RIGGING THE NUMBERS

Questions and Answers on Biogenic Carbon in Waste and Climate Change

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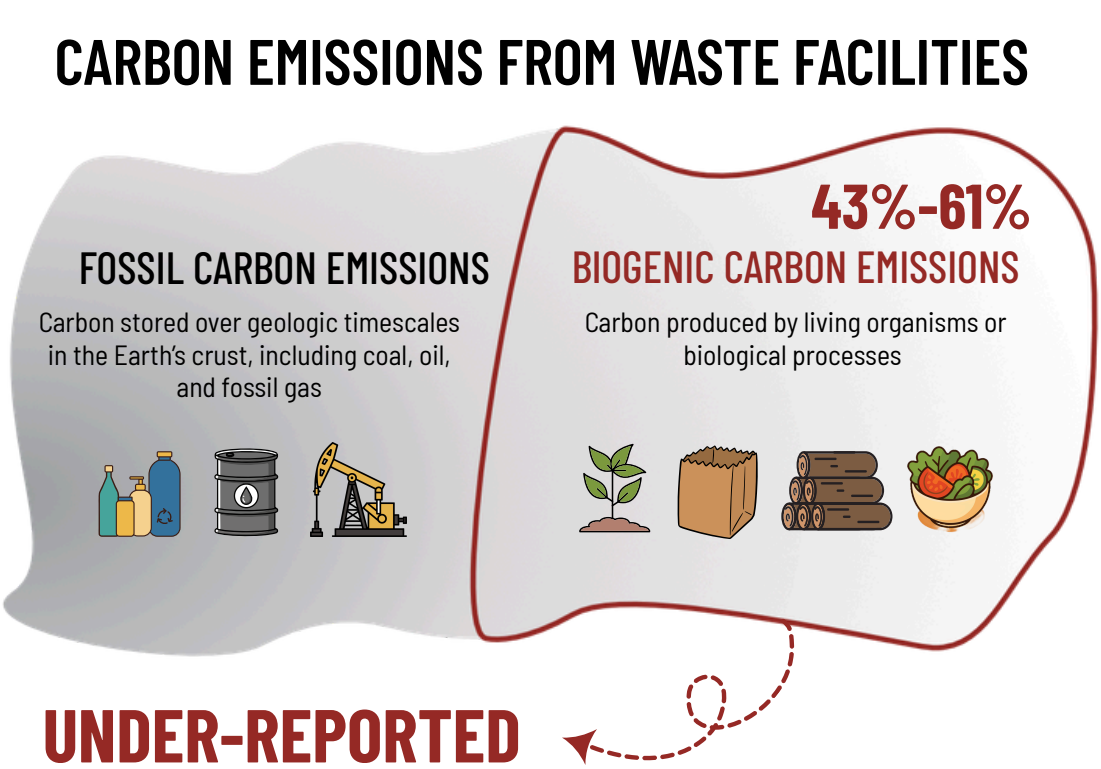
What's the issue?

Incineration ("waste-to-energy") and landfill gas-to-energy are increasingly being touted as "green" solutions to the twin problems of waste and climate change. In the waste sector, there's an accounting loophole that can lead to drastic under-reporting of carbon dioxide (CO_2) emissions: many facilities that burn waste do not report the emissions from burning biogenic carbon. With this accounting omission, they can avoid regulations and even receive subsidies intended for renewable energy alternatives such as wind and solar power.

Many industry actors apply a default assumption that 50% of emissions from burning mixed waste are biogenic; so they only report half of the actual CO_2 emitted. In fact, studies show a wide range of biogenic emissions from mixed waste, ranging from 43%[1] to 61%.[2]

Biogenic refers to something produced by living organisms or biological processes.[3] When discussing climate change, biogenic carbon refers to carbon that is stored in the Earth's biota (living matter) or has been released from it. Fossil carbon, on the other hand, is carbon stored over geologic timescales in the Earth's crust, including coal, oil, and fossil ("natural") gas (even though many of those were themselves once living matter). So, paper, wood, and food all contain biogenic carbon; plastic, oil, coal, and fossil gas contain fossil carbon.



