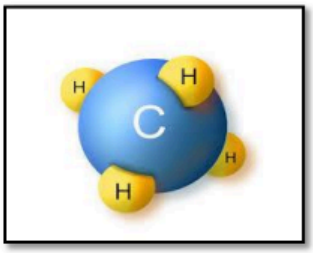
Methane - The Problem, and Positive News ?

This last week, our Judy von Ahlefeldt alerted me to the fact that Methane was making headlines on several fronts. In particular, she flagged an article on a new, non-governmental satellite which will open our eyes to methane leaks around the world! I also spotted some new regulations which will require greater transparency on emissions. We'll pick up on these articles later in this study, but first,

Let's get a handle on Methane

(CH_4 - the same as *Natural Gas* in your stove and the *Liquified Natural Gas* (LNG) being shipped worldwide)



WHAT IS METHANE?

Methane is a chemical compound with the molecular formula CH_4. It is the main component in natural gas. Methane is considered the simplest of ***alkanes***, compounds that consist only of hydrogen (H) and carbon (C) elements.

Methane is an odorless, colorless, tasteless gas that is lighter than air. When methane burns in the air it has a blue flame. In sufficient amounts of oxygen, methane burns to give off carbon dioxide (CO_2) and water (H_2O). When it undergoes combustion it produces a great amount of heat, which makes it very useful as a fuel source.

https://gml.noaa.gov/outreach/info_activities/pdfs/CTA_the_methane_cycle.pdf

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Climate Science Study Group

Approximate "Cheat Sheet":

1 meter → 3 feet **1 degree Celsius (^{0}C)** → 2 degree Fahrenheit (^{0}F)
ppm = parts per million **CO_2** = Carbon Dioxide
1 tonne = 1000 kilograms = 2205 pounds **1 gigatonne (1 Gt)** = 1 billion tonnes
1 trillion tonnes (1Tt) = 1000 gigatons

Methane - The Problem, and Positive News ?

To date, we have been mostly focused on carbon dioxide (CO_2), and for good reason. It stays around for centuries and is the greatest cause of the additional warming this planet is receiving.

BUT, this week we will turn our attention to Methane (CH_4), which is also a huge actor.

Some Punchlines include:

1. **The SCIENCE of Methane and Emissions so far…**
    a. Pound for pound, methane is a far more potent greenhouse gas than CO_2. When it is emitted, it is over 80x more potent in terms of warming. Fortunately, humans are emitting far fewer pounds of methane than of CO_2. Even so, **Methane is responsible for around 30% of the rise in global temperatures** since the industrial revolution.
    b. While very potent when emitted, Methane slowly reacts with oxygen in the air and converts to Carbon Dioxide (which is less potent, but lasts "forever"). This means that cutting methane **emissions** can strongly reduce **immediate** heating. (This does NOT mean CO_2 cuts can be delayed).
    c. Methane emissions are growing fast in the last few decades - and far faster than carbon dioxide.
2. **What can we do to cut emissions when it has been hard to find their specific sources (leaks, etc)**
    a. A new, private satellite will allow everyone to see where the emissions are coming from and who is responsible for them.
    b. New regulations (if not scuttled by the interests fighting them) will require public companies to disclose greenhouse gas emissions.

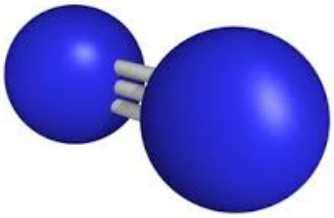
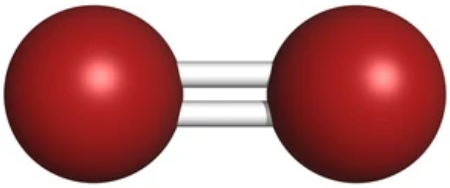
We will touch on each of these in a little more depth below.

Methane - The Problem, and Positive News ?

