Addressing Methane in Regards to Climate Change
Or
Biomass Energy Potential

> Methane is a greenhouse gas that has more than 80 times the warming power of carbon dioxide over the first 20 years it enters the atmosphere. Even though CO_2 has a longer lasting effect, methane sets the pace for warming in the near term.[1]

As the Environmental Defense Fund points out, and literally all science agrees, methane is a more immediate and potent factor in worsening climate change than carbon. It is 80-86 times more potent a greenhouse gas than carbon dioxide at trapping heat.

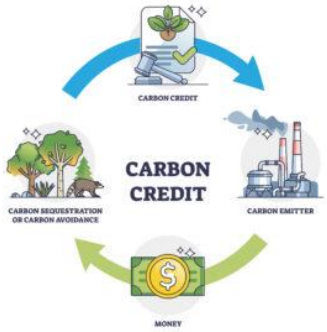
According to Google AI, over a 100 year timescale, methane is 28-30 times (2,800%-3,000%) more effective at warming than CO_2.

We have the concept of carbon credits to address carbon emissions; but why not a methane credit concept to mitigate the most dangerous greenhouse gas?

Answer this question for yourself and know this paper holds the position that a methane credit concept is easily understandable and presented herein; but first lets understand what the carbon credit is.

The carbon credit is tradeable, a product in the marketplace for companies. There are two types, each explained at this website where the illustration is from:

https://offsel.net/media-en/co2-reduction/carbon-credits



Briefly explained here, the market invented carbon credits so carbon emitters such as a coal power plant might get credit for planting a forest to absorb carbon and those credits then offset the carbon emissions from the coal plant–a type of balancing act.

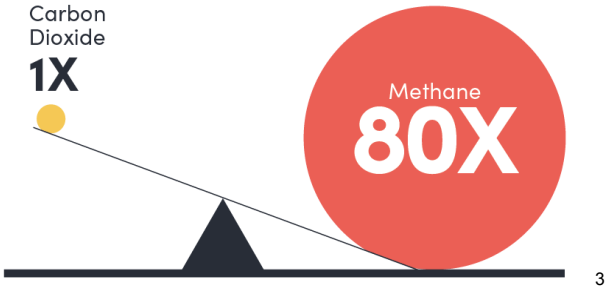
[1] Methane: A crucial opportunity in the climate fight.
https://www.edf.org/climate/methane-crucial-opportunity-climate-fight

The cap and trade aspect, or second aspect of the carbon credit is defined here by carbon credit traders.

> The cap-and-trade system trades according to greenhouse gas emissions allowances. In this method, each business has an upper limit (cap) on how much they can emit, and when they have excess emission allowances, they sell the surplus to other companies, and they purchase allowances from other companies when they do not have enough.
>
> - Company A sells the surplus 2,000 tons of the 10,000 tons of emission allowances: Gains from the sale
> - Company B buys 2,000 tons of surplus allowances from Company A to make up for the shortage of emission allowances: allowances increase.
>
> The advantage of the cap-and-trade system is that it greatly benefits businesses that make large reductions, or those who sell emissions allowances. On the other hand, businesses that have not reached their reduction targets will have to make their own money to secure emissions allowances.[2]

This concludes the straight-forward, easy to understand, explanation of carbon credits.

Now, we turn to the concept of methane credits–which exists although is not talked about nearly as much as carbon credits are spoken of.



[3]

Here we have an example by another carbon and methane credit broker, a company called Tradewater. When they speak of methane credits they are talking about capping, a physical capping, of old oil and gas wells so they no longer release methane into the atmosphere.

Again, I point out we are talking about methane being 80% worse than carbon dioxide, we are talking about it being 2,800-3,000% worse in a 100 year timeframe and 8,000-8,600% in a 20 year timeframe.

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[2] Advantages and Disadvantages of Carbon Credits 18 JUL. 2024 https://offsel.net/media-en/co2-reduction/carbon-credits

[3] Methane Plays Dirty https://tradewater.co/methane-plays-dirty

But this isn't exactly the type of methane credit I'm certain needs to be introduced to the energy market and should also become understood by the average citizen because I want to talk about methane credits in the context of biomass energy.

