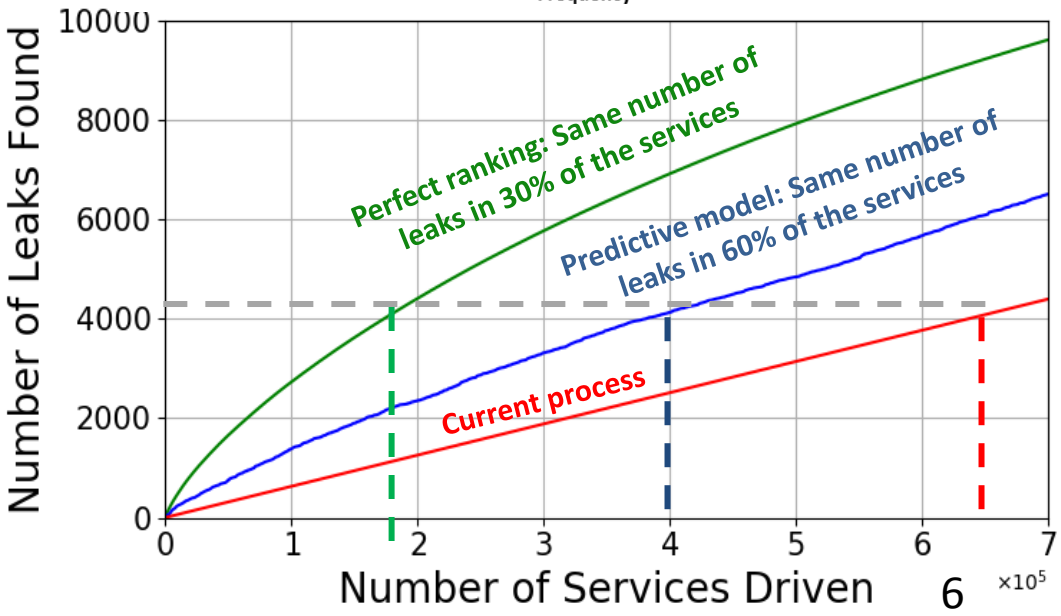


New Applications

- Methane abatement:
  - Accelerated detection and repair of large leaks of the distribution system
- Risk based leak survey:







Stationary Systems to address variable Sources

- In facilities, methane emissions are a function of operations
- Stationary detectors help to correlate emissions and operations
- We are also exploring quantification possibilities

Heath (right) and Sensit/Acutect (left) detectors installed at PG&E storage and regulation facilities

Towards light and versatile systems

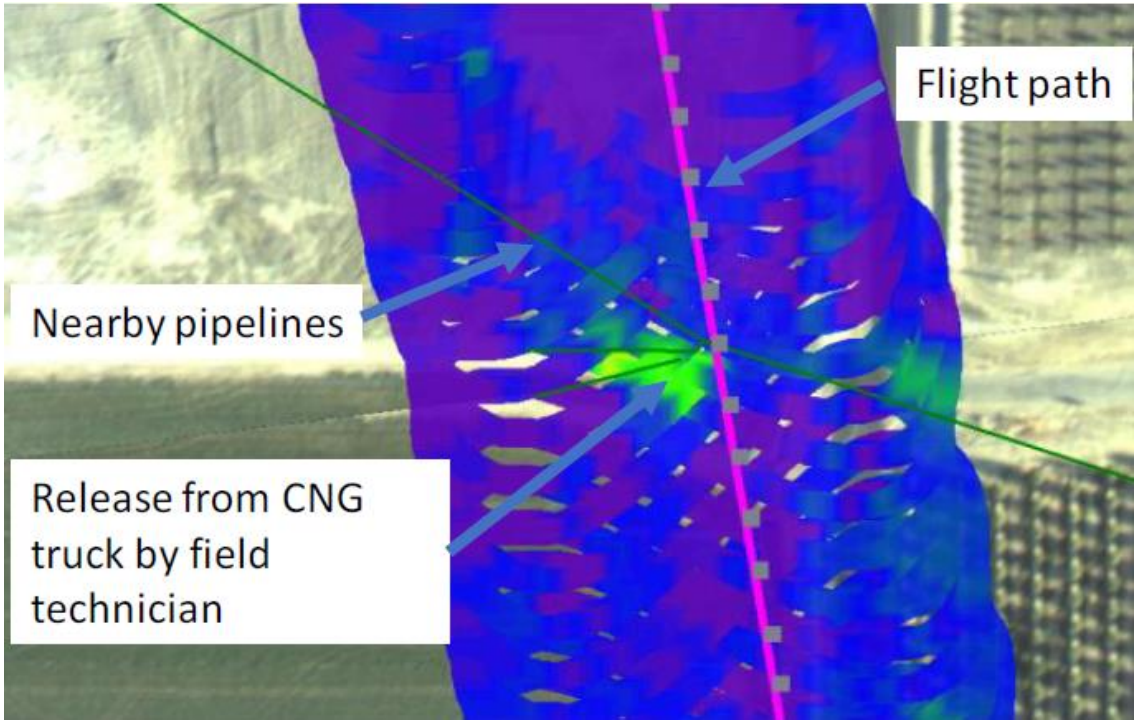
- Based on NASA's device used to detect methane on Mars.
- The detector has **superior sensitivity (parts per billion)** and is lightweight (150g) compared to existing technologies

Prototype of the handheld methane-ethane detector.

UAV mounted detector being tested at UC Merced.

New aerial survey system

- Quick detection of sizeable leaks on the transmission system
- Differential Absorption LiDAR DIAL system on a fix wing single engine aircraft
  - 150 - 900 ft. swath
  - Altitude: 3,000 ft.
  - Speed: 125 m/h
- Field tests in 2017
- Pre-deployment pilot in 2018



Controlled release of ~133 SCFH methane on October 3rd 2017

Exploring new technologies

- Inexpensive distributed leak detectors
  - Bioinspira
    - Reactive protein
  - Stanford
    - Electrochemical potential
- Optical Gas Imaging
  - Control and field testing
- Open-path Laser Comb technology
  - Demonstration at our storage facility

University of Colorado's methane sensor trailer at McDonald Island and a map of their plan

Take away

- Advanced Technology is a key part of PG&E's leak management strategy
- Mobile leak detection deployment has been a several year process that led successively to:
  - Vetting through controlled and field testing
  - Design and optimization of a new leak management process
  - Continuous improvement using data collection capabilities
  - Additional applications
- Beyond mobile leak detection a broad range of technologies are being explored and developed in collaboration with many organizations

Thank you

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