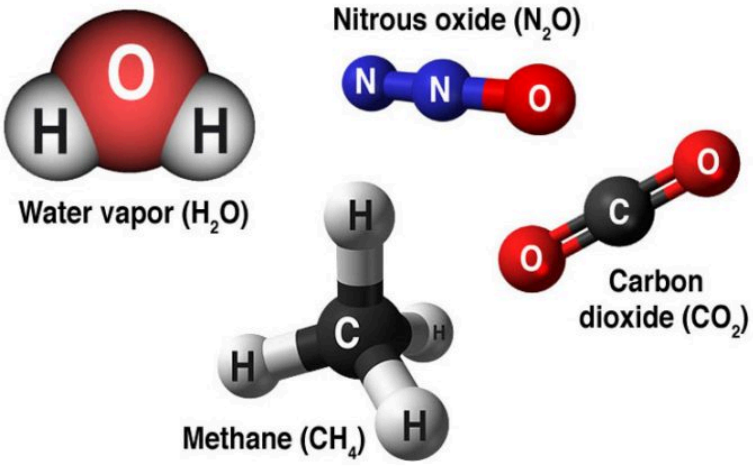
1. The SCIENCE of Methane and a look at Emissions so far…

a. Pound for pound, methane is a far more potent greenhouse gas than CO_2. When it is emitted, it is over 80x more potent in terms of warming.

What's going on here is the more complex structure of CH_4. Take a look at these dominant atmospheric gases: O_2, N_2, and Ar (99.96% of the atmosphere), and Argon, **which don't absorb infrared heat coming up from the ground**:

		
Oxygen O_2 (20.95%)	Nitrogen N_2 (78.08%)	Argon Ar (0.93 %)

Now, compare these **very rigid structures above** to the more complex greenhouse gases - which are much less than 1% of the atmosphere - these can vibrate in all sorts of ways. **This is how they can absorb so much energy**. And Methane has a LOT of ways to vibrate!



https://insideclimatenews.org/news/04032024/new-edf-harvard-satellite-will-monitor-methane-emissions-worldwide/

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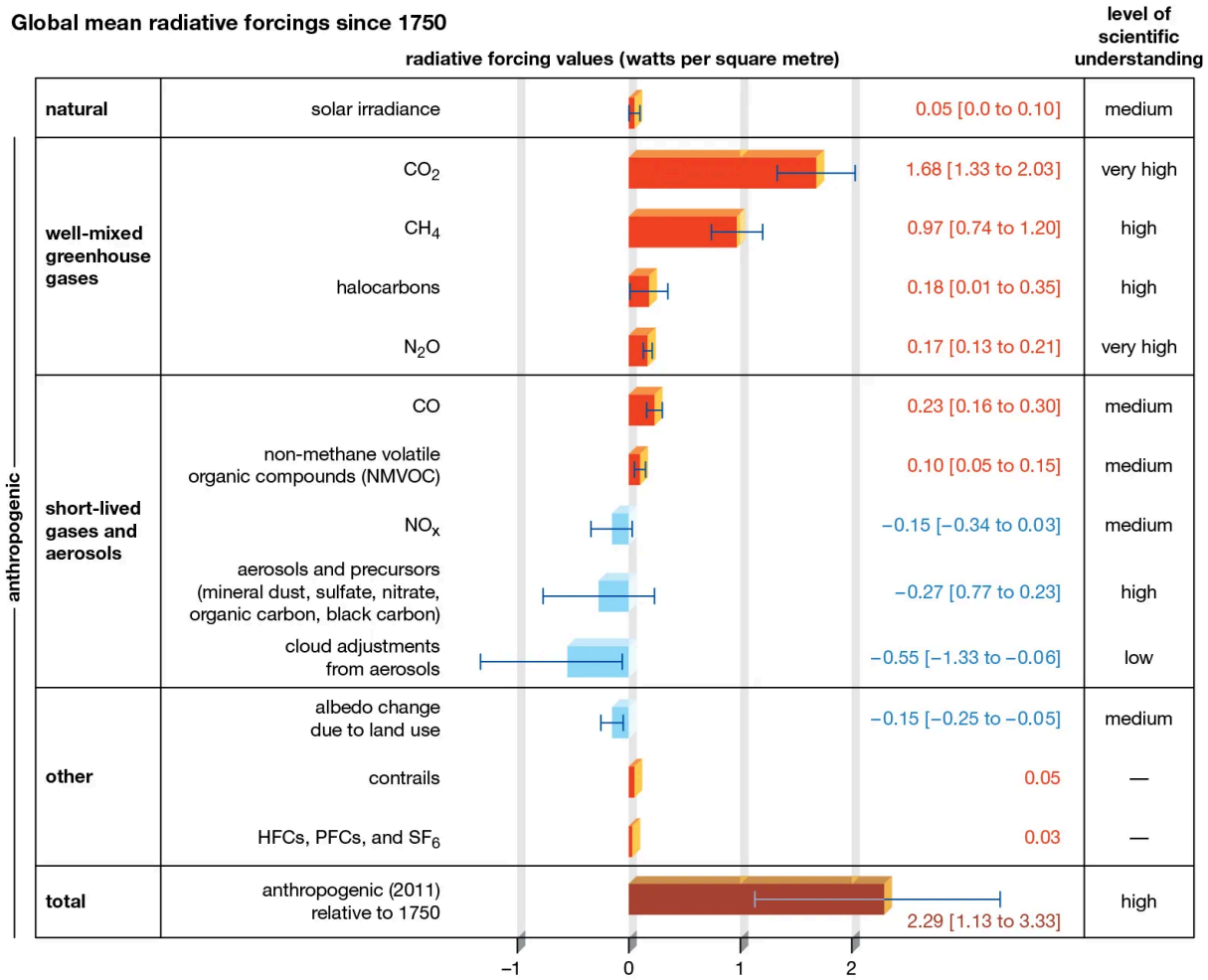
Fortunately, humans are emitting far fewer pounds of methane than of CO_2. Even so, Methane is responsible for around 30% of the rise in global temperatures since the industrial revolution.

