

# Thirteen Years of Methane Science

Seven things we did not know in 2013

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CH<sub>4</sub> Connections 2026



1939

ppb, May 2026

# 1. We built a way to be uncertain in public

## Before

A detection claim  
was a marketing claim.

## After

A detection limit  
and an error bar.

Blind controlled release turned vendor claims into measured performance.

Currently: the best characterized aerial system is unbiased in aggregate, but any single plume estimate is  $\pm 2x$ .

## 2. We built a tiered observing system

### Satellite

**TROPOMI, GHGSat, Tanager-1, MethaneSAT**

Basin screening, global coverage

### Aircraft

**Bridger Gas Mapping LiDAR, Kairos**

Pinpoints the source and sizes it

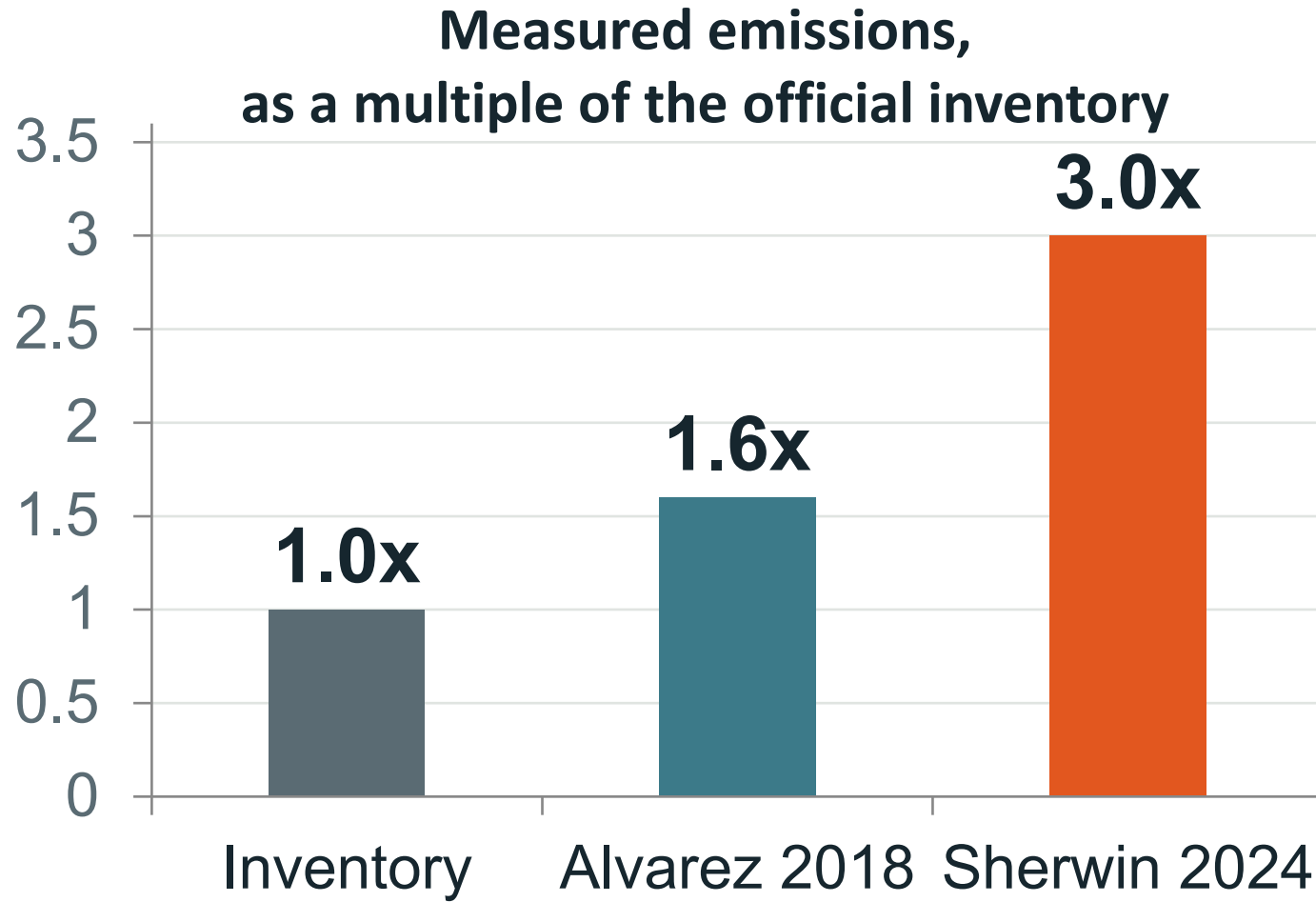
### On site

**Continuous monitors on the pad**

Catches what a flyover misses

**Aerial LiDAR now finds about 1 kg/h from 500 feet. None of this tier existed in 2013.**

### 3. The more we measured, the worse inventories looked



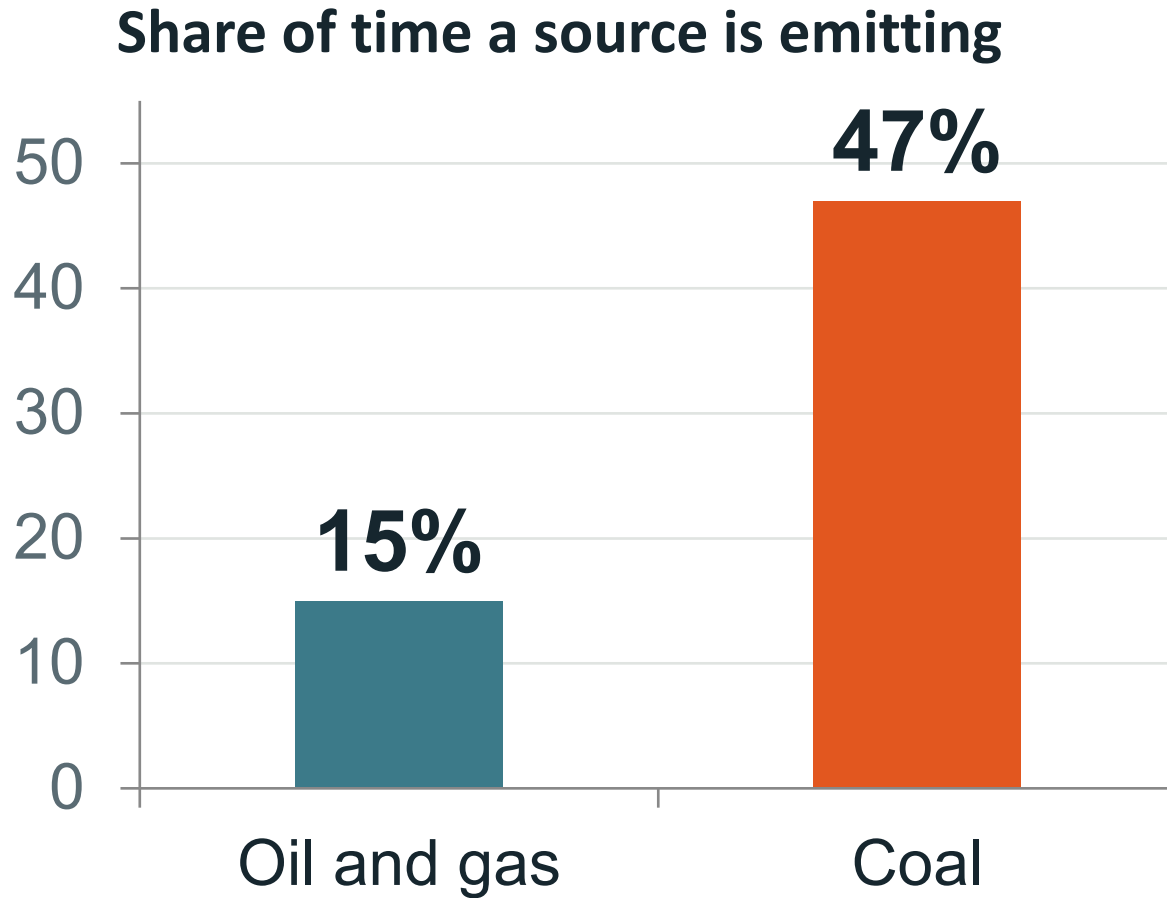
**2.43%**

of gas production lost, six  
US regions

**$r = 0.03$**

measured vs reported,  
