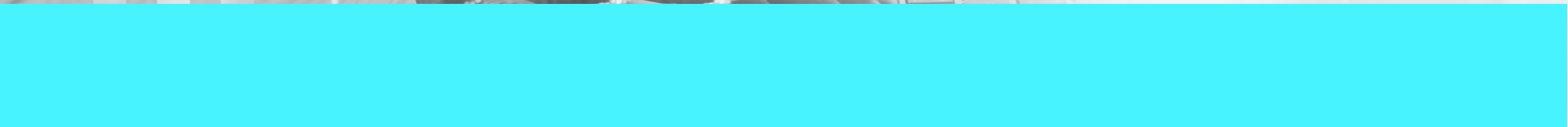


OCTOBER 2021

# A CARBON NEUTRAL BITCOIN



Prepared by:  
Kat Galloway  
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## 2 BITCOIN BASICS

Cryptocurrency (generally referred to in this paper as “Bitcoin”, though there are many different cryptocurrencies) mining is a process in which sophisticated computers with specialized chips are used to solve complex mathematical equations. When the miner is the first to complete a 1 MB block of transactions, 6.2 Bitcoins (approximately \$370,000 in today’s price) is awarded to the miner.

The problem that Bitcoin miners are tackling is the need for energy to power the operation and the potential environmental impacts of procuring that energy.

Depending on your news source, the global energy consumption of Bitcoin is around 100-175 TWh per year, and it is impossible to know exactly what the global blend of energy sources (i.e., coal, natural gas, solar, wind, renewables, etc.) fueling that mining is.

**Bitcoin miners MUST seek out sources of off-grid power.**

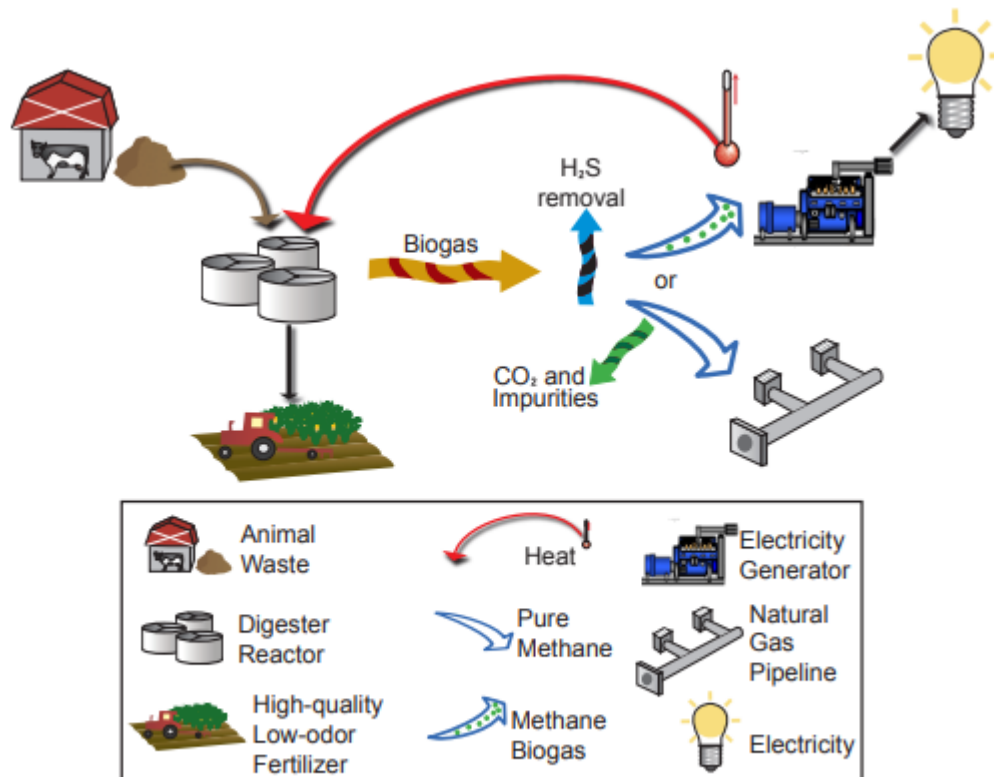
- **Harness energy that is currently being wasted.**
- **Look for energy that is renewable.**

# 03 RENEWABLE NATURAL GAS



Renewable Natural Gas (“RNG”) is a term used to describe biogas that has been upgraded for use as a substitute for fossil-based natural gas. Examples of biogas include gas from anaerobic digestion of manure and food waste (biodigesters), and landfill gas.

For example, anaerobic digestion is a process through which bacteria break down organic matter (animal manure, wastewater biosolids, food, etc) in the absence of oxygen. This process takes place in a sealed vessel in which microorganisms convert organic material into biogas containing methane and carbon dioxide. The process can be designed and operated to be a continuous flow process.