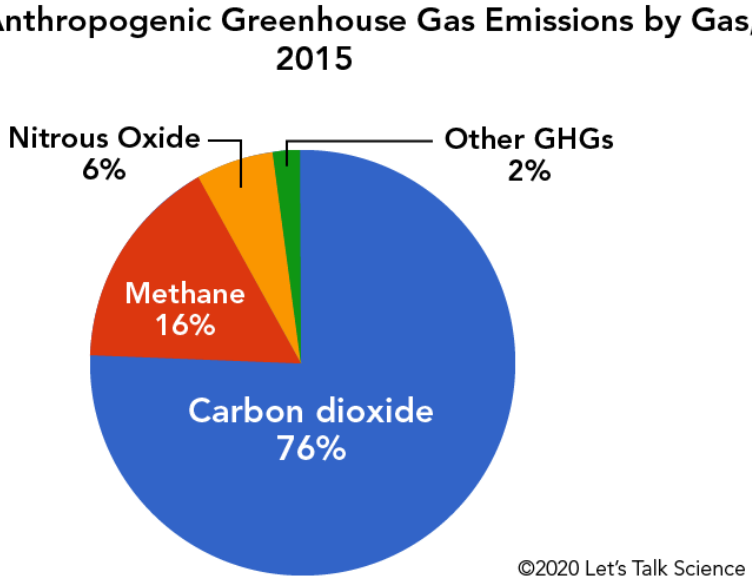
Here is a chart from the Intergovernmental Panel on Climate Change (IPCC). It's a handy summary of the many actors of human-induced warming (the difference between the energy we receive from the sun and the energy we are able to send back into space). When this "radiative forcing" is positive, we aren't getting rid of enough heat, so the planet will warm - which it is doing. (note the blue cooling from aerosols, which we've discussed). **Focus on the magnitude of CH_4.**



Source: Intergovernmental Panel on Climate Change, *Climate Change 2014: The Physical Science Basis*, "Summary for Policymakers."

Methane - The Problem, and Positive News ?

Here's a view of actual emissions in 2015. You can see Methane was a large chunk and, given its greater potency right after it is emitted, this is consistent with the large "radiative forcing" it has delivered since 1750 in the chart above.



