LEAK DETECTION AND REPAIR

(LDAR)

FINDING AND FIXING FUGITIVE EMISSION SOURCES

REGULATORY AGENCIES

The following agencies contain codes pertaining to detecting and repairing leaks in Oil and Gas operations in Utah:

- EPA (Environmental Protection Agency)
- BLM (Bureau of Land Management)
- UDAQ (Utah Department of Air Quality)
- DOGM (Division of Oil, Gas, and Mining)
- PHMSA (Pipeline and Hazardous Materials Safety Administration)

LDAR: A REGULATORY OVERVIEW

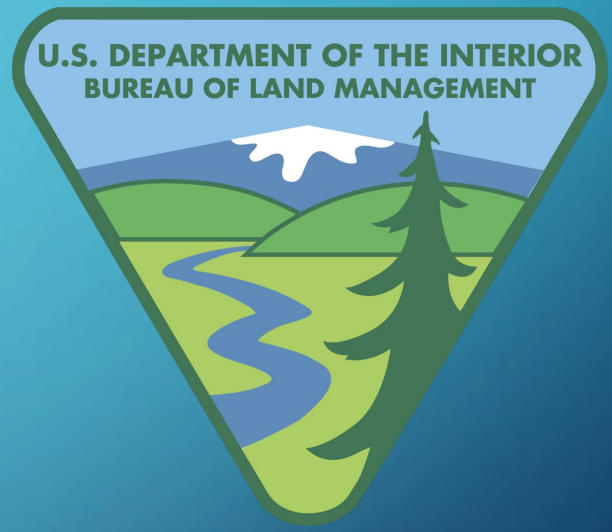
Environmental Protection Agency (EPA)

- 40 CFR Part 60: Standards of Performance for New Stationary Sources (NSPS)
  - Subpart OOOO(a) – emission standards for new/modified sources (legacy equipment exempt)
  - LDAR requirements for equipment/sites/components
  - Method 21 (instruments detecting leaks, not people)

- 40 CFR Part 98: Mandatory Greenhouse Gas Reporting
  - Subpart W: Calculates emissions from various sources in Oil & Gas operations
    - Pneumatic valves, engines (compressors, generators, heaters, etc), flares, tank flash gas
    - Oil & Gas production volumes

LDAR: A REGULATORY OVERVIEW

Bureau of Land Management (BLM)



- Waste Prevention Rule
  - Regulates waste of gas through venting, flaring, and leaks
  - Waste Minimization Plan (WMP)
  - Flaring limits

- 43 CFR Part 3170 Subpart 3179 - Leak Detection and Repair (LDAR)
  - Oil and gas operations on federal and tribal land
  - Audio-Visual-Olfactory (AVO) & Optical Gas Imaging (OGI) inspections

    (Human vs. instruments detecting leaks)
  - Mandatory repair timelines

LDAR: A REGULATORY OVERVIEW

Utah Division of Air Quality (UDAQ)

- Utah Administrative Code R307-509
  - Oil and Gas LDAR Requirements differ slightly from federal code
  - Repair timeline: no later than 15 calendar days

    (NSPS OOOOa: 1st attempt within 30 days, fixed within 30 days of 1st attempt)
  - "Fugitive Emissions" definition: OGI/Method 21 equipment reading of >500ppm
  - Applicability depends on type of facility, location, equipment on-site

Utah Division of Oil, Gas & Mining (DOGM)

- Utah Administrative Code R649 – indirectly relates to preventing waste & protecting the environment

LDAR: A REGULATORY OVERVIEW

Pipeline & Hazardous Materials Safety Admin (**PHMSA**)

- 49 CFR Part 192 Subpart M: Leakage Surveys & Repairs
  - § 192.701 – 736: transmission, distribution, some gathering pipelines
  - Frequency of leak surveys, grading leak severity, repair criteria

- PIPES Act 2020
  - Section 114 – Methane Emissions: operators must address minimizing emissions (replace leak-prone pipe, reduce blowdown volumes, fix leaks when found)

- LDAR Final Rule – PAUSED
  - Submitted to Federal Register Jan. 17, 2025
  - Jan. 20, 2025: Executive Order- Regulatory Freeze Pending Review
  - Order to "immediately withdraw any rules that have been sent to the Office of the Federal Register, but not yet published in the Federal Register."

LDAR FINAL RULE (PAUSED)

AI Summary:

- **In summary, the new regulations shift the focus from simply identifying leaks that pose an immediate safety risk to a more proactive, comprehensive, and technologically advanced approach aimed at significantly reducing methane emissions and enhancing overall pipeline safety.** This involves more frequent surveys with more sensitive equipment, a stricter grading and repair framework, and a greater emphasis on minimizing all types of gas releases.

