



This submission is addressed to the Senate Interim Committee On Environment and Natural Resources convening September 25, 2018 to support the Committee's interest in Biogas Plant permitting and carbon accounting (submittal link senr.exhibits@oregonlegislature.gov)

This submittal is identical to our file supporting the House Interim Committee On Energy and Environment Biogas Agenda for September 24, 2018.

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23 September 2018

Before the Oregon Legislature: THE SENATE INTERIM COMMITTEE ON ENVIRONMENT AND NATURAL RESOURCES

Commentary from Engineers for a Sustainable Future

Biogas Delivered by Pipeline Poses a Climate Threat

How Are Threats Being Identified and Handled

The US Department of Defense justifies its budget requests by citing threats to US sovereignty. Each identified threat is countered by acquisition of military assets and the training of forces. Neither the Environmental Protection Agency nor others attempting to deal with climate change have embraced this basic discipline.

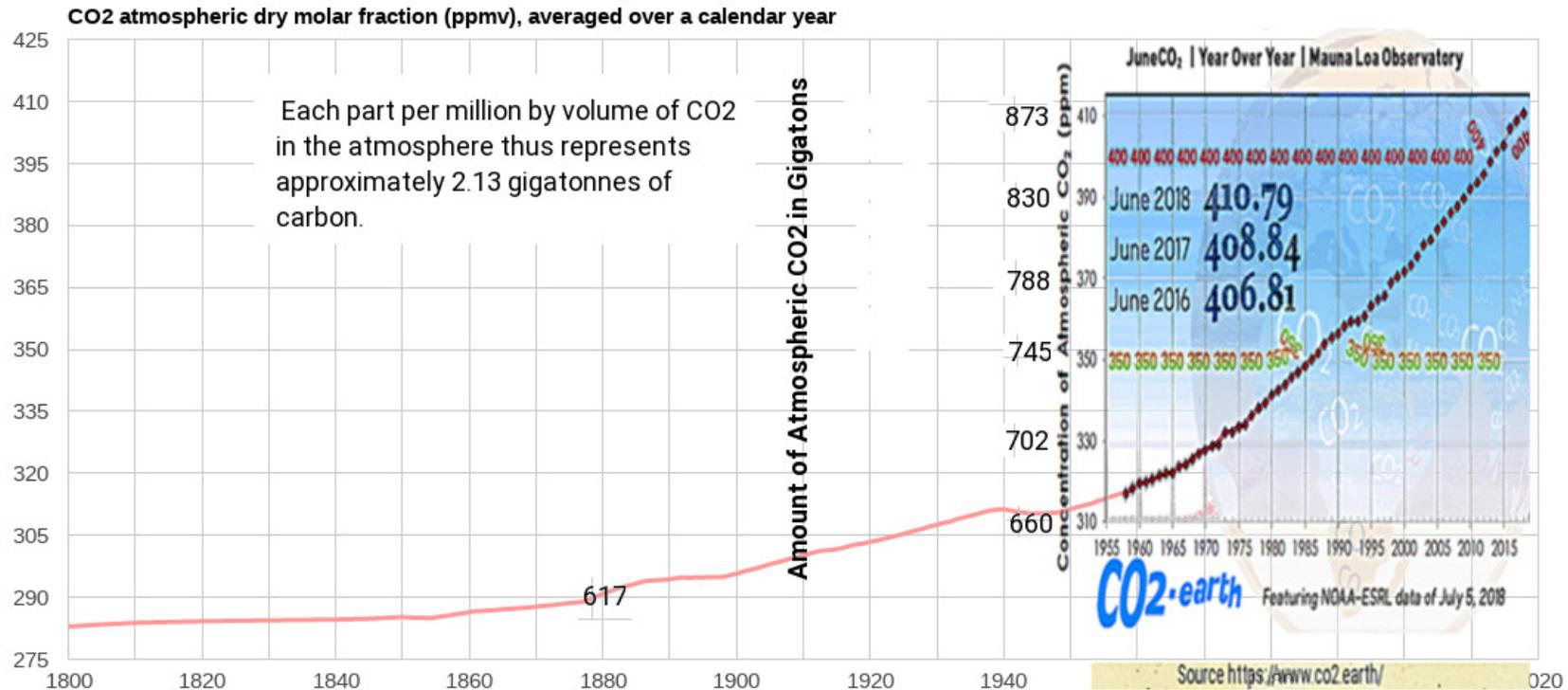
Threats to the environment need to be systematically examined and placed in rank order for their relative urgency. This would enable environmental and climate threats to be better understood and addressed by any interested party.

We have made an assessment of methane production and leakage as a threat to a balanced, stable, sustainable economy, to the extent that a healthy environment sustains a healthy economy.

A question (Q1): Why is the surge in renewable energy not bending the CO2 curve ?

Greenhouse Gas from too many sources is accumulating in atmosphere faster than nature can counterbalance it. This has been going on for a while. And scientists are nearly certain that increased CO2 levels from the burning of fossil fuels have caused [over half of the global temperature increase](#) since 1950.

Atmospheric Carbon Dioxide (CO₂) levels, 1800–present



Measured CO₂ concentration continues to increase year on year by 10 ppm, increasing the capacity of the atmosphere to trap more solar heating. The transition to renewable energy is apparently having no measurable effect.

Arctic Methane Release Threatens to Worsen Climate Conditions

The heat trapping characteristic of methane (CH₄) exceed those of CO₂ by a factor of 84x. Neither trees nor any carbon capture technology sequesters methane.