151 landfills

## 4. A few sources dominate, and they burp



**~50%**

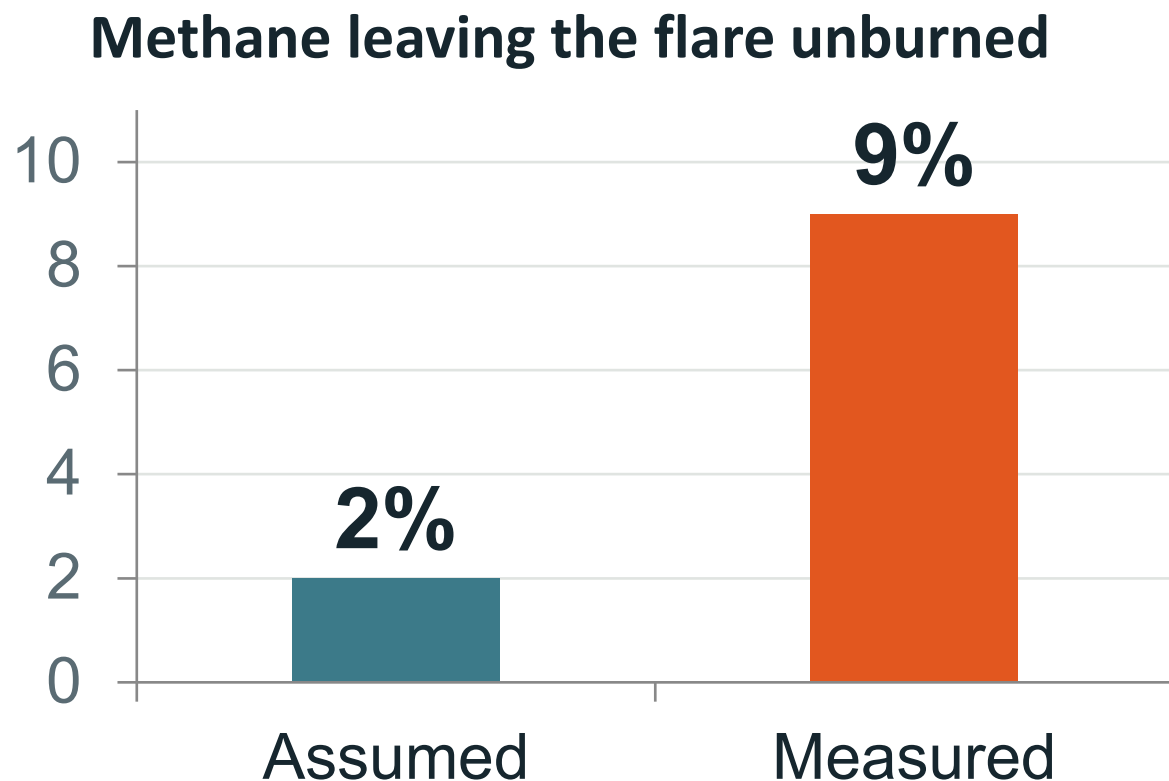
of Permian emissions come from super-emitters

Landfills sit at the persistent end: 60% of emitting sites ran for months or years.

**Surveys and monitors answer different questions.**

## 5. They burp because things break

*Inventories model equipment working. Emissions come from failures.*



**5x**

more methane from US flaring  
than assumed

- Flares unlit 3 to 5% of the time
- Stuck controllers, tank vents
- Maintenance, not engineering