  -Google Gemini AI

LDAR FINAL RULE (PAUSED)

- Leak survey frequencies & methodologies
  - Distribution:
    - Outside business districts: 5yr 3yr
    - Pipelines known to leak: 3yr Annual (15 months)
  - Gathering/transmission:
    - HCA's, valves/flanges/tie-ins/ILI locations: No standard 2-4x/yr
    - All regulated gathering lines: Type B & C exemptions removed
    - More stringent leak grading & repair requirements

LDAR FINAL RULE (PAUSED)

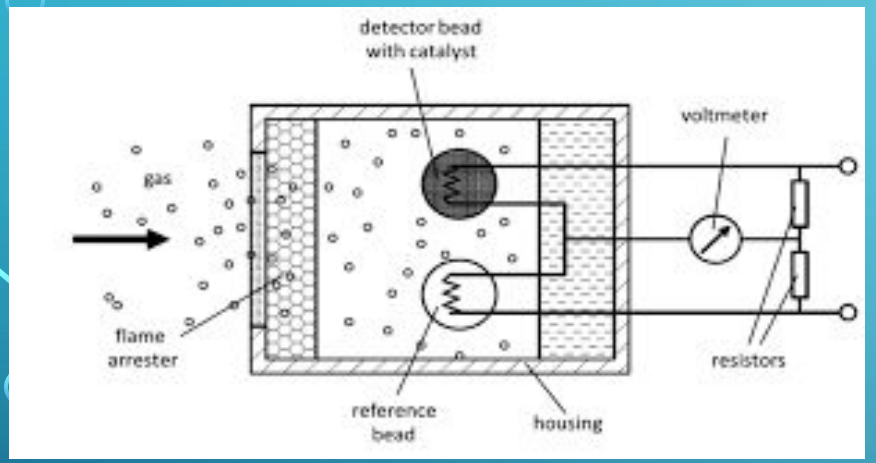
- Advanced Leak Detection Program (ALDP)
  - Sensitivity and Range requirements for leak detection instruments
    - Must be capable of detecting leaks that produce a 5 ppm or greater reading of gas from a distance of 5 feet from the pipeline
  - New written procedures incorporating changes to leak detection frequency, investigation, instrumentation and repairs.
- Leak Grading and Repair criteria are more strict and prescriptive in how repairs must be made

LEAK DETECTION EQUIPMENT

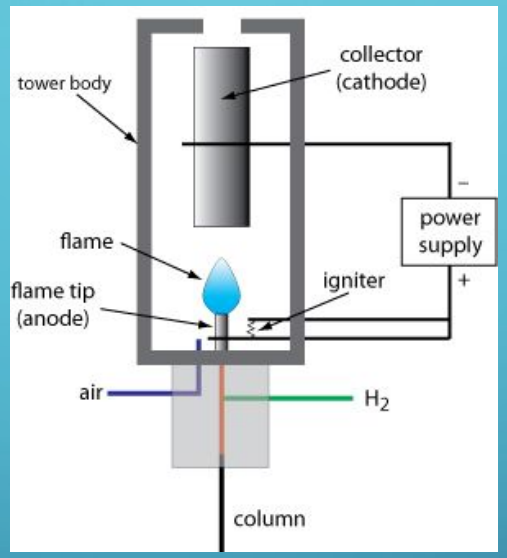
- Historic: sensory (sight, sound, smell)
  - Pre-1950's
- Handheld devices: catalytic sensors, flame ionization detectors, semiconductor sensors
  - 1950's – 1980's; chemical reactions, hydrogen flames, heated film resistance changes
- Advanced:
  - Optical Gas Imaging (OGI)
  - Ultrasonic and Acoustic
  - Infrared Sensors (IR)