- Biogenic emissions are not automatically climate-neutral as it can take hundreds to thousands of years to pay back the "carbon debt."
- Industry uses IPCC guidelines out of context – it's meant to prevent national inventory double-counting, not to erase emissions from individual facilities.

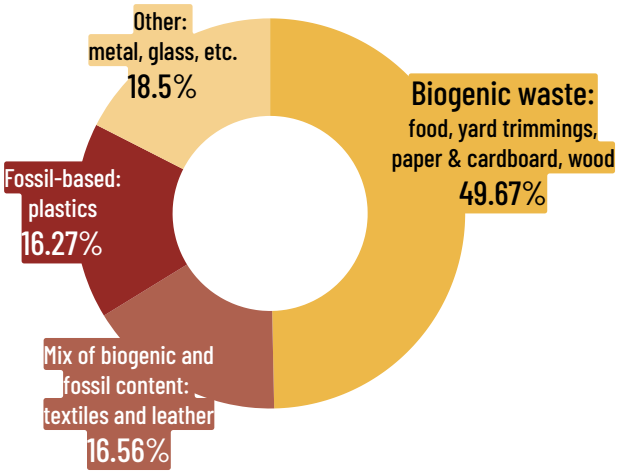
Q How are biogenic emissions different from fossil fuel emissions?

Biogenic and fossil CO_2 are chemically identical—one molecule warms the atmosphere just as much as the other—so all emissions must be counted. The difference lies in where the carbon comes from. Biogenic carbon participates in the Earth's carbon cycle, in which plants absorb CO_2, store it in their tissues, and eventually return it to the atmosphere, ocean, or soil through decomposition. The rates of absorption and release of biogenic carbon vary dramatically with different land uses affecting the net carbon balance. Fossil carbon, by contrast, comes from geologic deposits such as coal, oil, and natural gas; burning these fuels adds carbon that would otherwise remain locked underground.

However, "biogenic" does not mean "climate neutral." Human activity – such as burning trees that have grown over hundreds of years – adds CO_2 to the atmosphere. Burning biomass often produces more CO_2 per unit of energy than coal or natural gas because biomass is less energy-dense.[4] It can also cause environmental harm—for example, removing plant cover can degrade topsoil, reducing the land's capacity to absorb CO_2. For these reasons, biogenic emissions are not climate-neutral, and should be measured and reported just like fossil emissions.

In short, CO_2 is CO_2, and it all has the same effect on the climate. For this reason, scientists and environmentalists point out that all emissions should be accounted for and reported because they all affect the atmosphere.[5]

Biogenic portion of total municipal solid waste incinerated in the U.S. in 2018



Note: this is mass of material burned, which is different from the carbon content of each material.

Source: U.S. EPA. National Overview: Facts and Figures on Materials, Wastes and Recycling.

How do the companies justify not counting biogenic emissions?

Companies often cite IPCC guidelines to argue that biogenic CO_2 should not be counted, pointing to language stating that CO_2 from burning biomass "should not be included in national total emission estimates."[6] But this quote is incomplete. The full guidance clarifies that both fossil and biogenic CO_2 must still be estimated at waste-to-energy facilities, with fossil CO_2 reported under the Energy Sector and biogenic CO_2 reported separately.[7] The reason biogenic CO_2 is excluded from the energy sector totals is to avoid double-counting, since biogenic carbon flows are accounted for in Agriculture, Forestry and Other Land Use (AFOLU).[8]