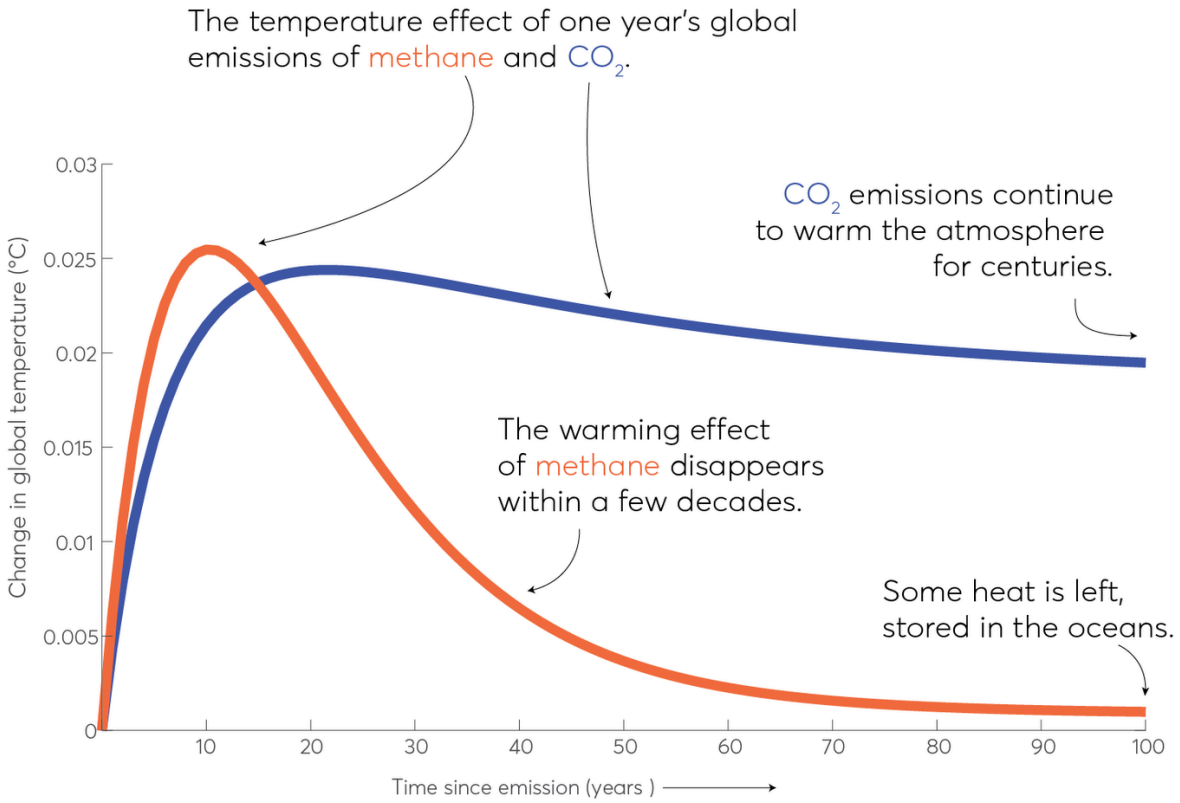
Global anthropogenic greenhouse gas emissions by gas, 2015, given in CO2 equivalents (Source: Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2015 (EPA, 2017).
https://letstalkscience.ca/educational-resources/stem-explained/cows-methane-and-climate-change

But, the "good" news is that over time Methane reacts with the atmosphere, with a "half life" of around 12 years (making carbon dioxide (!))…

Methane - The Problem, and Positive News ?

b. ***While very potent when emitted, Methane slowly reacts with oxygen in the air and converts to Carbon Dioxide (which is less potent, but lasts "forever"). This means that <u>cutting methane emissions can strongly reduce immediate heating</u>. (This does NOT mean CO_2 cuts can be delayed).***

Spend a little time with the following chart. It assumes a single, representative, years-worth "puff" of CO_2 or CH_4 at the start. It implies that for its first decade of heating, Methane has as great an impact as Carbon Dioxide!