LEAK DETECTION EQUIPMENT

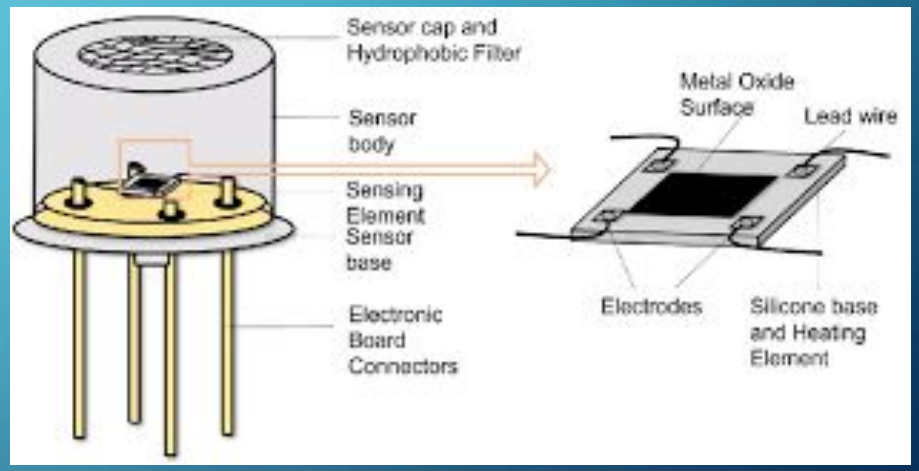
Catalytic Sensor



Flame Ionization

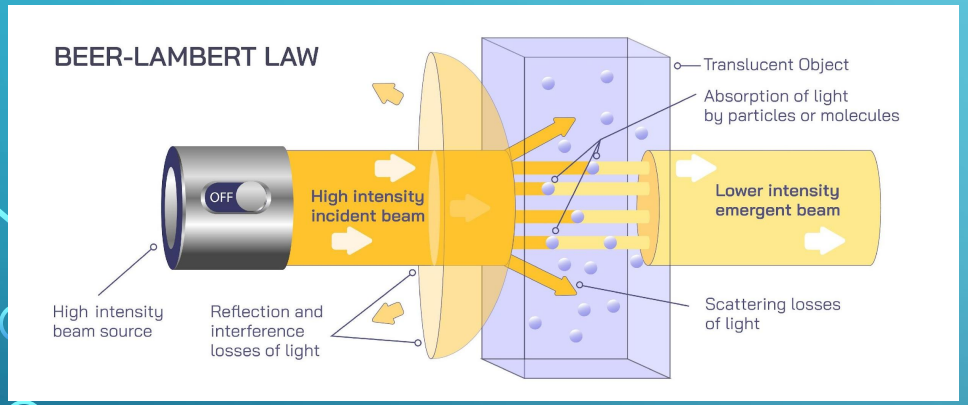


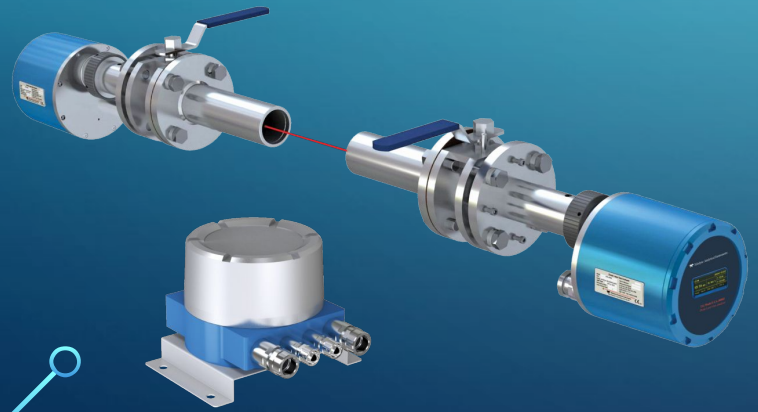
Semiconductor Sensor



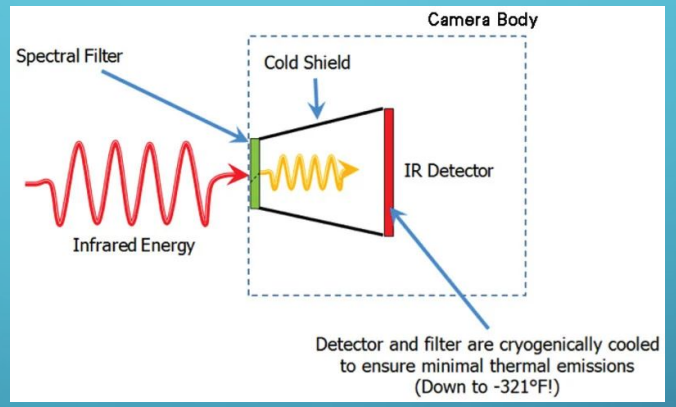
ADVANCED LEAK DETECTION EQUIPMENT

Tunable Diode Laser Absorption Spectroscopy (TDLAS)

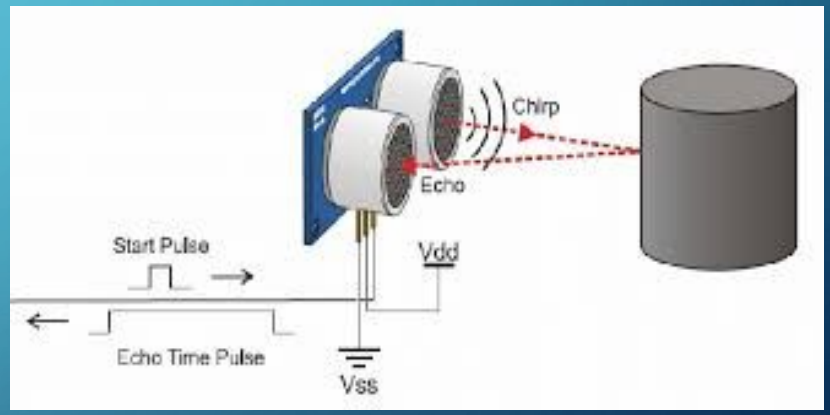




Optical Gas Imaging (OGI)



Acoustic & Ultrasonic



FEDERAL/NONPROFIT STUDIES

- Environmental Defense Fund
- Clean Air Task Force
- NASA/NOAA
- Department of Energy
- Environmental Integrity Project
- EPA Greenhouse Gas Reporting
- Ceres

FEDERAL/NONPROFIT STUDIES

- **Environmental Defense Fund's "Methane Studies":**
  - A series of studies conducted by the Environmental Defense Fund and a coalition of academic and industry partners from 2012 to 2018 demonstrated that methane emissions from the U.S. oil and gas industry were at least 60% higher than the EPA's official estimates at the time. This groundbreaking research was a key driver for new regulations
- **Satellite and Airborne Measurement Data (MethaneSAT and MethaneAIR):**
  - Advanced remote sensing technologies, particularly those developed by or in partnership with EDF, like MethaneSAT and the MethaneAIR program, have provided a new level of precision in measuring methane emissions. These "top-down" measurements have consistently shown that emissions from certain regions and specific "super-emitter" events are much higher than previously reported