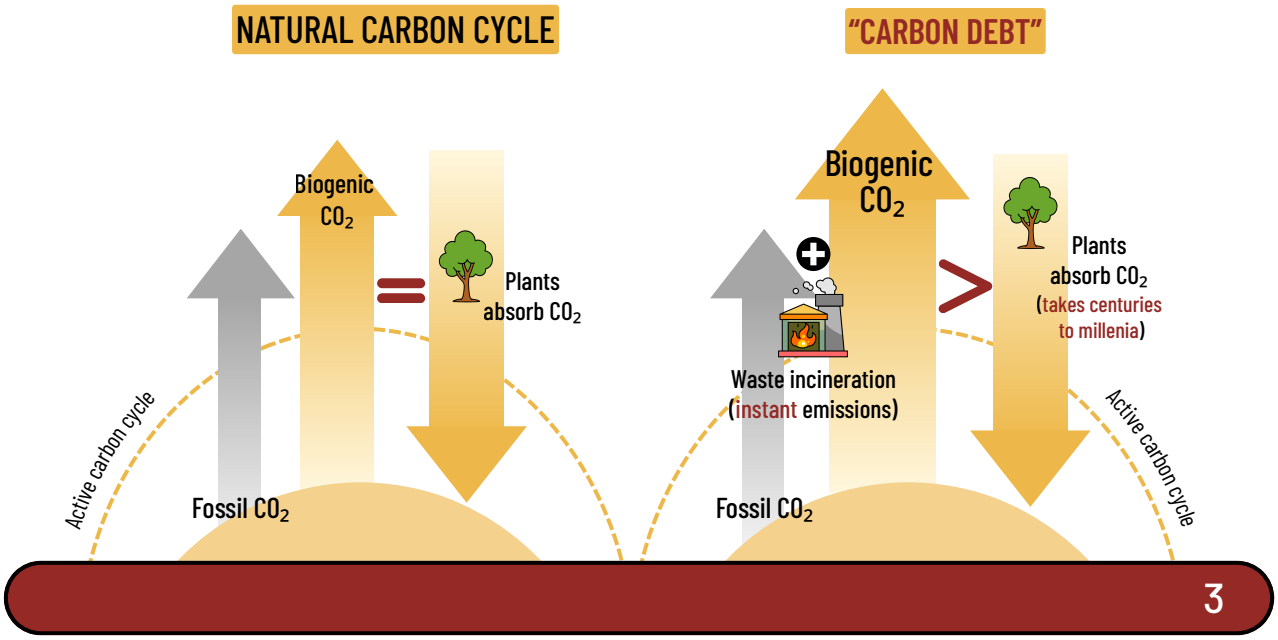
This accounting rule applies only to national inventories, not to facility-level reporting. At the level of a single incinerator or landfill, there is no risk of double-counting, so emissions should be counted exactly once. The IPCC and U.S. EPA recognize this distinction and recommend that all CO_2 emissions—biogenic and fossil—be quantified at the facility level.[9]

Comparing these multiyear processes to one that happens almost instantly (i.e., combustion) is simply inaccurate.

Why does the distinction matter?

If a company clear-cuts a forest and burns the wood for energy, ignoring biogenic emissions would imply near-zero climate impact, even though an entire forest's carbon has been released. Biogenic CO_2 is not automatically reabsorbed; regrowth can take decades, while emissions occur instantly, creating "carbon debt." In fact, CO_2 released today will remain in the atmosphere for centuries to millenia into the future.[11] Furthermore, a regrowing forest typically absorbs less carbon than if the forest were left uncut.[12] Compost, on the other hand, can store carbon in the soil for many years and even increase carbon uptake. The timing difference between emission and reabsorption is crucial, especially considering the urgent need to meet climate targets for 2030 and 2050.