# Despite our work ...

# +7%

methane in the atmosphere, 2013 to today

**1,810 ppb**

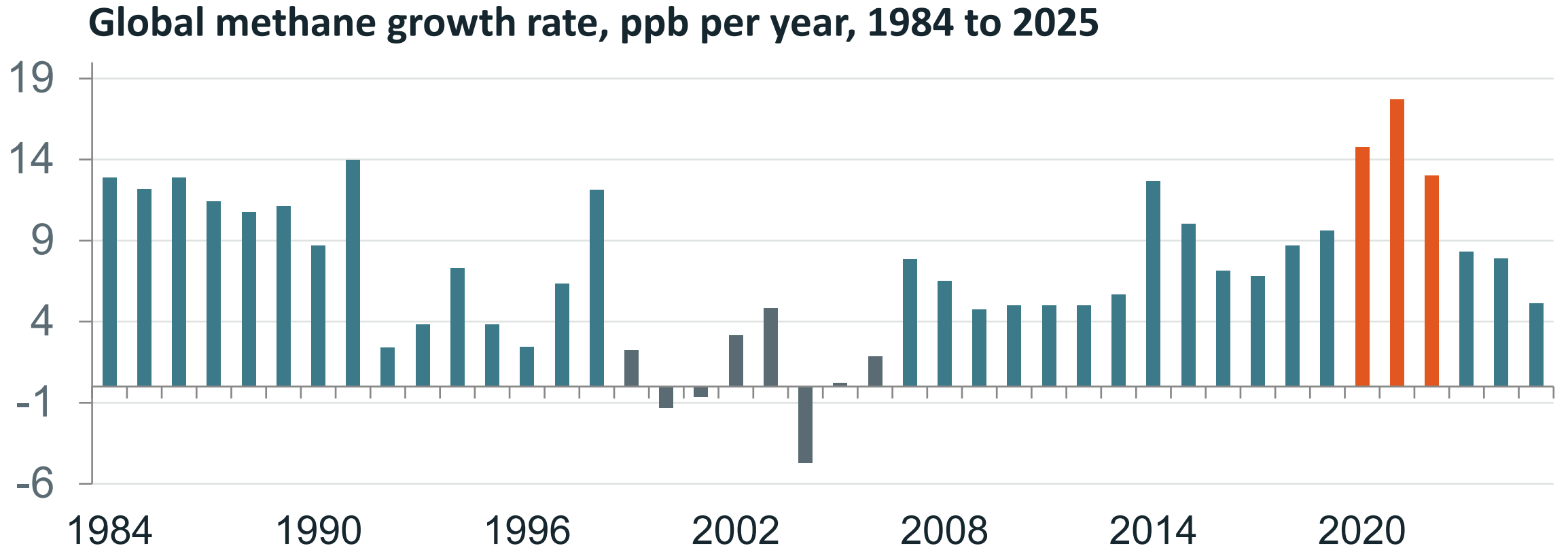
2013

**1,939 ppb**

May 2026

***Next year: 1943? 1953?***

## 6. The world's sources and sinks got erratic



Grey: the 1999 to 2006 plateau, when methane briefly stopped growing. Orange: the fastest growth on record.

## 7. The sink stopped being a constant

14.3

Tg per year of methane the  
weakened OH sink stopped  
removing

- About 2.6% of the global sink
- Implied lifetime: 9.1 to 9.3 years
- Methane lengthens its own lifetime

**A quarter of a year is small. The problem is that it is not supposed to move at all.**

Every CO<sub>2</sub>-equivalent number we report assumes a fixed methane lifetime.