STATE PROGRAM STUDIES

- Nevada Leak Survey Study
  - Shifted from 3-year to Annual leak survey in three regions
  - Studied leak grades and total number found
  - Results:
    - 725 leaks found in 2023
    - 701 leaks found in 2024
      - 3% decrease in total leaks found; 19% decrease in Grade 1 leaks
- East Coast States – New York, Massachussets, Pennsylvania

UNIVERSITY STUDIES

- Colorado State University – Methane Emission Technology Evaluation Center (METEC)
  - Projects like "Response Protocol for Large Underground Methane Emissions (R-PLUME)" and "Accelerating Pipeline Leak Detection Quantification Solutions Through Transparent and Rigorous Scientific Validation (APpLIED)" directly contribute to understanding leak behavior and optimizing detection protocols
- Johns Hopkins University – “walking surveys”
  - High-precision methane detectors: findings indicate under-reporting of leaks from traditional leak survey equipment
- Stanford University - Environmental Assessment and Optimization Group
  - This group conducts extensive research on methane leakage from natural gas systems, including systematic synthesis of research on gas leakage and testing of methane detection technologies in the field.

INDUSTRY-LED INITIATIVES

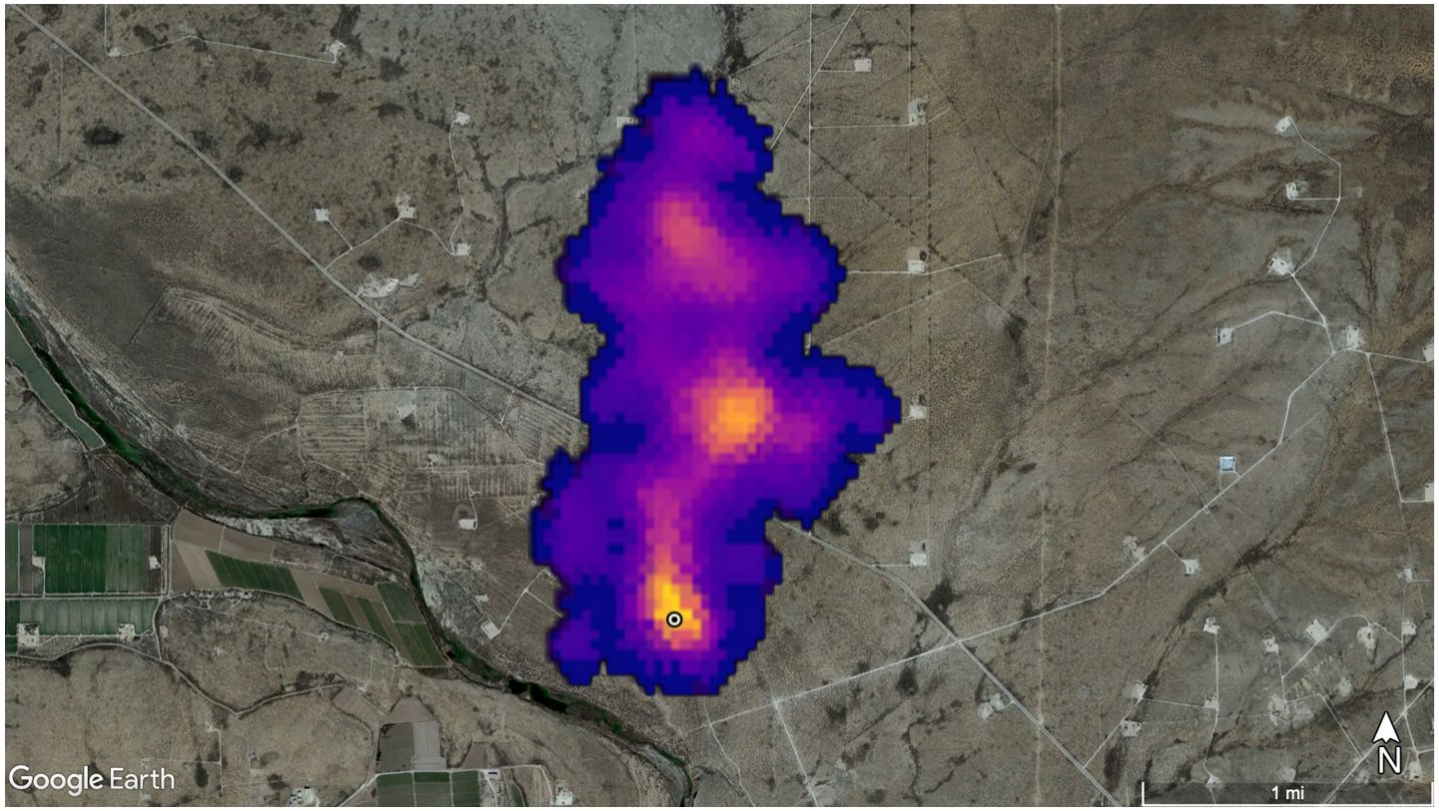
- Gas Research Institute
- Southwest Research Institute
- Oil and Gas Methane Partnership (OGMP 2.0)
- Kairos Aerospace and Carbon Mapper
- Oil and Gas Climate Initiative (OGCI)

COMMON FINDINGS

- **Underestimation of Leaks:** Studies consistently show that traditional leak survey methods (e.g., soap solution, flame ionization detectors) often underestimate the number and volume of methane leaks from natural gas infrastructure.
- **Effectiveness of Advanced Technologies:** Advanced leak detection (ALD) technologies, such as infrared cameras (OGI), laser-based sensors, and aerial surveys, are significantly more effective at identifying leaks, including those that are small or diffuse, compared to older methods.