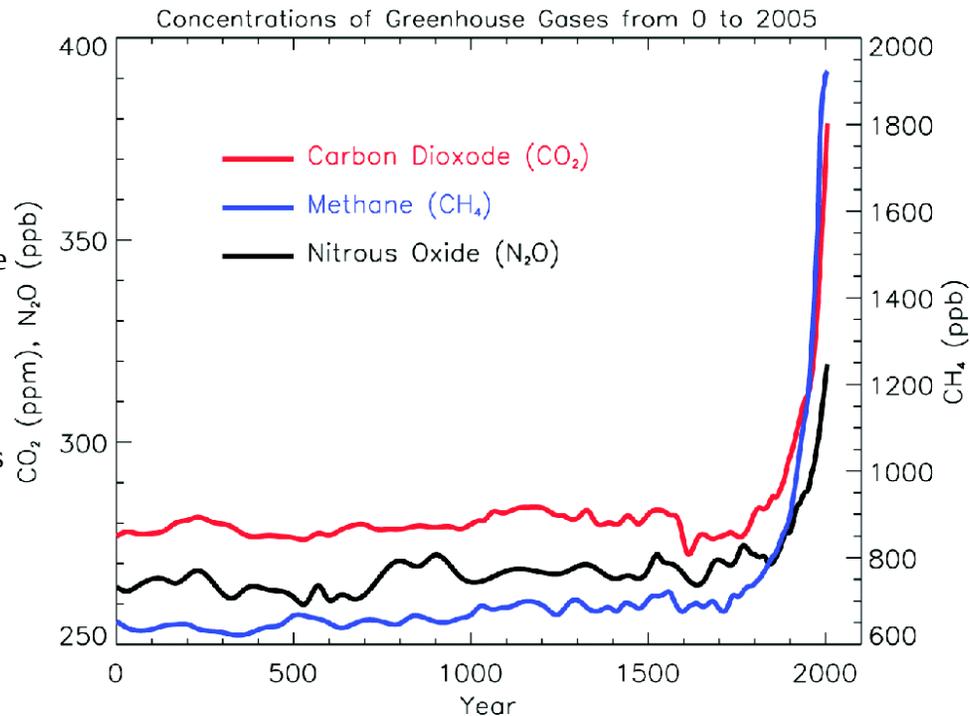
Q2: How has human behavior affected atmospheric CH₄?

The same way as CO₂: accumulation faster than nature can deal with it.

<https://nas-sites.org/americasclimatechoices/more-resources-on-climate-change/climate-change-lines-of-evidence-booklet/evidence-impacts-and-choices-figure-gallery/figure-6/>

As the Arctic warms geologically sequestered methane escapes tundra and permafrost, trapping more heat and warming more of the Arctic. Methane releases more methane in this cycle.

To dramatically report this unstable condition it is described as a Methane Bomb, a self-propagating event that occurs beyond control, one that we can't accurately forecast. There is the prospect of ripping control away from humans, ultimately heating the planet past the limits needed to support life as we know it. If nature starts putting out global warming gasses as fast as humans are, now, then it will no longer save the situation for humans to stop putting their share out. It is a real risk, and should bring an urgency to attempts to stop CO₂ emissions that has not been in anyone's serious planning yet.



The issue is that a huge amount of methane has been stored in the arctic over millions of years. This was necessary to switch life forms on earth from anaerobic life (organisms for which oxygen is a poison) to aerobic life (organisms that breathe oxygen). Almost all current animal life forms are aerobic, and they depend on the oxygen-tolerant plants on land and in the ocean to resupply the oxygen that we breathe.

Human-made methane emissions [account for a quarter of today's global warming](#).

How Much Should You Worry About an Arctic Methane Bomb? Answers were offered 5 years ago. See the following link. <http://www.motherjones.com/environment/2013/08/arctic-methane-hydrate-catastrophe?page=1>

Currently the warnings are increasingly more specific and more urgent.

1. Methane release from Arctic permafrost found to be more than doubled by unexpectedly abrupt thawing – Jeremy Leggett



<https://jeremyleggett.net/2018/08/20/methane-release-from-arctic-permafrost-found-to-be-doubled-by-unexpectedly-abrupt-thawing/>

2. Fuse on a Deadly Methane Bomb is being lit.



<https://truthout.org/articles/trump-lights-the-fuse-on-a-deadly-methane-bomb/>

The current administration is about to repeal restrictions on the venting and burning of methane that is created during drilling operations.

3. Methane Emissions EPA:



<https://www.nytimes.com/2018/09/10/climate/methane-emissions-epa.html>

The current administration, taking its third major step this year to roll back federal efforts to fight climate change, is preparing to make it significantly easier for energy companies to release methane into the atmosphere.

4. 'Not Doing Anything Is No Longer Acceptable': A Conversation With Alice Thomas, Climate Refugee Expert | Pacific Standard



<https://psmag.com/environment/not-doing-anything-is-no-longer-acceptable-a-conversation-with-alice-thomas-climate-refugee-expert>

In many ways, 2018 is the year of the refugee. Millions are fleeing war, hunger, and persecution in search of safety and shelter. And scientists believe things will only get worse due to climate change.

5. Domino-effect of climate events could move Earth into a ‘hothouse’ state



https://www.theguardian.com/environment/2018/aug/06/domino-effect-of-climate-events-could-push-earth-into-a-hothouse-state?CMP=Share_AndroidApp_K-%40_Mail

Leading scientists warn that passing such a point would make efforts to reduce emissions increasingly futile.

6. Climate change is speeding up. Our response needs to be even faster | World Economic Forum



<https://www.weforum.org/agenda/2018/09/why-there-need-for-speed-on-climate-action-paris-agreement/>

The race is on. This northern summer’s deadly, record-breaking heatwaves and wildfires leave us in no doubt that the impacts of global warming are accelerating, in many cases much faster than scientists predicted.

What used to be solidly frozen permafrost in the Arctic has now been partially thawed into swamps and lakes. Those swamps and lakes become generators and releasers of methane. Because of the amazing heating in the Arctic, this process doubled the Arctic methane release between 2015 and 2016. Government scientists warned of a [possible catastrophic 4 deg C](#) global temperature increase by 2060.