# The cuts add up. The noise doesn't.

Ten years of a pledge-sized cut, in teragrams



**Every ton not emitted is a ton not in the air.**

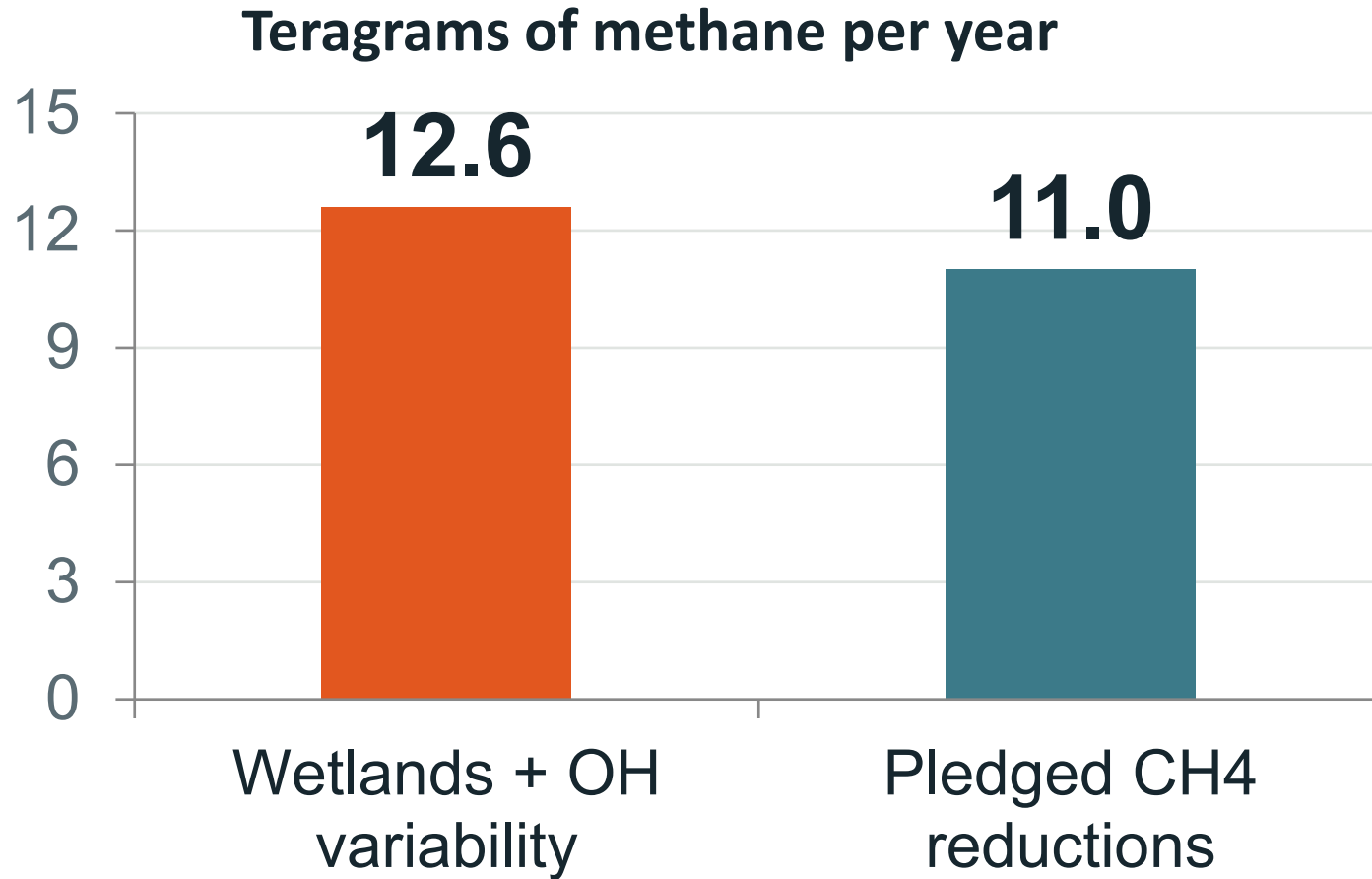
Natural swings hide that for a year or two. They do not undo it.

Measurements are the proof until the record catches up.

*A cut is a step and it stays. A swing is a wobble and it averages out.*

*Natural variability 12.6 Tg/yr from Wang et al., Nature Comm., 2026; pledge-sized cut of about 11 Tg/yr from the same source*

# So the atmosphere will not keep score for us



Nature's noise vs. the signal we are trying to create.

**Natural swings are big enough to erase a successful year of global mitigation.**

Your measurement record is the only evidence that will show the work succeeded.

Thirteen years ago, the problem was detection.

## The next thirteen years' problem: global scale proof.

- Plume to operator: close to solved
- Facility to basin inventory: getting there
- **Our measures to the atmosphere: not started**  
*The cuts are working, and we owe the world the evidence*

# Betting line: Atmospheric CH<sub>4</sub>, May 2027

| May 2027, ppb | Chance | Fair odds |
|---------------|--------|-----------|
| under 1943    | 17%    | 5 to 1    |
| 1943 to 1945  | 23%    | 3.4 to 1  |
| 1945 to 1947  | 24%    | 3.1 to 1  |
| 1947 to 1949  | 17%    | 5 to 1    |
| 1949 to 1951  | 10%    | 9 to 1    |
| 1951 to 1953  | 6%     | 16 to 1   |
| over 1953     | 4%     | 25 to 1   |

Method: AR(1) on NOAA annual growth 2007 to 2025 gives +6.1 ppb. Mixed 75/25 with a fire-year case to skew the tail. Central +6.5 ppb on May 2026's 1939.4.

*NOAA Global Monitoring Laboratory, 2026; NOAA CPC ENSO Diagnostic Discussion, 10 Sep 2026*

1,946

my central guess, ppb

90% range 1941 to 1953

## Why the wide upper tail

A historic El Nino is forecast. Dry tropics cut wetland emissions, but big fire years load the atmosphere with CO, which eats OH. 1998 did exactly that: +12.1 ppb.