COMMON FINDINGS

- **"Super-Emitters":** A small percentage of leaks (often dubbed "super-emitters") are responsible for a disproportionately large amount of total methane emissions, making their rapid detection and repair critical.
  - 2014 NASA study identified a massive methane cloud over 4 corners region in New Mexico
  - 2024 Super Emitter Program – certified 3rd parties notify EPA, operators must investigate
    - "Super Emitter" event = Methane release of >100kg/hr
- **Variability and Complexity:** Leak detection effectiveness can vary significantly based on pipeline material, age, location (urban vs. rural, above-ground vs. buried), weather conditions (especially **wind**), and surrounding infrastructure. Research helps to understand these complexities and develop more robust survey protocols.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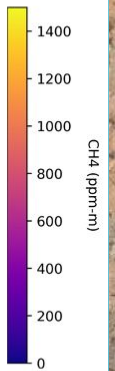
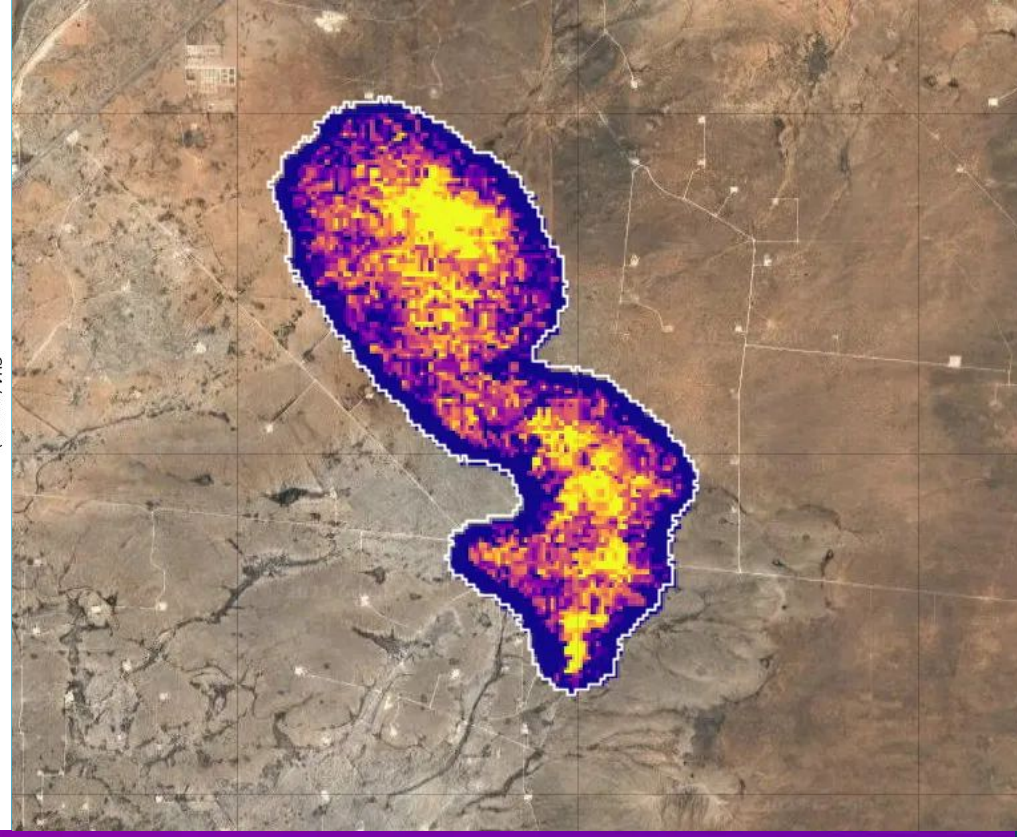
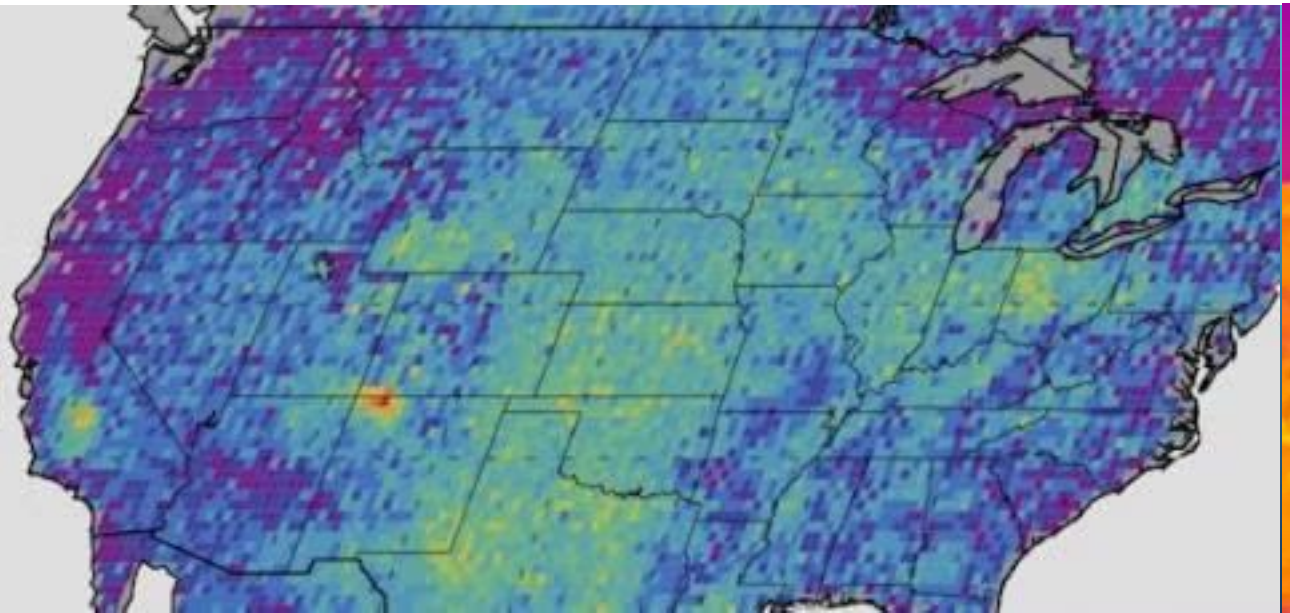
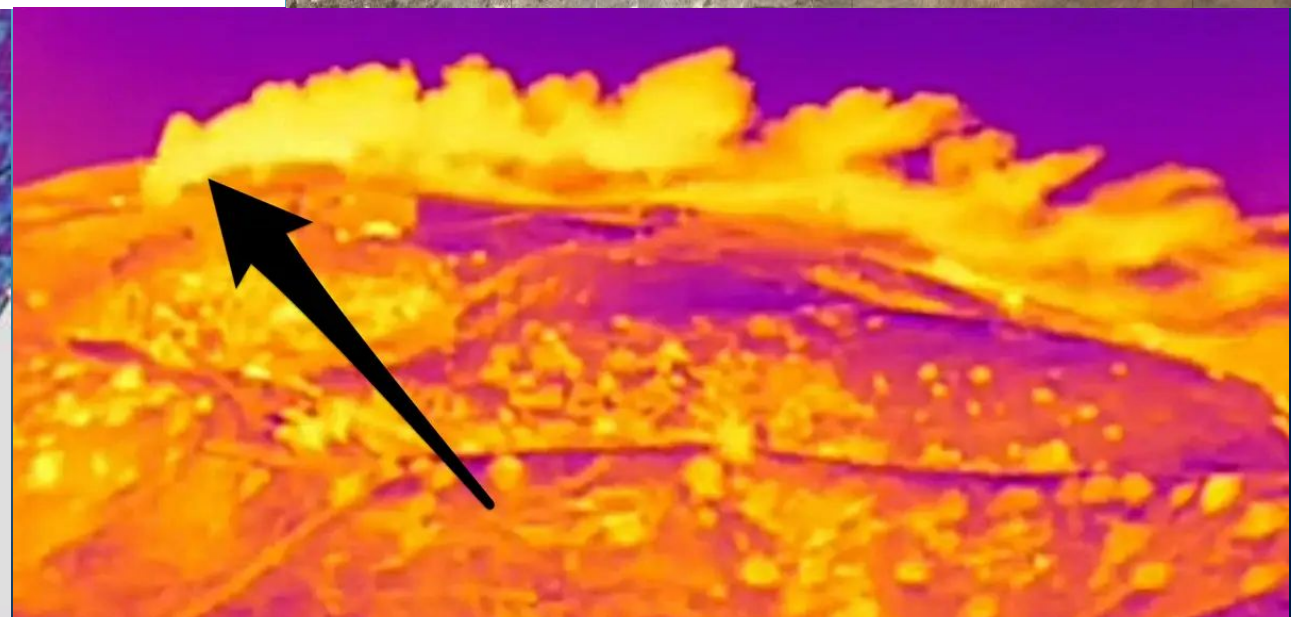