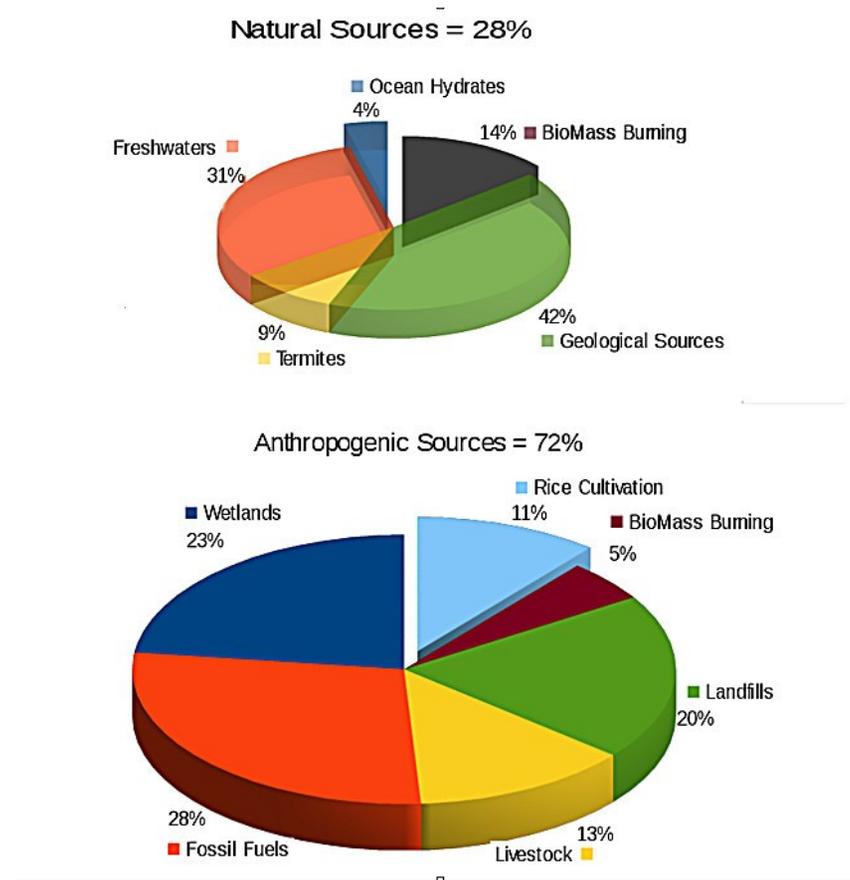
Gambling With Our Future ?

If you have a neighbor with a gambling problem, you don’t just go next door and tell him/her they are putting the future of their family at risk, by exposing themselves to known risks that mathematically favor the casino. Because gambling addiction requires the intervention of professionals.

What do you do with Government committing the nation, your sovereign nation, to risks where you absolutely can’t win, but the real problem is that it sets up their grandkids and your grandkids for a 100% sure loss of any habitable future? Knock on the door? Get a professional therapist? Knock the door down? OK, step back and study the risk so you can explain it to enough other neighbors to take ANY and all action because inaction is, in a real sense, terminal.

We know that the natural methane cycle involves natural sources of methane stemming from the anaerobic decomposition of decaying matter that is found in wetlands together with animal and termite digestion. The methane itself decomposes into CO₂ with a 12-year half-life. Before industrialization, the global methane source-sink balance was stable. The natural and anthropogenic sources of methane are depicted in the following figure:

Figure 1 Sources of Methane:

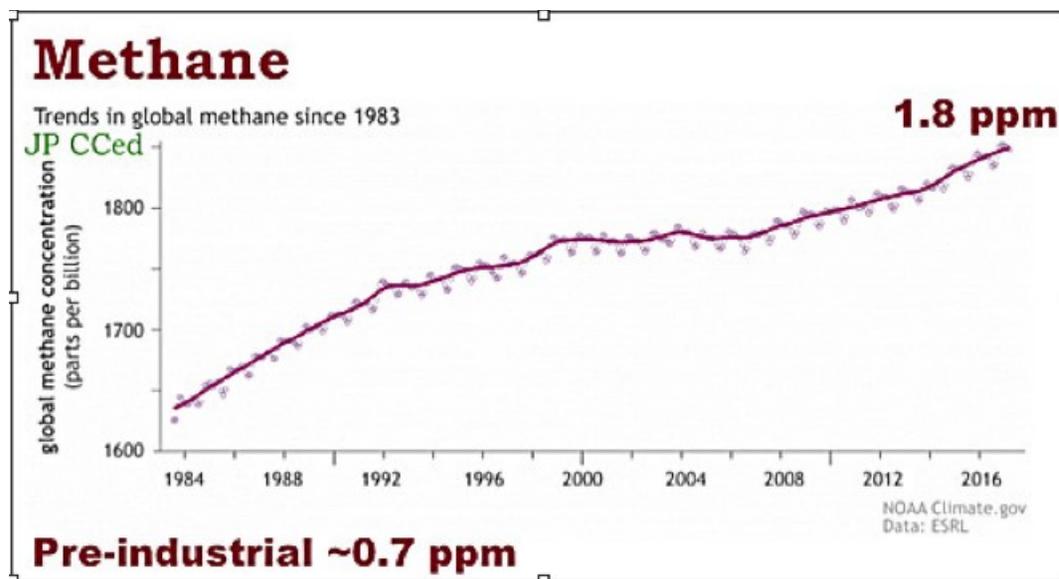


Since methane is such a powerful Greenhouse Gas, with 84x more global warming capacity than CO₂, it is possible for human-sourced methane to overdrive the planet's natural balance. Global warming is the response to the combined effect of accumulated CO₂ and CH₄ (methane) plus other pollutants.

Natural sources also include the release of methane captured in decayed matter frozen into permafrost in the Arctic. With the high increase in average annual temperatures in the Arctic (+5F) [+50F peak], the natural response is to release that captivated methane.