The literature regarding "methane credits" that is to be easily found on the Internet still revolves around the carbon credit.

Where someone will find a website talking about "methane credits" they will almost always find this concept discussed as it relates to the "carbon portfolio," for a company.

Eventually, the biomass industry ought to establish its own explanation of "methane credits" so people would understand they can mitigate methane emissions to address climate change and they can do this by processing waste–food and agricultural waste–to produce methane that is then combusted to create electricity.

That combustion will produce a fractional amount of carbon. This paper is perhaps among the first attempts to calculate a methane credit equation as it pertains to biomass energy–not methane from orphaned oil and gas wells, not methane from landfills, not a methane credit as a sidekick to a greater carbon portfolio.

ACR is a nonprofit enterprise of Winrock International and its website addresses methane emissions from landfills.[4]

ACR talks about the 2,000 active landfills and how they all produce methane gas and how the landfill industry has a standard where tubes are placed in the landfills. This process is called "well field tuning" and it allows for technicians to measure gas composition, flow, temperature and pressure.

I mention that here only so the reader has an understanding for how the term "methane credit" is already being used. It is being used in the context of capping orphaned wells and landfills.

What this paper brings to light, however, is diverting food and agricultural waste to biomass sites so that organic waste never gets dumped at a landfill, so never becomes methane released into the atmosphere–my idea of a "methane credit" necessarily means the methane is sequestered and combusted to produce renewable electricity.

This paper is summarizing what will hopefully become the further evolution of the methane credit concept into a formal mathematical equation to reconcile the difference between carbon and methane as greenhouse gasses and show how biomass energy is in fact the best form–the most utilitarian–of renewable energy in regards to profitability and addressing climate change.

Let's summarize the evolution of the concept so far.

[4] Methane Emissions from Landfills https://acrcarbon.org/resources/methane-emissions-from-landfills

1. We are still talking about methane gas being roughly 3,000% more harmful to the climate than carbon dioxide regardless of its source type–100 year timeframe. So, for our equation, we still have the simple math of multiplying by 30 a given amount of methane to understand its carbon dioxide equivalence in the context of greenhouse gases and climate change.

2. According to Google AI, when methane is combusted it creates 2.74 to 2.75 its original mass as carbon. $\mathbf{CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O}$ is the combustion reaction, in terms of chemistry. Google cites the MIT Climate Portal[5] for describing this high carbon mass increase from combustion due to oxygen being added for that process.

3. Assuming one unit of methane, we have 1 x 2.75 = 2.75 units of carbon created by combusting methane with the original 30 (3,000% worse given the 100 year timescale or 8,000% worse given a 20 year timescale) greenhouse gas value subtracted or 2.75 - 30 = negative 27.25.

4. This means combusting methane completely eliminates the methane as a greenhouse gas and in so doing creates a fractional amount of carbon. It means combusting methane produced in a biomass digester is 2,725% better for the environment than combusting natural gas within a 100 year timescale or 7,725% better in a 20 year timescale.

When you combust a unit of methane, you get that unit multiplied by 2.75 for carbon dioxide value in juxtaposition to doing nothing with the methane so multiplying that unit by 30 as the methane would otherwise exist as a greenhouse gas.

This is a 27.25 difference to be reconciled by a biomass energy idea on the methane credit concept–given a 100 year timescale.

Again, according to Google AI, when natural gas is combusted it creates 2.75 the original weight in carbon dioxide. Combusting a ton of natural gas creates 2.75 tons of carbon dioxide. When combusting a ton of methane we also get 2.75 tons of carbon dioxide but we reduce climate change by a factor of 30, or 30 tons of carbon dioxide when the methane value is converted to carbon dioxide value on a 100 year timescale, 80 tons of carbon dioxide on a 20 year timescale.

Unlike natural gas, which is procured with intention to combust, the methane gas is not intended. It is a byproduct of life. Humans have to eat food and don't eat all the food they create so throw some of it away and this will always cause methane to be released into the atmosphere and so speed climate change.