1400
1200
1000
800
600
400
200
0
CH4 (ppm-m)



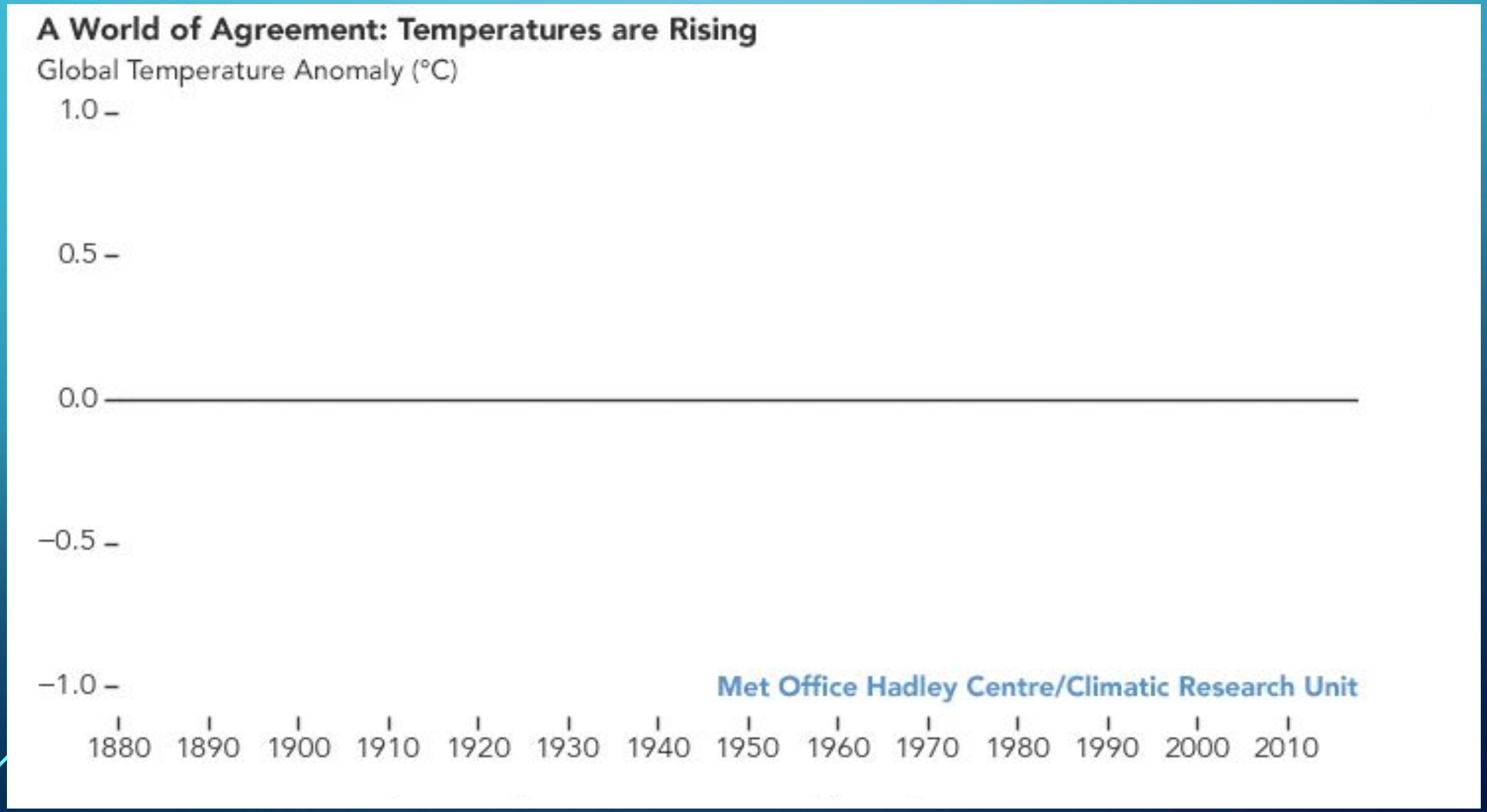




REGULATORY EVOLUTION

- Clean Air Act
  - Greenhouse Gases classified as "pollutants" resulting from 2007 supreme court case "Massachussets v. EPA"
    - Initially petitioned in 1999 to regulate GHG's from new motor vehicles
  - Endangerment Finding (2009) – GHG pollutants threaten human health and welfare
    - Enabled regulation of GHG emissions across various sectors
    - Repeatedly challenged in court by various industries and some states since issuance
    - Currently being reconsidered/challenged by current administration's EPA
      - This is the first time the EPA itself is revisiting this finding, arguing it is burdensome on industry
      - Proposed recission aims to allow EPA to eliminate regulations on cars, power plants, O&G industry

A CHANGING PLANET



LDAR IN THE GATHERING FIELDS

- Leak survey requirements for Type C gathering lines
  - Pipelines with a nearby “Building Intended for Human Occupancy”
  - All pipelines with diameter > 16”
- Aerial surveys
  - Fast and more efficient
  - Combined surveys for multiple companies at once
  - Wider coverage
  - Drones likely more available soon

WHAT IS GAS GATHERING?

- Transportation of gas from a production field (oil & gas wells, tank batteries, compressors) to a transmission line for further processing