Prepared by Sarah G. Lupis, Institute for Livestock and the Environment ([www.ifle.colostate.edu](http://www.ifle.colostate.edu)), Colorado State University. Symbols courtesy of the Integration and Application Network ([ian.umces.edu/symbols/](http://ian.umces.edu/symbols/)), University of Maryland Center for Environmental Science.

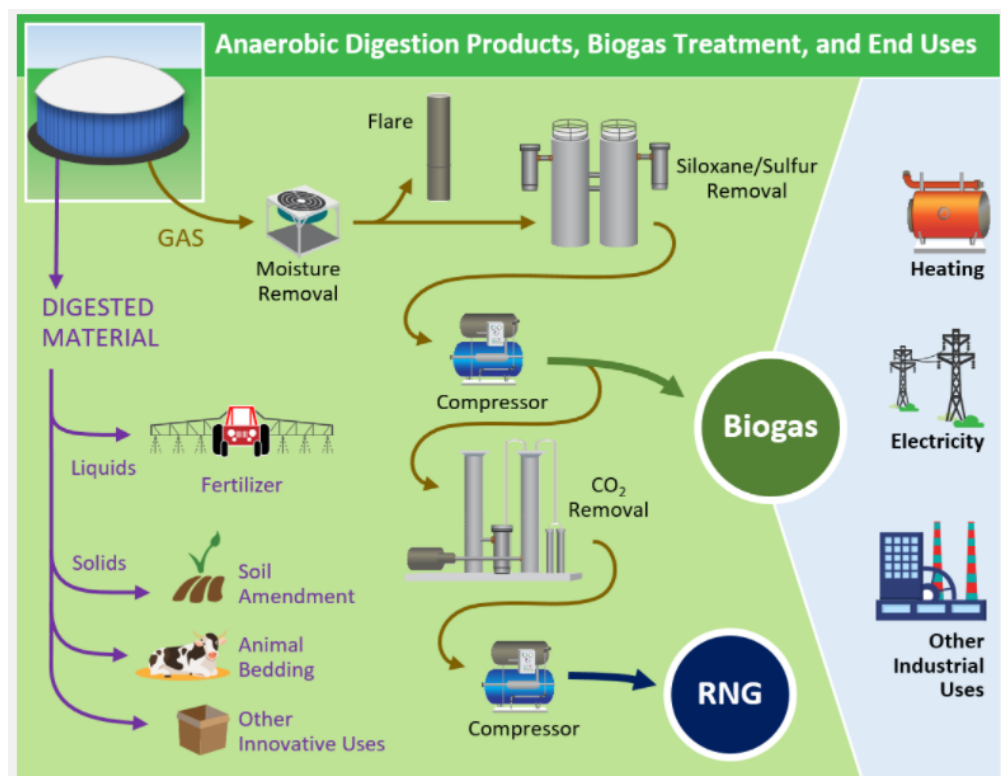
Image credit: <https://extension.colostate.edu/docs/pubs/livestk/01227.pdf>



# 04 RENEWABLE NATURAL GAS

Raw decomposed biowaste consists of 45-65% methane and carbon dioxide as the remainder. Many farms will use the anaerobic digesters to keep some of the gas to provide energy for the digestion process itself, use the methane for in-home heat, and more-recently purify the biogas to reach pipeline quality natural gas.

Having a relatively low BTU content, the gas must be treated (dehydrated, CO<sub>2</sub> removed, and trace contaminants removed) to be upgraded to pipeline quality natural gas with 96-98% methane. This treatment process in-itself is energy intensive – see the figure below.



[1] AN OVERVIEW OF RENEWABLE NATURAL GAS FROM BIOGAS – EPA 456-R-20-001, July 2020. [https://www.epa.gov/sites/default/files/2020-07/documents/lmop\\_rng\\_document.pdf](https://www.epa.gov/sites/default/files/2020-07/documents/lmop_rng_document.pdf)



## 05 RNG = CARBON NEUTRAL

According to all the experts, biogas is considered carbon neutral in the sense that the carbon from animal and food waste is captured and recycled into the energy supply.

- Carbon instead of being released into the atmosphere naturally is combusted to create electricity or other fuels.
- Biogas displaces the need to develop fossil fuels. [2]
- Reduces uncontrolled GHG emissions from landfills and anaerobic digestion sources (emissions are captured).
- The combustion of RNG releases biogenic carbon dioxide, which does not add to the natural carbon cycle. [3] [4]
- While combustion of biogas, like natural gas, produces carbon dioxide (CO<sub>2</sub>), a greenhouse gas, the carbon in biogas comes from plant matter that fixed this carbon from atmospheric CO<sub>2</sub>. Thus, biogas production is carbon-neutral and does not add to greenhouse gas emissions. [4][5]

[2] Author's note: But wait, don't fossil fuels come from decomposed animals and plants?