We find in Figure 2, before significant Arctic methane release, that the trend is toward increasing concentration every year, despite the CH₄ half-life. The risk of a sudden release of Arctic methane in response to increasing Arctic temperatures would further increase GHG-driven Arctic methane releases. We do not know for certain how close the planet is to the Arctic temperature where methane release starts tipping uncontrollably past its current retention state. We also do not know if the Methane Bomb is a standing threat or not. Making it a gambler's risk, with no chance of a win.

Figure 2 Recent Methane Concentration History



Some evidence points to 1.5 deg C as a likely threshold for permafrost melt. An examination of caves in Siberia found geologic evidence that permafrost melting occurred at 1.5 deg C above the historic average temperature. ([New Scientist](#)). Regarding the possibility of a methane runaway tipping point temperature, the same experts opined no risk, with no evidence given, because soil microbes consume some methane. This was before methane started forming post-blowout craters in Siberia.

The answers to two questions will decide the mass extinction of mammals:

- 1) Is there an Arctic runaway methane risk?
- 2) If so, what is the trigger threshold temperature?

You would think there would be settled science on these existential questions. There is no question in science that is more consequential than that for runaway methane. It remains open and neglected. Even if you are not a problem gambler, the lack of definitive answers to these two existentials still leaves no choice but to make worst-case contingency plans.

An Emergency Management Plan for the Onset of Methane Runaway

Given the dire consequences of exceeding the unknown Arctic Tipping Point temperature, a corporate-style risk management plan would be advisable. There actually is no such plan as we drive our planet forward into a risky unknown future. Maybe we should start one.

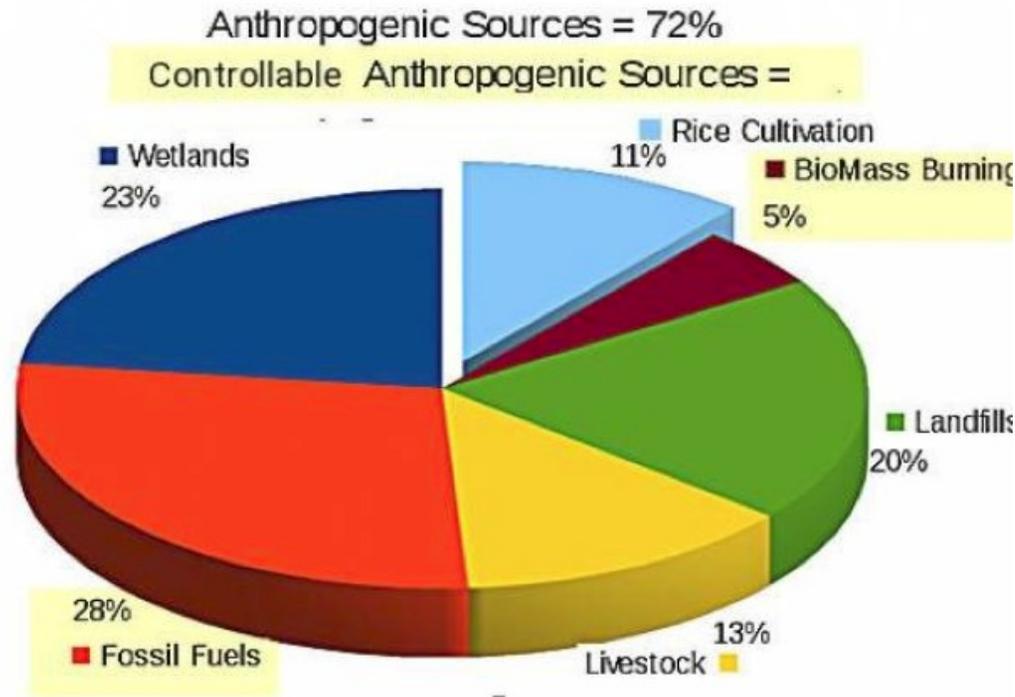
1. Risk Analysis

Human-sourced methane (72% before the tip) could conceivably be controlled and cut faster than the Arctic methane tips out. Which sources are controllable? The extent of controllability is depicted in Figure 3.

Rice cultivation emissions can be stopped under certain circumstances, also true for some waste decomposition, even reduction of enteric methane from domestic ruminants is possible by changing their diet. But for example, consider the more controllable sources - fossil fuels (28% of human sources) and biogas burning (5% of human sources), for a total of 33% of human sourced methane. This equates to 24% of all methane sources. ($0.33 + 0.05 = 0.33$, $0.33 \times 0.72 = 0.24$)

The range of control is 24%. A spike in Arctic methane releases that exceeds 24% before human sources can be cut would render the climate uncontrollable – just think about the math, not the extinctions. To date, no controls have been demonstrated to be effective.

Figure 3: Controllable Sources



2. Risk Management

Permitting an exceedance of the unknown Arctic Tipping Point Temp is not management of risk. Foreclosing the possibility of this exceedance is.

How would this foreclosure occur? The market for natural gas is well established but not well understood, given the inability to predict natural gas market valuation. The most obvious steps are no surprise.

Step 1

Perform gas infrastructure end-to-end Leak Detection and Repair (LDAR). There is no industry mandate to accomplish this (neither from regulators or civic-minded stakeholders). Near term all-encompassing LDAR requires impossible logistical mobilization across infrastructure that took decades to build in its present leaky form. The only attention to this critical issue is from a [US Government Accounting Office](#) report. This report ...

- (1) Defines levels of performance and address all core program activities and
- (2) Uses budget data to refine performance goals for its gas storage program.