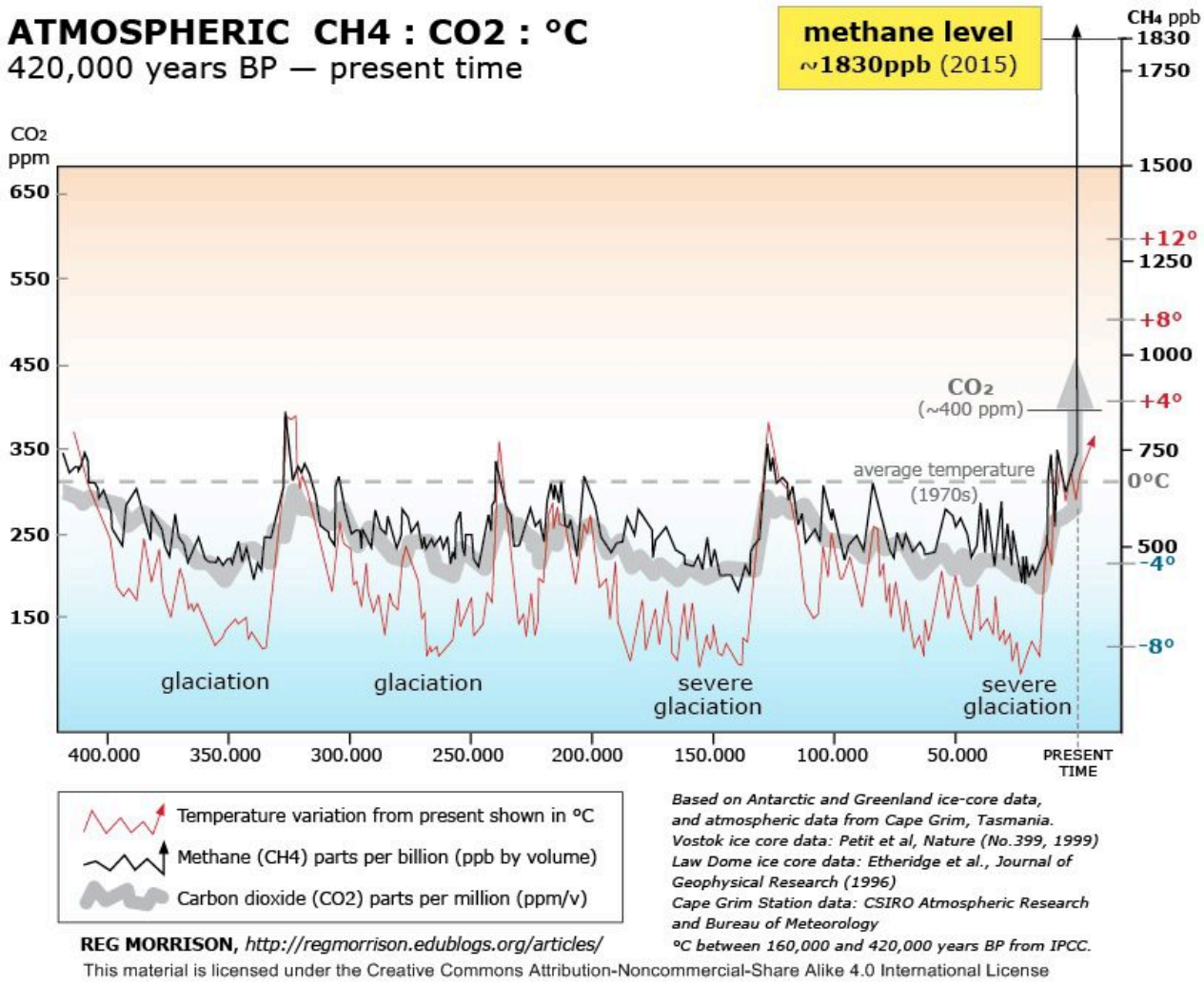
Global warming from methane drops off within a few decades while CO2 lasts for centuries
https://www.forbes.com/sites/davidrvetter/2021/08/13/no-cutting-methane-is-not-a-quick-fix-for-the-climate-crisis/?sh=1d72db2933b9

This has a profound implication: If we can **CUT ACTUAL EMISSIONS** of methane, heating can be immediately reduced!

Methane - The Problem, and Positive News ?

c. Methane emissions are growing fast in the last few decades - and far faster than carbon dioxide.