Methane produced by livestock is more in the news, but all organic matter that enters into a decomposition process is going to produce methane. The more organic matter on Earth, the more methane.

[5] How Can Burning One Ton of Fuel Create More Than One Ton of CO_2
https://climate.mit.edu/ask-mit/how-can-burning-one-ton-fuel-create-more-one-ton-co2

We need organic matter, we are organic matter ourselves; but we don't want runaway climate change and climate catastrophes–so we have to address methane with methane mitigation.

The question then is, are we going to use the waste food to create energy knowing it is 80 times better or 3,000% better for the environment given a 100 year timeframe to do that, than it is to create energy with natural gas?

When considering solar and wind, which emit no carbon nor methane as they generate electricity we have to still consider the amount of carbon created during the manufacturing of this equipment.

Google AI says a solar panel generates carbon mostly because of the manufacturing process so 41-50 grams of carbon per kilowatt hour they are in use, with an average lifespan of 25 years. Solar panels do nothing to mitigate methane, which is 80 times worse than carbon as a greenhouse gas.

Using the same AI, wind turbines produce 5-26 grams of carbon per kilowatt hour and it takes about seven months for a wind turbine to produce electricity before it has paid off that manufacturing cost in carbon. They do nothing to mitigate methane.

So, it's not a question of one or the other. We already have methane. It is here regardless of how many solar panels and wind turbines are built. We are already transporting that waste to landfills and so increasing carbon dioxide emissions to move methane around but doing nothing to mitigate it as a greenhouse gas.

We could transport this organic waste to biomass facilities, where it is put into a digester to sequester the methane and then that methane is combusted to produce electricity. Such facilities would compare to small natural gas power plants or fueled generators; yet be 30-80 times better for the environment than natural gas depending on the timescale applied.

If this is done, the people would certainly be improving their environment and sustainability by using their waste-methane to create electricity and this approach being about 3,000% better for the environment than not having such a system in place or only using other forms of renewable energy which do nothing to mitigate methane.

The biomass methane credit equation, then, I suggest would be as follows and derived from Google AI:

$$\textbf{Mass of } CH_4 \textbf{ x } GWP_{20}\,(CH_4) = \textbf{Mass of } CO_{2e}$$

Further elaboration of this equation is certainly possible and it is also possible technological advancements might allow for the combustion of methane which would produce less carbon than spoken of here.

As this paper is published by Verdantronix LLC to support any application for a study/planning grant for biomass energy, I hope anyone reviewing this paper and such grant applications would understand the community needs licensed engineers to crunch these numbers so we not only get a feasibility study in terms of costs and electricity yields, but also in terms of environmental benefits in light of climate change and methane mitigation.

I think the biomass energy industry ought to do more research and publication in regards to a methane credit concept–take more ownership of this concept which as of today mostly speaks to orphaned oil and gas wells, or landfills.

As I understand the methane credit equation, it needs to be owned by the biomass/biogas industry. It needs to be about the greenhouse gas reconciliation of combusting methane and that fractional carbon emission.

“Methane credits” isn’t a term being used on websites talking about methane digestion and where methane digestion is spoken to more can be said about the combustion of that methane to produce electricity.

Verdantronix LLC will continue to help develop the language of biomass energy and fill in gaps where mathematics and engineering ought to be published. Dialogue on these concerns is welcomed at the company website or by email.

Lastly, I’ll add, perhaps circular gasification of methane would be a process that would achieve even better environmental results–less carbon dioxide produced by combustion of methane because less oxygen is necessary to combust the methane in this way; but that subject too is set aside with the caveat Verdantronix LLC remains interested in such research and development projects, design engineering and possible patents.

Biomass Energy Potential

This paper now turns to a breakdown of equipment currently on the market regarding food waste digesters.

This part of the paper also supports the study/planning grant application of non profit organizations with the Portland Clean Energy Fund.

If such a grant is approved, Verdantronix LLC welcomes any opportunity to be a paid consultant for the applicant and to be the point of contact with the engineering firm that would conduct the feasibility study and to help that firm complete the study as there are very few biomass engineers in the USA–so Verdantronix LLC would help all parties in the study be mindful of relevant data.