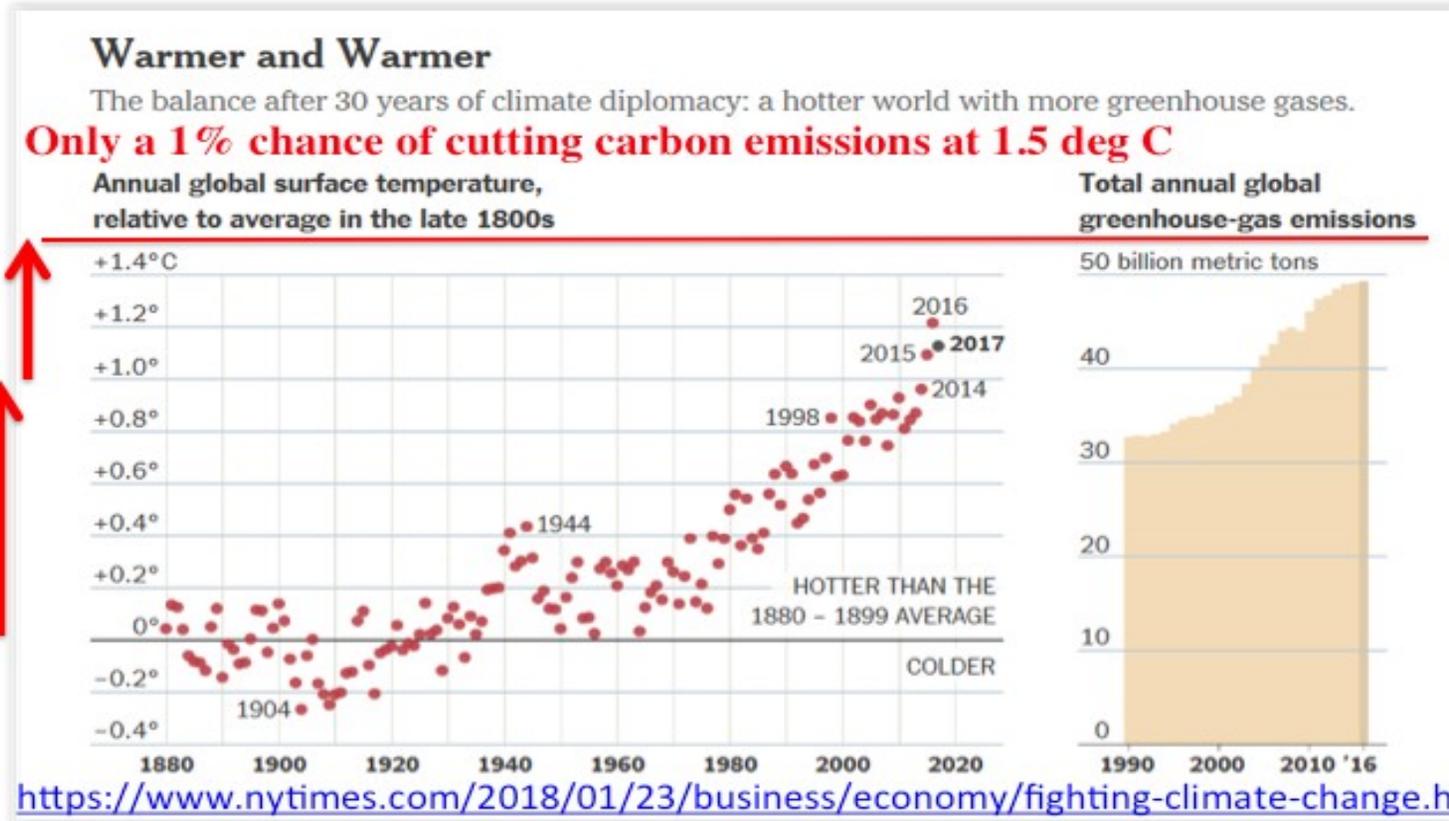
This GAO report has been issued in response to the discovery of unreported long term methane leaks like the [Sabine Pass LNG Export Plant Shutdown](#).

Step 2

Locate and cap all abandoned gas well bores. There is no industry mandate to accomplish this (neither from regulators or civic minded-stakeholders). The number of unlocated rogue wells is astounding.

Step 3

Target a gas price that is 2x the average from the last 10 years. Start shutting down well production until this price is reached. This is a measure of market demand sensitivity, currently unknown, that balances market demand against the unknown Tipping Temperature margin. Call this the Exxon Threshold for possible emergency methane shutdown of all gas and oil methane sources on the planet. No one can prove that this will never be necessary. And it's possible that this could be sufficient to avoid dire consequences - if managed. By the way there has been no methane management, is no methane management, and there will be no methane management until beneficial authority is instituted. The proof of "no management" is abundantly evident in 1.5 deg C threshold graphic on climate policy effectiveness, provided below.



Climate policy work has had no measurable effect for at least 40 years

The climbing temperature trend begins in mid-sixties. This brutal weather pattern suggests that climate policies are disconnected from the goals they are designed to achieve, and that the similar policies in the future will be rendered mere paperwork. Do we know of a climate policy that can halt global temperature at 1.5 deg C above 1880 ?

Biogas Capture Can Save Your Day Or Ruin It

Capturing methane is a serious accomplishment, although not the same thing as taking CH₄ out of the environment with sequestration (like theoretically reforming hydrates in permafrost). Here is a recent report describing a carbon capture project in Oregon.

<https://www.renewableenergymagazine.com/biogas/wartsila-biogas-upgrading-plant-to-significantly-reduce-20180917>

Carbon credits are awarded and the product is sold as Renewable Natural Gas (RNG), a biogas technology.

The advantages of capturing methane before it escapes to the environment are clear, proven and unarguable. It saves your day.

Having prevented climate damage by completely containing methane, what happens next will lock in your total climate success, or lock it out.

Researchers attempting to confirm the soundness of the national pipeline grid, which is essential in preventing leaks and releases of methane that undermine the possibility of a stable and habitable climate, have failed to verify industry estimates compiled by the US EPA. Third parties on their own dime have conducted actual measurements, thought by industry to be too costly to perform, and the results indicate a life cycle fugitive emission rate of 5% of delivered gas. We have not obtained data specific to pipeline infrastructure leaks and associated compressor station releases. Neither industry nor Government report pipeline grid emission measurements at scale. This leaves a tragic unknown as climate worsens and urgent judgments must be made. We all know the first principle of management: If you can measure it, you can manage it.