[3] [https://www.cdn.fortisbc.com/libraries/docs/default-source/services-documents/offsetters-biomethane\\_greenhouse\\_gas\\_emissions\\_reviewe6fecb594de843768ae02951f4b8d3eb.pdf?sfvrsn=821688c4\\_2](https://www.cdn.fortisbc.com/libraries/docs/default-source/services-documents/offsetters-biomethane_greenhouse_gas_emissions_reviewe6fecb594de843768ae02951f4b8d3eb.pdf?sfvrsn=821688c4_2)

[4] Author's note: Yes, the RNG carbon is still being emitted into the atmosphere as a greenhouse gas when it is combusted, but the argument is that it would be emitted anyway....and is thus "neutral."

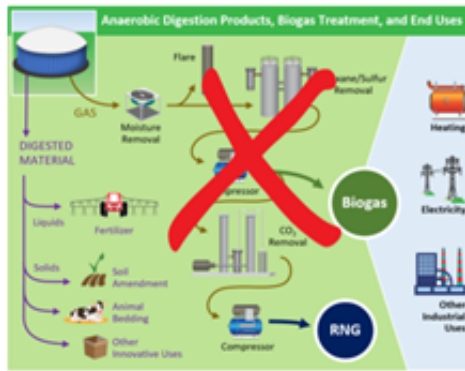
[5] <https://biogas.ifas.ufl.edu/faq.asp>



# 06 BITCOIN IT



So, instead of taking all the energy to process (clean) this gas, or to condition it to be a fuel as “clean” gasoline or diesel, **let’s take all of that gas and fire it directly into natural gas generators to power Bitcoin mining.**



Instead:



## You now have carbon neutral Bitcoin



# 07 HOW MUCH RNG GAS IS OUT THERE?

According to Argonne National Laboratory and Energy Vision, there were about 320 active biogas projects in the US that are upgrading biogas for pipeline injection or for use as fuel (this count includes projects that are operational, under construction, and planned) as of March 31, 2020. [6]

Initial research indicates that this gas is not an active target for Bitcoin miners, but it should be!



A few examples of livestock anaerobic digesters projects:

- Stotz Southern Dairy Digester (15,000 dairy) – 5,256,000 KWh/yr
- Linkenmeyer Family Feeders / Link Energy, LLC Digester (5,000 cattle + 4,000 swine) - 5,000,000 KWh/yr
- Stonyvale Farm / Exeter Agri-Energy, LLC Digester (1,500 dairy + food waste) – 8,600,000 KWh/yr

There are an additional 300 projects listed here:

<https://www.epa.gov/agstar/livestock-anaerobic-digester-database>.

[6] For full spreadsheet go here: <https://www.anl.gov/es/reference/renewable-natural-gas-database>



# 08 MINING CONSIDERATIONS

It is recommended that the Bitcoin mining operations be located directly at the source of the air emissions - the farm or the digester.

As discussed in our previous whitepaper, to effectively run power generation and the Bitcoin data center itself, consider the following:

- Gas flow must be steady. Intermittent flows will not provide the reliable energy needed to power the data center.
- Gas should have sufficient heat content to power the generators.
- Need space for engine skid(s) and trailer-mounted Bitcoin data center.
- Maintain the flare at the site for emergency backup (gas destruction).
- Data center will need a steady communication line. Ensure cellphone coverage is adequate.
- Data centers get hot. Cooler ambient temperatures are preferable.
- Provide heightened physical security and restricted access.





## 9

# CONCLUSIONS



As Bitcoin mining continues to grow globally, it is important to tap into currently-wasted gas and to seek renewable sources of energy for Bitcoin operations. The biogas market in the US is ripe for Bitcoin incorporation.

There are potential for opportunities to obtain USDA funding, renewable tax credits, and even carbon credits for this carbon-neutral Bitcoin.

## ABOUT KAT GALLOWAY



Kat Galloway is the founder and president of Bright Sky Environmental, LLC. With nearly 20 years of environmental consulting and air permitting experience focused on the energy industry, her goal is to help oil and gas companies develop and operate assets in accordance with environmental regulations. As ESG protocols emerge, she helps her clients identify emissions reductions opportunities to deliver impactful environmental results to shareholders.

Kat invests in cryptocurrency and crypto-funds, and is actively supporting Bitcoin mining and oil and gas operators.

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Special thanks to Dr. Bruce Eldridge at the University of Texas who invited me to give an environmental presentation on anaerobic digestion, which led me down this rabbit hole.

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