Let's take a look at https://www.biowatt-biogas.com/food-waste-to-energy

We see some listed examples of existing, larger scale, biogas power stations. One in particular stands out for having relevant data to the Tiny Home Eco Village project concept.

- Kitchen Waste Biogas Power Project: converting 200 tons of kitchen waste per day into 28,000 kilowatt hours of renewable energy.
    - This system suggests 1 ton of biomass produces 140 kilowatt hours of electricity.
    - This level of output compares to gasoline/diesel power generators, natural gas generators, and solar projects when factoring in peak hours of sunlight.
    - It takes only a small fraction of a single garbage truck to hold one ton of garbage.

With the Kitchen Waste Biogas Power Project as an example, and scaling down from 200 tons of kitchen waste to a single ton of kitchen waste, we can expect a feasibility study for **Cultivate Initiatives** and perhaps also **Our Just Future** to implement a small digester and methane fueled generator to create 140 kilowatt hours of renewable electricity with a small fraction of a single garbage truck containing organic/food waste per day.

According to Google AI, a small tiny home village in Portland, Oregon consisting of 20 tiny homes uses 100-160 kWh of electricity every day. Therefore it is likely a feasibility study would prove that a small biogas operation in a Tiny Home Eco Village project would produce all of its electricity needs every day, with a small (single ton) biomass/biogas operation.

Moreover, the job training that would accompany such a development to convert a tiny home village into a tiny home eco village might also develop a viable career path where those trained in the village could become employed at a larger biogas facility such as the Kitchen Waste Biogas Power Project example and process 200 tons of kitchen waste per day and this would supply enough renewable energy to meet the needs of *ALL* housing projects serving the unhoused population, in Multnomah County.

Let’s look at Novi Energy.

https://www.novienergy.com/2013/02/03/food-waste-is-turned-into-kilowatts-at-novi-energys-digester-plant

The Google AI overview of this article states between 200 kWh and 400 kWh of electricity might be produced for every ton of food waste. This example also includes livestock waste processing but still the data suggests that if that livestock waste were removed there would still be a level of output as in the previous example.

A feasibility study on different types of food waste should also include food waste in an advanced state of decomposition and so as organic sludge more compares to excrement than food waste in the early stages of decomposition.

There are many companies that manufacture biogas equipment in many different countries and they all have been published as being viable, profitable, operations. It's more a question about how profitable than whether or not they will be profitable at all.

We are talking about biomass energy development as a non profit enterprise where there is significant added value beyond what level of profitability the biogas project would produce.

We are, of course, talking about profitability–a tiny home village that is producing all of its own electricity and all of that renewable and more than that, mitigating methane so the project is helping address climate change at a level that is between 3,000% and 8,600% more valuable than any other type of climate change intervention–minus fractional carbon.

We are also talking about a workforce development program for a population that has the most barriers to finding employment and training. This labor can be calculated so residents would at least be paying for their own utilities or a greater than one ton of food waste per day operation might be funded so then worker-residents might exchange their day labor to pay for their full housing costs.

With scalability of biomass/biogas/bio-electric projects, it is entirely plausible a significant number of the unhoused population might find gainful employment that is also on the job training so they might then more easily find even more gainful employment.

In addition to this, there is the data cited in the Policy Advisory document also available on https://verdantronix.com/projects that this labor would necessarily prove to be the best intervention to mental health and addiction crisis–so added value as a recovery project.

For these reasons and all the others spoken to at https://verdantronix.com/projects, Verdantronix LLC strongly encourages the Portland Clean Energy Fund to approve every community grant application for a feasibility study for a Tiny Home Eco Village project.

1. Address climate change, in a way that is 3,000%-8,600% superior to carbon credit centered projects.
2. Help the most vulnerable population, by far, find employment and recovery by labor in renewable energy.
3. Help non profit organizations develop new funding pathways that become revenue streams so they are not entirely dependent on taxpayer monies and grants for their ongoing efforts and might even invest such profits into upscaling their biomass project.

Thank you for your time and consideration.