Managing a serious threat without data is a new and difficult thing for science, as in the past there was time to delay decisions until after the data could be collected. Are the advantages of RNG nullified by delivering it to a national pipeline grid, where it escapes back into the environment after once captured at considerable expense? Methane (CH₄) is 84x worse than CO₂ as a climate heating pollutant. [This is a recently discovered characteristic of CH₄ 20 years after its release. A 100-yr characteristic can be quoted, but with mounting evidence of runaway methane releases in the Arctic, we really don't have all century to wait for effective action].

The scale of this concern is staggering. The following gas grid map depicts the proximity of landfills that could be connected to the grid.

Figure 4. Washington Landfills and Major Natural Gas Pipelines



Figure 4 is taken from “Harnessing Renewable Natural Gas for Low-Carbon Fuel: A Roadmap for Washington State,” December 2017, found at this link:

<http://www.commerce.wa.gov/wp-content/uploads/2018/02/Energy-RNG-Roadmap-for-Washington-Jan-2018.pdf>

In this report from the Washington State University Energy Program, a search on “leaks” will locate a discussion of landfill leakage, but gas grid leakage is not acknowledged. A search on “certified” returns no hits acknowledging the need for gas grid certification. This is to be expected because nationally there is no certification of the integrity of the gas grid, and no authority is chartered to issue credible certification.

Feeding RNG to the pipeline infrastructure grid adds to the threats already posed by transporting fossil gas. More carbon gas distribution is not a solution to carbon gas leakage.

- **Facility operating permits must not be issued to methane capture projects that deliver product on the uncertified, leaky gas grid.**
- **To allow such deliveries, and to issue carbon offset credits for such deliveries, is to add to the existing methane threat while masquerading as a beneficial energy source.**

The deployment of on-site turbines can deliver energy on the electric grid, the grid that does not leak. Biogas RNG consumed on-site is an outstandingly effective method that intercepts, contains and consumes mass methane releases from farms, landfills and sewage treatment plants.

Issuing credits for this carbon capture is highly questionable, since this does not create a sink for methane carbon, it merely reduces the threat by converting CH₄ to CO₂, the latter being added to the overabundant load already punishing us, offering one answer to Q1. Producing methane and capturing it carefully, does no harm -- but **since it was otherwise never to have existed**, it is not eliminating the methane threat. Why would it be deserving of credits?

Incentives for Preventing Biogas Formation

The Arctic conscious legislator will spend equal time researching incentives that act to impede unnecessary methane generation. This is done by adding air to fermenting ponds, to accomplish [aerobic methane oxidation](#).

Oregon Lacks Administrative Defenses

ESF approached the ODOE and EFSC pleading for improved facility evaluation standards. Current standards are out of date, but more significantly they do not acknowledge methane as an aggressive pollutant. This means that in employing the permit issuance process for a natural gas pipeline, there are no constraints on methane leaks and releases. The candidate facility could later emit

volumes of methane under normal or abnormal conditions, and under the terms of existing rules, the permit would not be violated. Oregon has no defense against negligent methane handling.

The same misuse of infrastructure that caused the Aliso Canyon methane disaster is employed in the Mist gas field: Take a well bore designed to withstand immense negative pressures associated with extracting oil, and subject it to immense positive pressures needed to store gas underground. Why is a straw the right thing to use as a balloon? The Aliso Canyon well bore, the balloon that broke 700 feet below ground, was not repaired, because it was not repairable. The volumes from 4 months of methane emitted there are warming Arctic permafrost and releasing more methane today. So are the gas grid leaks. Is there any corrective authority in Oregon?

DEAR EXXON: Which methane is melting the Arctic the most? Aliso Canyon? Gas Grid Infrastructure Leaks?
Boston Neighborhood Gas Blow Out? Secret Sabine Pass Leaks? GOT DATA? Thanks
for nothing.

Faulty Engineering is Pervasive

In the field of engineering design, the designers answer to specified formal design requirements. If you limit or edit-out the climate safety requirements you do not get a climate safe product. You build unsafe infrastructure for 4 decades when you know the threat this locks in to the gas grid. Any redesign needs the right redesign requirements. Engineering redesign for product improvement is common practice.

In these days, much of energy law is still driven by extreme deregulation. Thus, we have little hope that Oregon could require interstate methane transmission pipes to EVER be certified as being designed according to Best Available Climate Science. For that reason, we see any production of biogas as needing to be done completely under State of Oregon regulation, and not connected to the interstate methane grid, which we believe contributes serious risk of continued climate damage.

Due to the need to defend the climate from methane and other greenhouse gasses (this is why we have decarbonization), any biogas generator (digester or cooker) or collector must be assessed and approved against criteria that enforce a 2 deg C budget. The goal of biogas permitting/regulation authority is to prevent counterproductive conflict with publicly funded decarbonization and drawdown projects, posed by biogas leaks and releases.

Thus, such projects should be confined in space such that leak inspections can readily assure they are not contributing more fugitive methane to the climate problem. The methane should be consumed on-site, and an excellent output would be electrical energy to the electric utility grid - which is incapable of leaking methane.

The Precautionary Principle

Be early. Lots of things could go sour, and one of them is the Methane Bomb, and one of them is something no one has thought about, yet.

So, if we get Decarbonization done before the first one would have wiped us out, we did the right thing.