Let's leap back to our 30,000 foot view (aka back 400,000 years through a few ice ages). We've seen earlier that CO_2 has gone up 50% (from 280 parts per million to 420 ppm) since the beginning of the industrial age in 1750. Methane has gone up 150% (from 750 parts per billion to 1911 ppb)!



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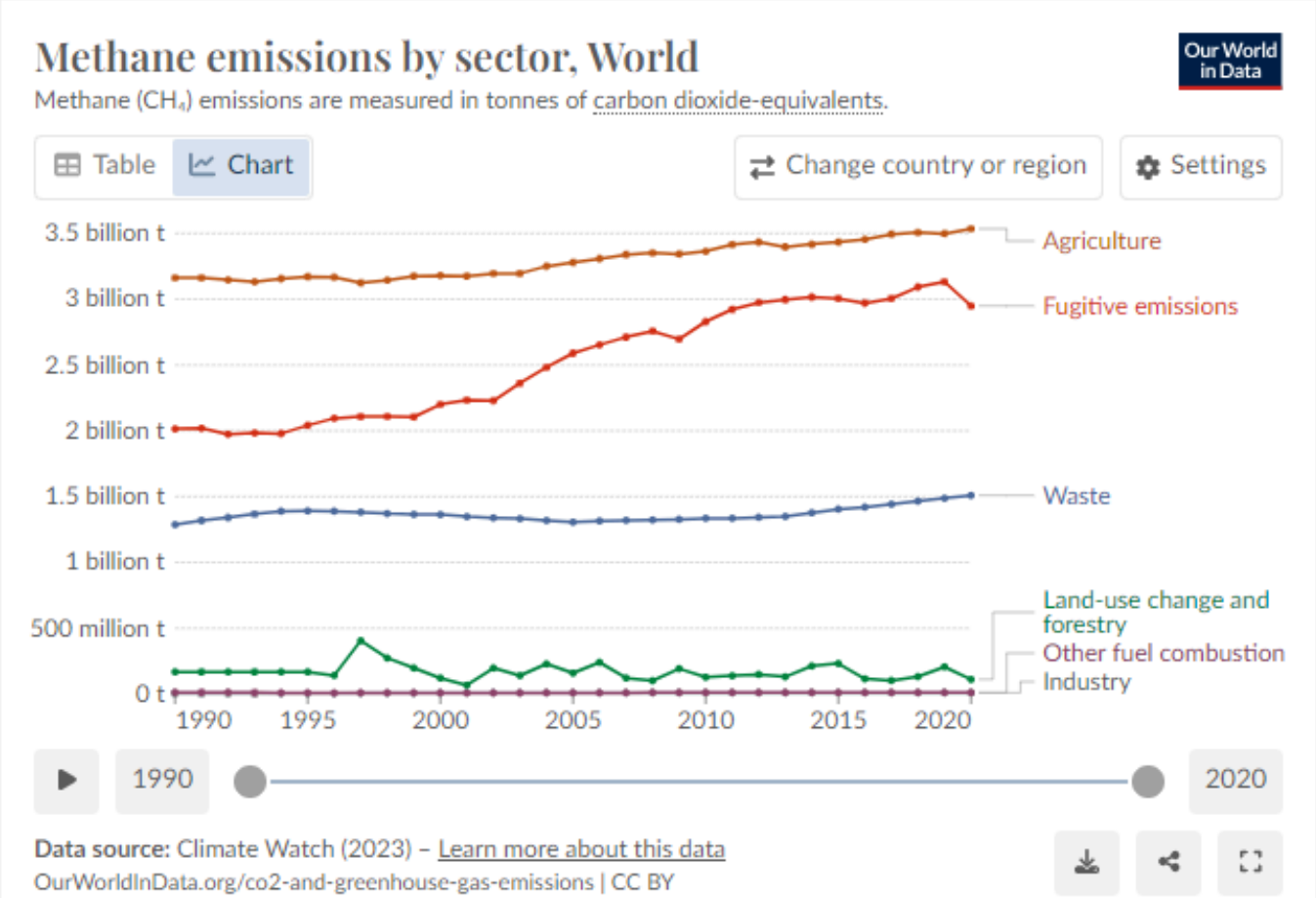
A look at the recent data shows the really sharp rise in emissions is from “Fugitive Emissions”.