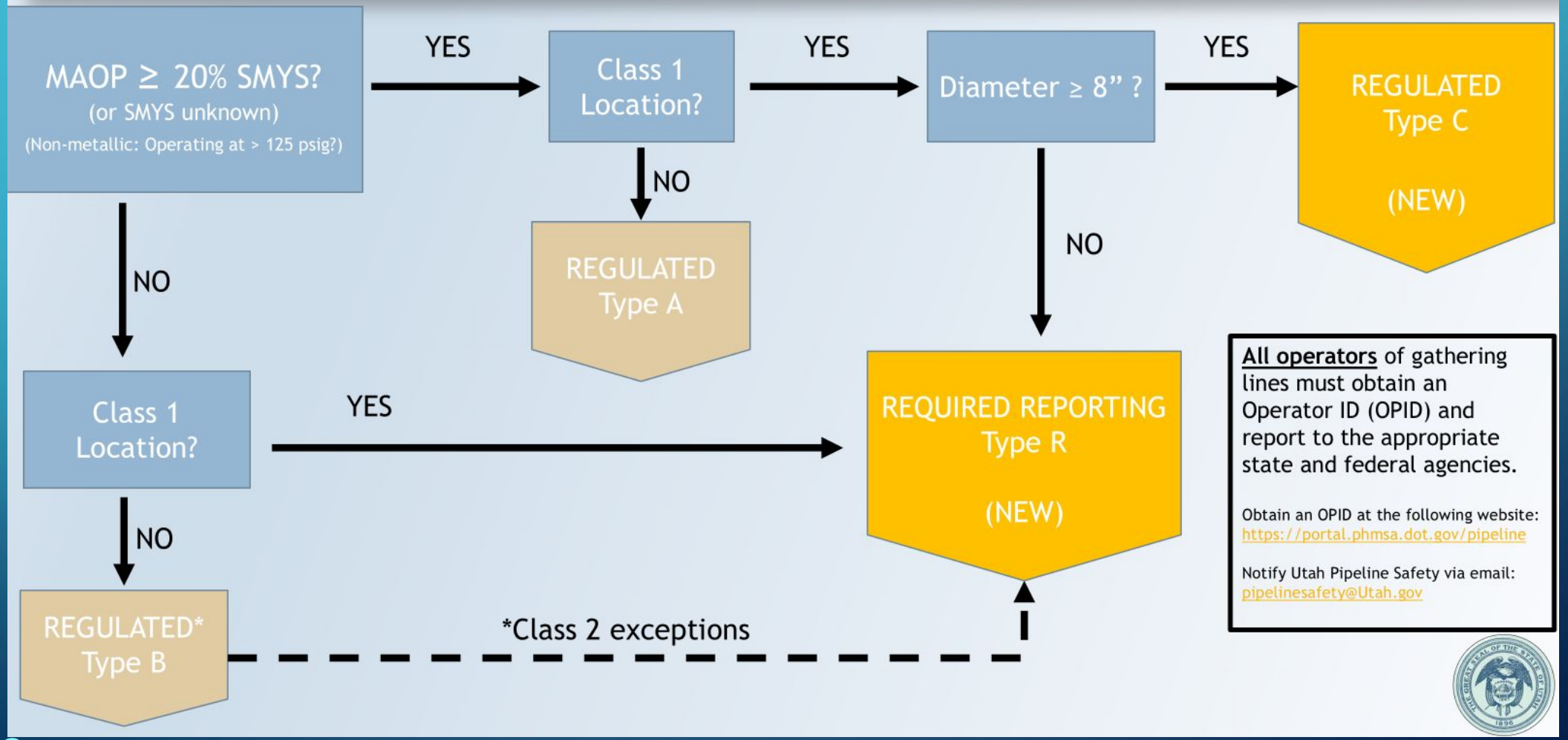
- Four categories of Gas Gathering
  - Type A (Pressure >20% SMYS, Class 2, 3 or 4 area)
  - Type B (Pressure >20% SMYS, Class 2, 3, or 4 area)
  - Type C (Newly Regulated in 2022; Class 1 areas, > 20% SMYS)
  - Type R (Newly Regulated in 2022: Class 1, Reporting requirements only)

- Type A and B Gas Gathering has been regulated by UTPS since 2006

2021 GAS GATHERING RULE

- Rule issued in response to proximity of neighborhoods/developments near high pressure, large diameter gathering pipelines across the US
- Newly regulated operators in Utah due to new categories: 10+ (more expected)
- Gathering Type C: Often leaving compressor stations transporting high pressure gas to a gas processing facility
  - Diameter > 8”
  - Class 1
  - SMYS > 20% (or > 125psig if non-metallic)
- Gathering Type R: Often plastic, aboveground, < 75psig, lots of mileage connecting wells to gas treatment
  - Diameter < 8”
  - Class 1
  - Any pressure

Intrastate Natural Gas Gathering Pipelines



Gathering Type C Requirements

Outside Diameter	Requirements (No Building Intended for Human Occupancy or Other Impacted Site)*	Additional Requirements (Building Intended for Human Occupancy or Other Impacted Site)*
≥8.625" to 12.75"	Reporting and OPID Design, Construction, Initial Inspection and Testing (New)** Damage Prevention Emergency Plans	Corrosion Control Line Markers Public Awareness Leakage Survey and Repair
>12.75" to 16"		Corrosion Control Line Markers Public Awareness Leakage Survey and Repair Plastic Pipe and Components MAOP***
>16"	Reporting and OPID Design, Construction, Initial Inspection and Testing (New)** Corrosion Control Damage Prevention Emergency Plans Line Markers Public Awareness Leakage Survey and Repair Plastic Pipe and Components MAOP***	

Gathering Type R Requirements

Reporting Requirements specified in Part 191
§191.5 & §191.15 - Incident Reporting §191.7 & §191.17 - Annual Reports §191.22-National Registry of Operators (OPID)

API RP 80: Incorporated by reference in Part 192

Operators must use Part 192 in conjunction with API RP 80 language in making determinations

QUESTIONS?