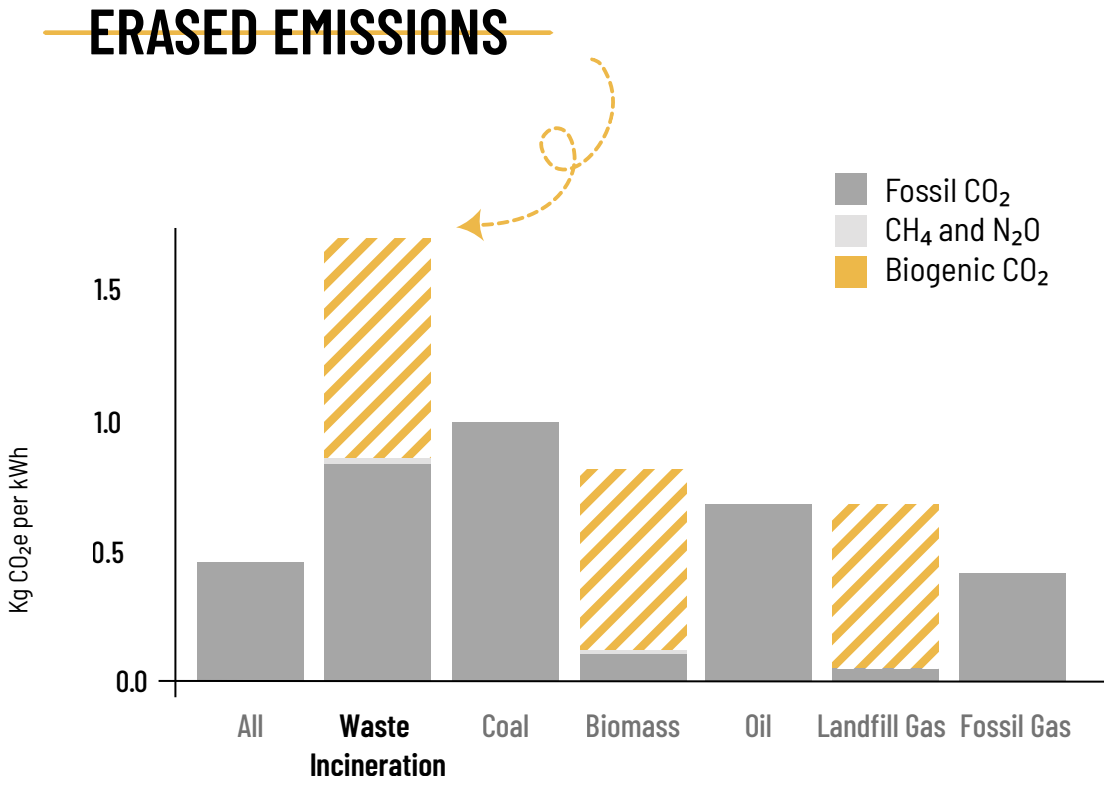
WASTE INCINERATION IMPACTS ON THE CARBON CYCLE



So how does all this relate to waste?

A large share of municipal waste—food scraps, paper, cardboard—is biogenic, which means that incinerators release substantial amounts of biogenic CO_2 when this material is burned. If these emissions are ignored, the climate impact of incineration is significantly understated.[13] Landfills also emit biogenic CO_2, and when landfill methane is captured and burned, the resulting CO_2 is typically unreported, further underestimating their climate footprint.

Biogenic carbon does not behave the same in all waste pathways. Incineration releases nearly all carbon in the waste immediately. In landfills, some biogenic carbon becomes CO_2 or methane, but roughly half remains buried for many years.[14] Composting, by contrast, returns part of the carbon to soil, improving soil health. Recycling paper and cardboard keeps much of the biogenic carbon out of disposal entirely. For these reasons, accurate climate assessment requires counting all CO_2 emissions—biogenic and fossil—across all waste management options.



Source: Tangri, Neil. 2023. "Waste incinerators undermine clean energy goals." https://doi.org/10.1371/journal.pclm.0000100

How should biogenic CO_2 be counted?

The most straightforward and accurate method is to measure and report all CO_2 emissions from a facility—both biogenic and fossil.[15] This allows different waste management options to be compared fairly. While a full life cycle analysis can provide additional insight into broader impacts such as recycling benefits, transport emissions, and soil carbon gains from compost, the minimum requirement is clear reporting of all emissions released at the smokestack.

How are biogenic emissions undercounted?

Most private and governmental emissions reporting protocols allow companies to omit reporting of biogenic CO_2 emissions, artificially lowering their reported climate impact. Incinerator operators are also often allowed to estimate the percentage of their CO_2 emissions, creating another opportunity to under-report emissions. This accounting loophole mirrors practices in the bioenergy and forestry sectors, where large amounts of biogenic CO_2 are treated as "carbon neutral" despite real and long-lasting climate effects.[16]

To summarize...

Waste companies are under-reporting their actual CO_2 emissions by 50% or more. They justify this by saying that biogenic emissions are a part of the Earth's natural carbon cycle and do not add to climate change—which is clearly false. The result is that waste incinerators and landfill gas systems often look better than they really are, which fools policymakers into thinking that they are actually "green" energy sources when the opposite is true. The solution is to require all facilities to report all emissions on an equal footing.

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