This dramatic increase in the last few decades may include emissions from leaking pipes and fracking. Other factors may include tundra loss with warming.

One analysis points strongly to the increased rainfall and warmer temperatures of climate change. These increase the size of wetlands and the decaying of matter from them. Also, the cleanup of some pollutants actually reduces some reactions which were reducing methane.

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The picture and headlines below are from a reference which identifies very significant undercounting of emissions from fossil fuel and fracking wells:

Methane emissions from rice fields, such as this one in India, have risen in recent years. ARUN SANKAR/AFP/GETTY IMAGES

THE GREENHOUSE GAS RIDDLE

What is Causing the Recent Rise in Methane Emissions?

The cause of the rapid increase in methane emissions since 2007 has puzzled scientists. But new research finds some surprising culprits in the methane surge and shows that fossil-fuel sources have played a much larger role over time than previously estimated.

BY FRED PEARCE • OCTOBER 25, 2016

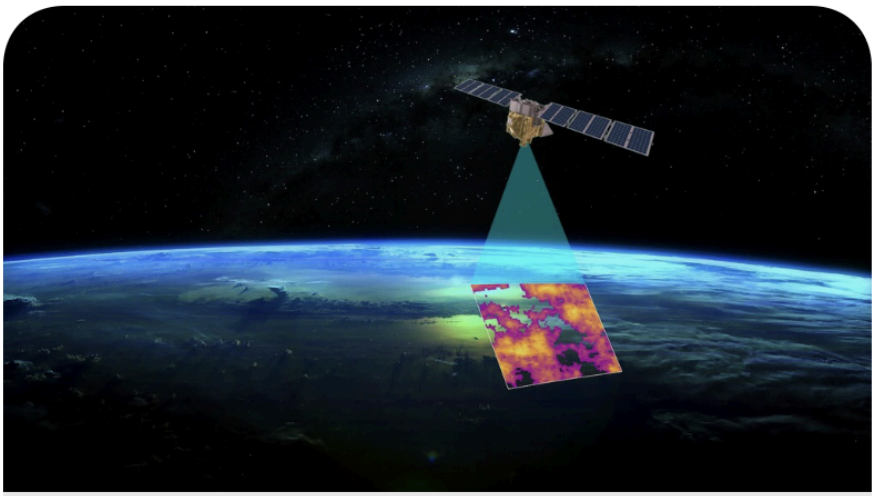
https://e360.yale.edu/features/methane_riddle_what_is_causing_the_rise_in_emissions

Methane - The Problem, and Positive News ?

Now, for the GOOD NEWS

2. *What can we do to cut emissions when it has been hard to find their specific sources (leaks, etc) ?*

    a. *A new, private satellite will allow everyone to see where the emissions are coming from and who is responsible for them.*



A new watchdog satellite will sniff out methane emissions from space

washingtonpost.com

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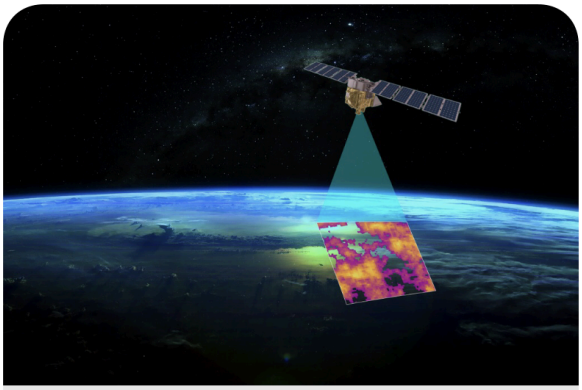

A New EDF-Harvard Satellite Will Monitor Methane Emissions From Oil and Gas Production...

insideclimatenews.org

https://insideclimatenews.org/news/04032024-edf-harvard-satellite-will-monitor-methane-emissions-worldwide/

MethaneSAT

methanesat.org

This is the place to go!!! You will be able to monitor methane leaks yourself soon!