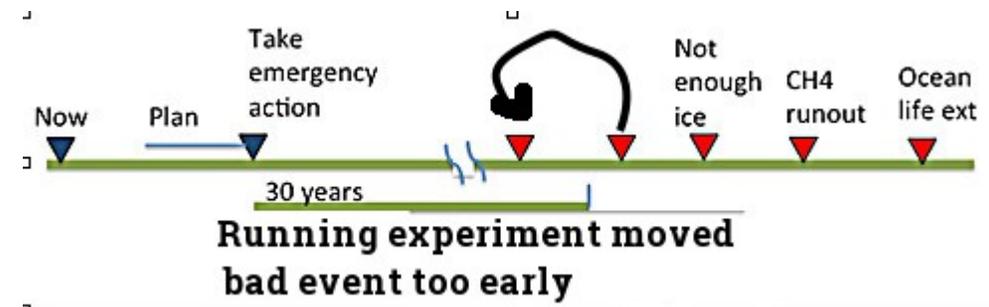
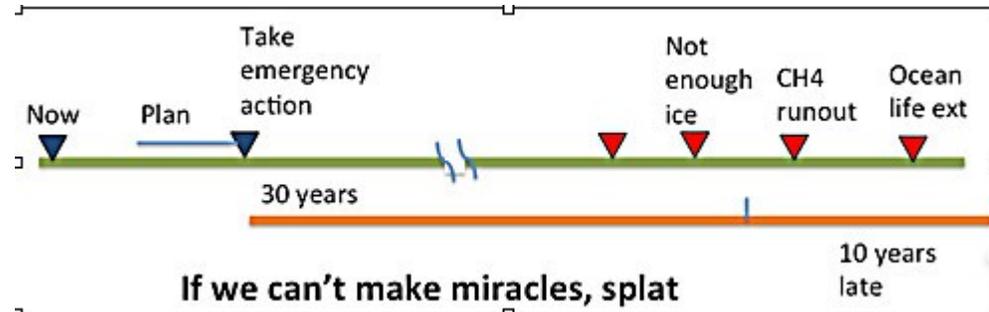
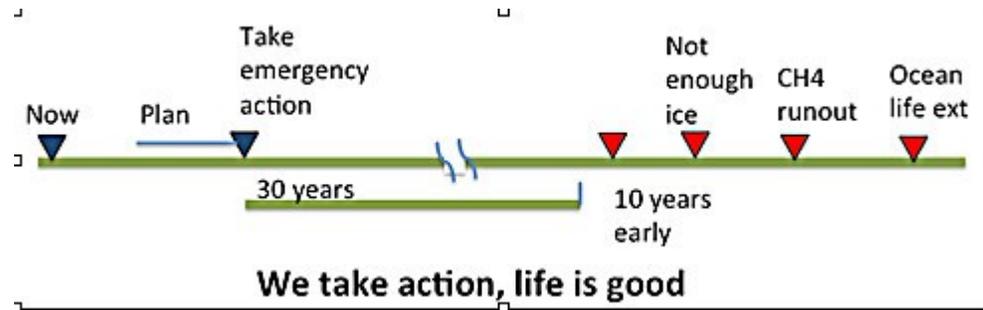
Because, if you aren't early, you are late.

Don't be too late!

If you are late, you lost your chance to stay in control.

Those are the first things to care about.

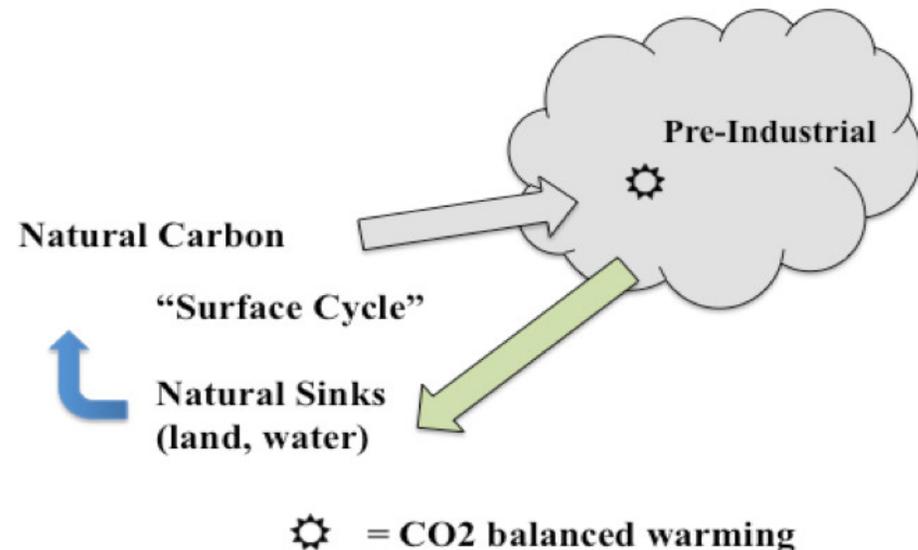
Don't choose the wrong experiment because it could move the deadline up – maybe even to today or tomorrow.



Remember Carbon Reduction means most urgently Decarbonization

The simple times, when things worked right:

The image to the right shows a wholesome pre-industrial-age atmosphere and earth relationship. To the extent that exists as a part of today's climate mixture, it is referred to as the "Surface Cycle" In it, animals breath out CO₂, plants rot and generate CO₂, etc. Then, when the sun shines, live plants turn the carbon and water and contributions from the earth into sugars, and puts out oxygen for all us animals to breath. These are the natural sources and sinks for the atmosphere that provided for the support of life for over a million years. It knew how to adjust to keep the earth's average temperature within approximately 2 degrees of the same temperature. For all that time. Reliably. By small adjustments of CO₂ around 280ppm in the atmosphere.