https://www.methanesat.org/

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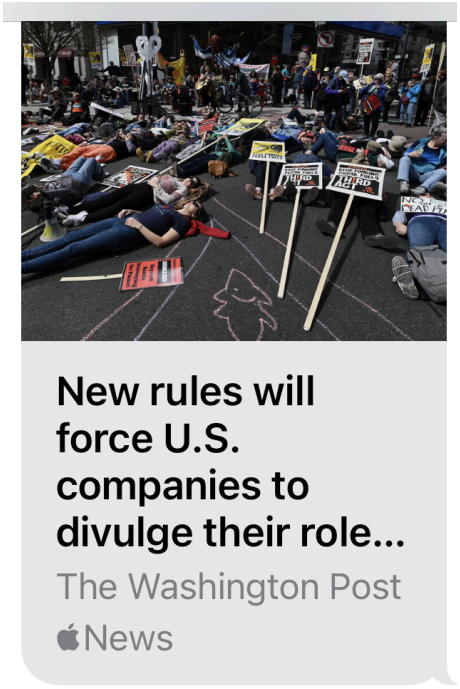
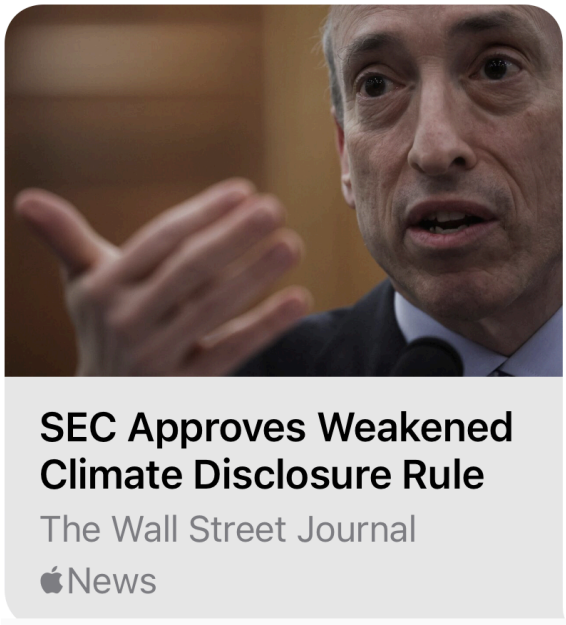
On a different front - regulations - there may be hope for transparency which will facilitate reductions of all greenhouse gas emissions, not just methane.

b. New regulations (if not scuttled by the interests fighting them) will require public companies to disclose greenhouse gas emissions.

	
https://apple.news/A0MPUyWkkQ1mfbXzdmaU6PQ	https://apple.news/AtsX5YKKKSrmLmM6c2VcJTg

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The actual rule can be seen at:
https://www.sec.gov/files/rules/final/2024/33-11275.pdf

Some major provisions:

- large firms will need to report the greenhouse gas emissions generated at their own facilities that are "material" or relevant to investors,
- companies will need to reveal any losses as a result of extreme weather events fueled by global warming, including severe storms, raging wildfires and rising seas
- They also will need to reveal any expenditures related to their climate goals, such as purchases of carbon offsets or renewable energy credits.

As reported in the Washington Post, this will likely be fought all the way to the Supreme Court. The rule will test the powers of the federal government to compel companies to confront warming, making it significantly harder for businesses to gloss over their carbon footprints and vulnerability to climate change with green marketing campaigns and upbeat impact reports.

The commission's prospects in court are uncertain. The Supreme Court in recent years has diminished the authority of federal agencies to advance ambitious regulations — particularly environmental regulations — without the consent of Congress. **The success of the rule could hinge on the SEC's ability to convince judges that the policy is not intended to drive companies to lower their emissions, but merely to require they share information investors need, which is a key role of the regulator.**

While this ruling is highly politicized, it shares a critical, scientific foundation - measurements. If you don't measure something, it is hard to change it. Both initiatives, satellite oversight and transparency in emissions reporting, are steps toward effective emissions reductions. Both allow oversight by everyone of behaviors which may be financially benefiting a few, but which can impact everyone negatively.