The complexities from the Industrial Revolution:

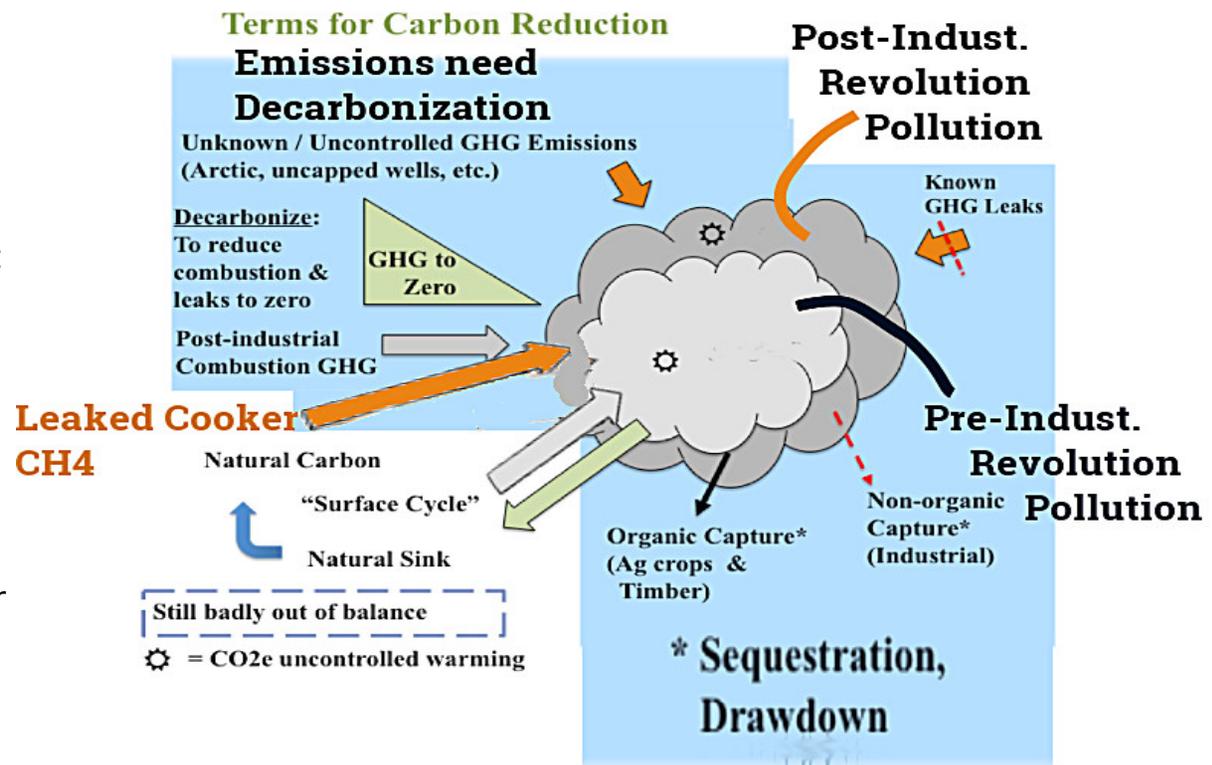
Then came the industrial revolution, and we used carbon based fuels in ever-growing quantities.

Note that there is a new and darker cloud in the sky. That represents the new CO2 and other greenhouse gasses put into the air by our industrial activity. We went from 280ppm to 410ppm and if we don't change things, now, we would soon be over 500 ppm. **All non-pre-industrial-age emissions must be cut off. That is called Decarbonization. That is the primary responsibility of the "Carbon Reduction Committee" - to generate a bill that will cause that to happen. That is what the GHG to zero triangle represents.**

The Leaked Cooker CH4 arrow is a representation of what could happen if people were free to design new methane cookers, like ponds of cow manure, and have them generate methane and fail to contain it. If methane is generated, it needs to be captured and burned, so that it becomes CO2 before getting into the atmosphere, because that reduces it's impact by 84x!

The importance of not leaking requires that the process be a certified / licensed process from beginning to end, and be easily measured to prove that it doesn't leak. Because the national grid will never be so certified, we don't believe it should ever play a part in handling cooker-created methane.

However, if a local process could drive a turbine and generate electricity while burning the CH4 into CO2 and water, the electricity it produces could be safely shared into the green economy on the electrical grid.



Where does this fit into other parts of the new green economy?

A separate problem from Decarbonization is Drawdown. The atmospheric pollution contributed to the atmosphere over the last 150 years all needs to be removed from the atmosphere. Drawdown is that reduction of CO₂ ppm (and CH₄ ppb, etc.) which must happen from the 410ppm or more that it will be at when we start the reduction, eventually to the 280ppm that it was before the industrial revolution.

The only way we know to cause that Drawdown is organic. We farm a huge portion of the earth. In the industrial age, we have used artificial fertilizers and tractors to till the soil to allow huge control over planting and harvesting. However, almost all the industrial processes have decreased the fertility of the soil and caused it to emit CO₂. So, we need to learn to go back to farming practices that actually allow the bacteria, fungi, and worms and such live in the soil and grow the carbon fertility of the soil.

Most industrial methane cookers associate with industrial animal raising for food in what are called Concentrated Animal Feeding Operations or CAFOs. These operations produce huge amounts of manure. Such huge amounts that it is treated like city sewage, in that the process of having it produce methane is considered a useful and primary way of killing the other bacteria in the manure (which is being mixed with a lot of water for this process to work).

It is not clear that this is good agriculture.

If land is used for growing plants, and between harvests is used as pasture for a small number of animals, the manure produced is pounded into the ground by the animals producing it. And it is a small enough amount that it acts well as a fertilizer, but doesn't bring risk to the soil. Such a process is known to grow healthy, sequestering soil that increases in fertility from year to year.

Our Conclusion

Addressing a problem described with Science by Scientists requires a careful process. In this paper we have concentrated on applying the following project management rules.

- 1 Make sure ideas are grounded in Best Available Science and related to them in such a way that when knowledge changes, the project can follow.
- 2 Use numerical information as much as possible.
- 3 Break pieces into small chunks so they are
 - a more easily understood, and
 - b more easily controlled (and regulated)

We suggest that for Biogas policy development, time is of the essence. Being too late controlling methane can be fatal. Thus it is important to build the rules to allow jobs to be done early. Not only allow it, but encourage it.

Scientists have described a principle for acting on sufficient but incomplete information as The Precautionary Principle we talked about that above, and recommend it to you highly.